

U.S. DEPARTMENT OF COMMERCE / National Oceanic and Atmospheric Administration

FEDERAL COORDINATOR FOR  
METEOROLOGICAL SERVICES  
AND SUPPORTING RESEARCH



# National Hurricane Operations Plan

FCM-P12-1984

Washington, D.C.  
May 1984



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NATIONAL HURRICANE OPERATIONS PLAN

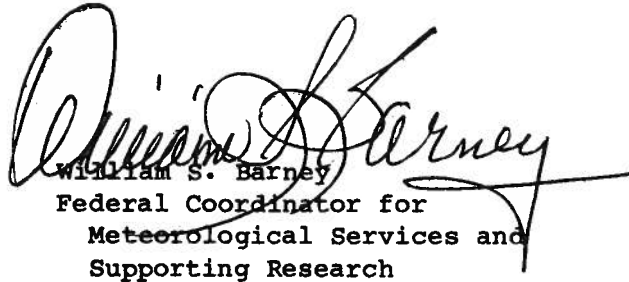
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## FOREWORD

An Interdepartmental Plan was first issued in 1962. This document is the 22nd edition and presents procedures and agreements reached at the 38th annual Interdepartmental Hurricane Conference held at the USAF Conference Center, Homestead Air Force Base, Florida, 24-26 January 1984.

The Conference is sponsored annually by the Committee for Basic Services, Interdepartmental Committee For Meteorological Services and Supporting Research, and brings together cognizant Federal agencies to achieve agreement on items of mutual concern related to hurricane warning services. The host this year for the Conference was the Air Weather Service of the Military Airlift Command, United States Air Force.



William S. Barney  
Federal Coordinator for  
Meteorological Services and  
Supporting Research

NATIONAL HURRICANE OPERATIONS PLAN

(ATLANTIC, EASTERN PACIFIC, AND CENTRAL PACIFIC)

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CHANGE LOG

Change No.	Page Numbers	Date Posted	Signature
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## CHAPTER 1

### INTRODUCTION

1. Introduction. The Hurricane Warning Service is an interdepartmental effort to provide the Nation and designated international recipients with environmental data, forecasts, and assessments concerning tropical and subtropical weather systems. Interdepartmental cooperation achieves economy and efficiency in the operation of the Hurricane Warning Service. This plan provides the basis for implementing the agreements of the Department of Commerce (DOC), Department of Defense (DOD), and the Department of Transportation (DOT) reached at the annual Interdepartmental Hurricane Conference (combined Atlantic and Pacific). It is the 22nd edition of the National Hurricane Operations Plan (first issued in 1962). The Hurricane Conference is sponsored by the

Subcommittee on Basic Services, Interdepartmental Committee for Meteorological Services and Supporting Research, to bring together cognizant Federal agencies and achieve agreement on items of mutual concern related to the Atlantic and Pacific hurricane warning services.

#### 2. Terms used in this Plan:

a. Center Fix. The location of the center of a tropical or subtropical cyclone obtained by means other than reconnaissance aircraft penetration.

b. Cyclone. An atmospheric closed-circulation rotating counterclockwise in the Northern Hemisphere.

c. Eye. The relatively calm center of a tropical cyclone which is more than 1/2 surrounded by wall cloud.

d. Hurricane Season. The portion of the year having a relatively high incidence of hurricanes. In the Atlantic, Caribbean, and Gulf of Mexico, this is the period from June through November; in the eastern Pacific June through November 15; and in the central Pacific the period from June through October.

e. Hurricane Warning Offices (HWO). The designated hurricane warning offices are: the National Hurricane Center, Miami, Florida; the Eastern Pacific Hurricane Center, Redwood City, California; the Central Pacific Hurricane Center, Honolulu, Hawaii and the Weather Service Forecast Offices at San Juan, Puerto Rico; New Orleans, Louisiana; Washington, D.C.; Los Angeles, California; Boston, Massachusetts.

f. Hurricane Warning. A warning that sustained winds of 74 miles an hour (64 knots) or higher associated with a hurricane are expected in a specified coastal area in 24 hours or less. A hurricane warning can remain in effect when dangerously high water or a combination of dangerously high water and exceptionally high waves continue, even though winds may be less than hurricane force.

g. Hurricane Watch. An announcement for specific areas that a hurricane or an incipient hurricane condition poses a possible threat to coastal areas generally within 36 hours.

h. Miles. The term "miles" used in this Plan refers to nautical miles unless otherwise indicated.

i. Mission Identifier. The nomenclature assigned to tropical and subtropical cyclone aircraft reconnaissance missions for weather data identification. It comprises an agency - aircraft indicator followed by a Chief, Aerial Reconnaissance Coordination, All Hurricanes (CARCAH) assigned mission-system indicator.

j. Present Movement. The best estimate of the movement of the center of a tropical cyclone at a given time and at a given position. This estimate does not reflect the short-period, small-scale oscillations of the cyclone center.

k. Reconnaissance Aircraft Sortie. A flight which meets the requirements of the tropical cyclone plan of the day (TCPOD).

l. Relocated. A term used in an advisory to indicate that a vector drawn from the preceding advisory position to the latest known position is not necessarily a reasonable representation of the cyclone's movement.

m. Storm Surge. The height difference between the observed level of sea water and the level of sea water that would have occurred in the absence of the storm.

n. Storm Tide. The actual level of sea water resulting from the astronomic tide combined with the storm surge.

o. Subtropical Cyclone. A low-pressure system developing over subtropical waters which initially has a non-tropical circulation but some elements of tropical cyclone cloud structure are present.

(1) Subtropical Depression. A subtropical cyclone in which the maximum sustained surface wind (1-minute mean) is 33 knots (38 statute mph) or less.

(2) Subtropical Storm. A subtropical cyclone in which the maximum sustained surface wind (1-minute mean) is 34 knots (39 statute mph) or greater.

p. Tropical Cyclone Plan of the Day. A coordinated mission plan that tasks operational weather reconnaissance requirements during the next 05Z to 05Z day or as required; describes reconnaissance flights committed to satisfy both operational and research requirements; and identifies possible reconnaissance requirements for the succeeding 24-hour period.

q. Tropical Weather Systems:

(1) Tropical Disturbance. A discrete system of apparently organized convection--generally 100 to 300 miles in diameter--originating in the tropics or subtropics, having a nonfrontal migratory character and maintaining its identity for 24 hours or more. It may or may not be associated with a detectable perturbation of the wind field. As such, it is the basic generic designation, which, in successive stages of intensification, may be classified as a tropical wave, depression, storm, or hurricane.

(2) Tropical Wave. A trough or cyclonic curvature maximum in the trade-wind easterlies. The wave may reach maximum amplitude in the lower middle troposphere or may be the reflection of an upper troposphere cold-low or equatorial extension of a middle-latitude trough.

(3) Tropical Cyclone. A nonfrontal low pressure system of synoptic scale developing over tropical or subtropical waters and having a definite organized circulation.

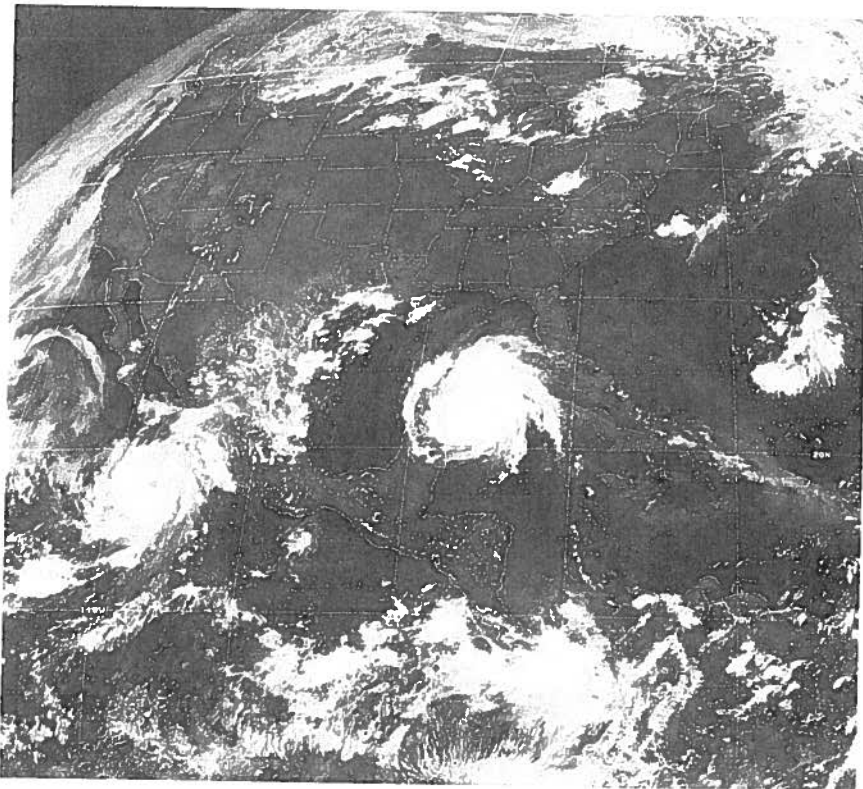
(a) Tropical Depression. A tropical cyclone in which the maximum sustained surface wind (1-minute mean) is 33 knots (38 statute mph) or less.

(b) Tropical Storm. A warm-core tropical cyclone in which the maximum sustained surface wind (1-minute mean) ranges from 34 knots (39 statute mph) to 63 knots (73 statute mph) inclusive.

(c) Hurricane. A warm-core tropical cyclone in which the maximum sustained surface wind (1-minute mean) is 64 knots (74 statute mph) or more.

r. Vortex Fix. The location of the surface and/or flight level center of a tropical or subtropical cyclone obtained by reconnaissance aircraft penetration.

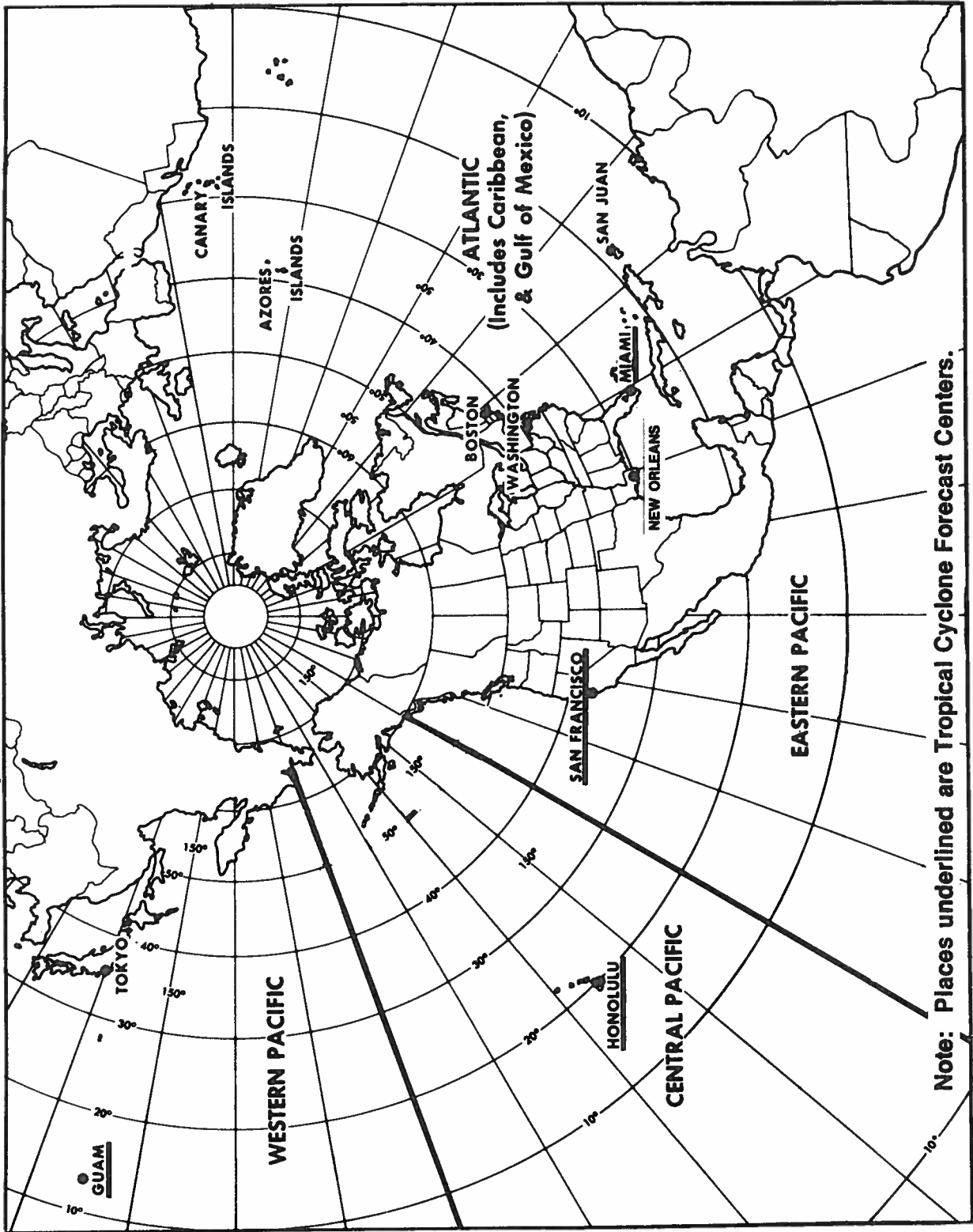
s. Wall Cloud. An organized band of cumuliform clouds immediately surrounding the center of a tropical cyclone. Wall cloud and eye wall are used synonymously.



Hurricane ALLEN in the Gulf of Mexico  
and ISIS in the Eastern Pacific, August 7, 1980

# NATIONAL HURRICANE OPERATIONS PLAN

(AREA OF RESPONSIBILITY)



## CHAPTER 2

### RESPONSIBILITIES OF COOPERATING AGENCIES

#### 1. Department of Commerce (DOC) Responsibilities.

a. Provide timely dissemination of all significant information regarding tropical and subtropical cyclones to appropriate agencies, general public, and marine and aviation interests.

b. Through the National Weather Service (NWS) - consult as necessary with Department of Defense (DOD) regarding day-to-day DOD requirements for cyclone assessments and attempt to meet these requirements within the capabilities of the Hurricane Warning Service; prepare through the National Hurricane Center (NHC) and distribute to DOD the coordinated DOC reconnaissance and other meteorological data requirements to be provided by DOD on tropical/subtropical cyclones and disturbances; provide facilities, administrative support, and dissemination of weather observation data for Operating Location-G (OL-G), Air Weather Service (AWS) as agreed to by DOC and DOD; provide DOD with basic meteorological information, warnings, forecasts, and associated prognostic reasoning concerning location, intensity and forecast movement of tropical and subtropical cyclones in the following maritime areas and adjacent states and possessions of the United States:

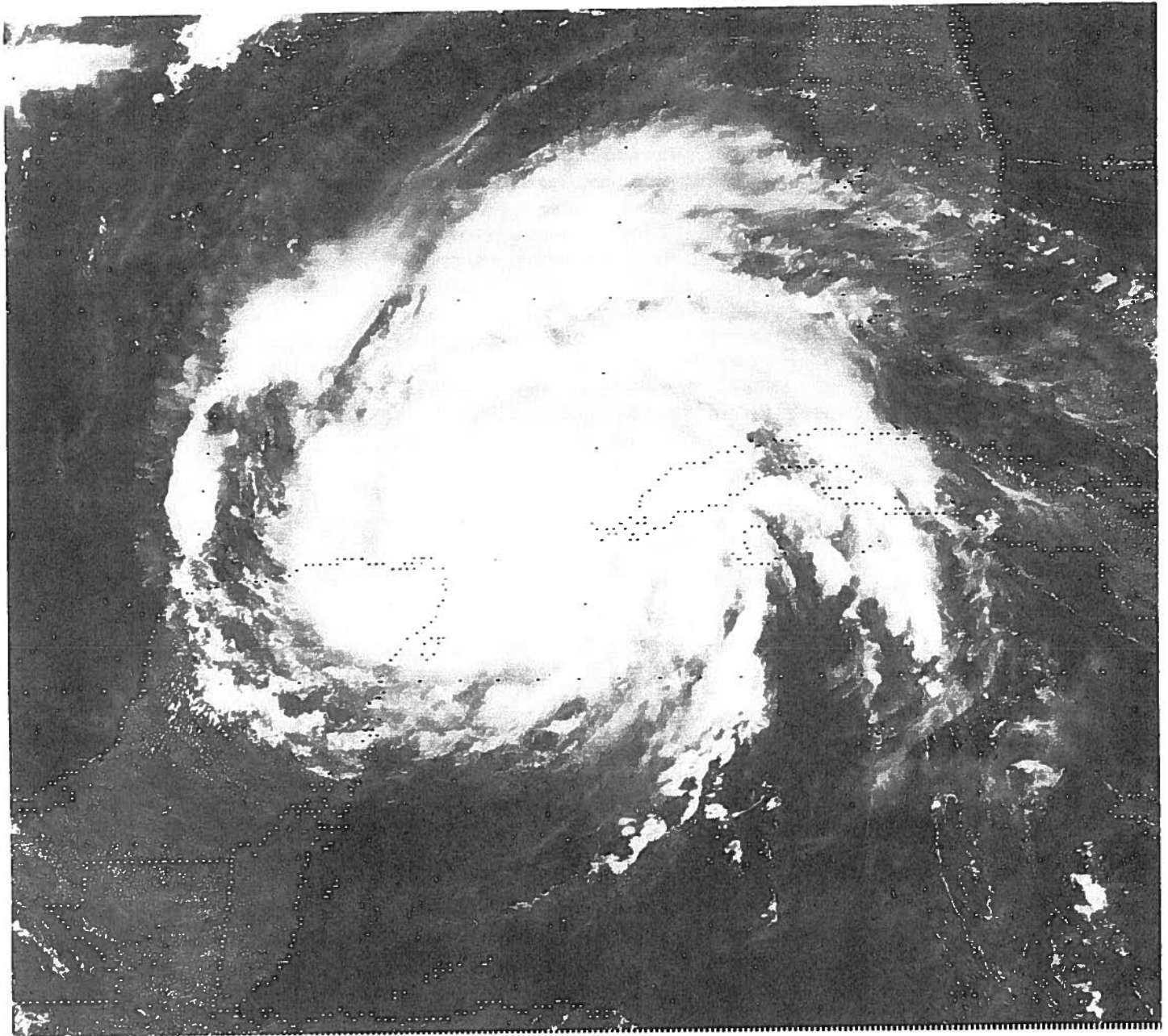
(1) Atlantic Ocean (north of the Equator including Caribbean Sea and Gulf of Mexico) - advices are the responsibility of the Director, NHC, Miami, FL. (NHC will consult with Naval Eastern Oceanography Center (NAVEASTOCEANCEN) Norfolk, VA, prior to issuance of an initial advisory.)

(2) Eastern Pacific Ocean (north of the Equator and east of 140°W) - advices are the responsibility of the Director, Eastern Pacific Hurricane Center (EPHC), Redwood City, CA. (EPHC will consult with Naval Western Oceanography Center (NAVWESTOCEANCEN), Pearl Harbor, HI, before issuance of initial and final advisories and prior to issuance of any advisory which indicates a significant change in forecast of intensity or track from last advisory.)

(3) Central Pacific Ocean (north of the Equator between 140°W and 180°) - advices are the responsibility of Director, Central Pacific Hurricane Center (CPHC), Honolulu, HI. [CPHC will consult with NAVWESTOCEANCEN Pearl Harbor, HI, and Detachment 4, 1 Weather Wing, Hickam AFB, HI, before issuance of an initial advisory.]

(4) Relating to (1) and (3) above, exchange of information is encouraged on subsequent warnings when significant changes are made, or as otherwise required.

c. Through the National Environmental Satellite, Data, and Information Service (NESDIS) - operate DOC environmental satellite systems capable of providing coverage of meteorological conditions in the Tropics during the tropical cyclone season, and monitor and interpret DOC satellite imagery; obtain as necessary, National Aeronautic and Space Administration (NASA) research/development satellite data for NWS operational use; comply with NHC, EPHC, and CPHC satellite data requirements.



Hurricane ALLEN approaching the Yucatan Peninsula,  
August 1980

## CHAPTER 3

### OBSERVATIONS, FORECASTS, AND RELATED INFORMATION TO BE FURNISHED BY NWS TO DOD

1. Observations. The National Hurricane Center (NHC), Eastern Pacific Hurricane Center (EPHC), and Central Pacific Hurricane Center (CPHC) will make available to Department of Defense (DOD) all significant tropical/subtropical cyclone observations that they receive.

