NOAA Techniques Development Laboratory
Computer Program NWS TDL CP 83-3

AFOS-ERA FORECAST VERIFICATION

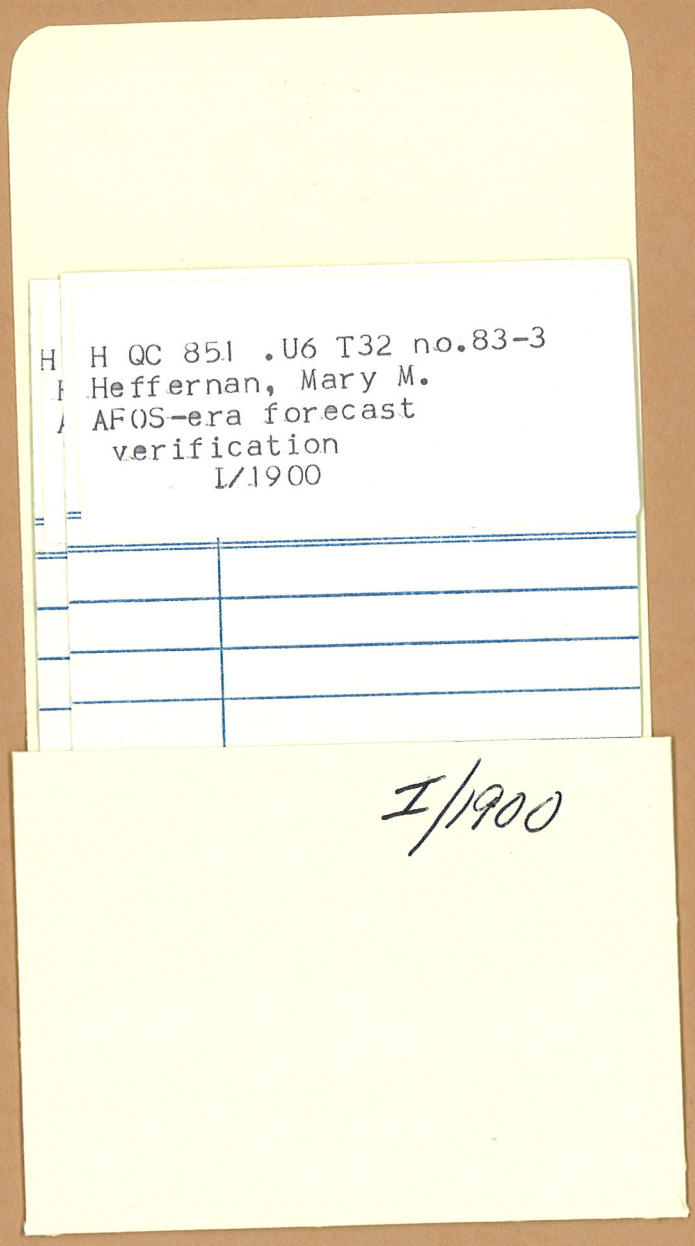
Silver Spring, Md.
October 1983

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

PREFACE

The Techniques Development Laboratory's (TDL's) computer program (CP) series is a subset of the Lab's technical memorandum series. The CP series documents computer programs written at TDL primarily for the Automation of Field Operations and Services (AFOS) computers.

The format for the series follows that given in the AFOS Reference Handbook, Volume 6, Background Applications.



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AFOS-ERA FORECAST VERIFICATION

Mary M. Heffernan, Mary C. Newton,
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1. INTRODUCTION

The National Weather Service (NWS) is implementing a national forecast verification system which utilizes the processing and communication capabilities of the Automation of Field Operations and Services (AFOS) system. This AFOS-era forecast verification (AEV) system is a major step in implementing the National Verification Plan (NWS, 1982a) and replaces two existing national verification programs (NWS, 1982b and NWS, 1973). Local and guidance forecasts of public and aviation elements are verified for two forecast cycles per day. The AEV system is designed to collect and collate forecasts and observations; to provide a local, quality controlled database; to transmit data to a central site; to provide a permanent central archive; and to produce local, regional, and national summaries. Fig. 1 shows an overview of this system. Functions are performed at two levels. At the (local) Weather Service Forecast Office (WSFO) level, forecasts and observations are collected and collated, archived for local use, and transmitted to a central site for use in national summaries. Portions of this local processing require manual intervention. At the national level, the data sent from WSFO's are collected and archived. National summaries are produced semiannually by the Techniques Development Laboratory in conjunction with the Office of Meteorology.

The software described here, which is implemented at WSFO's, creates and maintains the local database of collated forecasts and observations. It also transmits the locally collected forecasts and observations to NMC. The design of the local, long-term archive and the production of local summaries can be adjusted to suit local needs. Software to perform these functions is being developed at the regional and local levels and is not part of this package; see Dunn (1982) for an example.

2. METHODOLOGY AND SOFTWARE STRUCTURE

The local verification software is designed to extract the forecasts and observations for verification from the AFOS products automatically. All guidance forecasts and observations can be collected without manual intervention. However, some local forecasts cannot be extracted from the forecast products and must be entered into the verification database using the AFOS message composition feature. Table 1 shows the forecast elements selected for verification. Forecasts that must be manually entered are indicated. The projection times given are in relation to model run time (i.e. 0000 or 1200 GMT). A more detailed description of the forecasts and their verifying observations is given in Appendix I.

The local software is composed of three programs: VERCREAT, MERGE, and COLLATE. VERCREAT is run just once at initialization time and defines for the local software which stations in the WSFO area will be verified. MERGE decodes the official forecasts and merges them with the guidance forecasts. These merged forecasts are stored as an AFOS product which is used as one of the inputs to COLLATE after the non-decodable forecasts are entered through message composition by the forecaster. COLLATE performs several functions.

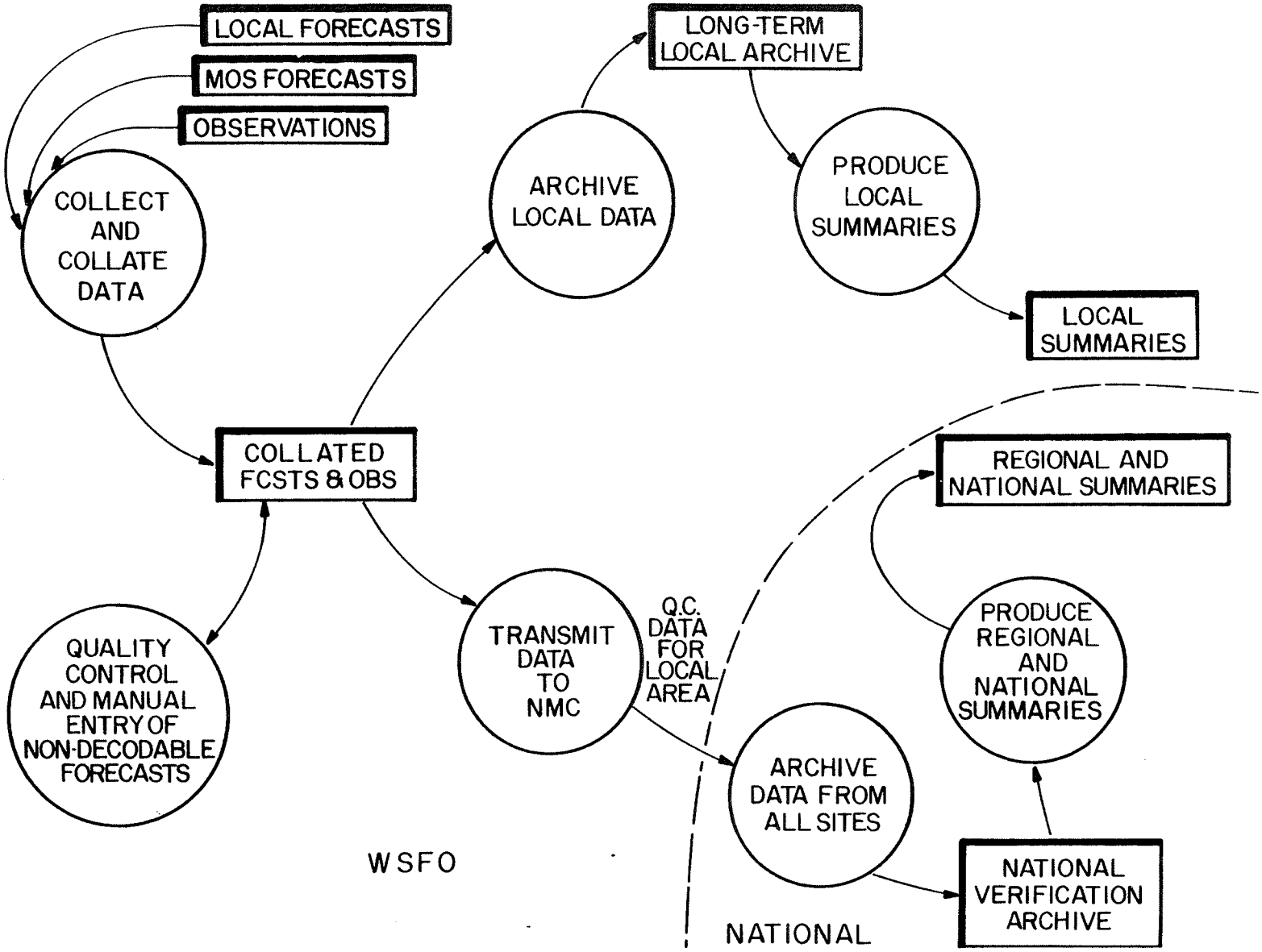


Figure 1. Overview of the AFOS-era verification system. Software described here is implemented at the WSFO and performs the functions of collecting and collating forecasts and obs and transmission of data to NMC.

Table 1. Forecast elements to be verified. Projections given are in relation to model run time (0000 or 1200 GMT). Elements with asterisks must be manually entered into the verification system.

Forecast Element	Projection
Maximum Temperature	12 - 24 and 36 - 48 h (0000 GMT) 24 - 36 and 48 - 60 h (1200 GMT)
Minimum Temperature	24 - 36 and 48 - 60 h (0000 GMT) 12 - 24 and 36 - 48 h (1200 GMT)
Probability of Precipitation	12 - 24, 24 - 36, and 36 - 48 h
Precipitation Type	18*, 30*, and 42* h
Cloud Amount	12*, 18*, and 24* h
Snow Amount	12 - 24* h
Ceiling Height	12, 15, 18, and 24 h
Visibility	12, 15, 18, and 24 h
Wind Speed and Direction	12, 18, 30, and 42* h

Primarily, it collates the forecasts of the past 5 days with the verifying observations, and it builds two AFOS products (one for public forecasts and one for aviation forecasts) of matched forecasts and observations and an RDOS disk file of this same information. The AFOS products can be quality controlled with the AFOS message composition feature, and it is possible to enter the non-decodable forecast directly into them. The RDOS disk file can be accessed by local software for generating statistics. COLLATE also prepares and transmits to NMC matched sets of forecasts and observations that have been locally quality controlled. Fig. 2 shows the data flow for the local software.

