



8329-A
8329-B
8329-C
Ceilometer



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1 PRESENTATION

1.1 General

The 8329-A cloud ceilometer is intended for fixed installation at airports, meteorological stations, or anywhere reliable cloud ceiling information is demanded. It continuously measures cloud height above the ground and indicates on one or more display units two different cloud bases, up to a height of 3840 m. If the vertical visibility is less than 1000 meters and the unit cannot detect a cloud base, the vertical visibility is indicated instead.

The 8329-A works in accordance with the principal for optical radar (LIDAR). Short laser light pulses are emitted, and the time taken for them to be reflected from the cloud base is measured. On the basis of the speed of light, the 8329-A can calculate cloud base height.

DANGER
THE 8329-A CEILOMETER CONTAINS A CLASS IIIB LASER PRODUCT PRODUCING INVISIBLE RADIATION AT A WAVELENGTH OF 910nm THAT CAN BE HAZARDOUS TO THE NAKED EYE. AVOID DIRECT EXPOSURE TO THE LASER BEAM.

The ceilometer can be connected to a data display unit or to one or more 8377-A Control Units. When multiple control units are used, one functions as the master and the others as slaves.

The 8329-B functions identically to the 8329-A, but is designed to operate with a supply voltage of 230 VAC. All discussion of the 8329-A applies equally to the 8329-B, with few exceptions. The few points of difference are clearly noted and discussed in the appropriate sections.

The 8329-C functions identically to the 8329-A, but is designed for connection to an Uninterruptible Power Supply (UPS). All discussion of the 8329-A applies equally to the 8329-C.

1.2 Brief functional description

The figures on the following pages (Figures 1.1, 1.2, and 1.3) describe the operating principle of the cloud ceilometer. This is based on the comparison of the time taken for a laser pulse to return from a cloud with a given time delay.

The transmitter emits a laser light pulse toward the clouds simultaneously with a gate pulse to a time delay. The laser pulse is reflected from the clouds and returns to the receiver after a time which is directly related to the cloud height

The reflected signal level is stored only when a gate pulse is present (when the time delay for the gate pulse corresponds to the time for the laser pulse to return from the clouds). Several pairs of pulses are sent out with the same time lag for the corresponding gate pulses and the measured values are integrated by the Sample-and-Hold circuit. The measurements thus obtained are stored in a buffer, each value in a slot intended for a particular cloud height.

After each measuring cycle (when all heights have been surveyed), an evaluation sequence scans all the measured values in the buffer. The values which fulfill preset "cloud criteria" are detected and the heights corresponding to those values are indicated as cloud heights on the data display.

