



1901 Sharp Point Drive, Suite E
 Fort Collins, CO 80525
 Phone: 970-484-7941
 Fax: 970-484-3423

QUALITY ASSURANCE/QUALITY CONTROL DOCUMENTATION SERIES	
TITLE	ANNUAL SITE VISITS FOR OPTICAL MONITORING INSTRUMENTATION (IMPROVE PROTOCOL)
TYPE	STANDARD OPERATING PROCEDURE
NUMBER	4115
DATE	MARCH 1994

AUTHORIZATIONS		
TITLE	NAME	SIGNATURE
ORIGINATOR	James H. Wagner	
PROJECT MANAGER	James H. Wagner	
PROGRAM MANAGER	David L. Dietrich	
QA MANAGER	Gloria S. Mercer	
OTHER		

REVISION HISTORY			
REVISION NO.	CHANGE DESCRIPTION	DATE	AUTHORIZATIONS
0.1	Changes to responsibilities.	April 1998	

TABLE OF CONTENTS

<u>Section</u>	<u>Page</u>
1.0 PURPOSE AND APPLICABILITY	1
2.0 RESPONSIBILITIES	1
2.1 Project Manager	1
2.2 Field Specialist	2
2.3 Instrument Technician	3
2.4 Data Analyst	3
2.5 Site Operator	4
2.6 Technical Assistant	4
3.0 REQUIRED EQUIPMENT AND MATERIALS	4
3.1 Equipment and Materials for Nephelometer Site Visits	4
3.2 Equipment and Materials for Transmissometer Site Visits	5
4.0 METHODS	6
4.1 Nephelometer Annual Site Visits	7
4.2 Transmissometer Annual Site Visits	7

1.0 PURPOSE AND APPLICABILITY

This standard operating procedure (SOP) outlines the general tasks performed during annual routine site visits to optical monitoring sites operated according to IMPROVE Protocol. Annual visits to optical monitoring sites are performed to assure quality data capture and minimize data loss by:

- Replacing all field monitoring instrumentation annually with fully refurbished and calibrated instrumentation.
- Ensuring that instrumentation removed from the field after one year of service is fully refurbished and calibrated.
- Ensuring that field support equipment (shelters, towers, power systems, system wiring, etc.) is in good condition and properly maintained.
- Verifying instrument performance in the field.
- Training site operator(s) in routine operations and system troubleshooting.

Two (2) types of optical monitoring instruments are currently operating in the IMPROVE visibility monitoring network:

- Ambient nephelometers (NGN-2)
- Transmissometers (LPV-2)

General tasks performed during an annual site visit are basically the same for both instruments. Detailed instrument-specific annual site visit procedures referenced by this SOP are as follows:

- TI 4115-3000, *Annual Site Visit Procedures for Optec LPV-2 Transmissometer Systems (IMPROVE Protocol)*
- TI 4115-3005, *Annual Site Visit Procedures for Optec NGN-2 Nephelometer Systems (IMPROVE Protocol)*
- SOP 4700, *Optec NGN-2 Nephelometer Audit Procedures (IMPROVE Protocol)*
- SOP 4710, *Transmissometer Field Audit Procedures*

2.0 RESPONSIBILITIES

2.1 PROJECT MANAGER

The project manager shall:

- Coordinate with the site operator, his/her supervisor, field specialist, instrument technician, and data analyst regarding priority and scheduling of routine servicing trips.

- Coordinate with the field specialist and instrument technician regarding scheduling, preparation, calibrations, and assignment of instrumentation for each optical field site.
- Communicate to the field specialist, data analyst, and site operator any on-site problems, maintenance needs, supplies, etc., that should be addressed during the site visit.
- Provide the Contracting Officer's Technical Representative (COTR) with a list of scheduled site servicing dates, ARS personnel who will visit each site, and names of the primary site contacts. Site operators and their supervisors must be notified either directly or through the COTR at least two weeks prior to a site visit.
- Review site visit documentation with the field specialist, data analyst, and instrument technician.
- Provide the field specialist with calibration numbers for the installation and reference transmissometers.
- Review on-site audit data to confirm correct system operation before the field specialist leaves the site.

2.2 FIELD SPECIALIST

The field specialist shall:

- Coordinate with the site operator, his/her supervisor, project manager, instrument technician, and data analyst regarding priority and scheduling of routine servicing trips.
- Coordinate with the project manager and instrument technician regarding scheduling, preparation, calibrations, and assignment of instrumentation for each nephelometer field site.
- Communicate to the instrument technician, data analyst, and site operator any on-site problems, maintenance needs, supplies, etc., that should be addressed during the site visit.
- Ensure that all instrumentation (and associated calibrations), equipment, materials, and tools are properly prepared and are fully functional.
- Perform all procedures outlined in this TI.
- Make travel and shipping arrangements.
- Follow-up on resolution of any problems encountered on-site that could not be resolved during the site visit.

- Arrange for on-site purchase and delivery of equipment and/or materials that are best obtained locally.
- Hold a training session for site operators during the site visit.
- Review site documentation with the project manager, instrument technician, and data analyst.

2.3 INSTRUMENT TECHNICIAN

The instrument technician shall:

- Coordinate with the site operator, his/her supervisor, field specialist, project manager, and data analyst regarding priority and scheduling of routine servicing trips.
- Coordinate with the field specialist and project manager regarding scheduling, preparation, calibrations, and assignment of instrumentation for each nephelometer field site.
- Perform all servicing, maintenance, modifications, and calibration of instrumentation prior to the site visit.
- Ensure that all instrumentation is in good operating condition prior to shipment.
- Communicate to the field specialist any equipment or instrument modification, or servicing requirements that must be performed on-site.
- Review site visit documentation with the field specialist, data analyst, and project manager.

2.4 DATA ANALYST

The data analyst shall:

- Coordinate with the site operator, his/her supervisor, field specialist, instrument technician, and project manager regarding priority and scheduling of routine servicing trips.
- Communicate to the instrument technician, project manager, and site operator any on-site problems, maintenance needs, supplies, etc., that should be addressed during the site visit.
- Review site documentation with the project manager, field specialists, and instrument technician.
- Communicate to the field specialist during the site visit any problems evident in the collected data.

2.5 SITE OPERATOR

The site operator shall:

- Coordinate with the project manager, field specialist, instrument technician, and data analyst regarding priority and scheduling of routine servicing trips.
- Communicate to the instrument technician, data analyst, and field specialist any on-site problems, maintenance needs, supplies, etc., that should be addressed during the site visit.
- Be available for training during the site visit and arrange to have at least one backup operator also attend the training session.
- Assist the field specialist with the optical system replacement and other tasks that require assistance.

2.6 TECHNICAL ASSISTANT

The technical assistant shall:

- Verify and update the IMPROVE transmissometer inventory using on-site inventory information recorded during the annual visit.
- Prepare transmissometer on-site inventory report after updating the inventory.

