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=====
International Comprehensive Ocean-Atmosphere Data Set (ICOADS):      Release 2.4
Long Marine Reports/Fixed-length (LMR6/LMRF6)                        22 September 2007
=====<lmr>

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Document Revision Information (previous version: 17 July 2006): Updates for Release 2.4. Following is a list of changes applicable to specific fields:

10) DCK. Table 6a: Added deck 730 (Climatological Database for the World's Oceans). Table 6b: Added deck 245 (Royal Navy Ship's Logs 1938-47, keyed by 2007).

11) SID. Changed the description of SID 121 (NDBC) to indicate "(obtained from NCDC 2005-2007)." Added SIDs 124 (Climatological Database for the World's Oceans; Release 2.0) and 126 (Royal Navy Ship's Logs 1938-47, keyed by 2007).

## {1. Introduction}

LMR6 is a hybrid format, packed binary plus characters, designed for efficient re-expression of observational data from a variety of input formats, including NCDC's Tape Deck-11 (TD-11) formats (NCDC, 1968; NCDC 1989a; NCDC, 1989b). Packed binary methods are employed to store information generally available in individual surface marine reports. A variable-length string of characters and binary information is appended, via an attachment feature, to store quality control flags, supplemental data from original formats (e.g., elements that underwent a questionable conversion), and erroneous data elements. "Uncertain" duplicate reports are also included in LMR6. The size of LMR6 currently averages about 99 bytes per report (including RPTIN overhead, as discussed in sec. 2). The LMR6 format is an updated version of the LMR5 format used for COADS Release 1 (this document updates material in Release 1, supp. F).

LMRF6 is a fixed-length format (512 bits = 64 bytes per report) designed to satisfy the needs of most users, without of complexity of the full variable-length LMR6 format. It incorporates the regular portions of LMR6 plus "trimming" and other selected quality control flags used to generate 2- and 1-degree monthly statistics (see <lmrf> for an overview of LMRF). LMRF6 replaces the CMR5 format (cf., Release 1, supp. D). Uncertain duplicate reports that are included in LMR6, plus landlocked and other suspicious reports, are deleted from LMRF. See <stat\_trim> for specific report rejection rules applied to create LMRF.

Tables 1-3 show the location, regular, and control sections, respectively, of LMR6. The first 448 bits of the LMRF6 format (through field 73 in the control section) are identical to LMR6. The trimming section (Table 5) follows bit 448 to complete the LMRF6 format.

Overall, LMR and LMRF compare in structure and size as follows:

	QC	trimming	suppl.	error	
[loc.][reg.][^ctrl]	[^Attm1]	[^Attm2]	[^Attm4]	[^Attm5]	= ~99 B/report
[loc.][reg.][^]		[ Attm2]			= 64 B (512 bits)

where ^ indicates the first 15 bits of the control section, or the first 12 bits preceding the data in each attachment.

Table 1. LMR6 and LMRF6 location section. Notation is as follows: m:n denotes m through n inclusive; @ is used as a plain text abbreviation for the degree symbol. "Units" gives the smallest increment of the data that has been encoded; thus a change of one unit in the integer coded value represents a change in the true value of one of the units shown (units of 1 are explained in the text describing each section).

No.	Field	Description	True value	Units	Base	Coded	Bits
	RPTIN		n/a	n/a	n/a	n/a	12
	RPTID		n/a	n/a	n/a	n/a	4
1	B10	10-deg box	1:648	1	0	same	10
2	YR	year	1770:2024	1	1769	1:255	8
3	MO	month	1:12	1	0	same	4
4	DY	day	1:31	1	0	same	5
5	HR	hour	0:23.99	0.01	-1	1:2400	12
6	TI	time indic.	0:3	1	-1	1:4	4
7	LON	longitude	0:359.99	0.01 @E	-1	1:36000	16
8	LAT	latitude	-90.00:90.00	0.01 @N	-9001	1:18001	15
9	LI	lat/lon indic.	0:6	1	-1	1:7	4
10	DCK	deck	0:999	1	-1	1:1000	10
11	SID	source ID	0:254*	1	-1	1:255*	8
12	PT	platform type	0:15	1	-1	1:16	5
13	QI#	quality indic.	0:2	1	-1	1:3	2
14	DS	dup status	0:13	1	-1	1:14	5
15	DC	dup check	0:2	1	-1	1:3	4
16	TC	track check	0:1	1	-1	1:2	3
17	PB	pressure bias	0:2	1	-1	1:3	2
section total							133

\* To accommodate additional SIDs, the true value and coded ranges were increased to 0:254 and 1:255 (from 0:99 and 1:100 in previous versions of this document), and the read software {rdlmr6,rdlmrf6} modified to print SID in three positions (formerly two) by shifting fields to the left of SID left by one character (eliminating a blank formerly designated for carriage control). The field width (8 bits) was unchanged, thus we did not classify this as a change in format version.

# Field currently unused.

Table 2. LMR6 and LMRF6 regular section (notation as for Table 1).

No.	Field	Description	True value	Units	Base	Coded	Bits
18	DI	wind dir. indic.	0:6	1	-1	1:7	4
19	D	wind direction	1:362	1 deg	0	same	9
20	WI	wind speed indic.	0:8	1	-1	1:9	4
21	W	wind speed	0:102.2	0.1 m/s	-1	1:1023	10
22	VI	vis. indic.	0:2	1	-1	1:3	2
23	VV	visibility	90:99	1	89	1:10	4
24	WW	present weather	0:99	1	-1	1:100	7
25	W1	past weather	0:9	1	-1	1:10	4
26	W2	2nd past weather	0:9	1	-1	1:10	4
27	SLP	sea level pressure	870.0:1074.6	0.1 hPa	8699	1:2047	11
28	T1	temp. indic.	0:9	1	-1	1:10	4
29	AT	air temperature	-99.9:99.9	0.1 @C	-1000	1:1999	11
30	WBT	wet bulb temp.	-99.9:99.9	0.1 @C	-1000	1:1999	11
31	DPT	dew point temp.	-99.9:99.9	0.1 @C	-1000	1:1999	11
32	SST	sea surface temp.	-99.9:99.9	0.1 @C	-1000	1:1999	11
33	SI	SST method indic.	0:12	1	-1	1:13	4
34	N	total cloud amt.	0:9	1	-1	1:10	4
35	NH	lower cloud amt.	0:9	1	-1	1:10	4
36	CL	low cloud type	0:10	1	-1	1:11	4
37	HI	cloud height indic.	0:1	1	-1	1:2	2
38	H	cloud height	0:10	1	-1	1:11	4
39	CM	middle cloud type	0:10	1	-1	1:11	4
40	CH	high cloud type	0:10	1	-1	1:11	4
41	WD	wave direction	0:38	1	-1	1:39	6
42	WP	wave period	0:30	1 s	-1	1:31	5
43	WH	wave height	0:49.5#	0.5 m#	-1	1:100	7
44	SD	swell direction	0:38	1	-1	1:39	6
45	SP	swell period	0:30	1 s	-1	1:31	5

46	SH	swell height	0:49.5#	0.5 m#	-1	1:100	7
47	C1	country code	0:40	1	-1	1:41	7
48	C2	2nd country code	0:40	1	-1	1:41	7
49	SC	ship course	0:9	1	-1	1:10	4
50	SS	ship speed	0:9	1	-1	1:10	4
51	A	barometric tendency	0:8	1	-1	1:9	4
52	PPP	amt. of SLP change	0:51.0	0.1 hPa	-1	1:511	9
53	IS	ice accretion	1:5	1	0	same	3
54	ES	ice thickness	0:99	1 cm	-1	1:100	7
55	RS	ice accretion rate	0:4	1	-1	1:5	3
56	II	ID indic.	0:10	1	-1	1:11	4
57-							
64	ID(8)	ID/call sign	33:95	1	32	1:63 8x6=	48
65	OS	observation source	0:6	1	-1	1:7	4
66	OP	observation plat.	0:9	1	-1	1:10	4
67	T2	2nd temp. indic.	0:6	1	-1	1:7	3
68	IX	stn/weather indic.	1:6	1	0	same	4
69	WX	wave per. indic.	1:1	1	0	same	1
70	SX	swell per. indic.	1:1	1	0	same	1
71	IRD	IMM receipt date	1:255	1	0	same	8
72	A6	allowance 6 flag	0:1	1	-1	1:2	2
section total							300

# The Fortran access program stores WH/SH with the indicated true value range and units (in array FTRUE), but prints them in two digits as "height in 1/2 meter increments" (i.e., 1=0.5 m, 2=1 m, etc.). See note under WH in the text.

Table 3. LMR6 and LMRF6 control section (notation as for Table 1).

No.	Field	Description	True value	Units	Base	Coded	Bits
		unused	n/a	n/a	n/a	n/a	10
73	CK	checksum	n/a	n/a	n/a	n/a	5
						cumulative total	448#
74	AC	attachment count	1:15	1	0	same	4
						section total	19
						cumulative total	452

# In LMRF6, field 73 is followed by the trimming section (Table 5).

Table 4. LMR6 irregular section (notation as for Table 1).

No.	Field	Description	True value	Units	Base	Coded	Bits
75	AL	attachment length	1:255	1	0	same	8
76	AID	attachment ID	1:15	1	0	same	4
77	AD	attachment data	n/a	n/a	n/a	n/a	n/a

Table 5. LMRF6 trimming section (notation as for Table 1). Except for field numbering, this is also the structure of the LMR6 trimming attachment data.  
NOTE: See <stat\_trim> for field configurations and for report rejection rules applied to create LMRF for Releases 1a-1c.

No.	Field	Description	True value	Units	Base	Coded	Bits
Miscellaneous fields							
74	B2	2-degree box	1:16202	1	0	same	14
75	ND	night/day report flag	1:2	1	0	same	2

Trimming flags

76	SF	SST flag	1:15	1	0	same	4
77	AF	AT flag	1:15	1	0	same	4
78	UF	U-wind flag	1:15	1	0	same	4
79	VF	V-wind flag	1:15	1	0	same	4
80	PF	SLP flag	1:15	1	0	same	4
81	RF	rel. humidity flag	1:15	1	0	same	4

## Composite QC flags (NCDC/other)

82	ZQ	report status flag	1:3	1	0	same	2
83	SQ	SST flag	1:3	1	0	same	2
84	AQ	AT flag	1:3	1	0	same	2
85	WQ	wind flag	1:3	1	0	same	2
86	PQ	SLP flag	1:3	1	0	same	2
87	RQ	WBT/DPT flag	1:3	1	0	same	2

## Composite QC flags (NCDC-only)

88	XQ	present weather flag	1:3	1	0	same	2
89	CQ	cloud flag	1:3	1	0	same	2
90	EQ	wind wave flag	1:3	1	0	same	2

## Landlocked flag

91	LZ	landlocked flag	1:1	1	0	same	1
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## Source exclusion flags

92	SZ	SST flag	1:1	1	0	same	1
93	AZ	AT flag	1:1	1	0	same	1
94	WZ	wind flag	1:1	1	0	same	1
95	PZ	SLP flag	1:1	1	0	same	1
96	RZ	rel. humidity flag	1:1	1	0	same	1

section total    64  
total            512

The Fortran access programs provide the logic necessary to transfer binary data into memory and then extract into INTEGER variables the bit strings whose lengths are given in Tables 1-5. Refer to Release 1, supp. H for more information about the techniques used.