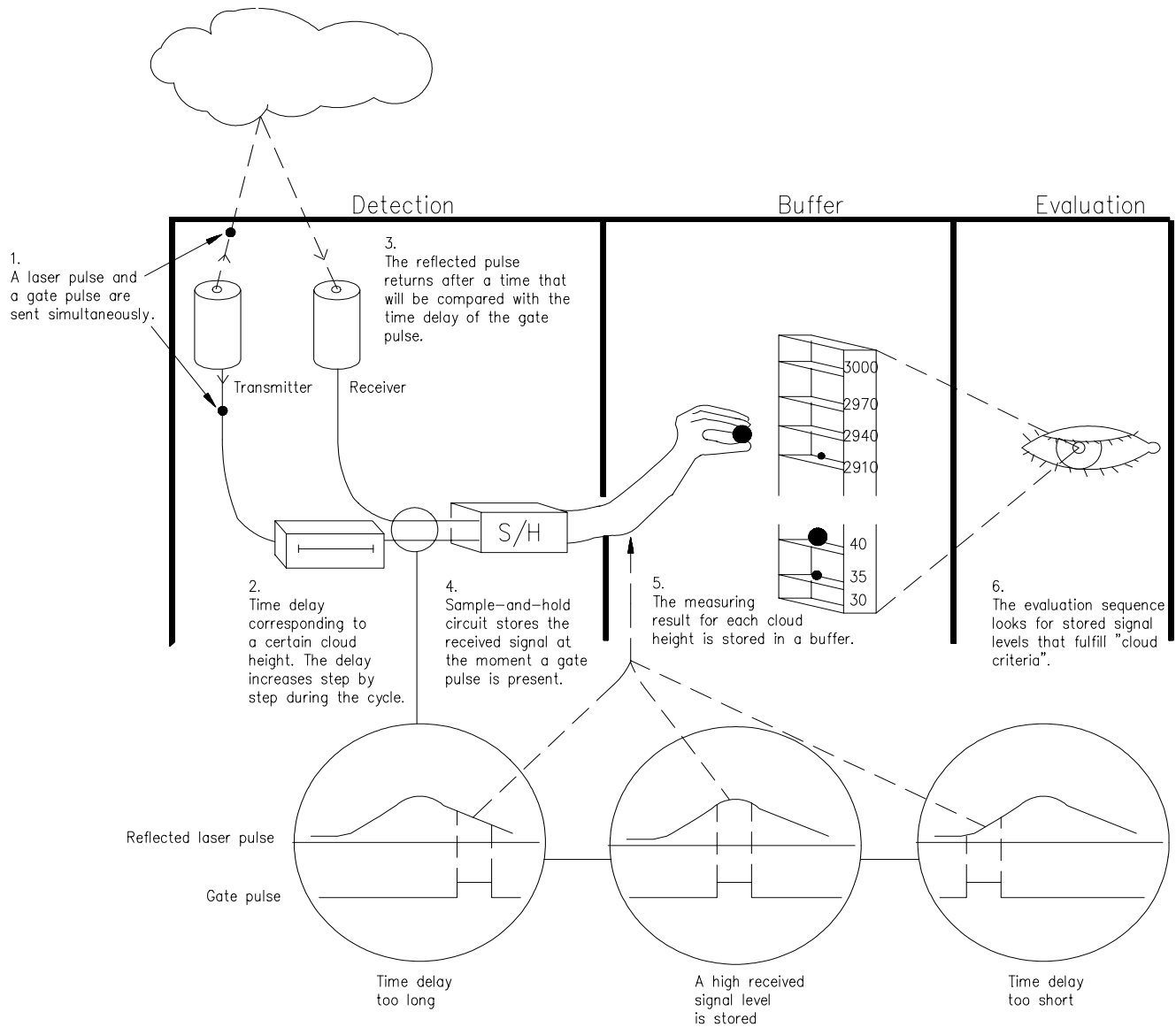


Figure 1.1

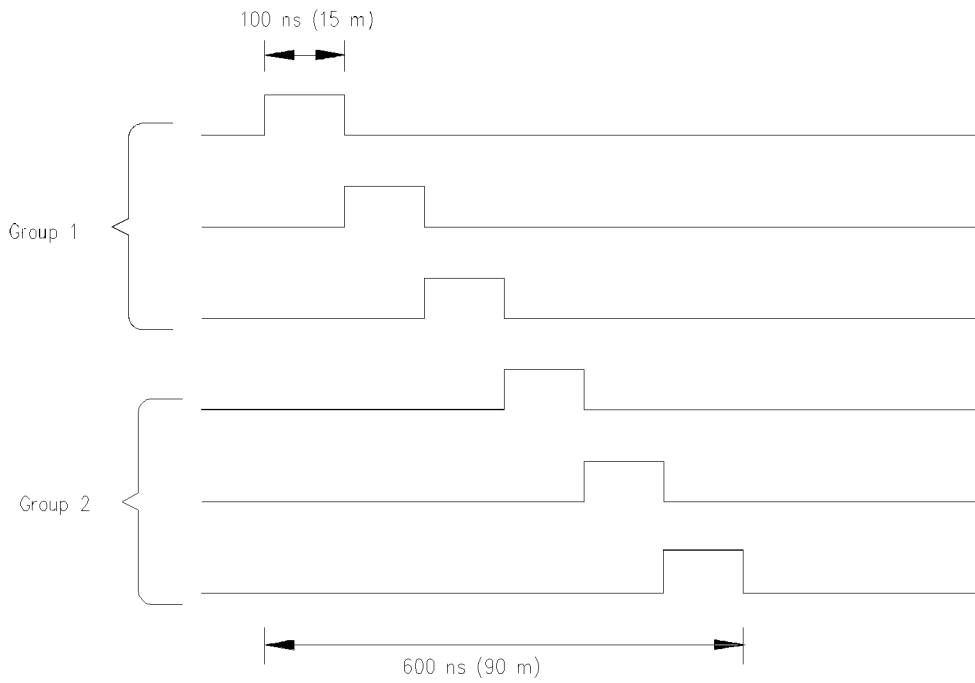


Figure 1.2

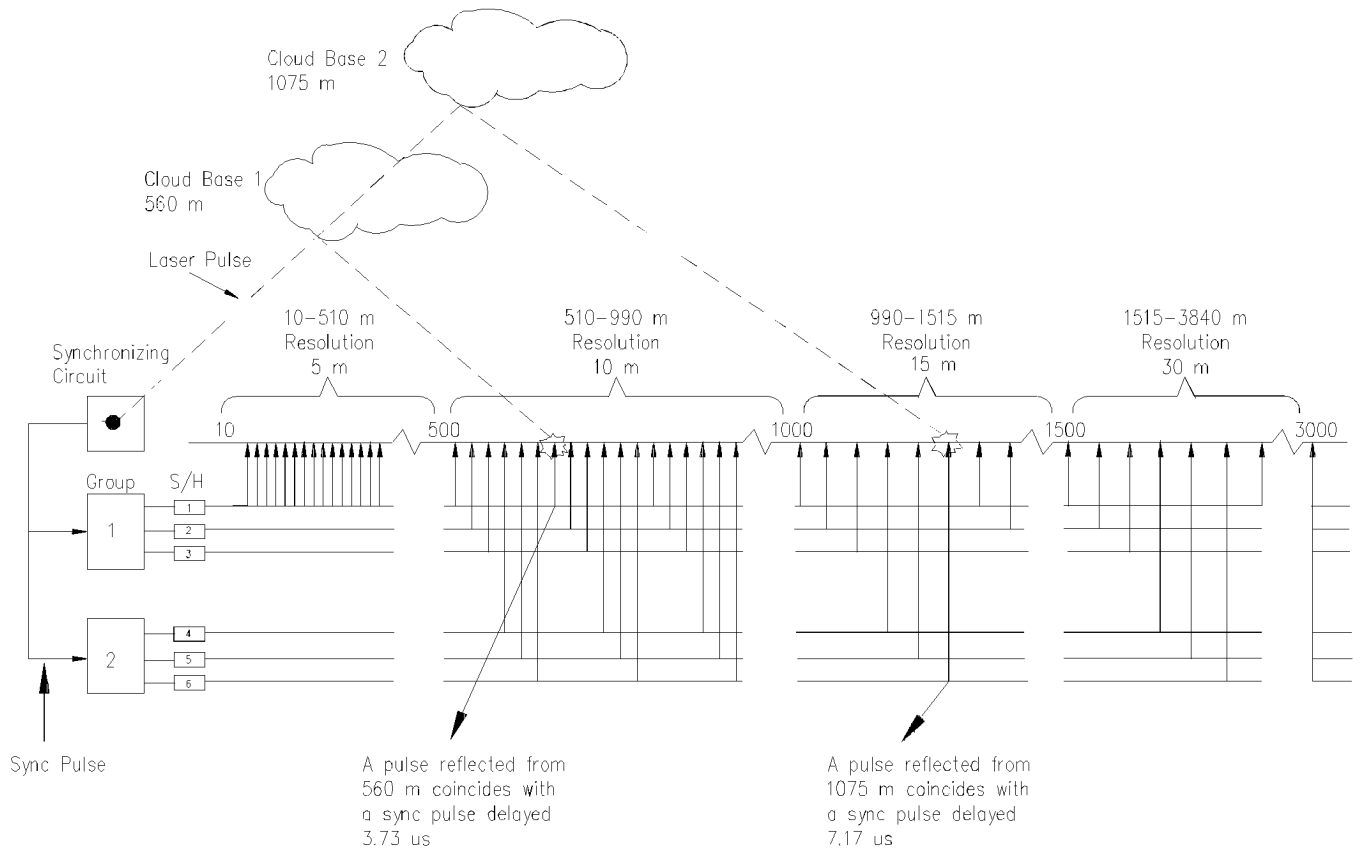


Figure 1.3

2 DESCRIPTION

2.1 Design

2.1.1 General

(Refer to Figure 2.1). The transceiver is designed for permanent outdoor operation. The electronics are hermetically sealed and protected from moisture by a replaceable desiccant cartridge. A blower clears the windows in the protective casing during adverse weather conditions and two heating elements are switched on when the temperature falls below 20°C.

The transceiver is fixed to a cast base frame which stands on three legs. The main frame, which includes the optics and the electronics, can be tilted to a horizontal position for servicing. The main frame is protected by a pressure-sealed casing with two sloping windows at the top for the optical systems of the transmitter and receiver.

A surrounding cover protects the apparatus from sun, wind, and snow. This is open at the top and separated from the casing by 20 mm to allow for air circulation. The casing is attached to the base stand by spring catches. Keyed metal flanges on the bottom rim of the cover fit over fixed bolts in the base stand, and the cover is clamped in place with nuts. The high-pressure fan which keeps the windows clear is positioned under the base stand.

The main frame carries the transmitter, the receiver, their respective lenses, the power unit, and the circuit board unit. The two heating elements are mounted on either side of the transmitter/receiver casting.

The signal and power connections are on the underside of the base frame. There is a window in the base frame through which a yellow LED (indicating power on) and a red LED (indicating laser on) are visible. There is also a desiccant cartridge on the base frame, with an outwardly visible color indicator. This indicator is dark blue while the drying agent is still functional, but turns pink when it has become moist and must be replaced.

2.1.2 Power, circuit board, and optical units

The power unit is made up of a transformer with rectifiers, filter capacitors, and a switched-mode power supply. The power transformer is toroidal and is attached to the base frame, beneath the main frame, as are the filter capacitors. The switched-mode power supply consists of a circuit board encased in a screen box on the main frame.

On the main frame is the circuit board unit - a rack with a backplane and space for three circuit boards (Control, Processor, and Signal Detector). The receiver and transmitter lenses, each with a focal length of 200 mm, are attached with four screws.