The AEV is designed to be run twice a day--once for early morning (00Z cycle) forecasts and once for the evening (12Z cycle) forecasts. If a forecast cycle or cycles have been missed, the AEV allows processing of missed cycles by searching back in the database for forecasts and verifying observations. The MERGE software can process the current cycle even if previous cycle(s) have been missed. This allows the verification to proceed with the minimum amount of missing data if it has not been operated for several days.

A. VERCREAT

VERCREAT is run once at initialization time at a WSFO. This program interactively requests from the user the name of the local WSFO followed by the stations to be verified. A maximum of 12 stations per WSFO is allowed.

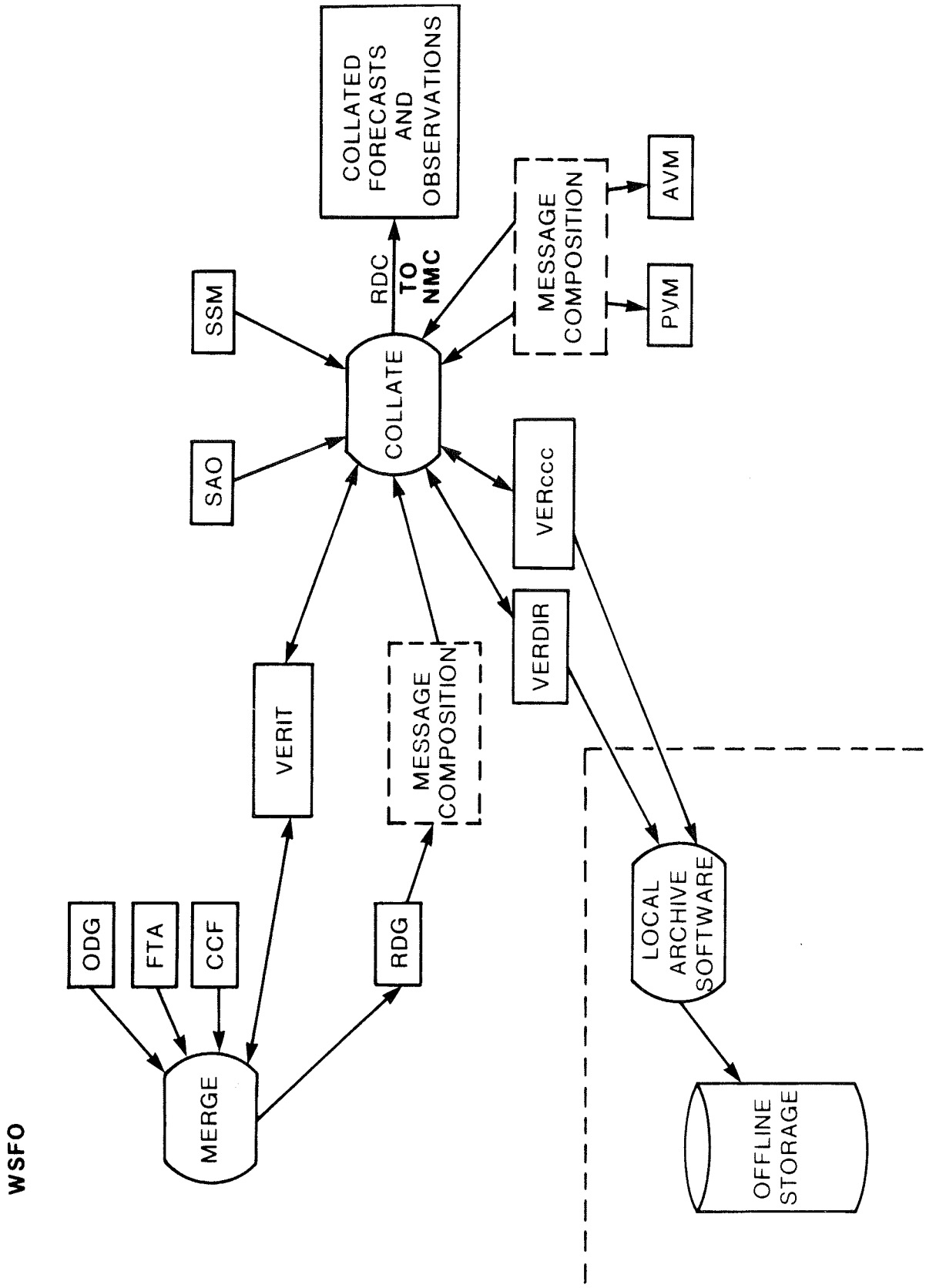


Figure 2. Data flow for the local verification software.

The first two stations in the list should be those stations that will participate in the national verification program. The software to produce local summaries (Dunn, 1982) accesses the first three station's data. The user is then requested to input the time zone of the WSFO. The program creates three files--VERIT, VERDIR, and VERccc.

The VERIT file is a verification information table. It keeps a record of when the MERGE and COLLATE programs run and also keeps track of the time of the last surface aviation observation (SAO) and surface synoptic report (SSM) read. MERGE and COLLATE communicate through this file. The format of VERIT is given in Table 2. The VERDIR file is a directory file used to access the VERccc file which contains the collated forecasts and observations. The structure of the file and its data content are given in Table 3.

The file containing the collated forecasts and observations is called VERccc where ccc is the local WSFO ID. It is a random RDOS file whose length is dependent on the number of stations being verified. The structure of the file is given in Fig. 3. Each block of the file contains data for a maximum of three stations for one forecast cycle. Table 4 gives the data content for a station. The most recent forecasts are stored first in the file. Forecasts get progressively older as you go back in the file.

B. MERGE

The MERGE program reads the VERIT file to determine the cycle time and stations to process. It then accesses the AFOS database and retrieves the following products:

1. the combined cities forecast bulletin (CCF) for public forecasts,
2. the aviation terminal forecasts for the selected stations (FTA), and
3. the MOS guidance for the selected stations (ODG).

Forecasts of max/min temperature and 12-h POP are taken from the CCF bulletin along with the public forecaster number. Forecasts of ceiling height, horizontal visibility, and wind direction and speed are taken from the FTA's. These forecasts and the MOS guidance forecasts, ODG's, are merged into one product for each station and entered into the database under the product category, RDG. (ODG stands for original digital guidance and RDG stands for revised digital guidance.) The product RDG is then available to the forecaster to quality control and enter additional forecasts that cannot be decoded from the forecast bulletins. The AFOS identifier used to retrieve the RDG product is cccRDGxxx where ccc is the local WSFO identifier and xxx is the station to be verified; the product can be displayed by entering d:RDGxxx or edited by entering e:RDGxxx. MERGE then updates the VERIT file with the cycle time of the cycle it just processed. MERGE operates on one forecast cycle's data at a time.

The aviation forecaster number may be entered for verification by use of a /A switch on MERGE. The format would be RUN:MERGE NN/A where NN is the forecaster number. Two digits are allowed for this field. This will be used for all stations for the current cycle time.

Table 2. Format of the VERIT File. Data type "A" indicates ASCII data; data type "B" indicates binary data.

Word Number	Information	Data Type
1-2	WSFO ID	A
3	Number of stations to verify	B
4-5	1st station call letters	A
6	Time zone of station	B
7	Month * 100 + Day of last cycle MERGE processed	B
8	Cycle time (0000 or 1200) of the last cycle MERGE processed	B
9	Month * 100 + Day of the last cycle COLLATE processed	B
10	Cycle time (0000 or 1200) of the last cycle COLLATE processed	B
11	Month * 100 + Day of last SAO read	B
12	Hour * 100 + Minute of last SAO read	B
13	Month * 100 + Day of last SSM read	B
14	Hour * 100 + Minute of last SSM read	B

Words 4 thru 14 are repeated for up to twelve stations.

Table 3. Format of the VERDIR File. Current values of variables are shown in parentheses where appropriate. Data type "A" indicates ASCII data; data type "B" indicates binary data.

Word Number	Information	Data Type
0-1	WSFO call letters	A
2	Number of stations being verified (maximum is 12)	B
3	Spare	
4-5	1st station's call letters	A
6-7	2nd station's call letters	A
8-9	3rd station's call letters	A
10-11	4th station's call letters	A
12-13	5th station's call letters	A
14-15	6th station's call letters	A
16-17	7th station's call letters	A
18-19	8th station's call letters	A
20-21	9th station's call letters	A
22-23	10th station's call letters	A
24-25	11th station's call letters	A
26-27	12th station's call letters	A
28	Number of cycles in file for station 1	B
29	Number of cycles in file for station 2	B
30	Number of cycles in file for station 3	B
31	Number of cycles in file for station 4	B
32	Number of cycles in file for station 5	B
33	Number of cycles in file for station 6	B
34	Number of cycles in file for station 7	B
35	Number of cycles in file for station 8	B
36	Number of cycles in file for station 9	B
37	Number of cycles in file for station 10	B
38	Number of cycles in file for station 11	B
39	Number of cycles in file for station 12	B
40	Number of words of data reserved for each station (85)	B
41	Number of stations per block (3)	B
42	Spare	
43	Length of header information for each station (6)	B
44	Code for M/M temp (100)	B
45	Offset for M/M temp data/length of data (0016)	B
46	Code for 12-h PoP (200)	B
47	Offset for 12-h PoP data/length of data (1612)	B
48	Code for precip type (300)	B
49	Offset for precip type data/length of data (2812)	B
50	Code for 12-h snow amount (400)	B
51	Offset for 12-h snow amount data/length of data (4004)	B
52	Code for cloud amount (500)	B
53	Offset for cloud amount data/length of data (4412)	B
54	Code for ceiling height (600)	B
55	Offset for ceiling height data/length of data (5618)	B
56	Code for visibility (700)	B
57	Offset for visibility data/length of data (7418)	B
58	Code for wind (800)	B
59	Offset for wind data/length of data (9232)	B
60-67	Spare	