Compression was achieved by packing data represented as positive integers into fields whose lengths are specified in the bits column of Tables 1-5. To accomplish this, a field's floating point true value (within the range of that column) was divided by the appropriate units (the smallest increment of the data that has been encoded). Then the base was subtracted to produce, after rounding, a coded positive integer (within the range of that column), which was finally right-justified with zero fill in the field's appropriate position within the report. Using the sea surface temperature (field 32) true value 28.6 degrees C as an example,  $(28.6/0.1) - (-1000) = 1286$ .

Once a given field has been extracted into a coded value, the true value can be reconstructed by reversing the process:

$$\text{true value} = (\text{coded} + \text{base}) * \text{units}$$

The above true value example is reconstructed by  $(1286 + (-1000) * 0.1) = 28.6$  degrees C. NOTE: in each coded value, zero is reserved as an indicator of missing data. None of B10, YR, MO, LON, or LAT should ever be missing, although DY and HR may be missing.

Explanations for each field in Tables 1-4 are given under the corresponding headings that follow, where all information refers to the true value (unless

explicit mention is made to the contrary). In general, indicators show the reliability or precision of the data they refer to, and may be extant only if the data are also non-missing (possibly in the error attachment). Additional technical or usage notes may appear indented below field descriptions.

An additional document, <stat\_trim>, provides a detailed explanation of the fields listed in Table 5, of the rules used to construct LMR from LMRF, and of those used to calculate monthly summary statistics from LMRF.

[NOTE: Because of processing differences, the three original COADS updates that compose ICOADS.DM, and accompanying documentation, are referred to as follows:

Release 1a: 1980-97 <dupelim\_1980>

Release 1b: 1970-79 <dupelim\_1970>

1946-69 <dupelim\_1946>

Release 1c: 1784-1949 <dupelim\_1784>

These four documents describe the "preconditioning" and duplicate elimination processing used to create LMR for the indicated periods. 1946-49 Release 1b data were replaced by Release 1c data. Fields PT, DS, DC, and II were set during this processing, for example.]

[NOTE: Notice is hereby given that some code descriptions, such as those for present weather, are quoted or paraphrased from sources including NCDC (1968) and WMO (1974) without any further indicator or credit.]

## {2. Location section}

RPTIN

RPTID

The RPTIN field is reserved for use of the RPTIN unblocking utility, where available (e.g., NCAR), and RPTID indicates the LMR format version number (6).

### 1) B10 10-degree box

See Release 1, supp. G for a description of the 10-degree box system. Also, {boxlib} is a set of Fortran software available for using 10-degrees boxes and other global grid systems.

### 2) YR year

The year can range from 1770 to 2024.

### 3) MO month

1=January, 2=February, ..., 12=December.

### 4) DY day

Day of the month.

### 5) HR hour

00.00 to 23.99 UTC.

### 6) TI time indicator

TI shows the incoming precision of time fields:

0 = nearest whole hour

1 = hour to tenths

2 = hour plus minutes

3 = high resolution (e.g., hour to hundredths)

[NOTE: No indication is given for quasi-instantaneous vs. time-period (e.g., daily) averaged data. We have not performed any time-averaging of the data contained in individual marine reports as received from data providers. However, some buoys and other platform types report time-averaged data (e.g., daily averages from PMEL deck 145). Limited time-averaging (or estimation of "prevailing conditions") also applies to some data elements under international or national shipboard observing practices (with significant historical variations). For instance, US-recruited observers are instructed to average wind direction over a period

of 10 minutes.]

7) LON longitude

8) LAT latitude

Position to hundredths of a degree +N or -S (measured north or south of the equator) and +E (measured east of the Greenwich Meridian).

9) LI lat/lon indicator

LI gives the precision to which LAT and LON were recorded or translated from, or if they were derived later by interpolation between known positions:

0 = degrees and tenths

1 = whole degrees

2 = non-random tenths

3 = interpolated

4 = degrees and minutes

5 = high resolution data (e.g., degrees to seconds)

6 = other (refer to metadata)

10) DCK deck

Number of the "deck" the report came from (Table 6a), with Tables 6b and 6c providing additional information about selected deck ranges.

Table 6a. Deck assignments ("deck" originally referred to a punched card deck). See Tables 6b and 6c for details about deck ranges 201-255, and 876-882 and 883.

Deck	Description
*001	US Navy Fleet Numerical Met. and Oceanography Cntr. (FNMOC) Data
*002-009	US National Cntrs. for Environ. Pred. (NCEP) Real-time Obs.
110	US Navy Marine
116	US Merchant Marine
117	US Navy Hourlies
118	Japanese Ships No. 1 (Kobe Collection Data keyed in 1961)
119	Japanese Ships No. 2 (Kobe Collection Data keyed in 1961)
128	International Marine (US- or foreign-keyed ship data)
143	Pacific Marine Environmental Laboratory (PMEL) Buoys
144	TAO/TRITON and PIRATA Buoys (from PMEL and JAMSTEC)
145	PMEL (Daily) Equatorial Moorings and Island Stations
150	Pacific (US Responsibility) HSST Netherlands Receipts
151	Pacific (US Responsibility) HSST German Receipts
152	Pacific (US Responsibility) HSST UK Receipts
155	Indian (Netherlands Responsibility) HSST
156	Atlantic (German Responsibility) HSST
184	Great Britain Marine (194 extension)
185	USSR Marine IGY
186	USSR Ice Stations
187	Japanese Whaling Fleet
188	Norwegian Antarctic Whaling Factory Ships
189	Netherlands Marine
192	Deutsche Seewarte Marine
193	Netherlands Marine
194	Great Britain Marine
195	US Navy Ships Logs
196	Deutsche Seewarte Marine (192 extension)
197	Danish (and Other) Marine (Polar)
201-255	UK Met. Office (MetO) Main Marine Data Bank (MDB) (see Table 6b)
281	US Navy Monthly Aerological Record (MAR)
#500	Gulf Offshore Weather Observing Network (GOWON) (plat data)
555	US Navy Fleet Num. Met. and Oceano. Center (FNMOC; Monterey) Telecom.
666	Tuna Boats
667	Inter-American Tropical Tuna Commission (IATTC)
700	UK Met. Office VOSclim GTS BUFR Data
701	US Maury Collection

702	Norwegian Logbook Collection
704	US Marine Meteorological Journals Collection (1878-94)
705	US Merchant Marine Collection (1912-46) (500 series)
706	US Merchant Marine Collection (1912-46) (600 series)
707	US Merchant Marine Collection (1912-46) (700 series)
714	Canadian Marine Environmental Data Service (MEDS) Buoys
&720	German Marine Meteorological Archive
730	Climatological Database for the World's Oceans (CLIWOC)
731	Russian S.O. Makarov Collection
732	Russian Marine Met. Data Set (MARMET) (received at NCAR)
733	Russian AARI North Pole (NP) Stations
734	Arctic Drift Stations
735	Russian Research Vessel (R/V) Digitization
740	Research Vessel (R/V) Data Quality-Evaluated by FSU/COAPS
749	First GARP Global Experiment (FGGE) Level IIb
761	Japanese Whaling Ship Data (CDMP/MIT digitization)
762	Japanese Kobe Collection Data (keyed after decks 118-119)
780	Levitus World Ocean Atlas/Database (WOA/WOD)
792	US Natl. Cntrs. for Environ. Pred. (NCEP) BUFR GTS: Ship Data
793	NCEP BUFR GTS: Buoy Data (transmitted in FM 13 "SHIP" code)
794	NCEP BUFR GTS: Buoy Data (transmitted in FM 18 "BUOY" code)
795	NCEP BUFR GTS: Coastal Marine Automated Network (C-MAN) Data
796	NCEP BUFR GTS: Miscellaneous (OSV, plat, and rig) Data
849	First GARP Global Experiment (FGGE)
850	German FGGE
874	Shipboard Environmental (Data) Acquisition System (SEAS)
876-#882	US National Data Buoy Center (NDBC) Data (see Table 6c)
883	US National Data Buoy Center (NDBC) Data (see Table 6c)
888	US Air Force Global Weather Central (GWC)
889	Autodin (US Dept. of Defense Automated Digital Network)
#890	US National Meteorological Center (NMC, now NCEP) Data (obsolete)
891	US National Oceanographic Data Center (NODC) Surface Data
892	US Natl. Cntrs. for Environ. Pred. (NCEP) Ship Data
893	NCEP Moored Buoy Data
#894	NCEP Drifting Buoy Data
#895	NCEP Coastal-Marine Automated Network (C-MAN) Data
896	NCEP Miscellaneous (OSV, plat, and rig) Data
897	"Eltanin"
898	Japanese
899	South African Whaling
900	Australian
901	FOSDIC Reconstructions (card images from 16mm film)
902	Great Britain Marine (184 extension)
926	International Maritime Meteorological (IMM) Data
927	International Marine (US- or foreign-keyed ship data)**
928	Same as 927 including Ocean Station Vessels (OSV)
992	NCDC GTS: Ship Data
993	NCDC GTS: Buoy Data (transmitted in FM 13 "SHIP" code)
994	NCDC GTS: Buoy Data (transmitted in FM 18 "BUOY" code)
995	NCDC GTS: Coastal Marine Automated Network (C-MAN) Data
996	NCDC GTS: Miscellaneous (OSV, plat, and rig) Data
999	US Air Force Environ. Technical Applications Center (ETAC)

\* Unofficial deck number for real-time data processing.

& Tentative assignment for a deck not yet obtained or not yet in use.

# Input for Release 1a but not output.

\*\* A mixture of US- and foreign-keyed data exists in deck 927 prior to 1980; starting about 1980 deck 927 is believed to contain only US-recruited ships. Country code (C1, field 47) should ordinarily be set for foreign-keyed data.

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Table 6b. UK Met. Office (MetO) Main Marine Data Bank (MDB) deck assignments (equivalent to MDB series numbers). Assignments falling in the range 201-255 that do not appear below (e.g., 243-253) are not yet assigned. Approximate time periods are also given from MDB documentation.