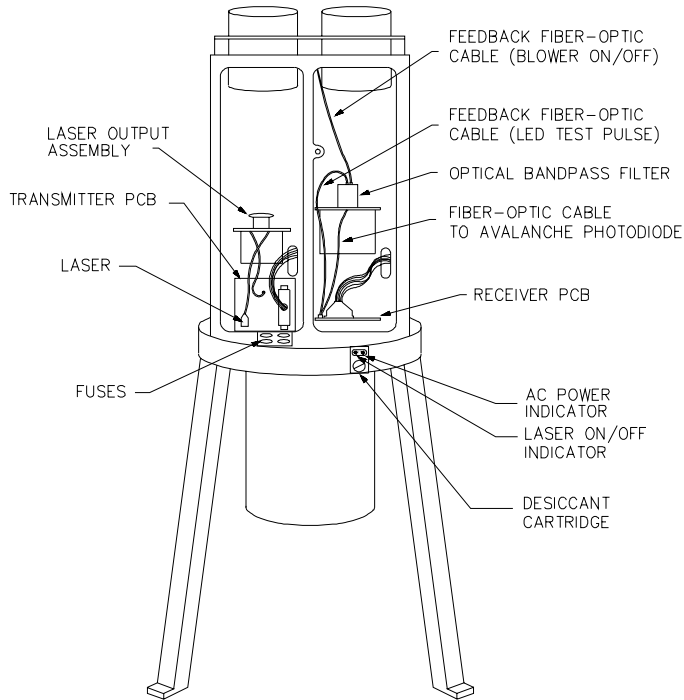


Figure 2.1 (a)
8329-A Ceilometer

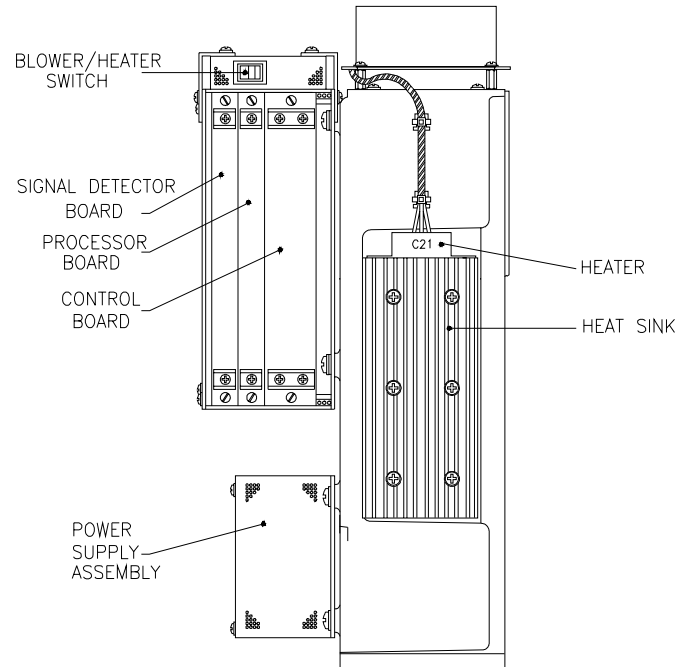


Figure 2.1 (b)
Main Frame

2.1.3 Transmitter unit

The transmitter unit on the main frame is composed of the transmitter optics beam power assembly and the transmitter circuit board. The laser diode is securely clamped to a small attachment bracket, which is glued to a Peltier element that heats or cools the diode as required. This is glued to a bracket which in turn is attached to the underside of the circuit board. The diode is connected to the optics through a fiber-optic cable.

The transmitter optics can be adjusted vertically and locked in place with set screws. This is done at the factory to ensure proper alignment and focus of the laser beam.

2.1.4 Receiver unit

The receiver unit is composed of the receiver optics (an optical bandpass filter) and the receiver circuit board. The receiver photodiode is mounted on the circuit board and is connected to the optics through a fiber-optic cable.

The receiver optics are adjusted at the factory along all three axes to ensure proper alignment with the transmitter, then locked in place with set screws and locknuts.

2.2 Functional description

2.2.1 Measurement

A GaAs laser diode in the transmitter unit emits a laser pulse which is partially reflected from the cloud. The time from when a pulse leaves the transmitter to when the reflected portion reaches the receiver varies with cloud height. The pulse emitted is 50 ns wide, but the light echo can take as long as several microseconds, depending upon the height of the cloud and the depth to which the pulse penetrates. For clouds at a height of 3000 m, for example, the travel time is 20 μ s. The time between pulses is 0.55 to 2.2 ms, depending on the pulse repetition frequency selected.

The time lags and the increase in the number of pulses per step are controlled by the master processor. It receives all the measuring results and stores them in a buffer. After each measuring cycle, this data is moved to the slave processor, which evaluates the data and transmits the results to the data display unit.

The measuring cycle time is dependent upon the pulse repetition frequency selected. A lower frequency loads the laser diode less and increases service life, but lengthens the cycle time. This may be 15 sec, 30 sec, 1 min, or 2 min, which may be of particular relevance at airports where two-minute old information may be inadequate.

2.3 Communication

The slave processor controls a half-duplex FSK modem, as well as an asynchronous RS-232 interface. These can be used for communication between the transceiver and a data display unit, a control unit, or any other peripherals required. The distance between the transceiver and the display or control unit may be several kilometers when using the FSK modem.

With the selector switch on the front panel of the Processor Board in position A, the transceiver slave processor receives measuring range and measuring time data from the control unit. Position B selects range 1530 m with measuring time 30 (or 15) sec, and position C selects range 3840 m with measuring time 60 (or 30) sec. The alternate measuring time is set with a strap on the Processor Board (see Section 5.4).

The master processor controls the measuring cycle on the basis of jumper positioning. It collects basic data, all signal levels from the S/H circuits, and converts them to digital information for use by the slave processor.

The slave processor interprets the data and sends the results to the data display or control unit. It also calculates and transmits the checksum of the digital values, as well as the raw data.

When a control unit is used, it in turn calculates the checksum of the digital values and compares this with the sum from the transceiver. A difference indicates an error in transmission. In the event of error, the control unit alerts the transceiver. When in Mode A, control data for the next measuring cycle is also sent. If the transfer problems remain, the slave processor continues to attempt to transfer the results from the first measuring cycle, this time without the raw data, until the control unit approves the transfer or until a new measuring cycle begins. If the connection between the transceiver and the control unit should fail completely while the selector switch is in position A, the laser is automatically shut off. The transceiver then sends a short transmission every 15 seconds to determine if the connection has been reestablished.

All bin entries are hexadecimal 000 to FFF

A = Status data

H = Cloud height (meters or feet)

R = Range (meters or feet)

T = Penetration depth (meters or feet)

V = Vertical visibility (meters or feet)

**2.4.3
3840 meter range**

Same format as above, extended to a total of 262 bins in 13 lines of raw data and a final line as follows:

```
N 000 S 000 S AAAA ... MAX 40 CHARACTERS ... S C L E B E
U      P      P                                P R F T C O
L                                             X C T
```

**2.4.4
Data message from
control unit to
ceilometer**

```
S C L S XXX S Y Y Y Y S L C E B E
T R F P      P          P F R T C O
X                                             X C T
```

X=	RANGE	TIME	FREQ.
1	1530 m	15 s	OFF
2	3840 m	30 s	2 KHz
3	1530 m	60 s	1 KHz
4	1530 m	120 s	500Hz
OTHER	1530 m	120 s	—

Table 2.4

X = Measuring range, measurement interval, and transmitter frequency (see Table 2.4 for values).

Y = Cloud base and visibility evaluation control data.

