M.E.W.S. WEATHER OBSERVER HANDBOOK

Rural Training Center-Thailand
Emergency Communications Program

Ready to sever and sustain our community

G.K. Lee
HSØZHM

This edition printed from digital media.

Published by Rural Training Center-Thailand (RTC-TH)
Ban Na Fa, Jompra Subdistrict, Thawangpha City, Nan Province, Thailand

Publication # RTC-TH-MEWS-WOH

Printed in the Thailand

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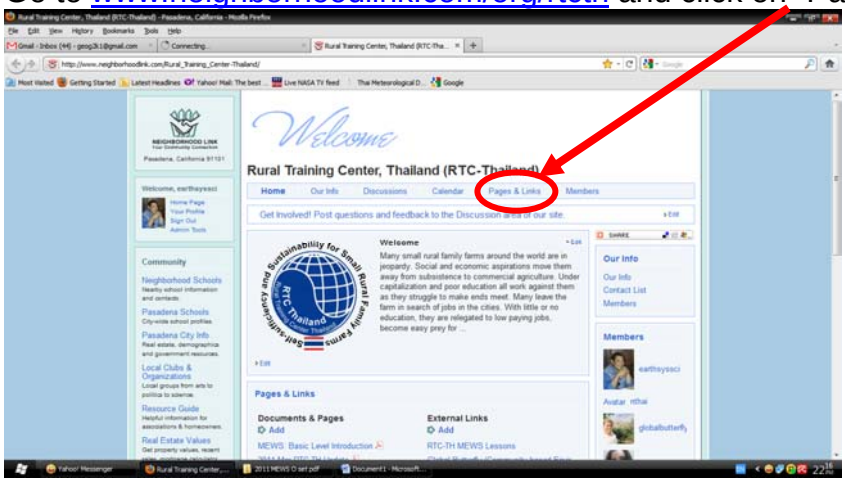
Mobile Emergency Weather Station (MEWS) Lesson Directory		
The MEWS directory lists the MEWS lessons in the suggested sequence. Instructions to access the lessons are found after the Table of Contents. Some of the files are large. So please be patient as the download time may vary depending on the speed of your connection.		
MEWS Orientation Presentations		
OA	MEWS Introduction	Overview of MEWS
OB	Observer orientation	Orientation for MEWS observers
OC	Log Form orientation	Step-by-step orientation of the MEWS Log Form
Basic MEWS Lessons		
MEWS Basic Level Introduction		
B1	Measuring Temperature	Temperature measurement (in the shade) of the local area Required Equipment: thermometer Optional Equipment: Umbrella, long measuring tape, short measuring tape, ruler
B2	Estimating Wind Speed	Systematic environmental observation of wind effects in the local area. Required Equipment: Modified Beaufort Wind Chart (in Handbook) Optional Equipment: Flag, long measuring tape, short measuring tape, ruler
B3	Measuring Wind Direction	Systematic measurement of wind azimuth in the local area. Required: Magnetic compass Optional Equipment: Flag, long measuring tape, short measuring tape, ruler
B4	Estimating Cloud Cover	Systematic observation of sky conditions over the local area. Required Equipment: Cloud Cover chart / terms (in Handbook) Optional Equipment
B5	Estimating Cloud Base Height	Systematic observation of clouds relative to the height of a local mountain or estimated based on cloud type. Required Equipment: Local topographic map (get online or purchase); Cloud ID chart (in Handbook) Optional Equipment: Binoculars
B6	Identifying Cloud Types	Systematic observation and identification of clouds in the local area. Required Equipment: Cloud ID chart (in Handbook) Optional Equipment: Binoculars
B7	Estimating Visual Range	Systematic observation of key local landscape features / landmarks relative to operating position or helicopter Landing Zone Required Equipment: Local topographic map (get online or purchase), ruler Optional Equipment: Binoculars
B8	Severe Weather Conditions	Systematic observation of local area storms Required Equipment: Instructions on “Flash to Boom” (on MEWS Log and in Handbook) Optional Equipment: Binoculars

Advanced MEWS Lessons		
MEWS Advanced Level Introduction		
A1	Relative Humidity and Heat Stress	Systematic measurement / calculation of relative humidity in the local area. Required Equipment: Hygrometer (buy or instructions to make your own); psychometric table and Heat Stress Index table (in Handbook) Optional Equipment: calculator, long measuring tape, short measuring tape, ruler; buy a digital thermometer with RH function or buy a hygrometer or digital weather station.
A2	Wind Speed and Wind-chill	Systematic measurement of wind speed and calculation of Wind-chill in the local area. Required Equipment: wind speed gauge/meter (by or instructions to make your own); Wind-chill table (in Handbook) Optional Equipment: long measuring tape, short measuring tape, ruler; buy digital anemometer with wind-chill function or digital weather station
A3	Dew Point and Cloud Base Height	Determining Dew Point Temperature and calculating the height of the cloud base in the local area Required Equipment: Dew Point table (in Handbook); Optional Equipment: calculator; buy a digital thermometer with Heat Stress function or a digital weather station.
A4	Rainfall	Systematic measurement of rainfall (in 24 hour period) in the local area. Required Equipment: rain gauge (buy or instructions to make your own) Optional Equipment: Buy a digital rain gauge or a digital weather station with a rain gauge.
A5	Severe Weather	Systematic observation of local area storms and use of lightning detector. Required Equipment: lightning detector (buy) Optional Equipment: Digital weather station.
A6	Weather Forecasting	Systematic observation of changes in cloud types, atmospheric pressure, and wind direction. Required Equipment: Cloud ID chart (in Handbook), barometer or barometric altimeter, magnetic compass.

To access the MEWS Lessons:

Go to www.neighborhoodlink.com/org/rtcth and click on “Pages & Links”



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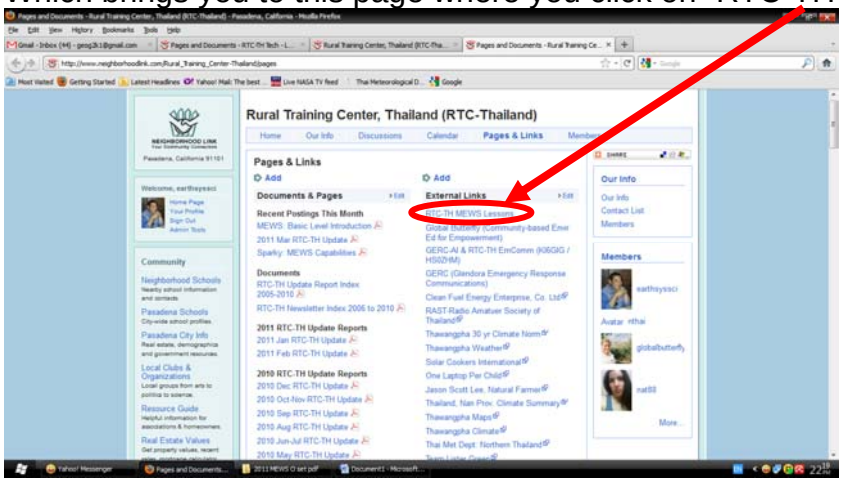
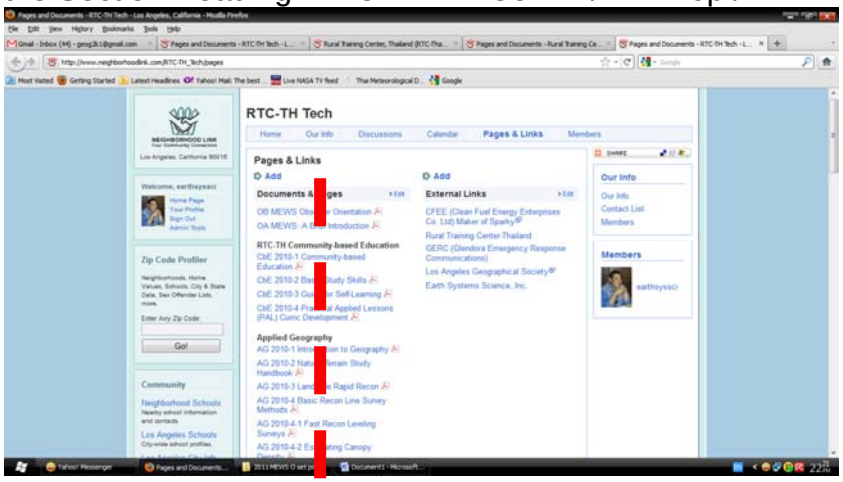
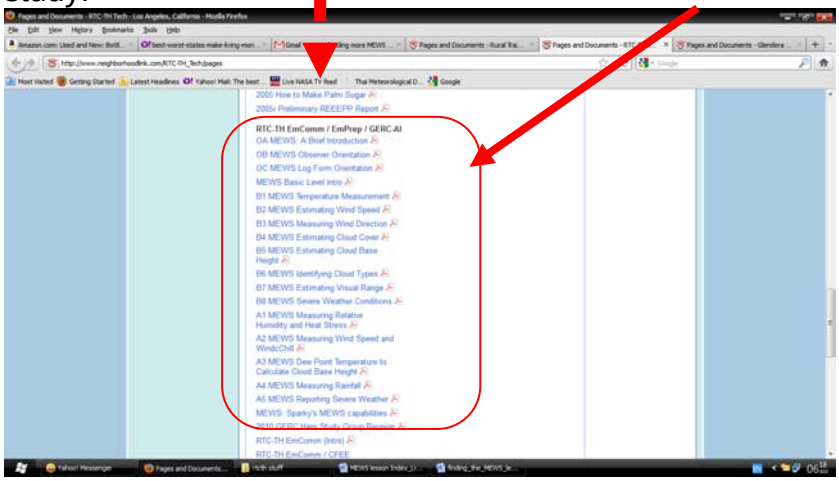


…which will bring you to this page. Then scroll down the left column and watch for the Section Heading “RTC-TH EmComm / EmPrep /



GERC-AI) where you will find the MEWS lesson listed in the suggested sequence of study.



Author's Preface

MEWS (the Mobile Emergency Weather Station) evolved from various lesson modules. The original lessons go back to the Field Methods in Geography colleges classes I taught for about the 1989-2007. Some of these lessons were adapted for various extra-curricular environmental education community service training programs in the US. An opportunity arose with the Rural Training Center-Thailand (RTC-TH) to adapt the weather lesson modules for the REEEPP (Rural Environmental Education Enhancement Pilot Project) at Ban Na Fa Elementary School in Nan Province, Thailand. These weather lessons were modified for use in the RTC-TH GROW (Getting Real On-farm Weather) program in support of implementing the King's Theory of Self-sufficiency.

My affiliation with GERC (the Glendora Emergency Response Communications) group stimulated my interest in amateur radio and EmComm (Emergency Communications). So it seemed quite natural to adapt the GROW lessons to create MEWS to serve and sustain our local community in times of emergencies.

Amateur radio has a long history of voluntary public service especially in emergencies. As a relative new and inexperienced amateur radio operator, I wanted to make a contribution. MEWS draws on my knowledge, skills, and experience as a teacher of natural sciences to the amateur radio community.

The MEWS lessons are designed for self-study. Questions can be posted to the RTC-TH website discussion page or sent by e-mail. Skype (a free internet phone service) can be used to organize conference calls for small group discussion. MEWS is available free for non-commercial purposes in the spirit of the amateur radio tradition.

MEWS is not a replacement or competitor of government or private sector meteorologists. MEWS is an emergency service provided by volunteers to gather and report weather data from the disaster area. Natural disasters (e.g. earthquakes, tropical storms, floods, etc.) can spread destruction over wide areas. Existing weather stations may be destroyed or damaged. In some remote areas, there may be no weather station. Local Hams (amateur radio operators) trained in MEWS could provide vital local weather data to help relief workers to better coordinate food, shelter, and clothing needs of the survivors. Emergency helicopter flights benefit by having local weather from the local disaster area.

These lessons are a first step on a long journey to improve and adapt the lessons to amateur emergency communications. Suggestions for improvement are welcomed. We are also interested in help to translate these lessons to other languages. MEWS is presented in the spirit of mutual respect, mutual benefit and striving to make the world a better place. It is my hope these lessons will enhance the abilities and skills of amateur radio operators and empower them to provide improved communications services to emergency response officials.

These lessons are dedicated to all teachers and seekers of knowledge, and to those who care to share information to empower others to improve and become better people who can better sustain their communities.

I would like to express my sincere thanks to:

- Mack and Irene Lee, my parents: for the basic values and education that make me what I am today;
- Saifon Lee, my wife: and her family for all their support and the opportunity to be in Thailand.
- Mark Hayden (N7YLA) for his friendship, mentoring, and collaborative support in teaching and amateur radio emergency communications (EmComm).
- Phat Kulphaichitra (HS1WFK) for his friendship and inspirational efforts in Thai EmComm.
- Alongkorn Porapukkham (E20NXT) for his friendship, encouragement and introduction to Khun Phat and other Thai amateurs.
- My adopted “urban” family, my many friends and former students who directly and indirectly helped and encouraged the development and evolution of these lessons and many other lessons over these past decades.

Respectfully,
Gregory Lee, HSØZHM
RTC-TH Co-founder

EMERGENCY FIELD WEATHER OBSERVATIONS

Compiled by G.K. Lee (HSØZHM)

1.0 Introduction

In times of emergency, first responders to the disaster area need precise information about weather conditions. In many cases, this is not readily available from the disaster area.

Current weather conditions at the site of the emergency are important details that affect relief operations. Weather conditions affect:

- The well-being of survivors
- The water, food, and shelter needs of survivors
- Flight operations at the emergency site
- Relief operations coming to and at the emergency site

A level area is more desirable than an unusual topographic setting. The weather station should not be on a slope, a ridge, or in a sheltered area. The station should be located where surroundings are uniform (i.e. similar surface materials within 30 m of the sensors (e.g. thermometer). Avoid hard surfaces (e.g. pavement, concrete, etc.) as these can distort temperature readings. Avoid being too close to vertical obstructions (trees, buildings, etc.) than four times the height of the obstructions. Set up the station in an area with a 35 degree horizon (i.e. no obstacles should be above 35 degrees on the local horizon).

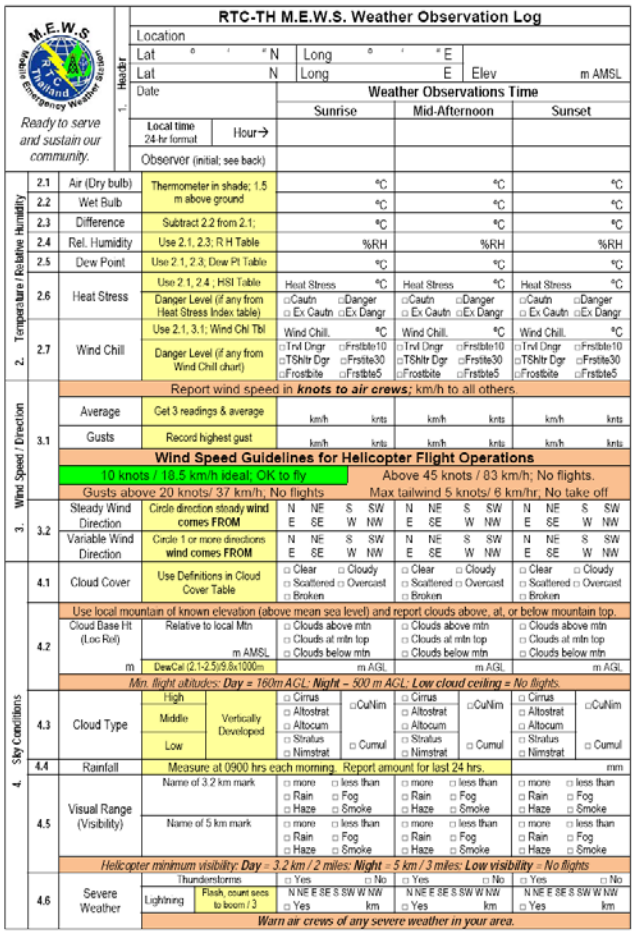
The more weather information you can provide the better. You need some basic equipment to do this: a thermometer, the wind direction (magnetic compass), wind speed chart and cloud cover (see attached forms), and a small to medium glass jar and a ruler. If helicopter flight operations are in progress, give temperature, wind direction / wind speed and visibility data to the pilot before takeoff.

General Weather Effects on		
People in the Disaster Area		Helicopter Flight Operations
• Overall well-being; water, food, clothing / shelter needs. • High temperatures and humidity increases risk of heat related stress injuries • High winds can increase stress as well as damage tents and temporary shelter • Low temperatures and high winds increase risk of wind chill discomfort • Cloud cover can reduce temperatures; but if cool enough increases need for clothing and shelter. Lack of cloud cover may increase exposure risk and increase need for clothing and shelter. • Rain can supply some needed drinking water. But also increases need for shelter, clothing, food, etc.	Temperature Relative Humidity Winds Sky Conditions	[Note: Weather conditions can vary dramatically from place to place. Having local weather data can greatly help helicopter flight operations] • Overall flight characteristics, cargo / passenger payload, and fuel consumption • Strong winds may limit or cancel helicopter flight operations. • Cloud base height can limit flight operations. • Horizontal visual range restrictions could limit or cancel flight operations.

This handbook is a basic guide to enable amateur radio emergency communications (HAM EmComm) volunteers to make systematic weather observations that would be useful to relief officials. These weather observations are not to replace traditional or official government weather services. The information is provided as raw data made under the harsh and chaotic conditions associated with disasters. This is quite

different than routine weather observations made along international and scientific weather observations for official government and research records.

The focus of the RTC-TH M.E.W.S. (Mobile Emergency Weather Station) is the systematic Emergency Field Weather Observation Log form.