#### 2. Military Advisories.

a. General. NHC, EPHC, and CPHC will provide DOD with forecasts and related information for tropical and subtropical weather disturbances of depression intensity or greater. Forecasts will include advice as to location, movement, intensity, and dimension of these disturbances. Advisories will be disseminated through the NWS weather communications facility at Suitland, MD, to the Automated Weather Network (AWN) at Carswell AFB, TX, for further relay to DOD agencies. Military advisories will not be disseminated to the public and are to be used by DOD forecasters for specific DOD purposes only. DOD forecasters who must give advice concerning an imminent operational decision may contact the appropriate Hurricane Center forecaster (see Chapter 2) when published military advisories require elaboration. Phone numbers for the NHC/-EPHC/CPHC are published in Appendix C to Chapter 4.

b. Military Advisory Issue Frequency. The first military advisory will normally be issued when meteorological data indicate that a tropical or subtropical cyclone has formed. Subsequent advisories will be issued at 0400Z, 1000Z, 1600Z, and 2200Z, (0300Z, 0900Z, 1500Z, 2100Z in the Eastern and Central Pacific). Advisories will continue to be issued until the system degenerates below depression level. In addition, special advisories will be issued whenever the following criteria are met (remarks stating the reason for the special advisory or the relocation will be mandatory in all special advisories or advisories that include a relocated position):

- (1) Conditions require a hurricane watch or warning to be issued.
- (2) A tropical depression becomes a tropical storm or vice versa.
- (3) A tropical storm changes to a hurricane or vice versa.
- (4) Conditions require initiation or upgrading of an existing coastal warning.
- (5) A tornado threat develops or the hurricane forecaster believes other significant changes have occurred.
- (6) Tropical Cyclone Updates are permitted without the requirement of a special advisory, including when coastal warnings are cancelled. However, in some cases a special advisory may follow.

c. Military Advisory Content. Military advisories will contain appropriate information as shown in Form 1 (WS Form C-13) of this chapter, Appendix A. Advisories will contain 12- and 24-hour forecasts and, when appropriate, 48- and 72-hour outlooks valid from times based on the latest 6-hourly synoptic time. At a minimum, advisories in which the winds are forecast to be greater than 33 knots within 24 hours will include outlooks through 72 hours.

d. Numbering of Advisories. All advisories will be numbered sequentially in the Eastern and Central Pacific; i.e., Advisory Number 1 on tropical depression (TD) 1, Advisory Number 2 on TD 1, Advisory Number 3 on Tropical Storm Anita, Advisory Number 4 on Hurricane Anita, Advisory Number 5 on TD Anita, etc. CPHC will append an alphabetic designator for intermediate advisories (e.g., 20A). In the Atlantic, Caribbean, and Gulf of Mexico advisories will be numbered consecutively beginning with each new depression. When the depression is numbered as a subtropical storm or named, the advisory numbering will revert to 1 and start all over again. In both the Atlantic and Pacific, once the system is named, however, that name will be retained on military advisories until no further advisories are issued on that system; advisory numbering will continue sequentially.

### 3. Other Information Provided to DOD.

#### a. Tropical Cyclone Discussion.

(1) NHC will issue a Tropical Cyclone Discussion on Atlantic tropical cyclones at 0330Z, 0930Z, 1530Z, and 2130Z. Discussion will be disseminated for intragovernmental use only and will contain preliminary prognostic positions up to 48 hours; will describe objective techniques, synoptic features, and climatology used; will provide reasons for track changes; and will include plans for warning display. Additionally, the Saffir/Simpson Hurricane Scale (SSH) as described in Appendix C to this chapter will be included whenever the tropical cyclone is within 72 hours of landfall on the U.S. coast or a military installation.

(2) EPHC and CPHC will issue a Tropical Cyclone Discussion twice daily. CPHC will issue the discussions not later than 0330Z and 1530Z. The discussion will describe objective techniques, synoptic features and climatology used; will provide reasons for track changes; and will include plans for warning display.

b. Tropical Weather Outlook. Issued by NHC, CPHC and EPHC during their respective hurricane seasons. In the Atlantic, it is transmitted at 0530, 1130, 1730, and 2230 Eastern Local Time (ELT). In the Central Pacific, it is transmitted at 1000Z and 2200Z. In the Eastern Pacific, it is transmitted at 1000Z and 2130Z. The outlook will briefly describe both stable and potentially unstable areas out to 48 hours. A tropical weather summary of Atlantic tropical cyclone activity will be prepared and issued at the end of each month during the hurricane season.

c. Public Advisories. Issued by NHC for all tropical storms and hurricanes, and for tropical depressions or subtropical storms threatening land in the Gulf of Mexico, Caribbean, or western North Atlantic areas. In the Pacific, public advisories are issued for storms and hurricanes that are expected to affect the United States within 48 hours. Scheduled public advisories are issued at the same time scheduled military advisories are issued.



When no coastal warnings are included, the 0400Z public advisory will be issued at 0230Z by NHC only. [Note: Public Advisories use statute miles for distance and miles per hour for speed. Nautical miles and knots may be added at the discretion of the Centers.]

d. Tropical Cyclone Updates. Tropical cyclone updates are brief statements in lieu of or preceding special advisories to inform of significant changes in a tropical cyclone or the posting or cancellation of watches and warnings.

e. Special Tropical Disturbance Statement. Special tropical disturbance statements are issued to furnish information on strong formative, non-depression systems.

f. Atlantic and Gulf of Mexico Tropical Cyclone Position Estimates. NHC may also issue hourly Tropical Cyclone Position Estimates when the tropical cyclone is under effective surveillance and within 200 nautical miles of land-based radar. These estimates when issued will be prepared a short time before each hour except at hours when advisories are issued. Position estimates will be disseminated to the public, DOD, and other Federal agencies and will provide geographical positions in latitude and longitude, and also by distance and direction from a well-known point.

g. Storm Summaries. Storm summaries are written by the National Severe Storms Forecast Center (NSSFC) after subtropical and tropical cyclones have moved inland and public advisories have been discontinued. Storm summaries will continue to be numbered in sequence with public advisories on named storms. Also, these summaries will reference the former storm's name and be issued as long as the remnants of the storm remain a serious flooding threat. Storm summaries will be transmitted at 0500Z, 1100Z, 1700Z, and 2300Z.

h. Marine Advisories. Issued by NHC, EPHC, and CPHC with the same frequency and at the same times as the Military Advisories. The content and format of these advisories are identical to those of the Military Advisories (see Appendix A, Form 1, this chapter), but will not include a 48- and 72-hour extended outlook. Marine Advisories will be transmitted to high-seas shipping according to the details found in Worldwide Marine Weather Broadcasts, jointly published by U.S. Navy (USN) and NWS.

i. Probability of Hurricane/Tropical Storm Conditions. The probability of the storm center passing within 50 miles to the right or 75 miles to the left of specific forecast points within 24, 36, 48 and 72 hours is included in the military/marine/aviation and public advisories for all named storms in the Atlantic and the Gulf of Mexico. Probabilities may also be included for yet to be named storms that are developing rapidly near a coast line, dependent upon NHC assessment. Probabilities will not be included on intermediate public advisories. The probabilities, which are based on the official forecast track, will be issued when the 72-hour forecast approaches the coast and continue up to 12 hours before forecast landfall. For storms forecast to parallel the coast, maximum value over water points will be included. NHC retains the right to discontinue issuance of probabilities earlier if other factors arise, such as difficulties with evacuation orders.

The probabilities will be computed shortly after synoptic times for the periods 0-24, 24-36, 36-48, and 48-72. A total probability for the next 72 hours will be shown in the last column and represents a total of all forecast periods. If the probability of a storm hitting a coastal location within 48 hours is needed, add the 0-24, 24-36, and 36-48 hour probabilities. If the probability for a location is less than one percent, a "X" will be indicated in the table.

When appropriate specific probabilities will be computed for the following locations:

Brownsville, Texas	West Palm Beach, Florida
Corpus Christi, Texas	Fort Pierce, Florida
Port O'Connor, Texas	Cocoa Beach, Florida
Galveston, Texas	Daytona Beach, Florida
Port Arthur, Texas	Jacksonville, Florida
New Iberia, Louisiana	Savannah, Georgia
New Orleans, Louisiana	Myrtle Beach, South Carolina
Buras, Louisiana	Charleston, South Carolina
Gulfport, Mississippi	Wilmington, North Carolina
Mobile, Alabama	Cape Hatteras, North Carolina
Pensacola, Florida	Norfolk, Virginia
Panama City, Florida	Ocean City, Maryland
Apalachicola, Florida	Atlantic City, New Jersey
St. Marks, Florida	New York, New York
Cedar Key, Florida	Montauk Point, New York
Tampa, Florida	Providence, Rhode Island
Venice, Florida	Nantucket, Massachusetts
Fort Myers, Florida	Hyannis, Massachusetts
Marco Island, Florida	Boston, Massachusetts
Key West, Florida	Portland, Maine
Marathon, Florida	Bar Harbor, Maine
Miami, Florida	Eastport, Maine

4. Abbreviated Communications Headings. Abbreviated communications headings are assigned to advisories on tropical and subtropical cyclones and other advices based on depression number (or storm name) and standard communication procedures. [Note: An abbreviated heading consists of three groups with ONE space between groups. The first group contains a data type indicator (e.g., WH for hurricane), a geographical indicator (e.g., CA for Caribbean), and a number. The second group contains a location indicator of the message originator (e.g., KMIA for Miami). The third group is a date-time group in GMT. An example of a complete header is WHCA31 KMIA 180400.

a. Atlantic.

WHCA21-25 KMIA	Marine hurricane or tropical storm advisory
WHCA31-35 KMIA	Public hurricane or tropical storm advisory
WHNT31-35 KMIA	Military hurricane or tropical storm advisory
WOCA21-25 KMIA	Marine tropical depression advisory

WOCA31-35 KMIA	Public tropical depression advisory
WONT31-35 KMIA	Military tropical depression advisory
WWCA21-25 KMIA	Subtropical storm advisory
WOCA41 KMIA	Special tropical disturbance statement
WHXX41-45 KMIA	Tropical cyclone discussion
ABCA20 KMIA	Tropical weather outlook and tropical weather summary (monthly)
WOXX41-45 KMIA	Tropical depression discussion
WHXX51 KMIA	Tropical cyclone position estimate
WHXX61 KMIA	Tropical cyclone update
WHXX90 KMIA	Tropical cyclone discussion for WMO Region IV stations

**Example:**

WH (named storms)	WO (depressions)
31 - A F K P W	31 - 1 6
32 - B G L R	32 - 2 7
33 - C H M S	33 - 3 8
34 - D I N T	34 - 4 9
35 - E J O V	35 - 5 0

In abbreviated headings shown in series in example above--21-25, 31-35, and 41-45--the second digit corresponds with the first letter of the name of the storm, or the last digit of the number of the depression.

b. East and Central Pacific. All advisories on hurricanes, tropical storms, and depressions are under WT abbreviated headings as follows:

WTPA21-25 KSFO	Marine
WTPA21-25 PHNL	Marine
WTPA31-35 KSFO	Public
WTPA31-35 PHNL	Public
WTPN31-35 KSFO	Military
WTPN31-35 PHNL	Military

Depressions are numbered internally and storms are named internally, but the number in the abbreviated heading does not relate to either the internal number of the depression or the name of the storm. The first cyclone would have 21 and 31 in the abbreviated headings, the second cyclone would have 22 and 32, the sixth cyclone would have 21 and 31, etc. The abbreviated heading would not change when a depression is upgraded to storm status.

WHXX41-45 KSFO	Tropical cyclone discussion
WHXX41-45 PHNL	Tropical cyclone discussion
WHXX51 KSFO	Tropical cyclone position estimate
WHXX61 KSFO	Tropical cyclone update
WHXX51 PHNL	Tropical cyclone position estimate
WHXX61 PHNL	Tropical cyclone update
WOPN41 KSFO	Special tropical disturbance statement
WOPN41 PHNL	Special tropical disturbance statement
WWPN21-25 PHNL	Subtropical storm advisory

## 5. Designation of Tropical and Subtropical Cyclones.

a. Numbering of Depressions. Each depression will be assigned a number that will be retained throughout the life of the cyclone. This depression number will not, however, be disseminated on advices after a depression is named as a tropical storm/hurricane or is numbered as a subtropical storm. For each hurricane center's area, numbering will begin with 01 at the start of each calendar year. When forecast responsibility is passed from one warning center to another, the assigned number will be retained.

(1) For the Atlantic, Caribbean, and Gulf of Mexico, depression numbers will be assigned by NHC after advising the NAVEASTOCEANCEN, Norfolk.

(2) For the Pacific area east of longitude  $140^{\circ}$ W, depression numbers, (with the suffix E, i.e., 1E, 2E, 3E, etc.) will be assigned by EPHC after advising the NAVWESTOCEANCEN, Pearl Harbor.

(3) For the Pacific area west of longitude  $140^{\circ}$ W and east of  $180^{\circ}$ , depression numbers (with suffix C, i.e. 1C, 2C, 3C, etc.) will be assigned by CPHC after advising the NAVWESTOCEANCEN, Pearl Harbor.

(4) For the Pacific area west of longitude  $180^{\circ}$ , depression numbers are assigned by the Joint Typhoon Warning Center (JTWC), Guam.

## b. Naming of Tropical Storms and Hurricanes.

(1) Atlantic and Eastern Pacific. A different set of names will be used each year. After a set is used, it will drop to the end of the list, to be used again in six years, except names of significant hurricanes will be retired and replaced with another. Lists of Atlantic and East and Central Pacific names are provided in Appendix B to this chapter.

(2) Central Pacific. When a tropical depression intensifies into a tropical storm or hurricane between longitude 140°W and the 180th meridian, the depression number will be discontinued and replaced by an appropriate name. The CPHC will select the name from the Central Pacific names in Appendix B to this chapter. All of the names listed in each column, beginning with column 1, will be used before going to the next column.

(3) Western Pacific. For the Pacific area west of longitude 180°, Tropical Storms and Typhoons are named by the Joint Typhoon Warning Center (JTWC), Guam. The names are listed in Appendix B to this chapter for information only.

c. Numbering of Subtropical Storms. When a system becomes a subtropical storm, it will be assigned a storm number to indicate its sequence of occurrence among subtropical storms for that area. Numbering will begin with 1 and be consecutive, returning to 1 each new year.

CHAPTER 3  
APPENDIX A  
FORM 1

WS FORM C-13 (3-80) (PRES. BY WSOM C-41)	U.S. DEPARTMENT OF COMMERCE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION NATIONAL WEATHER SERVICE
<b>MILITARY/MARINE/AVIATION HURRICANE ADVISORY</b>	
NOTE: Gusts included when maximum sustained winds reach 50 knots. Use of Quadrants is optional in East and Central Pacific. Twelve hour forecast not included for Atlantic Depressions and Subtropical Storms. <span style="float: right;">*For use in Pacific only.</span>	
Subtropical Depression _____ Subtropical Storm _____ Tropical Depression _____ Military/Marine/Aviation Advisory _____ Corrected <input type="checkbox"/> Tropical Storm _____ Name/Number _____ Number _____ Special <input type="checkbox"/> Hurricane _____	
NATIONAL WEATHER SERVICE _____ _____ City _____ State _____ _____ Z _____ _____ Time _____ Month _____ Day _____ Year _____	
(WARNINGS)	
DEPRESSION, STORM, HURRICANE CENTER LOCATED/RELOCATED _____ NORTH _____ WEST AT _____ Z. POSITION EXCELLENT (Within 10NM) _____ BASED ON AF RECONNAISSANCE TIME OF FIX _____ Z. GOOD (Within 20NM) _____ NOAA RECONNAISSANCE TIME OF FIX _____ Z. FAIR (Within 40NM) _____ LAND BASED RADAR _____ SATELLITE _____ SYNOPTIC REPORT _____ ACCURATE WITHIN _____ NM ACFT RADAR _____ SHIP REPORT _____ EXTRAPOLATION _____	
Remarks  NOTE: Leave 3 spaces after each latitude and longitude entry.	
PRESENT MOVEMENT _____ OR _____ DEGREES AT _____ KT. DIAMETER OF EYE _____ NM (if known) MAXIMUM SUSTAINED WINDS _____ KT WITH GUSTS TO _____ KT. *RADIUS OF 100 KT WINDS _____ NE _____ SE _____ SW _____ NW. RADIUS OF 64 KT WINDS _____ NE _____ SE _____ SW _____ NW. RADIUS OF 50 KT WINDS _____ NE _____ SE _____ SW _____ NW. RADIUS OF 34 KT WINDS _____ NE _____ SE _____ SW _____ NW. RADIUS OF SEAS 12 FT OR HIGHER _____ NE _____ SE _____ SW _____ NW. REPEAT CENTER LOCATED/RELOCATED NEAR _____ N _____ W AT _____ Z.	
FORECAST VALID _____ Z _____ N _____ W. MAXIMUM SUSTAINED WINDS _____ KT WITH GUSTS TO _____ KT. RADIUS OF 50 KT WINDS _____ NE _____ SE _____ SW _____ NW. RADIUS OF 34 KT WINDS _____ NE _____ SE _____ SW _____ NW. FORECAST VALID _____ Z _____ N _____ W. MAXIMUM SUSTAINED WINDS _____ KT WITH GUSTS TO _____ KT. RADIUS OF 50 KT WINDS _____ NE _____ SE _____ SW _____ NW. RADIUS OF 34 KT WINDS _____ NE _____ SE _____ SW _____ NW.	
AVIATION ADVISORY ENDS HERE	
STORM-TIDE OF _____	
HEAVY PRECIPITATION _____	
REQUEST FOR 3-HOURLY SHIP REPORTS _____	
SUBTROPICAL STORM AND MARINE ADVISORIES END HERE	
EXTENDED OUTLOOK FOR INTRAGOVERNMENTAL USE ONLY OUTLOOK VALID _____ Z _____ N _____ W. MAXIMUM SUSTAINED WINDS _____ KT WITH GUSTS TO _____ KT. RADIUS OF 50 KT WINDS _____ NE _____ SE _____ SW _____ NW. OUTLOOK VALID _____ Z _____ N _____ W. MAXIMUM SUSTAINED WINDS _____ KT WITH GUSTS TO _____ KT. RADIUS OF 50 KT WINDS _____ NE _____ SE _____ SW _____ NW.	
NEXT ADVISORY AT _____ Z	FORECASTER _____

CHAPTER 3  
APPENDIX B  
ATLANTIC HURRICANE NAMES

<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>
ARTHUR	ANA	ANDREW	ARLENE	ALBERTO	ALLISON
BERTHA	BOB	BONNIE	BRET	BERYL	BARRY
CESAR	CLAUDETTE	CHARLEY	CINDY	CHRIS	CHANTAL
DIANA	DANNY	DANIELLE	DENNIS	DEBBY	DEAN
EDOUARD	ELENA	EARL	EMILY	ERNESTO	ERIN
FRAN	FABIAN	FRANCES	FLOYD	FLORENCE	FELIX
GUSTAV	GLORIA	GEORGES	GERT	GILBERT	GABRIELLE
HORTENSE	HENRI	HERMINE	HARVEY	HELENE	HUGO
ISIDORE	ISABEL	IVAN	IRENE	ISAAC	IRIS
JOSEPHINE	JUAN	JEANNE	JOSE	JOAN	JERRY
KLAUS	KATE	KARL	KATRINA	KEITH	KAREN
LILI	LARRY	LISA	LENNY	LESLIE	LUIS
MARCO	MINDY	MITCH	MARIA	MICHAEL	MARILYN
NANA	NICHOLAS	NICOLE	NATE	NADINE	NOEL
OMAR	ODETTE	OTTO	OPHELIA	OSCAR	OPAL
PALOMA	PETER	PAULA	PHILIPPE	PATTY	PABLO
RENE	ROSE	RICHARD	RITA	RAFAEL	ROXANNE
SALLY	SAM	SHARY	STAN	SANDY	SEBASTIEN
TEDDY	TERESA	TOMAS	TAMMY	TONY	TANYA
VICKY	VICTOR	VIRGINIE	VINCE	VALERIE	VAN
WILFRED	WANDA	WALTER	WILMA	WILLIAM	WENDY

CHAPTER 3  
APPENDIX B  
EASTERN PACIFIC HURRICANE NAMES

<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>
ALMA	ANDRES	AGATHA	ADRIAN	ALETTA	ADOLPH
BORIS	BLANCA	BLAS	BEATRIZ	BUD	BARBARA
CRISTINA	CARLOS	CELIA	CALVIN	CARLOTTA	COSME
DOUGLAS	DOLORES	DARBY	DORA	DANIEL	DALILIA
ELIDA	ENRIQUE	ESTELLE	EUGENE	EMILIA	ERICK
FAUSTO	FEFA	FRANK	FERNANDA	FABIO	FLOSSIE
GENEVIEVE	GUILLERMO	GEORGETTE	GREG	GILMA	GIL
HERNAN	HILDA	HOWARD	HILARY	HECTOR	HENRIETTE
ISELLE	IGNACIO	ISIS	IRWIN	IVA	ISMAEL
JULIO	JIMENA	JAVIER	JOVA	JOHN	JULIETTE
KENNA	KEVIN	KAY	KNUT	KRISTY	KIKO
LOWELL	LINDA	LESTER	LIDIA	LANE	LORENA
MARIE	MARTY	MADELINE	MAX	MIRIAM	MANUEL
NORBERT	NORA	NEWTON	NORMA	NORMAN	NARDA
ODILE	OLAF	ORLENE	OTIS	OLIVIA	OCTAVE
POLO	PAULINE	PAINÉ	PILAR	PAUL	PRISCILLA
RACHEL	RICK	ROSLYN	RAMON	ROSA	RAYMOND
SIMON	SANDRA	SEYMOUR	SELMA	SERGIO	SONIA
TRUDY	TERRY	TINA	TODD	TARA	TICO
VANCE	VIVIAN	VIRGIL	VERONICA	VICENTE	VELMA
WALLIS	WALDO	WINIFRED	WILEY	WILLA	WINNIE



CHAPTER 3  
APPENDIX B  
CENTRAL PACIFIC HURRICANE NAMES

<u>Column 1</u>		<u>Column 2</u>		<u>Column 3</u>		<u>Column 4</u>	
<u>Name</u>	<u>Pronunciation</u>	<u>Name</u>	<u>Pronunciation</u>	<u>Name</u>	<u>Pronunciation</u>	<u>Name</u>	<u>Pronunciation</u>
AKONI	ah-KOH-nee	AKA	AH-kah	ALIKA	ah-LEE-kah	ANA	AH-nah
EMA	EH-mah	EKEKA	eh-KEH-kah	ELE	EH-leh	ELA	EH-lah
HANA	HAH-nah	HALI	HAH-lee	HUKO	HOO-koh	HALOLA	hah-LOH-lah
IO	EE-oo	INIKI	ee-NEE-kee	IOKE	ee-OH-keh	IUNE	ee-OO-neh
KELI	KEH-lee	KEONI	keh-OH-nee	KIKA	KEE-kah	KIMO	KEE-moh
LALA	LAH-lah	LI	LEE	LANA	LAH-nah	LOKE	LOH-keh
MOKE	MOH-keh	MELE	MEH-leh	MAKA	MAH-kah	MALIA	mah-LEE-ah
NELE	NEH-leh	NONA	NOH-nah	NEKI	NEH-kee	NIALA	nee-AH-lah
OKA	OH-kah	OLIWA	oh-LEE-vah	OLEKA	oh-LEH-kah	OKO	OH-koh
PEKE	PEH-keh	PAKA	PAH-kah	PENI	PEH-nee	PALI	PAH-lee
ULEKI	oo-LEH-kee	UPANA	oo-PAH-nah	ULIA	oo-LEE-ah	ULIKA	oo-LEE-kah
WILA	VEE-lah	WENE	WEH-neh	WALI	WAH-lee	WALAKA	wah-LAH-kah

NOTE: Use Column 1 list of names until exhausted before going on to Column 2, etc.  
All letters in the Hawaiian language are pronounced including double or triple vowels.