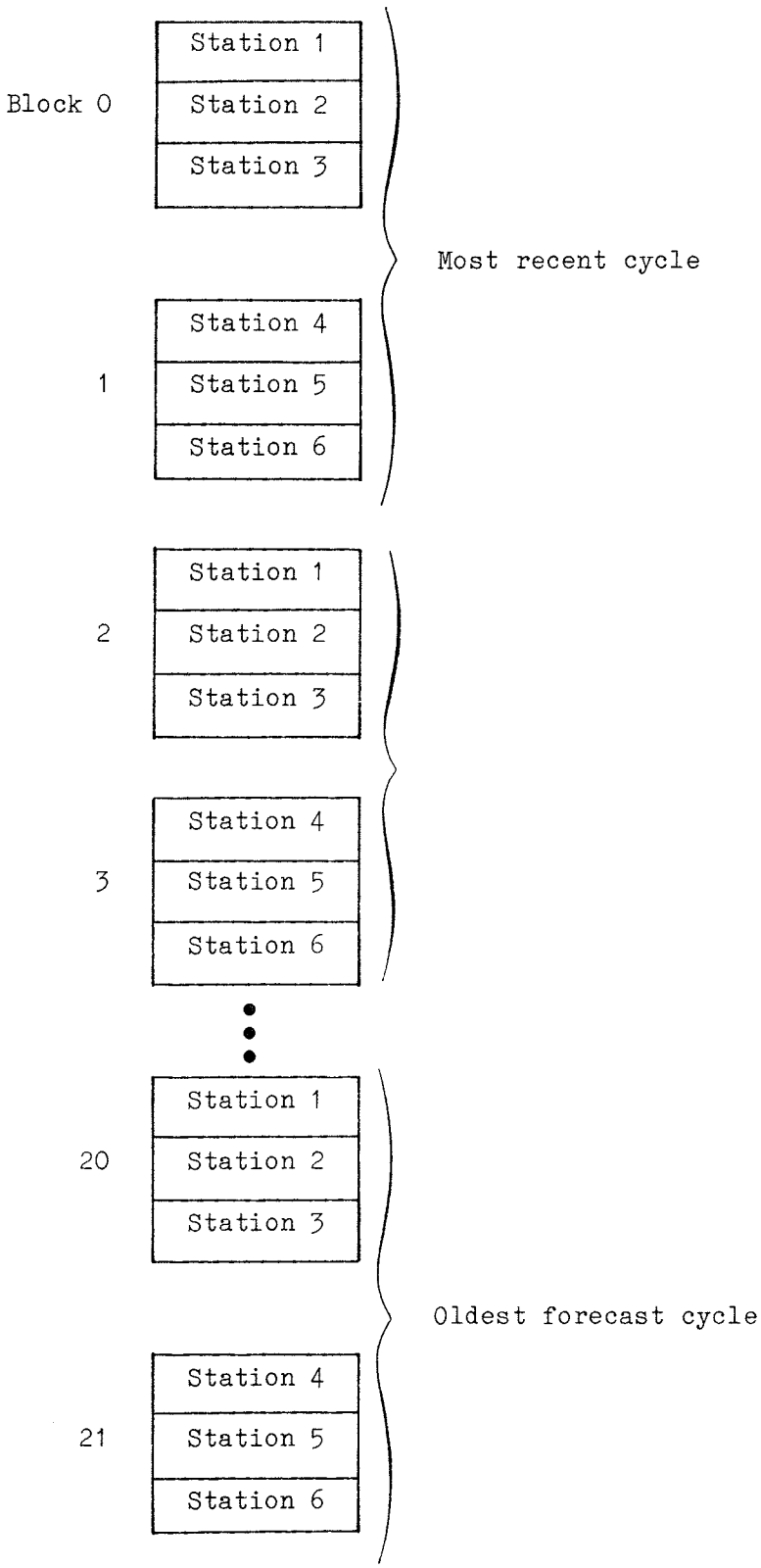


Figure 3. Format of VERccc file for most recent 11 forecast cycles of a WSFO archiving for 6 stations. For 3 or less stations the length would be 11 blocks; for 4 to 6 stations the length would be 22 blocks; and so on until for 10 to 12 stations the length would be 44 blocks.

Table 4. Data content for one station for one forecast cycle in the VERccc file (continued on next page).

Word Number	Information	
1-2	Station call letters	
3	Year/month	
4	Day/cycle	
5	Public forecaster #/Aviation forecaster #	
6	Spare	
7	MOS temp/local temp	12-24 h
8	Calendar day/12-h temp	
9	MOS temp/local temp	24-36 h
10	Calendar day/12-h temp	
11	MOS temp/local temp	36-48 h
12	Calendar day/12-h temp	
13	MOS temp/local temp	48-60 h
14	Calendar day/12-h temp	
15	MOS PoP/local PoP	12-24 h
16	Observed amount	
17	MOS PoP/local PoP	24-36 h
18	Observed amount	
19	MOS PoP/local PoP	36-48 h
20	Observed amount	
21	MOS precip type/local precip type	18 h
22	Verifying hour/2 hour window	
23	MOS precip type/local precip type	30 h
24	Verifying hour/2 hour window	
25	MOS precip type/local precip type	42 h
26	Verifying hour/2 hour window	
27	MOS snow amount/local snow amount	12-24 h
28	Observed snow amount	
29	MOS cloud amount/local cloud amount	12 h
30	Observed cloud amount	
31	MOS cloud amount/local cloud amount	18 h
32	Observed cloud amount	
33	MOS cloud amount/local cloud amount	24 h
34	Observed cloud amount	
35	MOS ceiling height/local ceiling height	12 h
36	9-h ceiling persistence	
37	Observed ceiling height	
38	MOS ceiling height*/local ceiling height	15 h
39	Observed ceiling height	
40	MOS ceiling height/local ceiling height	18 h
41	Observed ceiling height	
42	MOS ceiling height/local ceiling height	24 h
43	Observed ceiling height	
44	MOS visibility/local visibility	12 h

Table 4. (continued).

Word Number	Information	
45	9-h visibility persistence	
46	Observed visibility	
47	MOS visibility*/local visibility	15 h
48	Observed visibility	
49	MOS visibility/local visibility	18 h
50	Observed visibility	
51	MOS visibility/local visibility	24 h
52	Observed visibility	
53	MOS wind	12 h
54	Local wind	
55	Observed wind at hour	
56	Peak sustained wind	
57	MOS wind	18 h
58	Local wind	
59	Observed wind at hour	
60	Peak sustained wind	30 h
61	MOS wind	
62	Local wind	
63	Observed wind at hour	
64	Peak sustained wind	42 h
65	MOS wind	
66	Local wind	
67	Observed wind at hour	
68	Peak sustained wind	
69-85	Spare words	

*Forecast is not currently available.

Cycle Time

There are three possible ways MERGE can determine the cycle to process. The most frequent way is by adding 12 hours to the last cycle MERGE processed. However, if VERCREAT has just been run, MERGE checks the clock time and determines the cycle as follows:

CLOCK TIME	DAY	CYCLE
930<HHMM<2130 (2230 MTN/PAC)	Current	00Z
HHMM<930	Current -1	12Z
HHMM>2130 (2230 MTN/PAC)	Current	12Z

The third way MERGE would determine the cycle is if the user invoked the override switch. The override switch allows the user to direct MERGE to operate on a particular cycle. For example, if you wish to run MERGE on the 12Z cycle of data from the first of the current month which is March, you would enter at the console: RUN:MERGE 30112/0, where "/0" invokes the override switch. This option allows you to reprocess the same cycle to include forecasts which were missing the first time. As explained later, COLLATE will discard all but the last run of duplicate cycles of data. Note that if the override switch has been used, MERGE will execute as usual the next time by adding 12 hours to the last cycle processed. So unless the override switch was used to redo the current forecast cycle, the override switch will probably need to be used the next time to get MERGE back to the current cycle.

Product Time

MERGE will automatically retrieve from the database for each CCF, ODG, and FTA the required product to match the selected cycle time. Product times requested for each cycle time are found in Table 5. For each product, a window about the expected product time is allowed. The routine product issuance is used; no amendments are used. Corrected FT's are used.

Table 5. Product storage time (GMT) required for each cycle processed by MERGE. Enclosed in parentheses is the allowed time range for storage of products used in the program.

Product	Product Time	
	00Z Cycle	12Z Cycle
CCF	1000 (0800-1100)	2200 (2000-2300)
ODG	0600 (0500-0700)	1800 (1700-1900)
FTA	0930 (0830-1030)	2130* (2030-2230)

* 2130 denotes the storage time required for the FTA in the eastern/central time zones. 2230 with time range 2130-2330 is the appropriate storage time required in the mountain/pacific time zone.

C. COLLATE

The COLLATE program reads the quality controlled RDG product, surface observations, and synoptic observations for each station. In addition, COLLATE updates (or builds if just initialized) a public verification matrix product (PVM) and an aviation verification matrix product (AVM). Figs. 4 and 5 depict one page of the verification matrix for public and aviation forecasts, respectively. Each would be a five-page (10-cycle) product. The first few pages of the product would be incomplete with respect to the "observed" column since all events would not have yet occurred. Note that each cycle is identified by the day of the month and the GMT cycle time. The user is able to edit either of these products to make corrections. Each time COLLATE executes, the PVM product and AVM product will be read to obtain the previous cycle's forecasts and verifying observations if available. COLLATE will match the forecasts of the new cycle and previous cycles that have not already been matched with the observations.

COLLATE will sort cycles of data in the PVM and AVM into chronological order. It will insure that there are the same cycles in the PVM and AVM for any particular station. If duplicate cycles exist only the last one entered (processed by MERGE) will be retained.

Next, COLLATE will update the PVM and AVM products with the new forecast cycle's data and additional observations of previous forecasts. In addition to the PVM and AVM products, COLLATE updates the VERccc file with the same information. In this way, the local archive can be updated via the database products.

