MEWS: Advanced Level Introduction

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Ready to Serve and Sustain Our Community.

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MEWS (Mobile Emergency Weather Stat ion) is an emergency weather observing system operated under the RTC-TH EmComm (Rural Training Center-Thailand Emergency Communications) program. During times of local emergency, MEWS can provide on-scene weather observations and reports to emergency services and disaster relief agencies and responders.

Advanced level observations require additional time, equipment, measurements, and calculations than the Basic MEWS observations. This produces more precise data for the reports. Basic Level MEWS observations are general estimates based mostly on subjective observation with a minimal of measurement to get rapid results under dire circumstances. The table below shows the interrelatedness of the two. ***Note:*** All Advanced MEWS Functions include all the Basic Functions and methods. Advanced MEWS Observers can fall back to Basic methods to at least make a complete Basic report in the event of equipment malfunction.

<table>
<tr><th colspan="4"></th><th>Basic MEWS Functions</th><th colspan="2">Advanced MEWS Functions</th></tr>
<tr><td rowspan="7">2.0 Temperature</td><td>2.1</td><td colspan="2">Air (Dry) Temp</td><td>Thermometer / umbrella</td><td rowspan="2">Hygrometer, sling psychrometer with umbrella, and Ref. tables</td><td rowspan="2">Separate digital thermometer, hygrometer and reference tables</td></tr>
<tr><td>2.2</td><td colspan="2">Wet Bulb</td><td rowspan="6"></td></tr>
<tr><td>2.3</td><td colspan="2">Difference</td><td rowspan="5" colspan="2">or integrated digital weather station (pocket or table top unit; stationary or portable)</td></tr>
<tr><td>2.4</td><td colspan="2">Rel. Humidity</td></tr>
<tr><td>2.5</td><td colspan="2">Dew Point Temp</td></tr>
<tr><td>2.6</td><td colspan="2">Heat Stress Index</td></tr>
<tr><td>2.7</td><td colspan="2">Wind-chill Index</td></tr>
<tr><td rowspan="3">3.0 Wind</td><td rowspan="2">3.1</td><td rowspan="2">Speed</td><td>Average</td><td rowspan="2">Estimate using Beaufort Wind chart (optional flag)</td><td colspan="2" rowspan="3">Kestrel pocket weather station with wind vane or using magnetic compass and separate wind vane.</td></tr>
<tr><td>Gusts</td></tr>
<tr><td>3.2</td><td>Direction</td><td>Steady
Variable</td><td>Measure with magnetic compass and flag or facing into the wind</td></tr>
<tr><td rowspan="7">4.0 Sky Conditions</td><td>4.1</td><td colspan="2">Cloud Cover</td><td colspan="3">Estimate visually and using the Cloud Cover descriptive terms</td></tr>
<tr><td>4.2</td><td colspan="2">Cloud Base Ht</td><td>Estimate relative to local mountain or by cloud chart height by type</td><td colspan="2">Calculate by Dew Point Temperature method</td></tr>
<tr><td>4.3</td><td colspan="2">Cloud type</td><td colspan="3">Visually identify clouds using the Cloud ID reference chart</td></tr>
<tr><td>4.4</td><td colspan="2">Rainfall</td><td></td><td colspan="2">Measure using rain gauge</td></tr>
<tr><td>4.5</td><td colspan="2">Visual Range</td><td colspan="3">Use topographic map to locate/scale off local landmarks relative to operating site or helicopter landing zone</td></tr>
<tr><td rowspan="2">4.6</td><td rowspan="2" colspan="2">Severe Weather</td><td colspan="3">Systematic observation of local skies.</td></tr>
<tr><td>“Flash to Boom” storm distance estimate</td><td colspan="2">Lightning detector to determine distance to storm</td></tr>
</table>

The equipment can be carried in a backpack enabling transport to the site by foot, bicycle, motor bike or other means. Some of the equipment uses internal battery power and is relatively portable (though not all equipment is intended for outdoor use). Spare

batteries add to weight and bulk which would increase backpack weight. ***Note***: As in many outdoor activities, a "buddy" system is highly recommended. It is often best to work in 2-person teams rather than to work alone. It is standard operating procedure to inform others of where you plan to go and when you plan to return, and possible alternative routes/places you would use for emergencies. Ideally, a MEWS would be done by a 2-person team (a MEWS Observer and an amateur radio operator).