2.5 Technical information

Measurement range	10 - 3840 m	(30 - 12595 ft)
Measurement accuracy	10 m-510 m	+/- 5 m (+/- 16 ft)
	510 m-990 m	+/- 10 m (+/- 33 ft)
	990 m-1530 m	+/- 15 m (+/- 49 ft)
	1530 m-3840 m	+/- 30 m (+/- 98 ft)
Measurement interval	30, 60 sec	
Operating temperature	-40°C to +55°C	
Storage temperature	-40°C to +70°C	
Power voltage	120 VAC, -15%, +10% (8329-A) 230 VAC, -15%, +10% (8329-B)	
Power frequency	45 - 65 Hz	
Power requirements:		
Transceiver	Electronics	max 50 W
	Heating elements	max 300 W
Blower	Fan	max 250 W
	Heating elements	max 1000 W
Weight	62 kg (136.7 lbs.)	
Data communications interface:	<ol style="list-style-type: none"> 1) V23 half-duplex, 1300/2100 Hz 2) RS-232-C, 300 or 1200 baud, format and protocol as in 2.4 	
Transmitter	Light source	GaAs laser diode
	Pulse power	30 W
	Pulse length	50 ns
	Wavelength	912 +/- 2 nm
	Pulse repetition frequency PRF	456 Hz, 912 Hz or 1824 Hz
	Optics	1:2/200
	Divergence	approx 2 mrad
Receiver	Detector	avalanche photodiode
	Optical BPF	914 +/- 1 nm
	Bandwidth	7 +/- 1 nm
	Optics	1:2/200
	Field of view	approx 2 mrad
Note:	Optics specifications at 30°C	

3 UNPACKING AND INSTALLATION

3.1 General

The 8329-A transceiver is delivered ready for installation with the cable connectors and accessories listed below:

8329-A, 8329-B Transceivers

1	Technical manual	8329-A01
3	Desiccant cartridge	M028113
2	Blower filters: Fine	M028121
	Coarse	M103966
1	Set hexagonal wrenches	M033516
2	Cable connectors	M426090
		M426091

When the equipment is received, check immediately that all units and accessories listed on the packing slip have been supplied. At the same time, inspect the equipment for visible transport damage. Any faults must be reported to All Weather Inc. without delay.

When the equipment is not to be installed and commissioned until some time after delivery, its operation should be checked as soon as possible with a view to meeting the warranty conditions, etc.

Note

The equipment must be kept dry and not exposed to temperatures below -40°C or above +70°C during shipment and storage.

3.2 Site of installation

The equipment should be installed where there is free upward vision, and the transceiver should be as vertical as possible.

If the transceiver is not vertical, this results in a measuring error, which is insignificant if the angle is less than 5 degrees. An angle of 10 degrees will cause a 2% measuring error.

The following points should also be taken into account:

- a) Do not site the unit near trees. Leaves, twigs, etc. may settle on the transceiver windows and interfere with its operation.
- b) A shady location is preferable to one in which the transceiver is exposed to intense sunshine.
- c) If a control unit is used, it must be installed indoors.

3.3 Installation

Before installing the ceilometer, locate a suitable hard target for the alignment procedure as explained in section 3.5. The location of the hard target will determine the orientation of the ceilometer. The ceilometer must be oriented so that, once installed, it can be swiveled into the horizontal position and aimed at the selected hard target.

If the transceiver is permanently installed, it should be sited on a foundation or platform (see Figure 3.1). **Note: All materials are customer supplied.** The foundation should measure 36" x 36" x 6" in depth, with 1" extending above ground level. In areas where the ground freezes regularly, the foundation should extend 6" into unfrozen ground. A ground rod should be installed near the foundation as shown in Figure 3.1 and tied to one of the ceilometer's legs using #4 cable as shown in Figure 3.2.

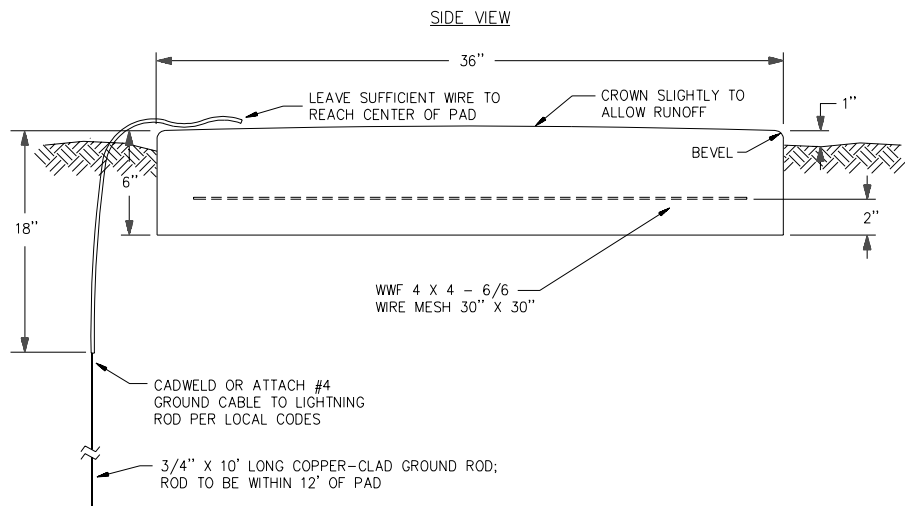


Figure 3.1

After the foundation concrete has set, orient the ceilometer to its final position, keeping in mind the precautions listed in sections 3.2 and 3.5. Mark the ceilometer leg mounting holes, then drill and set three 3/8" anchors into the concrete at these locations.

Bolt the legs to the foundation using three 3/8" bolts (see Figure 3.2).

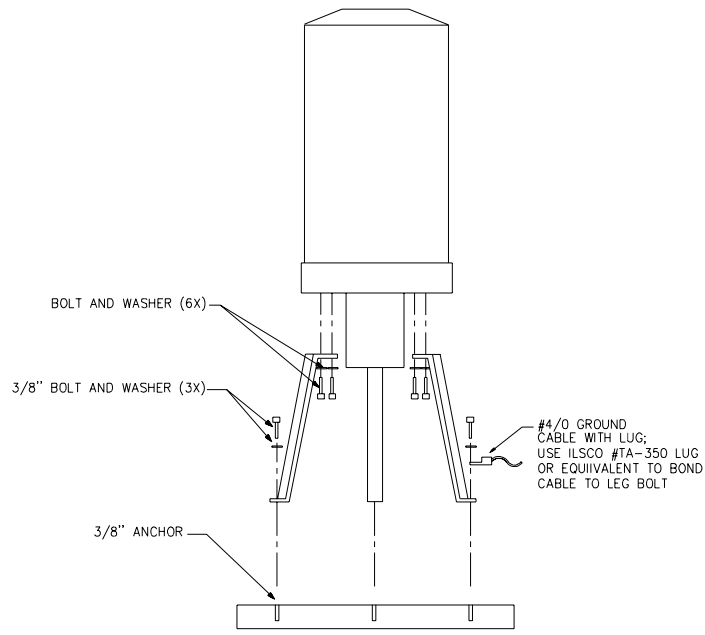


Figure 3.2

3.4 Connection

3.4.1 Connection to power

When selecting a power cable and preparing the equipment for connection to line voltage, the following points should be kept in mind:

- a) The transceiver power cable must be approved for outdoor use.
- b) With the heating elements and fan switched on, the transceiver consumes about 1600W. Make certain that the supply voltage does not drop below the lowest permissible value, especially if the power cable is very long.
- c) Ensure that the transceiver has been connected to the line voltage and frequency stated on the rating plate.
- d) Permissible line voltage variation: -15% to +10%.
- e) The transceiver must be provided with approved protective grounding as dictated by local code.

3.4.2 Connection of signal cable

A connector is provided for connecting the transceiver to an RS-232 port. This keyed connector fits into the connector on the underside of the base frame (X1). Jumpers on the Processor Board at S12 and S15 must also be set for RS-232 communications (see Section 5.4).

A different cable is used when connecting the transceiver to a control unit. This cable is provided with the control unit, and also connects to the ceilometer at X1. Jumpers on the Processor Board at S12 and S15 must be set for FSK communications (see Section 5.4).

3.4.3 Adaptation to other supply voltages

The equipment is adjusted prior to delivery for the line voltage specified when the order was placed and all units are provided with a rating plate indicating this voltage.