3.0 REQUIRED EQUIPMENT AND MATERIALS

The following subsections provide summary lists of equipment and materials required to perform routine on-site maintenance and servicing tasks during annual site visits to optical monitoring sites. Other system components or special tools may be required to perform non-routine field maintenance.

3.1 EQUIPMENT AND MATERIALS FOR NEPHELOMETER SITE VISITS

Specific instrumentation, equipment, tools, and materials generally required for a nephelometer annual site visit include the following (see TI 4115-3005 for a detailed list):

- A replacement nephelometer.
- A replacement datalogging and control subsystem.
- A replacement data collection platform (DCP) (if needed).
- A replacement AT/RH sensor.
- A digital voltmeter (DVM).
- An auditing AT/RH sensor.

- A replacement tank of calibration gas, calibration gas regulator, and uninterruptable power supply.
- A standard field service tool kit.
- An HP200LX Palmtop computer with programs required to communicate with and control the NGN-2 nephelometer, Campbell 21X datalogger, and the Blue Earth micro-controller.
- A telephone handset, line simulator, cables, and a cellular telephone for remote sites.
- Documentation cameras.
- A replacement rotameter (flowmeter).
- A replacement Campbell storage module.
- Nephelometer Servicing Site Visit Trip Report (Figure 4-1)
- Optec NGN-2 Nephelometer Field Installation Shipping Checklist (Figure 3-1)
- Post-maintenance nephelometer calibration data
- Miscellaneous site information (maps, contacts, directions, gates, locks, keys, etc.)
- A Site Operator's Manual containing all applicable technical instructions.
- Optec NGN-2 Technical Manual for Theory of Operation and Operating Procedures
- Log sheets

3.2 EQUIPMENT AND MATERIALS FOR TRANSMISSOMETER SITE VISITS

Specific instrumentation, equipment, tools, and materials generally required for a transmissometer annual site visit include the following (see TI 4115-3000 for a detailed list):

- A replacement transmissometer with calibrated lamps.
- A reference transmissometer with calibrated lamps.
- A replacement data collection platform (DCP) (if needed).
- A replacement AT/RH sensor.
- A digital voltmeter (DVM).
- An auditing AT/RH sensor.
- Replacement on-site receiver and transmitter DVMs (if needed).

- A replacement Campbell 21X datalogger.
- A standard servicing tool kit.
- A palmtop computer, capable of programming Handar 540A and 570A data collection platforms, with associated cable connectors.
- A calculator.
- Two 2-way radios.
- Documentation cameras.
- Replacement power supplies and surge protectors/suppressors.
- Replacement solar panel regulator(s) (if needed).
- Transmissometer Servicing Site Visit Trip Report (Figure 4-1)
- Optec LPV-2 Transmissometer Field Installation Shipping Checklist (Figure 3-1)
- Receiver and transmitter site transmissometer field audit forms.
- A Site Operator's Manual containing all applicable technical instructions.
- Log sheets.
- Optec LPV-2 Technical Manual for Theory of Operation and Operating Procedures

4.0 METHODS

Optical monitoring instruments at IMPROVE Protocol monitoring sites are removed from the field for laboratory servicing on an annual basis. Spare monitoring systems are installed as replacements for instruments and support equipment removed for laboratory servicing. Field specialists visit sites to perform this changeout of monitoring system components. As a part of an annual site visit, a field specialist also performs a number of equipment checks and performance tests that provide information relating to the system's operation during the past 12 months, and verify that the replacement system has a high probability of operating successfully over the next 12 months. To further ensure successful operation and collection of high quality data, a comprehensive site operator training session, which includes a thorough review of routine operations and system troubleshooting procedures, is conducted by the field specialist.

General procedures included in an annual site visit are basically the same for nephelometers and transmissometers. This section outlines the general procedures for each type of instrument and includes two (2) subsections:

- 4.1 Nephelometer Annual Site Visits
- 4.2 Transmissometer Annual Site Visits

Detailed descriptions of annual site visit procedures for nephelometers and transmissometers are provided in TI 4115-3000 and TI 4115-3005.

4.1 NEPHELOMETER ANNUAL SITE VISITS

The nephelometer annual site visit includes the following procedures:

- Pre-visit preparation
- Pre-removal system inspection and equipment inventory
- Pre-removal system performance check and nephelometer calibration
- Removal and replacement of nephelometer, datalogging and control subsystem, and AT/RH sensor
- Post-installation system performance check and nephelometer calibration
- Post-installation system inspection and equipment inventory
- On-site training of the site operator
- Post-visit site operations review and inventory verification
- Archiving of all annual site servicing documentation

4.2 TRANSMISSOMETER ANNUAL SITE VISITS

The transmissometer annual site visit includes the following procedures:

- Pre-visit preparation
- Pre-removal system inspection and equipment inventory
- Pre-removal system operations and performance verification
- Removal and replacement of the AT/RH sensor
- Field audit and removal of the on-site transmissometer
- Installation and field audit of the replacement transmissometer
- Post-installation system operations and performance verification
- Post-installation system inspection and equipment inventory
- On-site training of the site operator
- Post-visit site operations review and inventory verification
- Archiving of all annual site servicing documentation



1901 Sharp Point Drive, Suite E
 Fort Collins, CO 80525
 Phone: 970-484-7941
 Fax: 970-484-3423

QUALITY ASSURANCE/QUALITY CONTROL DOCUMENTATION SERIES	
TITLE	ANNUAL SITE VISIT PROCEDURES FOR OPTEC LPV-2 TRANSMISSOMETER SYSTEMS (IMPROVE PROTOCOL)
TYPE	TECHNICAL INSTRUCTION
NUMBER	4115-3000
DATE	FEBRUARY 1994

AUTHORIZATIONS		
TITLE	NAME	SIGNATURE
ORIGINATOR	David Beichley	
PROJECT MANAGER	James H. Wagner	
PROGRAM MANAGER	David L. Dietrich	
QA MANAGER	Gloria S. Mercer	
OTHER		

REVISION HISTORY			
REVISION NO.	CHANGE DESCRIPTION	DATE	AUTHORIZATIONS
1.0	Trip report modifications	March 1995	
2.0	Trip report modifications/change originator	April 1998	

TABLE OF CONTENTS

<u>Section</u>	<u>Page</u>
1.0 PURPOSE AND APPLICABILITY	1
2.0 RESPONSIBILITIES	2
2.1 Project Manager	2
2.2 Field Specialist	2
2.3 Instrument Technician	3
2.4 Data Analyst	3
2.5 Site Operator	4
2.6 Technical Assistant	4
3.0 REQUIRED INSTRUMENTATION, TOOLS, EQUIPMENT, AND MATERIALS	4
3.1 Instrumentation	6
3.2 Tools	6
3.3 Equipment	6
3.4 Materials	7
4.0 METHODS	8
4.1 Pre-Visit Preparation	8
4.2 General Trip Information	9
4.3 Initial Conditions at Receiver Stations	18
4.4 Receiver System Operation	20
4.5 Receiver Station Initial Inventory	21
4.6 Receiver Station Servicing	21
4.7 Initial Conditions at Transmitter Stations	22
4.8 Transmitter Station Initial Inventory	24
4.9 Transmitter Station Servicing	24
4.10 Training Procedures and Documentation	25
4.11 Field Audit Procedures	26
4.12 Post-Visit Procedures	27
4.12.1 Site Visit Review	27
4.12.2 Inventory Verification and Update	27
4.12.3 Archiving Site Visit Documentation	28

