Comprehensive Ocean-Atmosphere Data Set; Release 1
Supplement J: Quality Control Flowchart

0. Introduction

COADS contains data from numerous and varied sources. Reports were obtained from ship logs, ship weather reporting forms, published ship observations, automatic observing buoys, fixed platforms such as oil rigs, teletype reports, Global Telecommunication System (GTS) reports, and data on cards or magnetic tape that were acquired from foreign meteorological services.

Instrumentation varied from that found aboard a 19th Century Clipper ship to the sophisticated equipment aboard today's research vessels. Observer qualifications ranged from the deck hand with little meteorological experience to the trained meteorologist. A detailed quality control procedure was used to edit this conglomeration of widely differing data.

Each report has been selectively checked for internal consistency, extreme values, and legal codes. The results of the editing process appear as quality indicators (flags) for each element (or variable) checked. In general, if an element had already been flagged and was flagged again, the flag indicating the greatest error severity (i.e., with the largest numerical weight as defined in the following) was retained; and a flagged element was not used in determining if another variable should be flagged.* As an example, if air temperature had been flagged as erroneous, then present weather was not flagged because of that air temperature value. Any suspect or erroneous data found were left unchanged and only flagged in this quality control process, although some data corrections were made beforehand (see supps. I and K).

The quality control subroutine (QC) is an important part of the duplicate elimination program (described in supp. K) because it provided a measure, in the form of a quality code, to judge which report among duplicates was retained.** The quality code assigned to each report is the sum of the weights associated with the 14 flags given by Table J0-1, where the weight and the general meaning of each possible flag value is given by Table J0-2.

It should be noted that the design of the QC will have to be altered to handle observations starting in 1982, when again new coding procedures were introduced.

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* NOTE: a report with ship position flagged erroneous (e.g., landlocked) was also subjected to all other possible checks, and thus individual weather elements such as sea surface temperature may contain an unreliable flag.

** A number of errors discovered in QC were corrected in subsequent reprocessing of the data *after* duplicate elimination and completion of the untrimmed data products. Thus some errors could have influenced the selection of duplicates, and affect the untrimmed products to a largely unknown extent (see supp. E). The description given here describes the net effect of the QC that was originally performed plus the corrections done afterwards, with a few minor exceptions such as the following: 1) When negative dew point temperatures were recomputed because of round-off errors in Australian (deck 900) and HSST Exchange (decks 155-156) data, side-effects on flags were minimized by not completing recomputation unless the new dew point was exactly 0.1 °C colder than the old one. One possible side-effect is that the L and Q flags, for data outside long-term climatological limits $\bar{x} \pm 4.8\sigma$ and $\bar{x} \pm 5.8\sigma$, may no longer be strictly correct. 2) During corrections in which wind direction was temporarily substituted into a missing wave direction, wave fields (direction, period, and height) containing erroneous characters were treated as if they were missing, but would not be treated as such with a revised QC.

Table J0-1
Possible QC Flag Values

Abbrev.	Flag	Possible flag values (X)									
		R	A	B	J	K	L	M	N	Q	S
shipf	ship position	X				*		X			
windf	wind	X	X		X			X		X	X
visf	visibility	X						X			X
prswxf	present weather	X		X	X		X	X			X
pstwxf	past weather	X			X			X			X
pressf	pressure	X				*	X	X		X	X
dryf	air temp.	X			X	*	X	X	X	X	X
wetf	wet bulb temp.	X		X		*	X	X	X	X	X
dewf	dew point temp.	X		X		*	X	X	X	X	X
seaf	sea surface temp.	X				*	X	X		X	X
cloudf	cloud	X	*	X	X				X		X
seawvf	wave	X	X	X	X			X	X	X	X
swlwvf	swell	X		X	X			X	X	X	X
ptendf	pressure tendency	X				X		X			X

* Additional possible flag values in TD-1129 for data in the period 1970-1979 because of flag overlaying (see sec. 1).

Table J0-2
QC Flag Meaning

Value*	Coded**	Weight	Meaning	Reason
R	1	0	correct	--
A	2	1	correctable	legality
B	3	1	correctable	internal consistency
J	4	2	suspect	internal consistency
K	5	2	suspect	time
L	6	2	suspect	extreme (outside $\bar{x} \pm 4.8\,\sigma$)
M	7	3	erroneous	legality
N	8	3	erroneous	internal consistency
Q	9	3	erroneous	extreme (outside $\bar{x} \pm 5.8\,\sigma$)
S	10	3	missing	--

* Alphabetic representation in TD-1129(M).

** Numeric representation in LMR (see supp. F).

1. Effects of Previous Quality Control

For data in the period 1970-1979, at least the '70s Decade data set (source ID 18) had been previously quality controlled by NCDC using a process similar to that described here. In the later years (from May 1973 on) when individual ships could be identified, some track checks were conducted for unbroken series of reports (i.e., when the interval between reports was less than 24 hours). Table J1-1 describes the procedure used.

Table J1-1
Previous '70s Decade Track Checks

1) Ship position flag set to K if either an applicable limit on change in longitude, depending on latitude position, or the limit on change in latitude are exceeded:

Longitude change limit (degree/hour)	Latitude position (X)
0.7	$0 \leqslant \lvert X \rvert \leqslant 39.9$
1.0	$40 \leqslant \lvert X \rvert \leqslant 49.9$
1.4	$50 \leqslant \lvert X \rvert \leqslant 59.9$
2.0	$60 \leqslant \lvert X \rvert \leqslant 69.9$
2.7	$70 \leqslant \lvert X \rvert \leqslant 75.0$
Latitude change limit (degree/hour)	
0.7	

2) Ship position flag set to K in two or more reports with the same call sign and same time but different positions. If the ship positions are within 0.5 ° in both latitude and longitude, change the flag to C for a report with the lowest quality code (ties are handled by the arbitrary selection of one report to receive the C).