If the PVM and AVM products contain 10 cycles, COLLATE prepares the first two station's data in the oldest cycle (now the 11th) of the VERccc file for transmission to NMC for central archive and inclusion in national summaries. These data are transmitted as a local product with the identifier, cccVERccc, where ccc is the local WSFO ID. The product is stored in the local database and can be displayed by entering VERccc. Fig. 6 shows an example VERccc product and Table 6 explains the format of the product.

```
EXFMCPPVM
WOUS00 KEX1 272000
 DCA  0719   0000  FORECASTER  22                0718   1200  FORECASTER  33
ELEMENT  PROJ    MOS   LOCAL  OBSERVED             MOS   LOCAL  OBSERVED
TEMP M/M 12-24   88     90     92   92             73     75     74   74
DEG F    24-36   73     75     73   73             86     90     92   92
         36-48   91     90     90   90             75     76     73   73
24H/12H  48-60   69     70     69   69             90     91     90   90

12H POP  12-24   70     80       128              20     30        0
PERCENT  24-36   50     40        -2              80     80      128
         36-48   10     10         0              50     60       -2

POPT     18(+-1) 3      3      003  003            3      3      000  000
CTGY     30(+-1) 3      3      000  000            3      3      003  003
Z/F/L    42(+-1) 3      3      000  000            3      3      000  000

SNOW AMT 12-24   0       0         0              0       0         0
CTGY/AMT

CLD AMT    12    2      2         3              3      2         2
CTGY       18    3      2         2              2      2         2
           24    1      1         1              2      2         3          [ ]
                                                                    PAGE  01
```

One page of a Public Verification Matrix (PVM) product for one station. The forecasts get progressively older as you page through this five-page product. A brief description of the data elements follows. For more details refer to Appendix I.

TEMP M/M--All values for maximum and minimum temperature are in degrees Fahrenheit. Two observed temperatures are shown. The first observed temperature (on the left hand side) is the 24-h temperature and the second is the 12-h temperature.

PoP--MOS and local 12-h PoP forecasts are given in percent. The observed value is in hundredths of inches with a trace coded as a minus 2.

PoPT--Forecasts and observed values of precipitation type are categorical with a value of 1, 2, or 3 for freezing, frozen, and liquid precipitation, respectively. Three digits are reserved for each observed field which allows for a mixture of precipitation type to be recorded. The first observed field is from the routine surface observation at the verifying hour. The second observed field is a composite of precipitation for a 2-hour window about the verifying hour.

SNOW AMT--MOS forecasts are categorical. The categories are 0) $\leq$ 1, 2) 2-3, 4) 4-5, 6) $\geq$ 6 inches. Local forecasts and observed values are in whole inches.

CLD AMT--Cloud amount forecasts and observations are categorical with values of 1 through 4. The categories are 1) CLR, -X, -SCT, -BKN, -OVC, 2) SCT, 3) BKN, 4) X, OVC.

Figure 4. Public Verification Matrix product.

```
EXFMCPAVM
WOUS00 KEX1 231800
 DCA  0719   0000  FORECASTER  28              0718   1200  FORECASTER  24
ELEMENT  PROJ    MOS   LOCAL  OBSERVED            MOS   LOCAL  OBSERVED
CIG         9                    96                                 96
           12      6     80     80                 6     96     96
CTGY/FT    15                   80                                 96     96
           18      6     96     96                 6     96     96
           24      6     96     96                 6     96     80

VIS         9                   800                                800
           12      6     80     600                6     80     800
CTGY/MI    15                   80                                 80     800
           18      6     80     600                6     80     800
           24      6     80     800                6     80     600

WINDS    12(+-3) 2006   1805   2005   2308          1805   2005   1804   1807
DEG/     18(+-3) 1604   1805   1703   1705          2007   2005   2202   2004
KTS      30(+-3) 2208   2205   2305   1908          2210   2310   1703   1705
         42(+-3) 3011   0000   2406   2509          1807   0000   2305   1908

                                                                    [ ]
                                                                PAGE  01
```

One page of an Aviation Verification Matrix (AVM) product for one station. The forecasts get progressively older as you page through this five-page product. A brief description of the data elements follows. For more details refer to Appendix I.

CIG--MOS ceiling height forecasts are categorical with values of 1 through 6. The categories are 1) <200, 2) 200-400, 3) 500-900, 4) 1000-2900, 5) 3000-7500, 6) >7500 ft. Local forecasts and observed heights are given in hundreds of feet with 96 for a ceiling above 9000 ft and 97 for an unlimited ceiling.

VIS--MOS forecasts of horizontal visibility are categorical with values of 1 through 6. The categories are 1) <1/2, 2) 1/2-7/8, 3) 1-2 3/4, 4) 3-4, 5) 5-6, 6) >6 mi. Local forecasts are two digits where the first is miles and the second is quarters of miles; visibilities over 7 miles are coded as 80. Observed visibilities are given in hundredths of miles; visibilities over 7 miles are coded as 800.

WINDS--MOS and local wind forecasts and observed directions and speeds are given in tens of degrees/knots. The first observed wind is from the routine surface observation at the verifying hour. The second observed wind is the peak sustained wind reported in a 6-h window about the verifying hour.

Figure 5. Aviation Verification Matrix product.

```
WBCVERWBC
FPUS95 KWBC WBC  2
DCA 83071812
100  73  75  74  74  86  90  92  92  75  76  73  73  90  91  90  90
200  20  30    0  80  80  128  50  60   -2
300 33000000 33000003 33000000
400 0  0  0
500 322 222 223
600  96 6 96  96   96  96 6 96  96 6 96  80
700 800 6 80 800   80 800 6 80 800 6 80 600
800 1805 2005 1804 1807 2007 2005 2202 2004 2210 2310 1703 1705
    1807 0000 2305 1908
RIC 83071812
100  74  76  75  75  89  93  95  95  76  77  74  74  93  94  93  93
200  30  40    0  90  90   24  60  70    0
300 33000000 33000003 33000000
400 0  0  0
500 112 222 323
600  96 6 96  96   96  96 6 96  96 6 96  80
700 800 6 80 800   80 800 6 80 800 6 80 600
800 1906 2106 1905 1908 2108 2106 2303 2105 2311 2411 1804 1806
    1908 0000 2406 2009
                                                          PAGE  01
```

Figure 6. Example cccVERccc product which is transmitted back to NMC.

Table 6. Format of the cccVERccc message. Data from two stations are transmitted in each bulletin (continued on next page).

Line	Contents	
100	Temperature: 16 pieces of information (°F)	
	1 - MOS 24-h temp fcst (max or min)	
	2 - Local 24-h fcst (max or min)	
	3 - 24-h observation	
	4 - 12-h observation	
	5 - MOS 36-h fcst	
	6 - Local 36-h fcst	Pattern repeats for
	7 - 24-h observation	48- and 60-h fcsts
	8 - 12-h observation	
200	Probability of Precipitation: 9 pieces of information	
	1 - MOS 12-24 h PoP	
	2 - Local 12-24 h PoP	Pattern repeats for
	3 - Observed precip amt (hundredths of inches, trace = -2)	36- and 48-h fcsts
300	Precipitation Type: 12 pieces of information	
	1 - MOS 18-h PoPT forecast (category 1, 2, 3)	
	2 - Local 18-h PoPT forecast (category 1, 2, 3)	
	3 - Observation in form XYZ where X = 0 (1) if no freezing (freezing occurred); Y = 0 (2) if no snow (snow occurred); and Z = 0 (3) if no liquid precip. (liquid precip. occurred).	Pattern repeats for 30- and 42-h fcsts
	4 - Same (XYZ) as 3 above except the observation is for a 2-h period.	
400	Heavy Snow: 3 pieces of information	
	1 - MOS 12-24 h snow amt fcst (0, 2, 4, 6)	
	2 - Local 12-24 h snow amt fcst (inches)	
	3 - Observed snow amount (inches)	
500	Cloud Amount: 9 pieces of information	
	1 - MOS 12-h fcst (1, 2, 3, 4)	
	2 - Local 12-h fcst (1, 2, 3, 4)	Pattern repeats for
	3 - Observed cloud amount (1, 2, 3, 4)	18- and 24-h fcsts
600	Ceiling Height: 13 pieces of information	
	1 - 9-h persistence forecast (hundreds of feet)	
	2 - MOS 12-h fcst (1, 2, 3, 4, 5, 6)	
	3 - Local 12-h fcst (hundreds of feet)	
	4 - Observed ceiling height (hundreds of feet)	
	5 - MOS 15-h fcst (1, 2, 3, 4, 5, 6)	Pattern repeats for
	6 - Local 15-h fcst (hundreds of feet)	18- and 24-h fcsts
	7 - Observed ceiling height (hundreds of feet)	

Table 6. (continued).

Line	Contents	
	96 = ceiling above 9000 feet 97 = unlimited ceiling	
700	Visibility: 13 pieces of information 1 - 9-h persistence fcst (hundredths of miles) 2 - MOS 12-h fcst (1, 2, 3, 4, 5, 6) 3 - Local 12-h fcst (miles and quarters of miles) 4 - Observed visibility (hundredths of miles) 5 - MOS 15-h fcst (1, 2, 3, 4, 5, 6) 6 - Local 15-h fcst (miles and quarters of miles) 7 - Observed visibility (hundredths of miles) 80 = local forecasts of visibilities greater than 7 miles 800 = observed visibility greater than 7 miles	Pattern repeats for 18- and 24-h fcsts
800	Wind: 16 pieces of information 1 - MOS 12-h wind forecast (ddff) 2 - Local 12-h wind forecast (ddff) 3 - Observed wind direction and speed (ddff) 4 - Observed peak wind direction and speed in 6-h period	Pattern repeats for 18-, 30-, and 42-h fcsts

Switches

If, for some reason, the COLLATE program runs but the oldest cycle of the VERccc file is not successfully transmitted to NMC, you may transmit that particular cycle by using a switch. The command to enter at the console to accomplish this is: RUN:COLLATE/T where "/T" invokes the override switch. This command activates only that software in COLLATE that sends the first two stations in the oldest cycle of the VERccc file to NMC. No matching of forecasts and verifying observations is done.

The use of the /C switch allows matching of new observations to data in the PVM's and AVM's. No new cycle of data is added and no data are transmitted with this option. The command is RUN:COLLATE/C.

If the date and time of the new cycle of data COLLATE is reading from the RDG match the date and time of the last cycle COLLATE read from the RDG, COLLATE will not use this cycle unless the /O switch is invoked. This is generally only a concern when the /O switch has been used with MERGE to redo the current forecast cycle. In this case, the /O switch should be used with COLLATE to pick up that cycle and update the PVM and AVM products with it. The command is RUN:COLLATE/O.

Default Forecast Values

COLLATE will default certain local forecasts if the RDG indicates missing values for them. The defaulting scheme which is described below is conservative, and it should be remembered that the local forecasts are the forecasters responsibiltiy and the program default is merely a convenience that may many times meet the forecasters need.

The precipitation type forecasts are defaulted based on the local maximum or minimum temperature forecast for the 12-h period taken from the CCF as follows:

temperature	precipitation type is defaulted to
$\geq 45^{\circ}F$	3 (liquid)
$15 \leq T < 45^{\circ}F$	no default - missing
$\leq 15^{\circ}F$	2 (frozen)

The local snow amount forecast is defaulted to zero. The local 42-h wind forecast which is only verified when the forecast or observed value is $\geq$ 22 kt, is defaulted to calm winds (0000) if the 30-h local wind forecast is $\leq$ 20 kt. If the 30-h local wind forecast is > 20 kt, the 42-h forecast is left as missing.