Deck	Description	Approx. period
201	All Ships (1930 code)	1850-1920
202	All Ships (1921 code)	1921-1929
203	Selected Ships (1930 code)	1920-1939
204	British Navy (HM) Ships (1930 code)	1930-1948
205	Scottish Fishery Cruisers MARIDS (1930 code)	1946-1956
206	Ocean Weather Stations (OWS) (1930 code)	1947-1949
207	Selected Ships (1930 code)	1945-1948
208	Light Vessels	1949-1956
209	Selected Ships (including some foreign ships)	1951-1956
210	OWS (including Dutch "J")	1950-1956
211	Scottish Fishery Cruisers MARIDS	1956-1961
212	Light Vessels	1956-1961
213	Selected Ships	1956-1961
214	OWS	1956-1961
215	German Marine*	1860-1938
216	UK Merchant Ship Logbooks (METFORMS; keyed in 1996)	1935-1939
218	US OWS	1953-
221	MARIDS and Trawlers	1961-
222	Light Vessels	1961-
223	Selected Ships	1961-1981
224	OWS	1961-1981
225	Norwegian Format	1953-
226	OWS (1949 code)	1949-1952
227	Selected Ships	1949-1953
229	British Navy (HM) Ships	1961-
230	International Maritime Met. Punched Card (IMMPC) Data	1960-1981
233	Selected Ships	1982-
234	OWS	1982-
235	RIGG, PLAT, Automatic Weather-Observing System (AWS; buoy)	1982-
239	British Navy (HM) Ships	1982-
241	MetO GTS Receipts (primarily SHIP code; from MDB format)	**
&242	MetO GTS Receipts (SHIP code; raw messages from MetDb)	***
245	Royal Navy Ship's Logs 1938-47 (keyed by 2007)	
254	Int. Maritime Met. (IMM) Data (foreign or unknown origin)	
255	Undocumented TDF-11 Decks or MDB Series	

\* Believed to be derived from the same original German punched cards as deck 192 (Table 6a).

\*\* 1 Jan 1982-26 Jun 1998 (missing: Apr-Jun 82; Mar, Jun, Sep 85; Sep 88).

Some non-SHIP (e.g., BUOY) data may also be included in earlier years.

& Tentative assignment for a deck not yet obtained or not yet in use.

\*\*\* 21 Dec 1996-23 Feb 1998.

Table 6c. Deck assignments for early US National Data Buoy Center (NDBC) data (decks 876-882). Initially, separate deck numbers 876-880 were assigned to indicate hull design, etc.\* At a later date, this convention was abandoned, such that decks 882 and 883 were used for all moored buoy data subsequently received by NCDC from NDBC. Approximate (output) time periods are also given: for Release 1b, only deck numbers 876-882 were output; for Release 1a (1980-) only deck number 883 was output.

Deck	Description	Approx. period
876	NDBC Data (High Capability Buoy; HCB)	1972-77
877	NDBC Data (Limited Capability Buoy; LCB)	1973-76
878	NDBC Data (Prototype Environmental Buoy; PEB)	1974-78
879	NDBC Data (5-meter Continental Shelf Buoys)	1974-78
880	NDBC Data (10-meter Continental Shelf Buoys)	1976-78
881	NDBC Data (Offshore Platforms)	1976-77
882	NDBC Data	1978-79



\* Hull design information is based on informal NCDC documentation (NCDC, 1972a and 1972b) and D. Gilhousen (NDBC) personal correspondence (13 Dec. 1995).

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# 11) SID source ID

Table 7 lists current source ID assignments. Each SID may contain a single deck or a mixture of decks, but each SID is generally constrained to a single input format. This helps to identify the format of data stored in the LMR supplemental and error attachments (see sec. 5)

[NOTE: For UK MDB data, e.g., both DCK and SID are required to determine the supplemental format. To accommodate additional SIDs, the true value and coded ranges were increased to 0:254 and 1:255 (see Table 1 for additional information).

Table 7. Source ID assignments.

SID	Description
1	Atlas
2	HSST Pacific
3	HSST Indian
4	HSST Atlantic
5	Old TDF-11 Supplement B
6	Old TDF-11 Supplement C
7	Monterey Telecommunications
8	Ocean Station Vessels (OSV)
9	OSV Supplement
10	MSQ 486 and 105 Omissions
11	National Oceanographic Data Center (NODC) Surface
12	NODC Surface Supplement
13	"Eltanin"
14	Japanese
15	South African Whaling
16	Australian
17	International Maritime Meteorological (IMM) Data
18	'70s Decade
19	IMM '70s
20	OSV Z ('70s)
21	Australian ('70s)
*22	NCDC: 1980-84 Annual Receipts
23	'70s Mislocated Data
24	Buoy Data
25	NCDC: 1980-84 Annual Receipts (delayed data)
26	NCDC: 1980-84 Annual Receipts (corrections; 1975)
27	NCDC: 1985 Receipts (annual + delayed)
28	NCDC: 1985 Receipts (duplicates)
29	NCDC: US Nat. Met. Center (NMC, now NCEP) Reconversion (1980-92)
30	NCDC: 1980-84 Period of Record
#31	Corrected Canadian Data
32	NCDC: Annual Receipts (starting in 1986)
33	NCDC: Annual Receipts (duplicates; starting in 1986)
34	NCDC: 1986 Receipts (delayed)
35	NCDC: 1987 Receipts (delayed)
36	NCDC: 1988 Receipts (delayed)
37	NCDC: 1989 Receipts (delayed)
38	NCDC: 1990 Receipts (delayed)
39	NCDC: 1991 Receipts (delayed)
40	NCDC: 1992 Receipts (delayed)
41	NCDC: 1993 Receipts (delayed)
42	NCDC: 1994 Receipts (delayed)
43	NCDC: 1995 Receipts (delayed)
44	NCDC: 1996 Receipts (delayed)
45	NCDC: 1997 Receipts (delayed)

46 International Maritime Met. (IMM) Tape Archive (1982-): ebcidic  
 47 International Maritime Met. (IMM) Tape Archive (1982-): ascii  
 48 Levitus 1994 World Ocean Atlas (WOA94; Mar. 93 NODC archive data)  
 49 Levitus 1994 World Ocean Atlas (WOA94; non-NODC archive)  
 50 US National Data Buoy Center (NDBC) Data  
 51 Russian AARI North Pole (NP) Stations (revised; from EWG CD-ROM)  
 52 Russian AARI North Pole (NP) Stations (earlier; from Polar Science Cntr)  
 53 First GARP Global Experiment (FGGE) Level IIb: Surface Marine Data  
 54 FGGE Level IIb: Oceanographic Data  
 55 FGGE Level IIb: Drifting Buoy Data  
 56 Russian S.O. Makarov Collection  
 57 Russian Marine Meteorological Data Set (MARMET) (rec'd at NCAR)  
 #58 French International Maritime Met. (IMM) Uncorrected (1954-88)  
 59 UK IMM Corrections (1982-89)  
 60 French International Maritime Met. (IMM) Corrected (1954-88)  
 61 Canadian Marine Environmental Data Service (MEDS) Buoys  
 62 MEDS World Ocean Circulation Experiment (WOCE) Buoys  
 63 Canadian Marine Environ. Data Service (MEDS) Buoys (July 2005 Archive)  
 64 Russian Research Vessel (R/V) Digitization: Marine Surface  
 65 Russian Research Vessel (R/V) Digitization: Marine Actinometric  
 66 Pacific Marine Environmental Lab. (PMEL) TOGA/TAO Buoys  
 67 PMEL (Daily) Equatorial Moorings and Island Stations  
 68 Arctic Drift Stations  
 69 US Maury Collection  
 70 Inter-American Tropical Tuna Comm. (IATTC) Porpoise Obs. Logs  
 71 IATTC Fishing Logs  
 72 IMM Tape Archive from WMO Global Collecting Centre (GCC) (1994 format)  
 73 NCDC Marine Obs. Processing System (MOPS): Pre-MOPS (TD-9973)  
 74 NCDC MOPS: Duplicate File (TD-9974)  
 75 NCDC MOPS: Original Observations (TD-9980)  
 76 NCDC MOPS: Supplementary or Correction Data  
 77 NCDC: US National Cntrs. for Environ. Pred. (NCEP) Reconversion (1994-97)  
 78 NCDC: US-keyed Logbook Data Reconversion (TD-9972; keyed during 1996-97)  
 79 US Air Force Global Weather Central (GWC): DATSAV2 format  
 80 US Navy FNMOC Monterey Telecom: NCAR: Kunia (OPCON) format  
 81 US Navy FNMOC Monterey Telecom: NCAR: NEDN format  
 82 US Navy FNMOC Monterey Telecom: NCAR: Surface Ship (SPOT) format  
 83 US Navy FNMOC Monterey Telecom: NCDC: Surface Ship (SPOT) format (TD-9769)  
 84 US Merchant Marine Collection (1912-46): Full Quality Control (QC)  
 85 US Merchant Marine Collection (1912-46): Partial QC  
 86 Pacific Marine Environ. Lab. (PMEL) TOGA/TAO Buoys: RAM Data  
 87 Pacific Marine Environ. Lab. (PMEL) TOGA/TAO Buoys: SPOT Data  
 88 Levitus 1998 World Ocean Database (WOD98; Mar. 94 NODC archive data)  
 89 Levitus 1998 World Ocean Database (WOD98; non-NODC archive)  
 90 UK Met. Ofc. (MetO) Main Marine Data Bank (MDB): Flatfile 1 (no cardimage)  
 91 MetO MDB: Flatfile 1A (Flatfile plus cardimage data)  
 92 MetO MDB: Flatfile 1B (no Flatfile match; data derived from cardimage)  
 93 MetO Historical Metforms (1935-39): Flatfile 1C (data from cardimage)  
 94 MetO GTS Receipts (primarily SHIP code; from MDB format)  
 95 Japanese Kobe Collection Data (IMMT format; 2003 Edition)  
 96 Norwegian Logbook Collection  
 97 Japanese Kobe Collection Data (IMMT format; 1998 Edition)  
 98 US Merchant Marine Collection (1912-46): Full QC (CLICOM system)  
 99 Japanese Kobe Collection Data (IMMT format; 2001 Edition)  
 100 NCEP BUFR GTS: Operational Tanks: Converted from Original Message  
 101 NCEP BUFR GTS: Operational Tanks: Converted from BUFR  
 102 NCEP BUFR GTS: Dumped Data: Converted from Original Message  
 103 NCEP BUFR GTS: Dumped Data: Converted from BUFR  
 110 UK Met. Office VOSclim GTS BUFR Data  
 111 Shipboard Environmental (Data) Acquisition System (SEAS)  
 112 IMM Tape Archive from WMO GCC (IMMT-2 format)  
 113 International Marine (US-keyed ship data)  
 114 NCDC GTS  
 115 Japanese Whaling Ship Data (CDMP digitization)  
 116 Japanese Whaling Ship Data (MIT digitization)

117 PMEL TAO/TRITON and PIRATA Research Archive Hourly Average Data  
 118 PMEL TAO/TRITON and PIRATA Research Archive 10-Minute Average Data  
 119 JAMSTEC TRITON Hourly Average Data  
 120 PMEL TAO/TRITON and PIRATA Research Archive Hourly Average SLP Data  
 121 US National Data Buoy Center (NDBC) Data (obtained from NCDC 2005-2007)  
 (122-123 unused)  
 124 Climatological Database for the World's Oceans (CLIWOC; Release 2.0)  
 125 US Marine Meteorological Journals Collection (1878-94)  
 126 Royal Navy Ship's Logs 1938-47 (keyed by 2007)  
 130 Research Vessel (R/V) Data Quality-Evaluated by FSU/COAPS: WOCE ver.3.0  
 131 Research Vessel (R/V) Data Quality-Evaluated by FSU/COAPS: SAMOS  
 132 Research Vessel (R/V) Data Quality-Evaluated by FSU/COAPS: Other

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 \* SID 22 was assigned to "Islas Orcadas" for Release 1, but the data were never translated.