3) The following individual elements are flagged K if they show a change greater than the indicated value:

sea level pressure	5 mb/hour
air temperature	5 °C/hour
dew point/wet bulb temperature	5 °C/hour
sea surface temperature	3 °C/hour

Also, it should be noted that a few elements flagged "correctable" by the previous '70s Decade quality control were slightly modified at that time and carried forward. Otherwise the practice at NCDC, starting with data observed in 1970, has been to leave suspect or erroneous data unchanged.

Both the new and old sets of flags are available in LMR, but there is room for only one set of flags in TD-1129. Therefore, the two sets of flags were overlaid in TD-1129 as given in supp. I.

Prior to the 1970-79 period, the data came mostly from the Atlas (source ID 1), which had also been through an earlier editing process where some elements had been changed or eliminated during the quality control, including some creation of composite reports.* For most Atlas data, the flags assigned in the latest quality control will either be an S (missing) or an R (accepted as a valid element), as most of the inconsistencies were corrected during that first edit.

* See supp. K for details on a few similar substitutions between different reports that were carried out in duplicate elimination.

2. Quality Control Flowchart

The following flowchart (covering 14 pages) outlines all the QC checks and conditions for flag assignment. The flags are assigned a value from Table J0-2.

The different elements used to determine the flag values are abbreviated as follows:

y	-	latitude
wddir	-	wind direction
wdspd	-	wind speed
vis	-	visibility
preswx	-	present weather
pastwx	-	past weather
press	-	sea level pressure
dryblb	-	air temperature
wetblb	-	wet bulb temperature
dewpt	-	dew point temperature
seatmp	-	sea surface temperature
N	-	total cloud amount
N_h	-	lower cloud amount
C_L	-	low cloud type
h	-	cloud height
C_M	-	middle cloud type
C_H	-	high cloud type
wvdir	-	wave direction*
wvper	-	wave period
wvhgt	-	wave height
swldir	-	swell direction
swlper	-	swell period
swlhgt	-	swell height
a	-	barometric tendency
ppp	-	amount of pressure change

The order of these variables corresponds to that given in supp. F, which also contains a section describing the possible flag values and details on the representation of the flags in LMR. Barometric tendency and amount of pressure change are available only in the supplemental attachment for data converted into LMR from formats TD-1100 (when the additional data indicator is 6), TD-1127, and TD-1129.

* In their conversion of data into TD-11, NCDC usually substituted wind direction into missing (wind) wave direction since 1 January 1968, when wave direction was no longer ordinarily reported. Instead of continuing this practice, a temporary substitution of wind direction into missing wave direction was made during QC of the wave fields. Afterwards, the wave direction was left missing, thereby preserving any remaining information regarding whether it was separately reported. Note: this same procedure was followed for buoys, although they measure only height and period without discriminating between wave and swell (NCDC placed this information in wave fields).

The wave or swell variables or flags are occasionally abbreviated generically, as follows:

dir	-	wave or swell direction
per	-	wave or swell period
hgt	-	wave or swell height
wvf	-	wave or swell flag

The process so abbreviated is applied identically to both waves and swells.

The following are additional abbreviations:

MISS	-	missing value
n	-	number of observations in $\bar{x}$ and σ
$\bar{x}$	-	mean
σ	-	standard deviation

MISS is a legitimate value for any variable to indicate that it was missing. The mean and standard deviation are 5 ° latitude × 5 ° longitude long-term monthly values for selected variables, which were obtained together with the 1 ° Marsden Square (MSQ) landlocked table from NCDC. These were used to check for extreme values -- but only when the associated number of observations was 25 or more. Therefore, these checks were not made in regions of sparse data, such as high latitudes.

Four symbols make up the flowchart:

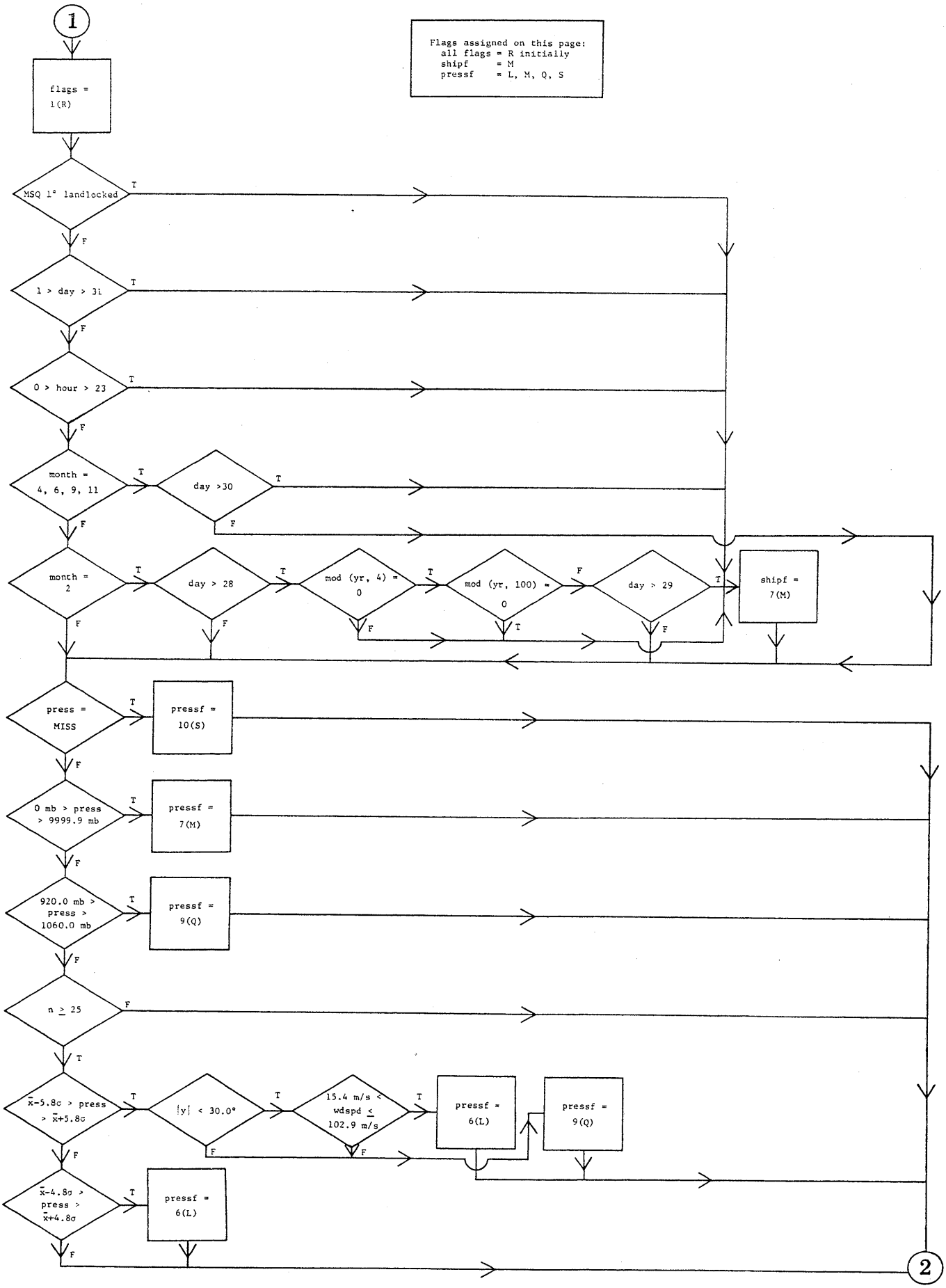
1) A rectangle denotes flag assignment in the form "flag = $n(a)$," where flag is abbreviated as given in Table J0-1, n is the *coded* value, and a is its corresponding character value.

