

REPAIRING, MAINTAINING, AND CALIBRATING METEOROLOGICAL INSTRUMENTS IN THE FIELD

Purpose This Meteorology and Air Quality Group (MAQ) procedure describes repair, maintenance, and calibration work performed in the field in support of the MAQ Meteorological Monitoring Project.

Scope This procedure applies to field repair, maintenance, and calibration work performed by MAQ Meteorological Monitoring Project personnel.

Signatures

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03/01/06

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General information about this procedure

In this procedure

This procedure addresses the following major topics:

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Attachments

This procedure has the following attachments:

Number	Attachment Title	Pages
1	Hazard Review	2

History of revision

This table lists the revision history and effective dates of this procedure.

Revision	Date	Description of Changes
0	5/27/99	New document.
1	3/9/00	Changed requirements for climbing Pajarito Mountain tower.
2	8/26/03	Deleted sodar notes, added Mortendad Canyon tower, and made minor updates and edits.
3	2/4/05	Replaced HCP with HR, added reference to new MAQ-408.
4	3/8/06	Updates to accessing meteorological sites

General information, continued

Who requires training to this procedure? The following personnel require training before implementing this procedure:

- the meteorological instrumentation technician assigned to calibrate, maintain, or repair meteorological instruments in the field

Annual retraining is required and will be by self-study (“reading”) training.

Training method The training method for this procedure is **mentored** training by a previously trained individual and is documented in accordance with the procedure for training (MAQ-024).

Prerequisites In addition to training to this procedure, the following training is also required prior to performing this procedure:

- Ladder safety course #12985
- RRES-ES-Field, “Field Safety For All Employees”
- RRES-ES-Driving, “Driving and Towing Safety For All Employees”
- Site-specific training for all areas to be visited
- MAQ-401, “Meteorological Tower Climbing and Support”
- MAQ-402, “Calibration and Maintenance of Instruments for the Meteorological Monitoring Program”
- MAQ-408, “Meteorological Tower Hoist Operation”
- Incidental Crane Operator’s License

Discretion is a must in all aspects of this project. A good mechanical ability with knowledge of tools is important. Meteorological knowledge is important for worker safety -- an awareness of changes in the weather can be life-saving as in the event of developing cumulonimbus and the attendant lightning threat.

Periodically review the field safety information in the New Employee Handbook (see MAQ-032).

General information, continued

References

The following documents are referenced in this procedure:

- MAQ-024, "Personnel Training"
- MAQ-032, "Orienting New Employees"
- MAQ-035, "Work Safety Review and Authorization"
- MAQ-401, "Meteorological Tower Climbing and Support"
- MAQ-402, "Calibration and Maintenance of Instruments for the Meteorological Monitoring Program"
- MAQ-408, "Meteorological Tower Hoist Operation"
- RRES-ES-Field, "Field Safety For All Employees"
- RRES-ES-Driving, "Driving and Towing Safety For All Employees"
- Operator's Manual For SWS-211-3Sx, Three Axis Sonic Anemometer/Thermometer
- Tower Log Notebook (a bound laboratory notebook that briefly notes all work from instrument work through data editing). The Tower Log Notebook covers all meteorological sites and is issued for one year.
- Tower Log Activity Notebooks (notebooks containing all instrument calibration information for each meteorological site)
- Tower Work Books (field notebooks containing information on datalogger programming, tower and instrument installation, etc.)

Note

Actions specified within this procedure, unless preceded with "should" or "may," are to be considered mandatory guidance (i.e., "shall").

Accessing meteorological sites

Overview Site access is different for each meteorological monitoring site. Below are specific requirements and instructions for accessing each site. The meteorological instrumentation technician has keys to access all locks described in this section. A four wheel drive government pickup truck is assigned to the Meteorological Monitoring Project to support project work.

Most sheds and equipment locations are locked with an H8-90 key. Other keys are called out below when needed.

Naming Convention The common naming convention used for the meteorological sites is simply the Technical Area (TA) within which the site is located. But some of the sites are named differently, e.g.:

- PJMT: Pajarito Mountain
 - MDCN: Mortedad Canyon
 - NCOM: North Community
 - PJCN: Pajarito Canyon (not installed at this time)
-

TA-6 tower (6-78) The TA-6 tower is located within a LANL security area. Access requires a Q or L clearance, although an un-cleared person may be escorted by a Q-cleared employee.

Go to TA-40 building 001 and exchange your security badge for a DX access control exchange-badge with a key to the locked chain across the road into the tower site. The shed, designated 6-91, contains the electrical panel for power distribution at this site. When leaving, retrieve your badge.

TA-41 tower (41-64) The TA-41 tower is located in Los Alamos Canyon east of the Omega Bridge. The road to TA-41 is gated and can be unlocked with the meteorology key.

TA-49 tower (49-123) The TA-49 tower is located in an open-access area along State Rd. 4 about 1.3 miles east of the gate into TA-49. There is an unlocked gate blocking the road into the tower site and a locked chain link fence around the base of the tower.

TA-53 tower (53-1020) The TA-53 tower is located on the mesa beyond the east end of the LANSCE facility. There is a dirt road with a chain stretched across that provides access to the tower. An MP-16 key is required to open the padlock. The shed, designated 53-1046, contains the electrical panel for power distribution at this site.