# Input for Release 1a but not output.

& Tentative assignment for a source ID not yet obtained or not yet in use.

## 12) PT platform type

The type of observing platform:

- 0 = US Navy or "deck" log, or unknown
  - 1 = merchant ship or foreign military
  - 2 = ocean station vessel--off station or station proximity unknown
  - 3 = ocean station vessel--on station
  - 4 = lightship
  - 5 = ship
  - 6 = moored buoy
  - 7 = drifting buoy
  - 8 = ice buoy [NOTE: currently unused]
  - 9 = ice station (manned, including ships overwintering in ice)
  - 10 = oceanographic station data (bottle and STD/CTD data)
  - 11 = mechanical bathythermograph (MBT)
  - 12 = expendable bathythermograph (XBT)
  - 13 = Coastal-Marine Automated Network (C-MAN) (NDBC operated)
  - 14 = other coastal/island station
  - 15 = fixed ocean platform (plat, rig)
- [NOTE: PT settings 0-4 are derived from "OSV or Ship Indicator" in NCDC (1968); PT settings 0-1 are very poorly documented and probably should be regarded as equivalent to ship data (PT=5).]

## 13) QI quality indicator

An overall quality measure as yet undefined and maybe reserved for subsequent analysis.

## 14) DS dup status

Indicates duplicate status (where WE stands for "weather element") to allow for retention in LMR of unclear duplicates (see Release 1, supp. K). Reports with "certain" DS (marked #) are not output, but the settings are listed here for informative purposes. DS settings marked by asterisks apply only to pre-1980 data (for Release 1: \* applied to 1854-1979 data; \*\* applied to 1854-1969 data):

- 0 = unique
- 1 = best duplicate
- 2 = best duplicate with substitution
- \*3 = worse duplicate, uncertain: uncertain WE match with hour cross
- 4 = worse duplicate, uncertain: uncertain WE match with no cross
- \*\*5 = worse duplicate, uncertain: uncertain WE match with day cross
- 6 = worse duplicate, uncertain: time/space match with ID mismatch
- \*7 = worse duplicate, uncertain: certain WE match with hour cross
- #8 = worse duplicate, certain: certain WE match with no cross
- #9 = worse duplicate, certain: combined DS 4 and 6
- #10 = worse duplicate, certain: combined DS 6 and 8
- #11 = worse duplicate, certain: time/space/ID match
- #12 = worse duplicate, certain: combined DS 4 and 11

#13 = worse duplicate, certain: combined DS 8 and 11  
 #14 = automatic data rejection  
 [NOTE: Most uncertain duplicates, plus some other selected reports, are deleted from LMRF (see <stat\_trim> for the specific deletion rules).]

#### 15) DC dup check

The presence of a duplicate match between a Global Telecommunication System (GTS) and logbook (or other delayed-mode) report may provide some location verification, with greater credibility if SLP and SST match under allowances (see Release 1, supp. K). DC indicates whether such matches were detected during duplicate elimination processing (either the GTS or delayed-mode report is retained in the output data mixture), in case users might wish to make use of this information for independent quality control purposes:

- 0 = GTS and logbook match with SLP and SST match
- 1 = GTS and logbook match without SLP and SST match
- 2 = not GTS and logbook match

#### 16) TC track check

TC, if set, indicates if a report was:

- 0 = not track checked
- 1 = track checked

[NOTE: Indicator unused prior to Release 1c; still missing in most data.]

#### 17) PB pressure bias

PB, if set, indicates questionable sea level pressure data:

- 0 = questionable SLP: level 0: individual platform
- 1 = questionable SLP: level 1: deck
- 2 = questionable SLP: level 2: deck

[NOTE: Indicator unused (with a different defined configuration) prior to Release 1c; still missing in most data (PB=0 is still unused). In the Release 1c data, PB=1 is set for decks 193, 702, and 762, if SLP is extant. See <dupelim\_1784> for background. For deck 701, PB=1 was set if temperature and gravity corrections were applied, or PB=2 was set if only the gravity correction was applied, to yield extant SLP.]

### {3. Regular section}

#### 18) DI wind direction indicator

Gives the compass (and approximate precision) used for reporting the wind direction:

- 0 = 36-point compass
- 1 = 32-point compass
- 2 = 16 of 36-point compass
- 3 = 16 of 32-point compass
- 4 = 8-point compass
- 5 = 360-point compass
- 6 = high resolution data (e.g., tenths of degrees)

[NOTE: It is not known what action was taken for codes 4-5 in the convert back of Release 1 data to NCDC's TD-1129 format.]

#### 19) D wind direction

The direction (true) from which wind is blowing is stored in whole degrees (i.e., 360-point compass), or with special codes:

- 361 = calm
- 362 = variable

E.g., a value of 90 degrees refers to wind from the East. For data converted from TD-11, a translation from the code value to D in whole degrees was made according to Table 8.

Table 8. Translation of wind direction code into degrees (blank indicates an

undefined conversion).\*

Code	DI				
	0	1	2	3	4
01	10	11			?
02	20	23	25	23	?
03	30	34			?
04	40	45		45	?
05	50	56	45		?
06	60	68		68	?
07	70	79	65		?
08	80	90		90	?
09	90	101	90		
10	100	113		113	
11	110	124	115		
12	120	135		135	
13	130	146			
14	140	158	135	158	
15	150	169			
16	160	180	155	180	
17	170	191			
18	180	203	180	203	
19	190	214			
20	200	225	205	225	
21	210	236			
22	220	248		248	
23	230	259	225		
24	240	270		270	
25	250	281	245		
26	260	293		293	
27	270	304	270		
28	280	315		315	
29	290	326	295		
30	300	338		338	
31	310	349			
32	320	360	315	360	
33	330				
34	340		335		
35	350				
36	360		360		
00 (calm)	361	361	361	361	
99 (variable)	362	362	362	362	

\* For Release 1, all other data (Exchange format) were already recorded in whole degrees, so no translation was made; consequently, for a given compass, only decks 155 and 156 (or source IDs 3 and 4) may have wind directions different than those shown above, since no checks for conformity were made. For subsequent updates, new data sources similarly may have wind directions different than those shown above depending on the input format.

[NOTE: The rationale for the degree values shown in Table 8 is as follows. DI=2 winds were translated to degrees based on the way the original 36-point values were translated to 16-point when the data were punched at NCDC. This translation was necessary since the punching equipment was designed specifically for entering 16-point winds. The 36 points were punched as the nearest point on the 16-point compass. Averaging the points included in each 16-point group results in direction values as shown. For example, 20 and 30 degrees were included as the first point (code 02) so 25 degrees is used as the best estimate of the direction in degrees. Seventy, 90, and 100 were punched as the fourth point (code 09) and 90 is used. DI=3 winds were translated as a simple 16-point compass, since it is not clear how the 32-point winds

were translated to 16-point. DI=4 winds were indicated only in the Exchange format and had already been translated into unknown degrees, hence the question marks.]

20) WI wind speed indicator

21) W wind speed

Wind speed is stored in tenths of a meter per second. WI shows the units in which and/or the method by which W was originally recorded (0, 1, 3, 4 follow WMO code 1855):

- 0 = meter per second, estimated
  - 1 = meter per second, measured
  - 2 = estimated (original units unknown)
  - 3 = knot, estimated
  - 4 = knot, measured
  - 5 = Beaufort force (conversion of original data, or based on documentation)
  - 6 = estimated (original units unknown)/unknown method
  - 7 = measured (original units unknown)
  - 8 = high resolution measurement (e.g., hundredths of a meter per second)
- [NOTE: No indication is given as to the incoming units and precision of W, e.g., whole knots. For reports derived, e.g., from TD-11 formats the meaning of WI=6 is either "estimated (units unknown)," or "both method and units unknown" (i.e., the indicator was missing). This unfortunate ambiguity derives from the dual meaning present in some original archive formats. WI=2 and WI=7 were used for reconversion of deck 555 from the original SPOT format. However, no missing value is available in the SPOT format; thus both WI settings should be interpreted with caution.]

22) VI visibility indicator

23) VV visibility

VI shows whether VV was

- 0 = estimated (or unknown method of observation)
- 1 = measured
- 2 = fog present

Codes 90 to 99 for VV correspond to horizontal visibility at the surface in kilometers:

- 90 = less than 0.05 kilometers
- 91 = 0.05
- 92 = 0.2
- 93 = 0.5
- 94 = 1
- 95 = 2
- 96 = 4
- 97 = 10
- 98 = 20
- 99 = 50 or more

NOTE: when VI=2, and VV=93, it means that fog was present and visibility was not reported.

[NOTE: The combination of VI=2 with VV=93 appears to stem from international keying (IMM) practices in the 1960s (more research is needed). Further details may also be desirable on how VV is determined, e.g., US instructions state that "if the visibility falls between two of the distances, select the code for the lesser distance," i.e., [50-200 m) = 90, [200-500 m)=91.]

24) WW present weather

Codes 00 to 99 (WMO code 4677; leading zeros are strictly notational, e.g., for use in comparison with past weather). NOTE: users of WW starting 1 January 1982, should also refer to IX (field 68). Codes 00 to 49 indicate no precipitation at the station (e.g., ship) at time of observation:

- 00 = cloud development not observed.
- 01 = clouds generally dissolving or becoming less developed.
- 02 = state of the sky unchanged.
- 03 = clouds generally forming or developing.
- 04 = visibility reduced by smoke.

- 05 = haze.
- 06 = widespread dust in suspension in the air, not raised by wind at or near the station at time of observation.
- 07 = dust or sand raised by wind at or near the station at time of observation, but no well-developed dust whirls or sand whirls and no dust storm or sandstorm seen.
- 08 = well developed dust whirls or sand whirls seen at or near the station during the preceding hour or at time of observation, but no dust storm or sandstorm.
- 09 = dust storm or sandstorm within sight at time of observation, or at the station during the preceding hour.
- 10 = light fog (visibility 1,100 yards or more); synonymous with European term "mist."
- 11 = patches of shallow fog or ice fog at the station, not deeper than about 10 meters.
- 12 = more or less continuous shallow fog or ice fog at the station, not deeper than about 10 meters.
- 13 = lightning visible, no thunder heard.
- 14 = precipitation within sight, not reaching the surface of the sea.
- 15 = precipitation within sight, reaching the surface of the sea, but more than 5 kilometers from the station.
- 16 = precipitation within sight, reaching the surface of the sea, near to, but not at the station.
- 17 = thunderstorm, but no precipitation at time of observation.
- 18 = squalls at or within sight of the station during the preceding hour or at time of observation.
- 19 = funnel cloud or waterspout at or within sight of the station during the preceding hour or at time of observation.