The transceiver high pressure fan and heating elements can only be used in the voltage range for which they are rated: 120V (-15%, +10%) for the 8329-A, and 230V (-15%, +10%) for the 8329-B. Use at a voltage other than the rated value requires exchanging the Blower Assembly for one rated for that voltage. Check that the proper fuse is installed at F2 (6.3A for the 8329-A, and 3.15A for the 8329-B).

3.5 Alignment

Prior to commissioning, a hard target alignment of the ceilometer must be performed. In order to do this, the ceilometer must be oriented so that it can be aimed at the selected hard target when swiveled into the horizontal position (see Figure 3.3).

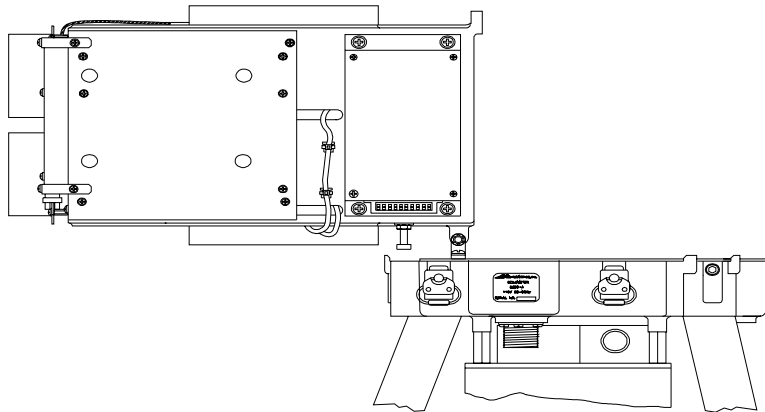


Figure 3.3

- A. The ceilometer target must be a solid source (building, thick line of trees, etc.) from 300-3000 feet distance from the ceilometer. If a hard target is not available, several possible fixed targets may work (no guarantee). Some examples of fixed target that might provide good return include a 8' x 4' sheet of plywood or a large motor vehicle located 300-500 feet away from the ceilometer. Small hills and knolls are ineffective as targets. Please note that the suggested targets require delicate aiming and level ground. Ground clutter may invalidate readings with such targets. Shooting over or across the runway may give erroneous readings in the summertime if the runway is slightly elevated from the AWOS site. The area between the AWOS site and the hard target should be as level as possible.
- B. The ceilometer hard target should be selected so that the ceilometer electronics unit can be folded at the base. Again, refer to Figure 3.3, which shows the ceilometer in the swiveled position.
- C. Align the unit from its center line through one leg of the ceilometer (refer to Figure 3.4). The alignment should be directly at the center of the hard target.

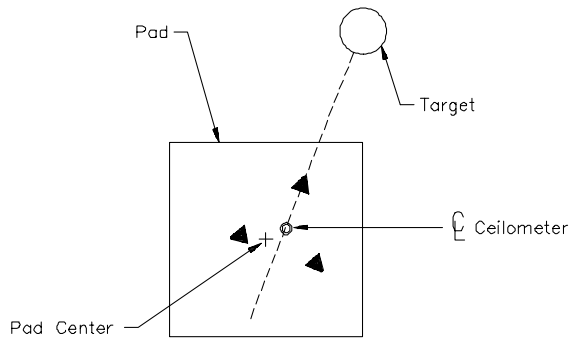


Figure 3.4

- D. The following steps and illustrations include examples of how **not** to align the ceilometer
1. **Do not** align the ceilometer through the middle of the concrete pad through one leg of the ceilometer as shown in Figure 3.5.

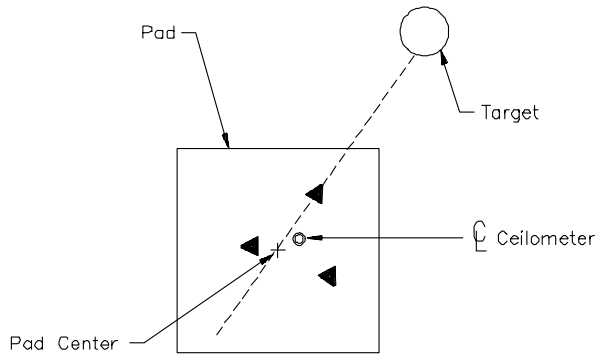


Figure 3.5

2. **Do not** align the ceilometer from the leg through the center line as shown in figure 3.6.

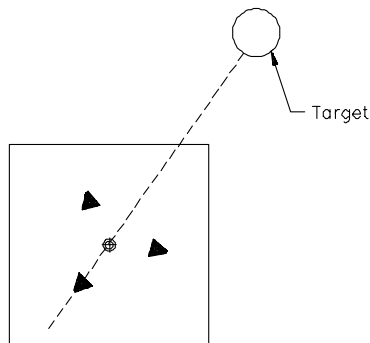


Figure 3.6

3. **Do not** align the ceilometer so that a post is directly in the line of sight between the target and the ceilometer, as shown in Figure 3.7.

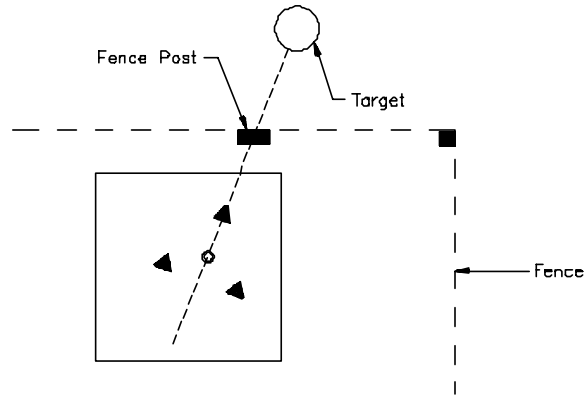


Figure 3.7

4. **Do not** align the ceilometer so that the ceilometer cannot be folded down (due to junction boxes, post etc.), as shown in Figure 3.8.

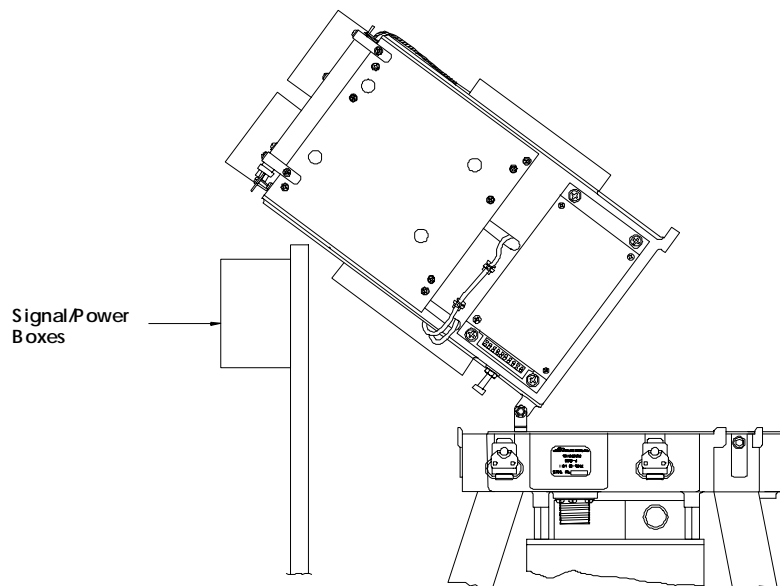


Figure 3.8

4 COMMISSIONING

4.1 Preparations

The equipment is ready for commissioning when the units are installed and connected as described in Section 3, and the procedures below are completed.