RTC-TH M.E.W.S. Weather Observation Log

Location

Lat ° ' "N Long ° ' "E

Lat N Long E Elev m AMSL

Date

Weather Observations Time

			Sunrise	Mid-Afternoon	Sunset
		Local time 24-hr format Hour→			
1. Header		Observer (initial; see back)			
2. Temperature / Relative Humidity	2.1	Air (Dry bulb)	Thermometer in shade; 1.5 m above ground	°C	°C	°C
	2.2	Wet Bulb		°C	°C	°C
	2.3	Difference	Subtract 2.2 from 2.1;	°C	°C	°C
	2.4	Rel. Humidity	Use 2.1, 2.3; R H Table	%RH	%RH	%RH
	2.5	Dew Point	Use 2.1, 2.3; Dew Pt Table	°C	°C	°C
	2.6	Heat Stress	Use 2.1, 2.4 ; HSI Table	Heat Stress °C	Heat Stress °C	Heat Stress °C
			Danger Level (if any from Heat Stress Index table)	□Cautn □Danger □Ex Cautn □Ex Dangr	□Cautn □Danger □Ex Cautn □Ex Dangr	□Cautn □Danger □Ex Cautn □Ex Dangr
	2.7	Wind Chill	Use 2.1, 3.1; Wind Chl Tbl	Wind Chill. °C	Wind Chill. °C	Wind Chill. °C
			Danger Level (if any from Wind Chill chart)	□Trvl Dngr □Frstbite10 □TShltr Dgr □Frstbite30 □Frostbite □Frstbte5	□Trvl Dngr □Frstbite10 □TShltr Dgr □Frstbite30 □Frostbite □Frstbte5	□Trvl Dngr □Frstbite10 □TShltr Dgr □Frstbite30 □Frostbite □Frstbte5
3. Wind Speed / Direction		Report wind speed in ***knots to air crews;*** km/h to all others.			
	3.1	Average	Get 3 readings & average	km/h knts	km/h knts	km/h knts
		Gusts	Record highest gust	km/h knts	km/h knts	km/h knts
		Wind Speed Guidelines for Helicopter Flight Operations			
		10 knots / 18.5 km/h ideal; OK to fly		Above 45 knots / 83 km/h; No flights.	
		Gusts above 20 knots/ 37 km/h; No flights		Max tailwind 5 knots/ 6 km/hr. No take off	
	3.2	Steady Wind Direction	Circle direction steady **wind comes FROM**	N NE E SE S SW W NW	N NE E SE S SW W NW	N NE E SE S SW W NW
		Variable Wind Direction	Circle 1 or more directions **wind comes FROM**	N NE E SE S SW W NW	N NE E SE S SW W NW	N NE E SE S SW W NW
4. Sky Conditions	4.1	Cloud Cover	Use Definitions in Cloud Cover Table	□Clear □Cloudy □Scattered □Overcast □Broken	□Clear □Cloudy □Scattered □Overcast □Broken	□Clear □Cloudy □Scattered □Overcast □Broken
		Use local mountain of known elevation (above mean sea level) and report clouds above, at, or below mountain top.			
	4.2	Cloud Base Ht (Loc Ref)	Relative to local Mtn	□Clouds above mtn □Clouds at mtn top □Clouds below mtn	□Clouds above mtn □Clouds at mtn top □Clouds below mtn	□Clouds above mtn □Clouds at mtn top □Clouds below mtn
		m	DewCal (2.1-2.5)/9.8x1000m	m AGL	m AGL	m AGL
		Min. flight altitudes: ***Day*** *= 160m AGL;* ***Night*** *– 500 m AGL;* ***Low cloud ceiling*** *= No flights.*			
	4.3	Cloud Type	High	□Cirrus □Altostrat □Altocum	□CuNim	□Cirrus □Altostrat □Altocum	□CuNim	□Cirrus □Altostrat □Altocum	□CuNim
			Middle						
			Low	□Stratus □Nimstrat	□Cumul	□Stratus □Nimstrat	□Cumul	□Stratus □Nimstrat	□Cumul
	4.4	Rainfall	Measure at 0900 hrs each morning. Report amount for last 24 hrs.			mm
	4.5	Visual Range (Visibility)	Name of 3.2 km mark	□more □less than □Rain □Fog □Haze □Smoke	□more □less than □Rain □Fog □Haze □Smoke	□more □less than □Rain □Fog □Haze □Smoke
			Name of 5 km mark	□more □less than □Rain □Fog □Haze □Smoke	□more □less than □Rain □Fog □Haze □Smoke	□more □less than □Rain □Fog □Haze □Smoke
		Helicopter minimum visibility: ***Day*** *= 3.2 km / 2 miles;* ***Night*** *= 5 km / 3 miles;* ***Low visibility*** *= No flights*			
	4.6	Severe Weather	Thunderstorms	□Yes □No	□Yes □No	□Yes □No
			Lightning / Flash, count secs to boom / 3	N NE E SE S SW W NW □Yes km	N NE E SE S SW W NW □Yes km	N NE E SE S SW W NW □Yes km
		Warn air crews of any severe weather in your area.			

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It is best to prepare BEFORE an emergency. Certain weather observations require visual references and landmarks. So it is best to scout these out beforehand. For EmComm, you should also know the quality of radio transceiver performance from possible local radio operating sites to possible coordinating sites.

To support helicopter flight operations, coordinate with local emergency responders to see if they have pre-selected landing zones. If not, refer to the separate RTC-TH EmComm handbook on Scouting for Helicopter Landing Zones.

The weather observation lessons in the handbook follow the sequence of the Weather Observation Log. This makes it easier for observers in the field to rapidly consult the handbook if needed when making observations.

A basic equipment list is provided at the end of this paper. Since helicopters may be used in most emergency situations, particular attention is paid to weather observations to support helicopter flight operations.

How to Learn MEWS

After looking at the MEWS Orientation series, have this Handbook as a ready reference as you view each PDF slide presentation. The sections are numbered to match the MEWS Log Form sections / items. This makes it easier to find detailed instructions for making the observations, measurements and calculations. MEWS can be learned by self-study. If you have questions, you can contact us (see the table below):

E-mail:	RTC-TH for general inquiries: rtc2k5@gmail.com
	RTC-TH EmComm for MEWS: hs0zhm@gmail.com
Skype:	rtc_th
EchoLink	HSØZHM-L node 520300
Website	Post a question at www.neighborhoodlink.com/Rural_Training_Center-Thailand/topics

Ready to serve and sustain our community.

RTC-TH M.E.W.S. Weather Observation Log

1. Header

Location

Lat ° ' " N | Long ° ' " E

Lat N | Long E | Elev m AMSL

Date

Weather Observations Time

	Sunrise	Mid-Afternoon	Sunset
Local time 24-hr format / Hour→			
Observer (initial; see back)			

2. Temperature / Relative Humidity

			Sunrise	Mid-Afternoon	Sunset
2.1	Air (Dry bulb)	Thermometer in shade; 1.5 m above ground	°C	°C	°C
2.2	Wet Bulb		°C	°C	°C
2.3	Difference	Subtract 2.2 from 2.1;	°C	°C	°C
2.4	Rel. Humidity	Use 2.1, 2.3; R H Table	%RH	%RH	%RH
2.5	Dew Point	Use 2.1, 2.3; Dew Pt Table	°C	°C	°C
2.6	Heat Stress	Use 2.1, 2.4 ; HSI Table	Heat Stress °C	Heat Stress °C	Heat Stress °C
		Danger Level (if any from Heat Stress Index table)	□Cautn □Danger □ Ex Cautn □Ex Dangr	□Cautn □Danger □ Ex Cautn □Ex Dangr	□Cautn □Danger □ Ex Cautn □Ex Dangr
2.7	Wind Chill	Use 2.1, 3.1; Wind Chl Tbl	Wind Chill. °C	Wind Chill. °C	Wind Chill. °C
		Danger Level (if any from Wind Chill chart)	□Trvl Dngr □Frstbte10 □TShltr Dgr □Frstite30 □Frostbite □Frstbte5	□Trvl Dngr □Frstbte10 □TShltr Dgr □Frstite30 □Frostbite □Frstbte5	□Trvl Dngr □Frstbte10 □TShltr Dgr □Frstite30 □Frostbite □Frstbte5

3. Wind Speed / Direction

Report wind speed in ***knots to air crews;*** km/h to all others.

			Sunrise	Mid-Afternoon	Sunset
3.1	Average	Get 3 readings & average	km/h knts	km/h knts	km/h knts
	Gusts	Record highest gust	km/h knts	km/h knts	km/h knts

Wind Speed Guidelines for Helicopter Flight Operations

10 knots / 18.5 km/h ideal; OK to fly

Above 45 knots / 83 km/h; No flights.

Gusts above 20 knots/ 37 km/h; No flights

Max tailwind 5 knots/ 6 km/hr; No take off

			Sunrise	Mid-Afternoon	Sunset
3.2	Steady Wind Direction	Circle direction steady **wind comes FROM**	N NE S SW E SE W NW	N NE S SW E SE W NW	N NE S SW E SE W NW
	Variable Wind Direction	Circle 1 or more directions **wind comes FROM**	N NE S SW E SE W NW	N NE S SW E SE W NW	N NE S SW E SE W NW

4. Sky Conditions

			Sunrise	Mid-Afternoon	Sunset
4.1	Cloud Cover	Use Definitions in Cloud Cover Table	□ Clear □ Cloudy □ Scattered □ Overcast □ Broken	□ Clear □ Cloudy □ Scattered □ Overcast □ Broken	□ Clear □ Cloudy □ Scattered □ Overcast □ Broken
4.2	Cloud Base Ht (Loc Rel) m	Relative to local Mtn m AMSL	□ Clouds above mtn □ Clouds at mtn top □ Clouds below mtn	□ Clouds above mtn □ Clouds at mtn top □ Clouds below mtn	□ Clouds above mtn □ Clouds at mtn top □ Clouds below mtn
		DewCal (2.1-2.5)/9.8x1000m	m AGL	m AGL	m AGL

Use local mountain of known elevation (above mean sea level) and report clouds above, at, or below mountain top.

Min. flight altitudes: ***Day*** *= 160m AGL;* ***Night*** *– 500 m AGL;* ***Low cloud ceiling*** *= No flights.*

				Sunrise	Mid-Afternoon	Sunset
4.3	Cloud Type	High	Vertically Developed	□ Cirrus □ Altostrat □ Altocum □CuNim	□ Cirrus □ Altostrat □ Altocum □CuNim	□ Cirrus □ Altostrat □ Altocum □CuNim
		Middle				
		Low		□ Stratus □ Nimstrat □ Cumul	□ Stratus □ Nimstrat □ Cumul	□ Stratus □ Nimstrat □ Cumul
4.4	Rainfall	Measure at 0900 hrs each morning. Report amount for last 24 hrs.				mm
4.5	Visual Range (Visibility)	Name of 3.2 km mark		□ more □ less than □ Rain □ Fog □ Haze □ Smoke	□ more □ less than □ Rain □ Fog □ Haze □ Smoke	□ more □ less than □ Rain □ Fog □ Haze □ Smoke
		Name of 5 km mark		□ more □ less than □ Rain □ Fog □ Haze □ Smoke	□ more □ less than □ Rain □ Fog □ Haze □ Smoke	□ more □ less than □ Rain □ Fog □ Haze □ Smoke

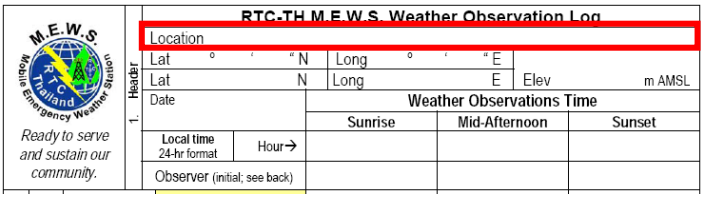
Helicopter minimum visibility: ***Day*** *= 3.2 km / 2 miles;* ***Night*** *= 5 km / 3 miles;* ***Low visibility*** *= No flights*

				Sunrise	Mid-Afternoon	Sunset
4.6	Severe Weather	Thunderstorms		□ Yes □ No	□ Yes □ No	□ Yes □ No
		Lightning	Flash, count secs to boom / 3	N NE E SE S SW W NW □ Yes km	N NE E SE S SW W NW □ Yes km	N NE E SE S SW W NW □ Yes km

Warn air crews of any severe weather in your area.

The MEWS Weather Observation Log Form

Section 1.The Header



Location: Write the common place name for your operating site. Make your weather observations from the same location. This will give more consistent information over time to outside agencies.

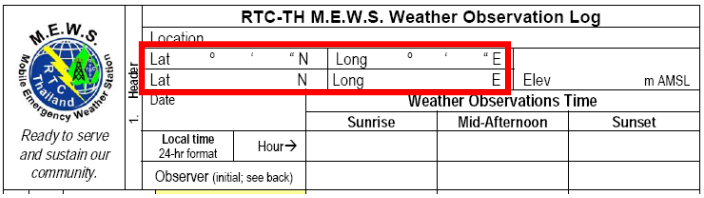
- **Safe Location:** Avoid areas that are subject to flooding, flash floods, wildfires, landslides and other natural hazards. You want to be able to set up and operate. Moving your location during the operation can lead to confusion.
- **Good Operating Potential for Radio and Helicopter Operations:** Higher ground that provides better radio transmissions, overall visibility of the surrounding area, open, clear, level with firm ground for a helicopter landing pad. [**Note**: Prepare ahead of time and scout out these areas. Test radio communications capability with other HAM EmComm stations. Record pertinent information about the radio, antenna, frequencies, and RST for the test.]
  - **Open / Clear Area:** Overall, the Landing Zone should be about the size of a football field. The helicopter would land in a square at least 25 m on a side. The landing pad should be a square no smaller than 17 m on a side. There should be at least two approach paths 100 m long separated by at least 90° from each other. This can allow a clear departure of one helicopter while a second helicopter is approaching the LZ. [**Note**: Prepare ahead of time and scout out possible LZs in your area. Make sketch diagrams noting dimensions, compass headings, and vertical obstructions. Refer to the separate RTC-TH EmComm guide on Helicopter Operations.]
  - **Clear Area:** There should be nothing sticking more than 30 cm above the ground in the landing pad. Cut tall grass to 30 cm or less and remove all grass cuttings to avoid blowing debris during landing operations. Clear away any loose debris. Helicopter rotor wash can exceed a wind velocity of 160 km/hr at the landing pad. There should be no vertical obstructions or very few vertical obstructions in the approach paths. [**Note**: Advise flight crews of trees, power lines, utility poles, towers, and other vertical obstructions near the LZ. Mark nearby man-made vertical obstructions with red lights if there will be night flight operations. The helicopter approach paths to and departure paths from the landing zone (LZ) must also be free of vertical obstructions for a distance of 100 m / 300 ft. There should be two approaches (landing / departure) for the LZ at least 90° apart from each other. If LZ is sloping, helicopter should land going up slope.
  - **Landing Zone Slope Determination:** This can be easily done:
    Step 1. Put a marker at the center of a potential landing zone.
    Step 2. Walk down hill away from the marker for a distance equal to 6 times your height (usually about 35 steps).
    Step 3. Face the marker, look at the marker, keeping your eyes level. If you eye level is even or above the ground level at the marker, the slope is less than 7%.
  - **Firm Surface:** A paved or compacted surface for the LZ is best. Avoid wet, muddy, loose sandy/dusty areas, or freshly ploughed fields. Helicopter rotor

wash can create a 160 km/hr wind. Dust in the LZ will reduce visibility and create hazardous flight operating conditions.

- **Other Landing Zone Considerations:** The landing zone should not be directly next to your operating location. Rotor wash from a helicopter can be equal to a 160 km/h winds. If the landing area has a dirt surface, things can get very dusty. Try to wet or compact the landing zone to reduce dust levels. If the area has grass, short grass would be best as taller grass can make for lots of blowing debris.

Summary Notes for Operating Location Selection		
Radio Operating Site	Characteristic	Helicopter Landing Zone
• Be sure to have sufficient space for radio equipment (including generator if any) and overhead clearance for antennas (including guy lines for antenna masts). [Note: Even though you may operate without guy lines, helicopter rotor downwash create very strong winds.] • If possible, set up radio station with a clear view of the LZ and approach paths. • Layout traffic flow to avoid interference of movement to and between the radio station and LZ.	Open / Clear Area [Note: Think where radio station and LZ will be set up.]	• About the size of a football field; helicopter lands in a square ~25m on a side (not smaller than ~17m on a side) • No vertical obstructions in 100 m long approaches to the LZ • Two approaches (in and out) that are 90º apart. • Allow room for safe zones for ground personnel and evacuees.
• Level ground is best. • If sloping, try to set up so water drains away from the radio station.	Level Ground	• LZ slope should be less than 7 º • If LZ is sloping, landing approach should be going upslope to landing pad.
• Check for hardness relative to equipment needed for ground rod and tent / guy line stakes	Firm Surface & Other Considerations	• Firm compacted surface; paved or short grass is best. • Avoid bare soil or tall grass.

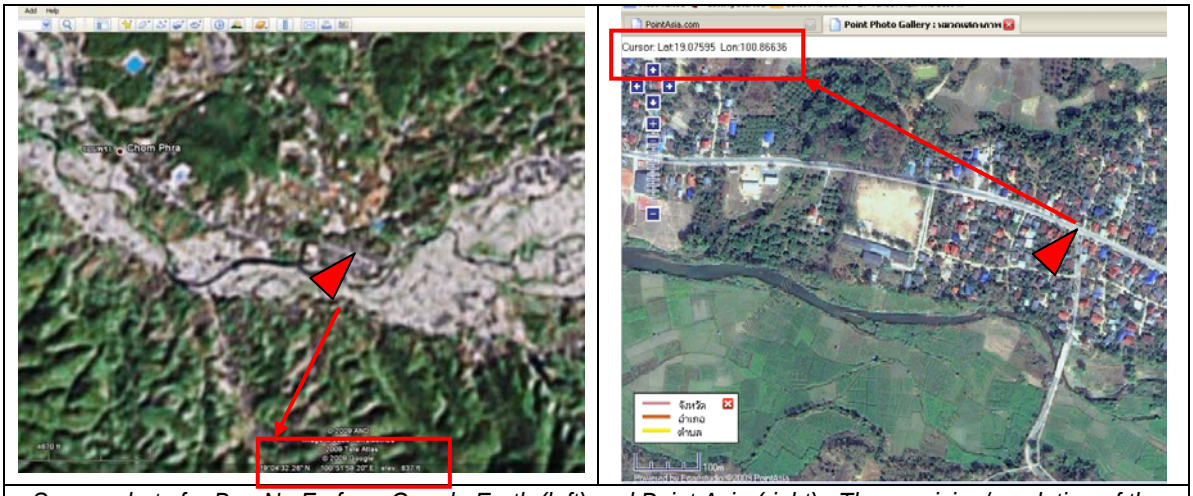
Geographic grid coordinates for a location are more precise than local place names. Follow the conventional standard practice listing Latitude first, then Longitude. The format is pre-set for use in SE Asia / Thailand with N and E designators. The two common formats are traditional (degrees, minutes, seconds) or digital (decimal degrees). [Note: Modern navigation systems rely on digital electronics. Space if provided for both formats. If recording only one format, decimal degrees are preferred. An online interactive conversion utility takes both formats and converts to the other. The utility is found at www.fcc.gov/mb/audio/bickel/DDDMMSS-decimal.htm]



1.1 Latitude, Longitude Coordinates can come from a number of sources:

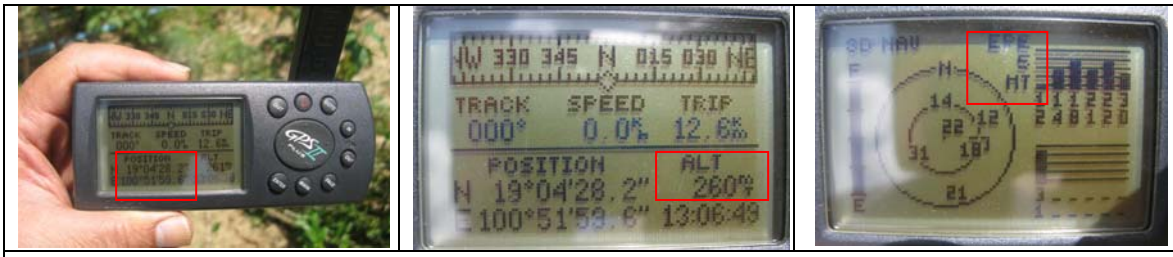
- **Topographic Maps:** Prime source for topographic maps is the Royal Thai Survey Department (www.rtsd.mi.th). However, some maps are restricted and not available to the public.
- **Local Officials and Surveyors** at the changwat, amphoe, and tambon (province, district, and subdistrict) offices.
- **Google Earth:** Available as a free download from www.google.earth.com
- **Point Asia:** More detailed free photo images can be found at http://pointme.pointasia.com/Category/Cate.aspx?photogallery

[**Note:** Coordinates are displayed at the margins of the screen image. For common Internet access, Point Asia has sharper images for Thailand. It lets you "zoom in" for more detail. (See sample screenshots below.)