3. DATA FORMAT

The AFOS displayable products (cccPVMxxx and cccAVMxxx) contain the same information as the data file VERccc in a different format. The products are provided for easy reference and editing, if necessary. Any changes made to the products will cause the VERccc file to be updated the next time COLLATE executes. Figs. 4 and 5 show one page each of cccPVMxxx and cccAVMxxx products, respectively. These figures also describe the data content of the products.

The VERccc file contains the same 5 days (10 most recent cycles) of data as the database products and an additional eleventh cycle that was transmitted by COLLATE the last time it executed. This eleventh cycle is kept in case a retransmission of the data is necessary. A description of the data in VERccc is found in Appendix I.

4. PROCEDURES

A. VERCREAT

The initialization program, VERCREAT, is activated at the dasher by entering: VERCREAT. The program is run once and executes in 10 K words in about 15 seconds. It requires as input the call letters of your WSFO followed by the call letters of all stations to be verified. A maximum of 12 stations may be verified. The first two stations should be the ones that will participate in the national verification program. The software structure and load line for VERCREAT are given in Fig. 7.

B. MERGE

MERGE is initiated at the console by entering: RUN:MERGE MMDDCC/O NN/A, where MM is the month number and DD is the day of the month and CC the cycle to be processed. Note that the date and cycle time, MMDDCC/O, may be omitted. In this case, the MERGE program will process the next cycle by adding 12 hours to the last cycle time processed, or if files are just initialized by checking the clock time.

The local /A switch is an option to input NN, the aviation forecaster number. Two digits are allowed for this field.

The program executes in 28 K words in about 1.5 minutes for three stations, and requires as input the data file that was created by VERCREAT. In addition, MERGE requires that certain database products be present. See Table 7 for a list of database products required for the MERGE program. The software structure and load line for MERGE are given in Fig. 8.

VERCREAT

MAIN PROGRAM

VERCREAT

SUBROUTINES

NONE

LOAD LINE

RLDR VERCREAT UTIL.LB FORT.LB

Figure 7. Software structure and load line for program VERCREAT.

Table 7. Database products required in the AEV program.

AFOS ID	Product Description	Fields Only	Purge Parameter
cccMCPODG	Preformat for MOS matrix	0=1	001M
cccMCPRDG	Same as above	0=1	001M
cccMCPPVM	Preformat for the public verification matrix	0=1	001M
cccMCPAVM	Preformat for the aviation verification matrix	0=1	001M
cccODGxxx	MOS matrix for verification station		005M*
cccRDGxxx	MOS plus local forecast for station		002M
cccPVMxxx	Collated MOS, local public forecasts, and observations for station xxx for five days		002M
cccAVMxxx	As above but for aviation		002M
cccCCFccc	Combined cities forecast bulletin-FP4		005M*
cccFTAxxx	Aviation terminal forecasts		010M*
cccSAOxxx	Surface airways observations		036M*
cccSSMxxx	Synoptic observations		012M*
cccVERccc	Station verification data to be transmitted to NMC		001M

*The number of versions of these products stored can be reduced. These numbers provide flexibility in being able to run the AEV application up to two days late.

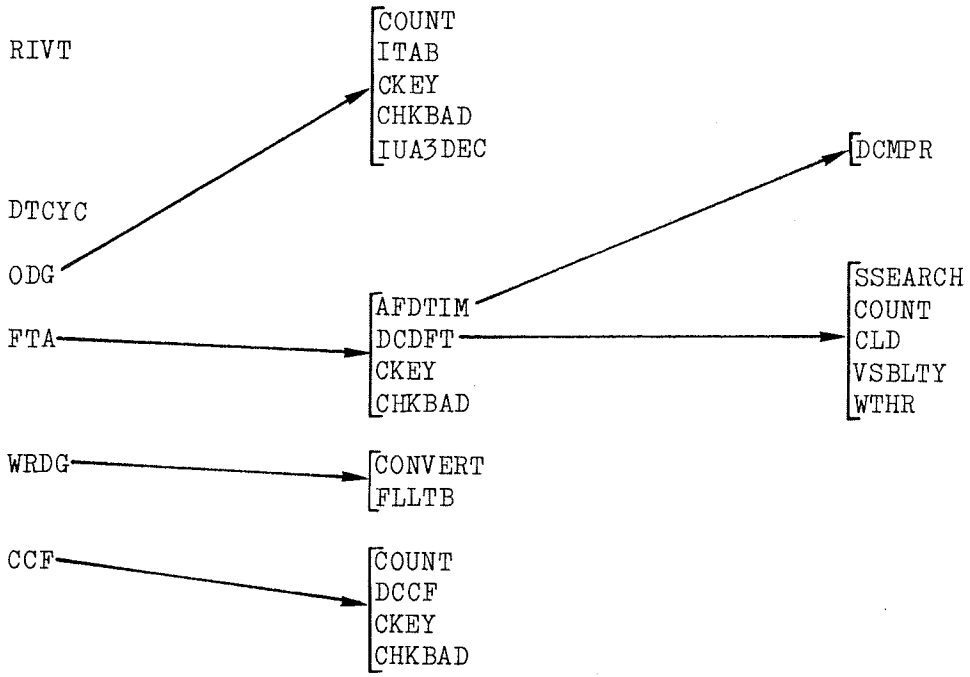
MERGE

MAIN PROGRAM

MERGE

SUBROUTINES

MEREV



LOAD LINE

```
RLDR MERGE MEREV RIVT SSEARCH AFDTIM DCMPR COUNT CKEY
     [CCF DCCF, FTA DCDFT] WTHR VSBLTY CLD ODG ITAB
     WRDG FLLTB CONVERT IUA3DEC CHKBAD DTCYC BG.LB UTIL.LB FORT.LB
```

Figure 8. Software structure and load line for program MERGE.

C. COLLATE

COLLATE runs after the MERGE program and may be initiated at the console by entering: RUN:COLLATE. The program executes in 28 K words in about 2 minutes for three stations to be archived. COLLATE requires VERDIR, VERccc, and VERIT data files that were created by VERCREAT. Also, Table 7 lists database products required. The software structure and load line for COLLATE are given in Fig. 9.

D. Message Composition

The AFOS message composition is used to enter the non-decodable local forecasts and to quality-control the verification data. Fig. 2 shows two message composition steps. The first is to edit the RDG after MERGE has run. This would be to quality control the decoded CCF's and FT's and to enter the missing local forecasts. The second step which is to edit the PVM and AVM products after COLLATE does run, is needed to quality control the decoded SAO's and SSM's. Since all the verification data are available in the PVM and AVM, it is possible to enter the missing local forecasts at this point and omit editing the RDG.

The RDG, PVM, and AVM are pre-formatted fields only AFOS products. To edit them enter e:RDGxxx, e:PVMxxx, or e:AVMxxx at the AFOS console. After completing the header block with addressee set to OOO, the first page of the product will appear. Each datum value will appear within square brackets ([ ]). To enter or modify a value, position the cursor within the brackets and enter the datum value right justified. To proceed to the next page simply hit the next page button. Because of a deficiency in the AFOS software, hitting the previous page button while editing a pre-formatted product will cause the product to become garbled. Do not hit the previous page button. If you need to go back to a previous page, terminate message composition either by hitting a display clear or by entering the product and then reenter message composition. To enter a product, position the cursor in the small box in the bottom right hand corner of any page and depress the enter button. All pages of the product will be saved.

RDG Product

This two-page product contains the MOS and local forecasts for both public and aviation elements. Fig. 10 shows an example RDG. MOS forecasts are shown on the first line for each element and local forecasts are beneath. In Fig. 10, the elements that must be manually entered are underlined. The public forecaster would quality control the max/min temperature and probability of precipitation forecasts and enter the precipitation type forecasts on page one of the RDG. On page two, the public forecaster would enter the snow amount and cloud amount forecasts and check to insure the public forecaster number is correct. The aviation forecaster would quality control the ceiling, visibility, and wind forecasts and enter the 42-h wind forecast and the aviation forecaster number if it is missing.