Accessing meteorological sites, continued

TA-54 tower (54-88) The TA-54 tower is located in an open-access area to the NW of the intersection of Pajarito Rd. and State Rd. 4 in White Rock. There are “serial-padlocks” on the gate and the meteorology key will open one. The shed, designated 54-169, contains the electrical panel for power distribution at this site.

TA59 tower (no designation) This tower is located outside the met lab, TA-59, building 001, room 178 on the south side of the building.

MDCN tower (05-61) This 10-m tower is located in Mortandad Canyon and is accessed by turning off Pajarito Rd. at TA-52. This tower tilts over for instrument access.

PJCN tower (36-250) This 10-m tower is located along Pajarito Road about $\frac{3}{4}$ mile east of the TA-18 turnoff. This tower tilts over for instrument access.

PJMT tower (Pajarito Mountain) Access to the Pajarito Mountain (PJMT) tower is controlled by the Los Alamos Ski Club. Drive to the Los Alamos Ski Club facilities and contact the Los Alamos Ski Club (currently Mike Green at 690-1668) to obtain permission to go to the tower site. There is a fence with a locked gate around the base of the tower that is opened with a key originally supplied by Verizon Wireless cell phone company.

Note: If the area is closed to driving, the Los Alamos Ski Club will allow you to ride a chair lift to the tower site. If necessary, the Los Alamos Ski Club will do a special chair run for a fee which the Lab will reimburse – obtain group leader permission before using this approach.

Overview of accessing rain gauge only sites There are rain-gauge-only sites located at NCOM and TA-16. Instrument access is different for each site. Below are specific requirements and instructions for accessing rain gauge sites.

TA-74 This station was removed from service on 11 Jan 2006.

Accessing meteorological sites, continued

North community

The north community (NCOM) rain gauge is located on the roof of the volunteer fire department building at 4017 Arkansas Avenue. It is necessary to climb a caged ladder to the roof. The datalogger for this rain gauge is located in the basement of the building. The basement is locked with a key supplied by the County.

Steps to access NCOM rain gauge

To access the NCOM rain gauge, perform the following steps:

Step	Action
1	Drive to 4017 Arkansas Avenue.
2	To access the gauge, climb the caged ladder to the roof. NOTE: The gauge is easily identified and has a sign indicating that it is an MAQ meteorological monitoring site.
3	To access the datalogger, unlock the basement door located at the rear of the building, using the key supplied by the County. The datalogger is housed in a locked fiberglass box located just inside the door and is identified with a sign.

TA-16

The TA-16 rain gauge is on the roof of building 209. The datalogger is located inside the building.

Steps to access TA-16 rain gauge

To access the TA-16 rain gauge, perform the following steps:

Step	Action
1	Load the extension ladder in place of the 8-foot step ladder on the meteorological section's pickup truck.
2	Use the extension ladder to access the rain gauge on the roof of building 16-209. When you reach the roof, tie the ladder to the building. NOTE: Building 16-209 is only 20 ft square. The gauge is readily apparent and is identified with an MAQ meteorological monitoring site sign.

Accessing meteorological sites, continued

Steps to access TA-16 datalogger To access the TA-16 datalogger, perform the following steps:

Step	Action
1	Go to the S-site Access Control Office in building 16-202 and request a key to building 16-209. Explain that you are not going into any controlled areas and need an exchange badge with a key to bldg. 16-209. NOTE: The Access Control Office will keep your LANL badge until you return the exchange badge.
2	Drive to building 16-209. Remove the 3-foot step ladder from the truck and use it to access the datalogger, which is inside the building in a fiberglass box on a high shelf.
3	After completing the work and removing all tools and equipment used, lock building 16-209 and return the key and exchange badge to the Access Control Office. Retrieve your LANL badge.

TA-6, TA-41, TA-49, TA-53, TA-54, & PJMT tower instrument field work

Overview Rain gauges are calibrated at the site and repaired and cleaned as part of the calibration cycle. The sonic anemometers, dataloggers, and sodar are also calibrated *in situ*. All other tower instrument calibrations are performed in the Meteorology Lab at TA-59 or the instruments are returned to the manufacturers for re-calibration. The re-calibrated instruments are then exchanged with the instruments in use at the sites.

Required equipment and supplies

The following equipment and supplies are needed to perform work:

- three foot ladder
- eight foot ladder
- hand tools such as screw drivers, wrenches, hammers
- carpenter's level
- az-scope
- tower elevator gap-fillers
- test cables
- Loctite 242 Removable Threadlocker
- pipette (for liquid measure)
- Tektronix equipment rack with signal generator, frequency counter and voltmeter
- voltmeter
- one liter bottle of water
- tool box & assorted tools stored in the meteorological team's pickup truck

Aligning propvane locator ring

The propvane azimuth measurement systems must be aligned to a true north reference. The alignment landmarks for the towers are shown in tables below.

Steps to align propvane locator ring

To align a propvane locator ring, perform the following steps:

Step	Action
1	Install the az-scope on the propvane locator ring. Note: The propvane locator ring has a pin that engages the az-scope and the propvane.

Steps continued on next page.