LIST OF FIGURES

<u>Figure</u>	<u>Page</u>
3-1 Optec LPV-2 Transmissometer Field Installation Shipping Checklist	5
4-1 Transmissometer Servicing Site Visit Trip Report	10
4-2 Example On-Site Inventory Report	29

1.0 PURPOSE AND APPLICABILITY

This technical instruction (TI) outlines and describes the procedures involved in performing annual routine site visits to Optec LPV-2 transmissometer sites operated according to IMPROVE Protocol, with the primary purpose of ensuring quality data recovery and minimizing data loss from the transmissometer system. This TI is referenced in standard operating procedure (SOP) 4115, *Annual Site Visits for Optical Monitoring Instrumentation (IMPROVE Protocol)*.

The annual routine site visit includes:

- Scheduling the visit.
- Preparing and shipping equipment and instrumentation to the site.
- Documenting initial conditions.
- Verifying system operation (pre-removal).
- Removing the existing transmissometer and AT/RH sensor.
- Installing the replacement transmissometer and AT/RH sensor.
- Verifying replacement system operation (post-installation).
- Performing inspections, operational checks, maintenance, and/or replacing support equipment.
- Performing a field audit of existing and replacement transmissometers with a reference transmissometer.
- Testing window transmittance.
- Servicing, cleaning, and maintenance.
- Updating site inventories.
- Providing operator training.
- Preparing and return shipping of all instruments, tools, etc.
- Documenting all aspects of the site visit.

This TI outlines annual site visit procedures, except field audit and window transmittance procedures (refer to SOP 4710, *Transmissometer Field Audit Procedures*).

2.0 RESPONSIBILITIES

2.1 PROJECT MANAGER

The project manager shall:

- Coordinate with the site operator, his/her supervisor, field specialist, instrument technician, and data analyst regarding priority and scheduling of routine servicing trips.
- Coordinate with the field specialist and instrument technician regarding scheduling, preparation, calibrations, and assignment of instrumentation for each transmissometer field site.
- Communicate to the field specialist, data analyst, and site operator any on-site problems, maintenance needs, supplies, etc., that should be addressed during the site visit.
- Provide the Contracting Officer's Technical Representative (COTR) with a list of scheduled site servicing dates, ARS personnel who will visit each site, and names of the primary site contacts. Site operators and their supervisors must be notified either directly or through the COTR at least two weeks prior to a site visit.
- Provide the field specialist with calibration numbers for the installation and reference transmissometers.
- Review on-site audit data to confirm correct system operation before the field specialist leaves the site.
- Review site visit documentation with the field specialist, data analyst, and instrument technician.

2.2 FIELD SPECIALIST

The field specialist shall:

- Coordinate with the site operator, his/her supervisor, project manager, instrument technician, and data analyst regarding priority and scheduling of routine servicing trips.
- Coordinate with the project manager and instrument technician regarding scheduling, preparation, calibrations, and assignment of instrumentation for each transmissometer field site.
- Communicate to the instrument technician, data analyst, and site operator any on-site problems, maintenance needs, supplies, etc., that should be addressed during the site visit.

- Ensure that all instrumentation (and associated calibrations), equipment, materials, and tools are properly prepared and are fully functional.
- Perform all procedures outlined in this TI.
- Make travel and shipping arrangements.
- Follow-up on resolution of any problems encountered on-site that could not be resolved during the site visit.
- Arrange for on-site purchase and delivery of equipment and/or materials that are best obtained locally.
- Hold a training session for site operators during the site visit.
- Review site documentation with the project manager, instrument technician, and data analyst.

2.3 INSTRUMENT TECHNICIAN

The instrument technician shall:

- Coordinate with the site operator, his/her supervisor, field specialist, project manager, and data analyst regarding priority and scheduling of routine servicing trips.
- Coordinate with the field specialist and project manager regarding scheduling, preparation, calibrations, and assignment of instrumentation for each transmissometer field site.
- Perform all servicing, maintenance, modifications, and calibration of instrumentation prior to the site visit.
- Ensure that all instrumentation is in good operating condition prior to shipment.
- Communicate to the field specialist any equipment or instrument modification, or servicing requirements that must be performed on-site.
- Review site visit documentation with the field specialist, data analyst, and project manager.

2.4 DATA ANALYST

The data analyst shall:

- Coordinate with the site operator, his/her supervisor, field specialist, instrument technician, and project manager regarding priority and scheduling of routine servicing trips.

- Communicate to the instrument technician, project manager, and site operator any on-site problems, maintenance needs, supplies, etc., that should be addressed during the site visit.
- Review site documentation with the project manager, field specialists, and instrument technician.
- Communicate to the field specialist during the site visit any problems evident in the collected data.

2.5 SITE OPERATOR

The site operator shall:

- Coordinate with the project manager, field specialist, instrument technician, and data analyst regarding priority and scheduling of routine servicing trips.
- Communicate to the instrument technician, data analyst, and field specialist any on-site problems, maintenance needs, supplies, etc., that should be addressed during the site visit.
- Be available for training during the site visit and arrange to have at least one backup operator also attend the training session.
- Assist the field specialist with the transmissometer system replacement and other tasks that require assistance.

2.6 TECHNICAL ASSISTANT

The technical assistant shall:

- Verify and update the IMPROVE inventory using on-site inventory information recorded during the annual visit.
- Prepare an on-site inventory report after updating the inventory.

3.0 REQUIRED INSTRUMENTATION, TOOLS, EQUIPMENT, AND MATERIALS

All required equipment and materials are listed on a checklist, which the field specialist completes when preparing for a site visit. Figure 3-1 presents the Optec LPV-2 Transmissometer Field Installation Shipping Checklist.