- a) Set the required measurement range and measurement time with the selector on the transceiver's Processor Board, and install any necessary jumpers (see Section 5.4). If a control unit is used, set the transceiver selector to MODE A (Remote).
- b) Check that the desiccant cartridge in the transceiver is dry. Replace the cartridge if the indicator window has turned pink.
- c) Check that the transceiver windows are clean. If necessary, clean with a lint-free cloth, water, and a suitable detergent or alcohol.

4.2 Connection To supply voltage

Connect the transceiver to the supply voltage. If commissioning is performed at low temperature (below 0°C), the transceiver must be allowed to warm up for 30 minutes to one hour before it will function properly.

5 OPERATION

5.1 General

The ceilometer operates automatically at the measurement range and time set on the transceiver selector (or control unit function selector). Some operating parameters also can be selected through the use of jumpers on the transceiver's Processor Board (see Section 5.4). Normally, the transceiver should be continuously connected to the line voltage.

5.2 Operating modes

The operating mode of the ceilometer is set using the rotary switch (S11) on the processor panel. There are six modes (A-F) available through this switch, but only the first three are used by the operator on a regular basis. Modes D, E, and F control maintenance functions used in regulating various circuit operations.

MODE A - REMOTE. Sets the ceilometer for remote operation. This is the mode used when the ceilometer is being operated in conjunction with an 8377-A Control Unit. Remote mode requires that specific jumpers be installed on the ceilometer Processor Board. Refer to the 8377-A Control Unit manual and Section 5.4 of this manual for instructions for jumper placement.

MODE B - 1500 METERS. Used to set the operating range to 1530 meters when not in remote mode.

MODE C - 3000 METERS. Used to set the operating range to 3840 meters when not in remote mode.

MODE D - TRIGGER ADJUST. This is a maintenance mode, used to adjust the test LED signal (LDTEST). It has no effect on the laser diode trigger pulse (LTRGT).

MODE E - ALIGNMENT. This is a maintenance mode, used to lock the laser ON when orienting the ceilometer for proper operation.

MODE F - BALANCE. This is a maintenance mode, used to adjust the balance and offset for the sample-and-hold circuits.

5.3 Status word

In addition to the data output concerning cloud conditions, a status word is included in each data transmission that describes the current functional status of the ceilometer. An example of a typical transmission is shown below with the status word highlighted:

```
TR1  3500 2490 750 0000 000 0000 3320
```

The first two digits of the status word correspond to the functional configuration of the system (timing, range, and transmitter frequency); the possible combinations are listed in Table 5-1.

The last two digits are the status code, which warns of any malfunctions or abnormal conditions registered by the system's fault detection circuitry. These codes are explained in Chapter 7.

Table 5-1
Functional Codes

First Two Digits Of Status Word	Timing	Range	Freq.
11	15 sec	1530 m	2 kHz
12	15 sec	1530 m	1 kHz
15	15 sec	3840 m	2 kHz
21	30 sec	1530 m	2 kHz
22	30 sec	1530 m	1 kHz
25	30 sec	3840 m	2 kHz
31	60 sec	1530 m	2 kHz
32	60 sec	1530 m	1 kHz
35	60 sec	3840 m	2 kHz
43	120 sec	1530 m	500 Hz

5.4
Processor
board jumpers

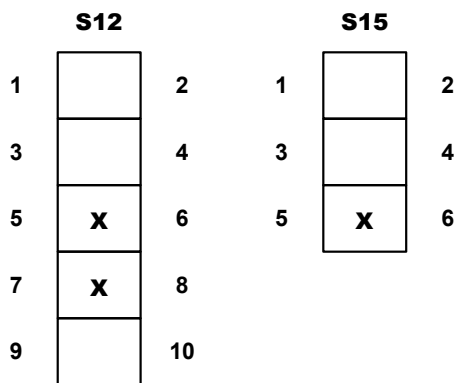
The Processor Board in the 8329-A ceilometer is equipped with jumpers to allow some flexibility in the operating parameters of the ceilometer. The illustrations below show the jumper configurations for several operating modes.

An "X" indicates a jumper installed at that position.

The standard AWOS jumper settings are:

- RS232 communications
- Feet
- 30 seconds
- 1200 baud
- String data

RS-232 Communications:



ESK Communications:

S12		S15		
1	X	2		
3	X	4	X	
5		6		
7		8	S14	
9		10	1	X
			3	

Units of Measure

<u>Meters</u>		<u>Feet</u>	
S10		S10	
1		2	X

Measurement Time

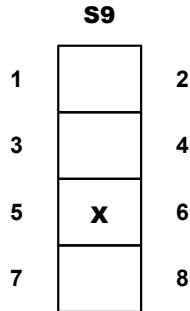
<u>30 Seconds</u>		<u>60 Seconds</u>	
S10		S10	
3	X	4	

RS232 Baud Rate

<u>300 Baud</u>		<u>1200 Baud</u>	
S10		S10	
5	X	6	
7	X	8	
9		10	

Internal Time Delay (delay between SYNC and I TRGT pulses, in nanoseconds)

There are four jumpers available at S9, each of which can be either jumped or open:



The combination of these jumper settings corresponds to a specific time delay between the synchronizing and trigger pulses in the transceiver. The time delay values for the various possible combinations are listed in the table below. A "1" signifies a jumper installed; a "0" signifies no jumper installed.

Jumper				Delay (in nanoseconds)
1-2	3-4	5-6	7-8	
0	0	0	0	47
1	0	0	0	139
0	1	0	0	175
1	1	0	0	210
0	0	1	0	239 *
1	0	1	0	273
0	1	1	0	308
1	1	1	0	342
0	0	0	1	376
1	0	0	1	411
0	1	0	1	433
1	1	0	1	482
0	0	1	1	515
1	0	1	1	549
0	1	1	1	581
1	1	1	1	614

* Standard setting

Data Format

The 8329-A ceilometer offers a choice of two formats in which to display the collected data, "string" or "bin dump". The format used most frequently is the string data format, where a single reading is given for each measurement sequence. Bin dump format displays the data in three hexadecimal digits for each height scanned, regardless of whether or not an echo was received (see Section 2.4 for a full explanation of this format). The choice of formats is controlled by jumpers at S17.

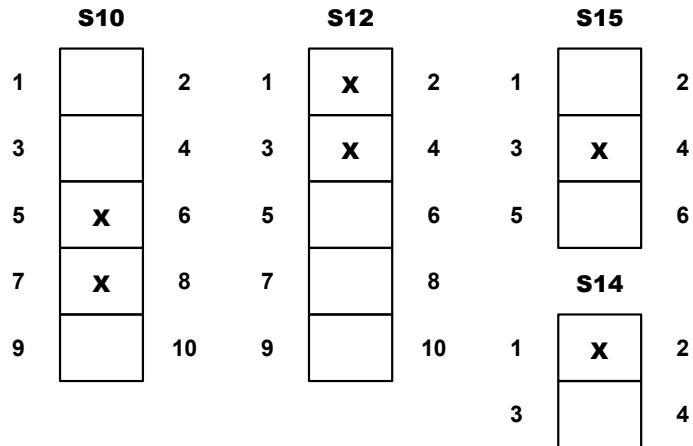
S17



When S17 is set for bin dump format, S10 must be set for 60 seconds (jumper at 3-4 removed).

**5.4.1
Remote settings**

The following jumper settings must be in place when operating the ceilometer in remote mode (MODE A) with an 8377-A Control Unit.



Specific jumper settings are required on the control unit as well, and for convenience are illustrated below. Consult the control unit manual for more detailed instructions.

S3		S4	
1	X	1	
2		2	
3		3	
4		4	
5	X	5	X
6		6	
7		7	X
8		8	
9	X	9	
10		10	
11	X	11	
12		12	
13	X	13	X
14		14	
15		15	X
16		16	
17	X	17	X
18		18	
19		19	
20		20	

6 MAINTENANCE

6.1

General

(Refer to Figure 6.1).