Advanced MEWS measurements require additional equipment to get the critical measurements to enhance the Basic MEWS functions. The summary table below shows the critical measurements and the equipment choices. Weather forecasting is "easy" with digital weather devices. But like the simple methods described in the Advanced MEWS lessons, these types of forecasts are only about 60% "accurate." There is a joke going around that being a weather announcer is one of the few jobs in the world where you can be wrong half the time and not get fired. ***Note:*** All Advanced MEWS Observers are expected to have mastered the Basic MEWS level skills. This ensures that MEWS Observations can continue if advanced equipment fails.

<table>
<tr><td colspan="4"></td><td colspan="2">Advanced MEWS Possible Equipment Choices</td></tr>
<tr><td rowspan="9">2.0 Temperature</td><td>2.1</td><td colspan="2">Air (Dry) Temp</td><td rowspan="7">Hygrometer ,sling psychrometer and reference tables</td><td rowspan="10">Separate digital thermometer, hygrometer or integrated digital weather station (pocket or table top unit; stationary or portable), Kestrel pocket weather station with wind vane or using magnetic compass and separate wind vane.</td></tr>
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Variable</td><td>Wind vane, wind streamer, magnetic compass</td></tr>
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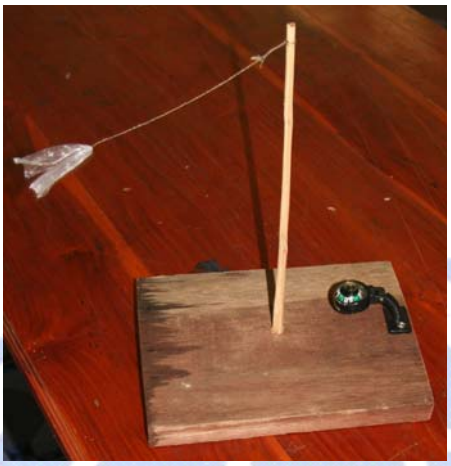
Some of weather equipment can be made. "Home brewing" is long-standing tradition in amateur radio. Some volunteers may already have some items of equipment or may choose to buy them. Striving to keep MEWS "no cost / low cost" is a way to encourage more people to get involved. The more MEWS observers you have in an area, the better a chances of having some in position should an emergency arise. This is the strength of amateur radio operators who step forward in times of need. It is unlikely that any one disaster will disable all of the potential amateur radio stations.

Some of the RTC-TH "home brewed" weather equipment is shown (below). Instructions to make these are included as "Addenda" to the MEWS lessons. A search of the internet may provide you with many other low-cost alternatives. The key goal is to obtain consistently repeatable measurements. Remember, weather is a 3-D

Wind vane on Sparky's roof



Wind Tell-Tail with magnetic compass

phenomenon of varying areal extent. MEWS Observers are at a single surface location. This represents a solitary sampling point locked in time. This perspective limits our data and perception of the environment. Pilots fly in 3-dimensional space in a dynamic atmosphere. They are keenly aware of the limitations of the data we provide. But our data means they won't be going into a totally unknown situation, especially when flying to unfamiliar places and landing zones.

Purchasing equipment doesn't have to be expensive. Some items can be found in discount stores, auto supply stores and garden supply shops. Whenever possible go for non-electronic analog systems. Think in terms of avoiding fragile systems to reduce the risk of damage when going to the field. Some devices and instruments have glass parts. Think about cases / packing to protect them during transport, storage, and use.

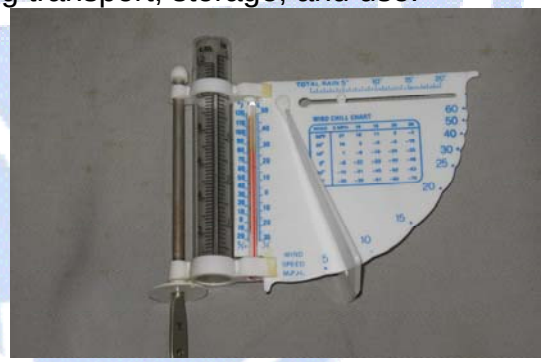
Rain gauge

wind streamer

But also think of spare parts and backup systems in case they get damaged in the field.