OPTEC LPV-2 TRANSMISSOMETER FIELD INSTALLATION SHIPPING CHECKLIST

Site: _____

Date: _____

Packing List #: _____

Method of Shipping: _____

[M] TO TAKE	[M] WHEN PACKED	ON-SITE EQUIPMENT	QUANTITY	SERIAL #
		Transmissometer		
		AT/RH Sensor		
		M16 Voltage Regulator with Spare Fuses		
		Battery Interconnects (3 pair)		
		Surge Suppressors		
		DCP		
		DCP Support Equipment:		
		a. Trickle Charger		
		DVM		
		Control Box Stand		
		Windows:		
		a. Transmitter		
		b. Receiver		
		Terminal Strip Board		
		Power Cords		
		10 amp Power Supply		
		5 amp Power Supply		
		Cleaning Supplies		

AUDIT EQUIPMENT

		Reference Transmissometer		
		Campbell Datalogger		
		Tool Box		
		Palmtop Computer		
		Radio Sets		
		AT/RH Audit Kit		
		Aperture Ring		
		Fuse Kit		
		Audit DVM		

(xtrchklist.doc 12/97)

Figure 3-1. Optec LPV-2 Transmissometer Field Installation Shipping Checklist.

3.1 INSTRUMENTATION

Instrumentation required during a routine site visit includes:

- A replacement transmissometer with calibrated lamps.
- A reference transmissometer with calibrated lamps.
- A replacement data collection platform (DCP) (if needed).
- A replacement AT/RH sensor.
- A digital voltmeter (DVM) (supplied by the field specialist).
- An auditing AT/RH sensor.
- Replacement on-site receiver and transmitter DVMs (if needed).

3.2 TOOLS

A complete tool kit is recommended as on-site tasks vary from instrument repair to minor shelter repairs or modifications. Non-standard tools often required include:

- A cordless drill with screw bits, drill bit set, and assorted ($\frac{3}{4}$ " – 1 $\frac{1}{2}$ ") wood bits.
- A battery electrolyte tester.
- A crimp tool for solar panel regulator "quick-connectors."

3.3 EQUIPMENT

Equipment required during a routine site visit includes:

- A standard field servicing kit (spare components, chips, hardware, batteries, fuses, etc.).
- A palmtop computer, capable of programming Handar 540A and 570A data collection platforms, with associated cable connectors.
- A calculator.
- A Campbell 21X datalogger programmed to log transmissometer receiver computer outputs, with associated cable and connector (refer to SOP 4710, *Transmissometer Field Audit Procedures*).
- Two 2-way radios.

- Digital camera for documentation.
- A replacement 10 amp power supply for AC line power transmitter sites (if needed).
- A replacement 5 amp power supply for AC line power receiver sites (if needed).
- Replacement surge protector(s)/suppressor(s) for AC line powered sites (if needed).
- Replacement solar panel regulator(s) with quick-connectors for solar powered receiver and transmitter sites (if needed).

Typically, the deep-cycle batteries used at solar-powered sites should be replaced every two years. Since long-range transport of these batteries is difficult, it is best to order these batteries from a local dealer near the site prior to the site visit. NAPA Group 27 deep-cycle batteries are found to be the most reliable. Verify that the batteries are fully charged prior to installation. Battery interconnect cables should be replaced at this time.

3.4 MATERIALS

The following documentation forms and information sheets should be taken on each visit:

- Transmissometer Servicing Site Visit Trip Report (Figure 4-1)
- Receiver and transmitter site transmissometer field audit forms (see SOP 4710)
- Operational calibration memos for existing and replacement transmissometers (see TI 4200-2100)
- Audit calibration memo for the reference transmissometer (see TI 4200-2100)
- Spare receiver and transmitter station LPV-2 transmissometer operator log sheets (see TI 4110-3100)
- Optec LPV-2 Transmissometer Field Installation Shipping Checklist (Figure 3-1)

The site operator's manual on-site should contain the following for reference:

- SOP 4110, *Transmissometer Maintenance (IMPROVE Protocol)*
- TI 4110-3100, *Routine Site Operator Maintenance Procedures for Optec LPV-2 Transmissometer Systems (IMPROVE Protocol)*
- TI 4110-3300, *Troubleshooting and Emergency Maintenance Procedures for Optec LPV-2 Transmissometer Systems (IMPROVE Protocol)*
- TI 4110-3350, *Transmissometer Monitoring System Diagrams and Component Descriptions*

- TI 4110-3375, *Replacing and Shipping Transmissometer Components*
- SOP 4115, *Annual Site Visits for Optical Monitoring Instrumentation (IMPROVE Protocol)*
- TI 4115-3000, *Annual Site Visit Procedures for Optec LPV-2 Transmissometer Systems (IMPROVE Protocol)*
- SOP 4710, *Transmissometer Field Audit Procedures*
- Optec LPV-2 Technical Manual for Theory of Operation and Operating Procedures
- Primeline manual

4.0 METHODS

This section describes annual site visit procedures for transmissometer systems, and includes 12 major subsections:

- 4.1 Pre-Visit Preparation
- 4.2 General Trip Information
- 4.3 Initial Conditions at Receiver Stations
- 4.4 Receiver System Operation
- 4.5 Receiver Station Initial Inventory
- 4.6 Receiver Station Servicing
- 4.7 Initial Conditions at Transmitter Stations
- 4.8 Transmitter Station Initial Inventory
- 4.9 Transmitter Station Servicing
- 4.10 Training Procedures and Documentation
- 4.11 Field Audit Procedures
- 4.12 Post-Visit Procedures

4.1 PRE-VISIT PREPARATION

Prior to travel to the site, the following preparations need to be made (for individual responsibilities refer to Sections 2.1 through 2.6):

- Schedule the site visit and notify the COTR.
- Schedule and perform instrument servicing, calibrations, and tests.
- Coordinate with site personnel to arrange for:
 - Site operator training (approximately 2-4 hours; schedule for the day prior to the field audit).
 - Assistance with the internal transmissometer audit and window transmittance tests (approximately 4-6 hours).
 - Any other assistance needed from on-site personnel.

- Organize all instruments, equipment, tools, and materials.
- Arrange for on-site procurement of equipment, tools, or materials.
- Verify transmissometer calibration numbers and lamp installation order.
- Investigate what site-specific problems need to be addressed on-site.
- Ship instruments, equipment, tools, and materials directly to the site or preferably airfreight all items to a major airport near the site to be held for pick-up by the field specialist.
- Arrange travel.

The field specialist should contact the site operators and their supervisor (if involved with the on-site transmissometer system servicing and maintenance) upon arrival at the site. The prearranged schedules for operator training, transmissometer field audit (reference instrument), window transmittance tests, and any other work the field specialist will need assistance with should be confirmed at this time.

The Transmissometer Servicing Site Visit Trip Report, Figure 4-1, must be used to document servicing tasks. This form generally follows the order in which procedures are performed and serves as a checklist for site conditions review, operational verifications and checks, and inventories. Procedures not included on the trip report are included in SOP 4710, *Transmissometer Field Audit Procedures*.

4.2 GENERAL TRIP INFORMATION

Refer to Figure 4-1, page 1 for the following:

SITE	Use either the full location name or the four-letter site abbreviation.
DATES	Record the calendar date duration of the entire servicing trip, including travel.
TECHNICIAN	Use the full name or the first initial and last name.
SITE VISIT OBJECTIVES	List the primary objectives of the site visit, especially any that are not standard for site visits.
TRIP SUMMARY	List the major actions taken for each day, including travel and locations. Any general comments pertaining to the trip should be noted in the comments section.