Periodic maintenance should include the following:

- Clean the transceiver windows at intervals determined by local conditions.
- Replace the filter in the high pressure fan at intervals on the order of 8-12 months, or as determined by local conditions.
- Check the desiccant cartridge in the transceiver, and replace when necessary. This should normally need replacement only when the casing is opened. Change the cartridge when the indicator window turns from blue to pink.

6.2

Periodic maintenance

6.2.1

Cleaning

The transmitter and receiver windows on the ceilometer must be cleaned periodically to assure reliable operation of the unit. How often this will need to be done will depend on local conditions (amount of rainfall, dust in the air, etc.), and can be determined by a visual inspection. Be careful not to look directly into the lens. The insides of the windows should not need to be cleaned except when the casing is removed to perform some other maintenance task. Any commercial glass cleaner is suitable to this purpose.

6.2.2

Desiccant replacement

A desiccant cartridge prevents moisture accumulation in the ceilometer interior, and should be checked each time the ceilometer site is visited. The cartridge is blue while it is in working order, and turns pink when it is no longer functional. It is visible through a window in the base frame and can be checked without removing the outside cover.

The tube in which the replacement cartridge is packed is equipped with a ridge on the bottom that fits into the slot on the front of the installed cartridge. Using this ridge (or a large screwdriver), unscrew and replace the old desiccant cartridge after it has turned color.

6.2.3

Filter replacement

Two filters are mounted on the underside of the blower unit and should be checked from time to time to assure that they are free enough of dirt to be useful. To remove the filters:

- (1) Remove the thumbscrew and screen from the underside of the blower unit.
- (2) Remove the two filters.

If the filters are excessively dirty, replace them with two new ones. When installing them in the blower housing, the fine filter is installed first, followed by the coarse filter. Reinstall the screen and secure it with the thumbscrew.

6.2.4 Blower check

Blower operation can be checked by placing a piece of paper over the sensor windows to simulate moisture buildup. The blower should begin operating within three minutes. If it does not, notify the appropriate maintenance personnel.

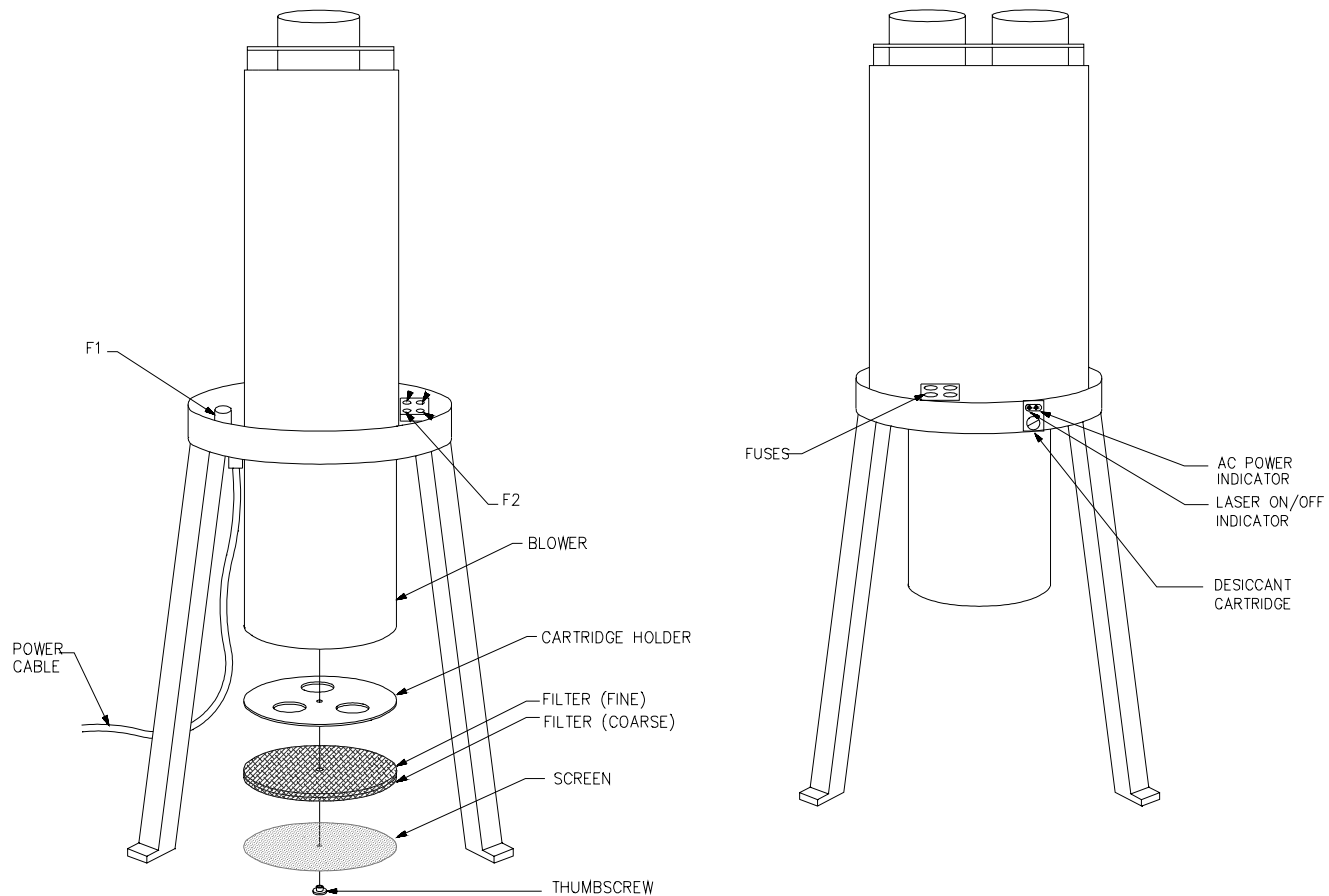


Figure 6.1
Periodic Maintenance Areas

6.2.5 Power and transmission indicators

Two lights can be seen through a window in the base frame above the desiccant cartridge. The yellow light should be on whenever power is being supplied to the ceilometer. The red light indicates that the ceilometer is transmitting, and should cycle on and off periodically.

If the yellow power light is not on, check the power connection and fuses F1 and F2 (see Section 6.2.6).

If the red light does not come on periodically, notify the appropriate maintenance personnel.

6.2.6 Fuses

The main power fuse (F1) is located on the base frame directly above the power cord connection. and unscrew the fuse holder from the base frame. Replace the fuse and restore power to the ceilometer.

A second fuse (F2) is provided between the power input and the primary of transformer T1, and is located on the base frame alongside four other fuses (F3-F6). F2 may blow due to line transients or surges and should be checked along with F1 whenever the yellow power indicator does not light when power is supplied to the ceilometer. Fuses F3-F6 should only be replaced by qualified maintenance personnel, since a more complex internal circuitry problem is usually This should be checked first if the yellow power indicator light is not lighted when power is being supplied to the ceilometer. To replace the fuse, remove power from the ceilometer associated with their failure.

6.3 AWOS periodic maintenance

Periodic maintenance of AWOS sensors is divided into three categories: monthly maintenance, quarterly maintenance, and annual maintenance. The listed maintenance routines are performed according to that schedule.

6.3.1 Tools and equipment required

- Assorted hand tools
- Ceilometer desiccant cartridge
- Ceilometer filters

6.3.2 Monthly maintenance

1. Clean the transmitter and receiver windows.
2. Visually check the desiccant cartridge and replace if the pad in the window has turned pink. The acceptable color is any shade of blue.
3. Remove the thumbscrew and retainer plate. Remove the two 11" filters and check for excessive dust and dirt on the filters. If they are excessively dirty, replace them with two new filters. The fine filter is installed first, then the coarse filter, followed by the retainer plate and thumbscrew. Electrical power removal is unnecessary as there are no exposed circuits in the filter area.