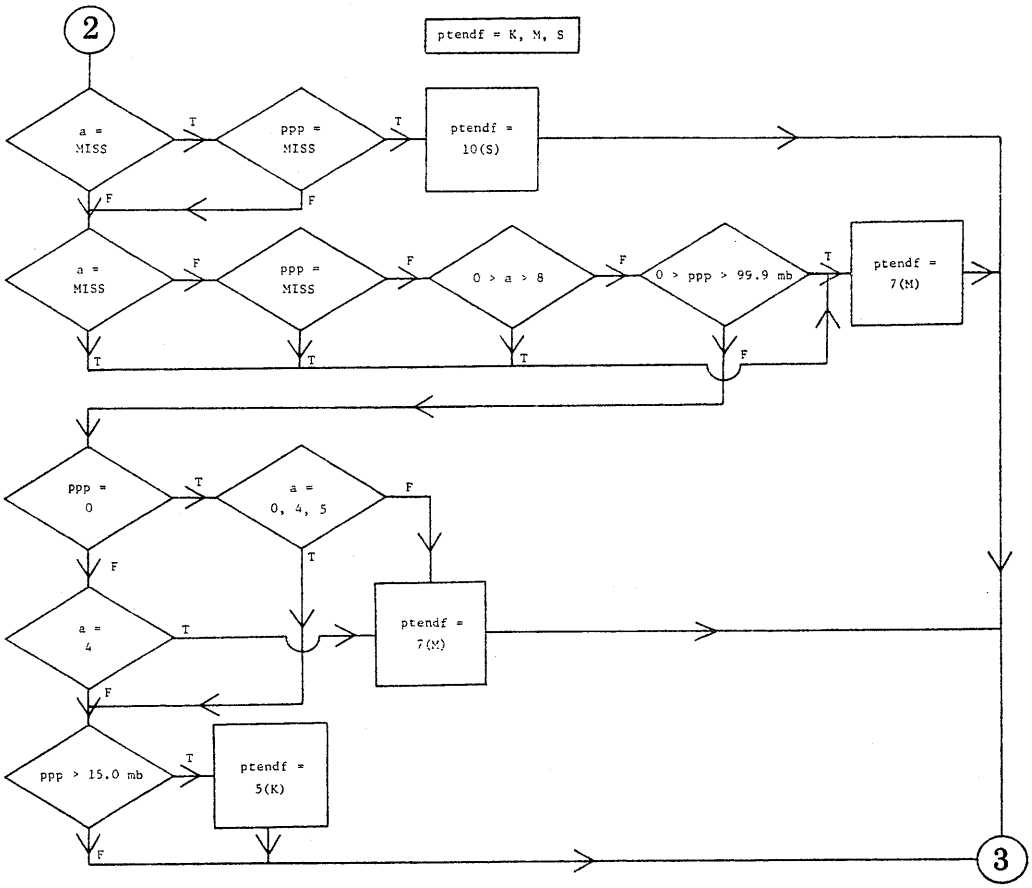
2) A diamond (or in a few cases, a large rectangle) denotes a test involving the element, where the path marked "T" is followed if the condition stated is true, and the path marked "F" is followed if the condition stated is false.

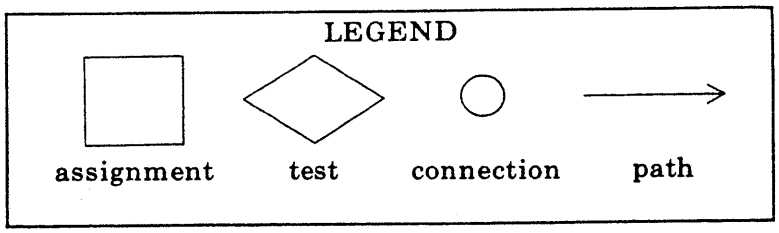
3) A circle denotes flow connections, which connect together the different pages. The flowchart starts at the connection labeled "1" and ends at the connection labeled "end" (on the second to last page).