TA-6, TA-41, TA-49, TA-53, TA-54, & PJMT tower instrument field work, continued

Step	Action																																
2	<p>Using the az-scope, check the vane angle alignment against the references given below. If adjustment is required and performed, record the adjustment in the Tower Log Notebook.</p> <table border="1"> <thead> <tr> <th>Tower</th> <th>Landmark</th> </tr> </thead> <tbody> <tr> <td>TA-6</td> <td>guyed commercial radio tower on Pajarito Mtn</td> </tr> <tr> <td>TA-41</td> <td>guyed commercial radio tower on Pajarito Mtn</td> </tr> <tr> <td>TA-53</td> <td>guyed commercial radio tower on Pajarito Mtn</td> </tr> <tr> <td>TA-49</td> <td>TA-33 water tower</td> </tr> <tr> <td>TA-54</td> <td>unique mountain feature to the SE of the tower</td> </tr> <tr> <td>PJMT</td> <td>TA-6 meteorological tower</td> </tr> <tr> <td>MDCN</td> <td>(see MDCN note below)</td> </tr> </tbody> </table> <table border="1"> <thead> <tr> <th>Tower</th> <th>Reference Angle</th> </tr> </thead> <tbody> <tr> <td>TA-6</td> <td>293.5 degrees (66.5 degrees west of true north)</td> </tr> <tr> <td>TA-41</td> <td>277.25 degrees (82.75 degrees west of true north)</td> </tr> <tr> <td>TA-53</td> <td>278.1 degrees (81.9 degrees west of true north)</td> </tr> <tr> <td>TA-49</td> <td>130.75 degrees (130.75 degrees east of true north)</td> </tr> <tr> <td>TA-54</td> <td>155.75 degrees (155.75 degrees east of true north)</td> </tr> <tr> <td>PJMT</td> <td>113.0 degrees (113.0 degrees east of true north)</td> </tr> <tr> <td>MDCN</td> <td>(see MDCN note below)</td> </tr> </tbody> </table> <p>NOTE: The propvane locator ring measurement is normally only a verification that the propvane locator ring is properly set. The locator ring is mechanically locked to the boom and not subject to accidental change or drift.</p> <p>MDCN NOTE: There is a special procedure for the vane angle alignment for this tower. There is a memo (dated 28 OCT 02) in the MDCN tower file (TA59/001/176) and the MDCN Tower Workbook that describes the procedure.</p>	Tower	Landmark	TA-6	guyed commercial radio tower on Pajarito Mtn	TA-41	guyed commercial radio tower on Pajarito Mtn	TA-53	guyed commercial radio tower on Pajarito Mtn	TA-49	TA-33 water tower	TA-54	unique mountain feature to the SE of the tower	PJMT	TA-6 meteorological tower	MDCN	(see MDCN note below)	Tower	Reference Angle	TA-6	293.5 degrees (66.5 degrees west of true north)	TA-41	277.25 degrees (82.75 degrees west of true north)	TA-53	278.1 degrees (81.9 degrees west of true north)	TA-49	130.75 degrees (130.75 degrees east of true north)	TA-54	155.75 degrees (155.75 degrees east of true north)	PJMT	113.0 degrees (113.0 degrees east of true north)	MDCN	(see MDCN note below)
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3	<p>After checking or setting the locator ring alignment, remove the az-scope and install the propvane.</p> <p>NOTE: The vane angle calibrator has a corresponding locator pin and the propvanes and az-scope have matching receptacles. The vane angle calibrator is the instrument used to calibrate the propvanes' azimuth measurement systems. The az-scope is also calibrated with the vane angle calibrator. In this way, the azimuth calibration is easily transferred from the calibration standard to the final installation.</p>																																
4	Clamp the propvane in position and connect the signal cable.																																
5	Verify the propvane is properly oriented by checking the azimuth angle indicated on the datalogger.																																

Removing and installing TA-6, TA-49, TA-53, & TA-54 tower instruments

Overview

The following procedure allows the operator to check the as-is condition of booms and the alignment of the azimuth vanes for each carriage. The elevator system has a limit switch at the six foot level to ensure that the carriage isn't lowered too far and each carriage has a limit in its umbilical connector to ensure proper engagement when the carriages are raised back to their stations. It is important that the carriage positions on the lifting cable be marked with paint and measured so that the carriage is reinstalled at the correct position on the lifting cable.

Steps to remove instruments

To remove instruments from the tower, perform the following steps:

Step	Action
1	Lower the tower carriages according to the appropriate steps for the specific tower in MAQ-408.
2	Use a ladder to gain access to the carriage and instruments mounted on the carriage boom. Ensure the ladder is positioned on firm level ground and that the legs are in equal contact with the ground.
3	Check the boom with a carpenter's level to verify that it is level.
4	Remove the propvane, install the az-scope on the propvane mount, and note the azimuth angle measured when the az-scope is aligned on the landmark. If needed, adjust the propvane's azimuth locator ring. NOTE: These reference angles are contained in the table in Step 2 of the previous section of this procedure.
5	Mark the cable, lower the next carriage, and remove it according to the appropriate steps in MAQ-408.
6	Remove the vertical wind anemometer.
7	Open the temperature instrument radiation shield and remove the thermistor probe.