Codes 20 to 29 refer to phenomena that occurred at the station during the preceding hour but not at time of observation:

- 20 = drizzle (not freezing) or snow grains.
- 21 = rain (not freezing).
- 22 = snow.
- 23 = rain and snow or ice pellets, type (a).
- 24 = freezing drizzle or freezing rain.
- 25 = shower of rain.
- 26 = shower of snow, or of rain and snow.
- 27 = shower of hail (ice pellets, type (b), snow pellets), or of rain and hail.
- 28 = fog or ice fog.
- 29 = thunderstorm (with or without precipitation).

Codes 30 to 99 refer to phenomena occurring at the ship at time of observation:

- 30 = slight or moderate dust storm or sandstorm has decreased during the preceding hour.
- 31 = slight or moderate dust storm or sandstorm with no appreciable change during the preceding hour.
- 32 = slight or moderate dust storm or sandstorm has begun or has increased during the preceding hour.
- 33 = severe dust storm or sandstorm has decreased during the preceding hour.
- 34 = severe dust storm or sandstorm with no appreciable change during the preceding hour.
- 35 = severe dust storm or sandstorm has begun or has increased during the preceding hour.
- 36 = slight or moderate drifting snow generally low (below eye level, less than 6 feet).
- 37 = heavy drifting snow generally low (below eye level, less than 6 feet).
- 38 = slight or moderate blowing snow generally high (above eye level, 6 feet or more).
- 39 = heavy blowing snow generally high (above eye level, 6 feet or more).
- 40 = fog or ice fog at a distance at time of observation, but not at the station during the preceding hour, the fog or ice fog extending to a level above that of the observer.

- 41 = fog or ice fog in patches.
- 42 = fog or ice fog (sky visible) has become thinner during the preceding hour.
- 43 = fog or ice fog (sky invisible) has become thinner during the preceding hour.
- 44 = fog or ice fog (sky visible) with no appreciable change during the preceding hour.
- 45 = fog or ice fog (sky invisible) with no appreciable change during the preceding hour.
- 46 = fog or ice fog (sky visible) has begun or has become thicker during the preceding hour.
- 47 = fog or ice fog (sky invisible) has begun or has become thicker during the preceding hour.
- 48 = fog, depositing rime, sky visible.
- 49 = fog, depositing rime, sky invisible.

Codes 50 to 99 indicate precipitation at the station at time of observation:

- 50 = drizzle, not freezing, intermittent, slight at time of observation.
- 51 = drizzle, not freezing, continuous, slight at time of observation.
- 52 = drizzle, not freezing, intermittent, moderate at time of observation.
- 53 = drizzle, not freezing, continuous, moderate at time of observation.
- 54 = drizzle, not freezing, intermittent, heavy (dense) at time of observation.
- 55 = drizzle, not freezing, continuous, heavy (dense) at time of observation.
- 56 = drizzle, freezing, slight.
- 57 = drizzle, freezing, moderate or heavy (dense).
- 58 = drizzle and rain, slight.
- 59 = drizzle and rain, moderate or heavy.
- 60 = rain, not freezing, intermittent, slight at time of observation.
- 61 = rain, not freezing, continuous, slight at time of observation.
- 62 = rain, not freezing, intermittent, moderate at time of observation.
- 63 = rain, not freezing, continuous, moderate at time of observation.
- 64 = rain, not freezing, intermittent, heavy at time of observation.
- 65 = rain, not freezing, continuous, heavy at time of observation.
- 66 = rain, freezing, slight.
- 67 = rain, freezing, moderate or heavy.
- 68 = rain or drizzle and snow, slight.
- 69 = rain or drizzle and snow, moderate or heavy.
- 70 = intermittent fall of snowflakes, slight at time of observation.
- 71 = continuous fall of snowflakes, slight at time of observation.
- 72 = intermittent fall of snowflakes, moderate at time of observation.
- 73 = continuous fall of snowflakes, moderate at time of observation.
- 74 = intermittent fall of snowflakes, heavy at time of observation.
- 75 = continuous fall of snowflakes, heavy at time of observation.
- 76 = ice prisms (with or without fog).
- 77 = snow grains (with or without fog).
- 78 = isolated star-like snow crystals (with or without fog).
- 79 = ice pellets, type (a) (sleet, U.S. definition).
- 80 = rain shower, slight.
- 81 = rain shower, moderate or heavy.
- 82 = rain shower, violent.
- 83 = shower of rain and snow mixed, slight.
- 84 = shower of rain and snow mixed, moderate or heavy.
- 85 = snow shower, slight.
- 86 = snow shower, moderate or heavy.
- 87 = slight showers of snow pellets or ice pellets, type (b), with or without rain or rain and snow mixed.
- 88 = moderate or heavy showers of snow pellets or ice pellets, type (b), with or without rain or rain and snow mixed.
- 89 = slight showers of hail, with or without rain or rain and snow mixed, not associated with thunder.
- 90 = moderate or heavy showers of hail, with or without rain or rain and snow, mixed, not associated with thunder.
- 91 = slight rain at time of observation, thunderstorm during preceding hour



but not at time of observation.

- 92 = moderate or heavy rain at time of observation, thunderstorm during preceding hour but not at time of observation.
- 93 = slight snow, or rain and snow mixed, or hail, at time of observation with thunderstorm during the preceding hour but not at time of observation.
- 94 = moderate or heavy snow, or rain and snow mixed, or hail, at time of observation with thunderstorm during the preceding hour but not at time of observation.
- 95 = thunderstorm, slight or moderate, without hail, but with rain and/or snow at time of observation.
- 96 = thunderstorm, slight or moderate, with hail at time of observation.
- 97 = thunderstorm, heavy, without hail but with rain and/or snow at time of observation.
- 98 = thunderstorm combined with dust storm or sandstorm at time of observation.
- 99 = thunderstorm, heavy, with hail at time of observation.

25) W1 past weather

26) W2 second past weather

Codes 0 to 9 (WMO code 4561) have the same meaning for W1 and W2, which more or less corresponds to that implied by the leading (tens) digit of present weather. The period covered by W1 and W2 is 6 hours for observations at 0000, 0600, 1200, and 1800 UTC, and 3 hours for observations at 0300, 0900, 1500, and 2100 UTC. W1 and W2 are intended to contain the higher and lower, respectively of two codes that describe the weather during the period, or both W1 and W2 may contain the same code. W2 became effective only starting on 1 January 1982, so it should always be missing before that date. NOTE: users of W1 or W2 starting 1 January 1982, should also refer to IX (field 68).

- 0 = cloud covering one-half or less of the sky throughout the period.
- 1 = cloud covering more than one-half of the sky during part of the period and covering one-half or less during part of the period.
- 2 = cloud covering more than one-half of the sky throughout the period.
- 3 = sandstorm, dust storm, or blowing snow.
- 4 = fog, ice fog, or thick haze (US includes thick smoke).
- 5 = drizzle.
- 6 = rain.
- 7 = snow, or rain and snow mixed.
- 8 = shower.
- 9 = thunderstorm with or without precipitation.

27) SLP sea level pressure

In tenths of hPa (i.e., millibars).

28) T1 temperature indicator

29) AT air temperature (i.e., dry bulb)

30) WBT wet bulb temperature

31) DPT dew point temperature

32) SST sea surface temperature

Temperatures are stored in tenths of a degree Celsius. T1 shows the precision and units that AT, WBT, DPT, and SST were recorded in or translated from (see also the second temperature indicator, T2):

- 0 = degrees Celsius and tenths
- 1 = half degrees Celsius
- 2 = whole degrees Celsius
- 3 = degrees Celsius (mixed or undetermined precision)
- 4 = degrees Fahrenheit and tenths
- 5 = half degrees Fahrenheit
- 6 = whole degrees Fahrenheit
- 7 = degrees Fahrenheit (mixed or undetermined precision)
- 8 = high resolution data (e.g., hundredths of a degree Celsius)
- 9 = other (refer to metadata)

[NOTE: Only starting 1 Jan. 1982 could DPT be reported to tenths over GTS, and AT and/or SST may have been optionally reported to whole degrees (using "/" for the tenths position, which was

set to zero by GTS centers, with a resulting loss of precision information) at least until 1982. DPT may still reported to whole degrees by some countries (e.g., US and Canada) in both GTS and logbook data, although starting 2 Nov. 1994, it became possible to report WBT (to tenths) over GTS.]

### 33) SI sea surface temperature method indicator

Shows the method by which SST was taken (0-7 follow the IMM code):

- 0 = bucket
- 1 = condenser inlet (intake)
- 2 = trailing thermistor
- 3 = hull contact sensor
- 4 = through hull sensor
- 5 = radiation thermometer
- 6 = bait tanks thermometer
- 7 = others
- 8 = unknown (applicable only to decks 705-707)
- 9 = unknown or non-bucket
- 10 = implied bucket (an HSST SID or any match)
- 11 = reversing thermometer or mechanical sensor
- 12 = electronic sensor

[NOTE: SI values should be used with extreme caution in earlier data (see discussion of "bucket indicators" in Release 1, sec. 4). For data translated from International Maritime Meteorological (IMM) logbook formats effective since 1982, SI=7 refers to "other than 0-6," because the only other extant values were 0-6. For GTS data reported since 2 Nov. 1994, in contrast, SI=7 refers to "other than 0-1 or 3," because the only other extant values were equivalent to 0-1 or 3 (SI information was available on GTS only starting 2 Nov. 1994). SI=8 indicates that no information was available; it resulted from a conversion error that was limited to the indicated decks (SI should have been set to missing). SI=9 arises because a distinct missing value was not available in some earlier IMM and archive formats (e.g., in the NCDC, 1968 format a blank in the SST indicator field for deck 128 meant "determined by other than bucket method," but blank also generally signified a missing field in the format).]

### 34) N total cloud amount

### 35) NH lower cloud amount

For N, codes 0 to 9 show the fraction of the celestial dome covered by all clouds. For NH they show the fraction of the celestial dome covered by all the low (CL) clouds and, if no CL cloud is present, the fraction covered by all the middle (CM) clouds present:

- 0 = clear.
- 1 = 1 okta or less, but not zero.
- 2-6 = 2-6 oktas.
- 7 = 7 oktas or more, but not 8 oktas.
- 8 = 8 oktas.
- 9 = sky obscured or cloud amount cannot be estimated.

[NOTE: Analyses of cloud types may be impacted by a 1 January 1982 WMO code change: When N=0, the types CM, CH, and CL are reported as missing (i.e., the 8 group is omitted). Previously, these types may have been reported zero (see, e.g., Hahn et al., 1992).]