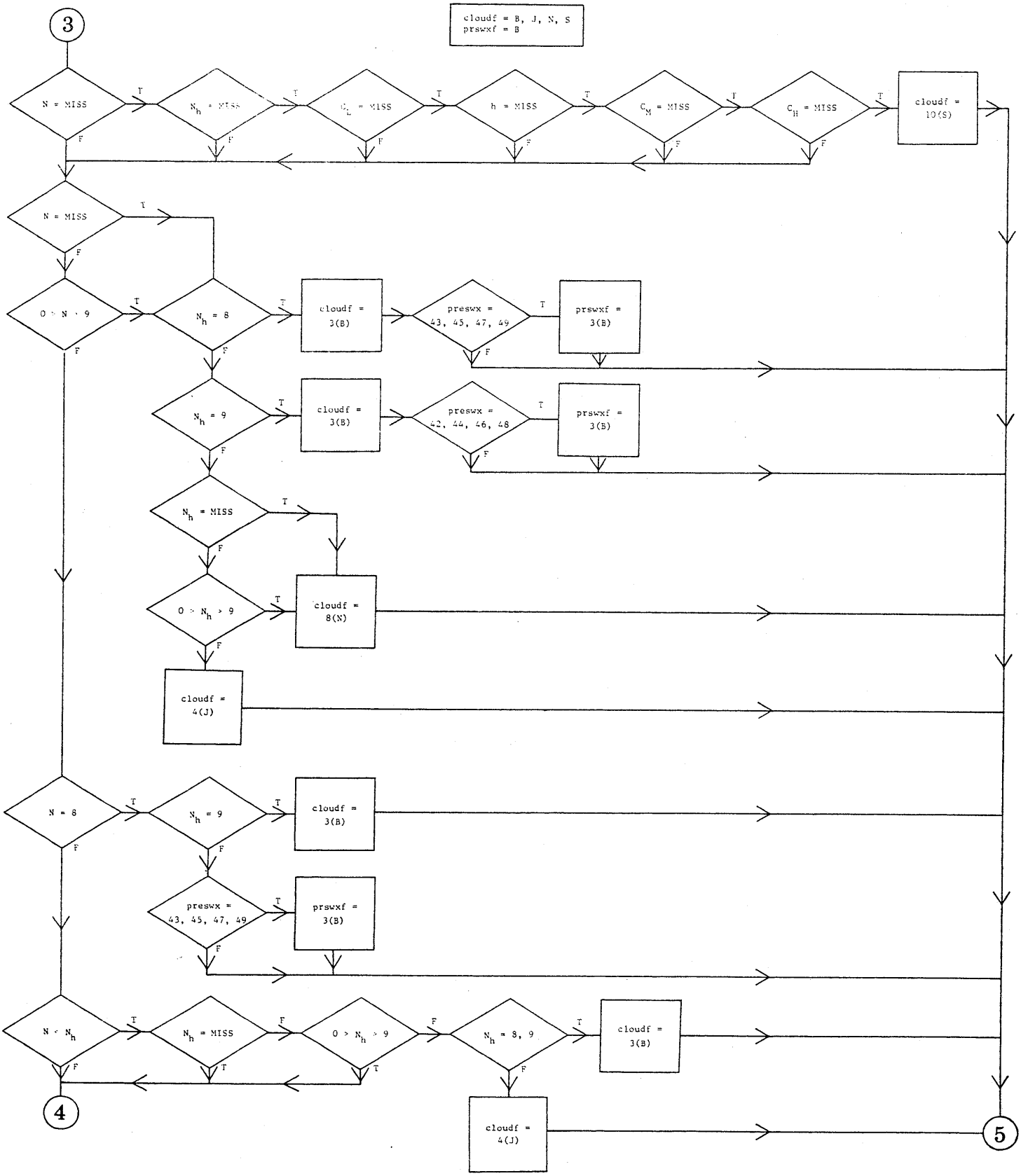
4) Lines with arrows show the path of logical flow (a half-circle on a line bridges the intersection with another line).

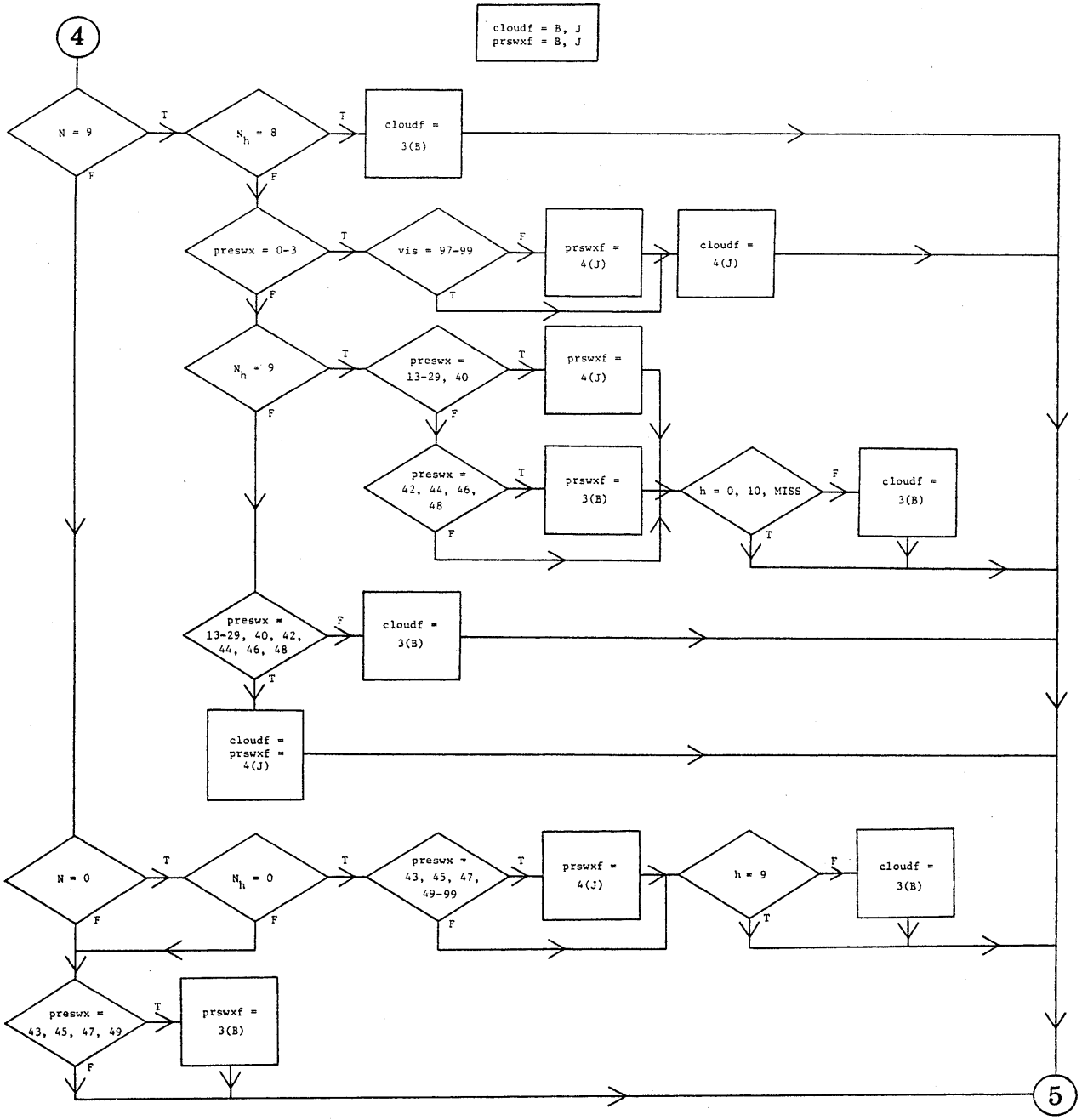
In addition, the various flag assignments covered by a particular page are given at the top of that page.