Steps continued on next page.

Removing and installing TA-6, TA-49, TA-53, & TA-54 tower instruments, continued

Step	Action
8	Lower and remove the remainder of the carriages (except top one) according to the appropriate steps in MAQ-408.
9	Return the removed instruments to the meteorological laboratory for post-calibration. NOTE: Calibration is performed in accordance with MAQ-402.

Steps to install instruments To install the instruments, perform the following steps:

Step	Action
1	Ensure replacement instruments are installed in the correct positions by verifying serial numbers as assigned on the instrument calibration sheets.
2	If it is time to replace the temperature instrument's aspirator fan, disassemble the radiation shield to gain access to the fan and replace it.
3	Install a re-calibrated temperature thermistor probe in the solar radiation shield.
4	Install a refurbished vertical wind anemometer.
Install a refurbished propvane	
5	Set the propvane on the mounting post and engage the locator pin on the azimuth locator ring in the receptacle on the propvane.
6	Tighten the hose clamp at the base of the propvane to lock it into position.
7	Reconnect any connections that were disconnected and reassemble anything that was disassembled.
8	Repeat steps 1-7 for each tower instrument level.
9	Record the time and date of installation and sign the calibration sheets. NOTE: These calibration sheets were created when the instruments were calibrated in accordance with procedure MAQ-402.
10	File the calibration sheets for the instruments just installed in the calibration log section of the appropriate Tower Activity Log Notebook.

Removing and installing TA-6, TA-49, TA-53, & TA-54 tower instruments, continued

Steps to re-install carriages

To re-install carriages on the tower, perform the following steps:

Step	Action
1	Lower the tower carriages according to the appropriate steps for the specific tower in MAQ-408.
2	This carriage signal jumper cable connection from the carriage to the tower J-box will complete the electrical connection to the station datalogger. The operator is then able verify that all the instruments are working properly before the carriage is raised to its working position on the tower.
3	Point the propvane at the known azimuth alignment landmark, then clamp the propvane and compare the reading displayed on the datalogger to the known landmark azimuth angle. Note this value in the "comments" section of the propvane CMF1 form and remove the clamp from the propvane.
4	Verify the operation of all the instruments on the carriage by examining the datalogger display for each instrument.
5	Refer to MAQ-408 and follow steps 15-23.
6	Make an entry in the Tower Log Notebook citing: <ul style="list-style-type: none"> • the work completed, • a description of any adjustments made, • data editing requirements, • the period for which the edits are required, and • any other pertinent information. Sign and date the entry.

Removing and installing TA-41 tower instruments

Overview The TA-41 meteorology tower is equipped with a tilt-over mechanism. The tower is tilted over to gain access to the instruments.

Steps to remove instruments

To remove the instruments at TA-41, perform the following steps:

Step	Action
1	Lower and tilt over the tower according to the appropriate steps for the tower in MAQ-408.
2	Use an eight foot ladder to reach the vertical wind anemometers. NOTE: The propvanes and temperature transducers are accessed at ground level.
3	Remove the vertical wind anemometers and the propvanes.
4	Open the temperature instrument radiation shield and remove the thermistor probe.
5	Remove the pyranometer.
6	Calibrate the datalogger in accordance with procedure MAQ-402. Note: This is a convenient time to calibrate the datalogger because none of the instruments are connected.

Steps to install instruments

To install the instruments at TA-41, perform the following steps:

Step	Action
1	Ensure instruments are installed in the correct positions by verifying serial numbers as assigned on the instrument calibration sheets.
2	If it is time to replace the temperature instrument's aspirator fan, disassemble the radiation shield to gain access to the fan. Replace it with another fan.
Install refurbished propvanes	
3	Set the propvane on the mounting post and engage the locator pin on the azimuth locator ring in the receptacle on the propvane.
4	Tighten the hose clamp at the base of the propvane to lock it into position.
5	Reconnect any connections that were disconnected and reassemble anything that was disassembled.

Removing and installing TA-41 tower instruments, cont.

Step	Action
6	Repeat steps 1-5 for each tower instrument level.
7	Record, on the instrument calibration sheets, the date and time the instruments were installed. Sign the sheets. NOTE: The calibration sheets were created when the instruments were calibrated in accordance with procedure MAQ-402.
8	File the calibration sheets for the instruments just installed in the Tower Activity Log Notebook.

Steps to re-erect the tower

To re-erect the TA-41 tower, perform the following steps:

Step	Action
1	Raise the tower according to the appropriate steps for the tower in MAQ-408.
2	Make an entry in the Tower Log Notebook citing: <ul style="list-style-type: none"> • the work completed, • a description of any adjustments made, • data editing requirements, • the period for which the edits are required, and • any other pertinent information. Sign and date the entry.

Removing and installing MDCN tower instruments

Overview The Mortandad Canyon (MDCN) meteorology tower is equipped with a tilt-over mechanism. The tower is tilted over to gain access to the instruments.

Steps to remove instruments

To remove the instruments at MDCN, perform the following steps:

Step	Action
1	Lower and tilt over the tower according to the appropriate steps for the tower in MAQ-408.
2	Remove the vertical wind anemometer and the propvane.
3	Remove the thermistor probes.
4	Remove the pyranometer.
5	Calibrate the datalogger in accordance with procedure MAQ-402. Note: This is a convenient time to calibrate the datalogger because none of the instruments are connected.