- (5) Temperature (flight level).
- (6) Sea-surface temperature.
- (7) Dewpoint temperature (flight level).

**b. Required Meteorological Reconnaissance Data, Ranges and Accuracies.**  
 Required reconnaissance data accuracies are as follows:

- (1) Geographic position:
  - (a) Data position (aircraft) - within 3 n.mi.
  - (b) Storm surface center (wind/pressure) - within 6 n.mi.
  - (c) Flight level storm center (wind/pressure) - within 6 n.mi.
- (2) Wind direction:
  - (a) Surface - within 10 degrees.
  - (b) Flight level (winds greater than 20 kts.) - within 5 degrees.
- (3) Wind speed:
  - (a) Surface - within 10 kts.
  - (b) Flight level - within 4 kts.
- (4) Pressure Height:
  - (a) Surface - within 2 mb.
  - (b) Flight level - within 2 decameters above 500 mb, within 10 meters at or below 500 mb.
- (5) Temperature:
  - (a) Sea surface - within 1°C.
  - (b) Flight level - within 1°C.
- (6) Dew point:
  - (a) Range from -20°C to 40°C - within 1°C.
  - (b) Colder than -20°C - within 3°C.
- (7) Absolute altitude - within 10 m.
- (8) Vertical sounding:
  - (a) Pressure - within 2 mb.
  - (b) Temperature - within 1°C.
  - (c) Dew point: Range -20°C to +40°C - within 1°C.  
Colder than -20°C - within 3°C.
  - (d) Wind direction - within 10°.
  - (e) Wind speed - within 5 kts.

c. Required Frequency and Content of Observations.

(1) ASDL - ADDS (automated systems):

(a) Time, latitude, longitude, flight level - pressure altitude, radar altitude, D value, wind, temperature, dewpoint, height of standard pressure surface - every minute. Observations transmitted each one-half hour.

(b) Standard RECCO and Vortex observations as required.

(2) Standard (non-automated systems):

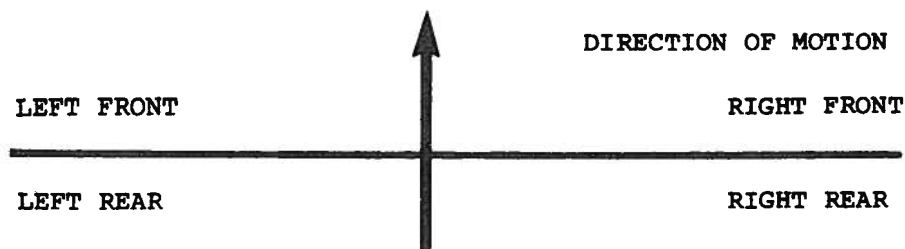
(a) Horizontal observations - RECCO Code Section 1 or Section 3 plus 4ddff and 9ViTWTWTW (4 and 9 groups if applicable) every 15 minutes enroute to and from storm within 15° from tasked coordinates (over water). 500 mb data preferred. RECCO obs transmitted hourly enroute to and from storm. Standard RECCO encoding and transmission IAW AWSR 105-25 outside of 15° from tasked coordinates. Horizontal observation data collection frequency, format, and transmission as specified (NHOP flight patterns) within tasked area.

(b) Vertical observations - Frequency enroute to and from tasked coordinates IAW AWSR 105-25 unless otherwise specified. Frequency as specified (NHOP flight patterns) within tasked areas. Format for all vertical observations is WMO TEMP DROP Code.

(c) Vortex and Supplementary Vortex observations collected, encoded, and transmitted IAW NHOP pattern requirements. (See Chapter 4, Appendix B, Forms 3 and 4, for data format.)

NOTE: Present weather reconnaissance capabilities are marginal in satisfying these requirements; data will be collected as close to stated requirements as possible. While the crews will attempt to meet customer requirements, it is understood that observations will not be considered unsatisfactory as long as they are accomplished every 30 minutes.

d. Standard Flight Patterns. Operational hurricane reconnaissance flights will fly designated flight patterns (Appendix A of this chapter) that use a quadrant system based upon the predicted direction of motion of the cyclone center. (See following diagram.) A tasked pattern may be adjusted by the flight meteorologist to best fulfill data requirements within operational capabilities of the aircraft or agency concerned.



e. High-Density Accuracy Requirements. DOC requires rapid acquisition and dissemination of high-density/accuracy data. Only a limited number of aircraft now have the capability to meet these requirements. DOC requests for aircraft reconnaissance should include the requirements for these resources to be committed to a particular system(s). Specific DOD aircraft resources will be provided on a "Resources Permitting" basis only.

f. High Level Profile Data Requirements. At times, the National Hurricane Center (NHC) will request mid-tropospheric reconnaissance data on the periphery of systems approaching the United States. The NHC will provide a specific track profile to include control point and control time to CARCAH for coordination with the reconnaissance units.

5. Reconnaissance Planning and Flight Notification.

a. DOC Requests for Aircraft Reconnaissance Data.

(1) NHC will coordinate with Eastern Pacific Hurricane Center (EPHC) and Central Pacific Hurricane Center (CPHC) to determine a list of the total DOC requirements for data on tropical and subtropical cyclones or disturbances for the next 24-hour period (0500Z - 0500Z) and an outlook for the succeeding 24-hour period. This coordinated request will be provided to CARCAH as soon as possible, but not later than (NLT) 1630Z each day (in the format of Form 1, Appendix B). Amendments will be provided as required.

(2) From this coordinated DOC request, CARCAH will publish the Tropical Cyclone Plan of the Day (TCPOD). When DOC needs exceed DOD and OAO resources, CARCAH will coordinate with NHC to establish priorities of accomplishment.

(3) The following requests can be anticipated for a forecast or actual storm location:

(a) Atlantic, Gulf of Mexico, Caribbean, Eastern and Central Pacific - up to four 6-hourly fixes per day when a storm is within 500 nautical miles of landfall west of 55° W and north of 8° N, and up to eight 3-hourly fixes per day when a storm is forecast to be within 300 nautical miles of the U.S. coast, Hawaiian Islands, Puerto Rico, Virgin Islands, DOD installations, and other DOD assets when specified.

(b) Investigative flights may be requested as required for disturbances in areas defined in paragraphs (a) and (b) above (i.e., one or two flights per day dependent upon proximity of landfall and upon known or suspected stage of development).

(c) Exceptions may be made when additional reconnaissance is essential to carry out warning responsibilities.

b. DOD Aircraft Reconnaissance Responsiveness.

(1) Notification of requirements must occur at least 16 hours plus en route time to the area of concern.

(2) The "Succeeding Day Outlook" portion of the TCPOD provides advance notification of requirements and authorizes units to preposition aircraft. For missions requiring repositioning, the "Succeeding Day Outlook" may not provide adequate advance notification. In these situations an "Additional Day Outlook" may be included in the TCPOD to authorize units to preposition aircraft.

(3) When circumstances do not allow the appropriate notification lead time, the requirement will be levied as "resources permitting". When a "Resources Permitting" requirement is levied in an amendment, NHC will indicate the priority of all existing or remaining requirements.

(4) At times a storm may develop unexpectedly and cause a serious threat to lives and property within a shorter time frame than provided for in the paragraphs above. These cases will be dealt with through emergency procedures not included in this plan.

c. Reconnaissance Tropical Cyclone Plan of the Day (TCPOD).

(1) Preparation. CARCAH will prepare the TCPOD (Appendix B, Form 2) daily during the period from 1 June through 30 November and at other times during the year as required. CARCAH will coordinate the TCPOD with NHC, 815th WRS, 53rd WRS, and OAO before publication.

(a) TCPOD will list all DOC-required tropical/subtropical reconnaissance operational missions. The Remarks section of the TCPOD will include appropriate comments whenever research and operational flights overlap.

(b) DOD-required tropical or subtropical cyclone reconnaissance missions in the Atlantic or the Pacific west to 180° will also be listed in the TCPOD and identified as Navy or USAF requirements.

(c) Amendments to the TCPOD will be prepared only when requirements change.

(2) Dissemination. The TCPOD will be made available to all appropriate agencies that provide support to or exercise control of reconnaissance missions or that are a part of the hurricane warning service. The TCPOD will be disseminated by 1800Z each day. Amendments will be disseminated as required.

d. Air Traffic Control (ATC) Clearances.

(1) Air traffic control will provide air traffic control separation between all aircraft operating on storm missions and between storm mission aircraft and nonparticipating aircraft operating on Instrument Flight Rules (IFR) within controlled airspace. Mission commanders should be aware that nonparticipating aircraft may be operating near storm areas; thus, adherence to ATC clearances is mandatory for safety purposes.

(2) When storm aircraft cannot maintain assigned altitudes due to turbulence, ATC should be advised. Normal vertical separation of 1,000 feet at FL 290 and below and 2,000 feet above FL 290 will be provided by ATC to aircraft operating in the storm area. Unless otherwise coordinated with ATC, the altitudes between storm-mission aircraft may be used by ATC for nonparticipating aircraft.

(3) Any procedure desired by storm-mission commanders which is outside the above parameters must be coordinated with the appropriate ATC facility.

(4) Dropsonde releases will be coordinated with the appropriate Air Route Traffic Control Center (ARTCC) and participating aircraft if within controlled airspace, and with participating aircraft only, if outside controlled airspace. Contact between participating aircraft will be made using the frequencies listed in Chapter 4, Appendix C, paragraph 3.

#### 6. Reconnaissance Effectiveness Criteria.

a. General. Specified reconnaissance times are established to allow sufficient time for the forecaster to analyze the data before issuing an advisory. Every effort should be made to obtain data at scheduled times. The following criteria will be used to assess reconnaissance effectiveness:

(1) ON-TIME - Fix is made not earlier than 1 hour before nor later than 1/2 hour after scheduled fix time. Investigative aircraft are within 250 nautical miles of the specified coordinates by the scheduled time.

(2) EARLY - Fix is made from 1 hour before scheduled fix time to one-half of the time interval to the preceding scheduled fix (not to exceed 3 hours).

(3) LATE - Fix is made within the interval from 1/2 hour after scheduled fix time to one-half of the time interval to the succeeding scheduled fix (not to exceed 3 hours). Investigative aircraft are within 250 nautical miles of specified coordinates no later than 2 hours after scheduled time.

(4) MISSED - Data are not obtained within the parameters specified for on-time, early, or late.

(5) EXCEPTIONS - Appropriate credit will be given when the aircraft arrives in the requested area but is unable to locate a center due to storm dissipation or rapid movement.

b. NHC, CPHC, or EPHC will provide CARCAH a written assessment of the reconnaissance mission anytime its timeliness or quality is outstanding or substandard (see Appendix B, Form 5). Requirements levied as "resources permitting" will not be assessed for timeliness.

c. CARCAH will maintain monthly and seasonal reconnaissance summaries detailing missions actually flown to satisfy NHC levied requirements.

7. Aerial Reconnaissance Weather Encoding, Reporting and Coordination.

a. Vortex Data. The detailed Vortex Data Message (Form 3, Appendix B) will be prepared with all observed vortex fix information for all scheduled fixes. For intermediate fixes, either an abbreviated or detailed Vortex Data Message may be transmitted, depending upon availability of information and forecaster requirements.

b. Center Fix Data. All radar fix reports and other type aircraft center fixes will be made in plain text and appended to the RECCO observation also taken at fix time. Remarks stating the degree of confidence should be included for radar fixes in the same manner as in Chapter 6, paragraph 2.b.

c. Supplementary Vortex Data. Penetration and collection of supplementary vortex data on operational flight patterns A will normally start at 700 millibars at a radius of approximately 100 nautical miles from the center as determined by the flight meteorologist. The supplementary vortex data required are as shown in Appendix B, Form 4. Note: Present weather reconnaissance equipment is inadequate to provide full data for 15NM supplemental vortex data; data will be collected as close to stated requirements as possible and within the capabilities of the flight crew.

d. Mission Coordination. Mission coordination for all missions will be accomplished through CARCAH. Meteorological discussions for central and eastern Pacific missions may be accomplished directly with the appropriate hurricane center; however, any changes to tasking requirements will be accomplished through CARCAH.

e. Post-flight Debriefing. Unless otherwise directed, the flight meteorologist will provide either an airborne or post-flight debriefing to the appropriate hurricane center to ensure all observations were received and understood.

f. Mission Identifier. Each reconnaissance report will include the mission identifier as the opening text of the message. Regular weather and hurricane reconnaissance messages will include the 5-digit agency/aircraft indicator followed by the CARCAH-assigned mission-system indicator. Elements of the mission identifier are:

Agency - Aircraft Indicator -- Mission System Indicator

Agency - Aircraft Number	No. of missions this system	Depression No. or XX if not a depression or greater (2 digits)	Storm name or words CYCLONE or INVEST
AF plus last 3 digits of tail number	(2 digits)		

NOAA plus last digit of aircraft  
registration number

EXAMPLES:

AF985      01XX      INVEST      (Air Force aircraft 985 on the first  
mission to investigate a suspect area.)

AF987	0503	CYCLONE	(Air Force aircraft 987 on the fifth mission on depression No. 3. Invest or fix as specified in TCPOD.)
NOAA2	0701	AGNES	(NOAA aircraft 42RF on the seventh mission to fix depression No. 1, which has acquired the name AGNES.)

g. Observation Numbering and Content.

(1) The first weather observation will have appended as remarks the ICAO four-letter departure station identifier, time of departure, and estimated time of arrival (ETA) at the coordinates or storm.

EXAMPLE:

```
AF966 0308 EMMY OB 01
97779 TEXT TEXT...DPTD KBIX AT 10/2100Z ETA 31.5N 75.0W AT
11/0015Z
```

(2) All observations (RECCO, Vortex, Supplemental, and Dropsonde) from the first to the last will be numbered sequentially. When an aircraft is diverted from standard reconnaissance to fulfill NHC requirements, the next observation from the diverted aircraft will be labeled OB 01, will use the CARCAH assigned mission identifier, and will include time of diversion and ETA to coordinates of interest. If diverted from an NHC mission to fulfill new NHC requirements or if the aircraft is programmed to satisfy separate NHC system requirements, the same rule applies except that last report remarks will be added to the terminated mission.

EXAMPLE:

```
AF968 01XX INVEST OB 01
97779 TEXT TEXT...DPTD FOXTROT TRACK AT 05/1438Z ETA 18N
85W AT 05/1630Z
```

(3) If a CARCAH assigned mission identifier is changed inflight as a result of system intensity changes, observation numbers will continue sequentially and appropriate remarks made.

EXAMPLE:

```
AF987 0308 EMMY OB 06
97779 TEXT TEXT...OBS 01 THRU 05 XMTD AS AF987 0308 CYCLONE
```

(4) Appended to the final weather observation will be a last report remark, which will include destination, ETA, number of observations, and monitor(s) that copied the observations.

EXAMPLE:

```
AF553 0308 EMMY OB 16
XXAA TEXT TEXT...LAST REPORT ETA KBIX 11/0910Z OBS 01
THRU 10 and 12 THRU 16 KMIA OB 11 KMHR
```

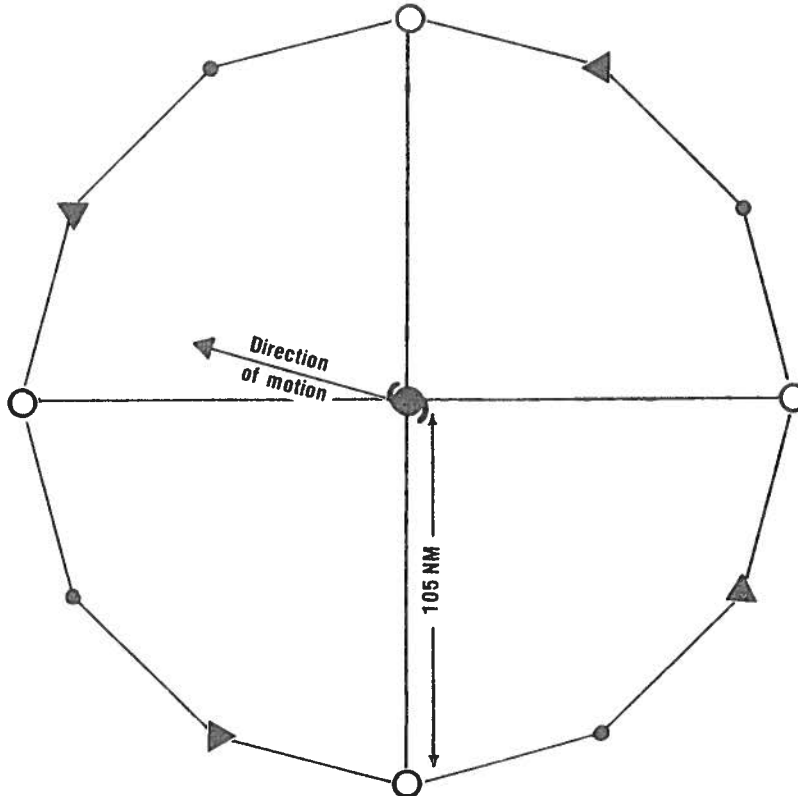


CHAPTER 4  
APPENDIX A  
ATTACHMENT 1

OPERATIONAL FLIGHT PATTERN "A"

Provides vortex and peripheral data on tropical and subtropical cyclones including two 6-hourly and intermediate fixes.

DATA REQUIREMENTS



OBSERVATION DETAILS

1. Flight level 700 millibars, but may be low-level if requested. Low-level missions are normally conducted at 1500 feet, but may be adjusted as dictated by data requirements, meteorological conditions, or flying safety factors. During day or night operations, when safety conditions dictate, an 850 millibar or higher altitude may be flown.

2. RECCO (Section 1 plus 4ddff and 9ViTWTwTw) is required for each transit of a triangle position. Transmit immediately. RECCO (Section 3 plus 4ddff and 9ViTWTwTw) is required for each transit of a darkened circle position (appended to next RECCO Section observation). Groups with indicator 4 or 9 are included in observations only when surface winds are discernible or flight is at low level. Open circle positions indicate the beginning or ending of supplementary vortex data inbound or outbound radials.

3. Supplementary Vortex data are required for each radial flown inbound or outbound. Transmit data to the appropriate monitor at the end of each pair of inbound/outbound radial legs flown.

4. On each transit of the center a fix will be made and a Vortex Data Message completed. If it is a scheduled fix, the Detailed Vortex Data Message will be completed using data gathered since the previous fix and will be transmitted immediately. If it is an intermediate (nonscheduled) fix, an Abbreviated Vortex Data Message using data gathered since the previous fix may be prepared in lieu of the detailed message and transmitted immediately. Center dropsonde data will also be provided for scheduled fixes made at 700 millibars or above.

5. Dropsonde data when required in the periphery of the storm will be taken at the triangular positions indicated. The requirement for these data will be determined on a case-by-case basis and coordinated through the POD.

#6. Entry and exit headings should be one of the cardinal directions (see recommended pattern "A" execution, Attachment No. 1A). These radial headings should be maintained within  $20^{\circ}$ .