Screen shots for Ban Na Fa from Google Earth (left) and Point Asia (right). The precision/resolution of the images depends on the databases of each service. To get Latitude/Longitude coordinates, point your cursor at the location of interest. The coordinates show up at the margins of the image on the computer screen.

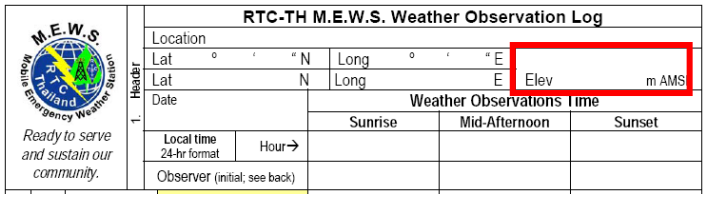
- GPS (Global Positioning System) unit: This device will usually provide geographic coordinates within +/- 5m to 10 m. [**Note:** Elevations provided by handheld GPS units are not very reliable.]



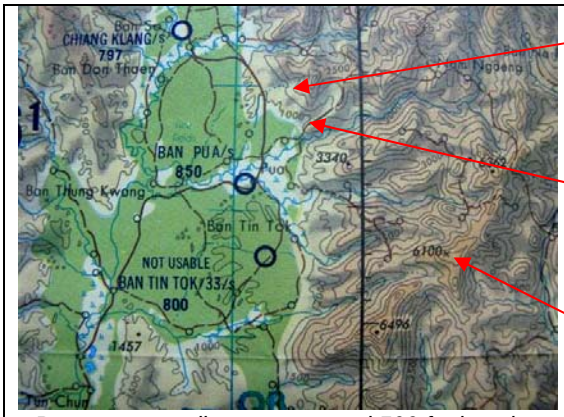
If you have a GPS unit, you can set the format for the Lat/Long coordinate display. The GPS will also show an elevation/altitude, however, these tend to be very error prone without additional data processing. The GPS may also indicate the horizontal precision of the Lat/Long data by displaying EPE (estimated probable error). This is usually reported as +/m meters or feet.

[Note: In most situations, ultra precision with location coordinates is not required. In a search and rescue (SAR), getting coordinates that are +/- 15-20 m will be better than "we are somewhere on the south of the Thawangpha near the river."]

1.2 Elevation: Conventional practice is to give elevations in relation to mean sea level, often abbreviated as "AMSL" (above mean sea level). In Thailand, use meters as the measurement unit.



- **Topographic Maps:** Accuracy of the elevation data depends on the map scale, map datum / date, and the contour interval.

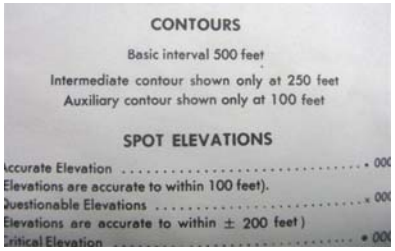


Brown contour lines are spaced 500 ft elevation

Brown contour lines are 500 ft apart so this line is 1500 ft

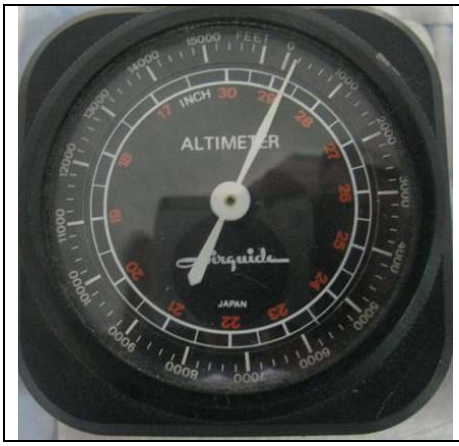
Index contour line is numbered (e.g. 1000 ft)

Spot elevations are in feet. (e.g. 6100 ft)



Check the map for the publication date, scale, and contour interval. They all affect the accuracy of your data. In the example above, spot elevations are given for mountain peaks in feet.

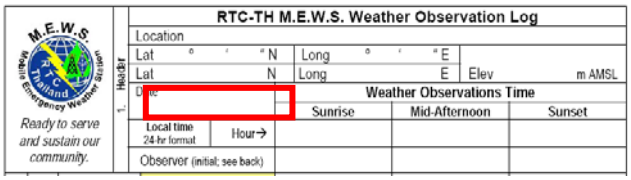
- **Check with local government officials or surveyors** at the changwat, amphoe, and tambon (province, district, and subdistrict) offices.
- **Altimeter:** Accuracy of the elevation depends on the precision of the altimeter and changes in barometric pressure. In most readily available altimeters, you need to start from a point of known elevation. The photos below show an example of a consumer grade altimeter sold as an automobile accessory.



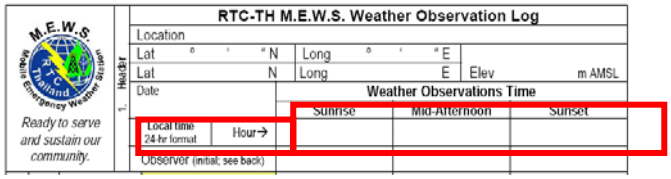
An analog altimeter is shown on the left. To use this kind of altimeter, you must start from a local point of known elevation. Check with local government officials or surveyors.

Set the altimeter to zero at a point of known elevation. When you get to a possible operating position, record the altimeter reading. For example, if you started from a survey marker at 2300 ft AMSL, and you get to a point where the altimeter read ~200 ft, you would estimate the elevation of that point to be 2500 ft +/- 200 ft. [**Note:** Ultra precision is not needed. Remember, when a flight crew unfamiliar with the area is told your field elevation is "about 2500 ft +/- 200 ft, they will have an idea of what to expect. In most cases, they have no elevation data at all. Flight operations are almost always at the discretion of the pilot. So if you were in their shoes, which would you prefer, some elevation data or no elevation data? Pilots won't trust radio reports blindly. They will listen to what you report, but then trust in their instruments, experience, and judgment.]

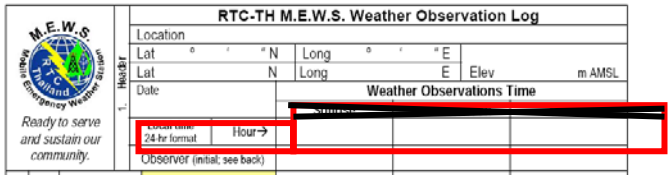
Date / Time (hour): In most amateur radio EmComm situations, UTC dates / times are used. We are supporting local area emergency responders who are in the same time zone. Avoid confusion. On the air clearly state "Local Thai time" in reports with dates / times to. Use the following formats to complete the MEWS Log.



- **Date:** Write the year, month, and day using the format YYYY (as digits), MMM (using the first 3 letters of the name of the month), DD (using two digits for the date). In this form, May 9, 2009 would be written 2009 May 09. This format will make it easy to organize and file the log sheets starting with the year. Using the first 3 letters of the month avoids confusion when using numerical formats for the month and day.



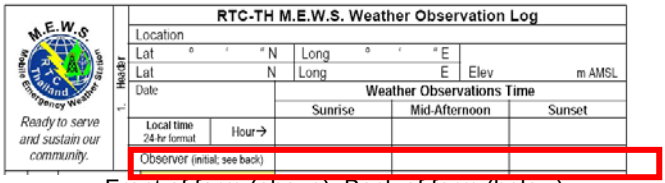
- **Time:** Use the 24-hour format (e.g. 2 AM = 0200; 2 PM = 1400) to avoid confusion. Weather observations should be made 3 times each day: Sunrise (often between 0500-0600 hrs; to get the lowest temperature of the day), Mid-Afternoon (often between 1400-1500 hrs; to get the highest temperature of the day), and Sunset (often between 1800-1900 hrs; to know the temperatures at the end of the daylight part of the day). Record the time you make your actual observations in the space provided for each part of the day.



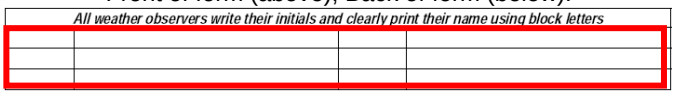
[Note: When supporting helicopter flight operations, it may be necessary to make more observations. This is done in the interest of flight safety. In an emergency situation, keeping air crews safe is better than adding them to the list of disaster victims. To keep the records straight when making additional observations:

- **Cross out** the headings "Sunrise, Mid-Afternoon, and Sunset".
- **Write the hour** of the observation in the space provided using 24-hr format.

Observer: Each observer should clearly put their initials in the appropriate column. Then on the back of the Weather Observation Log form, they should sign their name. Immediately below their signature, they should clearly print using block letters. This not about the "blame game" as much as it is a quality check on the MEWS weather observer training. If you are having problems with the observation task, we want to help you improve. After all, as a volunteer, you aren't paid, so we can't really fire you. And since you volunteered, you chose to do this work. So we assume that you would like to do it well. If problems arise, we are ready to help you learn and improve. And we also need your help to train others.



Front of form (above); Back of form (below).



Section 2. Temperature and Relative Humidity: Temperature and relative humidity are important weather data affecting the well-being and health of people. These data also have important effects on aircraft flight performance. There are several types of temperature measurements that can be taken. Some are reported, some are used to calculate other data to be reported.

- **Basic Weather Observers** are responsible for only 2.1.
- **Advanced Weather Observers** are responsible for 2.1-2.7.

[**Advisory Note:** Exposure to direct sunlight can add stress to survivors. If possible avoid heavy work between 1100-1500 hrs on sunny days, or plan extra water rations to prevent dehydration.]

2. Temperature / Relative Humidity						
	2.1	Air (Dry bulb)	Thermometer in shade; 1.5 m above ground	°C	°C	°C
	2.2	Wet Bulb		°C	°C	°C
	2.3	Difference	Subtract 2.2 from 2.1;	°C	°C	°C
	2.4	Rel. Humidity	Use 2.1, 2.3; R H Table	%RH	%RH	%RH
	2.5	Dew Point	Use 2.1, 2.3; Dew Pt Table	°C	°C	°C
	2.6	Heat Stress	Use 2.1, 2.4 ; HSI Table	Heat Stress °C	Heat Stress °C	Heat Stress °C
			Danger Level (if any from Heat Stress Index table)	□Cautn □Danger □ Ex Cautn □Ex Dangr	□Cautn □Danger □ Ex Cautn □Ex Dangr	□Cautn □Danger □ Ex Cautn □Ex Dangr
	2.7	Wind Chill	Use 2.1, 3.1; Wind Chl Tbl	Wind Chill. °C	Wind Chill. °C	Wind Chill. °C
			Danger Level (if any from Wind Chill chart)	□Trvl Dngr □Frstbte10 □TShltr Dgr □Frstite30 □Frostbite □Frstbte5	□Trvl Dngr □Frstbte10 □TShltr Dgr □Frstite30 □Frostbite □Frstbte5	□Trvl Dngr □Frstbte10 □TShltr Dgr □Frstite30 □Frostbite □Frstbte5

2.1 Air (Dry Bulb)

Temperature: This is the temperature shown on a typical thermometer or the Dry Bulb Thermometer on a hygrometer.

The instrument should be in a shaded location about 1.5 m above the ground. Other siting criteria: 1) open area with clear overhead air circulation; 2) keep a distance 4 X the height of nearby objects; 3) 33 m away from paved roads; and 4) surrounded by natural ground cover typical of your area. Record the Air temperature 3 times each day in the spaces provided in Line 2.1. Various thermometers are shown below. They range from Basic (on the left) to Advanced (on the right)

Use an umbrella if shade is not available.

Keeping things simple assures you can still get the job done under worst-case scenarios.

A typical thermometer (left), the dry bulb thermometer on a hygrometer (center), and a portable digital weather station (on the right). High tech equipment has a key disadvantage when it comes to replacing batteries and making repairs in the field in the chaos of a disaster.

2.2 Wet Bulb Temperature:

Read and record the temperature from the Wet Bulb Thermometer on a hygrometer. You do not report this temperature. You will use it to calculate the Relative Humidity.

2. Temperature / Relative Humidity						
	2.1	Air (Dry bulb)	Thermometer in shade; 1.5 m above ground	°C	°C	
	2.2	Wet Bulb		°C	°C	
	2.3	Difference	Subtract 2.2 from 2.1;	°C	°C	
	2.4	Rel. Humidity	Use 2.1, 2.3; R H Table	%RH	%RH	
	2.5	Dew Point	Use 2.1, 2.3; Dew Pt Table	°C	°C	
	2.6	Heat Stress	Use 2.1, 2.4 ; HSI Table	Heat Stress °C	Heat Stress °C	Heat Stress
			Danger Level (if any from Heat Stress Index table)	□Cautn □Danger □ Ex Cautn □Ex Dangr	□Cautn □Danger □ Ex Cautn □Ex Dangr	□Cautn □Dan □ Ex Cautn □Ex [illegible]
	2.7	Wind Chill	Use 2.1, 3.1; Wind Chl Tbl	Wind Chill. °C	Wind Chill. °C	Wind Chill.
			Danger Level (if any from Wind Chill chart)	□Trvl Dngr □Frstbte10 □TShltr Dgr □Frstite30 □Frostbite □Frstbte5	□Trvl Dngr □Frstbte10 □TShltr Dgr □Frstite30 □Frostbite □Frstbte5	□Trvl Dngr □Frst □TShltr Dgr □Frst □Frostbite □Frst

How to Use a Hygrometer

Step 1. Position the hygrometer 1.2 m / 5 ft above the ground in a shaded area. Also: A) open area with clear overhead air circulation; B) keep a distance 4 X the height of nearby objects; C) 33 m away from paved roads; and D) be surrounded by natural ground cover typical of your area.

Step 2. Be sure the fill the bottle with clean water and the cloth wick around the wet bulb thermometer is saturated.

Step 3. Read and record both the dry and wet bulb temperatures.

Step 4. Subtract the dry bulb temperature from the wet bulb temperature.

Step 5. Use the dry bulb temperature and the temperature difference from Step 3 to look up the % relative humidity in the reference table.

Be sure the water level in the small bottle is adequate to keep the cotton wick wet on the wet bulb thermometer. Refill the bottle as needed using clean water.

2.3 Difference between the Dry and Wet Bulb Temperatures. Simply subtract the Wet Bulb Temperature (in Line 2.2 from the Dry Bulb Temperature (Line 2.1). The Weather Observation Record the difference in Line 2.3 on the form.

2.4 Relative Humidity: Use the Relative Humidity chart along with the Dry Bulb temperature from Line 2.1 and the Dry-Wet temperature difference from Line 2.3.To read the table,

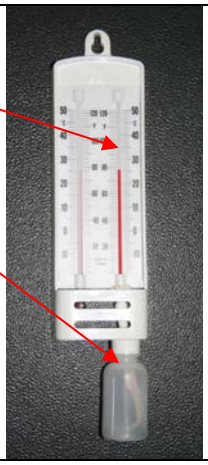
Step 1. Find the Dry Bulb temperature in the left-hand column on the chart. For example, 30ºC.

Step 2. Find the difference between the Dry and Wet Bulb temperatures along the row at the top of the chart. For example, 2 ºC.

Step 3. Find the intersection of the row and column. In this case 86% is the relative humidity that you write on the log form in the space provided for 2.4.

Wet bulb thermometer on a hygrometer.

A cloth wick surrounds the bulb of the wet bulb thermometer. Refill the bottle as needed using clean water. The hygrometer will not work properly unless the wet bulb thermometer is cooled by evaporation.



2. Temperature / Relative Humidity

2.1	Air (Dry bulb)	Thermometer in shade; 1.5 m above ground		°C	°C	°C
2.2	Wet Bulb			°C	°C	°C
2.3	Difference	Subtract 2.2 from 2.1;		°C	°C	°C
2.4	Rel. Humidity	Use 2.1, 2.3; R H Table		%RH	%RH	%RH
2.5	Dew Point	Use 2.1, 2.3; Dew Pt Table		°C	°C	°C
2.6	Heat Stress	Use 2.1, 2.4 ; HSI Table	Heat Stress	°C	Heat Stress °C	Heat Stress °C
		Danger Level (if any from Heat Stress Index table)	□Cautn □Danger □ Ex Cautn □Ex Dangr		□Cautn □Danger □ Ex Cautn □Ex Dangr	□Cautn □Danger □ Ex Cautn □Ex Dangr
2.7	Wind Chill	Use 2.1, 3.1; Wind Chl Tbl	Wind Chill.	°C	Wind Chill. °C	Wind Chill. °C
		Danger Level (if any from Wind Chill chart)	□Trvl Dngr □Frstbte10 □TShltr Dgr □Frstite30 □Frostbite □Frstbte5		□Trvl Dngr □Frstbte10 □TShltr Dgr □Frstite30 □Frostbite □Frstbte5	□Trvl Dngr □Frstbte10 □TShltr Dgr □Frstite30 □Frostbite □Frstbte5

Relative Humidity Chart for °C Temperatures

Dry Bulb Temperature minus Wet Bulb Temperature in °C

Dry Bulb Temperature (Air Temperature °C)	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	7.5	10.0	12.5	15.0	17.5	20.0	22.5	25.0
-20	70	41	11															
-17.5	75	51	26	2														
-15	79	58	38	18														
-12.5	82	65	47	30	13													
-10	85	69	54	39	24	10												
-7.5	87	73	60	48	35	22	10											
-5	88	77	66	54	43	32	21	11	1									
-2.5	90	80	70	60	50	42	37	22	12	3								
0	91	82	73	65	56	47	39	31	23	15								
2.5	92	84	76	68	61	53	46	38	31	24								
5	93	86	78	71	65	58	51	45	38	32	1							
7.5	93	87	80	74	68	62	56	50	44	38	11							
10	94	88	82	76	71	65	60	54	49	44	19							
12.5	94	89	84	78	73	68	63	58	53	48	25	4						
15	95	90	85	80	75	70	66	61	57	52	31	12						
17.5	95	90	86	81	77	72	68	64	60	55	36	18	2					
20	95	91	87	82	78	74	70	66	62	58	40	24	8					
22.5	96	92	87	83	80	76	72	68	64	61	44	28	14	1				
25	96	92	88	84	81	77	73	70	66	63	47	32	19	7				
27.5	96	92	89	85	82	78	75	71	68	65	50	36	23	12	1			
30	96	93	89	86	82	79	76	73	70	67	52	39	27	16	6			
32.5	97	93	90		83	80	77	74	71	68	54	42	30	20	11	1		
35	97	93	90		84	81	78	75	72	69	56	44	33	23	14	6		
37.5	97	94	91	87	85	82	79	76	73	70	58	46	36	26	18	10	3	
40	97	94	91	88	85	82	79	77	74	72	59	48	38	29	21	13	6	
42.5	97	94	91	88	86	83	80	78	75	72	61	50	40	31	23	16	9	2
45	97	94	91	89	86	83	81	78	76	73	62	51	42	33	26	18	12	6
47.5	97	94	92	89	86	84	81	79	76	74	63	53	44	35	28	21	15	9
50	97	95	92	89	87	84	82	79	77	75	64	54	45	37	30	23	17	11

- Use the hygrometer to get the Dry Bulb and the Wet Bulb Temperature. Example, Dry Bulb = 30°C, Wet Bulb = 28°C.
- Subtract the Wet Bulb temperature from the Dry Bulb temperature. Example, 30°C – 28°C = 2°C. Find the column for 2°C across the top of the chart.
- Locate 30°C in the Air Temperature column at the left side of the chart.
- Find the intersection of the column and row to get the % relative humidity. For the example of 2°C and 30°C, the relative humidity is 86%.