Steps to install instruments To install the instruments at MDCN, perform the following steps:

Step	Action
1	Ensure instruments are installed in the correct positions by verifying serial numbers as assigned on the instrument calibration sheets.
2	If it is time to replace the temperature instrument's aspirator fan, disassemble the radiation shield to gain access to the fan. Replace it with another fan.
Install refurbished propvanes	
3	Set the propvane on the mounting post and engage the locator pin on the azimuth locator ring in the receptacle on the propvane.
4	Tighten the hose clamp at the base of the propvane to lock it into position.
5	Reconnect any connections that were disconnected and reassemble anything that was disassembled.
6	Record, on the instrument calibration sheets, the date and time the instruments were installed. Sign the sheets. NOTE: The calibration sheets were created when the instruments were calibrated in accordance with procedure MAQ-402.
7	File the calibration sheets for the instruments just installed in the Tower Activity Log Notebook.

Removing and installing MDCN tower instruments, continued

Steps to re- erect the tower

To re-erect the MDCN tower, perform the following steps:

Step	Action
1	Raise the tower according to the appropriate steps for the tower in MAQ-408.
2	Make an entry in the Tower Log Notebook citing: <ul style="list-style-type: none">• the work completed,• a description of any adjustments made,• data editing requirements,• the period for which the edits are required, and• any other pertinent information. Sign and date the entry.

Removing and installing PJMT tower instruments

Overview The tower instruments at Pajarito Mountain (PJMT) are accessed by climbing the tower. All equipment and a newly calibrated propvane are carried to the top of the tower and the propvane is exchanged in one trip.

Steps to remove and install instruments To remove and install PJMT tower instruments, perform the following steps:

Step	Action
1	Upon reaching the PJMT tower measurement station, ready all the necessary equipment to be carried up the tower.
2	Refer to procedure MAQ-401, "Meteorological Tower Climbing and Support" for information defining requirements for tower climbing.
3	Climb the tower and remove the propvane.
4	Set the refurbished propvane on the monitoring post and engage the locator pin on the azimuth locator ring in the receptacle on the propvane.
5	As viewed from the top of the propvane, rotate the propvane anti-clockwise against the locator pin to remove slack in the mounting system.
6	Tighten the hose clamp on the propvane base to secure the propvane to the mounting post.
7	Connect the signal wires to the terminals in the propvane junction box.
8	Replace the temperature transducer with a newly calibrated unit. Note: The temperature solar radiation shield is a naturally aspirated device that requires no maintenance.
9	Record, on the instrument calibration sheets, the date and time the instruments were installed. Sign the sheets. NOTE: The calibration sheets were created when the instruments were calibrated in accordance with procedure MAQ-402.
10	File the calibration sheets for the instruments just installed in the PJMT Tower Activity Log Notebook.
11	Make an entry in the Tower Log Notebook citing: <ul style="list-style-type: none"> • the work completed, • a description of any adjustments made, • data editing requirements, • the period for which the edits are required, and • any other pertinent information. Sign and date the entry.

Removing and installing tower site ground level instruments

Overview The ground level instruments include temperature, relative humidity, barometric pressure and solar radiation. Not all sites have all the same ground level instrumentation.

Steps for removing and installing instruments To remove and install tower site ground level instruments, perform the following steps:

Step	Action
1	Replace the level 0 (1.2 m) temperature probe and if necessary the aspirator fan.
2	Replace the level 0 relative humidity probe.
Replace the up-facing solar pyranometer(s) or pyrgeometer(s)	
3	Remove the solar heat shield, disconnect the connector, remove the screws holding the unit in the aspirator housing, and remove the unit.
4	Set the new unit in place in the aspirator housing.
5	Reconnect the connector and replace the mounting screws.
6	Level the unit using its attached bull's-eye level. Use the six screws around the perimeter of the aspirator housing to level the unit.
7	After leveling the unit, re-attach the solar heat shield.
Replace the down-facing solar pyranometer and pyrgeometer	
8	Disconnect the connector, then carefully support the unit and remove the mounting screws.
9	Hold the new unit in place and replace the mounting screws leaving them slightly loose so that the unit can be leveled.
10	Set a 12" scale on the upper surface of the unit. NOTE: This would be the bottom-side of the unit since it is downfacing.
11	Set a bull's-eye level on the portion of the scale that extends beyond the unit.
12	Adjust the mounting screws to level the unit with the bull's-eye level.
13	After leveling the unit, adjust its thumbscrews up to the mounting plate to secure the setting.
14	Reconnect the connectors.
Other instruments	
15	Calibrate the snow depth gauge (TA6 & PJMT) and lightning detector (TA-6) per MAQ-402.

Steps continued on next page.

Removing and installing tower site ground level instruments, continued

Step	Action
16	Exchange the barometric pressure instrument with a newly calibrated unit.
17	Record, on the instrument calibration sheets, the date and time the instruments were installed. Sign the sheets. Note: The calibration sheets were created when the instruments were calibrated in accordance with procedure MAQ-402.
18	File the calibration sheets for the instruments just installed in the Tower Activity Log Notebook.
19	Make an entry in the Tower Log Notebook citing: <ul style="list-style-type: none">• the work completed,• a description of any adjustments made,• data editing requirements,• the period for which the edits are required, and• any other pertinent information. Sign and date the entry.