6.3.3 Quarterly maintenance

The cloud height sensor has a considerable number of internal checks and self-tests which are continuously monitored and verified via the RMM system. The details of the self-tests are given in Section 4.3. It is not, therefore, necessary to verify the calibration of the cloud height sensor on a quarterly basis. The following checks will be carried out:

1. Clean the transmitter and receiver windows.
2. The desiccant within the ceilometer inner chamber is to be checked by observing the color of the desiccant capsule through the window. If the desiccant is a shade of blue, it is acceptable. If the desiccant is pink, replace the capsule.
3. Remove the thumbscrew and retainer plate. Remove the two 11" filters and check for

excessive dust and dirt on the filters. If they are excessively dirty, replace them with two new filters. The fine filter is installed first, then the coarse filter, followed by the retainer plate and thumbscrew. Electrical power removal is unnecessary as there are no exposed circuits in the filter area.

4. Verify that the laser transmitting light is on periodically for approximately 15-25 seconds.
5. Cover the transmitter lens with a sheet of paper and see that the blower comes on within three minutes. If the blower does not come on, clear the fault by checking the optical rain monitoring feedback path.

6.3.4 Annual maintenance

1. Clean the transmitter and receiver windows.
2. Check the desiccant cartridge and replace if the pad in the window has turned pink. The acceptable color is any shade of blue.
3. Above the desiccant cartridge is a window with two lights. The yellow light indicates AC power is active. The red light cycles on and off periodically. When on, it indicates the laser is transmitting. Verify that the light cycles on and off.
4. Replace the blower filters. Remove the thumbscrew and retainer plate. Remove the two eleven-inch filters. Replace with two new filters. The fine filter is installed first, then the coarse filter, followed by the retainer plate and thumbscrew. Do not remove power from the sensor as there are no moving parts in the procedure area.
5. Check the blower operation by placing paper over the sensor lens. Wait three minutes. The blower will start operating. Remove the paper. The blower may or may not cycle off after three minutes depending on environmental conditions. If the blower is on without placing the paper, mark the pass condition.
6. At the CDP, view the ceilometer engineering log (accessed from the Maintenance Menu). Verify that no ceilometer status errors are being reported. Verify that when the ceilometer report indicates rainfall, clouds are also detected. Determine whether any pilot reports were logged in regard to the ceilometer.
7. Perform a minimum ceiling check by placing white paper over the transmitter and receiver windows (with the outer cover in place). The next reported cloud height value should be 100 feet. Note the reported value on the annual maintenance log.

6.4 Fault tracing

6.4.1 Status codes

A fault detection system has been incorporated into the 8329-A ceilometer to alert the operator to any problems or abnormal conditions. When such a fault occurs, a code indicating the nature of the problem will appear in the last two digits of the status word.

The status code indicates the type of fault and provides a good starting point for troubleshooting. Table 6-1 lists the status codes and a general description of the nature of the indicated faults. The priority numbers in the first column of Table 7-1 indicate the severity of the problem represented by that status code, with a priority of "1" demanding the most urgent attention.

A full discussion of faults and fault tracing is provided in the 8329-A Ceilometer Maintenance Manual available from All Weather Inc.

**Table 6-1
Status Codes**

XX = Functional codes (see Table 5-1)

Y = 0 Blower and heater OFF

Y = B Blower ON

Y = C Blower and heater ON

<u>Priority</u>	<u>Code</u>	<u>Description</u>
	XXYO	NO ERROR
30	XXY1	LOW TRANSMITTER POWER
31	XXY2	UNBALANCE DETECTOR
32	XXY3	OFFSET IN DETECTOR
34	XXY4	REFERENCE VOLTAGE ERROR
33	XXY5	ZERO POINT FAILURE
2	XX10	HIGH CURRENT CONSUMPTION IN S-BOARD
3	XX11	HIGH CURRENT CONSUMPTION IN M-BOARD
4	XX12	HIGH CURRENT CONSUMPTION IN H BOARD
10	XX13	VOLTAGE FAILURE +24V
6	XX14	VOLTAGE FAILURE +5V
7	XX15	VOLTAGE FAILURE +15V
8	XX16	VOLTAGE FAILURE -15V
9	XX17	VOLTAGE FAILURE +230V
11	XX18	VOLTAGE FAILURE +10V
12	XX19	VOLTAGE FAILURE -10V
5	XX20	A/D CONVERTER FAILURE IN H-BOARD
13	XX21	RHV FAILURE (RECEIVER HIGH VOLTAGE)
14	XX22	TEMPERATURE FAILURE
15	XX23	OVERHEAT
16	XX30	POWER FAILURE (NO OR LOW OUTPUT POWER)
17	XX31	CHARGE FAILURE (LASER CIRCUIT NOT CHARGED)
18	XX32	IPEAK CIRCUIT OUT OF FUNCTION
19	XX33	LASER HIGH VOLTAGE (LHV) REGULATION FAILURE
20	XX34	IPEAK CANNOT REACH MAX. ALLOWED CURRENT (55A)
21	XX35	LHV/20 NOT CORRESPONDING TO LHV REFERENCE
22	XX36	UNDEFINED FAILURE IN LHV CIRCUIT
23	XX40	RECEIVER FAILURE (VIDEO SIGNAL TOO LOW)
29	XX41	DETECTOR FAILURE
24	XX45	ADDRESS FAULT S-BOARD
25	XX46	ADDRESS FAULT H-BOARD
26	XX50	LPF MISSING
27	XX51	SYNC MISSING
28	XX52	LASER TRIGGER FAILURE
1	XX60	MASTER-SLAVE COMMUNICATIONS FAILURE
35	XX70	SOFTWARE REBOOT

7 WARRANTY

All instruments are warranted for one year, unless otherwise specified, against defects in material or workmanship. Should any instrument prove to be defective within the warranty period, All Weather Inc. will, at its option, repair or replace the defective unit and return it freight collect. Instruments abused, improperly used or installed, or modified or altered by others may cancel the warranty.

7.1 AWOS WARRANTY

This equipment has been manufactured and will perform in accordance with requirements of FAA Advisory Circular 150/5220-16B. Any defect in design, materials, or workmanship which may occur during proper and normal use during a period of 1 year from date of installation or a maximum of 2 years from shipment will be corrected by repair or replacement by All Weather Inc.

8 REPLACEABLE PARTS

Table 8-1 lists the user-replaceable parts available for the 8329-A Ceilometer and the All Weather Inc. part number to use when ordering.

**Table 8-1
User-Replaceable Parts List**

Item	Description	Part No.
FILTER	15 MICRON FILTER (FINE)	M028121
FILTER	COMPRESSOR FILTER (COARSE)	M103966
SCREEN	FILTER RETAINING SCREEN	M104006
COVER	OUTER COVER	M103950
DESICCANT	DESICCANT CARTRIDGE	M028113
FUSE (F1)	20A (8329-A)	M442044
	12A (8329-B)	M442054
FUSE (F2)	6.3A (8329-A)	M442049
	3.15A (8329-B)	M442047
LAMP (POWER IND.)	RED, SLIDE BASE, 24V	M456078
LAMP (TRANS. IND.)	YELLOW, SLIDE BASE, 24V	M456079
BLOWER HOSE	HOSE, RUBBER COATED	M027026
ELECTRO-OPTICS	OPTICS ASSY. W/LASER	M403200

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