RECEIVER STATION – INITIAL CONDITIONS

Transmissometer LPV No. _____ Does the instrument appear to be working properly: YES NO

Comment: _____

Receiver Display: C _____ B _____ VR _____ Local Time _____:_____ Toggle ON OFF

Settings: Gain _____ Cal _____ Dist _____ A1 _____ A2 _____ Int _____ Cycle _____



Alignment: Mark initial location of transmitter light source with a "+".

Comments: _____

Window Cleanliness: good moderate poor Comments: _____

Lens Cleanliness: good moderate poor Comments: _____

Timing:

1. Is your watch synchronized with NBS (WWW) time? (303-499-7111) YES NO

2. Receiver update time (HR:MIN:SEC) _____:_____:

*** Note transmitter on/off times on Transmitter Station – Initial Conditions section ***

Alti-azimuth Base Operation: _____

AT/RH Sensor and Holder: _____

DCP Antenna Elements/Cable: _____ Alignment Azimuth (°T) _____ Incl. _____

Terminal Strip and Wiring: _____

Power System: Power Supply _____ Output _____ V

Solar Panels _____ Output _____ V

Batteries _____ Output _____ V

Surge Protector Indicators _____

Regulator Operation _____

Wiring Condition _____

Shelter: Hood/Window Frame Condition _____

Shelter Cleanliness _____

Shelter Condition _____

Vents: Size _____ No. _____ Filters _____ Foam Inserts _____

Comments: _____

Figure 4-1. (Continued). Transmissometer Servicing Site Visit Trip Report.

SYSTEM OPERATION VERIFICATION

Pre-Removal

Post-Installation

Digital Voltmeter MFR/Model/SN: _____

AT/RH audit sensor MFR/Model/SN: _____

Data Check: Date: _____ Time: _____

	<u>Front Panel</u>	<u>Terminal Strip</u>	<u>DCP (570A Only)</u>	<u>Downloaded</u>
A1 Switch (C)	_____	_____ VDC	CH1 _____	Data _____
(B)	_____	_____ VDC	_____	Data _____
Toggle Lamp	ON OFF	_____ VDC	CH2 _____	Data _____
A2 Switch (SD)		_____ VDC	CH3 _____	Data _____
(CR)		_____ VDC	_____	Data _____

	<u>Measured</u>		
AT (DEG F or C)	_____	CH4 _____	Data _____
RH (%)	_____	CH5 _____	Data _____
DCP Battery (VDC)	_____	CH10 _____	Data _____

b_{ext} Check: b_{ext} Calculated: _____ From Raw Reading (C): _____

b_{ext} (1/km) = -(ln T/Path Distance), T = C (A1 Raw Counts) / Cal. No.

Comments: _____

Figure 4-1. (Continued). Transmissometer Servicing Site Visit Trip Report.

RECEIVER STATION – INITIAL INVENTORY

	Changed	On-Site Mfr./Model/SN	Replacement Mfr./Model/SN
Transmissometer	<input type="checkbox"/>	_____	_____
Alti-azimuth Base	<input type="checkbox"/>	_____	_____
Data Collection Platform	<input type="checkbox"/>	_____	_____
AT/RH Sensor	<input type="checkbox"/>	_____	_____
Antenna	<input type="checkbox"/>	_____	_____
Strip Chart	<input type="checkbox"/>	_____	_____
Window	<input type="checkbox"/>	_____	_____
Terminal Strip	<input type="checkbox"/>	_____	_____
Batteries	<input type="checkbox"/>	_____	_____
Power Supply	<input type="checkbox"/>	_____	_____
Surge Protector	<input type="checkbox"/>	_____	_____
Solar Panels	<input type="checkbox"/>	_____	_____
DCP Solar Panel	<input type="checkbox"/>	_____	_____
Regulator	<input type="checkbox"/>	_____	_____

With Quick-connectors? YES NO

Voltmeter	_____	_____	_____
Battery Replaced?	YES	NO	Spare Battery? YES NO
Vandal Plate?	YES	NO	Comment: _____
Tool Box	YES	NO	With Detector Head Allen Wrench YES NO With Adjustable Wrench YES NO With Medium Flathead Screwdriver YES NO With Medium Phillips Screwdriver YES NO With Signal Mirror YES NO

Fuse Kit	YES	NO	Numbers and Types: _____
Supplies:	Kimwipes _____	Bottle Alcohol _____	Log Sheets _____
	Window Cleaner _____	Blower Brush _____	Operator's _____
	Paper Towels _____	Distilled H ₂ O _____	Manual _____
		H ₂ O Dispenser _____	b _{ext} SVR Sheet _____

Shipping Cases: Recvr. Computer _____ Transmitter _____ DCP _____ Recvr. Telescope _____

Storage Location(s): _____

Shelter Type/Size: _____

Shelter Key: _____ Spare Key Hidden: _____

Comments: _____

Figure 4-1. (Continued). Transmissometer Servicing Site Visit Trip Report.

RECEIVER STATION - SERVICING

Receiver Replacement Date: _____ Time: _____ Receiver No.: _____

AA Batteries Installed?	YES	NO
Computer Cards Seated?	YES	NO
Interconnect Cables:	OK	Replaced
Battery Terminals cleaned?	YES	NO
Power Cable	OK	Replaced
Battery Voltage Monitoring Cable	OK	Replaced

Miscellaneous Replaced Items: _____

Antenna Alignment Connection: Azimuth (°T) _____ Incl. _____

Additional Power Supply Servicing/Checks: _____

Supplement Tool Kit: _____

Supplement Cleaning Supplies: _____

Supplement Log Sheets/Update Operator's Manual: _____

Shelter Cleaning: _____

Additional Servicing Done: _____

Follow-up Tasks Required: _____

***** Complete and attach LPV-2 Transmissometer Operator Log Sheet – Receiver Station *****

Figure 4-1. (Continued). Transmissometer Servicing Site Visit Trip Report.

TRANSMITTER STATION – INITIAL CONDITIONS

Lamp Number: _____ Does the instrument appear to be working properly: YES NO

Comment: _____



Alignment: Mark initial location of receiver shelter window with a "+".