Relative Humidity Chart for °C Temperatures

Dry Bulb Temperature (Air Temperature °C	Dry Bulb Temperature minus Wet Bulb Temperature in °C																	
	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	7.5	10.0	12.5	15.0	17.5	20.0	22.5	25.0
-20	70	41	11															
-17.5	75	51	26	2														
-15	79	58	38	18														
-12.5	82	65	47	30	13													
-10	85	69	54	39	24	10												
-7.5	87	73	60	48	35	22	10											
-5	88	77	66	54	43	32	21	11	1									
-2.5	90	80	70	60	50	42	37	22	12	3								
0	91	82	73	65	56	47	39	31	23	15								
2.5	92	84	76	68	61	53	46	38	31	24								
5	93	86	78	71	65	58	51	45	38	32	1							
7.5	93	87	80	74	68	62	56	50	44	38	11							
10	94	88	82	76	71	65	60	54	49	44	19							
12.5	94	89	84	78	73	68	63	58	53	48	25	4						
15	95	90	85	80	75	70	66	61	57	52	31	12						
17.5	95	90	86	81	77	72	68	64	60	55	36	18	2					
20	95	91	87	82	78	74	70	66	62	58	40	24	8					
22.5	96	92	87	83	80	76	72	68	64	61	44	28	14	1				
25	96	92	88	84	81	77	73	70	66	63	47	32	19	7				
27.5	96	92	89	85	82	78	75	71	68	65	50	36	23	12	1			
30	96	93	89	86	82	79	76	73	70	67	52	39	27	16	6			
32.5	97	93	90	86	83	80	77	74	71	68	54	42	30	20	11	1		
35	97	93	90	87	84	81	78	75	72	69	56	44	33	23	14	6		
37.5	97	94	91	87	85	82	79	76	73	70	58	46	36	26	18	10	3	
40	97	94	91	88	85	82	79	77	74	72	59	48	38	29	21	13	6	
42.5	97	94	91	88	86	83	80	78	75	72	61	50	40	31	23	16	9	2
45	97	94	91	89	86	83	81	78	76	73	62	51	42	33	26	18	12	6
47.5	97	94	92	89	86	84	81	79	76	74	63	53	44	35	28	21	15	9
50	97	95	92	89	87	84	82	79	77	75	64	54	45	37	30	23	17	11

- Use the hygrometer to get the Dry Bulb and the Wet Bulb Temperature. Example, Dry Bulb = 30°C, Wet Bulb = 28°C.
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- Locate 30°C in the Air Temperature column at the left side of the chart.
- Find the intersection of the column and row to get the % relative humidity. For the example of 2°C and 30°C, the relative humidity is 86%.

Note: Temperature and relative humidity are important weather data for flight crews. To support flight operations, be prepared to get these data and report them to air crews before landing at your site and before they depart.

2. Temperature / Relative Humidity	2.1	Air (Dry bulb)	Thermometer in shade; 1.5 m above ground	°C	°C	°C
	2.2	Wet Bulb		°C	°C	°C
	2.3	Difference	Subtract 2.2 from 2.1;	°C	°C	°C
	2.4	Rel. Humidity	Use 2.1, 2.3; R H Table	%RH	%RH	%RH
	2.5	Dew Point	Use 2.1, 2.3; Dew Pt Table	°C	°C	°C
	2.6	Heat Stress	Use 2.1, 2.4 ; HSI Table	Heat Stress °C	Heat Stress °C	Heat Stress °C
			Danger Level (if any from Heat Stress Index table)	□Cautn □Danger □ Ex Cautn □Ex Dangr	□Cautn □Danger □ Ex Cautn □Ex Dangr	□Cautn □Danger □ Ex Cautn □Ex Dangr
	2.7	Wind Chill	Use 2.1, 3.1; Wind Chl Tbl	Wind Chill. °C	Wind Chill. °C	Wind Chill. °C
			Danger Level (if any from Wind Chill chart)	□Trvl Dngr □Frstbte10 □TShltr Dgr □Frstite30 □Frostbite □Frstbte5	□Trvl Dngr □Frstbte10 □TShltr Dgr □Frstite30 □Frostbite □Frstbte5	□Trvl Dngr □Frstbte10 □TShltr Dgr □Frstite30 □Frostbite □Frstbte5

2.5 Dew Point Temperature: You need to know the Air temperature (Dry Bulb temperature) from Line 2.1 and the Difference between the Dry and Wet Bulb temperatures from Line 2.3. Then use the Dew Point Temperature chart. To read the table,

Step 1. Find the Dry Bulb temperature in the left-hand column on the chart. For example, 30ºC.

Step 2. Find the difference between the Dry and Wet Bulb temperatures along the row at the top of the chart. For example, 2 ºC.

Step 3. Find the intersection of the row and column. In this case 27 ºC is the Dew Point Temperature you write on the log form in the space provided on Line 2.5.

DEW POINT TEMPERATURE CHART (°C)

Dry Bulb Temperature (Air Temperature °C	Dry Bulb temperature minus Wet Bulb temperature in °C															
	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	7.5	10.0	12.5	15.0	17.5	20.0
-20	-25	-33														
-17.5	-21	-27	-38													
-15	-19	-23	-28													
-12.5	-15	-18	-22	-29												
-10	-12	-14	-18	-21	-27	-36										
-7.5	-9	-11	-14	-17	-20	-26	-34									
-5	-7	-8	-10	-13	-16	-19	-24	-31								
-2.5	-4	-6	-7	-9	-11	-14	-17	-22	-28	-41						
0	-1	-3	-4	-6	-8	-10	-12	-15	-19	-24						
2.5	1	0	-1	-3	-4	-6	-8	-10	-13	-16						
5	4	3	2	0	-1	-3	-4	-6	-8	-10	-48					
7.5	6	6	4	3	2	1	-1	-2	-4	-6	-22					
10	9	8	7	6	5	4	2	1	0	-2	-13					
12.5	12	11	10	9	8	7	6	4	3	2	-7	-28				
15	14	13	12	12	11	10	9	8	7	5	-2	-14				
17.5	17	16	15	14	13	12	12	11	10	8	2	-7	-35			
20	19	18	18	17	16	15	14	14	13	12	6	-1	-15			
22.5	22	21	20	20	19	18	17	16	16	5	10	3	-6	-38		
25	24	24	23	22	21	21	20	19	18	18	3	7	0	-14		
27.5	27	26	26	25	24	23	23	22	21	20	16	11	5	-5	-32	
30	29	29	28	27	27	26	25	25	24	23	19	14	9	2	-11	
32.5	32	31	31	30	29	29	28	27	26	26	22	18	13	7	-2	
35	34	34	33	32	32	31	31	30	29	28	25	21	16	11	4	
37.5	37	36	36	35	34	34	33	32	32	31	28	24	20	15	9	0
40	39	39	38	38	37	36	36	35	34	34	30	27	23	18	13	6
42.5	42	41	41	40	40	39	38	38	37	36	33	30	26	22	17	11
45	44	44	43	43	42	42	41	40	40	39	36	33	29	25	21	15
47.5	47	46	46	45	45	44	44	43	42	42	39	35	32	28	24	19
50	49	49	48	48	47	47	46	45	45	44	41	38	35	31	28	23

- Use the hygrometer to get the Dry Bulb and the Wet Bulb Temperature. Example, Dry Bulb = 30°C, Wet Bulb = 28°C.
- Subtract the Wet Bulb temperature from the Dry Bulb temperature. Example, 30°C – 28°C = 2°C.
- Find the column for 2°C across the top of the chart. Locate 30°C in the Air Temperature column at the left side of the chart. Find the intersection of the column and row to get the Dew Point Temperature. For the example of 2°C and 30°C, the Dew Point Temperature is 27°C.
- Divide 27°C by 10°C = 2.7 X 1000 m = 2700 m (the altitude of the bottom of the clouds)

2. Temperature / Relative Humidity	2.1	Air (Dry bulb)	Thermometer in shade; 1.5 m above ground	°C	°C	°C
	2.2	Wet Bulb		°C	°C	°C
	2.3	Difference	Subtract 2.2 from 2.1;	°C	°C	°C
	2.4	Rel. Humidity	Use 2.1, 2.3; R H Table	%RH	%RH	%RH
	2.5	Dew Point	Use 2.1, 2.3; Dew Pt Table	°C	°C	°C
	2.6	Heat Stress	Use 2.1, 2.4 ; HSI Table	Heat Stress °C	Heat Stress °C	Heat Stress °C
			Danger Level (if any from Heat Stress Index table)	□Cautn □Danger □ Ex Cautn □Ex Dangr	□Cautn □Danger □ Ex Cautn □Ex Dangr	□Cautn □Danger □ Ex Cautn □Ex Dangr
	2.7	Wind Chill	Use 2.1, 3.1; Wind Chl Tbl	Wind Chill. °C	Wind Chill. °C	Wind Chill. °C
			Danger Level (if any from Wind Chill chart)	□Trvl Dngr □Frstbte10 □TShltr Dgr □Frstite30 □Frostbite □Frstbte5	□Trvl Dngr □Frstbte10 □TShltr Dgr □Frstite30 □Frostbite □Frstbte5	□Trvl Dngr □Frstbte10 □TShltr Dgr □Frstite30 □Frostbite □Frstbte5

[**Note:** The Dew Point Temperature is not usually reported as part of the weather observations. But it does help local authorities about possible weather effects on the disaster survivors.]

When Air temperature = Dew Point Temperature (Line 2.1 = Line 2.5), dew will be forming	
For survivors	• Tents and bedding will become damp or wet. People sleeping in the open will get wet and cold. • Given advanced warning, dew can be a source of clean drinking water if collected with clean collection containers. • Relative humidity will increase. If temperatures are low, people will feel colder than the measured air temperature.
For air crews	• Local ground observers at the landing zone (LZ) can use the Dew Point Temperature to calculate the height from the ground to the base of the lower clouds. This is called the "ceiling") and can set restrictions of flight operations.

DEW POINT TEMPERATURE CHART (°C)

Dry Bulb Temperature (Air Temperature °C	Dry Bulb temperature minus Wet Bulb temperature in °C															
	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	7.5	10.0	12.5	15.0	17.5	20.0
-20	-25	-33														
-17.5	-21	-27	-38													
-15	-19	-23	-28													
-12.5	-15	-18	-22	-29												
-10	-12	-14	-18	-21	-27	-36										
-7.5	-9	-11	-14	-17	-20	-26	-34									
-5	-7	-8	-10	-13	-16	-19	-24	-31								
-2.5	-4	-6	-7	-9	-11	-14	-17	-22	-28	-41						
0	-1	-3	-4	-6	-8	-10	-12	-15	-19	-24						
2.5	1	0	-1	-3	-4	-6	-8	-10	-13	-16						
5	4	3	2	0	-1	-3	-4	-6	-8	-10	-48					
7.5	6	6	4	3	2	1	-1	-2	-4	-6	-22					
10	9	8	7	6	5	4	2	1	0	-2	-13					
12.5	12	11	10	9	8	7	6	4	3	2	-7	-28				
15	14	13	12	12	11	10	9	8	7	5	-2	-14				
17.5	17	16	15	14	13	12	12	11	10	8	2	-7	-35			
20	19	18	18	17	16	15	14	14	13	12	6	-1	-15			
22.5	22	21	20	20	19	18	17	16	16	5	10	3	-6	-38		
25	24	24	23	22	21	21	20	19	18	18	3	7	0	-14		
27.5	27	26	26	25	24	23	23	22	21	20	16	11	5	-5	-32	
30	29	29	28	27	27	26	25	25	24	23	19	14	9	2	-11	
32.5	32	31	31	30	29	29	28	27	26	26	22	18	13	7	-2	
35	34	34	33	32	32	31	31	30	29	28	25	21	16	11	4	
37.5	37	36	36	35	34	34	33	32	32	31	28	24	20	15	9	0
40	39	39	38	38	37	36	36	35	34	34	30	27	23	18	13	6
42.5	42	41	41	40	40	39	38	38	37	36	33	30	26	22	17	11
45	44	44	43	43	42	42	41	40	40	39	36	33	29	25	21	15
47.5	47	46	46	45	45	44	44	43	42	42	39	35	32	28	24	19
50	49	49	48	48	47	47	46	45	45	44	41	38	35	31	28	23

- Use the hygrometer to get the Dry Bulb and the Wet Bulb Temperature. Example, Dry Bulb = 30°C, Wet Bulb = 28°C.
- Subtract the Wet Bulb temperature from the Dry Bulb temperature. Example, 30°C – 28°C = 2°C.
- Find the column for 2°C across the top of the chart. Locate 30°C in the Air Temperature column at the left side of the chart. Find the intersection of the column and row to get the Dew Point Temperature. For the example of 2°C and 30°C, the Dew Point Temperature is 27°C.
- Divide 27°C by 10°C = 2.7 X 1000 m = 2700 m (the altitude of the bottom of the clouds)

2.6 Heat Stress Index tells you the sensible temperature due to a combination of high temperature and humidity. This is the temperature people "feel". It is not the same as the air temperature indicated by the thermometer. This is a measure of discomfort using the Air (Dry Bulb) temperature (Line 2.1), the Relative Humidity (Line 2.4), and the Heat Stress Index (H.S.I.) Chart.

2. Temperature / Relative Humidity	2.1	Air (Dry bulb)	Thermometer in shade; 1.5 m above ground	°C	°C	°C
	2.2	Wet Bulb		°C	°C	°C
	2.3	Difference	Subtract 2.2 from 2.1;	°C	°C	°C
	2.4	Rel. Humidity	Use 2.1, 2.3; R H Table	%RH	%RH	%RH
	2.5	Dew Point	Use 2.1, 2.3; Dew Pt Table	°C	°C	°C
	2.6	Heat Stress	Use 2.1, 2.4 ; HSI Table	Heat Stress °C	Heat Stress °C	Heat Stress °C
			Danger Level (if any from Heat Stress Index table)	□Cautn □Danger	□Cautn □Danger	□Cautn □Danger
	2.7	Wind Chill	Use 2.1, 3.1; Wind Chl Tbl	Wind Chill. °C	Wind Chill. °C	Wind Chill. °C
			Danger Level (if any from Wind Chill chart)	□Trvl Dngr □Frstbte10 □TShltr Dgr □Frstite30 □Frostbite □Frstbte5	□Trvl Dngr □Frstbte10 □TShltr Dgr □Frstite30 □Frostbite □Frstbte5	□Trvl Dngr □Frstbte10 □TShltr Dgr □Frstite30 □Frostbite □Frstbte5

In Thailand, tropical heat and humidity can result in a high risk of various heat related illnesses. Combined with a general shortage of clean drinking water and shelter means many survivors are at risk of dehydration, sun and heat stroke, and even death. Onsite weather reports that provide the Heat Stress Index can help relief organizers set priorities that can save lives.

[**Advisory Note:** During times of danger avoid heavy work between 1100-1500 hrs on sunny days, or plan extra shaded rest and water rations to prevent dehydration.]

Record the H.S.I. temperature in the space provided in the upper part of Line 2.6. Any Danger advisory notice would be indicated by checking the appropriate box in the lower part of Line 2.6.

For example, if the air temperature was 32ºC with a relative humidity of 70%. This is how to use the table:

Step 1. Find the Air temperature in the left-hand column on the chart.

Step 2. Find the Relative Humidity in the top row of the chart.

Step 3. Follow the row for 32ºC until it intercepts the column for 70% Relative Humidity. The sensible temperature is 51 ºC. This means that although the air temperature is 32ºC, people feel as though it were 51 ºC.

Step 4. Look up the warning advisory for the orange color. In this example, this combination of heat and humidity qualifies as a Type III = Danger. The types of heat related illnesses are described in the chart. If there is a Danger level advisory, check the appropriate box in the lower part of Line

Heat Stress Index (Sensible Temperature)

Air Temp	Relative Humidity								
	10%	20%	30%	40%	50%	60%	70%	80%	90%
46°C	44°C	49°C	57°C	66°C					
43°C	41°C	44°C	51°C	58°C	56°C				
41°C	38°C	41°C	45°C	51°C	57°C	65°C			
38°C	35°C	37°C	40°C	43°C	49°C	56°C	62°C		
35°C	32°C	34°C	36°C	38°C	42°C	46°C	51°C	58°C	
32°C	29°C	31°C	32°C	34°C	36°C	38°C	41°C	45°C	50°C
29°C	27°C	28°C	29°C	30°C	31°C	32°C	34°C	36°C	36°C
27°C	24°C	25°C	26°C	26°C	27°C	28°C	29°C	30°C	31°C

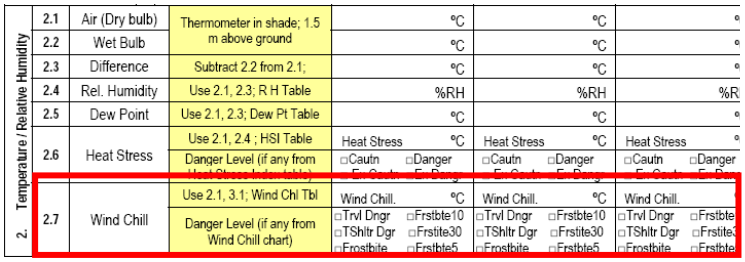
Danger Level	I Caution	II Extreme Caution	III Danger	IV Extreme Danger	---
Heat Index	27-32°C	32-40°C	40-54°C	Above 54°C	Relative humidity rarely observed
Heat Syndrome	Fatigue possible with prolonged exposure and/or physical activity	Sunstroke, heat cramps, or heat exhaustion possible with prolonged exposure and/or physical activity	Sunstroke, heat cramps, or heat exhaustion likely; heat stroke possible with prolonged exposure and/or physical activity	Heat / sunstroke highly likely with continued exposure	Generally not applicable but conditions would be extremely dangerous

- Use a hygrometer placed in a shaded position about 1.2 m / 5 ft above the ground.
- Air Temperature is read from the Dry Bulb Thermometer.
- Relative Humidity is calculated using the Relative Humidity Table. This requires the following data: Air Temperature and the Temperature Difference between the Dry and Wet Bulb readings.