### 36) CL low cloud type

Codes 0 to 10 show characteristics observed of clouds of the types stratocumulus, stratus, cumulus, cumulonimbus, and their variations:

- 0 = no stratocumulus, stratus, cumulus, or cumulonimbus.
- 1 = cumulus with little vertical extent and seemingly flattened, or ragged cumulus other than of bad weather, or both.
- 2 = cumulus of moderate or strong vertical extent, generally with protuberances in the form of domes or towers, either accompanied or not by other cumulus or by stratocumulus, all having their base at the same level.

- 3 = cumulonimbus the summits of which, at least partially, lack sharp outlines but are neither clearly fibrous (cirriform) nor in the form of an anvil; cumulus, stratocumulus, or stratus may also be present.
- 4 = stratocumulus formed by the spreading out of cumulus; cumulus may also be present.
- 5 = stratocumulus not resulting from the spreading out of cumulus.
- 6 = stratus in a more or less continuous sheet or layer, or in ragged shreds, or both, but no stratus fractus of bad weather.
- 7 = stratus fractus of bad weather (generally existing during precipitation and a short time before and after) or cumulus fractus of bad weather, or both (pannus), usually below altostratus or nimbostratus.
- 8 = cumulus and stratocumulus other than that formed from the spreading out of cumulus; the base of the cumulus is at a different level from that of the stratocumulus.
- 9 = cumulonimbus, the upper part of which is clearly fibrous (cirriform), often in the form of an anvil; either accompanied or not by cumulonimbus without anvil or fibrous upper part, by cumulus, stratocumulus, stratus, or pannus.
- 10 = low clouds not visible, owing to darkness, fog, blowing dust or sand, or other similar phenomena.

### 37) HI cloud height indicator

Shows if the cloud height H was:

- 0 = estimated
- 1 = measured

### 38) H cloud height

Codes 0 to 10. Codes 0 to 9 show the height above sea surface of the base of the lowest cloud or fragment thereof as given by Table 9.

Table 9. Cloud height codes.

Code	Approximate height	
	Feet	Meters
0	0-149	0-49
1	150-299	50-99
2	300-599	100-199
3	600-999	200-299
4	1000-1999	300-599
5	2000-3499	600-999
6	3500-4999	1000-1499
7	5000-6499	1500-1999
8	6500-7999	2000-2499
9	>=8000 or no clouds	>=2500 or no clouds

Code 10 indicates H cannot be estimated because of darkness or for other reasons.

### 39) CM middle cloud type

Codes 0 to 10 show characteristics observed of clouds of the types altocumulus, altostratus, and nimbostratus:

- 0 = no altocumulus, altostratus, or nimbostratus.
- 1 = altostratus, the greater part of which is semi-transparent; through this part the sun or moon may be weakly visible, as through ground glass.
- 2 = altostratus, the greater part of which is sufficiently dense to hide the sun or moon, or nimbostratus.
- 3 = altocumulus, the greater part of which is semi-transparent; the various elements of the cloud change only slowly and are all at a single level.
- 4 = patches (often in the form of almonds or fishes) of altocumulus, the greater part of which is semi-transparent; the clouds occur at one or

- more levels and the elements are continually changing in appearance.
- 5 = semi-transparent altocumulus in bands, or altocumulus in one or more fairly continuous layers (semi-transparent or opaque), progressively invading the sky; these altocumulus clouds generally thicken as a whole.
  - 6 = altocumulus resulting from the spreading out of cumulus (or cumulonimbus).
  - 7 = altocumulus in two or more layers, usually opaque in places, and not progressively invading the sky; or opaque layer of altocumulus, not progressively invading the sky; or altocumulus together with altostratus or nimbostratus.
  - 8 = altocumulus with sproutings in the form of small towers or battlements; or altocumulus having the appearance of cumuliform tufts.
  - 9 = altocumulus of a chaotic sky, generally at several levels.
  - 10 = middle clouds not visible, owing to darkness, fog, blowing dust or sand, or other similar phenomena, or more often because of the presence of a continuous layer of lower clouds.

#### 40) CH high cloud type

Codes 0 to 10 show characteristics observed of clouds of the types cirrus, cirrocumulus and cirrostratus:

- 0 = no cirrus, cirrocumulus or cirrostratus.
- 1 = cirrus in the form of filaments, strands, or hooks, not progressively invading the sky.
- 2 = dense cirrus, in patches or entangled sheaves, which usually do not increase and sometimes seem to be the remains of the upper part of a cumulonimbus, or cirrus with sproutings in the form of small turrets or battlements, or cirrus having the appearance of cumuliform tufts.
- 3 = dense cirrus, often in the form of an anvil, being the remains of the upper parts of cumulonimbus.
- 4 = cirrus in the form of hooks or of filaments, or both, progressively invading the sky; they generally become denser as a whole.
- 5 = cirrus (often in bands converging towards one point or two opposite points of the horizon) and cirrostratus, or cirrostratus alone; in either case, they are progressively invading the sky, and generally growing denser as a whole, but the continuous veil does not reach 45 degrees above the horizon.
- 6 = cirrus (often in bands converging towards one point or two opposite points of the horizon) and cirrostratus, or cirrostratus alone; in either case, they are progressively invading the sky, and generally growing denser as a whole; the continuous veil extends more than 45 degrees above the horizon, without the sky being totally covered.
- 7 = veil of cirrostratus covering the celestial dome.
- 8 = cirrostratus not progressively invading the sky and not completely covering the celestial dome.
- 9 = cirrocumulus alone, or cirrocumulus accompanied by cirrus or cirrostratus, or both, but cirrocumulus is predominant.
- 10 = high clouds not visible, owing to darkness, fog, blowing dust or sand, or other similar phenomena, or more often because of the presence of a continuous layer of lower clouds.

#### 41) WD wave direction

Codes 00 to 38 (WMO code 0877; leading zeros are strictly notational). Codes 00 to 36 show the direction (if any) from which (wind) waves come, in tens of degrees:

00 = calm	19 = 185-194 degrees
01 = 005-014 degrees	20 = 195-204 "
02 = 015-024 "	21 = 205-214 "
03 = 025-034 "	22 = 215-224 "
04 = 035-044 "	23 = 225-234 "
05 = 045-054 "	24 = 235-244 "
06 = 055-064 "	25 = 245-254 "
07 = 065-074 "	26 = 255-264 "
08 = 075-084 "	27 = 265-274 "
09 = 085-094 "	28 = 275-284 "

10 = 095-104	"	29 = 285-294	"
11 = 105-114	"	30 = 295-304	"
12 = 115-124	"	31 = 305-314	"
13 = 125-134	"	32 = 315-324	"
14 = 135-144	"	33 = 325-334	"
15 = 145-154	"	34 = 335-344	"
16 = 155-164	"	35 = 345-354	"
17 = 165-174	"	36 = 355-004	"
18 = 175-184	"		

Codes 37 and 38 (99 in WMO code 0877) show:

37 = waves confused, direction indeterminate (wave height less than or equal to 4.75 meters).

38 = waves confused, direction indeterminate (wave height greater than 4.75 meters, or irrespective of wave height).

[NOTE: a) Both sea (i.e., wind wave) and swell were reported in descriptive terms according to the SHIP code prior to 1949, thus the wave fields are all expected to be missing before then (and the swell fields are expected to be missing prior to 1 July 1963, as discussed under SD, SP, SH).

b) In addition to ship observations, the wind wave fields contain buoy measurements, thus possibly introducing systematic data differences. NDBC (e.g., deck 883) moored buoy data are based on wave spectra, without any distinction between (wind) wave and swell. Specifically, principal wave direction, dominant wave period, and significant wave height are included from the NDBC format in WD, WP, and WH, respectively.]

b) In conversion of data into TD-1129, NCDC usually substituted wind direction (D) into missing WD since 1 January 1968, when WD was no longer part of the WMO SHIP code. Instead of continuing this practice, modifications were made to properly QC the wave fields without actually substituting from D (see Release 1, supp. J), thereby preserving any remaining information regarding whether WD was separately reported.

c) Code 37 should appear only in earlier data; starting 1 July 1963, the meaning of code 38 changed to become irrespective of wave height. Background: In earlier versions of the SHIP code (e.g., 1949) wind waves were reported in group ldwdwPwHw (w's are subscripts in the code), such that dwdw (00-36) was the wave direction, and height (Hw) a single-character half-meter code. For heights greater than 9 half-meters (i.e., 4.5 m; representing the range 4.25-4.75 m), 50 was added to dwdw to indicate that the 0-9 Hw instead represented heights from 10 to 19 half-meters (to 9.5 m; range 9.25-9.75 m). For heights greater than 9.75 meters (31 feet), the code figure for 19 half-meters was used, and the wave group was followed by the word WAVES plus the actual height in meters or feet (such extreme heights apparently were not digitized). In addition to wave directions reported as 00-36, 49 was used for "waves confused, direction indeterminate." In cases where the height exceeded 9 half-meters and 50 was added to this direction value: 49 + 50 = 99. Thus both 49 and 99 were legitimate values in some earlier data, represented by 37 and 38, respectively, in this format.]

#### 42) WP wave period

If indicated by the wave period indicator, WX, a code for wave period has been converted to whole seconds as given by Table 10, choosing the higher of 2-second class intervals where applicable (if indicated by the swell period indicator, SX, a code for swell period has been similarly converted according to Table 10 or 11). Periods in whole seconds were taken in preference to the old codes if both were available, e.g., from TD-1127 and TD-1129.

[NOTE: a) Information that periods were converted from code was not retained for Release 1; WX and SX were not defined in LMR5.

b) Note 3 under specification of period of wind waves in seconds (PwPw) in WMO (1988) states: "A confused sea shall be indicated by coding 99 for PwPw." Any such values are preserved in the

error attachment, since a separate configuration for PwPw=99 is not presently defined in LMR. NCDC (1989b) indicates a range of 00-99 for wave/swell periods in seconds, without defining 99.]

Table 10. Conversion for WP always, and for SP prior to 1968.

Seconds	Code	Interval
5	2	5 seconds or less
7	3	6-7 seconds
9	4	8-9 seconds
11	5	10-11 seconds
13	6	12-13 seconds
15	7	14-15 seconds
17	8	16-17 seconds
19	9	18-19 seconds
21	0	20-21 seconds
22	1	over 21 seconds
0	-	calm or period not determined

Table 11. Conversion for SP beginning 1 January 1968.

Seconds	Code	Interval
10	0	10 seconds
11	1	11 seconds
12	2	12 seconds
13	3	13 seconds
14	4	14 seconds or more
5	5	5 seconds or less
6	6	6 seconds
7	7	7 seconds
8	8	8 seconds
9	9	9 seconds
0	-	calm or period not determined

#### 43) WH wave height

Wave height stored as meters to tenths, with a half-meter increment.