Rain gauge field work

Overview The rain gauges at the tower sites and TA-74 are all in locations about 1.5 meters above the ground. The rain gauges at TA-16 and NCOM are located on roof tops.

To calibrate rain gauges To calibrate the rain gauges, perform the following steps:

Step	Action
1	Follow the instructions in procedure MAQ-402 to clean, repair, and calibrate rain gauges.
2	Record, on the instrument calibration sheets, the date and time the instruments were calibrated. Sign the sheets. NOTE: The calibration sheets are created when the instruments are calibrated in accordance with procedure MAQ-402.
3	File the calibration sheets for the instruments in the appropriate Tower Activity Notebook.
4	Make an entry in the Tower Log Notebook citing: <ul style="list-style-type: none">• the work completed,• a description of any adjustments made,• data editing requirements,• the period for which the edits are required, and• any other pertinent information. Sign and date the entry.

Datalogger field work

Overview The dataloggers are contained in buildings and shelters for each meteorological measurement site and are easily accessed.

To calibrate rain gauges To calibrate the dataloggers, perform the following steps:

Step	Action
1	Follow the instructions in procedure MAQ-402 to clean, repair, and calibrate dataloggers.
2	Record, on the dataloggers calibration sheets, the date and time the dataloggers were calibrated. NOTE: The calibration sheets are created when the instruments are calibrated in accordance with procedure MAQ-402.
3	File the calibration sheets for the dataloggers just calibrated in the appropriate Tower Activity Log Notebook.
4	Make an entry in the Tower Log Notebook citing: <ul style="list-style-type: none">• the work completed,• a description of any adjustments made,• data editing requirements,• the period for which the edits are required, and• any other pertinent information. Sign and date the entry.

Sonic anemometer field work

Overview Sonic anemometer calibration is well documented in the equipment manual. Follow that procedure. The sonic transducer assembly is mounted on the level 1 tower boom and this calibration is done as a last step before the level 1 is returned to its station.

Steps to calibrate the anemometer

To calibrate the anemometer, perform the following steps:

Step	Action
1	Using the tower's winch, position the level 1 boom at the nine foot above-the-ground position to allow access to the sonic transducer assembly.
2	Perform the calibration procedure described in the sonic anemometer equipment manual, in accordance with procedure MAQ-402.
3	Using the tower's winch, run the carriages up to their normal operating positions and shut off the winch power.
4	Wait until a good 15 minute average data block has been collected by the tower and flux dataloggers. From each datalogger, note the corresponding values of wind speed and direction, vertical speed, and temperature, as recorded by the sonic (flux datalogger) and level one tower instruments (tower datalogger).
5	Record these measurements on the calibration sheet for the sonic anemometer. NOTE: The calibration sheet is created when the instrument is calibrated in accordance with procedure MAQ-402.
6	Record, on the instrument calibration sheet, the date and time the work was performed. Sign the sheets.
7	File the calibration sheets for the instruments just installed in the TA-6 Tower Activity Log Notebook.
8	Make an entry in the Tower Log Notebook citing: <ul style="list-style-type: none"> • the work completed, • a description of any adjustments made, • data editing requirements, • the period for which the edits are required, and • any other pertinent information. Sign and date the entry.

Fast response hygrometer field work

Overview The fast response hygrometer is mounted on the level 1 tower boom. This instrument is calibrated by the manufacturer. A newly-calibrated unit is installed when the level 1 boom is at the nine foot position.

Steps to install calibrated hygrometer To install a newly-calibrated hygrometer, perform the following steps:

Step	Action
1	Using the tower's winch, position the level 1 boom at the nine foot above-the-ground position, which allows access to the hygrometer.
2	Remove the old hygrometer from the boom and install the newly-calibrated unit, in accordance with procedure MAQ-402.
3	Using the tower's winch, run the carriages up to their normal operating positions and shut off the winch power.
4	File the calibration sheet for the instrument just installed in the Tower Activity Log Notebook. Record the time and date of installation and sign the sheet.
5	Make an entry in the Tower Log Notebook citing: <ul style="list-style-type: none">• the work completed,• a description of any adjustments made,• data editing requirements,• the period for which the edits are required, and• any other pertinent information. Sign and date the entry.

Fuel moisture transducer field work

Overview Fuel moisture measurement is of primary importance through the summer fire season.

Steps to maintain fuel moisture transducer

To maintain the fuel moisture transducer, perform the following steps:

Step	Action
1	During March or April, note the last 15 minute average reading of the old transducer (existing in the field) and record that value in the comments section of the calibration sheet for the refurbished transducer.
2	Remove the old transducer and replace it with the refurbished unit.
3	Note a 15 minute average reading from the installed refurbished transducer 24 hours after installation and record this value in the comments section of the calibration sheet. If the reading agrees within $\pm 5\%$ moisture of the reading from Step 1 (assuming weather conditions have not changed drastically), the new transducer is functioning correctly.
4	File the calibration sheet for the instrument just installed in the Tower Activity Log Notebook.
5	Make an entry in the Tower Log Notebook citing: <ul style="list-style-type: none">• the work completed,• a description of any adjustments made,• data editing requirements,• the period for which the edits are required, and• any other pertinent information. Sign and date the entry.