2. Temperature / Relative Humidity	2.1	Air (Dry bulb)	Thermometer in shade; 1.5 m above ground	°C	°C	°C
	2.2	Wet Bulb		°C	°C	°C
	2.3	Difference	Subtract 2.2 from 2.1;	°C	°C	°C
	2.4	Rel. Humidity	Use 2.1, 2.3; R H Table	%RH	%RH	%RH
	2.5	Dew Point	Use 2.1, 2.3; Dew Pt Table	°C	°C	°C
	2.6	Heat Stress	Use 2.1, 2.4 ; HSI Table	Heat Stress °C	Heat Stress °C	Heat Stress °C
			Danger Level (if any from Heat Stress Index table)	□Cautn □Danger	□Cautn □Danger	□Cautn □Danger
	2.7	Wind Chill	Use 2.1, 3.1; Wind Chl Tbl	Wind Chill. °C	Wind Chill. °C	Wind Chill. °C
			Danger Level (if any from Wind Chill chart)	□Trvl Dngr □Frstbte10 □TShltr Dgr □Frstite30 □Frostbite □Frstbte5	□Trvl Dngr □Frstbte10 □TShltr Dgr □Frstite30 □Frostbite □Frstbte5	□Trvl Dngr □Frstbte10 □TShltr Dgr □Frstite30 □Frostbite □Frstbte5

2.6. This should be reported to the authorities so they can consider this in their disaster relief planning efforts.

2.7 Wind Chill Temperature tells you the sensible temperature due to low Air temperatures and High wind speeds. This combination makes people feel colder than the measured temperature.



2. Temperature / Relative Humidity	2.1	Air (Dry bulb)	Thermometer in shade; 1.5 m above ground	°C	°C	°
	2.2	Wet Bulb		°C	°C	°
	2.3	Difference	Subtract 2.2 from 2.1;	°C	°C	°
	2.4	Rel. Humidity	Use 2.1, 2.3; R H Table	%RH	%RH	%R
	2.5	Dew Point	Use 2.1, 2.3; Dew Pt Table	°C	°C	°
	2.6	Heat Stress	Use 2.1, 2.4 ; HSI Table	Heat Stress °C	Heat Stress °C	Heat Stress °
			Danger Level (if any from Heat Stress Index table)	□Cautn □Danger	□Cautn □Danger	□Cautn □Danger
	2.7	Wind Chill	Use 2.1, 3.1; Wind Chl Tbl	Wind Chill. °C	Wind Chill. °C	Wind Chill.
			Danger Level (if any from Wind Chill chart)	□Trvl Dngr □Frstbte10 □TShltr Dgr □Frstite30 □Frostbite □Frstbte5	□Trvl Dngr □Frstbte10 □TShltr Dgr □Frstite30 □Frostbite □Frstbte5	□Trvl Dngr □Frstbte □TShltr Dgr □Frstite3 □Frostbite □Frstbte

At first glance, it seems this condition is inconsistent with the humid tropics. However, on mountains and places with higher elevations, winds can be rather strong. And as you increase your altitude, temperature decreases. So while injuries due to extreme cold may not occur, survivor discomfort when faced with shortages of clothing and shelter can be increased.

Most concern about wind chill deals with the extreme low temperatures associated with frostbite. The table calculations are for conditions of 5ºC or less. For the tropics, the concern would be the cooling effect of the wind under conditions of high humidity and the fragile condition of survivors. They may have little or no shelter, bedding, or clothing. In some situations, the cooling effect of the wind may be welcomed. In other circumstances, the cooling effect may bring added discomfort and suffering for the weak and injured. Although this table may not directly apply in the tropics, it is included in case other volunteers in Southeast Asia (or the world) may need it for their locations.

To determine the Wind Chill sensible temperature, you will need the Air (Dry Bulb) temperature from Line 2.1, the Wind Speed from Line 3.1, and the Wind Chill chart. [**Note:** Details on measuring wind speed will be presented in the Section 3 of this handbook.]

For example, at a temperature of -5 ºC and a wind speed of 35 km/h, find the Wind Chill.

Step 1. Find the Wind speed in the left column.

Step 2. Find the air temperature across the row.

Step 3. Find the intercept of the row and column (-14 ºC). This means a person would feel the temperature was -14 ºC and not the -5 ºC showing on the thermometer. Record the temperature in the space provided in the upper part of Line 2.1.

Step 4. Look at the color coded notes for warnings. If any, check the appropriate box in the lower part of Line 2.1.

Wind Chill

Wind Velocity (km/h) \ Measured Air Temperature (°C)	0	5	0	-5	-10	-15	-20	-25	-30	-35	-40
0	5	4	-2	-7	-13	-19	-24	-30	-36	-41	-47
5	10	3	-3	-9	-15	-21	-27	-33	-39	-45	-51
10	15	2	-4	-11	-17	-23	-29	-35	-41	-48	-54
15	20	1	-5	-12	-18	-24	-31	-37	-43	-49	-56
20	25	1	-6	-12	-19	-25	-32	-38	-45	-51	-57
25	30	0	-7	-13	-20	-26	-33	-39	-46	-52	-59
30	35	0	-7	-14	-20	-27	-33	-40	-47	-53	-60
35	40	-1	-7	-14	-21	-27	-34	-41	-48	-54	-61
40	45	-1	-8	-15	-21	-28	-35	-42	-48	-55	-62
45	50	-1	-8	-15	-22	-29	-35	-42	-49	-56	-63
50	55	-2	-9	-15	-22	-29	-36	-43	-50	-57	-63
55	60	-2	-9	-16	-23	-30	-37	-43	-50	-57	-64
60	65	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65
65	70	-2	-9	-16	-23	-30	-37	-44	-51	-59	-66
70	75	-3	-10	-17	-24	-31	-38	-45	-52	-59	-66
75	80	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67

Travel can be dangerous
Use heated vehicles; temporary shelters unsuitable and dangerous.
Frostbite in 30 minutes
Starts danger of frostbite and possible death.
Frost-bite in 10 minutes
Frostbite within 5 minutes
Adapted by G.K. Lee for RTC-TH M.E.W.S.

Heat Stress Index (Sensible Temperature)

Air Temp	Relative Humidity								
	10%	20%	30%	40%	50%	60%	70%	80%	90%
46°C	44°C	49°C	57°C	66°C					
43°C	41°C	44°C	51°C	58°C	56°C				
41°C	38°C	41°C	45°C	51°C	57°C	65°C			
38°C	35°C	37°C	40°C	43°C	49°C	56°C	62°C		
35°C	32°C	34°C	36°C	38°C	42°C	46°C	51°C	58°C	
32°C	29°C	31°C	32°C	34°C	36°C	38°C	41°C	45°C	50°C
29°C	27°C	28°C	29°C	30°C	31°C	32°C	34°C	36°C	36°C
27°C	24°C	25°C	26°C	26°C	27°C	28°C	29°C	30°C	31°C

Danger Level	I Caution	II Extreme Caution	III Danger	IV Extreme Danger	---
Heat Index	27-32°C	32-40°C	40-54°C	Above 54°C	Relative humidity rarely observed
Heat Syndrome	Fatigue possible with prolonged exposure and/or physical activity	Sunstroke, heat cramps, or heat exhaustion possible with prolonged exposure and/or physical activity	Sunstroke, heat cramps, or heat exhaustion likely; heat stroke possible with prolonged exposure and/or physical activity	Heat / sunstroke highly likely with continued exposure	Generally not applicable but conditions would be extremely dangerous

- Use a hygrometer placed in a shaded position about 1.2 m / 5 ft above the ground.
- Air Temperature is read from the Dry Bulb Thermometer.
- Relative Humidity is calculated using the Relative Humidity Table. This requires the following data: Air Temperature and the Temperature Difference between the Dry and Wet Bulb readings.

Wind Chill

Wind Velocity (km/h)	Measured Air Temperature (°C)										
	0	5	0	-5	-10	-15	-20	-25	-30	-35	-40
	5	4	-2	-7	-13	-19	-24	-30	-36	-41	-47
	10	3	-3	-9	-15	-21	-27	-33	-39	-45	-51
	15	2	-4	-11	-17	-23	-29	-35	-41	-48	-54
	20	1	-5	-12	-18	-24	-31	-37	-43	-49	-56
	25	1	-6	-12	-19	-25	-32	-38	-45	-51	-57
	30	0	-7	-13	-20	-26	-33	-39	-46	-52	-59
	35	0	-7	-14	-20	-27	-33	-40	-47	-53	-60
	40	-1	-7	-14	-21	-27	-34	-41	-48	-54	-61
	45	-1	-8	-15	-21	-28	-35	-42	-48	-55	-62
	50	-1	-8	-15	-22	-29	-35	-42	-49	-56	-63
	55	-2	-9	-15	-22	-29	-36	-43	-50	-57	-63
	60	-2	-9	-16	-23	-30	-37	-43	-50	-57	-64
	65	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65
	70	-2	-9	-16	-23	-30	-37	-44	-51	-59	-66
	75	-3	-10	-17	-24	-31	-38	-45	-52	-59	-66
	80	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67

Travel can be dangerous

Use heated vehicles; temporary shelters unsuitable and dangerous.

Frostbite in 30 minutes

Starts danger of frostbite and possible death.

Frost-bite in 10 minutes

Frostbite within 5 minutes

Adapted by G.K. Lee for RTC-TH M.E.W.S.

3.0 Wind Speed / Direction

3.1 Wind Speed can be determined indirectly by observing its effects on the environment or directly using wind meters / gauges. Wind speed observations should be done in clear open areas away from tall buildings or trees. Winds are not always steady and constant. So Line 3.1 has space for recording steady winds and gusts. For steady winds, try to make 3 observations, then average them before recording and reporting the wind speed.

3. Wind Speed / Direction		Report wind speed in **knots to air crews**; km/h to all others.														
	3.1	Average	Get 3 readings & average	km/h		knts		km/h		knts		km/h		knts		
		Gusts	Record highest gust	km/h		knts		km/h		knts		km/h		knts		
		Wind Speed Guidelines for Helicopter Flight Operations														
		10 knots / 18.5 km/h ideal; OK to fly						Above 45 knots / 83 km/h; No flights.								
		Gusts above 20 knots/ 37 km/h; No flights						Max tailwind 5 knots/ 6 km/hr; No take off								
	3.2	Steady Wind Direction	Circle direction steady **wind comes FROM**	N	NE	S	SW	N	NE	S	SW	N	NE	S	SW	
				E	SE	W	NW	E	SE	W	NW	E	SE	W	NW	
		Variable Wind Direction	Circle 1 or more directions **wind comes FROM**	N	NE	S	SW	N	NE	S	SW	N	NE	S	SW	
				E	SE	W	NW	E	SE	W	NW	E	SE	W	NW	

Gusts may be sudden and infrequent. But if gusty conditions persist, try to get an idea of the "average" but air crews should be advised of the maximum gust you observed. In that case, report maximum gusts to "__" knots, averaging "__" knots.

Estimating the wind speed visually requires using the Beaufort Scale for wind effects on land. To use the chart:

Step 1. Look around for signs of the wind.
Step 2. Look at the left column and find the description that fits what you see.

Step 3. Read across the row to the column for km/h and knots. Record the estimated wind speed in the space provided in Line 3.1. [**Note:** Report wind speeds in knots to air crews.]

The chart and weather observation log have been annotated with reminders of wind speeds affecting helicopter flight operations. When wind speeds approach these advisory levels you should report the advisory to air crews immediately.

Direct measurement of wind speed is done using a wind gauge or meter.

Beaufort Wind Table for Land Effects

MEWS weather observers should set up a flag near their operating position. Use the Description and flag references to estimate the wind speed. Report the range of wind speeds from the chart rather than a specific number.

Description	Flag	WMO term	Mph	Km/ hr	Knots	Force	Psu lbs/sq ft (Kg/sq m)
			Report wind speed in knots to flight crews				
Calm; smoke rises vertically	---	Calm	<1.0	<1.5	<0.9	0	0.006266 (0.003059)
Smoke indicates wind; flag hangs limp, wind vanes do not move		Light Air	1-3	1.5-6	1-3	1	0.02924 (.01428)
Wind felt on face, leaves rustle, flag stirs, wind vanes move		Light breeze	4-7	6-12	4-6	2	0.142 (0.6934)
		5 Knots maximum tailwind for helicopter take-off					
Leaves and twigs in constant motion; flag occasionally extends		Gentle Breeze	8-12	12-20	7-10	3	0.3759 (1.835)
		10 Knots ideal for helicopter flight operations					
Dust and paper fly; small branches move; Flag flaps		Mild Breeze	13-18	21-29	11-16	4	0.8145 (3.977)
small leafy trees begin to sway; white crested wavelets appear on lakes/ponds; Flag ripples		Fresh Breeze	19-24	30-39	17-21	5	1.504 (7.342)
		20 Knots maximum gusts for helicopter flight operations					
Large branches move; wires whistle; umbrellas hard to use; Flag snaps		Strong Breeze	25-31	40-50	22-27	6	2.485 (12.13)
Whole trees sway; hard to walk; Flag extended		Near Gale	32-38	51-61	28-33	7	3.822 (18.66)
Twigs and small branches broken; cars veer on roads; Flag tatters		Gale	39-46	62-74	34-40	8	5.597 (27.33)
Slight structural damage occurs (roof shingles blow off)		Strong Gale	47-54	75-87	41-47	9	7.769 (37.93)
		45 Knots maximum winds for helicopter flight operations					
Trees broken or uprooted, considerable damage to buildings		Storm	55-63	88-101	48-55	10	10.53 (51.39)
Wide spread damage caused	---	Violent Storm	64-72	02-114	56-63	11	13.78 (67.3)
	---	Hurricane	>73	>115	>63	12	>13.78 (>67.3)

Disclaimer: Use of the pressure data to calculate tower/antenna wind loads is at your own risk. The RTC-TH and HSØZHM assume no liability for the use of this data. Pressure values are the upper limits for a wind category.

Dwyer wind gauge

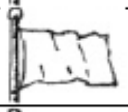
Kestrel 3500 pocket weather station

Fully integrated field weaterh station sensor array

Wind gauges or gauges can be small hand held devices or more complete weather station units. Some are marked in units of mph while others can be set for various units. Report all wind speeds to air crews as "knots" to make it easier for them to use.

Beaufort Wind Table for Land Effects

MEWS weather observers should set up a flag near their operating position. Use the Description and flag references to estimate the wind speed. Report the range of wind speeds from the chart rather than a specific number.

Description	Flag	WMO term	Mph	Km/ hr	Knots	Force	Psu lbs/sq ft (Kg/sq m)
			Report wind speed in knots to flight crews				
Calm; smoke rises vertically	---	Calm	<1.0	<1.5	<0.9	0	0.006266 (0.003059)
Smoke indicates wind; flag hangs limp, wind vanes do not move		Light Air	1-3	1.5-6	1-3	1	0.02924 (.01428)
Wind felt on face, leaves rustle, flag stirs, wind vanes move		Light breeze	4-7	6-12	4-6	2	0.142 (0.6934)
		5 Knots maximum tailwind for helicopter take-off					
Leaves and twigs in constant motion; flag occasionally extends		Gentle Breeze	8-12	12-20	7-10	3	0.3759 (1.835)
		10 Knots ideal for helicopter flight operations					
Dust and paper fly; small branches move; Flag flaps		Mild Breeze	13-18	21-29	11-16	4	0.8145 (3.977)
small leafy trees begin to sway; white crested wavelets appear on lakes/ponds; Flag ripples		Fresh Breeze	19-24	30-39	17-21	5	1.504 (7.342)
		20 Knots maximum gusts for helicopter flight operations					
Large branches move; wires whistle; umbrellas hard to use; Flag snaps		Strong Breeze	25-31	40-50	22-27	6	2.485 (12.13)
Whole trees sway; hard to walk; Flag extended		Near Gale	32-38	51-61	28-33	7	3.822 (18.66)
Twigs and small branches broken; cars veer on roads; Flag tatters		Gale	39-46	62-74	34-40	8	5.597 (27.33)
Slight structural damage occurs (roof shingles blow off)		Strong Gale	47-54	75-87	41-47	9	7.769 (37.93)
		45 Knots maximum winds for helicopter flight operations					
Trees broken or uprooted, considerable damage to buildings		Storm	55-63	88-101	48-55	10	10.53 (51.39)
Wide spread damage caused	---	Violent Storm	64-72	02-114	56-63	11	13.78 (67.3)
	---	Hurricane	>73	>115	>63	12	>13.78 (>67.3)

Disclaimer: Use of the pressure data to calculate tower/antenna wind loads is at your own risk. The RTC-TH and HSØZHM assume no liability for the use of this data. Pressure values are the upper limits for a wind category.

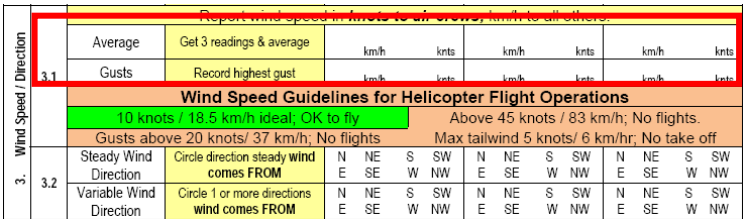
To use a handheld unit, follow the instructions for the particular unit. In general:

Step 1. Stand in an open area away from tall buildings and trees. Also: A) open area with clear overhead air circulation; B) keep a distance 4 X the height of nearby objects; C) 33 m away from paved roads; and D) be surrounded by natural ground cover typical of your area. Hold the unit above your head and watch the indicator.

- If the wind speed readings are fairly consistent, the winds are steady. If the readings jump around, the wind speed is variable.
- Variable wind speeds could be associated with gusts.

Note: For the Dwyer wind gauge we have is marked in miles per hour (mph). The readings need to be converted using a reference table (see below). This wind gauge has 2 scales, Lo (2-10 mph) and Hi (4-66 mph). To decide which scale to use, watch the white indicator ball in the central tube. If it is below 10 mph, use the Lo scale. If above 10 mph, use the Hi scale. To shift to the Hi scale, place a finger over the red tube at the top of the instrument.

Step 2. Record the measured wind speed. Repeat Step 1 until you have 3 measurements.



3. Wind Speed / Direction																
			Report wind speed in **knots to air crews;** km/h to all others.													
	3.1	Average	Get 3 readings & average	km/h		knts		km/h		knts		km/h		knts		
		Gusts	Record highest gust	km/h		knts		km/h		knts		km/h		knts		
		Wind Speed Guidelines for Helicopter Flight Operations														
		10 knots / 18.5 km/h ideal; OK to fly						Above 45 knots / 83 km/h; No flights.								
		Gusts above 20 knots/ 37 km/h; No flights						Max tailwind 5 knots/ 6 km/hr; No take off								
	3.2	Steady Wind Direction	Circle direction steady **wind comes FROM**	N E	NE SE	S W	SW NW	N E	NE SE	S W	SW NW	N E	NE SE	S W	SW NW	
		Variable Wind Direction	Circle 1 or more directions **wind comes FROM**	N E	NE SE	S W	SW NW	N E	NE SE	S W	SW NW	N E	NE SE	S W	SW NW	

Step 3. Average the 3 readings and record the average wind speed in the space provided on Line 3.1.

Step 4. Use the conversion table below to record the wind speed in both knots and km/h in Section 3.1 of the MEWS Log form. Use the upper line in Section 3.1 for regular winds. Use the lower line to record Gusts.