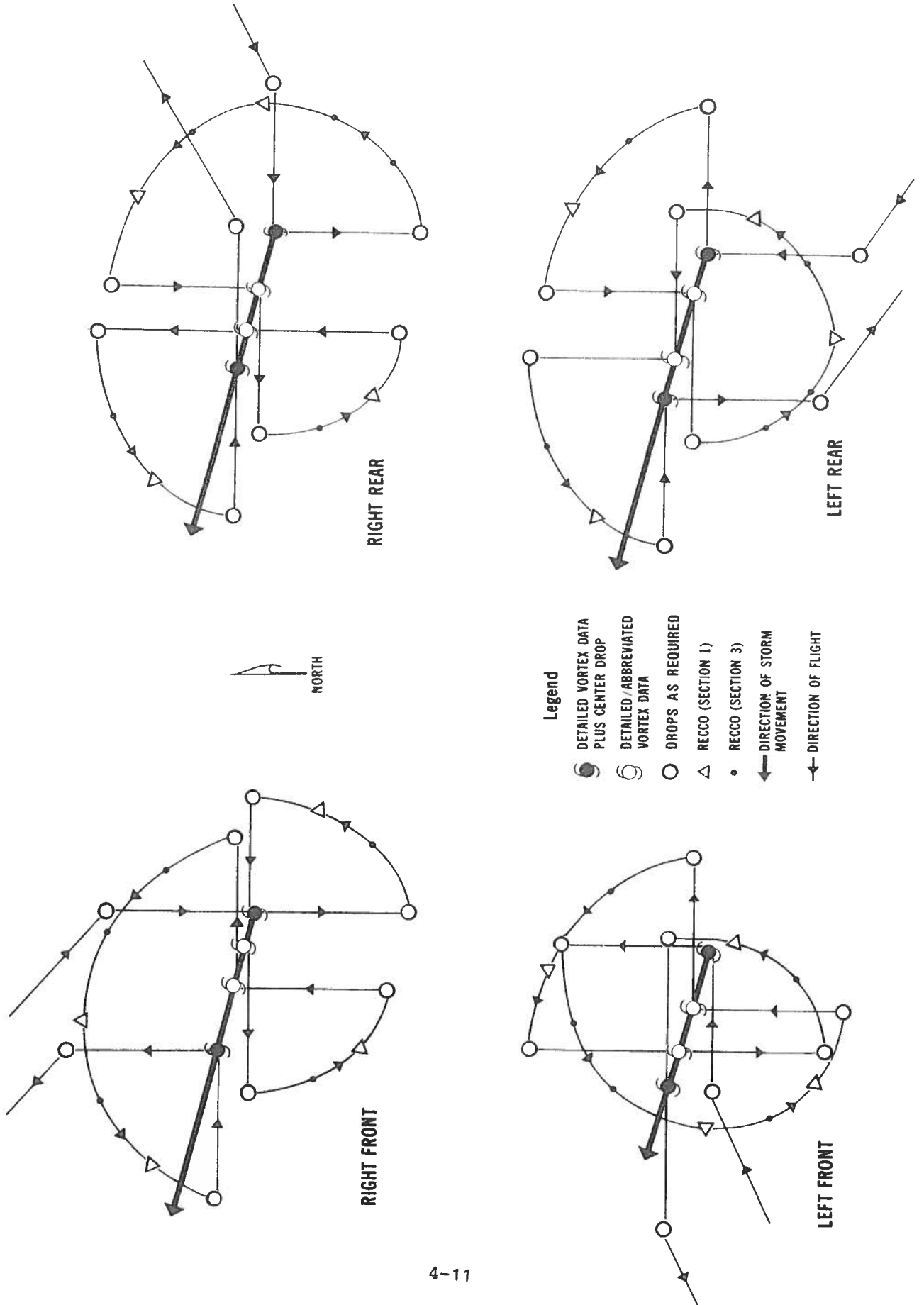
7. Current weather reconnaissance capability may preclude complete and timely satisfaction of these requirements.



Weather Instrumented USAF WC-130 Flown  
for Hurricane Reconnaissance

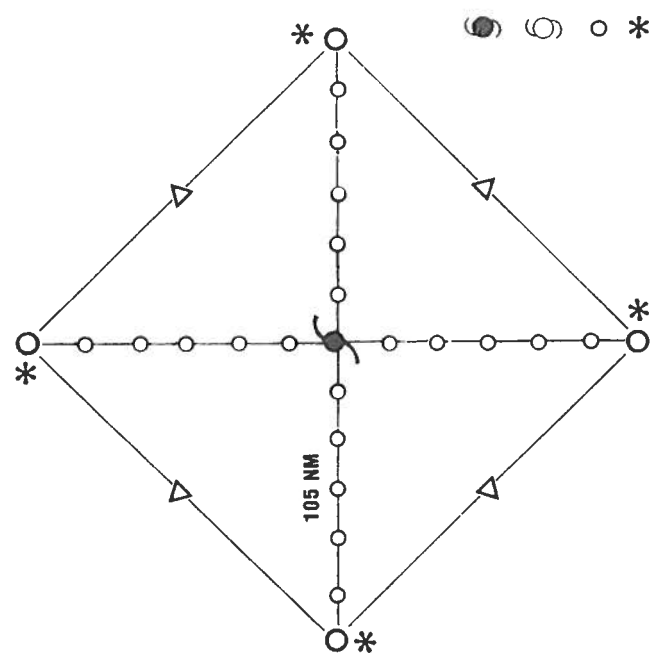
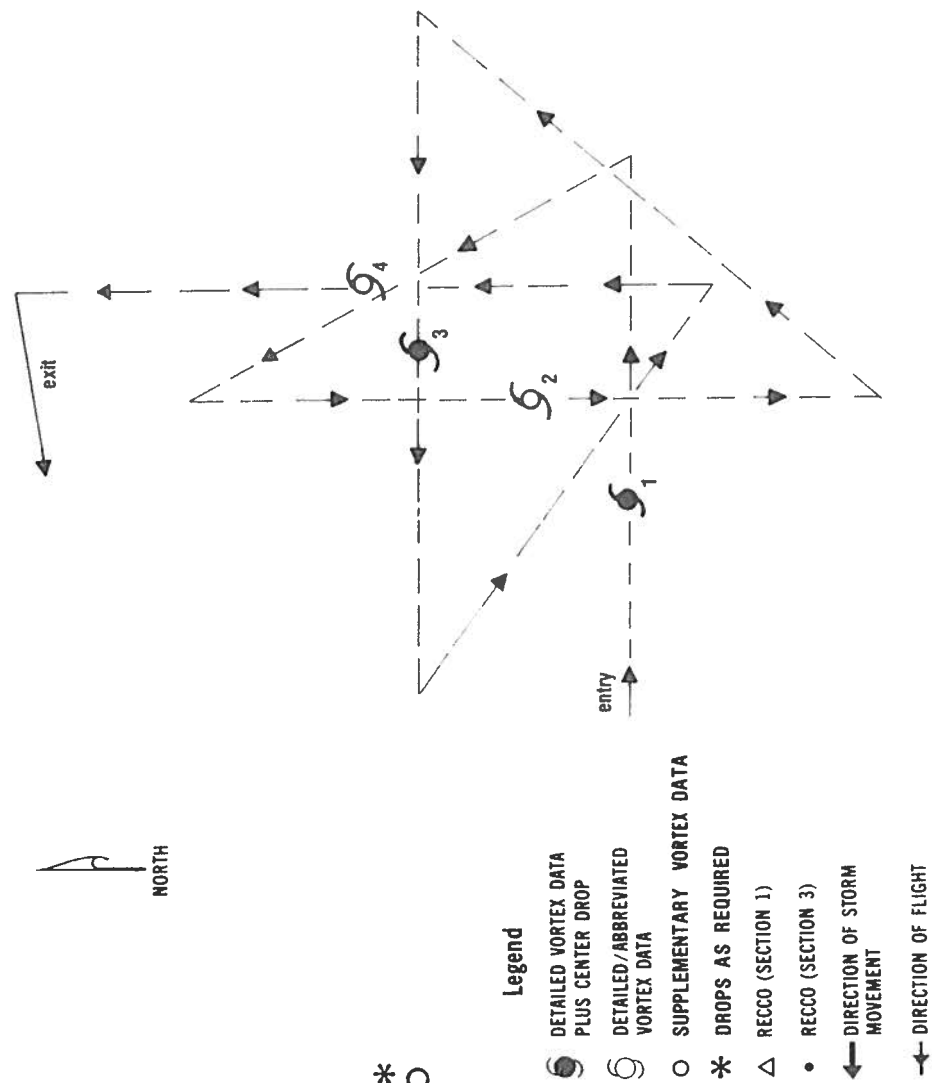
CHAPTER 4  
APPENDIX A  
ATTACHMENT 1A

RECOMMENDED PATTERN "A" EXECUTION



CHAPTER 4  
APPENDIX A  
ATTACHMENT 1B

RECOMMENDED PATTERN "A" (MODIFIED) EXECUTION

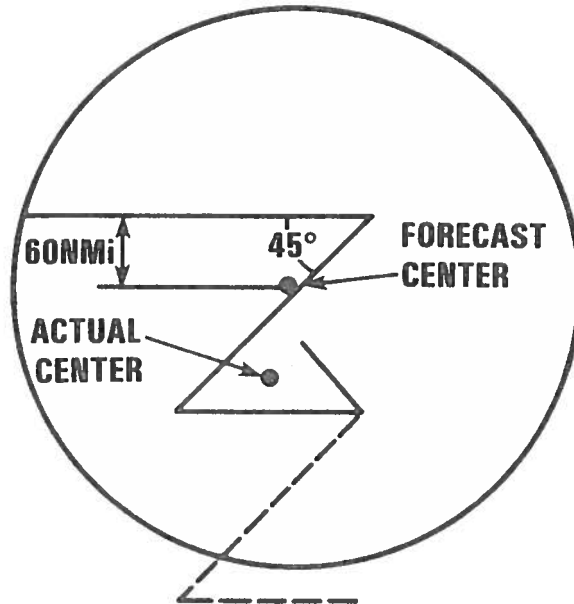


Pattern may be entered on any leg

CHAPTER 4  
APPENDIX A  
ATTACHMENT 2

OPERATIONAL FLIGHT PATTERN DELTA

Provides a suggested approach to the investigation of a disturbance to ascertain the existence or nonexistence of a closed circulation, supply RECCO observations in required areas, and locate the vortex center. This pattern is normally not tasked when a closed circulation has been identified and scheduled fixes are required.



OBSERVATION DETAILS

1. Flight level 1500 feet, but may be adjusted as dictated by data requirements, meteorological conditions, or flying safety factors. During day or night operations when flying safety conditions dictate, an 850 milibar or higher altitude may be flown.

2. RECCO (Section 1 plus 4ddff and 9ViTwTwTw) required every 30 minutes. RECCO (Section 3 plus 4ddff and 9ViTwTwTw) required approximately every 15 minutes. Section 3 data are appended to next RECCO Section 1 observation. The 4 or 9 Group will not be reported if data are not available.

3. Detailed Vortex Data Message required if vortex fix is made.

DISCUSSION:

The Delta pattern is designed to provide the flexibility required in the investigation of a disturbance as follows:

1. The pattern is converted west-east to a mirror image if entry is to be made from the east.

2. The length of the legs is to be adjusted during the pattern to coincide with cyclonic circulation wind shifts, i.e., turn points are selected by the flight meteorologist after observing appropriate sustained wind shifts.

3. If observed data indicate that the aircraft is on the southern side of the circulation, the pattern is converted south-north to a mirror image pattern to enable investigation in the proper areas.

4. If data indicate to the flight meteorologist that the aircraft is far north of any existing circulation, the pattern is extended (as shown by dashed lines) to allow further investigation.

5. If the location of the center becomes obvious, the pattern may be broken off to accomplish a vortex fix. Forecast agencies may request changes in the pattern as dictated by their data requirements.

CHAPTER 4  
 APPENDIX B  
 FORM 1

NHOP COORDINATED REQUEST FOR AIRCRAFT RECONNAISSANCE

\_\_\_ Original  
 \_\_\_ Amendment  
 (Check One)

I. ATLANTIC REQUIREMENTS

STORM NAME	FIX OR ON	COORDI-	FLIGHT	FCST	HIGH	NHC
DEPRESSION #	STATION	NATES	PATTERN	MVMT	DENS	PRI-
SUSPECT AREA	TIME				ACCY	ORITY

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SUCCEEDING DAY OUTLOOK \_\_\_\_\_

REMARKS \_\_\_\_\_

---

II. EASTERN AND CENTRAL PACIFIC REQUIREMENTS

STORM NAME	FIX OR ON	COORDI-	FLIGHT	FCST	HIGH	NHC
DEPRESSION #	STATION	NATES	PATTERN	MVMT	DENS	PRI-
SUSPECT AREA	TIME				ACCY	ORITY

---



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SUCCEEDING DAY OUTLOOK \_\_\_\_\_

REMARKS \_\_\_\_\_

---

III. DISTRIBUTION

A. TO CARCAH BY 1630Z OR AMEND AT ANY TIME

B. DATE \_\_\_\_\_ TIME \_\_\_\_\_ FCSTR INIT \_\_\_\_\_

CHAPTER 4  
APPENDIX B  
FORM 2

TROPICAL CYCLONE PLAN OF THE DAY FORMAT  
--ATLANTIC, EASTERN, AND CENTRAL PACIFIC OCEANS--

FM OL-G HQ AWS CORAL GABLES FL/CARCAH

TO (MAC-APPROVED ADDRESSEES)/(NOAA-APPROVED ADDRESSEES)

-----  
SUBJECT TROPICAL CYCLONE

RECON POD FROM \_\_\_\_\_ Z (MONTH) (YEAR) TO \_\_\_\_\_ Z (MONTH) (YEAR) FOLLOWS

I. ATLANTIC

1. (STORM NAME, DEPRESSION, SUSPECT AREA) or (NEGATIVE RECON REQUIREMENTS)

FLIGHT ONE (NHC PRIORITY, if applicable)

A. \_\_\_\_\_ Z                      FIX TIMES/ON STATION TIMES  
   (Resources Permitting if applicable)  
   \_\_\_\_\_ Z

B. \_\_\_\_\_                      MISSION IDENTIFIER

C. \_\_\_\_\_ Z                      ETD

D. \_\_\_\_\_                      DEPARTURE STATION

E. \_\_\_\_\_                      FORECAST POSITION/STORM NAME

F. \_\_\_\_\_                      DESTINATION STATION

G. \_\_\_\_\_                      FLIGHT PATTERN

H. \_\_\_\_\_                      FORECAST MOVEMENT

I. \_\_\_\_\_                      REMARKS

FLIGHT TWO (if applicable, same as FLIGHT ONE)

2. (SECOND SYSTEM, if applicable, same as in 1. above)

3. OUTLOOK FOR SUCCEEDING DAY (NHC PRIORITY, if applicable)

A. POSSIBLE \_\_\_\_\_ (Unit) ON STATION REQUIREMENT NEAR \_\_\_\_\_ (Location)  
   AT \_\_\_\_\_ (Time) Z.

II. EASTERN AND CENTRAL PACIFIC (Same as in ATLANTIC)



CHAPTER 4  
APPENDIX B  
FORM 3

VORTEX DATA MESSAGE

MANOP HEADING (PRECEDENCE IMMEDIATE)			
MISSION IDENTIFIER AND OBSERVATION NUMBER			
(ABBREVIATED) (DETAILED) VORTEX DATA MESSAGE			
A		Z	DATE AND TIME OF FIX
B	DEG	MIN N S	LATITUDE OF VORTEX FIX
	DEG	MIN E W	LONGITUDE OF VORTEX FIX
C	MB	M	MINIMUM HEIGHT AT STANDARD LEVEL
D		KT	ESTIMATE OF MAXIMUM SURFACE WIND OBSERVED
E	DEG	NM	BEARING AND RANGE FROM CENTER OF MAXIMUM SURFACE WIND
F	DEG	KT	MAXIMUM FLIGHT LEVEL WIND NEAR CENTER
G	DEG	NM	BEARING AND RANGE FROM CENTER OF MAXIMUM FLIGHT LEVEL WIND
H		MB	MINIMUM SEA LEVEL PRESSURE COMPUTED FROM DROPSONDE OR EXTRAPOLATED FROM WITHIN 1500 FT OF SEA SURFACE
I	C/	M	MAX FLT LVL TEMP/PRESSURE ALT OUTSIDE EYE
J	C/	M	MAX FLT LVL TEMP/PRESSURE ALT INSIDE EYE
K	C/	C	DEWPOINT TEMP/SEA SURFACE TEMP INSIDE EYE
L			EYE CHARACTER. Closed wall, poorly defined, open SW, etc.
M			EYE SHAPE/ORIENTATION/DIAMETER. Code eye shape as: C - Circular; CO - Concentric; E - Elliptical. Transmit orientation of major axis in tens of degrees, i.e., 01-010 to 190; 17-170 to 350. Transmit diameter in nautical miles. <i>Examples:</i> C8 - Circular eye 8 miles in diameter. E09/15/5 - Elliptical eye, major axis 090-270, length of major axis 15 NM, length of minor axis 5 NM. CO8-14 - Concentric eye, diameter inner eye 8 NM, outer eye 14 NM.
N	DEG	MIN N S	CONFIRMATION OF FIX: Coordinates and Time
	DEG	MIN E W	
		Z	
O	/		FIX DETERMINED BY/FIX LEVEL. FIX DETERMINED BY: 1 - Penetration; 2 - Radar; 3 - Wind; 4 - Pressure; 5 - Temperature. FIX LEVEL (Indicate surface center if visible; indicate both surface and flight level centers only when same): 0 - Surface; 1 - 1500 ft; 8 - 850 mb; 7 - 700 mb; 5 - 500 mb; 4 - 400 mb; 3 - 300 mb; 2 - 200 mb; 9 - Other.
P	/	NM	NAVIGATION FIX ACCURACY/METEOROLOGICAL ACCURACY
Q			REMARKS
<p><b>INSTRUCTIONS:</b> Items A through G (and H when extrapolated) are transmitted from the aircraft immediately following the fix. The remainder of the message is transmitted as soon as available for scheduled fixes and at the ARWO's discretion for unscheduled (intermediate) fixes.</p>			

CHAPTER 4  
APPENDIX B  
FORM 4

SUPPLEMENTARY VORTEX DATA MESSAGE																																																																																					
MANOP HEADING <i>(completed by monitors only)</i>																																																																																					
UR _____ 12 _____																																																																																					
MISSION IDENTIFIER AND OBSERVATION NUMBER <i>(completed by flight meteorologist and monitor)</i>																																																																																					
AF _____																																																																																					
SUPPLEMENTARY VORTEX DATA MESSAGE					LEGEND																																																																																
(L <sub>o</sub> L <sub>o</sub> L <sub>o</sub> )	(L <sub>o</sub> L <sub>o</sub> L <sub>o</sub> L <sub>o</sub> )	(iHHH)	(TTT <sub>d</sub> T <sub>d</sub> )	(ddfff)	<p>01 INDICATOR FOR DATA COLLECTED APPROXIMATELY 105 NM FROM STORM CENTER (INBOUND) OR APPROXIMATELY 15 NM FROM CENTER (OUTBOUND)</p> <p>OTHER INDICATORS (02/2, 03/3...) FOR DATA AT APPROXIMATELY 15 NM INTERVALS INBOUND OR OUTBOUND FROM STORM CENTER. INDICATORS MAY BE EXPANDED BEYOND 07 (08, 09...) AS NECESSARY AT APPROXIMATELY 15 NM INTERVALS.</p> <p>MF = INDICATOR FOR MAXIMUM FLIGHT LEVEL WIND OBSERVED</p> <p>fff = SPEED OF WIND IN KNOTS</p> <p>dd = TRUE DIRECTION OF FLIGHT LEVEL WIND SPEED IN TENS OF DEGREES</p> <p>TTT<sub>d</sub> T<sub>d</sub> = TEMP/DEWPOINT IN DEGREES CELSIUS: ADD 50 FOR NEGATIVE VALUES</p> <p>IHHH = PRESSURE HEIGHT DATA IN RECCO FORMAT</p> <p>L<sub>o</sub> L<sub>o</sub> L<sub>o</sub> = LATITUDE IN DEGREES/TENTHS</p> <p>L<sub>o</sub> L<sub>o</sub> L<sub>o</sub> L<sub>o</sub> = LONGITUDE IN DEGREES/TENTHS</p> <p>/ = DATA UNKNOWN/UNOBTAINABLE</p>																																																																																
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CHAPTER 4  
APPENDIX B  
FORM 5

MISSION EVALUATION FORM

DATE: \_\_\_\_\_

TO: OL-G, HQ AWS/CARCAH

FROM: \_\_\_\_\_ (Director, NHC, CPHC, EPHC)

SUBJECT: Mission \_\_\_\_\_ Evaluation  
(Mission Identifier)

PUBLISHED REQUIREMENTS:

Permission Coordinates (As Updated Prior to TKO) \_\_\_\_\_ N \_\_\_\_\_ W

Flight Pattern \_\_\_\_\_

Mission Requirements Times \_\_\_\_\_

RECONNAISSANCE MISSION PERFORMANCE:

Flight Flown: \_\_\_\_\_ Completely \_\_\_\_\_ Partially \_\_\_\_\_ Other

Horizontal Data Coverage: \_\_\_\_\_ Complete \_\_\_\_\_ Timely \_\_\_\_\_ Accurate  
\_\_\_\_\_ Incomplete \_\_\_\_\_ Untimely \_\_\_\_\_ Inaccurate

Vertical Data Coverage: \_\_\_\_\_ Complete \_\_\_\_\_ Timely \_\_\_\_\_ Accurate  
\_\_\_\_\_ Incomplete \_\_\_\_\_ Untimely \_\_\_\_\_ Inaccurate

Requirements Accomplished: \_\_\_\_\_ On Time \_\_\_\_\_ Early \_\_\_\_\_ Late  
\_\_\_\_\_ Missed

Remarks: \_\_\_\_\_

OVERALL MISSION EVALUATION:

	<u>Outstanding</u>	<u>Satisfactory</u>	<u>Unsatisfactory</u>
Equipment:	_____	_____	_____
Accuracy:	_____	_____	_____
Timeliness:	_____	_____	_____
Procedures:	_____	_____	_____
Completeness:	_____	_____	_____