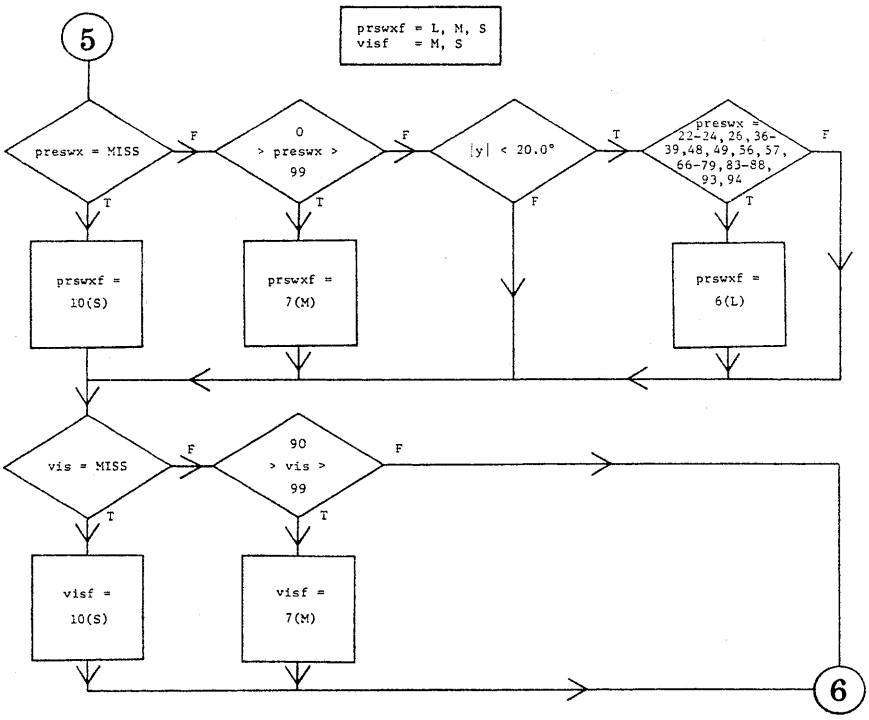


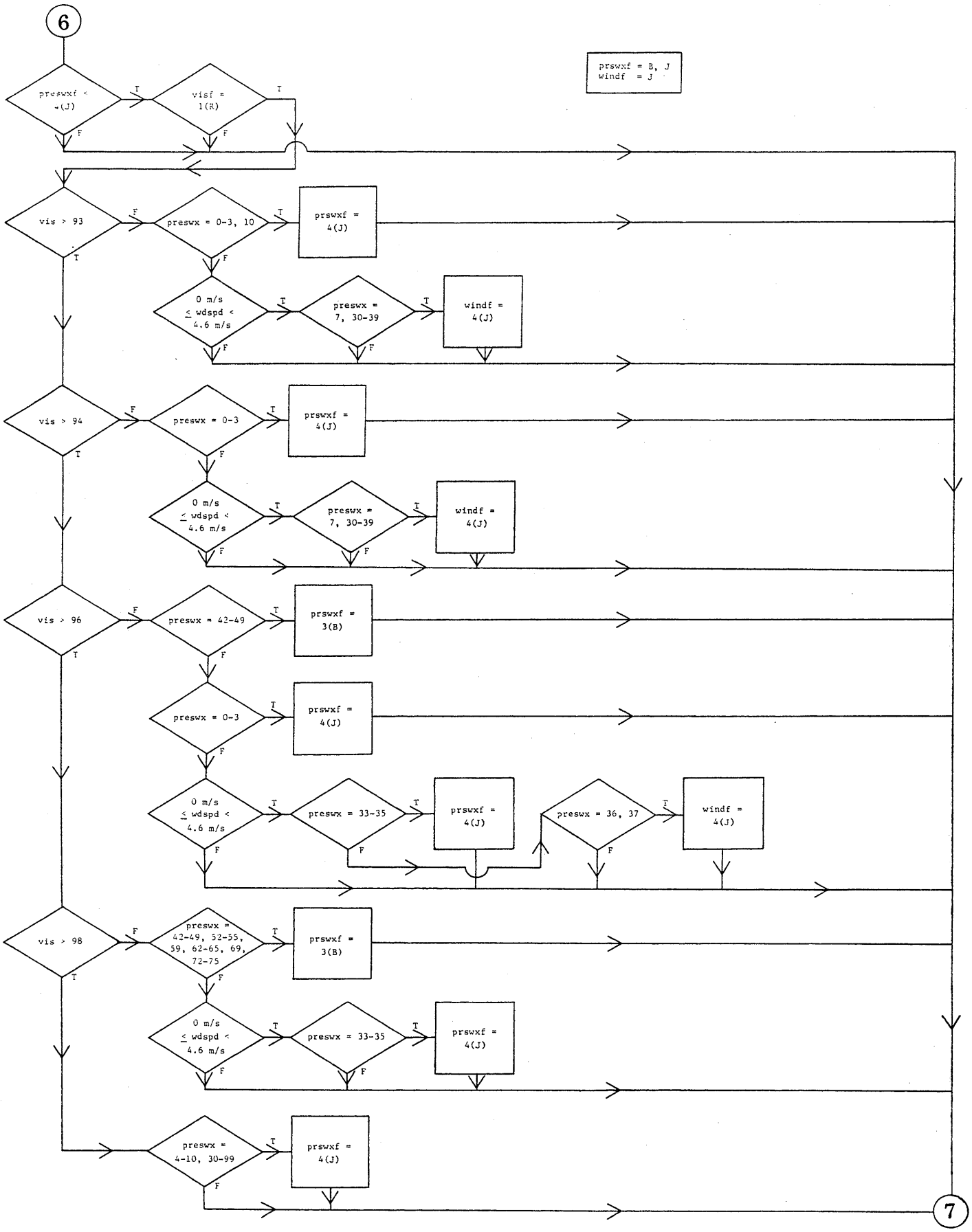