[NOTE: Release 1, supp. F provides an imprecise description of the wave and swell height fields, which are stored as meters to tenths (with a half-meter increment) according to Table 2 (and Table F0-2 in Release 1). This contrasts with "height in 1/2 meter increments" as used in TD-1129 (i.e., 1=0.5 m, 2=1 m, etc.). The format of the wave and swell height fields (WH/SH) as printed by the LMR and LMRF access programs is also "height in 1/2 meter increments." This is because all decimal points are removed by a uniform procedure: the programs divide each FTRUE value by the corresponding units as listed, for WH/SH, in Table 2. Only in the case of WH/SH, which have units of 0.5 m, does this produce a non-intuitive result. E.g.: LON=33.80/0.01 = 3380, versus WH=6.5/0.5 = 13 printed.]

#### 44) SD swell direction

#### 45) SP swell period

#### 46) SH swell height

As given by the corresponding wave fields WD, WP, and WH.

[NOTE: Beginning 1 July 1963 both sea (i.e., wind wave) and swell were reported; prior to that date only the higher of sea or swell data was reported (reported data are expected to be stored in the wave fields). The SHIP code now also allows for reporting of secondary swell fields, which, if available in the input formats,

are stored in the supplemental attachment.]

47) C1 country code

48) C2 second country code

The country that recruited a ship (C1), which may differ from the country of immediate receipt (C2) and may also differ from the ship's registry:

0 = Netherlands	10 = Ireland	20 = Sweden	30 = Spain
1 = Norway	11 = Philippines	21 = FRG	31 = Thailand
2 = US	12 = Egypt	22 = Iceland	32 = Yugoslavia
3 = UK	13 = Canada	23 = Israel	33 = Poland
4 = France	14 = Belgium	24 = Malaysia	34 = Brazil
5 = Denmark	15 = South Africa	25 = USSR	35 = Singapore
6 = Italy	16 = Australia	26 = Finland	36 = Kenya
7 = India	17 = Japan	27 = Rep. of Korea	37 = Tanzania
8 = Hong Kong	18 = Pakistan	28 = New Caledonia	38 = Uganda
9 = New Zealand	19 = Argentina	29 = Portugal	39 = Mexico
			40 = GDR

[NOTE: a) The above numeric code values are documented by WMO, which transitioned to 2-character alpha codes effective 1 Jan. 1998. Presently, any codes out of range are stored in the LMR error attachment, but format revisions are needed in the future to accommodate the transition.

b) During earlier years of the international exchange program, NCDC's recollection is that tapes were frequently received from other countries with country code missing. When this problem was detected, NCDC often may have filled C1 with the country code of the country from which the tape was received (e.g., another responsible member). Since the country that recruited a ship may or may not correspond to the country of immediate receipt (i.e., C2), this practice, although well intentioned, would have introduced misleading values into C1.

c) "Overpunches" (as defined in Table 1 of <dupelim\_1970>) appearing over the first or second position of the country code field in TD-11 formats are stripped off for all years (although documented as a possibility only prior to 1982; NCDC, 1989b), thus retaining the numeric in C1 and the original characters in the supplemental attachment. NCDC (1989b) states that an "X" overpunch over the first position indicates a foreign receipt, and over the second position an auxiliary ship.]

49) SC ship course

Ship's course (true) made good during the 3 hours preceding the time of observation:

0 = ship hove to (stationary)	5 = SW
1 = NE	6 = W
2 = E	7 = NW
3 = SE	8 = N
4 = S	9 = unknown

50) SS ship speed

Ship's average speed made good during the 3 hours preceding the time of observation. Prior to 1968:

0 = 0 knots	5 = 13-15 knots
1 = 1-3 knots	6 = 16-18 knots
2 = 4-6 knots	7 = 19-21 knots
3 = 7-9 knots	8 = 22-24 knots
4 = 10-12 knots	9 = over 24 knots

Beginning 1 January 1968:

0 = 0 knots	5 = 21-25 knots
1 = 1-5 knots	6 = 26-30 knots
2 = 6-10 knots	7 = 31-35 knots
3 = 11-15 knots	8 = 36-40 knots
4 = 16-20 knots	9 = over 40 knots

51) A barometric tendency

- 0 = increasing, then decreasing; atmospheric pressure same or higher than 3 hours ago
- 1 = increasing, then steady; or increasing then increasing more slowly; atmospheric pressure now higher than 3 hours ago
- 2 = increasing (steadily or unsteadily); atmospheric pressure now higher than 3 hours ago
- 3 = decreasing or steady, then increasing; or increasing then increasing more rapidly; atmospheric pressure now higher than 3 hours ago
- 4 = steady; atmospheric pressure same as 3 hours ago
- 5 = decreasing, then increasing; atmospheric pressure the same or lower than 3 hours ago
- 6 = decreasing, then steady; or decreasing then decreasing more slowly; atmospheric pressure now lower than 3 hours ago
- 7 = decreasing (steadily or unsteadily); atmospheric pressure now lower than 3 hours ago
- 8 = steady or increasing, then decreasing; or decreasing then decreasing more rapidly; atmospheric pressure now lower than 3 hours ago

## 52) PPP amount of SLP change

Amount of pressure change from 3 hours ago in tenths of hPa (i.e., millibars).

## 53) IS ice accretion

- 1 = icing from ocean spray
- 2 = icing from fog
- 3 = icing from spray and fog
- 4 = icing from rain
- 5 = icing from spray and rain

## 54) ES ice thickness

Ice thickness in centimeters.

## 55) RS ice accretion rate

- 0 = ice not building up
- 1 = ice building up slowly
- 2 = ice building up rapidly
- 3 = ice melting or breaking up slowly
- 4 = ice melting or breaking up rapidly

## 56) II ID indicator

II indicates whether a call sign or some other sort of recognizable ID is contained in the ID array.

- 0 = ID present, but unknown type
- 1 = ship, OSV, or ice station call sign
- 2 = generic ID (e.g., SHIP, BUOY, RIGG, PLAT)
- 3 = WMO 5-digit buoy number (possibly followed by A-L for NCEP data)
- 4 = other buoy number (e.g., Argos or national buoy number)
- 5 = C-MAN ID
- 6 = station name or number
- 7 = NODC platform/cruise
- 8 = IATTC pseudo ID
- 9 = national ship number
- 10 = ship name or composite information from early ship data  
 [NOTE: In track-checking, for example, consideration should be given to using a combination of II and ID, since identical IDs can sometimes have different II values and thus may represent different platforms. GTS reports generally contain a radio call sign or WMO buoy number, but International Maritime Meteorological (IMM) logbook reports sometimes contain IDs that appear to be national ship numbers or "log" numbers. Documentation of the format of such numbers was unavailable (but could potentially be sought from individual countries), thus PT=9 was assigned only for earlier (pre-IMM) card decks for which the format of the information was known.]

## 57)-64) ID(8) ID/call sign



Array of 8 fields, each containing one 6-bit ascii value in the range 33 (!) through 95 (underline), thus enabling storage of modern radio call signs consisting of up to 7 alphanumeric characters (left-justified in the array). Note that blank has been translated to missing. One extra 6-bit byte is available for earlier data requirements or unanticipated needs. Using intrinsic Fortran functions on a computer with native ascii, the character corresponding to each non-missing byte's true value should be CHAR(NINT(true)).

#### 65) OS observation source

For International Maritime Meteorological (IMM) logbook data, OS shows the observation source:

0 = unknown	
1 = logbook	national
2 = telecommunication channels	national
3 = publications	national
4 = logbook	international data exchange
5 = telecommunication channels	international data exchange
6 = publications	international data exchange

#### 66) OP observation platform

For International Maritime Meteorological (IMM) logbook data, OP shows the observation platform:

0 = unknown
1 = selected ship
2 = supplementary ship
3 = auxiliary ship
4 = automated station/data buoy
5 = fixed sea station
6 = coastal station
7 = aircraft
8 = satellite
9 = others

#### 67) T2 second temperature indicator

The second temperature indicator (T2) shows which of the psychrometric elements, wet bulb temperature (WBT), dew point temperature (DPT), or ice bulb temperature (IBT) (value stored in WBT field), were reported or computed (or claimed to be reported or computed; see <dupelim\_1980> and <dupelim\_1970>):

0 = WBT reported, DPT computed (either may be missing)
1 = DPT reported, WBT computed (either may be missing)
2 = IBT reported, DPT computed (DPT may be missing)
3 = DPT computed during preconditioning (T2 was missing)
4 = DPT computed during preconditioning (T2 was 0)
5 = DPT computed during preconditioning (T2 was 1)
6 = DPT computed during preconditioning (T2 was 2)

[NOTE: Separate fields for ice bulb conditions that are available in the supplemental attachment, are documented, e.g., for deck 128 (NCDC, 1968) and in the Netherlands version (deck 155) of the HSST Exchange format (see Release 1, supp. I, Table I1-5).]

#### 68) IX station/weather indicator

IX indicates both whether the station is manned or automatic, and the status of present and past weather data (WMO code 1860):

Station operation: Present (WW) and past (W1, W2) weather:	
1 = manned	included
2 = manned	omitted (no significant weather to report)
3 = manned	omitted (not observed, data not available)
4 = automatic	included using (possibly) WMO codes 4677 and 4561
5 = automatic	omitted (no significant weather to report)
6 = automatic	omitted (not observed, data not available)

Another IX value was documented too late to incorporate in this format, which would ordinarily be preserved in the error attachment:

7 = automatic	included using WMO codes 4680 and 4531
---------------	--

Starting 1 January 1982, the procedure for reporting present weather (WW) and past weather (W1W2) in the GTS Ship Code was altered significantly by adding

IX, which allowed the 7 group (7wwW1W2 for manual stations, and usually 7wawaW1Wa2 for automatic stations) to be omitted when there was no significant present or past weather to report (WMO, 1981a). If IX is not used properly to re-establish a non-significant WW (i.e., 00-03), then statistics will generally be biased toward significant weather (e.g., higher precipitation frequencies). Although IX was added to the Ship Code beginning 1 January 1982, apparently it was not added to the NCEP archival format (decks 892-896) until 9 May 1984, nor was it added to the International Maritime Meteorological (IMM) tape format for ship logbook exchange under WMO Resolution 35 (deck 926), until March 1985. Even for US-recruited ships (deck 927), IX was not keyed until February 1985 (including any delayed data processed as of that date). We have attempted to address these problems through substitution of IX from GTS into logbook data (see <dupelim\_1980>), but IX might still frequently be missing until at least 1985. In this case, one approach to avoid biasing statistics is to convert missing WW to a non-significant code such as 02 (i.e., assume WW is always missing due to no significant weather, rather than data not available). This approach tends to bias the statistics towards fair weather, but probably to a lesser extent than the bias toward significant weather if the correction is not made (see, e.g.: Warren et al., 1988; Hahn et al., 1992; and Petty, 1995). Handling of missing past weather in conjunction with missing IX (starting in 1982) is even more problematical, due to the lack of an obvious corrective measure. Starting 2 November 1994 the Ship Code was modified so that any present and past weather including phenomena without significance shall be reported, thus allowing only IX=1 or 3 (WMO, 1993).