These analog weather instruments all have glass parts. The analog weather station has a thermometer, barometer, and hygrometer. The Taylor hygrometer has both a dry and a wet bulb thermometer and psychometric table for relative humidity. The sling psychrometer is similarly equipped but is

Dwyer wind gauge



This combination outdoor weather station was found in a garden supply shop for under $10. It has a rain gauge, wind speed/ direction indicator, thermometer and wind-chill chart.

Altimaster II barometric altimeter

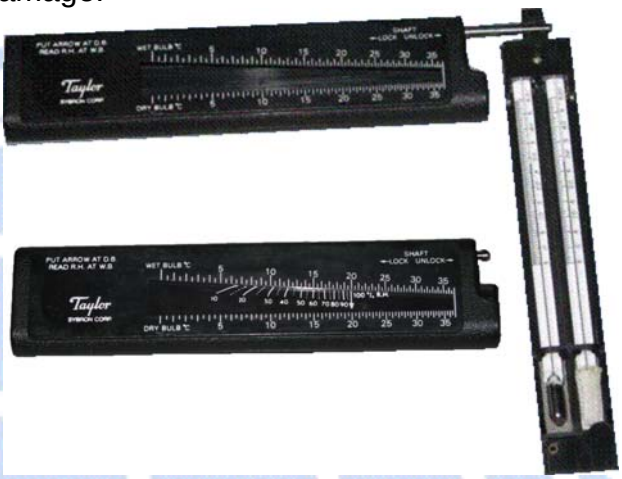
Airguide (automobile) altimeter

Strike Alert lightning detector

intended for field use. I have used it in the field for over 10 years and haven't had a mishap with it yet. Select analog equipment carefully and consider your field set up. For example, in pedestrian, bicycle, motorbike mobile modes, we use the sling psychrometer. In Sparky, Sam, or at base camp or stations, the hygrometer is in a more stable environment with less risk of damage.

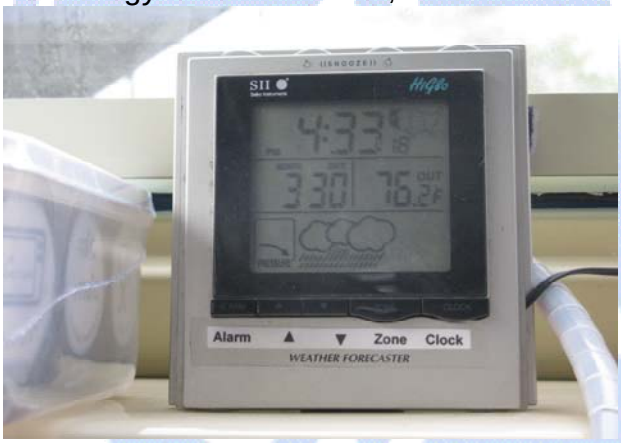
Analog weather station

Taylor hygrometer



Taylor sling psychrometer (closed and extended)

Just like ham radio equipment, the sky's the limit when it comes to the higher end technology. But remember, it doesn't have to be expensive to be effective. Some key



Seiko Weather Forecaster II

SpeedTech electronic barometer / weather forecaster

Kestrel 4500NV pocket weather station with wind vane

GPS unit is an easy way to get accurate date/time, latitude, longitude, and azimuth data. (Elevation is given, but is not very reliable)

Considerations are power supply. Most digital electronic units use internal batteries. This is great for portability. But try to avoid "exotic" gum pack or coin batteries which may be hard to find in disaster areas. The most widely available batteries are AA. And of course, be sure to have a supply of spare batteries on hand for all of these devices. [Note: Many digital barometers often need 24-hours to stabilize after being moved several km from their initial operating position. Readings taken prior to this may be unreliable. During the "stabilization" period, we monitor atmospheric pressure changes by using our altimeter or an analog barometer. A key feature of digital barometers and weather stations is the "forecast icon". Though only about 60-70% accurate, it works automatically and saves us time.]