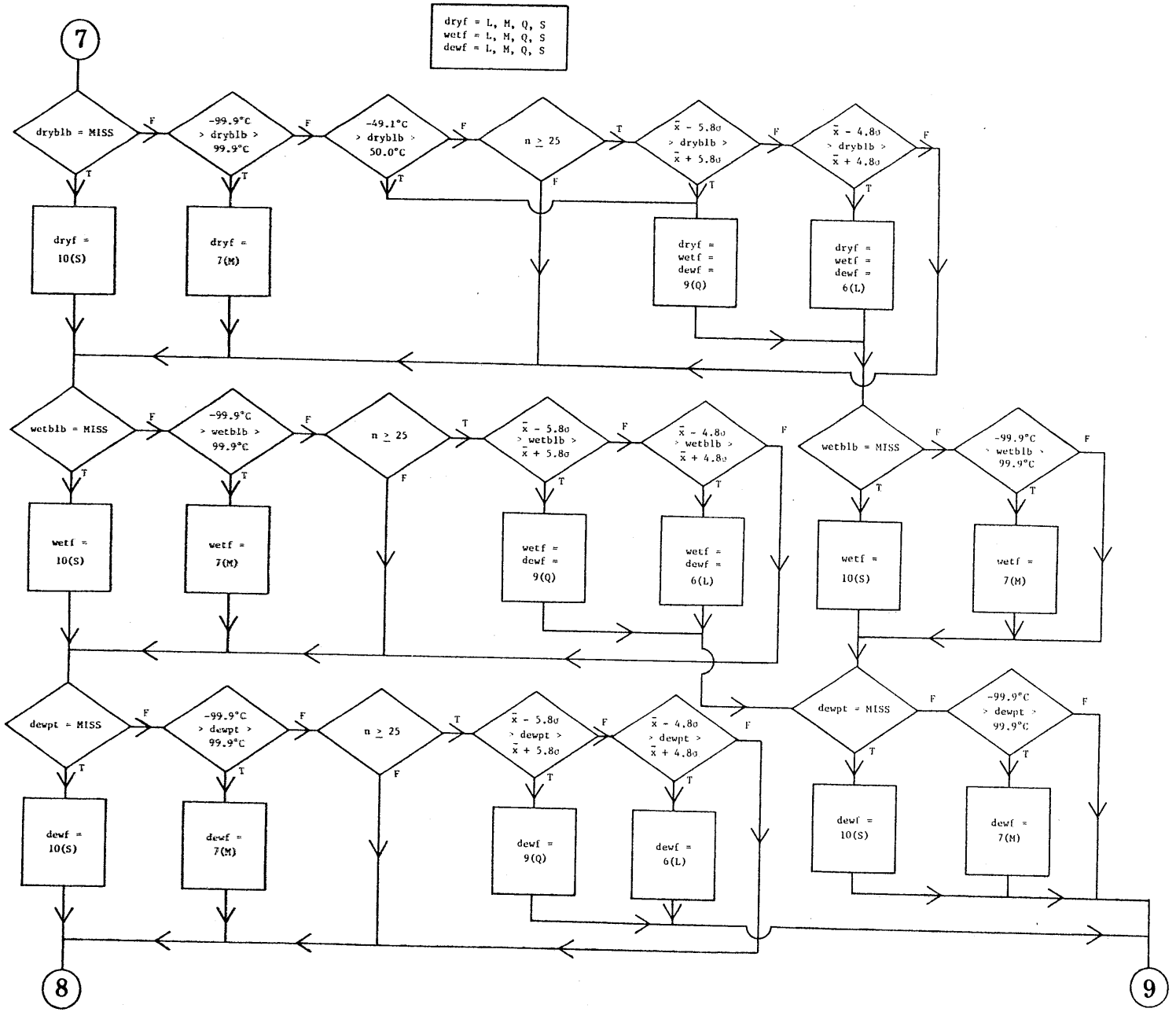


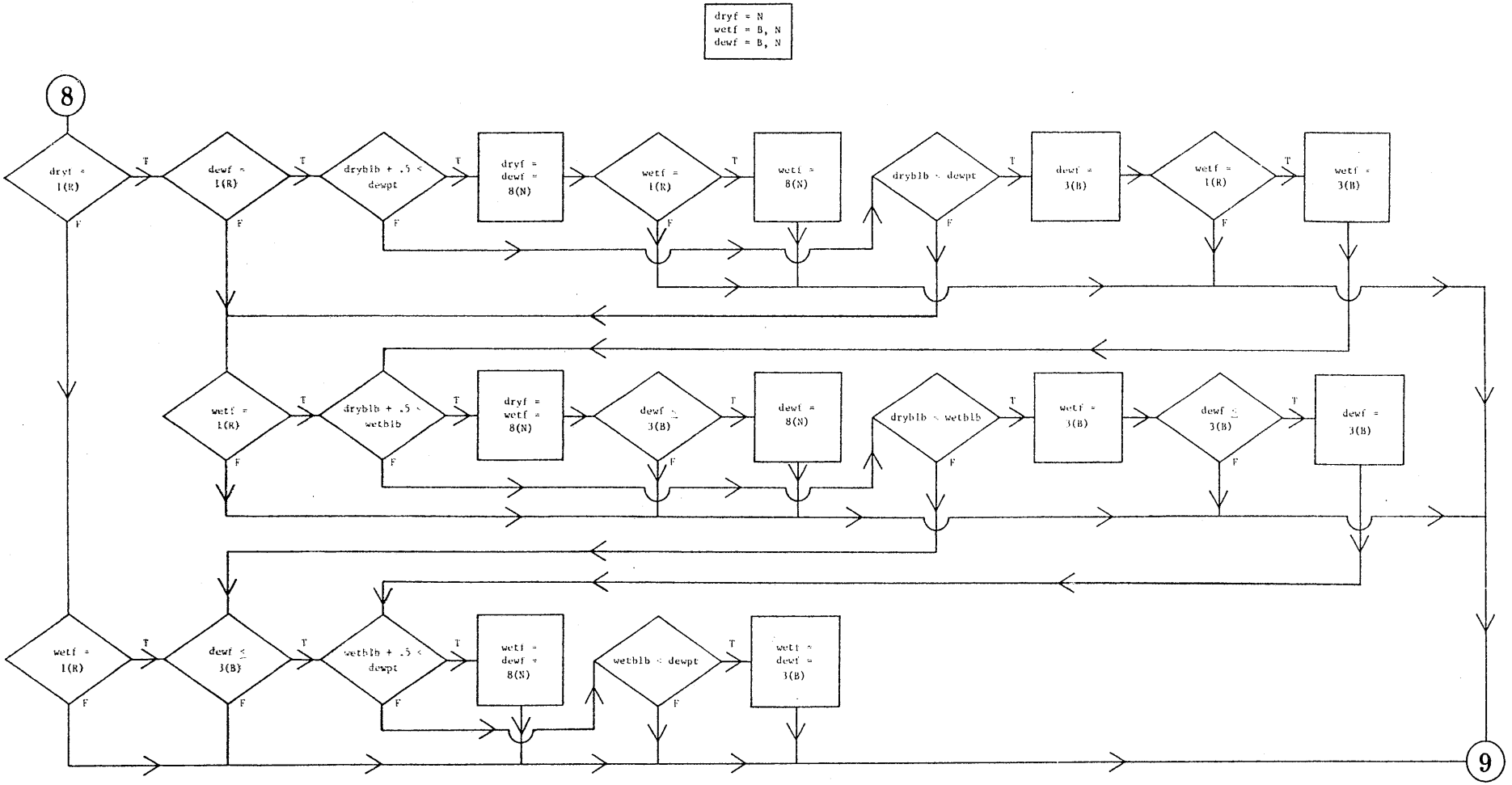


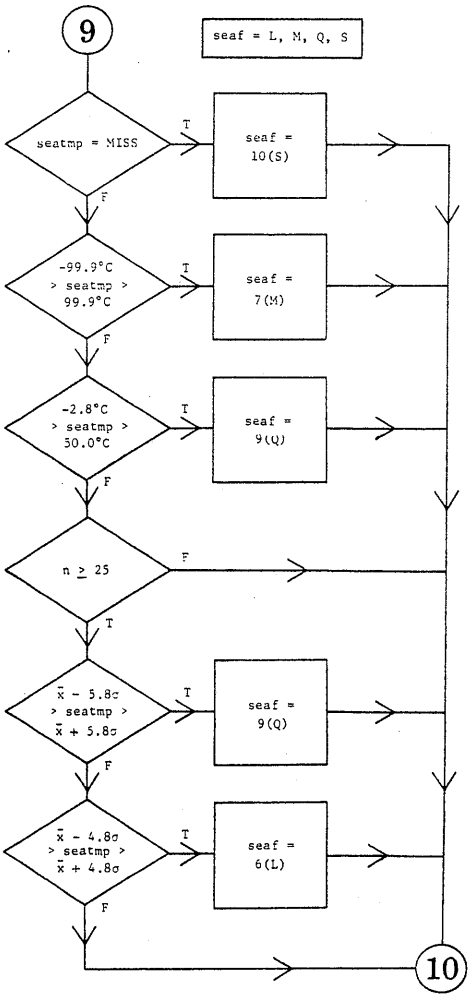