[NOTE: "/" and any other unrecognized codes were apparently passed through by NCDC; NCDC also inserted WW=02 in place of missing WW for some data sources in the event IX=2 or 5. IX=7 was defined by WMO in 1988 or 1991 (needs to be checked). Apparently, the original definition of IX=4 (e.g., WMO, 1981b) did not explicitly refer to codes WMO codes 4677 and 4561, hence the parenthetical "possibly" in the above IX=4 definition. WMO (1988) has a typo for IX=7 in referring to code 4631 instead of 4531.]

69) WX wave period indicator

70) SX swell period indicator

Unless missing, WX and SX indicate that the wave and swell periods were converted from code into whole seconds:

1 = period converted from code into whole seconds

71) IRD IMM receipt date

Julian month starting January 1982 (i.e., 1=January 1982, 2=February 1982,..., 13=January 1983,...,255=March 2004) of tape receipt at NCDC.

[NOTE: Used only for tapes received during the course of routine international exchange. This information was not tracked until 1982.]

72) A6 allowance 6 flag

In Release 1 processing, both reports matched under dupelim allowance number 6 (see Release 1, supp. K) were assigned a value showing the number of hours by which the HSST Indian report lagged the deck 193 report, after which either or both reports may have been output:

0 = six hours, or

1 = seven hours

{4. Control section}

73) CK checksum

A checksum was computed and stored with each report as a measure of reliability during storage and transmission. The checksum is computed by

i) Summing coded values of all fields in the report preceding the checksum, except RPTIN and RPTID.

ii) Obtaining the modulo ( $2^{*}5 - 1$ ) of the sum.

Repeating this calculation for every unpacked report, and then verifying that the checksum so obtained agrees with the coded checksum stored in the report,

is strongly encouraged (and already implemented in the Fortran access program). For example, supposing that the coded values of the preceding fields 1 through 72 (excluding RPTIN and RPTID) are available in an array FIELD, the checksum CK is computed and verified against the stored checksum CKS in Fortran as follows:

```

      INTEGER CK,J,FIELD(72),CKS
      CK = 0
      DO 500 J = 1,72
500  CK = CK + FIELD(J)
      CK = MOD(CK,31)
      IF(CK .NE. CKS) THEN
          PRINT *, 'ERROR. CK = ',CK,' .NE. CKS = ',CKS
          STOP
      ENDIF

```

Note that using modulus  $2^{*}5 - 1$  takes into account every bit of CK, versus chopping at the fifth bit using modulus  $2^{*}5$ .

#### 74) AC attachment count

Applicable only for the LMR format (in LMRF, field 73 is followed by the trimming section; see Table 5). This shows that AC attachments, as described in sec. 5, follow.

### {5. Irregular section}

Applicable only for the LMR format. The combined length of the preceding three sections is 452 bits, which is equivalent in length to 113 4-bit bytes. Appended after bit 452 are AC attachments (unless AC is zero) whose purpose is to contain information that does not conveniently fit into the binary section of the format. Currently implemented are attachments 1, 2, 4, and 5:

- Attm1 = quality control flags generated in the NCDC-defined quality control program.
- Attm2 = additional "trimming" quality control flags.
- Attm4 = supplemental data from the original input format.
- Attm5 = fields that contain invalid characters or out of range values in the original input format.

#### 75) AL attachment length

AL is the length of the attachment data following AID in 4-bit bytes.

#### 76) AID attachment ID

Numeric identifier of this attachment:

- 1 = quality control attachment (Attm1)
- 2 = trimming attachment (Attm2)
- 4 = supplemental attachment (Attm4)
- 5 = error attachment (Attm5)

#### 77) AD attachment data

Attachment data are defined in the following.

[NOTE: Attm1 and Attm2 are added during dupelim processing; Attm3 remains not implemented. For Attm4, a description is given of the handling of binary data, and to clarify the handling of ascii versus ebcdic. Also, Table 14 is modified from Release 1, Table F4-3 such that the 12-0 and 11-0 overpunches now appear as curly brackets (see Table 14). Attm5 documentation, which was written but inadvertently omitted from the Release 1 publication, is modified to describe the handling of binary data.]

#### Attm1. Quality Control Attachment

Flag values generated by the NCDC defined QC procedure (see Release 1, supp. J) are stored in TD-11 as alphabetic characters given in Table 12, together with their coded (or true value) equivalents as stored in LMR.

Table 12. QC flag meaning.

Char	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 (mean + or - 4.8 sigma)
M	7	3	erroneous	legality
N	8	3	erroneous	internal consistency
Q	9	3	erroneous	extreme (mean + or - 5.8 sigma)
S	10	3	missing	--

One of the possible flag values was assigned to each of the flags given in Table 13.

Table 13. QC flag order and possible values.

#	Flag	Coded	Bits	Possible flag values (X)											
				R	A	B	J	K	L	M	N	Q	S		
1	ship position	1:10	4	X						X					
2	wind	1:10	4	X	X		X			X		X	X		
3	visibility	1:10	4	X						X			X		
4	present weather	1:10	4	X		X	X		X	X			X		
5	past weather	1:10	4	X			X			X			X		
6	pressure	1:10	4	X					X	X		X	X		
7	air temperature	1:10	4	X			X		X	X	X	X	X		
8	wet bulb temp.	1:10	4	X		X			X	X	X	X	X		
9	dew point temp.	1:10	4	X		X			X	X	X	X	X		
10	sea surface temp.	1:10	4	X					X	X		X	X		
11	cloud	1:10	4	X		X	X				X		X		
12	wave	1:10	4	X	X	X	X			X	X	X	X		
13	swell	1:10	4	X		X	X			X	X	X	X		
14	pressure tendency	1:10	4	X					X		X		X		
15	quality code	1:43	8												
	total		64												

The quality code is the sum of the weight of flags 1-14. NOTE: in each coded value, zero is reserved as an indicator of a missing flag. Thus the quality code true value is actually:

$$\text{quality code true value} = \text{coded} - 1$$

For the flags, the coded and true values are the same.

#### Attm2. Trimming Attachment

Table 5 gives the structure of the trimming attachment data (note that field numbering in Table 5 is not applicable to the LMR trimming attachment, but to the trimming section of LMRF). See <stat\_trim> for Attm2 field numbering, field configurations, and other details.

Attm3 (not currently implemented).

#### Attm4. Supplemental Attachment

All fields not converted to fit into LMR fields and other designated fields are packed into a character string:

a) For Release 1 data: This consists of all characters beginning in position 78, 78, and 79, for the TD-1100, TD-1127, and TD-1129 formats, respectively. For the Exchange format this consists of characters from positions 33-35 and 42-46. Refer to Release 1, supp. I for more details on these formats.

b) For subsequent updates: We are working on making documentation of the input formats and contents of the supplemental attachment, depending on SID and/or DCK, available in electronic form.

Since the vast bulk of the data is numeric, or numeric overpunch, a 4/8/12-bit "ship" character set was used that maximizes compression but has close ties to ebcdic. These rules were followed in translation to the ship character set:

- a) All numeric characters are translated into values 0-9 (equivalent to the low order 4 bits of ebcdic).
- b) Spaces translate to the value 10.
- c) A subset of other characters is stored as 8-bit where the first 4 bits contain 12, 13, or 14. (See Table 14.)
- d) Characters not appearing in Table 14 are represented by a 4-bit flag of 15, followed by the original 8-bit character.
- e) More than 2 consecutive spaces are represented by a 4-bit flag of 11, followed by a 4-bit count of the (number minus three) of consecutive spaces that these 8 bits replaced. Thus a count of 0=3 spaces, 1=4 spaces, ..., 15=18 spaces. Trailing spaces are simply omitted.

Table 14. 4/8/12-bit ship character table.\*

Low-order 4-bit byte	Empty	High-order 4-bit byte	12	13	14
0	0	3 sp	{**	**}	
1	1	4 sp	A	J	/
2	2	5 sp	B	K	S
3	3	6 sp	C	L	T
4	4	7 sp	D	M	U
5	5	8 sp	E	N	V
6	6	9 sp	F	O	W
7	7	10 sp	G	P	X
8	8	11 sp	H	Q	Y
9	9	12 sp	I	R	Z
10	1 sp	13 sp	&	-	*
11	8-bit	14 sp	+		
12	8-bit	15 sp			
13	8-bit	16 sp			
14	8-bit	17 sp			
15	12-bit	18 sp			

\* Read the value of the first 4-bit byte as low-order. If "8-bit" is shown, this byte is read instead as high-order and the next 4-bit byte as low-order. If "12-bit" is shown, the next 8-bit byte is the original input character. A run of n spaces is denoted by n sp. Blank positions in the table will be defined as needed.

\*\* These appeared as 12-0 and 11-0 overpunches in Release 1, Table F4-3 because various representations for the overpunches, including the curly brackets, were translated into these ship characters according to Release 1, Table I2-1. For Release 1a and subsequent processing, only the curly brackets were translated into these ship characters.

Fields stored in this attachment originated from character or binary data, as indicated by source ID and/or DCK (each SID generally is associated with a single input format). Characters were translated from the original character set into the ship character set according to Table 14. However, if no mapping was defined by Table 14, the original 8-bit ascii character, or a translation of the original 8-bit ebcdic character into ascii, was stored according to rule d) above (ebcdic translation was accomplished using the reversible mapping described in <soft\_lmr>). The original form of binary data, or mixed binary and characters, was stored by treating each 8-bit byte as if a character during translation into the ship character set (all such formats had supplemental fields with an integral number of 8-bit bytes). Adoption of these procedures

complicates interpretation of the supplemental data, but minimizes storage volume and ensures that the original bit-stream can be reconstructed.

[NOTE: Russian MARMET (deck 732) data are an exception to the otherwise uniform storage of data in the supplemental attachment using the "ship" character set as described above. For deck 732, the data were written directly into the attachment rather than translated into the ship character set. Since this may produce unexpected results if deck 732 supplemental attachment data are unpacked or printed using standard software, we intend to correct this minor discrepancy as part of a future update.]

#### Attm5. Error Attachment

When an input data field was encountered that had an invalid configuration or was out of range, the entire field (or in some cases multiple input fields, if utilized to construct a single LMR output field) was stored in this attachment. Each such original input field is preceded by an 8-bit field identifier that contains the LMR field number according to Tables 1 and 2, and a 4-bit field that contains the 8-bit character- or byte-count for the field. Similarly to Attm4, fields stored in this attachment originated from character or binary data, as indicated by source ID and/or DCK (each SID generally is associated with a single input format). For characters, 8-bit ascii was stored, translated if necessary from 8-bit ebcdic (ebcdic translation was accomplished using the reversible mapping described in <soft\_lmr>). Binary data were stored in original form with zero-padding to the left (i.e., as part of the first 8-bit byte) if necessary to create an integral number of 8-bit bytes.

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