For any purchased equipment, we strongly suggest keeping a copy of the instruction manual handy in the field. Be aware that digital weather equipment are not created equal. Therefore not all procedures to operate the equipment will be the same. To reduce weight, consider making a summary card for critical procedure. A challenge we have with digital equipment is the tendency to set and forget. So like taxes, we don't do it that often, so it's easy to forget. The alternatives are frequent practice or "cheat sheet" reminders….or both. In the RTC-TH community-based education system, we use "Teach backs" as pragmatic proficiency tests and as practical training and review. Each person trained in a MEWS topic is expected to share it and teach it to at least 4 other individuals. (Note: Contact us at hs0zhm@gmail.com and ask about the RTC-TH Community-based education methods and our Self-Study Guide.)

As a last resort, all Advanced Level MEWS Observers would be able to fall back on the Basic Level MEWS protocols to continue gathering and reporting MEWS data to relief officials.

Recommended optional equipment is listed below. If possible, include these in your Advanced MEWS kit as standard.

Optional Equipment include an umbrella, a flag or wind streamer, local area topgraphic maps and binoculars

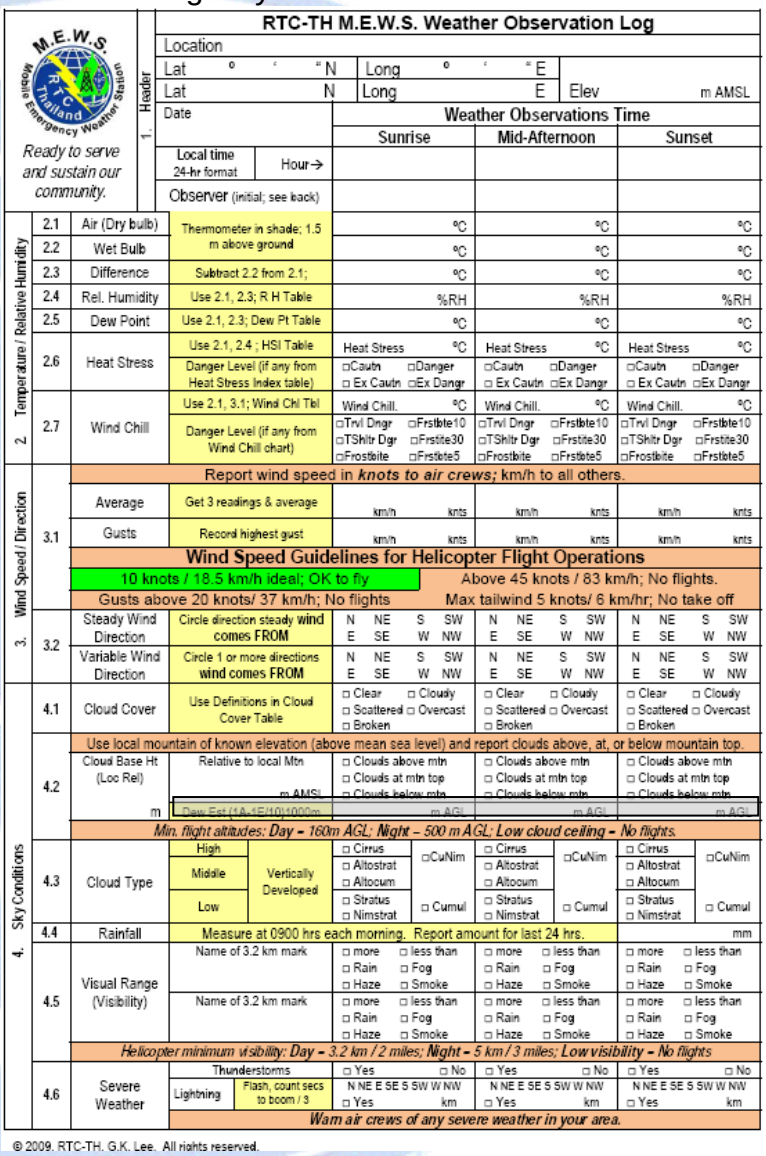
It is important for all volunteers to understand their families and property are secure BEFORE going to the aid of others. If you and your family are not safe, you are not in a good position to try to help others. When you are able to get on the scene, you need to be sure you are prepared, equipped, and provisioned so you don't become burden to the survivors or the relief workers. Supplies of just about everything are usually in short supply in a disaster area. Think about how long you can operate with the supplies you bring with you. This would be your commitment duration before needing to be re-supplied. This is why we tend to suggest focusing on your local community first and foremost. You are close to home and can get resupplied easier. If an emergency