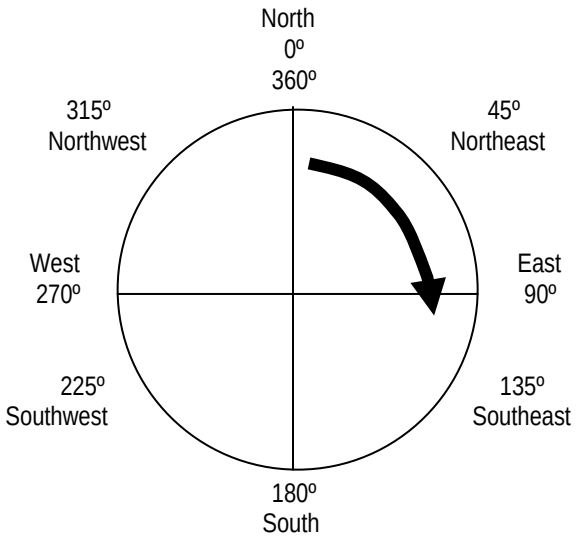
Step 5. ***Issue a Flight Advisory if any wind speeds or gusts are near, at, or above the limits indicated on the MEWS Log form.*** If operating / supporting a helicopter landing zone, advise officials immediately.

Wind Speed Conversion Table									
mph	km/h	knots		mph	km/h	knots		mph	km/h	knots
1	1.61	0.869		9	14.48	7.821		45	71.42	39.10
2	3.22	1.738		10	16.09	8.69		50	80.47	43.45
3	4.83	2.607		15	24.14	13.03		55	88.51	47.79
4	6.44	3.476		20	32.19	17.38		60	96.56	52.14
5	8.05	4.345		25	40.23	21.72		65	104.60	56.48
6	9.66	5.214		30	48.28	26.07		70	112.70	60.83
7	11.27	6.083		35	56.33	30.41		75	120.70	65.17
8	12.87	6.592		40	64.37	34.76		80	128.70	69.52
Report wind speeds in knots to air crews.										
Wind Speed Guidelines for Helicopter Flight Operations										
10 knots / 18.5 km/h ideal; OK to fly							Above 45 knots / 83 km/h; No Flights			
Gusts above 20 knots / 37 km/h; No Flights							Max tailwind 5 knots / 6 km/h; No take off.			
Advise air crews when wind velocities approach guideline limits.										

3.2 Wind Direction: The wind can also come from a steady direction or be highly variable. Winds are named based on the direction FROM which they come. If you are familiar with the area, you may know the basic directions (e.g. north, south, east, and west). However, if operating in an unfamiliar area, using a magnetic compass is helpful. Pictured below are some examples of compasses you might find in stores.

To measure the wind direction, see the steps in the diagram below. This also shows the convention matching direction names with azimuth numbers.

MEASURING WIND DIRECTION



Imagine you are standing in the middle of the circle in the picture on the left.

Step 1. Stand facing the wind (looking into the direction from which the wind is blowing).

Step 2. Aim the magnetic compass directly into the wind, but keep the compass level so the needle swings freely.

Step 3. Read off the azimuth angle in degrees ranging from 0º (starting at North) going clockwise around the circle or report the general name (e.g. North, Northeast, etc.)

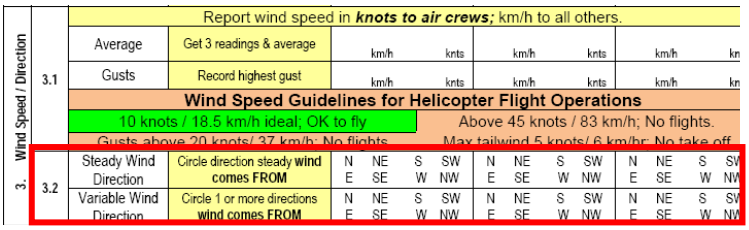
Step 4. Change the azimuth number into the name of the direction using the table below. Ultra precision is not needed. The general direction is good enough. Record the data in Line 3.2 by circling the appropriate direction in the "steady" or "variable" section.

It's probably best to report wind directions using the terms North, Northeast, etc. rather than magnetic azimuth numbers. The terms are more general. An azimuth number may imply precision which may or may not exist.

Note: And to keep things simple, we haven't talked about correcting for magnetic declination or determining local magnetic anomalies that can distort magnetic compass readings. The magnetic declination for most of Nan Province is less than 1°. Most consumer grade magnetic compasses readily available to MEWS volunteers have scale markings in 2° to 5° increments. This makes it impossible to accurately correct for magnetic declination to convert magnetic azimuths to True North readings.

The compass on the left appears to be "better" than the one on the right. However, both are fairly general in terms of their scale markings. For the compass on the left, the smallest azimuth increment is 2º, and about 9º for the compass on the right. You cannot get very precise measurements with these compasses.

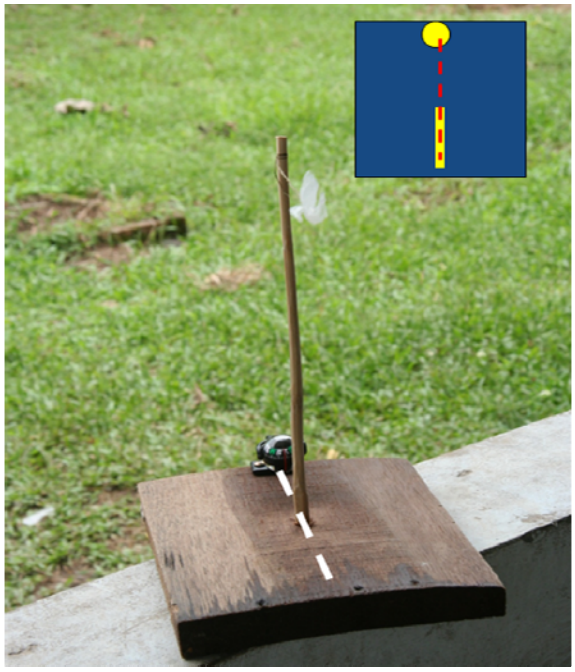
Record the wind direction by circling the appropriate letters in Section 3.2 on the MEWS Log form. Use the upper line for steady winds. Use the lower line for variable winds and gusts.



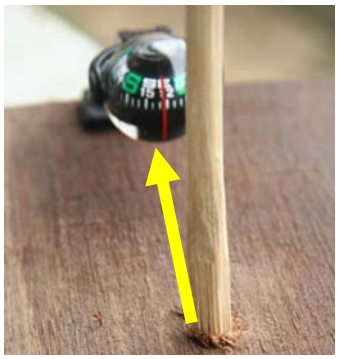
3. Wind Speed / Direction																				
		Report wind speed in ***knots to air crews;*** km/h to all others.																		
	3.1	Average	Get 3 readings & average	km/h		knts		km/h		knts		km/h		kn						
		Gusts	Record highest gust	km/h		knts		km/h		knts		km/h		kn						
		Wind Speed Guidelines for Helicopter Flight Operations																		
		10 knots / 18.5 km/h ideal; OK to fly										Above 45 knots / 83 km/h; No flights.								
		Gusts above 20 knots/ 37 km/h: No flights										Max tailwind 5 knots/ 6 km/hr: No take off								
	3.2	Steady Wind Direction	Circle direction steady **wind comes FROM**	N	NE	S	SW	N	NE	S	SW	N	NE	S	SW					
				E	SE	W	NW	E	SE	W	NW	E	SE	W	NW					
		Variable Wind Direction	Circle 1 or more directions **wind comes FROM**	N	NE	S	SW	N	NE	S	SW	N	NE	S	SW					
				E	SE	W	NW	E	SE	W	NW	E	SE	W	NW					

Using a Wind Tell-Tail to Measure Wind Direction: You can find information about making a wind tell-tail at www.neighborhoodlink.com/RTC-TH_Tech/pages . Scroll down the left column to the section "RTC-TH REEEPP at Na Fa Elementary School", and look for the PDF title "2005 W-3 Wind Direction."

Set the tell-tail in an open area.



Turn the unit until the tell-tail lines up with the axis

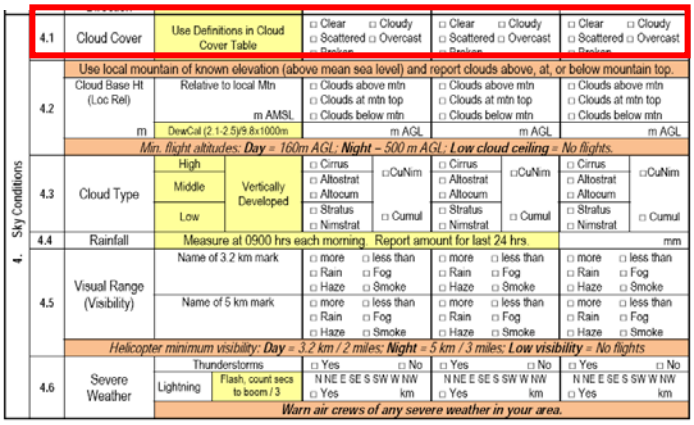


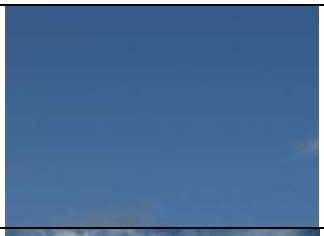
The magnetic compass is aligned with the post forming the sighting axis. The Tell-tail string is tied to the top of the post. The wind blows the tell-tail. You turn the compass/post base board until the tell-tail lines up with the sighting axis. Then you read off the magnetic compass direction and record it on the MEWS Log form in Section 3.2.

You can use a similar technique with a flag on a flag pole. But in that case, you move to align yourself with the axis of the flag and the flag pole. Aim the compass IN the direction of the wind and take the compass reading. Remember, winds are named for the direction FROM which they come. So if you are facing NE, the wind is called a NE wind.

4.0 Sky Conditions

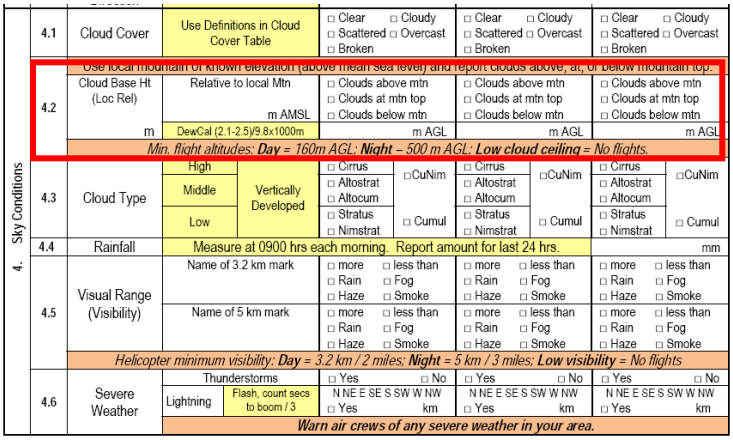
4.1 Cloud Cover: Look at the relative amount of clouds in the sky dome overhead. You try to describe how much of the dome is covered with clouds. This is not the same as looking off in one direction and describing the cloud cover. The photos at the right cannot show the "dome" view but notice the relative amounts of cloud to blue sky. Check the box for the best term that matches what you see.



Sky Condition: Cloud Cover Terms	
Clear Sky is blue with no clouds or very few small clouds.	
Scattered Sky is blue, but small patches of clouds are present.	
Broken Large patches of clouds, but patches of blue sky can be seen between the clouds.	
Cloudy The sky is covered mostly with clouds and a few blue patches.	
Overcast Clouds cover the sky; no patches of blue can be seen.	

4.2 Cloud Base Height (Ceiling) is the distance from the ground to the bottom of the lowest layer of clouds. Report this in meters above ground level (m AGL). There are two ways to estimate the cloud base height.

The first method is to get the cloud base height generally by the altitude of the cloud ID (see the chart in Section 4.3.

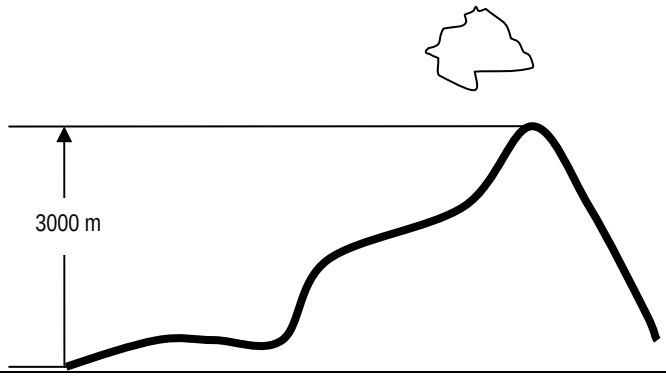


4. Sky Conditions						
4.1	Cloud Cover	Use Definitions in Cloud Cover Table	□ Clear □ Cloudy □ Scattered □ Overcast □ Broken	□ Clear □ Cloudy □ Scattered □ Overcast □ Broken	□ Clear □ Cloudy □ Scattered □ Overcast □ Broken
	Use local mountain of known elevation (above mean sea level) and report clouds above, at, or below mountain top.				
4.2	Cloud Base Ht (Loc Rel)	Relative to local Mtn	□ Clouds above mtn □ Clouds at mtn top □ Clouds below mtn	□ Clouds above mtn □ Clouds at mtn top □ Clouds below mtn	□ Clouds above mtn □ Clouds at mtn top □ Clouds below mtn
	m	m AMSL	m AGL	m AGL	m AGL
		DewCal (2.1-2.5)/9.8x1000m			
	Min. flight altitudes: **Day** = 160m AGL; **Night** – 500 m AGL; **Low cloud ceiling** = No flights.				
4.3	Cloud Type	High	□ Cirrus □ Altostrat □ Altocum	□ Cirrus □ Altostrat □ Altocum	□ Cirrus □ Altostrat □ Altocum
		Middle			
		Low	□ Stratus □ Nimstrat	□ Stratus □ Nimstrat	□ Stratus □ Nimstrat
		Vertically Developed	□ CuNim □ Cumul	□ CuNim □ Cumul	□ CuNim □ Cumul
4.4	Rainfall	Measure at 0900 hrs each morning. Report amount for last 24 hrs.			mm
4.5	Visual Range (Visibility)	Name of 3.2 km mark	□ more □ less than □ Rain □ Fog □ Haze □ Smoke	□ more □ less than □ Rain □ Fog □ Haze □ Smoke	□ more □ less than □ Rain □ Fog □ Haze □ Smoke
		Name of 5 km mark	□ more □ less than □ Rain □ Fog □ Haze □ Smoke	□ more □ less than □ Rain □ Fog □ Haze □ Smoke	□ more □ less than □ Rain □ Fog □ Haze □ Smoke
	Helicopter minimum visibility: **Day** = 3.2 km / 2 miles; **Night** = 5 km / 3 miles; **Low visibility** = No flights				
4.6	Severe Weather	Thunderstorms	□ Yes □ No	□ Yes □ No	□ Yes □ No
		Lightning / Flash, count secs to boom / 3	N NE E SE S SW W NW □ Yes km	N NE E SE S SW W NW □ Yes km	N NE E SE S SW W NW □ Yes km
	Warn air crews of any severe weather in your area.				

4.21 Relative to a local mountain of known elevation. Then you can say the clouds are above, below, or at the same height as the peak of the mountain. This is not very precise, but 1) this gives air crews a general idea of the ceiling conditions; 2) it can help them to avoid flying into the mountains; 3) the sky is very dynamic variable that reporting a specific altitude number is not always that useful.

Cloud Base Height Relative to a Local Mountain Top

When using a local mountain as a visual reference for relative cloud base height, be sure to give the name of the mountain and its peak elevation above mean sea level. Write this is the space provided in the upper part of Section 4.2 on the form. It is also helpful to know the distance and direction from the LZ (landing zone) to the mountain.

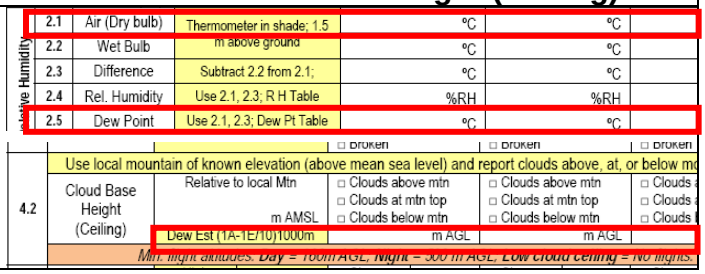


If you have hills or mountains nearby, find out their height. Report the cloud height relative to the mountain top. For example, if the mountain top was at 300 m above sea level, the cloud height would be more than 300 m.

4.2.2 Dew Point Method: Advanced MEWS Observers determine the height of the cloud base by making a calculation using the Dew Point Temperature.

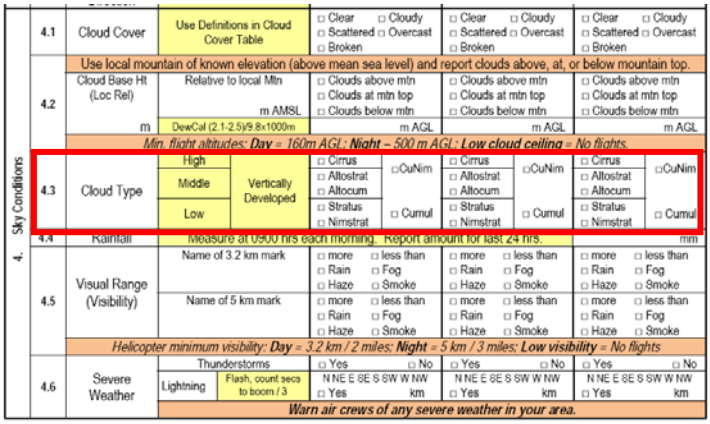
Dew Point Temperature Method to Estimate Cloud Base Height (Ceiling)

Step 1. Get the Air temperature (2.1).
Step 2. Subtract the Dew Point temp (2.5)
Step 3. Divide the remainder by 10.
Step 4. Multiply the quotient by 1000 m.
Step 5. Record the result in the space provided



Relative Humidity					
2.1	Air (Dry bulb)	Thermometer in shade; 1.5 m above ground	°C	°C	
2.2	Wet Bulb		°C	°C	
2.3	Difference	Subtract 2.2 from 2.1;	°C	°C	
2.4	Rel. Humidity	Use 2.1, 2.3; R H Table	%RH	%RH	
2.5	Dew Point	Use 2.1, 2.3; Dew Pt Table	°C	°C	

			□ Broken	□ Broken	□ Broken
	Use local mountain of known elevation (above mean sea level) and report clouds above, at, or below mo				
4.2	Cloud Base Height (Ceiling)	Relative to local Mtn	□ Clouds above mtn □ Clouds at mtn top □ Clouds below mtn	□ Clouds above mtn □ Clouds at mtn top □ Clouds below mtn	□ Clouds □ Clouds □ Clouds
		m AMSL	m AGL	m AGL	
		Dew Est (1A-1E/10)1000m			
	Min. flight altitudes: **Day** = 160m AGL; **Night** – 500 m AGL; **Low cloud ceiling** = No flights.				



The main concern for flight operations is meeting VFR minimums. Issue an advisory any time the cloud base height is below 160 m in the day or 500 m at night.