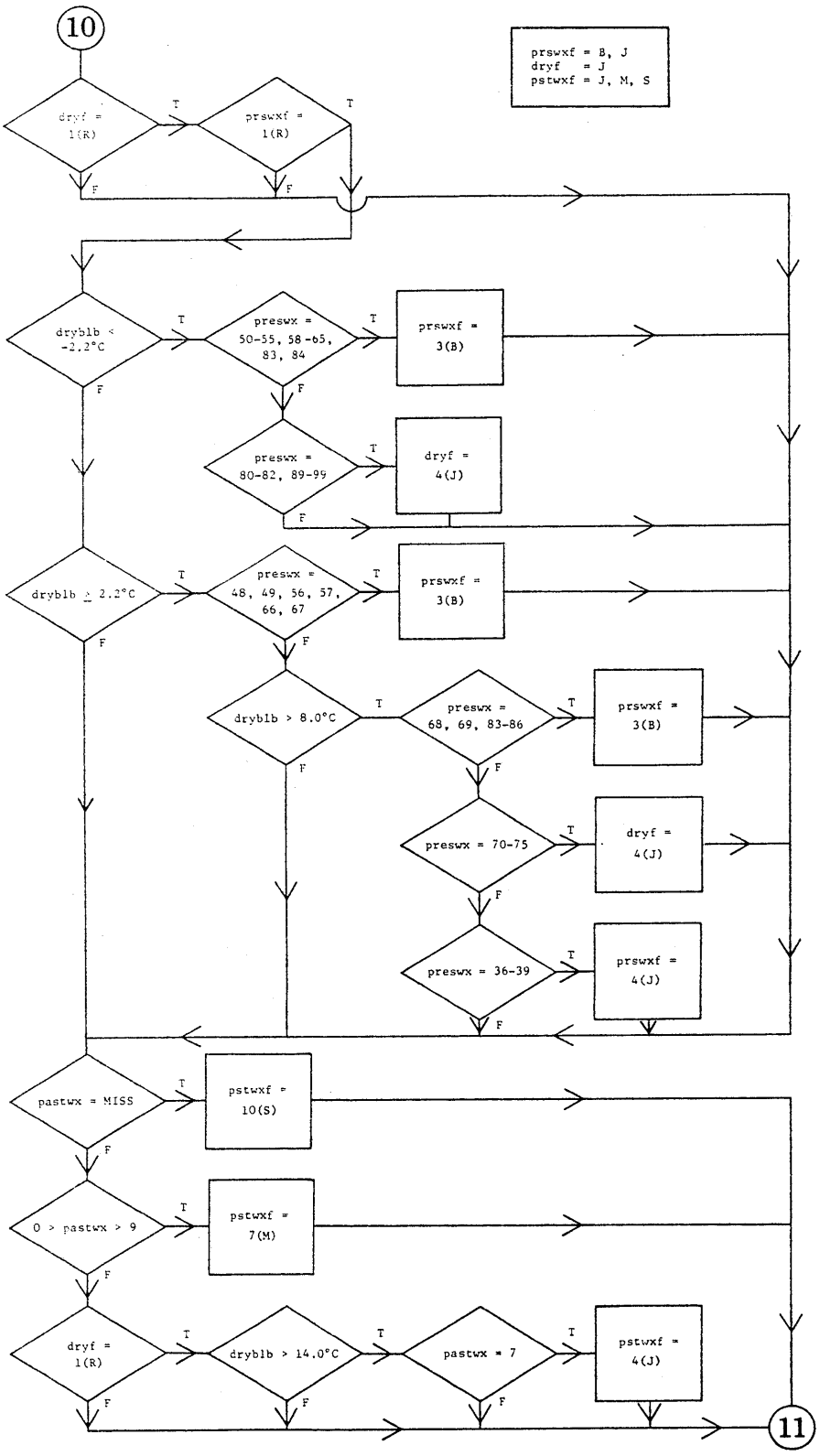


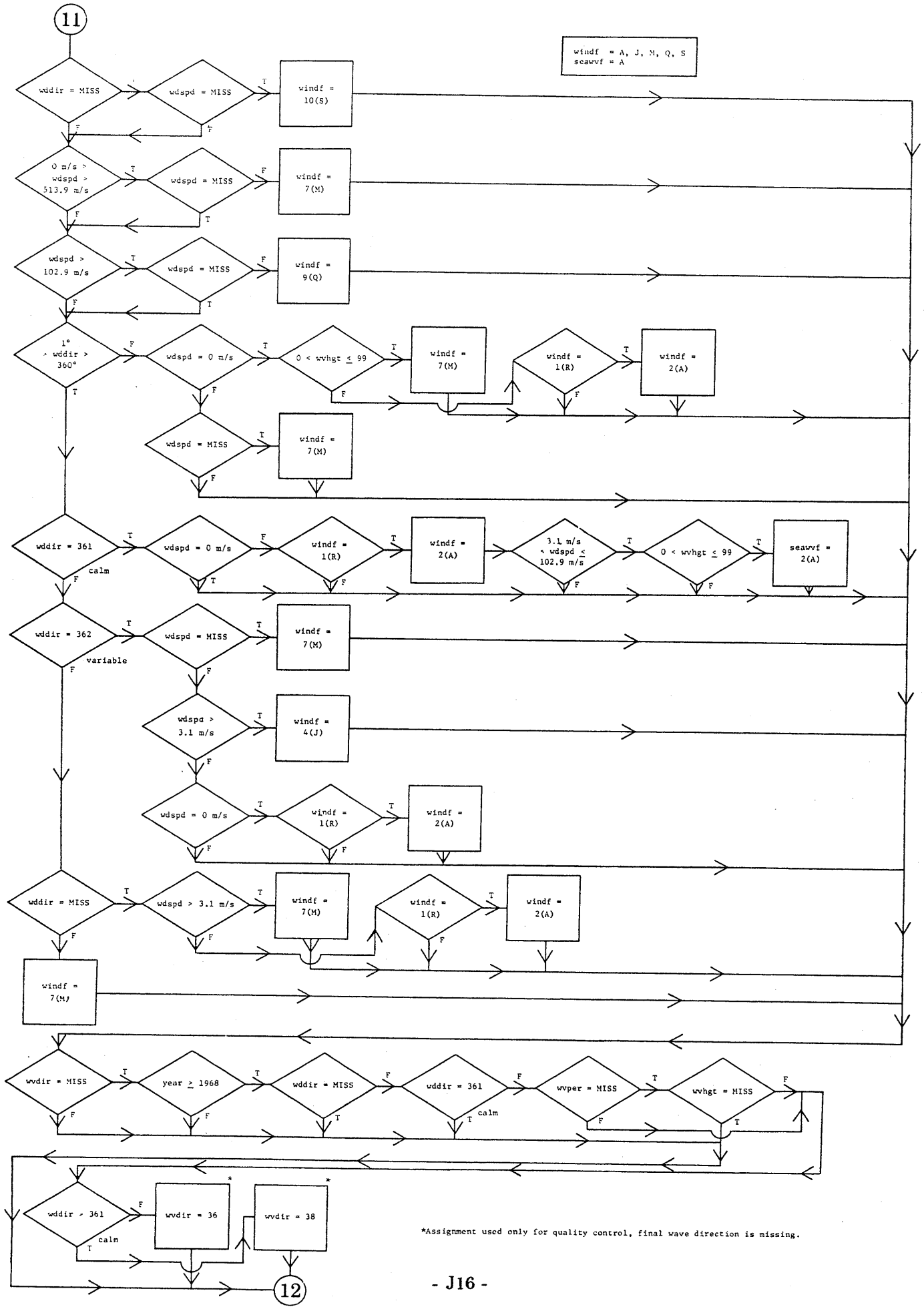












*Assignment used only for quality control, final wave direction is missing.