Remarks: \_\_\_\_\_



CHAPTER 4  
APPENDIX B  
FORM 6  
NOTES

1. At the time of the observation the aircraft observing platform is considered to be located on the axis of a right vertical cylinder with a radius of 30 nautical miles bounded by the earth's surface and the top of the atmosphere. Present weather, cloud amount and type, turbulence, and other subjective elements are reported as occurring within the cylinder. Flight level winds, temperature, dew point, and geopotential values are sensed or computed and reported as occurring at the center of the observation circle. Radar echoes, significant weather changes, distant weather, and icing are phenomena that may also be observed/reported. Code groups identifying these phenomena may be reported as necessary to adequately describe met conditions observed.
2. The intermediate observation (Section Three) is reported following Section One (or Section Two if appended to Section One) in the order that it was taken.
3. Plain language remarks may be added as appropriate. These remarks follow the last encoded portion of the horizontal or vertical observation and will clearly convey the intended message. Vertical observations will not include meteorological remarks. These remarks must begin with a letter or word—E.G. "FL TEMP" vice "700 MB FL TEMP". The last report plain language remarks are mandatory, i.e., "LAST REPORT. OBS 01 thru 08 to RJTY, OBS 09 and 10 to RPMK".
4. The hundreds digit of longitude is omitted for longitudes from 100° to 180°.
5. Describe conditions along the route of flight actually experienced at flight level by aircraft.
6. TT, T<sub>d</sub>T<sub>d</sub>. When encoding negative temperatures, 50 is added to the absolute value of the temperature with the hundreds figure, if any, being omitted. A temperature of -52°C is given as 02, the distinction between -52°C and 2°C being made from id. Missing unknown temperatures are reported as //. When the dew point is colder than -49.4°C, Code T<sub>d</sub>T<sub>d</sub> as // and report the actual value as a plain language remark — E.G. DEW POINT -52°C.
7. When two or more types of w co-exist, the type with the higher code figure will be reported. Code Figure 1, 2 and 3 are reported based on the total cloud amount through a given altitude, above or below the aircraft, and when other figures are inappropriate. The summation principle applies only when two or more cloud types share a given altitude.
8. When j is reported as a 9, HHH is encoded as ///.
9. If the number of cloud layers reported exceeds 3, k<sub>n</sub> in the first 1-group reports the total number of cloud layers. The second 1-group reports the additional number of layers being reported exclusive of those previously reported. In those cases where a cloud layer(s) is discernible, but a descriptive cloud picture of the observation circle is not possible, use appropriate remarks such as "clouds blo" or "As blo" to indicate the presence of lclouds. In such cases, coded entries are not made for group 9. The sequence in which cloud amounts are encoded depends upon type of cloud, cloud base, and vertical extent of the cloud. The cloud with the largest numerical value of cloud type code (C) is reported first, regardless of coverage, base, or vertical extent. Among clouds of the same cloud type code sharing a common base, the cloud of greatest vertical extent is reported first. The summation principle is not used; each layer is treated as though no other clouds were present. The total amount of clouds through one altitude shared by several clouds will not exceed 8 oktas. Only use code figure 0 as a place holder when you can determine that no additional cloud layers exist. In case of undercast, overcast, etc., use code figure 9 as a placeholder.
10. Due to limitations in the ability to distinguish sea state features representative of wind speeds above 130 knots, surface wind speeds in excess of 130 knots will not be encoded. Wind speeds of 100 to 130 knots inclusive will be encoded by deleting the hundreds figure and adding 50 to dd. For wind speeds above 130 knots, dd is reported without adding 50 and ff is encoded as // with a plain language remark added, i.e., -sfc wind above 130 knots.
11. Significant weather changes which have occurred since the last observation along the track are reported for Ws.
12. When aircraft encounters icing in level flight, the height at which the icing occurred will be reported for h<sub>i</sub>h<sub>i</sub>. The H<sub>i</sub>H<sub>i</sub> will be reported as //.

CHAPTER 4  
APPENDIX B  
FORM 6  
CODE TABLES

<p><b>TABLE 1 XXX</b></p> <p>222 Sec One Observation without radar capability 555 Sec Three (Intermediate) observation with or without radar capability 777 Sec One Observation with radar capability</p> <p><b>TABLE 2 id</b></p> <p>0 No dew point capability/acft below 10,000 meters 1 No dew point capability/acft at or above 10,000 meters 2 No dew point capability/acft below 10,000 meters and flight lvl temp <math>-50^{\circ}\text{C}</math> or colder 3 No dew point capability/acft at or above 10,000 meters and flight lvl temp <math>-50^{\circ}\text{C}</math> or colder 4 Dew point capability/acft below 10,000 meters 5 Dew point capability/acft at or above 10,000 meters 6 Dew point capability/acft below 10,000 meters and flight lvl temp <math>-50^{\circ}\text{C}</math> or colder 7 Dew point capability/acft at or above 10,000 meters and flight lvl temp <math>-50^{\circ}\text{C}</math> or colder</p> <p><b>TABLE 3 Q</b></p> <table style="width: 100%; border: none;"> <tr><td>0 <math>0^{\circ} - 90^{\circ}</math> W</td><td>Northern</td></tr> <tr><td>1 <math>90^{\circ}</math> W - <math>180^{\circ}</math> W</td><td>Northern</td></tr> <tr><td>2 <math>180^{\circ} - 90^{\circ}</math> E</td><td>Northern</td></tr> <tr><td>3 <math>90^{\circ} - 0^{\circ}</math> E</td><td>Northern</td></tr> <tr><td>4 Not Used</td><td></td></tr> <tr><td>5 <math>0^{\circ} - 90^{\circ}</math> W</td><td>Southern</td></tr> <tr><td>6 <math>90^{\circ} - 180^{\circ}</math> W</td><td>Southern</td></tr> <tr><td>7 <math>180^{\circ} - 90^{\circ}</math> E</td><td>Southern</td></tr> <tr><td>8 <math>90^{\circ} - 0^{\circ}</math> E</td><td>Southern</td></tr> </table> <p><b>TABLE 4 B</b></p> <p>0 None 1 Light turbulence 2 Moderate turbulence in clear air, infrequent 3 Moderate turbulence in clear air, frequent 4 Moderate turbulence in cloud, infrequent 5 Moderate turbulence in cloud, frequent 6 Severe turbulence in clear air, infrequent 7 Severe turbulence in clear air, frequent 8 Severe turbulence in cloud, infrequent 9 Severe turbulence in cloud frequent</p> <p><b>TABLE 5 fc</b></p> <p>0 In the clear 8 In and out of clouds 9 In clouds all the time (continuous IMC) / Impossible to determine due to darkness or other cause</p>	0 $0^{\circ} - 90^{\circ}$ W	Northern	1 $90^{\circ}$ W - $180^{\circ}$ W	Northern	2 $180^{\circ} - 90^{\circ}$ E	Northern	3 $90^{\circ} - 0^{\circ}$ E	Northern	4 Not Used		5 $0^{\circ} - 90^{\circ}$ W	Southern	6 $90^{\circ} - 180^{\circ}$ W	Southern	7 $180^{\circ} - 90^{\circ}$ E	Southern	8 $90^{\circ} - 0^{\circ}$ E	Southern	<p><b>TABLE 6 d<sub>i</sub></b></p> <p>0 Spot Wind 1 Average Wind / No wind reported</p> <p><b>TABLE 7 d<sub>o</sub></b></p> <p>0 Winds obtained using doppler radar or inertial systems 1 Winds obtained using other navigation equipment and/or techniques / Navigator unable to determine wind or wind not compatible</p> <p><b>TABLE 8 w</b></p> <p>0 Clear 1 Scattered (trace to 4/8 cloud coverage) 2 Broken (5/8 to 7/8 cloud coverage) 3 Overcast/undercast 4 Fog, thick dust or haze 5 Drizzle 6 Rain (continuous or intermittent precip - from stratiform clouds) 7 Snow or rain and snow mixed 8 Shower(s) (continuous or intermittent precip - from cumuliform clouds) 9 Thunderstorm(s) / Unknown for any cause including darkness</p> <p><b>TABLE 9 j</b></p> <p>0 Sea level pressure in whole millibars (thousands fig if any omitted) 1 Altitude 200 mb surface in geopotential decameters (thousands fig if any omitted) 2 Altitude 850 mb surface in geopotential meters (thousands fig omitted) 3 Altitude 700 mb surface in geopotential meters (thousands fig omitted) 4 Altitude 500 mb surface in geopotential decameters 5 Altitude 400 mb surface in geopotential decameters 6 Altitude 300 mb surface in geopotential decameters 7 Altitude 250 mb surface in geopotential decameters (thousands fig if any omitted) 8 D - Value in geopotential decameters; if negative 500 is added to HHH 9 No absolute altitude available or geopotential data not within <math>\pm 30</math> meters/4 mb accuracy requirements.</p> <p><b>TABLE 10 N<sub>s</sub></b></p> <p>0 No additional cloud layers (place holder) 1 1 okta or less, but not zero (1/8 or less sky covered) 2 2 oktas (or 2/8 of sky covered) 3 3 oktas (or 3/8 sky covered) 4 4 oktas (or 4/8 of sky covered) 5 5 oktas (or 5/8 of sky covered) 6 6 oktas (or 6/8 of sky covered) 7 7 oktas or more but not 8 oktas 8 8 oktas or sky completely covered 9 Sky obscured (place holder)</p>	<p><b>TABLE 11 C</b></p> <p>0 Cirrus (Ci) 1 Cirrocumulus (Cc) 2 Cirrostratus (Cs) 3 Altcumulus (Ac) 4 Altostratus (As) 5 Nimbostratus (Ns) 6 Stratocumulus (Sc) 7 Stratus (St) 8 Cumulus (Cu) 9 Cumulonimbus (Cb) / Cloud type unknown due to darkness or other analogous phenomena</p> <p><b>TABLE 12 h<sub>s</sub>h<sub>2</sub>H<sub>1</sub>H<sub>1</sub>h<sub>1</sub>h<sub>1</sub>H<sub>1</sub>H<sub>1</sub></b></p> <p>00 Less than 100 01 100 ft 02 200 ft 03 300 ft etc, etc 49 4,900 ft 50 5,000 ft 51-55 Not used 56 6,000 ft 57 7,000 ft etc, etc 79 29,000ft 80 30,000 ft 81 35,000 ft 82 40,000 ft etc, etc 89 Greater than 70,000 ft // Unknown</p> <p><b>TABLE 13 d<sub>w</sub></b></p> <table style="width: 100%; border: none;"> <tr><td>0 No report</td><td></td></tr> <tr><td>1 NE</td><td>7 NW</td></tr> <tr><td>2 E</td><td>8 N</td></tr> <tr><td>3 SE</td><td>9 all directions</td></tr> <tr><td>4 S</td><td></td></tr> <tr><td>5 SW</td><td></td></tr> <tr><td>6 W</td><td></td></tr> </table> <p><b>TABLE 14 W<sub>s</sub></b></p> <p>0 No change 1 Marked wind shift 2 Beginning or ending of marked turbulence 3 Marked temperature change (not with altitude) 4 Precipitation begins or ends 5 Change in cloud forms 6 Fog or ice fog bank begins or ends 7 Warm front 8 Cold front 9 Front, type not specified</p> <p><b>TABLE 15 S<sub>b</sub>S<sub>e</sub>S<sub>s</sub></b></p> <p>0 No report 1 Previous position 2 Present position 3 30 nautical miles 4 60 nautical miles 5 90 nautical miles 6 120 nautical miles 7 150 nautical miles 8 180 nautical miles 9 More than 180 nautical miles / Unknown (not used for S<sub>s</sub>)</p>	0 No report		1 NE	7 NW	2 E	8 N	3 SE	9 all directions	4 S		5 SW		6 W	
0 $0^{\circ} - 90^{\circ}$ W	Northern																																	
1 $90^{\circ}$ W - $180^{\circ}$ W	Northern																																	
2 $180^{\circ} - 90^{\circ}$ E	Northern																																	
3 $90^{\circ} - 0^{\circ}$ E	Northern																																	
4 Not Used																																		
5 $0^{\circ} - 90^{\circ}$ W	Southern																																	
6 $90^{\circ} - 180^{\circ}$ W	Southern																																	
7 $180^{\circ} - 90^{\circ}$ E	Southern																																	
8 $90^{\circ} - 0^{\circ}$ E	Southern																																	
0 No report																																		
1 NE	7 NW																																	
2 E	8 N																																	
3 SE	9 all directions																																	
4 S																																		
5 SW																																		
6 W																																		

CHAPTER 4  
APPENDIX B  
FORM 6  
CODE TABLES (CONTINUED)

TABLE 16  $w_d$

- 0 No report
- 1 Signs of a tropical cyclone
- 2 Ugly threatening sky
- 3 Duststorm or sandstorm
- 4 Fog or ice fog
- 5 Waterspout
- 6 Cirrostratus shield or bank
- 7 Altostratus or altocumulus shield or bank
- 8 Line of heavy cumulus
- 9 Cumulonimbus heads or thunderstorms

TABLE 17  $l_r$

- 7 Light
- 8 Moderate
- 9 Severe
- / Unknown or contrails

TABLE 18  $l_t$

- 0 None
- 1 Rime ice in clouds
- 2 Clear ice in clouds
- 3 Combination rime and clear ice in clouds
- 4 Rime ice in precipitation
- 5 Clear ice in precipitation
- 6 Combination rime and clear ice in precip
- 7 Frost (icing in clear air)
- 8 Nonpersistent contrails (less than 1/4 nautical miles long)
- 9 Persistent contrails

TABLE 19  $S_r, E_w, E_l$

- |        |                      |
|--------|----------------------|
| 0 0NM  | 5 50NM               |
| 1 10NM | 6 60-80NM            |
| 2 20NM | 7 80-100NM           |
| 3 30NM | 8 100-150NM          |
| 4 40NM | 9 Greater than 150NM |
|        | / Unknown            |

TABLE 20  $O_e$

- 0 Circular
- 1 NNE - SSW
- 2 NE - SW
- 3 ENE - WSW
- 4 E - W
- 5 ESE - WNW
- 6 SE - NW
- 7 SSE - NNW
- 8 S - N
- / Unknown

TABLE 21  $c_e$

- 1 Scattered Area
- 2 Solid Area
- 3 Scattered Line
- 4 Solid Line
- 5 Scattered, all quadrants
- 6 Solid, all quadrants
- / Unknown

TABLE 22  $i_e$

- 2 Weak
- 5 Moderate
- 8 Strong
- / Unknown

TABLE 23  $V_i$

- 1 Inflight visibility 0 to and including 1 nautical mile
- 2 Inflight visibility greater than 1 and not exceeding 3 nautical miles
- 3 Inflight visibility greater than 3 nautical miles

RECCO SYMBOLIC FORM

SECTION ONE (MANDATORY)

9XXX9 GGggi<sub>d</sub> YQL<sub>c</sub>L<sub>a</sub>L<sub>a</sub> L<sub>o</sub>L<sub>o</sub>L<sub>o</sub>Bf<sub>c</sub> h<sub>a</sub>h<sub>a</sub>h<sub>a</sub>d<sub>t</sub>d<sub>a</sub>  
ddfff TTT<sub>d</sub>T<sub>d</sub>w /jHHH

SECTION TWO (ADDITIONAL)

lk<sub>n</sub>N<sub>s</sub>N<sub>s</sub>N<sub>s</sub> Ch<sub>s</sub>h<sub>s</sub>H<sub>t</sub>H<sub>t</sub> ..... 4dfff  
6W<sub>s</sub>S<sub>s</sub>W<sub>d</sub>d<sub>w</sub> 7I<sub>r</sub>I<sub>r</sub>S<sub>b</sub>S<sub>e</sub> 7h<sub>i</sub>h<sub>i</sub> H<sub>i</sub>H<sub>i</sub> 8d<sub>r</sub>d<sub>r</sub>S<sub>r</sub>O<sub>e</sub>  
8E<sub>w</sub>E<sub>l</sub>c<sub>e</sub>i<sub>e</sub> 9V<sub>i</sub>T<sub>w</sub>T<sub>w</sub>T<sub>w</sub>

SECTION THREE (INTERMEDIATE)

9XXX9 GGggi<sub>d</sub> YQL<sub>c</sub>L<sub>a</sub>L<sub>a</sub> L<sub>o</sub>L<sub>o</sub>L<sub>o</sub>Bf<sub>c</sub> h<sub>a</sub>h<sub>a</sub>h<sub>a</sub>d<sub>t</sub>d<sub>a</sub>  
ddfff TTT<sub>d</sub>T<sub>d</sub>w /jHHH

CHAPTER 4

APPENDIX C

AIRCRAFT RECONNAISSANCE COMMUNICATIONS

1. General. USAF and NOAA aircraft will normally transmit reconnaissance observations using HF single sideband radio through the USAF Aeronautical Station complex to the appropriate weather reconnaissance data monitor. Weather monitors will evaluate these reports and disseminate them to either the AWN at Carswell AFB, TX, or the weather communications facility at Suitland, MD.

2. Air Ground Communications. The USAF aeronautical station contacted will depend upon aircraft location and radio propagation conditions. Initial contact radio frequencies are as published in appropriate en-route flight publications. After initial contact, aeronautical stations will provide a discrete frequency for mission use if possible. Aircrew relay of weather reconnaissance data will be by direct phone-patch to the weather monitor. Specific radio procedures and terminology will be described in Allied Communications Publication (ACP) 125. USAF has authorized the use of "Immediate" precedence for transmission of hurricane reconnaissance reports as follows:

PRIMARY

Direct phone-patch between aircraft and Miami Monitor (Atlantic and Eastern Pacific) or Hickam Weather Monitor (Central Pacific) through any aero station.

SECONDARY

Direct phone-patch between aircraft and any weather monitor through any aero station.

3. Air-to-Air Communications. When more than one reconnaissance aircraft is known to be operating in a particular area of interest, the following frequencies will be used for plane-to-plane communications and coordination:

- a. Primary VHF 123.05 MHz.
- b. Secondary UHF 304.8 MHz
- c. Back-up HF 4701 KHz USB

4. Aircraft Satellite Data Link (ASDL) Equipped Aircraft. Aircraft equipped with ASDL have the option to utilize the ASDL system using the following procedures:

- a. Data Format - This format will be used for data transmission by the ASDL System.



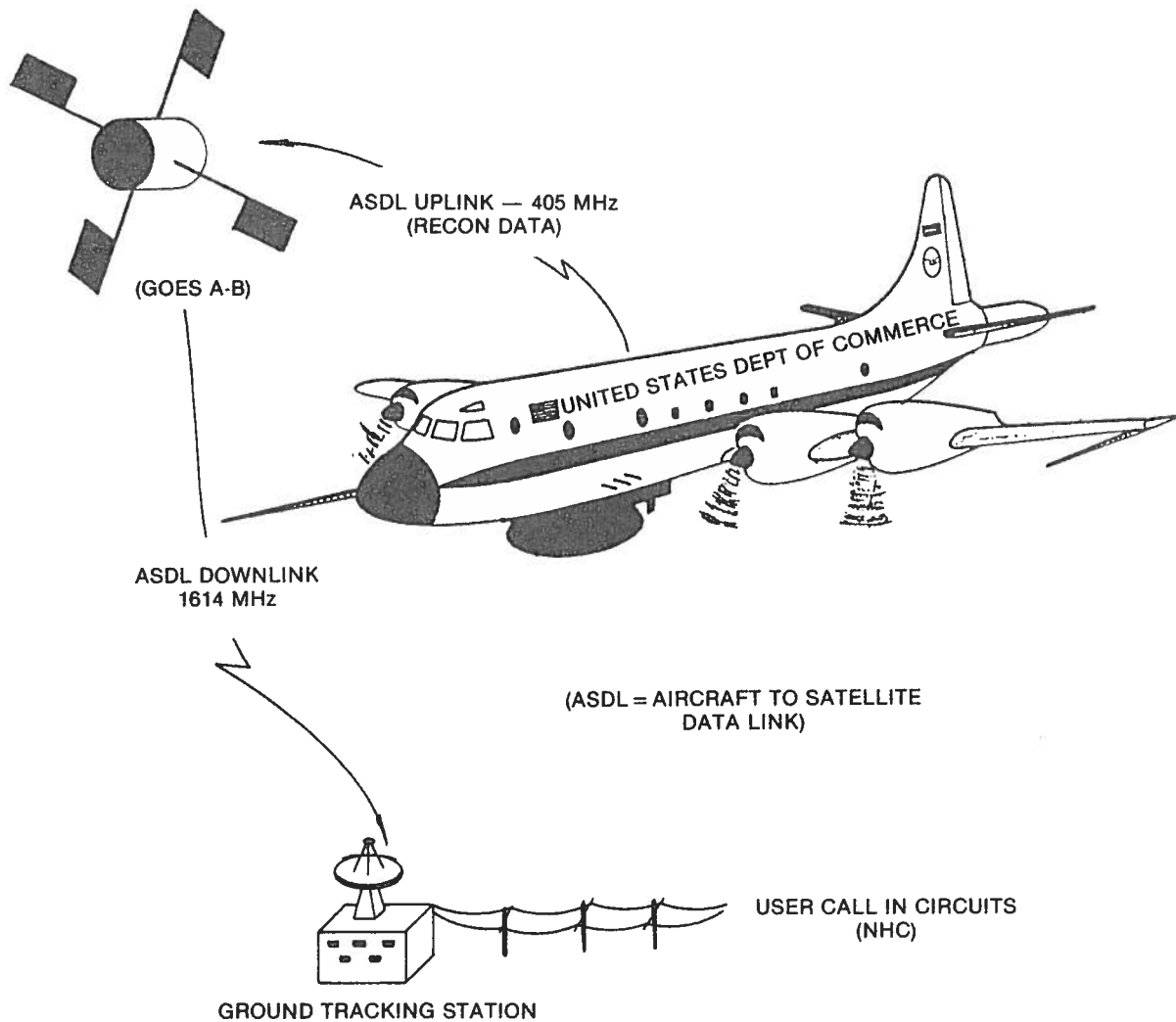
- (1) One Minute Observation - All locations  
 (Message Header) (Date/Time)  
 URNT40 KMIA 291630  
 (Platform Identifier) (Date/Time-NESDIS)  
 15C9419C 23012 3220  
 (Mission Identifier)  
 NOAA2 0401 ANA  
 (TIME) (LATITUDE) (LONGITUDE) (PRESS ALT) (D VALUE)  
 1233 2803 08037 06173 +0436  
  
 (WIND) (TEMP) (DP)  
 213010 +138 +096  
 NNNN
- (2) RECCO Observation - Atlantic Area  
 (Message Header) (Date/Time) Same as for 1 minute  
 observation.  
 (Platform Identifier) (Date/Time-NESDIS) - Same as for 1  
 minute observation.  
 (Observation Manop Heading) (Date/Time)  
 URNT11 KMIA 281642  
 NOAA2 0401 ANA OB 03  
 (RECCO text)  
 97779 12428.....93275  
 NNNN
- (3) RECCO Observation - Eastern and Central Pacific - Same as for  
 Atlantic except that observation manop heading is URPN11 KMIA.  
 Note: 11 used for routine tropical cyclone observation  
 12 used for vortex reports, etc.

b. Data Transmission Schedule - To facilitate the transmission of data from several aircraft through one circuit, each aircraft will be assigned a specific block of time within the 30-minute interval for transmission of its data using the following schedule:

0—— +5	+5—— +10	+10—— +15	+15—— +20
	OAO 42RF P-3(A)	OAO 43RF P-3(B)	
+20—— +25	+25—— +30	+30—— +35	+35—— +40
RADAR	RADAR		OAO 42RF P-3(A)
+40—— +45	+45—— +50	+50—— +55	+55—— +60
OAO 43RF P-3(B)		RADAR	RADAR

Because only 4 minutes and 28 seconds of each 5-minute time block can be used for data transmission, roughly 1/2 minute is left in each transmission block. This schedule is designed to eliminate diagnostic statements that would appear at the NESDIS computer if data from specific sources arrived at the computer at unscheduled times.

c. Data Transmission Test - Prior to the beginning of the hurricane season (June), each aircraft equipped with ASDL will perform a ground or airborne test of the equipment and data ground handling procedures to determine the equipment reliability, transmission errors, and time lapse between transmission of the data from the aircraft and receipt of the data by the hurricane forecaster. Test data will be forwarded to the Chairman of the Working Group for Hurricane and Winter Storms Operations.