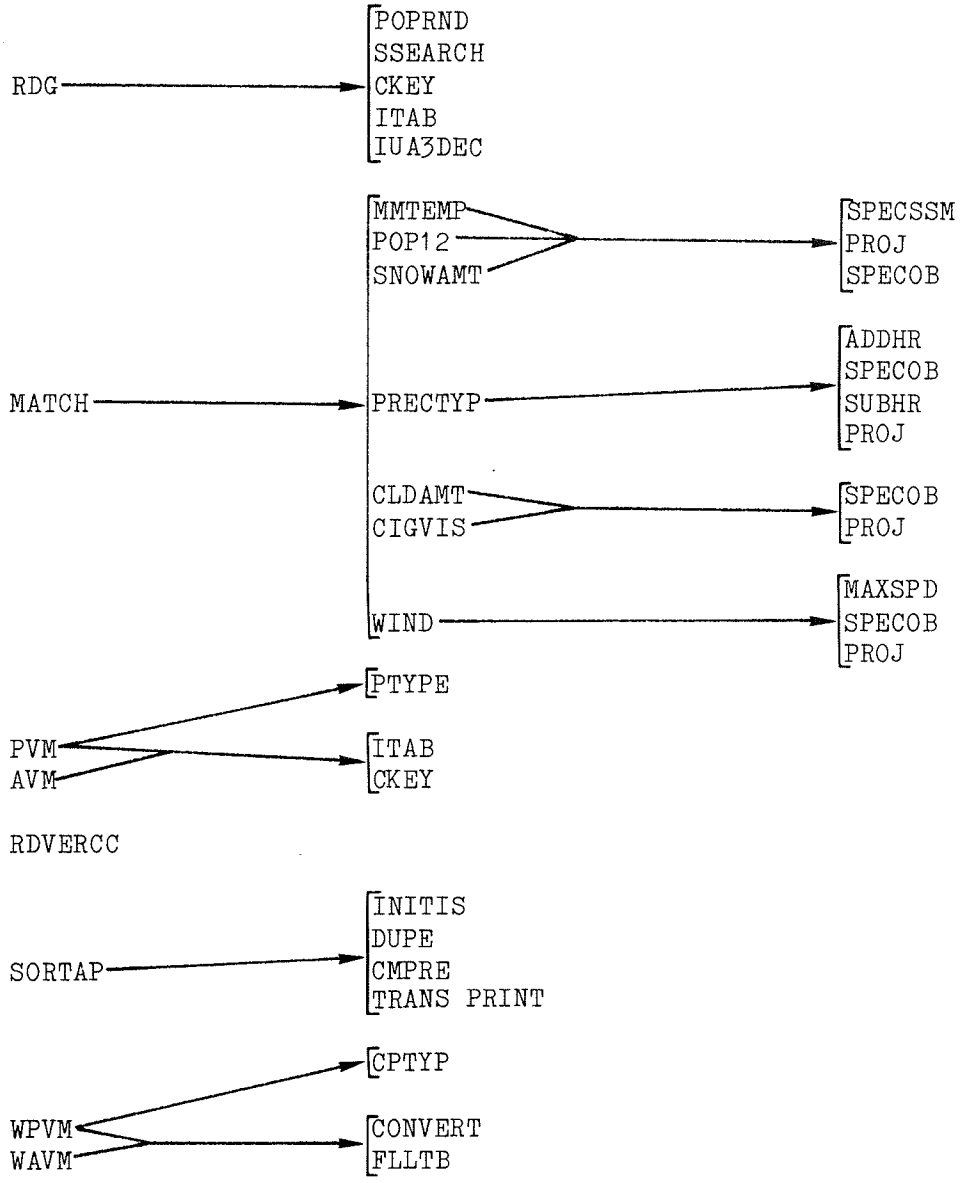
COLLATE

MAIN PROGRAM

COLLATE

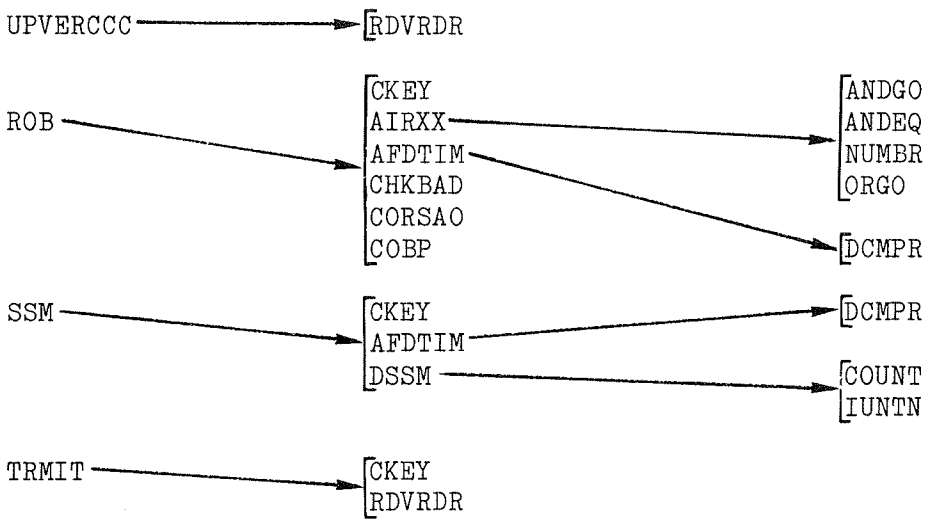
SUBROUTINES

COREV
RIVT
OPNVER



RDVERCC

Figure 9. Software structure and load line for program COLLATE (continued on next page).



LOAD LINE

```
RLDR COLLATE COREV [OPNVER RDG POPRND PVM PTYPE AVM RDVERCC,
AIRXX NUMBR ANDGO ANDEQ ORGO,
  MATCH MMTEMP POP12 PRECTYP SNOWAMT
CLDAMT CIGVIS WIND PROJ SPECOB SPECSSM
MAXSPD ADDHR, UPVERCCC TRMIT WPVM WAVM FLLTB CONVERT CPTYP,
  SSM IUNTN DSSM SORTAP SORTIS INITIS TRANS DUPE CMPRE PRINT ]
ROB RDVRDR COBP SUBHR RIVT ITAB AFDTIM DCMPR SSEARCH COUNT CKEY IUA3DEC
CHKBAD CORSAO
UTIL.LB BG.LB FORT.LB
```

Figure 9. (continued).

```
EXFMCPRDG
WOUS00 KEX1 231800
FORECAST FOR        DCA                 VALID TIME
                      00Z   06Z   12Z   18Z   00Z   06Z   12Z   18Z   00Z
ELEMENT     UNITS     (--TONIGHT--)(-TOMORROW-)(-TMW NIGHT-)(-NEXT DAY-)
TEMP M/M    DEG F           77          89          75          89
                            76          88          74          89
TEMP        DEG F     86 83 82 81 78 78 85 88 87 82 80 78 76 78 84

DEW PT      DEG F     70 71 72 72 73 72 70 69 69 69 70 70 70 71 70

POP(12)     PERCENT                 15          38          16          30
                                    10          30          20          30
POP(6)      PERCENT         4   11    24    25    8     9     18    19

POF(P)      PERCENT   0     0   0     0     0     0     0     0     0

POZR(P)     PERCENT   0     0   0     0     0     0     0     0     0

PRECP TYP   CATEGORY  3     3   3     3     3     3     3     3     3

QPF         CATEGORY        ___     1     ___   1     ___   1
                                                                  [ ]
                                                          PAGE  01

 GUIDANCE MATRIX CON'T
                                VALID TIME
ELEMENT     UNITS     00Z   06Z   12Z   18Z   00Z   06Z   12Z   18Z   00Z
                      (--TONIGHT--)(-TOMORROW-)(-TMW NIGHT-)(-NEXT DAY-)
SNOW AMT    CATEGORY
                        ___
RW/L/R      PERCENT   48/  2/ 50    80/  0/ 13    50/  0/ 53    78/  2/ 20

TSTM        PERCENT         3           18          5           16

SVR TSTM    PERCENT

CLOUDS      CATEGORY    2     2     2     2     2     2     2     2     3

                        ___   ___   ___         ___
OB VIS      CATEGORY    1     1     2     1     1     1     2

WINDS       DEG KTS   0810  0806  0104  1209  1107  1004  0405  1112  1011
                      0810  0000        0000
CIG         CATEGORY    6     6     6     6     6     ___   6     6
                       97    97    97    97
VIS         CATEGORY    5     6     4     6     5     6     6
                       40    50    60    60
YESTERDAY MX/MN      77     PUBLIC FCSTR          AVIATION FCSTR          ]
                                                          PAGE  02
```

Figure 10. Example RDG product. Underlined areas indicate where non-decodable forecasts should be entered.

PVM and AVM Products

The PVM (AVM) product contains the public (aviation) MOS and local forecasts and observations for the most recent 10 cycles. COLLATE chronologically sorts the cycles so the most recent cycle is always first. COLLATE insures that the cycles are the same (in number and date) in the PVM and the AVM. Figs. 4 and 5 show examples of a PVM and AVM. The month, day, and cycle time for each cycle are shown on the first line with forecaster number. If the date and cycle fields are blank, COLLATE will delete that cycle on the next run. To completely eliminate a cycle it should be blanked out both in the PVM and the AVM.

If the RDG has been edited to enter the non-decodable forecasts, the PVM and AVM need only be quality controlled for decoding errors. If the RDG has not been edited, the local forecasts of precipitation type, cloud amount, and snow amount should be entered under the local column for the most recent cycle of the PVM. In the AVM, the 42-h wind forecast would need to be entered.

Observations that have recently been added by COLLATE should be quality controlled. The last cycle will be transmitted the next time COLLATE runs. In this way ample time is allowed to quality control the data.

The data from the PVM and AVM are used to update the VERccc file. Changes made to the PVM and AVM will be put into VERccc the next time COLLATE runs. If the PVM or AVM is garbled or not available, COLLATE will reconstruct the PVM and AVM from VERccc.

When editing a PVM or AVM that is less than full (such as when the verification is first installed) it is necessary to page through all five pages of the product and blank out the date and cycle spaces. An alternative is to wait several days until the PVM's and AVM's are full before editing.

5. CAUTIONS

COLLATE decodes up to 36 surface aviation observations (SAO's) and up to 12 surface synoptic reports (SSM's). An effort has been made to correct systematic errors that may occur in the decoding of observations. However, the decoders are not fail proof, and occasionally an SAO or SSM will contain errors and cause the decoding of that report to cease. When this happens, the observation that had the error is written to the dasher. It is important that the operator supply the PVM and/or AVM product(s) with the missing information from that report.

6. REFERENCES

Dunn, L. B., 1982: AFOS-era automated forecast verification. Preprints Ninth Conference on Weather Forecasting and Analysis, Seattle, Amer. Meteor. Soc., 35-37.

National Weather Service, 1973: Combined aviation/public weather forecast verification. National Weather Service Operations Manual, Chapter C-73, National Oceanic and Atmospheric Administration, U.S. Department of Commerce, 14 pp.

_____, 1982a: National Verification Plan. National Oceanic and Atmospheric Administration, U.S. Department of Commerce, 81 pp.

_____, 1982b: Public forecast verification. National Weather Service Operations Manual, Chapter C-71, National Oceanic and Atmospheric Administration, U.S. Department of Commerce, 8 pp.

7. PROGRAM INFORMATION AND PROCEDURES FOR INSTALLATION AND EXECUTION

A. INITIALIZATION PROGRAM FOR LOCAL AFOS-ERA FORECAST VERIFICATION SOFTWARE

PART A: PROGRAM INFORMATION and INSTALLATION PROCEDURE

PROGRAM NAME: VERCREAT

AAL ID: MSC006
Revision No.: 01.00

FUNCTION: Creates the verification information table (VERIT), the verification directory file (VERDIR), and the file containing collated forecasts and observations (VERccc) for a particular WSFO. Accepts WSFO call letters, stations to verify, and the time zone of the WSFO from the background terminal.

PROGRAM INFORMATION:

Development Programmer(s):

Mary Heffernan
Mary Newton
Robert L. Miller

Location: Techniques Development Laboratory
Phone: FTS - 427-7639

Maintenance Programmer(s):

Robert L. Miller

Location: Techniques Development Laboratory
Phone: FTS - 427-7639

Language: FORTRAN IV

Type: Standard program

Save file creation dates:
Original release/Revision 01.00 - August 29, 1983

Running time: 15 seconds

Disk Space: Program files - 22 RDOS blocks
Data files - 11 RDOS blocks

PROGRAM REQUIREMENTS

Program files:

NAME
VERCREAT.SV

Data files:

NAME	DP location	READ/WRITE	COMMENTS
VERIT	DPO	W	Created by program
VERDIR	DPO	W	Created by program
VERccc	DPO	W	Created by program

AFOS Products: None

LOAD LINE

```
RLDR VERCREAT UTIL.LB FORT.LB
```

PROGRAM INSTALLATION

1. Move VERCREAT.SV to DPO.
2. Be prepared to give your station's identifier (ccc) followed by the stations to be verified (xxx).