4.3 Cloud Type: Clouds are named based on the height at which they are found and their general form.

According to height, there are 4 classes of clouds: Low, Middle, High, and Vertically Developed. See the groupings in the chart below.

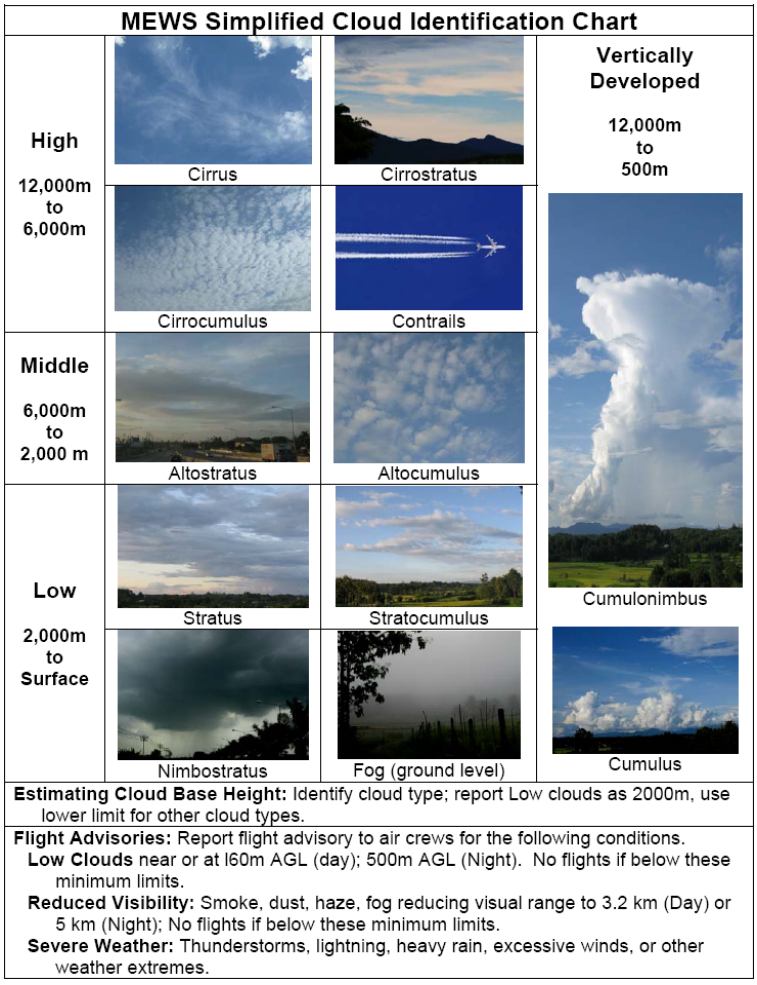
If using the Cloud ID to estimate the height of the cloud base, use the lower altitude number for the cloud group.

When you look into the sky, there may be many different clouds present at the same time. Low and Vertically developed clouds affect helicopter VFR conditions. The main concerns are visibility and turbulence. VFR calls for visibility minimum of 8 km. Rain fall from Middle and Low types of clouds.

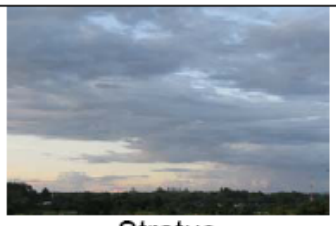
Turbulence is associated with cumulus and cumulonimbus clouds. The later are the famous clouds of thunderstorms and severe weather (which can include lightning and/or hail).

To complete Section 4.3, check the boxes for the types of clouds you see overhead.

Keeping good records of the cloud types can help to predict the weather. Changes in the cloud types can indicate if the weather will change to stormy or sunny conditions. Weather forecasting by this simple method is summarized in an Appendix at the end of this paper and is the subject of Advanced MEWS Lesson 6. MEWS Observers with digital weather stations or barometric units can usually see a display of a forecast graphic icon. All these forecast methods are about 60-70% accurate.



MEWS Simplified Cloud Identification Chart

High **12,000m to 6,000m**	 Cirrus	 Cirrostratus	**Vertically Developed** **12,000m to 500m**
	 Cirrocumulus	 Contrails	
Middle **6,000m to 2,000 m**	 Altostratus	 Altocumulus	
Low **2,000m to Surface**	 Stratus	 Stratocumulus	 Cumulonimbus
	 Nimbostratus	 Fog (ground level)	 Cumulus

Estimating Cloud Base Height: Identify cloud type; report Low clouds as 2000m, use lower limit for other cloud types.

Flight Advisories: Report flight advisory to air crews for the following conditions.

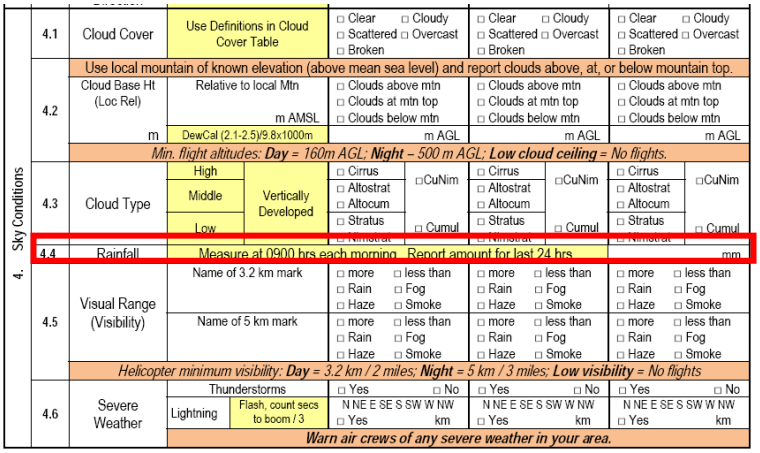
Low Clouds near or at l60m AGL (day); 500m AGL (Night). No flights if below these minimum limits.

Reduced Visibility: Smoke, dust, haze, fog reducing visual range to 3.2 km (Day) or 5 km (Night); No flights if below these minimum limits.

Severe Weather: Thunderstorms, lightning, heavy rain, excessive winds, or other weather extremes.

Code	**Name**	**Cloud Description**	**Altitude**		
			m	ft	
Ci	Cirrus	Delicate, wispy, feathery; streaky, stringy; slow moving; doesn't block the sun; mares tails—large ice crystals extending down	6,000 to 12,000	20,000 to 40,000	**High (Ice)**
Cc	Cirrocumulus	Thin sheets or closely packed small puffs without shadows; "mackerel" sky			
Cs	Cirrostratus	Whitish veil, usually fibrous; makes halo around the sun or moon.			
Ac	Altocumulus	Layer of separate cloud masses; fit closely in geometric pattern; blue sky visible between masses; white or gray on shaded side; associated with bad weather.	2,000 to 6,000	6,500 to 20,000	Middle
As	Altostratus	Extensive, eve, gray layer over entire sky; gray, smooth bottom; sun is a bright spot; associated with bad weather.			
St	Stratus	Dense, dark gray layer; uniform base	Ground to 2,000	Ground to 6,500	Low
Ns	Nimbostratus	Dense, dark gray layer with precipitation (rain or snow); thick enough to block the sun			
Sc	Stratocumulus	Distinct gray masses (long rolls, right angles to the wind and cloud motion) with patches of open sky, flat tops; often associated with fair or clearing weather; but snow flurries or rain are possible from individual cloud masses.			
Cu	Cumulus	White, wooly mass, flat base, lumpy top; gray or dark on shaded side or bottom; small clouds associated with fair weather.	300 to 1,525	1,000 to 5,000	Vertical Dev.
Cb	Cumulonimbus	White, anvil shaped top; very dark base; vertical dimension greater than horizontal; heavy rainfall, thunder, lightning, gusty winds, hail possible; strong updrafts	12, 000 to 300	40,000 to 1,000	

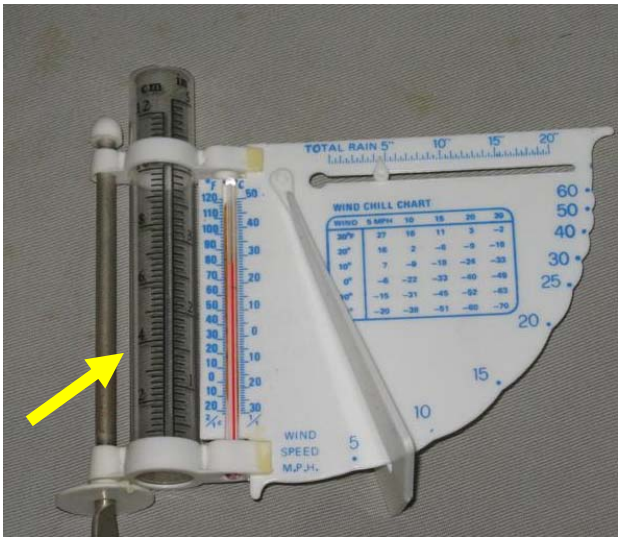
4.4 Rainfall: Rainfall is recorded only 1 time a day (we suggest you do this routinely at 0900 hrs local time). Record the data in Section 4.4 of the MEWS log form.



Rainfall data can be used in a number of ways. It can be used to assess additional flooding potential, and landslide hazards. Increased flash flood risk is associated with heavy rainfall in a short time span (e.g. intense thunderstorm) especially in mountain areas. General flooding can occur with light rains that fall continuously for a few days. This can cause streams, rivers, dams and reservoirs to overflow. Prolonged light rainfall can also saturate soils and increase the chance of landslides. For survivors, rain can mean additional misery and discomfort. But rain can also be a source of much needed drinking water.

[**Note:** When scouting out locations for possible "safe sites", shelter locations, and landing zones, avoid areas likely to flood or be subject to flash floods and landslides.]

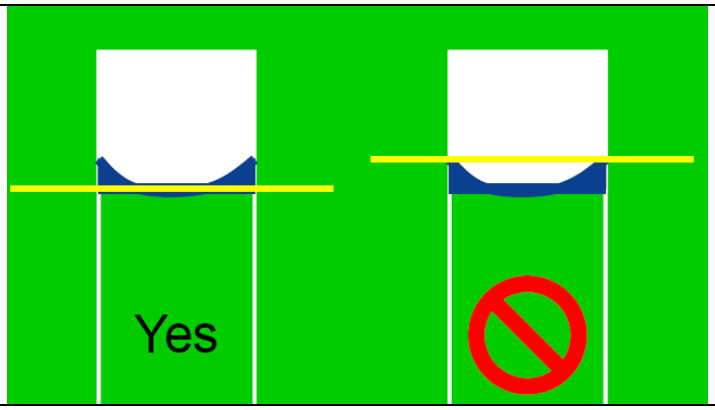
Reading the rain gauge will depend on the rain gauge you are using. The RTC-TH has a consumer grade rain gauge purchased from a garden supply shop and a home-made rain gauge made with PVC pipe. If you have a digital weather station system with a rain gauge, you simply record the station's displayed rainfall measurement.



The rain fall measurement is read directly from the scale.

The rain water is poured into a graduated cylinder for measuring the amount indirectly from the rain gauge.

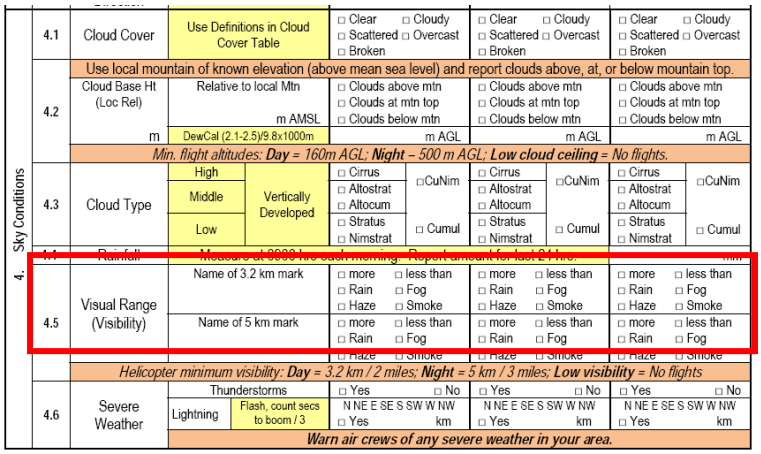
Direct Reading of a Rain Gauge: Reading actual water levels in manual rain gauges (yellow arrow in left photo, above) must be done in a systematic way. Water in the measuring tube does not make a flat even surface. It is slightly curved.

Correct Reading *Read the correct rain fall level where the bottom of the curved water level touches the measurement line on the rain gauge.*		*Incorrect Reading* *Do not read the rain fall level where the upper part of the curved water surface touches the measurement line on the rain gauge.*
The blue is the surface of the water in the rain gauge. The yellow line is the marking on the rain gauge.		

Indirect reading of a rain gauge: First you must empty the rain from the rain gauge into a graduate measuring device. We use a 100 mL graduated cylinder. After reading the water level, we multiply number of milliliters of water by 1000 to get the number of millimeters of rain fall. This is the number to write in Section 4.4 on the MEWS Log form.

4.5 Visual Range (Visibility):

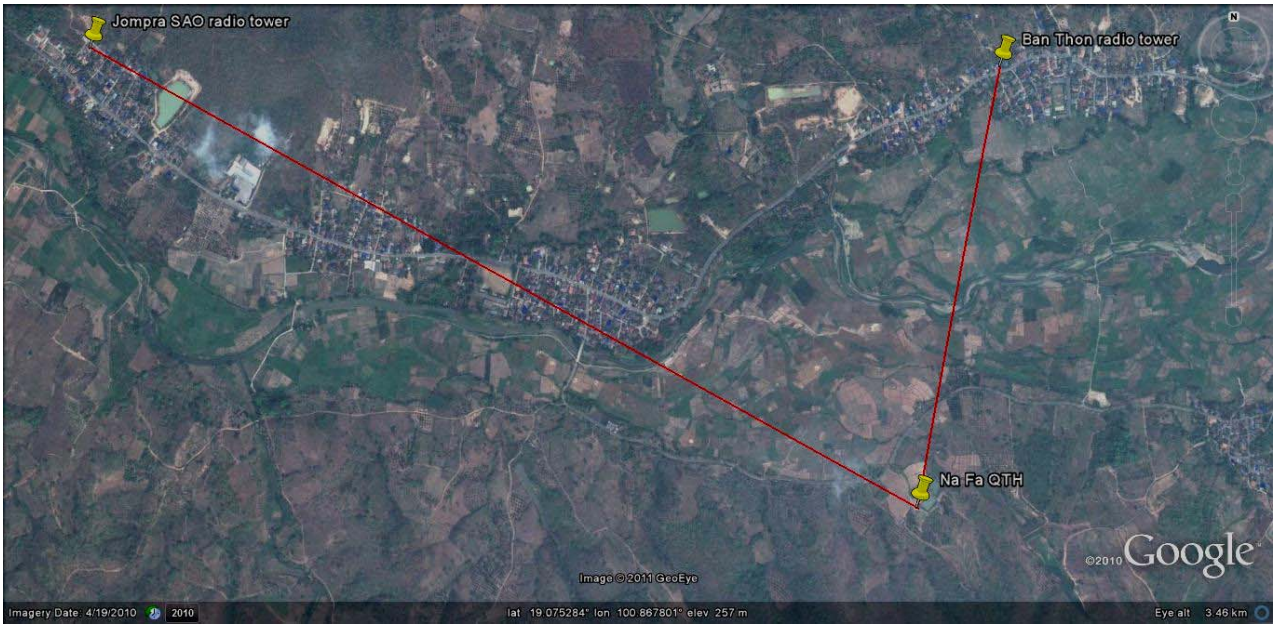
This is easiest done from maps. If you cannot get topographic maps of your area, try searching the internet or use Goggle Maps. The visual ranges we are concerned about are for helicopter VFR minimum conditions: Day 3.2 km; night 5 km.



4. Sky Conditions											
	4.1	Cloud Cover	Use Definitions in Cloud Cover Table		□ Clear □ Cloudy □ Scattered □ Overcast □ Broken		□ Clear □ Cloudy □ Scattered □ Overcast □ Broken		□ Clear □ Cloudy □ Scattered □ Overcast □ Broken	
		Use local mountain of known elevation (above mean sea level) and report clouds above, at, or below mountain top.								
	4.2	Cloud Base Ht (Loc Rel)	Relative to local Mtn	m AMSL	□ Clouds above mtn □ Clouds at mtn top □ Clouds below mtn		□ Clouds above mtn □ Clouds at mtn top □ Clouds below mtn		□ Clouds above mtn □ Clouds at mtn top □ Clouds below mtn	
		m	DewCal (2.1-2.5)/9.8x1000m		m AGL		m AGL		m AGL	
		*Min. flight altitudes: **Day** = 160m AGL; **Night** – 500 m AGL; **Low cloud ceiling** = No flights.*								
	4.3	Cloud Type	High	Vertically Developed	□ Cirrus	□CuNim	□ Cirrus	□CuNim	□ Cirrus	□CuNim
			Middle		□ Altostrat □ Altocum		□ Altostrat □ Altocum		□ Altostrat □ Altocum	
			Low		□ Stratus □ Nimstrat	□ Cumul	□ Stratus □ Nimstrat	□ Cumul	□ Stratus □ Nimstrat	□ Cumul
	4.4	Rainfall	Measure at 0900 hrs each morning. Report amount for last 24 hrs.							mm
	4.5	Visual Range (Visibility)	Name of 3.2 km mark		□ more □ less than □ Rain □ Fog □ Haze □ Smoke		□ more □ less than □ Rain □ Fog □ Haze □ Smoke		□ more □ less than □ Rain □ Fog □ Haze □ Smoke	
			Name of 5 km mark		□ more □ less than □ Rain □ Fog □ Haze □ Smoke		□ more □ less than □ Rain □ Fog □ Haze □ Smoke		□ more □ less than □ Rain □ Fog □ Haze □ Smoke	
		*Helicopter minimum visibility: **Day** = 3.2 km / 2 miles; **Night** = 5 km / 3 miles; **Low visibility** = No flights*								
	4.6	Severe Weather	Thunderstorms		□ Yes □ No		□ Yes □ No		□ Yes □ No	
			Lightning	Flash, count secs to boom / 3	N NE E SE S SW W NW □ Yes km		N NE E SE S SW W NW □ Yes km		N NE E SE S SW W NW □ Yes km	
		Warn air crews of any severe weather in your area.								

First locate your operating position on the map. Then search for key landmarks that are 3.2 m and 5 km away. Ideally this would be readily recognized features: mountain peaks, tall radio towers or buildings. Note their name, coordinates, and for towers, their height above the ground level (AGL). These will be key reference markers for you. When recording the Visual range data, check the box that most closely states the prevailing conditions.

- If you can see the landmark or beyond, check “more.”
- If you cannot see the landmark, check “less.” Then check a box to indicate the most likely reason for the loss of visibility: rain, fog (mist), haze, or smoke.



In this example, two radio towers can be seen from our farm station. We used Google Earth to measure the distances from the farm station to the towers which are our visual range markers.