Schematic of the Aircraft to Satellite Data Link (ASDL)  
on NOAA P-3 Aircraft

RECONNAISSANCE ORGANIZATION COMMUNICATION CAPABILITIES

<u>STATION</u>	<u>ADDRESS</u>	<u>TELETYPE</u>	<u>TELEPHONE</u>
Federal Coordinator for Meteorology (OFCM)	Suite 300, 11426 Rockville Pike Rockville, MD 20852	-	AV 851-1460 CO 301-770-3464 FTS 443-8704
CARCAH/MIAMI Monitor	OL-G, AWS Coral Gables, FL	A B C	AV 894-3430 CO 305-666-4612 FTS 350-5547 AV 894-1150 (phone patch only)
Mather Weather Monitor	Det 7, 24 WS Mather AFB, CA	B	AV 828-4377
Hickam Weather Monitor	Det 4, 1 WW Hickam AFB, HI	B	AV 315-449-1279
National Hurricane Center	Nat'l. Hurricane Center Coral Gables, FL	A B C	CO 305-667-3108 FTS 350-5547
Alternate National Hurricane Center	WSFO Washington, DC	A C	CO 301-899-3152 FTS-763-3864
	WSFO New Orleans, LA	A C	CO 504-522-7330 FTS 682-6891
Eastern Pacific Hurricane Center	WSFO Redwood City, CA	C	CO 415-364-4610 FTS 463-7767
Central Pacific Hurricane Center	WSFO Honolulu, HI	C	CO 808-836-1831 FTS 546-2853
Naval Eastern Oceano- graphy Center, Norfolk	NAVEASTOCEANCEN Norfolk, VA	B	AV 564-7750/3770 FTS 954-7750/3770
Naval Western Oceano- graphy Center, Pearl Harbor	NAVWESTOCEANCEN Pearl Harbor, HI	B	AV 315-430-0111 (ask for 471-0004)
Office of Aircraft Operations	OAO Miami, FL		CO 305-526-2936 FTS 350-2936
Det 5, AWS	Det 5, AWS Keesler AFB, MS		AV 868-2544
AF Global Weather Central	AFGWC Offutt AFB, NE	B	AV 271-2586 FTS 866-2586
CINCLANTFLT OAC	CINCLANTFLT OAC Ronkonkoma, NY	C	AV 938-1694
ARTCC Miami	ARTCC Miami, FL	C	AV 894-1910
53 WRS	53 WRS Keesler AFB, MS		AV 868-4540 CO 601-377-4540
815 WRS	815 WRS Keesler AFB, MS		AV 868-4318 CO 601-377-4318

A - GT7072  
B - COMEDS  
C - AFTN



## CHAPTER 5

### SATELLITE SURVEILLANCE OF TROPICAL AND SUBTROPICAL CYCLONES

#### 1. Satellites

a. Geostationary Operational Environmental Satellite (GOES). The GOES system consists of two operational spacecraft, GOES East at 75 degrees W and GOES West at 135 degrees W. Standby spacecraft with limited operational capabilities are positioned between 75W and 135W. The principal GOES products are 1/2-hourly pictures with implanted grids automatically applied to all sectors. During daylight hours, approximately 1, 2, and 4 km resolution fixed standard sectors are produced. During the night (also available in daylight), the same geographical coverage standard sectors are produced with 7 Km resolution infrared (IR). The IR data may be enhanced to emphasize various features. Floating sectors which are scheduled by the Satellite Field Services Stations (SFSS's) are produced to augment the standard sector coverage support. All products are delivered in near real time to the National Environmental Satellite, Data and Information Service (NESDIS) Synoptic Analysis Branch (SAB), the SFSS's, and Weather Service Forecast Offices (WSFOs). (See GOES Operational Data Flow, Appendix A, Attachment 1; Satellite Data Availability, Appendix A, Attachment 2.)

b. NOAA Polar-Orbiting Satellites. These satellites cross the U.S. twice daily near the equatorial crossing times as indicated in Appendix A, Attachment 2. Data are available via direct read-out (HRPT and APT) or central processing. AVHRR data are available on a limited basis through the GOES distribution system. The Air Force Global Weather Central (AFGWC) Offutt AFB, NB, receives global NOAA imagery data direct from central readout sites on pass by pass basis. Data are processed in mapped and unmapped form for use internally.

#### 2. Satellite Field Services Stations (SFSS)

a. Support Concept. GOES imagery in support of the hurricane warning service is distributed to the Central Data Distribution Facility (CDDF) at Marlow Heights, MD, to the SFSS's in Miami, San Francisco, Washington, New Orleans, and Honolulu. These SFSS's are colocated with NWS hurricane warning offices and are responsible for providing direct satellite support to the warning center. This support includes the use of floating sectors at 1, 2, and 4 km visible and 7 km IR positioned over the storm area. SFSS's and SAB routinely provide classification of storms using Dvorak Techniques for both visible and IR data.

b. Station Contact. SFSS satellite meteorologists can be contacted as follows:

(1) Miami - 24 hours a day at (305) 350-4460 or FTS 350-4460.

(2) San Francisco - 24 hours a day at (415) 896-9122/23 or FTS470-9122/9123.

- (3) Honolulu - 24 hours a day at (808)836-2776.
- (4) Washington - 24 hours a day at (301)763-8239 or FTS 763-8425.
- (5) New Orleans - 24 hours a day at (504)649-5130 or FTS 682-2807.

c. Satellite Tropical Disturbance Summary. The Miami, San Francisco, and Honolulu SFSS's distribute twice daily at the times indicated (Appendix B, Form 1 to this Chapter) a satellite summary which describes significant weather in the tropical regions of the Atlantic, Eastern Pacific, and Central Pacific (north and south between 140° W to 170° E, respectively).

3. NESDIS Synoptic Analysis Branch (SAB). SAB operates 24 hours a day to provide satellite support to the National Meteorological Center (NMC). The SAB also distributes twice daily a "Satellite Tropical Disturbance Summary for the Pacific (West of 170° E) and the Indian Ocean." SAB may be contacted at (301) 763-8444 or FTS 763-8444.

4. AFGWC Support and the Defense Meteorological Satellite Program (DMSP). AFGWC uses all available METSAT data when providing fix information. DMSP will provide coverage of tropical/subtropical cyclones whenever possible. Data covering the National Hurricane Operations Plan (NHOP) areas of interest will be received centrally at the AFGWC and locally at the direct readout site at Hickam AFB, HI.

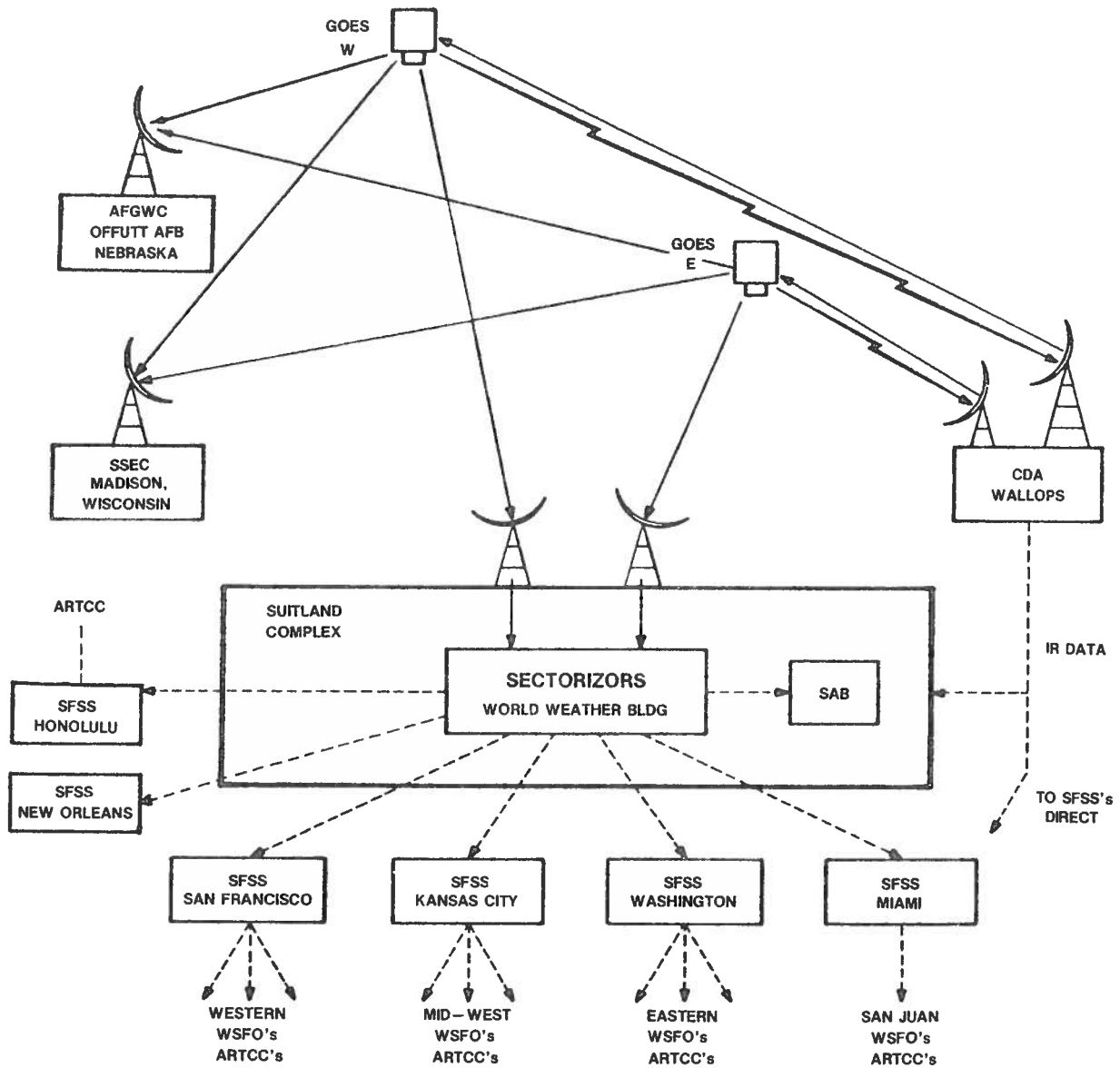
a. North Atlantic and Central Pacific Surveillance. AFGWC readouts will augment NESDIS surveillance for the North Atlantic and Central Pacific. AFGWC will transmit teletype bulletins describing the location and intensity classification of the system (in the format shown in Appendix B, Form 2) to the NHC or CPHC as appropriate, on organized disturbances evident at the Tropical Classification - 1 (T-1) level or higher.

b. Eastern Pacific Surveillance. If EPHC determines the coverage from available NESDIS satellites should be supplemented, they will request the data from AFGWC.

5. Satellites and Satellite Data Availability for the 1984 Hurricane Season. Appendix A, Attachment 2 of this chapter lists satellite capabilities for the 1984 hurricane season.

CHAPTER 5  
 APPENDIX A  
 ATTACHMENT 1

**GOES**  
 OPERATIONAL DATA FLOW



NOTE: Anchorage SFSS is in the GOES Operational Data Flow, but primarily uses the NOAA Polar-Orbiting Satellite data.

CHAPTER 5  
APPENDIX B  
FORM 2

CENTER FIX DATA FORM AND MESSAGE FORMAT (SATELLITE)

<p>MESSAGE HEADING: TPNT CCCC</p>									
<p>A CYCLONE DESIGNATOR</p>	<p>A. Designator of tropical cyclone category including name/number. When a cloud system has not yet been designated by name/number enter TROPICAL DISTURBANCE. Sample entry: TROPICAL STORM AMY (15)</p>								
<p>B DATE/TIME (Z) OF FIX</p>	<p>B. Date and nodal crossing time in Zulu; round time to nearest minute. Sample entry: 252303Z</p>								
<p>C LATITUDE OF POSITION</p>	<p>C. Latitude to nearest tenth of degree (N or S), followed by checksum. Sample entry: 29.9N/0</p>								
<p>D LONGITUDE OF POSITION</p>	<p>D. Longitude to nearest tenth of degree followed by checksum. Sample entry: 56.7 W/8</p>								
<p>E POSITION CODE NUMBER</p>	<p>E. Enter Position Code number (PCN) and source of data (DMSP, NOAA 2, etc.). Spell out PCN number. Select PCN number from code below:</p> <table style="width: 100%; border: none;"> <thead> <tr> <th style="text-align: left; border-bottom: 1px solid black;"><u>GEOGRAPHICAL GRIDDING</u></th> <th style="text-align: left; border-bottom: 1px solid black;"><u>EPHEMERIS GRIDDING</u></th> </tr> </thead> <tbody> <tr> <td>ONE: eye fix</td> <td>TWO: eye fix</td> </tr> <tr> <td>THREE: well defined circulation center</td> <td>FOUR: well defined circulation center</td> </tr> <tr> <td>FIVE: poorly defined circulation center</td> <td>SIX: poorly defined circulation center</td> </tr> </tbody> </table> <p style="text-align: center;">Sample entry: ONE/DMSP</p>	<u>GEOGRAPHICAL GRIDDING</u>	<u>EPHEMERIS GRIDDING</u>	ONE: eye fix	TWO: eye fix	THREE: well defined circulation center	FOUR: well defined circulation center	FIVE: poorly defined circulation center	SIX: poorly defined circulation center
<u>GEOGRAPHICAL GRIDDING</u>	<u>EPHEMERIS GRIDDING</u>								
ONE: eye fix	TWO: eye fix								
THREE: well defined circulation center	FOUR: well defined circulation center								
FIVE: poorly defined circulation center	SIX: poorly defined circulation center								
<p>F DVORAK CLASSIFICATION</p>	<p>F. Dvorak classification for storm intensity as described in NOAA technical Memorandum NESS 45 and IWW/TN-81/001. Dvorak classification will be made once each day and must be based on visual data. If a new Dvorak classification number cannot be derived, use the last reported number. Include in parenthesis the date and nodal time of the data on which the Dvorak analysis is based.  Sample entry: T 4.5/4.5/D1.0/25HRS (252305Z)</p>								
<p>G REMARKS</p>	<p>G. Include information, as appropriate, on data type, eye characteristics, spiral rainbands, unexpected changes in storm movement, departures from Dvorak (modelled) intensities, etc.</p>								



CHAPTER 5  
APPENDIX B

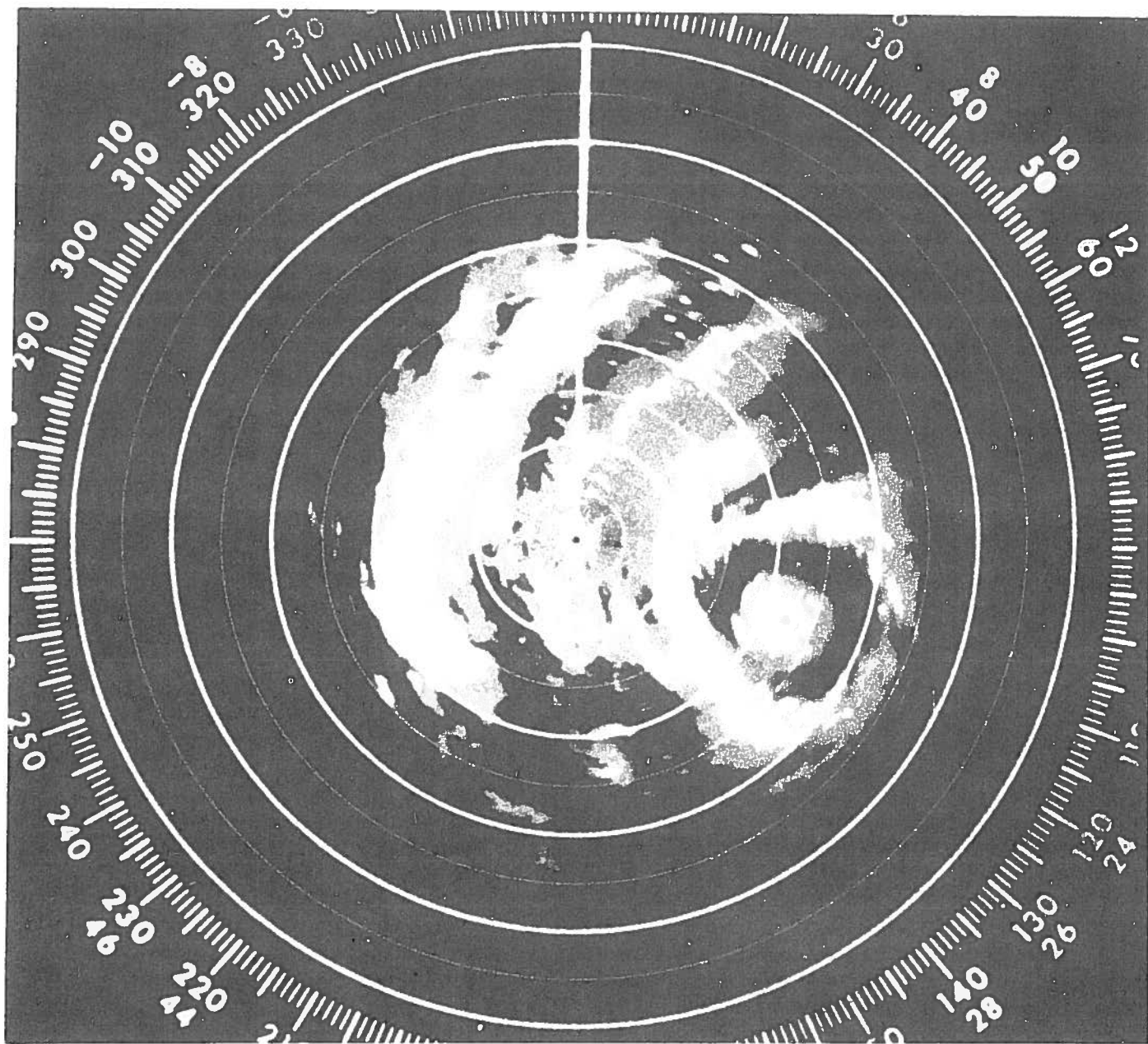
CURRENT INTENSITY AND "T" NUMBER  
CLASSIFICATION TABLE

The current intensity (C.I.) number relates directly to the intensity of the storm. The empirical relationship between the C.I. number and a storm's wind speed is shown in this table.

The C.I. number is the same as the T-number (Tropical Classification number) during the development stages of a tropical cyclone, but is held higher than the T-number while a cyclone is weakening. This is done because a lag is often observed between the time a storm pattern indicates weakening has begun and the time when the storm's intensity decreases. An added benefit from this rule is the stability it adds to the analysis when short-period fluctuations in the cloud pattern occur. In practice, the C.I. number is not lowered until the T-number has shown weakening for 12 hours or more.