PART B: PROGRAM EXECUTION and ERROR CONDITIONS

PROGRAM NAME: VERCREAT AAL ID: MSC006
Revision No.: 01.00

PROGRAM EXECUTION

NOTE: VERCREAT should be run only once: during initialization for the local software. VERCREAT.SV may be purged from DP0 after successful execution.

1. From the dasher enter:

   VERCREAT

2. Enter answers to questions asked.

The stations to be verified followed by the "R" prompt denotes successful execution of the program.

ERROR CONDITIONS

Program contains only error conditions that occur while manipulating files. This includes opening channels to; setting position of; and reading, closing, creating, and writing to files. Error messages in all cases explain what file was being handled at the time the problem occurred.

B. MERGE PROGRAM FOR LOCAL AFOS-ERA FORECAST VERIFICATION SOFTWARE

PART A: PROGRAM INFORMATION and INSTALLATION PROCEDURE

PROGRAM NAME: MERGE

AAL ID: MSC006
Revision No.: 01.00

FUNCTION: Reads and decodes the local public and aviation weather forecasts from the combined cities forecast (CCF), and FTA bulletins for stations specified in the VERIT file. Merges these forecasts and MOS forecasts from the ODG product into an RDG product for each station being verified.

PROGRAM INFORMATION:

Development Programmer(s):

Mary Heffernan
Mary Newton
Robert L. Miller

Location: Techniques Development Laboratory
Phone: FTS - 427-7639

Maintenance Programmer(s):

Robert L. Miller

Location: Techniques Development Laboratory
Phone: FTS - 427-7639

Language: FORTRAN IV

Type: Overlay program

Save file creation dates:
Original release/Revision 01.00 - August 29, 1983

Running time: 1.5 minutes

Disk Space: Program files - 103 RDOS blocks
Data files - 2 RDOS blocks

PROGRAM REQUIREMENTS

Program files:

NAME
MERGE.SV
MERGE.OL

Data files:

NAME	DP location	READ/WRITE	COMMENTS
VERIT	DPO	R/W	Created by VERCREAT

AFOS Products:

ID	ACTION	COMMENTS
cccRDGxxx	Stored	Use d:RDGxxx to display.

LOAD LINE

```
RLDR MERGE MEREV RIVT SSEARCH AFDTIM DCMPR COUNT CKEY
   [CCF DCCF, FTA DCDFT] WTHR VSBLTY CLD ODG ITAB
     WRDG FLLTB CONVERT IUA3DEC CHKBAD DTCYC BG.LB UTIL.LB FORT.LB
```

PROGRAM INSTALLATION

1. Move MERGE.SV and MERGE.OL to DP0.

2. Verify that required database products are present.

PART B: PROGRAM EXECUTION and ERROR CONDITIONS

PROGRAM NAME: MERGE

AAL ID: MSC006
Revision No.: 01.00

PROGRAM EXECUTION

NOTE: In an operational environment, MERGE should be run twice a day--at about 10Z and 23Z.

1. From the console enter:

   RUN:MERGE MMDDCC/O NN/A

   MMDDCC/O invokes the override switch, where MM is the month number, DD is the day of the current month, and CC is the cycle time, 12Z or 00Z. If the override switch is omitted, the program will compute the appropriate cycle time if files are just initiated or continue from the last time MERGE was run by adding 12 hours. NN is the aviation forecaster verification number that may be input.

2. The ADM will be alerted with the message "JOB COMPLETE MERGE: PRODUCT RDG STORED".

ERROR CONDITIONS

For complete description of possible errors see Appendix II, TDL CP 83-3.

In general, the messages that will be printed at the dasher will refer to locating or decoding one of the forecast products--CCF, FTA, or ODG. If a product is missing or entered erroneously, it may be added or corrected and MERGE may be rerun for the same cycle by using the override switch. If this is not possible, the missing local forecasts can be added to the output product, RDG.

C. COLLATION PROGRAM FOR LOCAL AFOS-ERA FORECAST VERIFICATION SOFTWARE

PART A: PROGRAM INFORMATION and INSTALLATION PROCEDURE

PROGRAM NAME: COLLATE

AAL ID: MSC006
Revision No.: 01.00

FUNCTION: Reads the RDG product, surface observations, and synoptic observations for each station. Builds or updates a public verification matrix product (PVM) and an aviation verification matrix product (AVM) for each station with the new cycle's forecast data. Matches the forecasts of the new cycle and previous cycles that have not been matched with the observations. Updates the PVM and AVM products with the new forecast cycle data and additional observations of previous forecasts. Updates the VERccc archive file with the same information. The data for two stations from the eleventh (oldest) cycle are formatted into a product and transmitted to NMC.

PROGRAM INFORMATION:

Development Programmer(s):

Mary Heffernan
Mary Newton
Robert L. Miller

Location: Techniques Development Laboratory
Phone: FTS - 427-7639

Maintenance Programmer(s):

Robert L. Miller

Location: Techniques Development Laboratory
Phone: FTS - 427-7639

Language: FORTRAN IV

Type: Overlay program

Save file creation dates:
Original release/Revision 01.00 - August 29, 1983

Running time: 3 minutes

Disk Space: Program files - 202 RDOS blocks
Data files - 41 RDOS blocks per 3 stations

PROGRAM REQUIREMENTS

Program files:

NAME
COLLATE.SV
COLLATE.OL

Data files:

NAME	DP location	READ/WRITE	COMMENTS
VERIT	DPO	R/W	Created by VERCREAT
VERDIR	DPO	R/W	Created by VERCREAT
VERccc	DPO	R/W	Created by VERCREAT

AFOS Products:

ID	ACTION	COMMENTS
cccPVMxxx	Stored	Use d:PVMxxx to display.
cccAVMxxx	Stored	Use d:AVMxxx to display.
cccVERccc	Stored	Data from oldest cycle transmitted to NMC in this product.

LOAD LINE

```
RLDR COLLATE COREV [OPNVER RDG POPRND PVM PTYPE AVM RDVERCC,
AIRXX NUMBR ANDGO ANDEQ ORGO,
  MATCH MMTEMP POP12 PRECTYP SNOWAMT
CLDAMT CIGVIS WIND PROJ SPECOB SPECSSM
MAXSPD ADDHR, UPVERCCC TRMIT WPVM WAVM FLLTB CONVERT CPTYP,
  SSM IUNTN DSSM SORTAP SORTIS INITIS TRANS DUPE CMPRE PRINT ]
ROB RDVRDR COBP SUBHR RIVT ITAB AFDTIM DCMPR SSEARCH COUNT CKEY IUA3DEC
CHKBAD CORSAO
UTIL.LB BG.LB FORT.LB
```

PROGRAM INSTALLATION

1. Move COLLATE.SV and COLLATE.OL to DPO.

2. Store preformats cccMCPAVM and cccMCPPVM into the database.

PART B: PROGRAM EXECUTION and ERROR CONDITIONS

PROGRAM NAME: COLLATE AAL ID: MSC006
Revision No.: 01.00

PROGRAM EXECUTION

NOTE: In an operational environment, COLLATE should be run after MERGE has been run and its output verified.

1. From the console enter:

   RUN:COLLATE

2. The ADM will be alerted with the message "JOB COMPLETE COLLATE: PRODUCT PVM AVM STORED".

ERROR CONDITIONS

For complete description of possible errors see Appendix III, TDL CP 83-3.

The most common error messages will be related to decoding SAO's or SSM's. User action may be required to manually input an observation not in PVM or AVM when the data cannot be decoded.

APPENDIX I

Description of VERccc File

The following information explains the data in the VERccc file (see Table 2). In many cases, to conserve space, two values are stored in one word. In these cases, the first value uses the upper 8 bits and the second uses the lower 8 bits. If a datum is missing, all bits in the field are set to one. For a full word field (16 bits), this corresponds to a -1 decimal or 177777 octal. For a one byte field (8 bits) the value is a 377 octal.

A. Station/Cycle Information

Station call letters - the AFOS assigned station call letters.

Year/month - last 2 digits of the year multipled by 100 plus the month of the year.

Day/cycle - day of the month multiplied by 100 plus the cycle number (00 or 12) for the forecast being made.

Public forecaster number/aviation forecaster number - public forecaster number multiplied by 100 plus the aviation forecaster number.

B. Max/Min Temperature

Forecast and observed temperatures are in whole degrees Fahrenheit plus 100. For example, 53°F is coded as 153. Two verifying temperatures are archived for each forecast max (or min) temperature. The first is a calendar day max (or min) and the second a 12-h max (or min). These observed temps are obtained from synoptic observations. Federal Meteorological Handbook No. 2 (FMH-2) Chapter C13 describes the fields. Specifically, the values that are saved are:

- the previous calendar day max temperature reported at 1200 GMT
- the previous 12-h max temperature reported at 0000 GMT
- the previous 24-h min temperature reported at 1800 GMT
- the previous 12-h min temperature reported at 1200 GMT

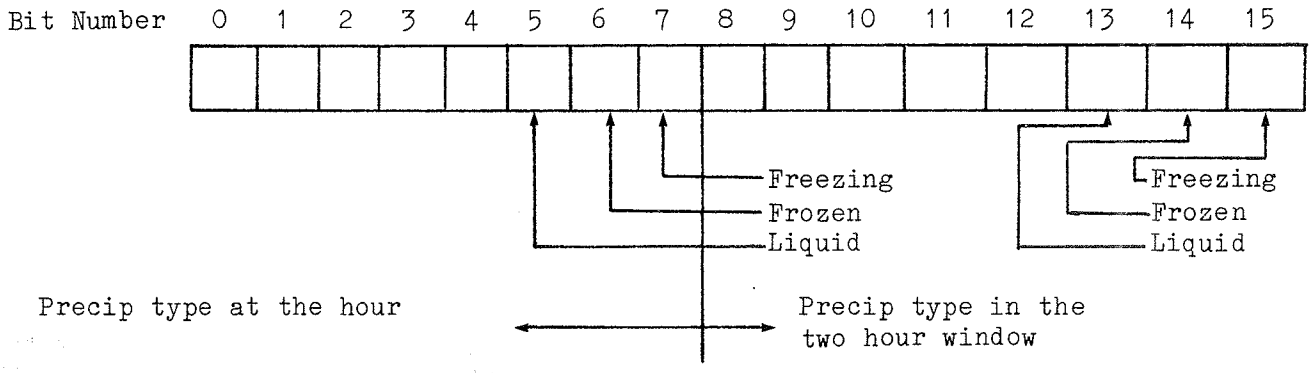
If temperatures are unavailable from synoptic observations, then they are extracted from SAO's if possible; the 24-h max is not available from SAO's.