Comments: _____

Window Cleanliness: good moderate poor Comments: _____

Lens Cleanliness: good moderate poor Comments: _____

Lamp Check: **IMPORTANT:** Must be done when lamp is ON under automatic control.

a) LED (indicator light on side of control box) ON OFF

b) Lamp voltage with on-site DVM: _____ volts audit DVM: _____ volts

Timing:

1. Is your watch synchronized with NBS (WWW) time? (303-499-7111) YES NO

2. Transmitter Light ON, Exact Time (HR:MIN:SEC) _____ : _____ : _____

3. Transmitter Light OFF, Exact Time (HR:MIN:SEC) _____ : _____ : _____

Alti-azimuth Base Operation: _____

Lamp Voltage Monitoring DVM and Connections: _____

Power System: Power Supply _____ Output _____ V
Solar Panels _____ Output _____ V
Batteries _____ Output _____ V
Surge Protector Indicators _____
Regulator Operation _____
Wiring Condition _____

Shelter: Hood/Window Frame Condition _____
Shelter Cleanliness _____
Shelter Condition _____
Vents: Size _____ No. _____ Filters _____ Foam Inserts _____

Comments: _____

Figure 4-1. (Continued). Transmissometer Servicing Site Visit Trip Report.

TRANSMITTER STATION - SERVICING

Transmitter Replacement Date: _____ Time: _____ Transmitter No.: _____
Lamp No. Put Into Service: _____ Lamps On-Site: _____

AA Batteries Installed?	YES	NO
Interconnect Cables:	OK	Replaced
Battery Terminals cleaned?	YES	NO
Power Cable	OK	Replaced
Battery Voltage Monitoring Cable	OK	Replaced
Lamp Voltage Monitoring Cable	OK	Replaced

Miscellaneous Replaced Items: _____

Supplement Tool Kit: _____

Supplement Cleaning Supplies: _____

Supplement Log Sheets/Update Operator's Manual: _____

Shelter Cleaning: _____

Additional Servicing Done: _____

Follow-up Tasks Required: _____

***** Complete and attach LPV-2 Transmissometer Operator Log Sheet – Transmitter Station *****

Figure 4-1. (Continued). Transmissometer Servicing Site Visit Trip Report.

4.3 INITIAL CONDITIONS AT RECEIVER STATIONS

Document the “as found” conditions of the following (refer to Figure 4-1, page 2):

INSTRUMENT NUMBER	Record the Optec instrument number from the receiver telescope, detector head, or computer. All components should have the same number, if not, carefully document the number of each individual component.
OPERATIONAL STATUS	Note if the instrument appears to be operating correctly. Comment on any observed inconsistency.
RECEIVER DISPLAY READING SETTINGS	Record the current display reading, also noting the local time and if the toggle light is on or off.
SWITCH A1 READINGS	Record the A1 display values for C, B, and VR A1 switch settings.
ALIGNMENT	Mark the initial location of the light source inside the reticle diameter on the form. If misaligned, record the severity of the misalignment by using the diameter of the reticle circle and the angle from the center of the reticle (i.e., alignment off by $0.4D @ 345^\circ$).
INITIAL WINDOW CLEANLINESS	Record degree of window cleanliness and type of uncleanliness.
LENS CLEANLINESS	Record degree of lens cleanliness and type of uncleanliness. If degree and/or type of uncleanliness is significant, do not clean. This will be incorporated into the post-calibration of the system at the ARS calibration facility.
TIMING	Record update time of the receiver and on/off times of the transmitter. Ensure that time is according to NBS (National Bureau of Standards) (WWV) time.
ALTI-AZIMUTH BASE OPERATION	Note operation and condition of the alti-azimuth base.
AT/RH SENSOR AND HOLDER	Note the condition of the AT/RH sensor and holder. Look for any accumulation of dirt, insects, or corrosion on the sensor or shield.

DCP ANTENNA
ELEMENTS/
CABLE AND
ALIGNMENT

Note the condition of the DCP antenna elements and cable. All elements should be tight and perpendicular to the shaft. The cable should be in good condition and all connectors secure. Note the alignment (azimuth and inclination) of the antenna.

TERMINAL STRIP
AND WIRING

Check and record terminal strip and related wiring condition. All wires should be in good condition and all terminals secure.

POWER SYSTEM

At AC-powered sites, note the condition of the power supply and measure the power supply output voltage at the connectors. Also check the indicator lights on the surge protector.

At solar-powered sites, note the condition of the panels, support frame, and wiring. Panel output voltage is best measured by disconnecting the "quick-connector" at the solar panel regulator on the side coming in from the panels and measuring the output voltage at this point using the field specialist DVM. Lighting conditions on the panels should also be noted.

Note the battery condition (degree of terminal corrosion, electrolyte levels, etc.). Also record the output voltage. This is best measured at the power cable connection on the back of the receiver after disconnecting the connector.

At solar-powered sites, observe solar panel regulator operation to ensure that it is cycling properly. With adequate incident light on the solar panels to charge the batteries, proper Sun Selector M-16 Status Indicator LED cycling is as follows:

Ready: The ready LED will light when the solar panel voltage is high enough to charge the batteries.

Analyzing: The analyzing LED will light for 10-15 seconds before the charging light engages.

Charging: The charging LED will light when full charging current is flowing to the batteries. Charging continues for a maximum of 5 minutes per cycle or until the batteries have reached the maximum charging voltage. This LED cycles on and off opposite the analyzing LED.

Finishing: The finishing LED will start to flash as the battery voltage increases over 14.0 VDC.

Also refer to the Sun Selector M-8/M-16 Operation and Installation Sheet.

Note the condition of the power system wiring.

SHELTER

Note the condition of the hood and window frame.

Note the cleanliness of the shelter.

Note general condition of the shelter and any related maintenance needs.

Note the size and number of vent openings in the shelter and if there are filters and/or foam inserts in the vents.

4.4 RECEIVER SYSTEM OPERATION

The purpose of this check is to ensure agreement between receiver computer displayed readings, computer output voltages, and DCP transmitted data. An audit AT/RH sensor is used to check operation of the on-site AT/RH sensor. The pre-removal verification check is performed prior to any site servicing. The post-installation verification check is performed after the field audit has been completed.

At sites with 570A DCPs, the DCP stored transmissometer outputs, AT/RH measurements, and DCP battery voltage can be checked on the DCP display by scrolling through the channels using the display button. This can be done at any time after half past the hour when the inputs from the transmissometer computer and AT/RH sensor are scanned. Perform the operation verification check at least twice, preferably for consecutive hourly transmissometer readings.

Transmitted DCP data for the time of the operation verification checks should be verified from the field by calling the data analyst to obtain the DCP transmitted values. All transmissometer readings should be taken between 20 minutes after the hour and before the next hour, and a DCP reading must be taken between 31 minutes after the hour and before the next hour, to properly record the current hour's data.

The procedures for performing the operation verification check are detailed below (refer to Figure 4-1, page 3):

PRE-REMOVAL
OR POST-
INSTALLATION

Note if the check is for pre-removal or post-installation of an instrument.

DVM AND
AT/RH

Record the make, model, and serial number of the digital voltmeter (DVM) and audit AT/RH sensor.

DATA CHECK

Record the date and local time.

A1 Switch. With the receiver computer displaying a valid reading, record the A1 display values for the A1 switch: Raw Reading (C) and b_{ext} (B). For each switch setting, also measure and record the voltage at the terminal strip. Refer to the terminal strip wiring

diagram (TI 4110-3350, *Transmissometer Monitoring System Diagrams and Component Descriptions*) for the corresponding terminal voltage points.