Subsurface measurement instrument field work

Overview

Subsurface measurements are made at the TA-6 and TA-54 tower sites. The instruments are buried at various depths up to 18 cm below the ground surface. Optimal installation is in undisturbed soil. To that end, care is used during instrument installation to minimize disturbing the soil and damaging plants and their roots. Any periodic work on these instruments, such as annual calibrations, would be detrimental to this objective.

The instruments are disturbed only if there is evidence of damage or other malfunction. This can be determined by intra-comparisons of the measurements. This is possible because of the numbers of instruments measuring the same variable under slightly different conditions. For example, temperature is measured at 2 and 6 cm depths in two different locations about 1.5 meters apart, there are two ground heat flux plates about 1.5 m apart, and there are two soil moisture probes.

Steps to maintain instruments

To maintain subsurface measurement instruments, perform the following steps:

Step	Action
1	Begin by removing soil around the instrument cables at a distance away from the instruments. In this way, the instruments can be located with the least disruption of the soil and risk of instrument damage if blind probing of the soil is done.
2	Remove the suspect instrument and replace it with a unit calibrated in accordance with procedure MAQ-402.
3	Disconnect the old instrument (just removed from the ground) at the "J" box and connect the new unit.
4	Replace the removed soil.
5	Record, on the instrument calibration sheet(s), the date and time the instruments were installed. Sign the sheet(s). NOTE: The calibration sheets were created when the instruments were calibrated in accordance with procedure MAQ-402.
6	File the calibration sheet(s) for the instrument(s) just installed in the Tower Activity Log Notebook.
7	Make an entry in the Tower Log Notebook citing: <ul style="list-style-type: none"> • the work completed, • a description of any adjustments made, • data editing requirements, • the period for which the edits are required, and • any other pertinent information. Sign and date the entry.

Site work associated with independent audit

Overview

To assure the veracity of the meteorological measurements, we periodically employ the services of an outside contractor to conduct an independent audit. This contractor does calibration checks on the instruments at a tower site following the guidance provided in MAQ-402. For some of the instruments, the calibration check is with co-located NIST traceable instrumentation.

The contractor is on-site for about two days to complete the field work and then an audit report is created to document all the findings.

Steps to perform an independent audit

To set up and perform an independent meteorology instrument audit, perform the following steps:

Step	Action
1	Create ES&H screening documentation for the tower site.
2	Have the ES&H documentation signed by the responsible person in the FMU.
3	Create a purchase request for the independent audit.
4	Submit the ES&H screening documents with the purchase request.
5	Accompany the independent auditor(s) for all field work.
6	Provide security control access to TA-6 and escort the auditor(s) at all times.
7	Conduct the audit following the steps set out in this document, MAQ-401, MAQ-402, and the scope of the work contained in the purchase request.
8	Make an entry in the Tower Log Notebook citing: <ul style="list-style-type: none">• the work completed,• a description of any adjustments made,• data editing requirements,• the period for which the edits are required, and• any other pertinent information. Sign and date the entry.

Site work associated with tower safety inspections

Overview

The tower safety inspection requires the services of a tower erection company who will send workers to Los Alamos for the inspection work. The workers will conduct a climbing inspection of each tower checking for corrosion, loose hardware, warning lights and operation, guying and guy tension, tower plumb, safety equipment integrity, and winch system operation.

Steps to perform safety inspection

To set up and perform a tower safety inspection, perform the following steps:

Step	Action
1	Create ES&H screening documentation for each tower site, since each tower site is in a separate Facility Management Unit (FMU).
2	Have the ES&H documentation signed by the responsible person in each FMU.
3	Create a purchase request for the tower safety inspection.
4	Submit the ES&H screening documents with the purchase request.
5	Accompany the inspector(s) for all field work.
6	Provide security control access to TA-6 and escort the inspector(s) at all times.
7	Make an entry in the Tower Log Notebook citing: <ul style="list-style-type: none">• the work completed,• a description of any adjustments made,• data editing requirements,• the period for which the edits are required, and• any other pertinent information. Sign and date the entry.
8	If problems are identified during the inspection, notify the Meteorology Monitoring Project Team Leader and take appropriate steps to have the problems corrected.
9	File the resulting inspection report in the files maintained at TA-59, building 0001, room 176.

Additional meteorological work

Overview

Additional meteorological work includes installing new monitoring systems at existing or new monitoring sites and performing work requested by other MAQ projects or Laboratory organizations. This work is divided into two categories:

1. Work that is essentially identical to work described in a procedure, but is performed at a different monitoring site. The hazard analysis and mitigation is covered by existing Hazard Reviews (HRs). Documented training (according to MAQ-024) to an HR or to a procedure constitutes authorization to perform the work described in the HR or procedure.
 2. Work that varies significantly from work described in a procedure or is to be performed at a potentially hazardous location. Hazards may not be adequately covered by existing HRs. This work will be considered non-routine work and a new HR or Integrated Work Document (IWD) must be developed and approved in accordance with procedure MAQ-035 before the work may be performed.
-

Determining if additional hazard analysis is needed

The individual proposing or planning additional work must consult with the Meteorological Monitoring Project Leader to determine if the hazards of the work are adequately covered by an existing HR or if the additional work is non-routine work that requires a new HR or IWD, pursuant to procedure MAQ-035.