<u>C.I. Number</u>	<u>MWS (Knots)</u>	<u>T- Number</u>	<u>MSLP (Atlantic)</u>	<u>MSLP (NW Pacific)</u>
1	25K	1		
1.5	25K	1.5		
2	30K	2	1009 mb	1003 mb
2.5	35K	2.5	1005 mb	999 mb
3	45K	3	1000 mb	994 mb
3.5	55K	3.5	994 mb	988 mb
4	65K	4	987 mb	981 mb
4.5	77K	4.5	979 mb	973 mb
5	90K	5	970 mb	964 mb
5.5	102K	5.5	960 mb	954 mb
6	115K	6	948 mb	942 mb
6.5	127K	6.5	934 mb	929 mb
7	140K	7	921 mb	915 mb
7.5	155K	7.5	906 mb	900 mb
8	170K	8	890 mb	884 mb

The empirical relationship between the current intensity (C.I.) number and the maximum wind speed (MWS), and the relationship between the T-number and the minimum sea level pressure (MSLP).



Hurricane ALLEN (August 9, 1980) as seen by the  
National Weather Service WSR-57 Radar  
at Brownsville, Texas (250 Nautical Mile Range)

## CHAPTER 6

### SURFACE RADAR REPORTING

1. General. Radar observations of tropical cyclones will be made at Department of Defense (DOD), National Weather Service (NWS), and Federal Aviation Administration (FAA) radar facilities and at other cooperating radar facilities according to established agreements with NWS.

#### 2. Procedures.

a. Radar observation of tropical cyclones will be made in accordance with the Federal Meteorological Handbook (FMH) No. 7, Part A, Weather Radar Observations. Stations that normally transmit hourly radar weather observations (network stations) will include tropical cyclone features in routine reports (H+35) and will make and transmit special observations at H+10 whenever an eye or center is observed. It is highly desirable for stations that do not normally transmit hourly reports (WSR-74C's) to make and transmit a radar observation whenever an eye, center, or spiral band is observed. The weather surveillance radar (WSR-74C) sites may transmit only abbreviated special observations, defined in FMH-7, at H+10 and H+35.

b. If the central region of a storm is defined by an identifiable wall cloud; the radar fix is reported as an EYE. If the central region is recognizable, but not well defined by a wall cloud, it is reported as a CENTER. When the EYE or CENTER is only occasionally recognizable or some other central region uncertainty exists, the EYE or CENTER is reported as PSBL EYE or PSBL CENTER. Remarks stating degree of confidence will be included with EYE fixes only and will be classified as either GOOD, FAIR, or POOR. A GOOD fix is reported when the EYE is symmetrical - virtually surrounded by wall cloud; a POOR fix is reported when the EYE is asymmetrical - less than 50 percent surrounded by wall cloud; a FAIR fix is reported to express a degree of confidence between GOOD and POOR.

c. Timely transmission of tropical cyclone radar reports is essential. Normally, radar reports are transmitted on Radar Report and Warning Coordination Circuit (RAWARC), GT 7072, or Conus Meteorological Data System (COMEDS) circuit equipment. Those radar facilities not having weather transmission capability may call the nearest Weather Service Office (WSO) collect.

#### 3. Special Provisions.

a. If NWS Weather Surveillance Radar (WSR 57) and DOD weather radar facilities are collocated (within 25 nautical miles), the NWS radar will have the primary responsibility for making and transmitting tropical cyclone radar reports - DOD will provide backup service. If a radar facility is less powerful than the WSR 57 and is collocated with North American Aerospace Defense Command (NORAD) long-range radar facility, the NORAD long-range radar facility will have the primary responsibility for making and transmitting tropical cyclone radar reports provided it is manned by a qualified weather radar operator, the less powerful radar facility will provide backup service. Any backup radar facility, however, may transmit radar reports as desired.

b. If radar reports are needed from NORAD long-range radar facilities NWS will dispatch weather radar specialists to these facilities to make and transmit tropical cyclone radar observations. DOD has authorized the Director, NWS, to dispatch NWS radar specialists to NORAD sites during critical hurricane threat situations to make and transmit hurricane radar observations. Specific procedures regarding notification, access to sites, clearances, etc., as agreed to by DOD and NWS will be the responsibility of the Severe Weather Branch, Operations Division, NWS Headquarters, and will be strictly adhered to.

c. Air Weather Service staff weather officers providing support to NORAD long-range radar units act as coordinators for visits. These coordinators are: Commander, Det. 9, 3 Weather Sq., 23rd NORAD Regional Operations Control Center (ROCC), Tyndall AFB, FL. (904) 283-2856; Commander Det. 8, 26 Weather Sq., 24 NORAD ROCC, Griffiss AFB, NY (314) 330-2410; Commander, Det. 4, 1 Weather Wing, 326 Air Division, Det. 4, 1WW, Hickam AFB, HI (AV 315-449-6262). Sites are listed in Appendix A of this chapter.

CHAPTER 6  
APPENDIX A  
PARTICIPATING RADAR STATIONS

<u>National Weather Service</u>	<u>Radar</u>	<u>Latitude</u>	<u>Longitude</u>
Apalachicola, FL	WSR-57	29°44'N	84°59'W
Atlantic City, NJ	WSR-57	39°27'N	74°35'W
Baton Rouge, LA	WR-100-5	30°32'N	91°09'W
Brownsville, TX	WSR-57	25°54'N	97°26'W
Brunswick, ME	WSR-57	43°54'N	69°56'W
Cape Hatteras, NC	WSR-57	35°16'N	75°33'W
Charleston, SC	WSR-57	32°54'N	80°02'W
Chatham, MA	WSR-57	41°39'N	69°57'W
Daytona Beach, FL	WSR-57	29°11'N	81°03'W
Galveston, TX	WSR-57	29°18'N	94°48'W
Jackson, MS	WSR-57	32°19'N	90°05'W
Key West, FL	WSR-57	24°33'N	81°45'W
Lake Charles, LA	WSR-57	30°07'N	93°13'W
Miami, FL	WSR-57	25°43'N	80°17'W
New York, NY	WSR-57	40°46'N	73°59'W
Patuxent, MD	WSR-57	38°17'N	76°25'W
Pensacola, FL	WSR-57	30°21'N	87°19'W
San Juan, PR	FPS-67*	18°16'N	65°46'W
Slidell, LA	WSR-57	30°17'N	89°46'W
Tampa, FL	WSR-57	27°42'N	82°24'W
Victoria, TX	WR-100-5	28°51'N	96°55'W
Volens, VA	WSR-74S	36°57'N	79°00'W
Waycross, GA	WSR-57	31°15'N	82°24'W
Wilmington, NC	WSR-57	34°16'N	77°55'W

\*FAA-U.S. Navy joint-use radar.

Department of Defense

Andrews AFB, MD	FPS-77	38°48'N	76°53'W
Barksdale AFB, LA	FPS-77	32°30'N	93°40'W
Bermuda NAS	FPS-106	32°22'N	64°41'W
Cape Canaveral AFS, FL	FPS-77	28°28'N	80°33'W
Chase Field NAS, Beeville, TX	FPS-106	28°22'N	97°40'W
Cherry Point MCAS, NC	FPS-106	34°54'N	76°53'W
Corpus Christi NAS, TX	FPS-106	27°42'N	97°16'W
Eglin AFB, FL	FPS-77	30°29'N	86°31'W
Homestead AFB, FL	FPS-77	25°29'N	80°23'W
Howard AFB, CZ	FPS-77	08°77'N	79°36'W
Jacksonville NAS, FL	FPS-106	30°14'N	81°41'W
Keesler AFB, MS	FPS-77	30°24'N	88°55'W
MacDill AFB, FL	FPS-77	27°51'N	82°30'W
McGuire AFB, NJ	FPS-77	40°00'N	74°36'W
New Orleans NAS, LA	FPS-106	29°50'N	90°01'W
Norfolk NAVEASTOCEANCEN, VA	FPS-106	36°56'N	76°18'W

APPENDIX A (continued)

Pope AFB, NC	FPS-77	35°12'N	79°01'W
Randolph AFB, TX	FPS-77	29°32'N	98°17'W
Robins AFB, GA	FPS-77	32°38'N	83°36'W
Seymour Johnson AFB, NC	FPS-77	35°20'N	77°58'W
Guantanamo Bay Cuba, NAVOCEANCOMDET	FPS-106	19°54'N	75°10'W
Roosevelt Roads PR, NAVOCEANCOMDET	FPS-106	18°15'N	65°38'W

ADCOM Sites

23 NORAD Region Operations Control Center

		<u>Latitude</u>	<u>Longitude</u>
**OLAF, 23 ADS, Patrick AFB, FL		28°13'N	80°36'W
**OLAD, 23 ADS, Ft. Lonesome, FL		27°36'N	82°06'W
OLAJ, 23 ADS, Key West NAS, FL		24°35'N	81°41'W
**678 Radar Sq., Tyndall AFB, FL		30°05'N	85°37'W
701 Radar Sq., Ft. Fisher AFS, NC		33°59'N	77°55'W
OLAC, 23 ADS, Jedburg, SC		33°06'N	80°12'W

24 NORAD Region Operations Control Center

762 Radar Sq., North Truro AFS, MA		42°02'N	70°03'W
772 Radar Sq., Gibbsboro AFS, NJ		39°49'N	74°57'W
OLAA, 24 ADS, Suffolk, NY		40°54'N	72°42'W
**OLAE, 24 ADS, Bucks Harbor AFS, ME		44°38'N	67°24'W

\*\*Remoted in the FAA ARTCC

Cooperating Sites

Bay St. Louis, MS (NASA)	CPS-9	30°42'N	89°07'W
Cambridge, MA (Massachusetts Institute of Technology)	CPS-9 and M-33	42°42'N	71°06'W
College Station, TX (Texas A. & M. University)	CPS-9	30°37'N	96°21'W
Coral Gables, FL (University of Miami)	SP-1M and CPS-68	25°43'N	80°17'W
Wallops Station, VA (NASA)	MPS-19	37°50'N	75°29'W
	SPS-12	37°56'N	75°28'W
	FPS-16	37°50'N	75°29'W
	FPQ-6	37°52'N	75°31'W

Radar used depends upon the location of the hurricane; the one in use will be properly identified.

CHAPTER 7

NOAA DATA BUOY CENTER REPORTING STATIONS

1. General. NOAA Data Buoy Center (NDBC) reporting stations in the Gulf of Mexico and Great Lakes, and off the U.S. east and west coasts obtain data on meteorological and oceanographic parameters for operational and research purposes. Station location and configuration are given in paragraph 4. The status and capability of stations can be obtained from the Data Systems Division, NOAA Data Buoy Center, NSTL Station, MS 39529, telephone: (601) 688-2836, FTS 494-2836. During non-working hours, NDBC can be contacted through the U. S. Coast Guard in New Orleans, LA, telephone: (504) 589-6225, or FTS 682-6225.

2. Procedures. Reporting stations routinely acquire, store, and transmit data every hour. Data obtained operationally include sea-level pressure, wind speed and direction, air temperature, sea-surface temperature, and wave spectral data.

3. Communications. Data are transmitted by UHF communications via the GOES satellite to NESDIS and then are relayed on to NMC, Suitland, MD, for processing and dissemination. Data are formatted into WMO FM13VII synoptic code (see Attachment 1).

4. NOAA Data Buoy Locations and Configurations

a. Gulf of Mexico

<u>Station ID</u>	<u>Location</u> °N/°W	<u>Buoy Size</u>	<u>Sensor Height</u>
42001	25.9/89.7	10 m	10 m
42002	26.0/93.5	10 m	10 m
42003	26.0/85.9	10 m	10 m
42008*	28.7/95.3	Platform	15 m
42011*	26.6/93.5	Platform	12 m

b. Atlantic Ocean

<u>Station ID</u>	<u>Location</u> °N/°W	<u>Buoy Size</u>	<u>Sensor Height</u>
41001	34.9/72.9	12 m	10 m
41002	32.3/75.3	6 m	5 m
41006	29.3/77.3	6 m	5 m
44003	40.8/68.5	6 m	5 m
44004	38.5/70.7	12 m	10 m
44005	42.7/68.3	12 m	10 m
44007	43.5/70.1	12 m	13 m
44008	40.5/69.4	12 m	13 m

\*Temporary sites established in support of other programs.

c. Pacific Ocean.

<u>Station ID</u>	<u>Location</u> <u>°N/°W</u>	<u>Buoy</u> <u>Size</u>	<u>Sensor</u> <u>Height</u>
46011	34.9/120.9	10 m	10 m
46023	34.3/120.7	10 m	10 m
46024	32.8/119.5	10 m	10 m
46025	33.6/119.0	6 m	5 m
51001	23.4/162.3	6 m	5 m



CHAPTER 7  
APPENDIX A

CODE FORM FM 13-V

Report of Synoptic Surface Observation  
from a Sea Station (AUTOMATIC Weather Station)

M<sub>i</sub> M<sub>i</sub> M<sub>j</sub> M<sub>j</sub>

A<sub>i</sub> b<sub>w</sub> N<sub>b</sub> N<sub>b</sub> N<sub>b</sub>

YYGGi<sub>w</sub>

99L<sub>a</sub> L<sub>a</sub> L<sub>a</sub>

Q<sub>c</sub> L<sub>o</sub> L<sub>o</sub> L<sub>o</sub> L<sub>o</sub>

i<sub>r</sub> i<sub>x</sub> ///

/ddff

1s<sub>n</sub> TTT

4PPP

5appp

22200

Os<sub>n</sub> T<sub>w</sub> T<sub>w</sub> T<sub>w</sub>

1P<sub>wa</sub> P<sub>wa</sub> H<sub>wa</sub> H<sub>wa</sub>

333

921ff

925ff

926dd

The numbers of the code tables are the numbers given in the WMO Manual on Codes.



## CHAPTER 8

### MARINE WEATHER BROADCASTS

1. General. The Department of Defense (DOD) and Department of Transportation (DOT) are responsible for broadcasting marine tropical cyclone advisories issued by the National Hurricane Center, the Eastern Pacific Hurricane Center and the Central Pacific Hurricane Center. Appendix A of this chapter lists the stations involved. The broadcasts are for the purpose of providing warnings to meet U.S. international obligations in Department of Commerce (DOC) areas of forecast responsibility given in Chapter 2.

2. Broadcast Procedures. DOT and DOD will arrange for broadcast of all marine tropical cyclone advices immediately upon receipt. The latest tropical cyclone forecast will be transmitted according to the schedule and on the frequencies given in Worldwide Marine Weather Broadcasts. The latest position estimate will be used by DOT and DOD along with the latest forecast for storms on which position estimates are being issued. These broadcasts will be made in both voice and CW mode.

CHAPTER 8

APPENDIX A

List of Marine Tropical Cyclone Forecast  
Broadcast Stations

<u>Station Call Letters</u>	<u>Location</u>
NMW	Astoria, OR
NMF	Boston, MA
NMO	Honolulu, HI
NMQ	Channel Island, CA
NMA	Miami, FL
NMG	New Orleans, LA
NAM	Norfolk, VA
NMN	Portsmouth, VA
NMC	San Francisco, CA
NMR	San Juan, PR

Note: All sites are NOAA with the exception of "NAM", which is DOD.

CHAPTER 9

WARNING TRANSFER POLICIES

1. Transfer of Warning Responsibility.

a. When a tropical/subtropical cyclone approaches longitude 140°W, the coordinated transfer of warning responsibility from Eastern Pacific Hurricane Center (EPHC) to Central Pacific Hurricane Center (CPHC) will be made and appropriate advice issued.

b. When a tropical/subtropical cyclone crosses the 180° meridian from east to west, the coordinated transfer of warning responsibility from CPHC to Joint Typhoon Warning Center (JTWC) will be made and appropriate advice issued.

c. When a tropical/subtropical cyclone crosses the 180° meridian from west to east, the coordinated transfer of warning responsibility from JTWC to CPHC will be made. JTWC will append the statement "Next advisory by CPHC-HNL" to their last advisory.

2. Alternate Responsibilities.

a. In the event of impending or actual operational failure of a hurricane forecast center, responsibilities will be transferred to the appropriate alternate facility in accordance with existing directives and retained there until resumption of responsibility is made. Naval Eastern Oceanography Center, Norfolk, will be advised of impending or actual National Hurricane Center (NHC) and Chief, Aerial Reconnaissance Coordination, All Hurricanes (CARCAH) transfer of responsibility by the most rapid means available.

b. Alternate facilities are as follows:

<u>PRIMARY</u>	<u>ALTERNATE</u>
(1) NHC	HWO (Hurricane Warning Office): Washington (covers Atlantic only) New Orleans (covers Gulf of Mexico and Caribbean)
(2) EPHC	NHC
(3) CPHC	EPHC
(4) JTWC	AJTWC, NAVWESTOCEANCEN, Pearl Harbor
(5) HWO San Juan	NHC

c. In the event of the operational failure of CARCAH, direct communication is authorized between DET. 5, AWS, and the forecast facility. Contact Detachment 5, AWS, at AV 868-2544/CO 601-377-2544, or through the Keesler AFB Command Post at AV 868-4330/CO 601-377-4330.

(continued)

NAM	Navy Communications Area Master Station Atlantic
NASA	National Aeronautics and Space Administration
NAVEASTOCEANCEN	Naval Eastern Oceanography Center
NAVOCEANCOMDET	Naval Oceanography Command Detachment
NAVWESTOCEANCEN	Naval Western Oceanography Center
NDBC	NOAA Data Buoy Center
NESDIS	National Environmental Satellite, Data and Information Service
NHC	National Hurricane Center
NHOP	National Hurricane Operations Plan
NLT	Not Later Than
NMC	National Meteorological Center
NOAA	National Oceanic and Atmospheric Administration
NPSU	National Public Service Unit
NRCC	North American Air Defense Command Regional Control Center
NWS	National Weather Service
OAO	Office of Aircraft Operations
OL-G	Operating Location G
PM	Preventive Maintenance
RAWARC	Radar Report and Warning Coordination
RECCO	Reconnaissance Code
SAB	Synoptic Analysis Branch
SFSS	Satellite Field Services Station
SMS	Synchronous Meteorological Satellite
SR	Scanning Radiometer
SSH	Saffir/Simpson Hurricane
SST	Sea Surface Temperature
TCPOD	Tropical Cyclone Plan of the Day
TD	Tropical Depression
TF	Thermal Fine (Infrared Scanning Radiometer 0.3 n mi)
TS	Thermal Smooth (Infrared Scanning Radiometer 1.5 n mi)
UHF	Ultra High Frequency
US	United States
USAF	United States Air Force
USCG	United States Coast Guard
USN	United States Navy
VIS	Visible
VISSR	Visible - Infrared Spin Scan Radiometer
VTPR	Vertical Temperature Profile Radiometer
WMO	World Meteorological Organization
WRG	Weather Reconnaissance Group
WRS	Weather Reconnaissance Squadron
WSFO	Weather Service Forecast Office
WSO	Weather Service Office
WSOM	Weather Service Operations Manual
WSR	Weather Surveillance Radar
Z	Zulu (Coordinated Universal Time)

## APPENDIX II

### METRIC CONVERSION

This appendix presents in capsular form a description of the International System of Units (SI) metric system and selected standard conversion factors commonly used in meteorology and hydrology. The American National Standard Institute/IEEE Standard 268-1982 Metric Practice has been approved for use by the Department of Defense, other Federal agencies, and by many industries. Users are encouraged to acquire and use the ANSI/IEEE 268-1982 Standard Metric Practice to ensure consistent conversion and implementation.

The first part of this appendix is the Federal Register Notice of February 26, 1982, titled: "Metric System of Measurement; Interpretation and Modification of the International System of Units for the United States." The table herein is a list of selected conversion factors by classification excerpted from the ANSI/IEEE Standard. Finally, the figure shows the relationships of SI units with names. It shows graphically how the 19 SI derived units with special names listed in Table 2 of the Federal Register Notice are derived in a coherent manner from the base and supplementary units. A description of the chart precedes the figure.

The Interdepartmental Committee for Meteorological Services and Supporting Research (ICMSSR) has adopted the kilopascal for use in the U. S. except for aeronautical operations where inches of mercury or hectopascal may be used as appropriate. Termination of the use of the unit bar should begin to be phased in immediately to facilitate conversion to meet the official termination date for the bar of 31 December 1985; however, retrofitting existing systems or modifying existing specifications for new systems is not required.

#### National Bureau of Standards

##### **Metric System of Measurement; Interpretation and Modification of the International System of Units for the United States**

Section 3 of Pub. L. 94-168, the Metric Conversion Act of 1975, declares that the policy of the United States shall be to coordinate and plan the increasing use of the metric system in the United States. Section 403 of Pub. L. 93-380, the Education Amendments of 1974, states the policy of the United States to encourage educational agencies and institutions to prepare students to use the metric system of measurement as part of the regular education program. Under both these acts, the "metric system of measurement" is defined as the International System of Units as established by the General Conference

on Weights and Measures in 1960 and interpreted or modified for the United States by the Secretary of Commerce (sec. 4(4), Pub. L. 94-168; sec. 403(a)(3), Pub. L. 93-380). The Secretary has delegated his authority under these subsections to the Director of the National Bureau of Standards.

In implementation of this authority, tables and associated materials were published in the Federal Register of October 26, 1977 (42 FR 56513-56514), setting forth the interpretation and modification of the International System of Units (hereinafter "SI") for the United States.