Toggle LED. Note the state (on/off) of the toggle light and measure the corresponding voltage at the terminal strip.

A2 Switch. Measure and record the voltages at the terminal strip for the reading (CR) and standard deviation (SD) A2 – switch positions.

AT/RH SENSOR AT/RH measurements with the audit AT/RH sensor should be taken at half past the hour. This is when the DCP logs the on-site AT/RH sensor measurement.

b_{EXT} Calculate the b_{ext} from the raw reading (C) using the following equations:

$$b_{ext} (1/km) = -(\ln T/Path Distance), T = C/Cal. No.$$

COMMENTS Comment on any problems, conditions, etc. that were encountered during the operation verification check.

4.5 RECEIVER STATION INITIAL INVENTORY

Refer to Figure 4-1, page 4. Inventory of all items at the receiver site according to the inventory list on the servicing form. Also note any additional items on-site that do not appear on the inventory list.

4.6 RECEIVER STATION SERVICING

Servicing tasks and procedures at the receiver site are primarily replacement or operational checks of instruments and equipment. Shelter cleaning and supplementation of operator servicing materials is also done at this time. The individual tasks, procedures, and operational checks are as follows (refer to Figure 4-1, page 5):

RECEIVER REPLACEMENT Remove the existing receiver. Install the replacement receiver and record the LPV number and the date and time installed.

Refer to TI 4110-3375, *Replacing and Shipping Transmissometer Components*, for procedures in removing and replacing the transmissometer receiver unit.

Note if the AA timing batteries were installed and if cables were replaced.

MISCELLANEOUS REPLACED ITEMS	Record replacement of any items not included above.
ANTENNA ALIGNMENT	If antenna alignment needs to be corrected, document the adjusted alignment azimuth and inclination. (refer to TI 4110-3375, <i>Replacing and Shipping Transmissometer Components</i>).
ADDITIONAL POWER SUPPLY SERVICING/ CHECKS	Document any additional servicing and/or checks that were performed on the power supply system.
SUPPLEMENT TOOL KIT	Document if the tool kit was supplemented with any tools, fuses, or miscellaneous items.
SUPPLEMENT CLEANING SUPPLIES	If the cleaning supplies were supplemented, document the type and number.
SUPPLEMENT LOG SHEETS/ UPDATE SITE OPERATOR'S MANUAL	Document the supplementation of log sheets and/or the updating of the Site Operator's Manual for Transmissometer Monitoring Systems.
SHELTER CLEANING	Note if the shelter was cleaned. Cleaning normally involves wiping down shelves, system components and mounts, sweeping out the shelter, and removing any trash.
ADDITIONAL SERVICING	Document any additional servicing tasks performed.
FOLLOW-UP TASKS	Document the need for any additional servicing/maintenance that is not performed during the site visit and if this is to be done by site or ARS personnel.

4.7 INITIAL CONDITIONS AT TRANSMITTER STATIONS

Document the "as found" condition of the following, (refer to Figure 4-1, page 6):

LAMP NUMBER	Record the lamp number currently in the instrument.
OPERATIONAL STATUS	Note whether or not the transmitter unit appears to be working correctly. If not, comment on any observed inconsistency.
ALIGNMENT	Mark the initial location of the receiver shelter window inside the reticle diameter on the form. If misaligned, record the severity of

the misalignment by using the diameter of the reticle circle and the angle from the center of the reticle (i.e., alignment off by $0.4 D @ 345^\circ$).

INITIAL WINDOW
CLEANLINESS

Record degree of window cleanliness and type of uncleanliness.

LENS
CLEANLINESS

Record degree of lens cleanliness and type of uncleanliness. If degree and/or type of uncleanliness is significant, do not clean. This will be incorporated into the post-calibration of the system at the ARS calibration facility.

LAMP CHECK

LED. When the lamp is on under automatic control, note if the LED indicator light on the side of the control box is on or off.

Lamp Voltage Reading. Measure and record the lamp voltage using the on-site DVM and the lamp voltage measurement pigtail. Also measure the voltage with the field specialist's DVM to confirm correct operation of the on-site DVM.

TIMING

Note whether or not the watch has been synchronized with NBS (National Bureau of Standards) (WWV) time; if not, this can be done by calling 303-499-7111. Note the exact time (hours, minutes, seconds) that the transmitter light comes on. Also note the exact time the light turns off.

ALTI-AZIMUTH
BASE OPERATION

Note operation and condition of the alti-azimuth base and if the transmitter telescope unit attaches securely to the base.

LAMP VOLTAGE
MONITORING
DVM AND
CONNECTIONS

Note the operation and condition of the lamp voltage monitoring digital voltmeter and the cables and connectors.

POWER SYSTEM

At AC-powered sites, note the condition of the power supply and measure the power supply output voltage at the connectors. Also check the indicator lights on the surge protector.

At the solar-powered sites, note the condition of the panels, support frame, and wiring. Panel output voltage is best measured by disconnecting the "quick-connector" at the solar panel regulator on the side coming in from the panels and measuring the output voltage at this point using the field specialist DVM. Lighting conditions on the panels should also be noted.

At solar-powered sites, observe solar panel regulator operation to ensure that it is cycling properly. With adequate incident light on

the solar panels to charge the batteries, proper Sun Selector M-16 Status Indicator LED cycling is as follows:

Ready. The ready LED will light when the solar panel voltage is high enough to charge the batteries.

Analyzing. The analyzing LED will light for 10-15 seconds before the charging light engages.

Charging. The charging LED will light when full charging current is flowing to the batteries. Charging continues for a maximum of 5 minutes per cycle or until the batteries have reached the maximum charging voltage. This LED cycles on and off opposite the analyzing LED.

Finishing. The finishing LED will start to flash as the battery voltage increases over 14.0 VDC.

Also refer to the Sun Selector M-8/M-16 Operation and Installation Sheet.

Note the condition of the power system wiring.

SHELTER

Note the condition of the hood and window frame.

Note the cleanliness of the shelter.

Note general condition of the shelter and any related maintenance needs.

Note the size and number of vent openings in the shelter and if there are filters and/or foam inserts in the vents.

4.8 TRANSMITTER STATION INITIAL INVENTORY

Refer to Figure 4-1, page 7. Inventory all items at the transmitter site according to the inventory list on the servicing form. Also note any additional items on-site that do not appear on the inventory list.