Records resulting from this procedure

Records

The following calibration and maintenance records generated as a result of performing these procedures are filed in the appropriate Tower Activity Log Notebook within one week of generation:

- Forms generated by the performance of calibration or maintenance work described in MAQ-402
- Independent Instrument Calibration Audit reports
- Tower Safety Inspection reports
- Any notes or reports resulting from the performance of work described in the *Additional Meteorological Work* chapter of this procedure

The Tower Activity Log Notebooks and the Tower Log Notebook (a bound laboratory notebook) are maintained as records at TA-59, building 0001, room 176.

HAZARD REVIEW FOR REPAIRING, MAINTAINING, AND CALIBRATING METEOROLOGICAL INSTRUMENTS IN THE FIELD

Work tasks/Steps	Hazards, Concerns, and Potential accidents; Likelihood/ Severity	Controls, Preventive Measures (e.g., safety equipment, administrative controls, etc.)	Hazard Level from IMP 300-00-00 Hazard Grading Matrix
All steps, as needed: Ladders are frequently used to access instruments.	Falls. Remote / moderate = low	Ensure that the ladder is properly placed on level ground with a solid footing so that it does not shift when the worker is on the ladder. The ladder must be positioned so that the worker does not have to over-extend and therefore unbalance the ladder. Do not stand on the top two steps of a ladder. Workers will take the laboratory ladder training course.	Low
All steps, as needed: Use hand tools (screw drivers, wrenches, knives, pliers & wire cutters, etc.).	Cuts, scrapes, bruises, etc. Occasional / negligible = minimal	Ensure that hand tools are in good condition and are proper for the application.	Low
All steps, as needed: Use of hand power tools (drill motors, saber saw, Sawzall, soldering irons, etc.).	Cuts, scrapes, bruises, burns, lacerations, etc. Remote / moderate = minimal	As with hand tools, ensure that power tools are in good condition and are proper for the application.	Low
All steps, if necessary to complete work: work at night in rare cases.	Increased chance of injury due to darkness. Improbable / moderate = minimal	In the rare event that work is performed after dark, the workers will wear a headlamp style light, carry a flashlight, or aim the vehicle headlights at the work area.	Low

Wastes or residual materials resulting from process

None.

Emergency actions to take in event of control failure

For all injuries, provide first aid and see that injured person is taken to Occupational Medicine (only if immediate medical attention is not required) or the hospital. Notify supervisor and group office as soon as possible. Follow all site-specific emergency plans for any radiation or explosives emergencies.

Meteorology and Air Quality Group
PROCEDURE TRAVELER

This form is from MAQ-022

Part 1 (completed by any group employee)

Procedure number: ENV-MAQ-404 Revision 3-4

Procedure title: REPAIRING, MAINTAINING & CALIBRATING METEOROLOGICAL TEST IN THE FIELD

Action Requested: New procedure Major revision of existing procedure Deletion of existing procedure

Description of and reason for action: Quick-change revision of existing procedure (parts 3 and 5 N/A)

CHANGED TOWER LOCATION AND ACCESS INFORMATION IN THE SECTION ENTITLED: "ACCESSING METEOROLOGICAL SITES". Convert HEP to HR

[Signature]
Signature

WILLIAM A. OLSEN
Name (print)

23 JAN 06
Date

Part 2 (completed by appropriate manager)

I agree with the action requested: Yes No If No, enter reasons below.

If Yes, assigned preparer: William A. Olsen Affected teams, programs, groups, or individuals required to review this procedure and others who should review it (see procedure page 5):

Required reviewers: N/A

Optional reviewers: N/A

[Signature]
Signature

H. DARRELL HOLT
Name (print)

1/23/06
Date

Part 3 (completed by preparer or other qualified safety reviewer)

I have evaluated, according to MAQ-035 and LIR300-00-01, the risks inherent in performing this procedure and have documented them on the Hazard Control Plan form, or referred to a plan that covers this type of work.

[Signature]
Preparer

WILLIAM A. OLSEN
Name (print)

Date

Draft prepared and sent for formal review on: _____ Comments resolved on: _____ After comments have been resolved with each reviewer, obtain signatures of the reviewers in part 5.

Part 4 (signed by safety officer or group leader)

I agree that the appropriate safety-related activities and appropriate risk level were identified during the hazard evaluation:

[Signature]
Safety officer or group leader

DIANNE WILBURN
Name (print)

2/27/06
Date

Part 5 (signed by required reviewers: NA for quick-change revisions)

I attest that all my comments and concerns have been satisfactorily discussed, resolved, and/or incorporated into the final version of the procedure.

[Signature]
Signature

H. DARRELL HOLT
Name (print)

2/27/06
Date

Signature

Name (print)

Date

Signature

Name (print)

Date

Signature

Name (print)

Date

Preparer: After all reviewers have signed above section, submit this form with copy of draft and final procedure to records coordinator.