Other weather characteristics affecting visibility:

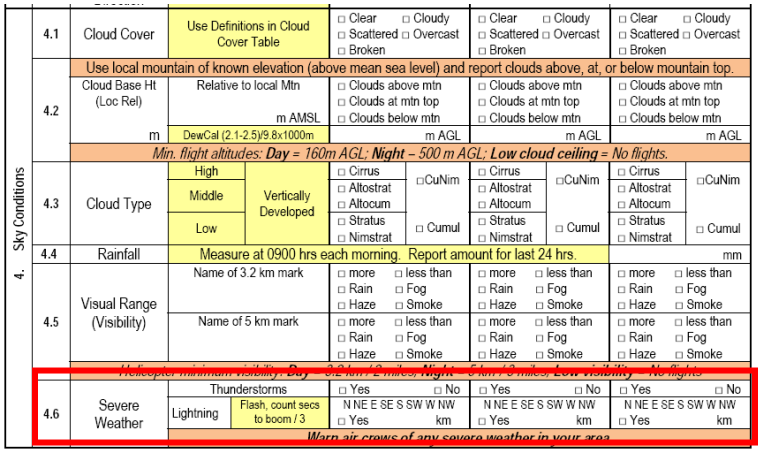
- High relative humidity can add to haze and obscure vision.
- Clouds and rain can limit visibility.
- Low cloud base height: Pilots can see about 1.6 km for every 300 m of altitude. If the cloud base is high, they can see farther than if the cloud base were low.

Weather is dynamic. From the time a helicopter takes off, the weather can be changing. Nan Province is a mountainous region. Weather in mountain areas can change rapid. It is quite possible for a helicopter to take off from an airport with CAVU (ceiling and visibility unlimited) conditions, and en route or at the destination encounter conditions that severely affect VFR conditions. This is why MEWS Observer reports are important for flight operations.

Nan Province has only 3 official government weather stations (Nan Muang 18.76°N, 100.76°E; Thawangpha 19.11°N, 100.8°E, and Tung Chang 19.41°N, 100.88°E). The RTC-TH demonstration farm is about 8-9 km LOS (line of sight) from Thawangpha. But there have been times when heavy rain fell on the farm, yet the Thawangpha station recorded no rain fall that day. This shows how much weather conditions can vary over a short distance.

Disasters can damage or destroy existing weather stations. During an emergency, each MEWS Observer is another "weather station" that increases the number of available weather stations. This can be very helpful to authorities. Pilots will certainly agree that it is better to have more weather stations than less.

4.6 Severe Weather: If a thunderstorm is in the area, check the "Yes" box. If none, check "No". For MEWS observers supporting flight operations, turbulence and lightning are primary concerns. Heavy rain is associated with those, and brings with it reduced visibility and wet landing zones to further slow operations.



Other associated weather conditions are found in

- Section 3.1 Wind Speed:
  - Tail winds (at take off) over 5 knots
  - Gusts over 20 knots
  - Winds over 45 knots
- Section 4.2 Cloud Base Height:
  - Day: ceiling less than 160 m
  - Night: ceiling less than 500 m
- Section 4.3 Cloud Type: Cumulonimbus (Thunderstorm); Nimbostratus (rain clouds)
- Section 4.5 Visual Range:
  - Day: less than 3.2 km
  - Night: less than 5 km

Lightning is of particular concern for MEWS reporting. Lightning poses a life threatening condition for amateur radio operators, their equipment and for flight crews and aircraft.

If you have a lightning detector, be sure it is positioned away from any radio frequency source. Close proximity to RF sources can give false readings. If you do not have a lightning detector, use the "Flash-Boom" method to estimate the distance of the thunderstorm. Once you have a distance to the thunderstorm, write it on the lower line of Section 4.6 on the MEWS Log form.

NOTE: When a thunderstorm is 9.5 km from your position:

- Immediately remove your headset.
- Transmit a message that you need to stop transmitting due to lightning. State what frequency you will resume transmitting when it is safe to do so. (This is about 30 minutes AFTER the last sign of thunder/lightning).
- Shut down your station. Disconnect the coax to the radio and ground the coax to the station bus panel (i.e. the point closest to the main lightning ground rod for the station.
- Seek shelter in an enclosed building with steel frame or a vehicle with the windows rolled up.

Lightning / Thunder (Flash-Boom Method)

Step 1. Watch for lightning flash; count seconds (Time) until hearing the thunderclap.
Step 2. Use the reference table below or divide the Time (in seconds) from Step 1 by:

- 3 to get the distance in kilometers (km)
- 5 to get the distance in miles (mi)

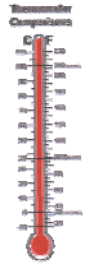
Lightning Hazard: When the flash and thunderclap are almost instantaneous, you may be in trouble. People have been struck by lightning 48+ km away from a thunderstorm, some of them while under clear blue skies!

Report thunderstorms and lightning to all air crews and shut down your station.

# Secs	km	mi	# Secs	km	mi
1	0.33	0.20	11	3.67	2.20
2	0.67	0.40	12	4.00	2.40
3	1.00	0.60	13	4.33	2.60
4	1.33	0.80	14	4.67	2.80
5	1.67	1.00	15	5.00	3.00
6	2.00	1.20	16	5.33	3.20
7	2.33	1.40	17	5.67	3.40
8	2.67	1.60	18	6.00	3.60
9	3.00	1.80	19	6.33	3.80
10	3.33	2.00	20	6.67	4.00

Note 2: Hail is considered to be "precipitation", the broad term for any form of water falling from clouds in the atmosphere. Hail may occur in some very intense thunderstorms. This has occurred in other parts of northern Thailand in recent years. But this is not a common occurrence here. The MEWS Log form doesn't have space to record hail. If hail does occur, make a note of it and immediately issue a flight advisory to report it. If possible, give the diameter size of the hail stones. Use the terms "light" (hail sits on the ground but sparsely covers the ground or melts quickly), "moderate" (hail sits on the ground but seems to cover about half the surface and melts); "heavy" (hail sits on the ground causing it to look mostly white and does melts very slowly).

Appendix 1: Weather Observation Equipment

<table>
<tr><th colspan="3">Observation</th><th colspan="3">Instrument / Reference Chart</th></tr>
<tr><td rowspan="9">Basic Equipment</td><td colspan="2">Temperature</td><td colspan="2">Thermometer
Dual scale (°C / °F) can be helpful in international operations when helicopter pilots coming from different countries.</td><td>   </td></tr>
<tr><td colspan="2">Wind Speed</td><td colspan="2">Use reference chart or wind speed gauge (Use the reference chart to convert mph wind speed values to knots. Air crews usually report wind speed in knots.)</td><td>   </td></tr>
<tr><td colspan="2">Wind Direction</td><td colspan="2">Magnetic compass and reference chart (Keep it simple and report all directions as magnetic to avoid errors when trying to adjust to True North readings.)</td><td>  </td></tr>
<tr><td rowspan="2">Sky Condition</td><td>Cloud Cover</td><td colspan="3">Use reference chart</td></tr>
<tr><td>Cloud Height</td><td colspan="3">Relative to local mountain</td></tr>
<tr><td colspan="2">Rainfall</td><td colspan="2">Medium sized empty glass jar and a ruler</td><td>   </td></tr>
<tr><td colspan="2">Visibility</td><td colspan="3">Relative to a local mountain or object from topographic map</td></tr>
<tr><td colspan="2">Elevation</td><td colspan="3">Topographic map</td></tr>
<tr><td rowspan="3">Advanced Equipment</td><td colspan="2">Relative Humidity</td><td>Hygrometer or dry bulb/wet bulb thermometer</td><td>   </td><td>  </td></tr>
<tr><td rowspan="2">Comfort Temperature</td><td>Heat Stress</td><td colspan="3">Relative humidity and temperature data and reference chart</td></tr>
<tr><td>Wind Chill</td><td colspan="3">Relative humidity and wind speed and reference chart.</td></tr>
</table>

Appendix 2: Weather Forecasting

Clouds of Fair Weather

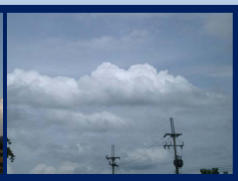
Cumulus clouds

Altocumulus clouds

Cloud Type	Fair Weather
Cumulus	When small and widely scattered
Altocumulus	Settled weather conditions

Rainy Weather Clouds

Cumulonimbus



Cumulus

Nimbostratus

Stratocumulus

Stratus

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Cloud Type	Rainy Weather
Cumulonimbus	Rain, lightning, thunder, heavy rain, hail possible.
Cumulus	Rain possible especially on hot summer days and when clouds get thick and dark
Nimbostratus	Rainstorm likely when dark gray clouds are low and widely cover the sky; drizzly rain.
Stratocumulus	When wide spread possible drizzly rain.
Stratus	Drizzly rain when clouds stretched out widely in calm flat layers.

Darker clouds are thicker and block more sunlight. Thicker clouds mean more vertical development which could mean more turbulence, rain, lightning, thunder.

Clouds Foretelling Weather Change

Cirrus clouds

Altostratus clouds

Stratus Clouds

Cloud Type	Changing Weather
Cirrus	Storm clouds coming in 24-48 hours
Altostratus	Changing weather is approaching
Stratus	Bad weather is approaching

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Weather Forecasting by Cloud Observation

If the change is from Cumulus to Cirrus type clouds, there may be a change in 24-48 hours to possible stormy or rainy weather.

Cumulus

Cirrus clouds

Cirrostratus

Cirrocumulus

Cloud Feature	Clear / Fair Weather	Changing Weather
4.1 Cloud cover	Decreasing cloudiness	Increasing cloudiness
4.2 Cloud Base Ht	Increasing height	Decreasing height
4.3 Cloud Type	Cumulus	Cirrus Cirrostratus Cirrocumulus

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Weather Forecasting by Cloud Changes

If rain clouds are followed by Cirrus type clouds, fair / clear weather is 24-48 hours away.

Cirrus
Cirrostratus Cirrcumulus

Altocumulus Altostratus Cumulonimbus Nimbostratus

Cloud Feature	Changing Weather	Stormy / Rainy Weather
4.1 Cloud cover	Decreasing cloudiness	Increasing cloudiness
4.2 Cloud Base Ht	Increasing height	Decreasing height
4.3 Cloud Type	Cirrus Cirrostratus Cirrocumulus	Altocumulus Altostratus Cumulonimbus Nimbostratus

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Weather Forecasting by Barometric Pressure Change

Generally, low pressures = foul weather

Generally, high pressures = fair weather

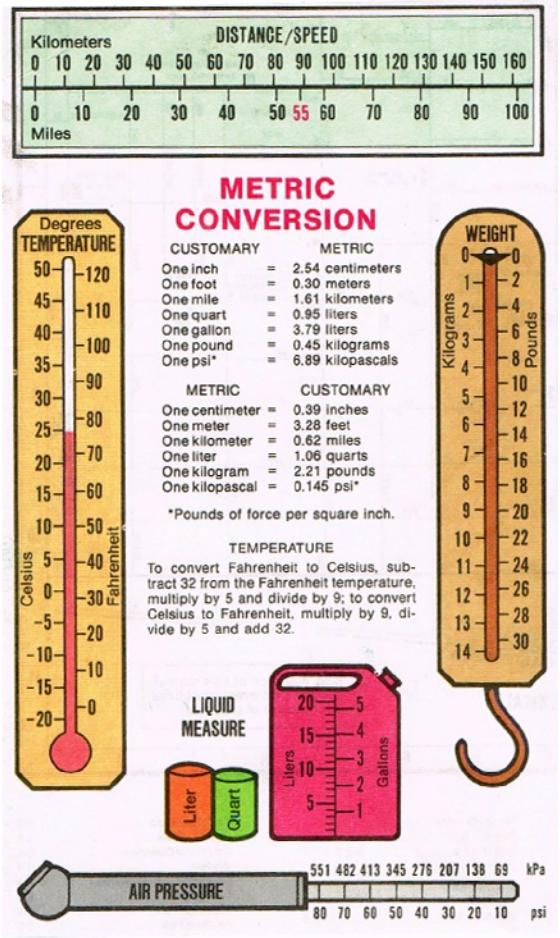
Pressure Trend	Clear / Fair Weather	Changing Weather	Stormy / Rainy Weather
Rising	Fair weather ahead		
Steady		No change from present weather	
Falling			Cloudy/rainy weather ahead

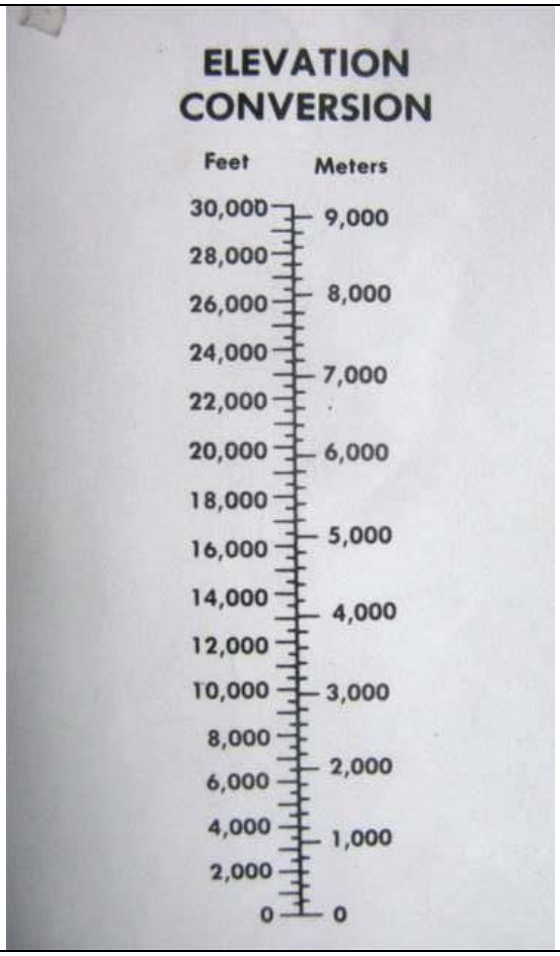
Pressure Change	Descriptive Details
Fast	More than 6 mb change in 3 hours
Moderately	3-6 mb change in 3 hours
Slowly	Less than 3 mb change in 3 hours
Steady	Little or no change

Weather Forecasting by Pressure / Wind Changes

Psu (mb)	Psu Trend	Wind Change	Forecast
1020-1024	Steady	SW to NW	Fair for 1-2 days
	Rising Fast		Fair; warmer temps and rain in 2 days
	Falling Slowly		Warmer with rain 24-36 hrs
	Falling Fast		Warmer with rain 18-24 hrs
1024+	Steady		Continued fair
1024+	Falling Slowly		Slow temp increase; fair for 2 days
1020-1024	Falling Slowly	S to SE	Rain in 24 hrs
	Falling Fast		Increasing winds; rain in 12-24 hrs.
	Falling Slowly	SE to NE	Rain in 18-24 hrs.
	Falling Fast		Increasing winds; rain in 12 hrs
1020 +	Falling Slowly	E to NE	Summer: light wind, no rain for several days. Winter: rain in 24 hrs
	Falling Fast		Summer: rain in 12-24 hrs. Winter: rain; increasing winds from NE
Psu (mb)	**Psu Trend**	**Wind Change**	**Forecast**
1019 or less	Falling Slowly	SE to NE	Rain continues 1-2 days
	Falling Fast		Rain, high winds; clearing in 24 hrs
	Rising Slowly	S to SW	Clearing in a few hrs; continues several days
1009 or less	Falling Fast	S to E	Severe storm; clearing in 24 hrs
	Falling Fast	E to N	Severe storm; cooler temperatures follow
	Rising Fast	Going to W	Clearing; colder temperatures

Appendix 3: Conversion References





Wind Speed Conversion Table									
mph	km/h	knots		mph	km/h	knots		mph	km/h	knots
1	1.61	0.869		9	14.48	7.821		45	71.42	39.10
2	3.22	1.738		10	16.09	8.69		50	80.47	43.45
3	4.83	2.607		15	24.14	13.03		55	88.51	47.79
4	6.44	3.476		20	32.19	17.38		60	96.56	52.14
5	8.05	4.345		25	40.23	21.72		65	104.60	56.48
6	9.66	5.214		30	48.28	26.07		70	112.70	60.83
7	11.27	6.083		35	56.33	30.41		75	120.70	65.17
8	12.87	6.592		40	64.37	34.76		80	128.70	69.52
Report wind speeds in knots to air crews.										
Wind Speed Guidelines for Helicopter Flight Operations										
10 knots / 18.5 km/h ideal; OK to fly								Above 45 knots / 83 km/h; No Flights		
Gusts above 20 knots / 37 km/h; No Flights								Max tailwind 5 knots / 6 km/h; No take off.		
Advise air crews when wind velocities approach guideline limits.										

Appendix 4: Notes on Supporting Flight Operations

Landing Zones (LZ)

Elevation of the Landing Zone: Report the elevation of the landing zone in meters above mean sea level. You will need to get before an emergency by scouting out possible locations using a topographic map or talk with a surveyor or government official to get the elevation information. This is important because helicopters will probably be used in the emergency relief operations. The elevation information is especially important in mountain areas as some helicopters have operational flight altitude limitations, especially when carrying cargo.

Vertical Obstructions: Report all vertical obstruction relative to landing spot. Give detailed description of the type of hazard, height (AGL), distance / azimuth from landing spot (or use "clock" hour positions relative to the landing spot. NOTE: Power and utility wires are very hard to spot from the air (especially at night). If possible, mark the poles with red lights.

General LZ Summary Notes:

<table>
<tr><td rowspan="5">LZ (Landing Zone)</td><td colspan="2">• General LZ about the size of a football field (33 m wide X 100 m long; 100 ft X 300 ft)
• Max slope 7% (1 m up-down / 100 m); firm surface preferred or short grass (<30 cm); helicopter should land heading UPSLOPE.
• Report vertical obstructions by azimuth, distance from LZ center and relative to approach / departure paths; secure all loose debris that can be blown around by rotor wash.
• Describe LZ type (see section below or describe landing surface) by radio if possible
• Approach: give magnetic azimuth inbound and approach path length.
• Depart: give magnetic azimuth outbound and departure path length.
[See notes for details of 1-way and 2-way approach / departure patterns.]</td></tr>
<tr><td rowspan="2">LZ Preparations:</td><td>Day</td><td>• Remove all loose debris that can be blown by rotor wash.
• No tree stumps taller than 12 in / 30 cm; no tall grasses / shrubs</td></tr>
<tr><td>Night</td><td>• Turn off all rotating beacons and strobe lights.
• Red illumination of hazards and 4 corners of the touchdown pad
• If vehicle lights used to illuminate LZ, 2 vehicles, low beams only, aim lights upwind to landing signal officer; opposed 45° angle to for X at landing pad center (120 ft / 40 m). Key is to NOT have lights shining at the pilot when helicopter is approaching, landing, or taking off.</td></tr>
<tr><td rowspan="3">LZ Types</td><td colspan="2">IGE (In Ground Effect): Helicopter is at an altitude below rotor diameter.</td></tr>
<tr><td colspan="2">OGE (Out of Ground Effect): Helicopter is at an altitude above rotor diameter (esp. over tall grass, water, and some types of rough terrain.</td></tr>
<tr><td colspan="2">Hover Hole: Limited landing zone requiring nearly vertical takeoff / landing. Avoid this type of LZ as much as possible.</td></tr>
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