In accordance with recent decisions of the International Committee for Weights and Measures of the General Conference on Weights and Measures, and to refine the earlier interpretation and modification, it is deemed appropriate to amend that interpretation

and modification, as published in the above-cited Federal Register notice of October 26, 1977. To assist interested parties and encourage the proper use of SI, the entire interpretation and modification, as hereby amended, is republished. Accordingly, this notice supersedes the notice of October 26, 1977.

The amendments consist of the inclusion in table 2 of the sievert, a special name for the SI derived unit of dose equivalent, the inclusion in table 6 of the electronvolt and the unified atomic mass unit, and the inclusion in table 7 of the rem, a unit of dose equivalent. The unit "standard atmosphere" is no longer included in table 7. The amendments are indicated by a dagger symbol (†).

The SI is constructed from seven base units for independent quantities plus two supplementary units for plane angle and solid angle, listed in table 1.

TABLE 1.—SI BASE AND SUPPLEMENTARY UNITS

Quantity	Name	Symbol
<b>SI base units</b>		
length	meter	m
mass <sup>1</sup>	kilogram	kg
time	second	s
electric current	ampere	A
thermodynamic temperature	kelvin	K
amount of substance	mole	mol
luminous intensity	candela	cd
<b>SI supplementary units</b>		
plane angle	radian	rad
solid angle	steradian	sr

<sup>1</sup> "Weight" in common parlance is often used to mean "mass."

Units for all other quantities are derived from these nine units. In table 2 are listed 19 SI derived units with special names which were derived from the base and supplementary units in a coherent manner, which means, in brief, that they are expressed as products and quotients of the nine base and supplementary units without numerical factors.

TABLE 2.—SI DERIVED UNITS WITH SPECIAL NAMES

Quantity	SI unit		
	Name	Symbol	Expression in terms of other units
frequency	hertz	Hz	s <sup>-1</sup>
force	newton	N	kg m/s <sup>2</sup>
pressure, stress, energy, work, quantity of heat	pascal	Pa	N/m <sup>2</sup>
power, radiant flux	joule	J	N m
electric charge, quantity of electricity	watt	W	J/s
electric potential, potential difference, electromotive force	coulomb	C	A s
capacitance	volt	V	W/A
electric resistance	farad	F	C/V
conductance	ohm	Ω	V/A
magnetic flux	siemens	S	A/V
magnetic flux density	weber	Wb	V s
inductance	tesla	T	Wb/m <sup>2</sup>
luminous flux	henry	H	Wb/A
illumination	lumen	lm	cd · sr
Celsius temperature <sup>1</sup>	lux	lx	lm/m <sup>2</sup>
activity (of a radionuclide)	degree Celsius	°C	K
absorbed dose, specific energy imparted, absorbed dose index	becquerel	Bq	s <sup>-1</sup>
dose equivalent, dose equivalent index	gray	Gy	J/kg
	sievert	Sv	J/kg

<sup>1</sup> In addition to the thermodynamic temperature (symbol T) expressed in kelvins (see table 1), use is also made of Celsius temperature (symbol t) defined by the equation  $t = T - T_0$  where  $T_0 = 273.15$  K by definition. The unit "degree Celsius" is equal to the unit "kelvin," but "degree Celsius" is a special name in place of "kelvin" for expressing Celsius temperature. A temperature interval or a Celsius temperature difference can be expressed in degrees Celsius as well as in kelvins.

All other SI derived units, such as those in tables 3 and 4, are similarly derived in a coherent manner from the 28 base, supplementary, and special-name SI units.

TABLE 3.—EXAMPLES OF SI DERIVED UNITS EXPRESSED IN TERMS OF BASE UNITS

Quantity	SI unit	Unit symbol
area	square meter	m <sup>2</sup>
volume	cubic meter	m <sup>3</sup>
speed, velocity	meter per second	m/s
acceleration	meter per second squared	m/s <sup>2</sup>
wave number	1 per meter	m <sup>-1</sup>
density, mass density	kilogram per cubic meter	kg/m <sup>3</sup>
specific volume	cubic meter per kilogram	m <sup>3</sup> /kg
current density	ampere per square meter	A/m <sup>2</sup>
magnetic field strength	ampere per meter	A/m
concentration (of amount of substance)	mole per cubic meter	mol/m <sup>3</sup>
luminance	candela per square meter	cd/m <sup>2</sup>

TABLE 4.—EXAMPLES OF SI DERIVED UNITS EXPRESSED BY MEANS OF SPECIAL NAMES

Quantity	Name	Unit symbol
dynamic viscosity	pascal second	Pa s
moment of force	newton meter	N m
surface tension	newton per meter	N/m
heat flux density, irradiance	watt per square meter	W/m <sup>2</sup>
heat capacity, entropy	joule per kelvin	J/K
specific heat capacity, specific entropy	joule per kilogram kelvin	J/(kg K)
specific energy	joule per kilogram	J/kg
thermal conductivity	watt per meter kelvin	W/(m K)
energy density	joule per cubic meter	J/m <sup>3</sup>
electric field strength	volt per meter	V/m
electric charge density	coulomb per cubic meter	C/m <sup>3</sup>
electric flux density	coulomb per square meter	C/m <sup>2</sup>
permittivity	farad per meter	F/m
permeability	henry per meter	H/m
molar energy	joule per mole	J/mol
molar entropy, molar heat capacity	joule per mole kelvin	J/(mol K)
exposure (x and γ rays)	coulomb per kilogram	C/kg
absorbed dose rate	gray per second	Gy/s

For use with the SI units there is a set of 16 prefixes (see table 5) to form multiples and submultiples of these units. It is important to note that the kilogram is the only SI unit with a prefix. Because double prefixes are not to be used, the prefixes of table 5, in the case of mass, are to be used with gram (symbol g) and not with kilogram (symbol kg).

TABLE 5.—SI PREFIXES

Factor	Prefix	Symbol
10 <sup>18</sup>	exa	E
10 <sup>15</sup>	peta	P
10 <sup>12</sup>	tera	T
10 <sup>9</sup>	giga	G
10 <sup>6</sup>	mega	M
10 <sup>3</sup>	kilo	k
10 <sup>2</sup>	hecto	h
10 <sup>1</sup>	deka	da
10 <sup>-1</sup>	deci	d
10 <sup>-2</sup>	centi	c
10 <sup>-3</sup>	milli	m
10 <sup>-6</sup>	micro	μ
10 <sup>-9</sup>	nano	n
10 <sup>-12</sup>	pico	p
10 <sup>-15</sup>	femto	f
10 <sup>-18</sup>	atto	a

Certain units that are not part of the SI are used so widely that it is impractical to abandon them. The units that are accepted for continued use in the United States with the International System are listed in table 6.

TABLE 6.—UNITS IN USE WITH THE INTERNATIONAL SYSTEM

Name	Symbol	Value in SI unit
minute (time)	min	1 min = 60 s
hour	h	1 h = 60 min = 3 600 s
day	d	1 d = 24 h = 86 400 s
degree (angle)	°	1° = (π/180) rad
minute (angle)	'	1' = (1/60)° = (π/10 800) rad
second (angle)	"	1" = (1/60)' = (π/648 000) rad
liter	L <sup>*</sup>	1 L = 1 dm <sup>3</sup> = 10 <sup>-3</sup> m <sup>3</sup>
metric ton	t	1 t = 10 <sup>3</sup> kg
hectare (land area)	ha	1 ha = 10 <sup>4</sup> m <sup>2</sup>
electronvolt	eV	1 eV = 1.602 · 10 <sup>-19</sup> J, approximately**
unified atomic mass unit	u	1 u = 1.660 57 · 10 <sup>-27</sup> kg, approximately**

\* Both L and l are international symbols for liter. Because "l" can easily be confused with the numeral "1" the symbol "L" is recommended for United States use.  
\*\* The values of these units in terms of SI units are obtained experimentally.

In those cases where their usage is already well established, the use, for a limited time, of the units in table 7 is accepted, subject to future review.

TABLE 7.—UNITS IN USE TEMPORARILY WITH THE INTERNATIONAL SYSTEM

nautical mile	angstrom	cune
knot	barn	roentgen
	bar	rad <sup>2</sup>
	gal <sup>1</sup>	rem <sup>2</sup>

<sup>1</sup> Unit of acceleration.  
<sup>2</sup> Unit of absorbed dose.  
<sup>3</sup> Unit of dose equivalent.

Metric units, symbols, and terms that are not in accordance with the foregoing Interpretation and Modification are no longer accepted for continued use in the United States with the International System of Units. Accordingly, the following units and terms listed in the table of metric units in section 2 of the Act of July 28, 1866 that legalized the metric system of weights and measures in the United States are no longer accepted for use in the United States: myriameter, stère, millier or tonneau, quintal, myriagram, kilo (for kilogram).

For more information regarding the International System of Units, contact Dr. David T. Goldman, National Measurement Laboratory, National Bureau of Standards, U.S. Department of Commerce, Washington, D.C. 20234, telephone (301) 921-3304.

Dated: February 2, 1982.

Ernest Ambler,  
Director.

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BILLING CODE 3510-12-88

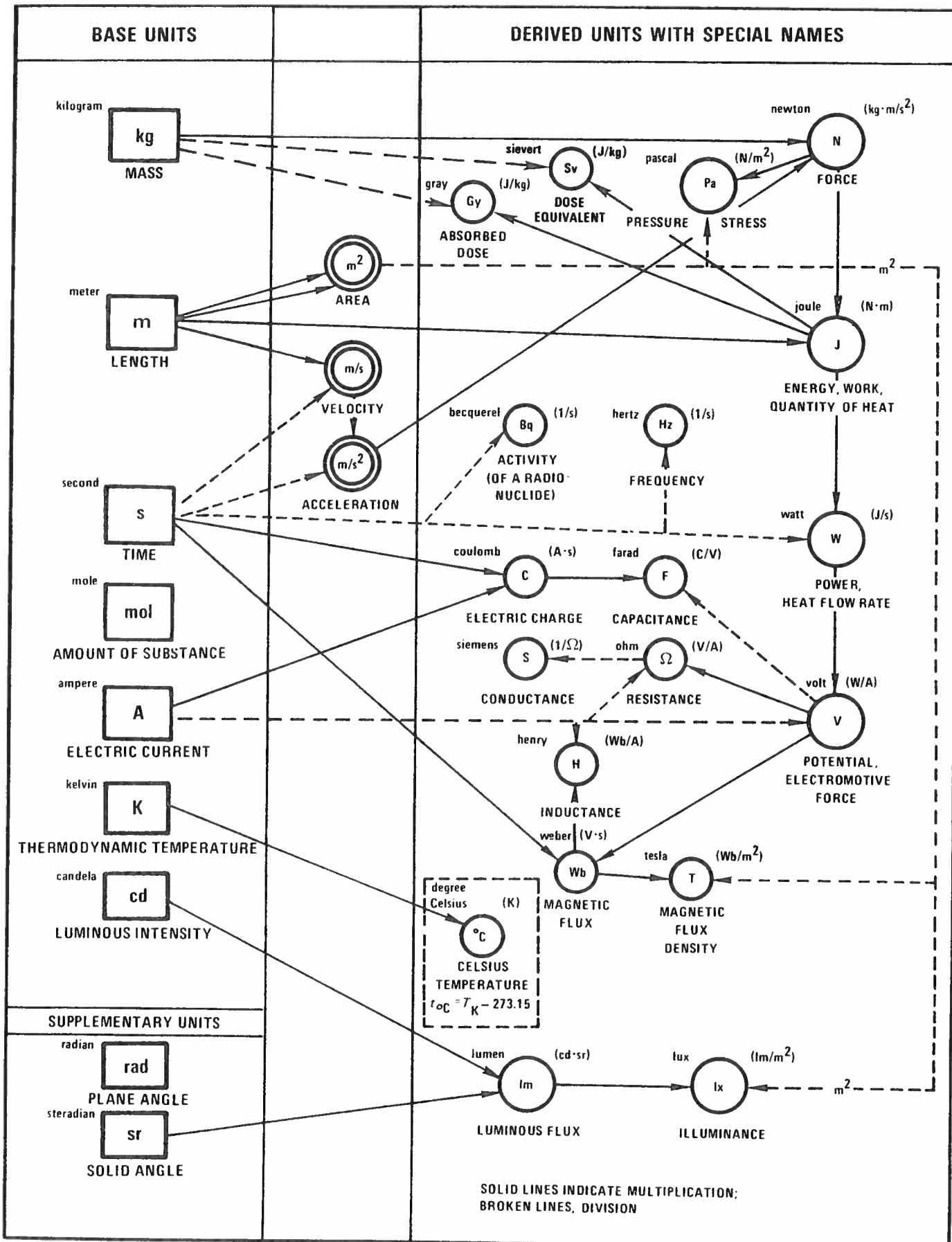


The following chart shows graphically how the 19 SI derived units with special names listed in Table 2 of the Federal Register Notice are derived in a coherent manner from the base and supplementary units. In the first column the symbols of the base and supplementary units are shown in rectangles, with the name of the unit shown toward the upper left of the rectangle and the name of the quantity (measurable attribute) shown below the rectangle. In the third column the symbols of the derived units with special names are shown in solid circles, with the name of the quantity shown below the circle, and an expression of the derived unit in terms of other units shown toward the upper right. In the second column are shown those derived units without special names that are used in the derivation of the derived units with special names. In the chart the derivation of each unit is indicated by arrows bringing in numerator factors (solid lines) and denominator factors (broken lines).

The degree Celsius, shown on the chart in a broken-line rectangle, is a special name for the kelvin, for use in expressing Celsius temperatures or temperature intervals. Where it is used to express temperature intervals, it is equal to the kelvin, as shown on the chart, with the symbol K toward the upper right of the  $^{\circ}\text{C}$  circle; where it is used to express Celsius temperatures, the equation below "CELSIUS TEMPERATURE" relates Celsius temperature ( $t_{\text{OC}}$ ) to thermodynamic temperature ( $T_{\text{K}}$ ).

As stated in the ANSI/IEEE 268 Standard Metric Practice, "The SI unit of pressure and stress is the pascal (newton per square meter) and with proper SI prefixes is applicable to all such measurements. Old metric gravitational units for pressure and stress such as kilogram-force per square centimeter shall not be used. Widespread use has been made of other non-SI units such as bar and torr for pressure, but this use is strongly discouraged. The millibar has been widely used by meteorologists for communication within their profession; there is now some attempt to introduce the name hectopascal as a substitute for millibar. However, the kilopascal should be used in presenting meteorological data to the public."

# RELATIONSHIPS OF SI UNITS WITH NAMES



SELECTED STANDARD CONVERSION FACTORS

Factors with an \* are exact

Unit = SI Standard Unit

ACCELERATION

1 ft/s<sup>2</sup> = 3.048 000\*E-01 m/s<sup>2</sup>  
 standard acceleration of free fall = 9.806 650\*E+00 m/s<sup>2</sup>

ANGLE

1 degree = 1.745 329 E-02 rad

AREA

1 acre = 4.046 873 E+03 m<sup>2</sup>  
 1 ft = 9.290 304\*E-02 m<sup>2</sup>  
 1 hectare = 1.000 000\*E+04 m<sup>2</sup>  
 1 in = 6.451 600\*E-04 m<sup>2</sup>

BENDING MOMENT OR TORQUE

1 dyne.cm = 1.000 000\*E-07 N.m  
 1 lbf.ft = 1.355 818 E+00 N.m

ELECTRICITY AND MAGNETISM

1 ampere hour = 3.600 000\*E+03 C  
 1 EMU of capacitance = 1.000 000\*E+09 F  
 1 EMU of current = 1.000 000\*E+01 A  
 1 EMU of electric potential = 1.000 000\*E-08 V  
 1 EMU of inductance = 1.000 000\*E-09 H  
 1 EMU of resistance = 1.000 000\*E-09 Ω  
 1 ESU of capacitance = 1.112 650 E-12 F  
 1 ESU of current = 3.335 641 E-10 A  
 1 ESU of electric potential = 2.997 925 E+02 V  
 1 ESU of inductance = 8.987 554 E+11 H  
 1 ESU of resistance = 8.987 554 E+11 Ω

ENERGY (Includes WORK)

1 British thermal unit (International Table) = 1.055 056 E+03 J  
 1 British thermal unit (thermochemical) = 1.054 350 E+03 J  
 1 calorie (International Table) = 4.186 800\*E+00 J  
 1 calorie (thermochemical) = 4.184 000\*E+00 J  
 1 electronvolt = 1.602 19 E-19 J  
 1 erg = 1.000 000\*E-07 J  
 1 kW.h = 3.600 000\*E+06 J  
 1 therm = 1.054 804\*E+08 J

ENERGY PER UNIT AREA TIME

1 Btu (International Table)/(ft <sup>2</sup> .h)	=	3.154 591 E+00 W/m <sup>2</sup>
1 erg/(cm <sup>2</sup> .s)	=	1.000 000*E-03 W/m <sup>2</sup>

FLOW (See MASS PER UNIT TIME or VOLUME PER UNIT TIME)

FORCE

1 dyne	=	1.000 000*E-05 N
1 kilogram-force	=	9.806 650*E+00 N
1 pound-force (lbf)	=	4.448 222 E+00 N

FORCE PER UNIT AREA (See PRESSURE)

FORCE PER UNIT LENGTH

1 lbf/ft	=	1.459 390 E+01 N/m
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HEAT

1 Btu (International Table).ft/(h.ft <sup>2</sup> .°F) (thermal conductivity)	=	1.730 735 E+00 W/(m.K)
1 Btu (thermochemical).ft/(h.ft <sup>2</sup> .°F) (thermal conductivity)	=	1.729 577 E+00 W/(m.K)
1 Btu (International Table)/lb	=	2.326 000*E+03 J/kg
1 cal (thermochemical)/(cm.s.°C)	=	4.184 000*E+02 W/(m.K)
1 cal <sub>p</sub> (thermochemical)/s	=	4.184 000*E+00 W <sub>p</sub>
1 ft <sup>2</sup> /h (thermal diffusivity)	=	2.580 640*E-05 m <sup>2</sup> /s

LENGTH

1 angstrom	=	1.000 000*E-10 m
1 astronomical unit	=	1.495 979 E+11 m
1 foot	=	3.048 000*E-01 m
1 inch	=	2.540 000*E-02 m
1 micron	=	1.000 000*E-06 m
1 mile (nautical)	=	1.852 000*E+03 m
1 mile (statute)	=	1.609 344*E+03 m

LIGHT

1 footcandle	=	1.076 391 E+01 lx
1 lambert	=	3.183 099 E+03 cd/m <sup>2</sup>
1 lumen per ft <sup>2</sup>	=	1.076 391 E+01 lm/m <sup>2</sup>

MASS

1 gram	=	1.000 000*E-03 kg
1 pound (avoirdupois)	=	4.535 923 7*E-01 kg
1 tonne	=	1.000 000*E+03 kg

MASS PER UNIT TIME (Includes FLOW)

1 lb/min = 7.559 873 E-03 kg/s

MASS PER UNIT VOLUME (Includes DENSITY and MASS CONCENTRATION)

1 g/cm<sup>3</sup> = 1.000 000\*E+03 kg/m<sup>3</sup>  
 1 lb/ft<sup>3</sup> = 1.601 846 E+01 kg/m<sup>3</sup>

POWER

1 Btu (International Table)/h = 2.930 711 E-01 W  
 1 Btu (thermochemical)/h = 2.928 751 E+01 W  
 1 cal (thermochemical)/s = 4.184 000\*E+00 W  
 1 erg/s = 1.000 000\*E-07 W  
 1 horsepower (electric) = 7.460 000\*E+02 W  
 1 ton of refrigeration (12 000 Btu/h) = 3.517 E+03 W

PRESSURE OR STRESS (FORCE PER UNIT AREA)

1 atmosphere (standard) = 1.013 250\*E+05 Pa  
 1 inch of mercury (60°F) = 3.376 85 E+03 Pa  
 1 millibar = 1.000 000\*E+02 Pa  
 1 psi = 6.894 757 E+03 Pa

RADIOLOGY

1 rem (dose equivalent) = 1.000 000\*E-02 Sv  
 1 roentgen = 2.58 E-04 C/kg

TEMPERATURE

Celsius Temperature = (t<sub>OF</sub> - 32)/1.8  
 Fahrenheit Temperature = 1.8 t<sub>OC</sub> + 32  
 Kelvin Temperature = t<sub>OC</sub> + 273.15

TIME

1 day (mean solar) = 8.640 000\*E+04 s  
 1 day (sidereal) = 8.616 409 E+04 s  
 1 year (sidereal) = 3.155 815 E+07 s  
 1 year (tropical) = 3.155 693 E+07 s

1 VELOCITY (Includes SPEED)

1 ft/min = 5.080 000\*E-03 m/s  
 1 knot (international) = 5.144 444 E-01 m/s  
 1 mi/h (international) = 4.470 400\*E-01 m/s  
 1 mi/h (international) = 1.609 344\*E+00 km/h

VISCOSITY

1 poise = 1.000 000\*E-01 Pa.s  
 1 lb/ft.s = 1.488 164 E+00 Pa.s

VOLUME (Includes CAPACITY)

1 acre-foot	=	1.233 5 E+03 m <sup>3</sup>
1 barrel (oil, 42 gal)	=	1.589 873 E-01 m <sup>3</sup>
1 in <sup>3</sup>	=	1.638 7064*E-05 m <sup>3</sup>
1 L (liter)	=	1.000 000*E-03 m <sup>3</sup>

VOLUME PER UNIT TIME (Includes FLOW)

1 ft <sup>3</sup> /min	=	4.71A19 474 E-04 m <sup>3</sup> /s
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