4.9 TRANSMITTER STATION SERVICING

Servicing tasks and procedures at the receiver site are primarily replacement or operational checks of instruments and equipment. Shelter cleaning and supplementation of operator servicing materials is also done at this time. The individual tasks, procedures, and operational checks are as follows (refer to Figure 4-1, page 8):

TRANSMITTER REPLACEMENT	Remove the existing transmitter. Install the replacement transmitter and record the LPV number and the date and time installed. Refer to TI 4110-3375, <i>Replacing and Shipping Transmissometer Components</i> , for procedures in removing and replacing the transmissometer transmitter unit.
LAMPS	Record the lamp number that is put into service and also the lamp numbers that are left on-site.
TIMING BATTERIES AND CABLES	Note if the four (4) AA timing batteries were installed in the transmitter control box. Note if any cables were replaced.
MISCELLANEOUS REPLACED ITEMS	Record replacement of any items not included above.
SUPPLEMENT TOOL KIT	Document if the tool kit was supplemented with any tools, fuses, or miscellaneous items.
SUPPLEMENT CLEANING SUPPLIES	If the cleaning supplies were supplemented, document the type and number.
SUPPLEMENT LOG SHEETS/ UPDATE SITE OPERATOR'S MANUAL	Document the supplementation of log sheets and/or the updating of the Site Operator's Manual for Transmissometer Monitoring Systems.
SHELTER CLEANING	Note if the shelter was cleaned. Cleaning normally involves wiping down shelves, system components and mounts, sweeping out the shelter, and removing any trash.
ADDITIONAL SERVICING	Document any additional servicing tasks performed.
FOLLOW-UP TASKS	Document the need for any additional servicing/maintenance that is not performed during the site visit and if this is to be done by on-site personnel or ARS personnel.

4.10 TRAINING PROCEDURES AND DOCUMENTATION

Scheduling of the operator training session should occur with the scheduling of the annual site visit and the transmissometer field audit. Typically, the training session is scheduled for the day prior to the field audit.

All site operators and backup operators should attend the training session, along with the site monitoring manager, if possible. When initially contacting site personnel, confirm that on-site copies of the site operator's manual (refer to Section 3.4) are on hand.

The following technical instructions should be reviewed by operators unfamiliar with the transmissometer system prior to the training session:

- TI 4110-3100, *Routine Site Operator Maintenance Procedures for Optec LPV-2 Transmissometer Systems (IMPROVE Protocol)*
- TI 4110-3300, *Troubleshooting and Emergency Maintenance Procedures for Optec LPV-2 Transmissometer Systems (IMPROVE Protocol)*
- TI 4110-3350, *Transmissometer Monitoring System Diagrams and Component Descriptions*
- TI 4110-3375, *Replacing and Shipping Transmissometer Components*

Approximately 3-4 hours should be allotted for the training session. It is preferable to begin the training at the transmitter station and then proceed to the receiver station. If time constraints, weather, site accessibility, etc. make training at the transmitter station difficult or infeasible, transmitter training can be done at the receiver station or in a room using the reference transmitter unit.

Training topics include:

- Purpose of the monitoring program and the role of Air Resource Specialists, Inc.
- Theory of transmissometer system operation.

The following topics are addressed at both the transmitter and receiver stations using the information and procedures outlined in the technical instructions:

- TI 4110-3100, *Routine Site Operator Maintenance Procedures for Optec LPV-2 Transmissometer Systems (IMPROVE Protocol)*
- TI 4110-3350, *Transmissometer Monitoring System Diagrams and Component Descriptions*
- TI 4110-3375, *Replacing and Shipping Transmissometer Components*

4.11 FIELD AUDIT PROCEDURES

The field audit of the transmissometer system is performed after site servicing and operator training have been completed. Procedures for performing the field audit are described in SOP 4710, *Transmissometer Field Audit Procedures*.

4.12 POST-VISIT PROCEDURES

The following post-visit procedures must be completed within one (1) week following the field specialists' return:

- Site visit review
- Inventory verification and update
- Archiving site visit documentation

4.12.1 Site Visit Review

The field specialist will meet with the project manager, data analyst, and instrument technician to review all annual site servicing and field audit documentation. Items to be discussed in this review include:

- On-site equipment or operations problems identified.
- Site operator evaluation.
- Audit results.
- Site-related routine servicing requirements.
- Observed factors that could influence transmissometer readings.
- Operations-related requests from the site operator or other on-site personnel.
- Miscellaneous follow-up needs.

4.12.2 Inventory Verification and Update

The IMPROVE equipment inventory is maintained by the technical assistant. Items from the on-site initial inventory (Figure 4-1, pages 4 and 7) that are included in the IMPROVE equipment inventory are:

- Receiver station equipment:
 - Alti-azimuth base
 - Data collection platform (DCP)
 - DCP antenna
 - DCP solar panel
 - AT/RH sensor
 - Solar panels

- Transmitter station equipment:
 - Alti-azimuth base
 - Solar panels

The technical assistant will verify that the on-site initial inventory property numbers match the corresponding property numbers in the IMPROVE inventory for all items listed above. For system components replaced during the annual site visit (Figure 4-1, pages 5 and 8), the technical assistant will update the IMPROVE inventory to reflect these changes. An on-site inventory report (See Figure 4-2 for an example) is prepared by the technical assistant after the inventory has been updated.

4.12.3 Archiving Site Visit Documentation

Upon completion of the site visit review and IMPROVE inventory verification/update, the data analyst archives all annual site servicing documentation. This documentation is filed in site-specific operations notebooks located in the ARS Data Collection Center. Specific annual site visit documentation archived includes:

- Transmissometer Servicing Site Visit Trip Report
- On-Site Inventory Report
- Field Installation Shipping Checklist
- Field audit documentation as specified in SOP 4710, *Transmissometer Field Audit Procedures*

INVENTORY REPORT FROM FILE CBIMPINV.VWS
FOR SITE BANDELIER
02/10/94 16:26:36

ITEM ID#	ITEM NAME	MAN'F	MODEL	SERIAL #	PROPERTY NO.
58	ANTENNA	HANDAR	443A	2106	2106
128	DCP	HANDAR	540A	168	168
262	SOLAR PANEL	SOLAREX	SX-20	K-140031TF	K-140031T
312	SOLAR PANEL	SOLAREX	SX-56	K-160018TF	K-160018T
221	STRIP CHT RECOR	PRIMELINE	6723	851754B122	851754B12
612	TRANSMIS RECEIV BASE	OPTEC	86230	LPVR	NPS-90207
436	TRANSMIS RECEIV COMPUTER	OPTEC	86210	LPVR011	NPS-90145
469	TRANSMIS RECEIV DET HEAD	OPTEC	86222	LPVR011	NPS-90144
501	TRANSMIS RECEIV TELESCOP	OPTEC	86222	LPVJ011	NPS-90146
648	TRANSMIS TRANSM BASE	VON			NPS-90127
532	TRANSMIS TRANSM CONTROLLE	OPTEC	86200	LPVT011	NPS-90143
564	TRANSMIS TRANSMITTER	OPTEC	86200	LPVT011	NPS-90142
1132	AT/RH SENSOR	ROTRONIC	MP-100MF	28329	28329

(site1_h)
Page number 1

Figure 4-2. Example On-Site Inventory Report.