affects your community, the disaster may be all around you. As a MEWS Observer, you ARE on scene even by staying home. So don't feel awkward about not being fully mobile or unable to pack up and travel to a disaster site to serve. Weather reports from nearby areas unaffected by the immediate emergency are just as important. Relief workers and supplies need to transit the adjacent areas. Evacuees and survivors may seek safety in those areas. In an emergency, the authorities need to know the situation and resources available to respond to the emergency.

So these are the Advanced MEWS observations:

- Measured temperatures (dry buld, wet bulb)
- Calculated temperatures (Dew Point, Heat Stress, Windchill)
- Measured Wind speed
- Measured Wind direction
- Estimated Cloud cover
- Calculated Cloud-base height using Dew Point Temperature
- Cloud type Identification
- Estimated Visual Range
- Severe Storms (measured distance to storm via lightning detector.

Unlike the Basic MEWS observations, these require additional equipment and calculations. These observations do not replace standard aviation weather stations and observers. In many disasters, there may be no weather reports available inside the disaster zone. So although these observations are subjective, the weather data can be useful for air crews and for emergency relief planning and coordination.



M.E.W.S. Mobile Emergency Weather Station — RTC Thailand

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

Local time 24-hr format Hour→

Observer (initial; see back)

				Weather Observations Time: Sunrise	Mid-Afternoon	Sunset
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 □Frstbite5	□Trvl Dngr □Frstbite10 □TShltr Dgr □Frstbite30 □Frostbite □Frstbite5	□Trvl Dngr □Frstbite10 □TShltr Dgr □Frstbite30 □Frostbite □Frstbite5
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 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	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			
			Dew Est (1A-1E/4)*1000=	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 / Middle / Low — Vertically Developed	□ Cirrus □ Altostrat □ Altocum □ Stratus □ Nimstrat □ Cumul □CuNim	□ Cirrus □ Altostrat □ Altocum □ Stratus □ Nimstrat □ Cumul □CuNim	□ Cirrus □ Altostrat □ Altocum □ Stratus □ Nimstrat □ Cumul □CuNim
	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 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
		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.				

The Observation form is designed as a teaching aid and guides the observer as to how to make the observations. With a minimum amount of training (~2-3 hours), Basic MEWS observers can be ready to work. The ideal situation is tohave 2 Hams (licensed amateur radio operator) trained for Basic MEWS duties. Alternatively, a MEWS observer could team up with an amateur radio operator.

MEWS training is available to any interested community volunteer free of charge.

There is no minimum age requirement. The training can be done in small groups or over the internet (e.g. via email, Skype, or EchoLink) or on the air with Hams. Materials can be downloaded and printed. There are 6 Advanced MEWS lessons in PDF slide shows so learners can work at their own pace. Observers would print their own supply of forms or keep notes on plain paper referencing the data block numbers on the standard MEWS form.

The reference tables are included in the various individual lessons and in the MEWS Weather Observer Handbook. Volunteers are expected to provide all of their own equipment. Practice can be done at home just looking out the window.

Temperature measurements are made with a thermometer in the shade. In an emergency, use an umbrella for shade.

Advanced MEWS observations can be taught to school children. This would be an excellent application of the basic math and science they learn in the classroom. Home-bound volunteers can also make observations from the comfort of their home. Thus, a wide range of volunteers can be recruited from the community and contribute to providing valuable service in times of an emergency. For school children, the added benefit is the opportunity to actively contribute to their community. This could be a first step to a future job.

To begin the Advanced MEWS training, complete or review the Basic MEWS lessons. Then send an email request to hs0zhm@gmail.com with the phrase "Advanced MEWS training" in the subject line. We will contact you and help get you started.