C. 12-h PoP

MOS and local forecasts are given in percent rounded to the nearest tens of percent. For MOS there are also 2 and 5 percent forecasts. The observed precip amount is in hundredths of inches. For example, 3.15 inches would be coded as 315. A trace is coded as a minus 2. For the 00Z cycle, this is the sum of the 6-h amounts reported in the 18Z and 00Z synoptic reports. For the 12Z cycle, the 06Z and 12Z reports are used. FMH-2 Chapter B10 describes these reports. If precipitation amounts are unavailable from synoptic observations, then they are extracted from SAO's if possible.

D. Precipitation Type

The forecasts of type of precipitation will be a value 1, 2, or 3 for freezing, frozen, and liquid precip, respectively. There will be two verifying values archived for each forecast. The first will be type(s) of precipitation reported in the routine surface observation at the verifying hour. The second will be the type(s) of precipitation reported in routine and special observations from the routine observation at an hour before the verifying hour to the routine observation at an hour after the verifying hour. The format of the word to store these two verifying values is shown below.



If a type of precipitation is reported, the corresponding bit is set to one. It will be possible to have anywhere from 0 to 3 bits set in a field. For example, if the observation(s) reported ZR and R then the freezing bit and liquid bit would be set. If no precip is reported, all bits are zero. If either (or both) values are missing, all 8 (16) bits in the field are set to one.

The categories of freezing, frozen, and liquid are defined as follows:

Freezing	Frozen	Liquid
ZL, ZR	IC	L
	IF, IPW	R, RW
	S, SG, SP, SW	

E. 12-h Snow Amount

MOS forecasts are categorical. The categories are defined as follows:

Category	Snow Amount (inches)
0	≤ 1
2	2-3
4	4-5
6	≥ 6

MOS forecasts are coded as 0, 2, 4, 6 for ≤ 1, 2-3, 4-5, and ≥ 6 inches of snow, respectively. Local forecasts and observed snow amount are entered in whole inches. The observed amount for the 00Z cycle is the sum of the amounts reported in the 18Z and 00Z synoptic reports. For the 12Z cycle, the 06Z and 12Z reports are used. FMH-2 Chapter B12, Section 4.4 describes the reports.

F. Cloud Amount

The forecasts and observed values will be coded as 4 categories.

1	CLR, -X, -SCT, -BKN, -OVC
2	SCT
3	BKN
4	X, OVC

Observed values are coded from the routine surface observation at the verifying hour.

G. Ceiling Height

MOS forecasts are categorical where the six categories are

1	<200
2	200 - 400
3	500 - 900
4	1000 - 2900
5	3000 - 7500
6	>7500

Local forecasts and observed ceiling heights are given in hundreds of feet with 96 for a ceiling above 9000 feet and 97 for an unlimited ceiling. Observed ceiling heights are taken from the routine surface observation at the verifying hour.

H. Visibility

MOS forecasts are categorical where the six categories are

1	<1/2
2	1/2 - 7/8
3	1 - 2 3/4
4	3 - 4
5	5 - 6
6	>6

Local forecasts are two digits where the first is miles and the second is quarters of miles. Visibilities over 7 miles are coded as 80. Observed visibilities are given in hundredths of miles up to 7 miles. Visibilities over 7 miles are coded as 800. Observed visibilities are taken from the routine surface observation at the verifying hour.

I. Wind Direction and Speed

MOS and local forecasts and observed directions and speeds are given in tens of degrees/knots. If the speed exceeds 100 knots, the tens and units digits are given and 50 is added to the direction.

In addition to the wind reported at the verifying hour, the direction and speed of the peak sustained (one minute) wind in the 6 hours around the verifying hour are given. All observed values are taken from surface observations.

APPENDIX II

MERGE Error Conditions

MESSAGE	MEANING
1- "MERGE:VERIT ERROR"	Probable cause is that the VERIT file has been deleted or its contents have been destroyed. Restore from backup or rerun VERCREAT. Rerun MERGE with override switch for desired cycle.
2- "UNABLE TO PROCESS THIS CYCLE YET, MONTH, DAY, CYCLE" "CURRENT IS MONTH DAY CYCLE"	MERGE won't allow the 0000 GMT cycle to be processed until 930 GMT and 1200 GMT until 2131 (2230 MTN/PAC) GMT. Wait until proper time and rerun MERGE.
3- "MERGE:CCF ERROR" and "NO SUCH KEY-cccCCFxxx" or "REQUESTED VERSION OF CCF NOT FOUND-DAY HOUR"	Error occurred in locating or decoding CCF product. Check to make sure key is in database. Obvious errors in the CCF could be corrected and MERGE can be rerun for the same cycle using the override switch. Or, the data from the CCF can be manually entered into the RDG or PVM product.
4- "MISSING ODG-" or "DECODE ERROR" or "ODG NOT FOUND-cccODGxxx" or "CAN'T FIND STATION NAME"	Error occurred in locating the ODG. Check to make sure proper key is in the database. No further user action is required. MERGE will proceed without the guidance forecasts.
5- "MERGE:RDG ERROR"	MERGE creates a file cccRDGxxx for each station. The probable cause of this error is creating the file or writing to the file. If the file exists, delete it and rerun MERGE. There should be 3 to 5 blocks of space available on DP0 to accommodate the file.
6- "KEY NOT FOUND" "cccFTAxxx"	The error occurred because there was no product key stored in the AFOS database for the FT for this station. Check database key and rerun MERGE.

7- "ERROR DECODING FT-ERROR=N", or "REQUESTED VERSION OF FT NOT FOUND," or "ERROR READING FT"
"MERGE:FTA ERROR"
"cccFTAxxx"
"DAY, HOUR"

The terminal forecast decoder was unable to locate or decode the FT for station xxx.

N corresponds to error type. Obvious errors in FT could be corrected and MERGE can be rerun for the same cycle using the override switch. Or, the data from the FTA can be manually entered into the RDG or AVM product.

N = 1 FT is delayed.
2 Unable to find issue Date/Time field.
3 More time groups than allowed.
4 Unable to find valid time of forecast group.
5 Unknown number field of length greater than 4.
6 Invalid wind field.
7 Invalid gust field.
8 FT too long.
9 No time groups in FT.
10 Identical time periods in FT group.
11 Error in reading FT.
12 No key present for FT.
13 No data.

APPENDIX III

COLLATE Error Conditions

	MESSAGE	MEANING
1-	"COLLATE:VERIT ERROR"	Probable cause is that the VERIT file has been deleted or its contents have been destroyed. Restore VERIT from backup or rerun VERCREAT and rerun COLLATE.
2-	"MISSING RDG-cccRDGxxx" "COLLATE:RDG ERROR" "UNABLE TO FIND END OF TEXT HEADER" "READING PAST END OF CHAIN"	Error in locating or decoding the RDG. Check that proper key is in the database. If RDG is not available or not in proper format, rerun MERGE for the cycle using the override switch and then rerun COLLATE.
3-	"NO KEY PRESENT PVM" "COLLATE:PVM ERROR"	This error occurred because there is no such key cccPVMxxx stored in the database. Check validity of product key and, if necessary, add correct key to database. Rerun COLLATE.
4-	"TOO MANY CYCLES cccPVMxxx" "USE VERccc FOR DATA" "COLLATE:PVM ERROR"	This error occurred because the number of forecast cycles stored in the PVM product exceeded the maximum number allowed (11). The number of cycles includes the new cycle being added from RDG. Data will be restored to the PVM and AVM products from the VERccc file. No user action is required.
5-	"NO KEY PRESENT AVM" "COLLATE:AVM ERROR"	The error occurred because there was no such key cccAVMxxx stored in the database. Check validity of product key and, if necessary, add correct key to database. Rerun COLLATE.
6-	"TOO MANY CYCLES cccAVMxxx" "USE VERccc FOR DATA" "COLLATE:AVM ERROR"	This error occurred because the number of forecast cycles stored in the AVM product exceeded the maximum number allowed (11). The number of cycles includes the new cycle being added from RDG. Data will be restored to the PVM and AVM products from the VERccc file.
7-	"READING VERccc-RDVERCC" "COLLATE:RDVERCC ERROR"	Probable cause is that the VERccc file has been deleted or its contents have been destroyed. Restore the backup of VERccc file from floppy onto the fixed disk. Rerun COLLATE using "/C" option.

8- "NO KEY"
"cccSAOxxx"
"COLLATE:ROB ERROR"

The error occurred because there was no such SAO product key stored in the AFOS database. Check validity of the product key and, if necessary, add the correct key to the database. Rerun COLLATE.

9- "DECODE ERROR"
"cccSAOxxx" "N"
"MONTH, DAY, HOUR, MINUTE"

The error occurred because the SAO decoder was unable to decode the observation for station xxx. "N" refers to the SAO error number as defined below. The only user action that may be necessary is to supply missing observational information in the PVM and AVM products. An observation can be corrected by editing it, correcting the problem, and storing it back in the database locally (addressee=000). The edited ob should include "COR" after the call letters and have the same observation time.

N = 1 Successful decode.
2 Not used.
3 Not used.
4 Unknown observation type or identification not found.
5 Error in locating time.
6 Couldn't locate wind group.
7 Temperature/Pressure errors.
8 Clouds/weather/visibility errors.
9 Not used.
10 Altimeter group error.
11 Remarks error.

10- "DECODE SSM ERROR -N"
"cccSSMxxx"
"MONTH/DAY, HOUR/MINUTE"

The error occurred because the synoptic decoder was unable to decode the synoptic report for the station, xxx. "N" refers to the SSM error number as defined below. User action may be required to supply missing observational information in the PVM and AVM products.

N = 1 Invalid block/station number group.
2 Unable to find date/time in text header.
3 Problem in the mandatory group containing the precip indicator. Not a five-character group.
4 Invalid precip indicator field.
5 Problem in a supplementary group. Not a five-character group.

6 Sign of max temperature is not a zero (for positive temperatures and zero) or a one (for negative temperatures).
7 Sign of min temperature is not a zero or a one.

11- "COLLATE:UPVERCCC ERROR" — The error occurred while manipulating the VERccc file. A system error message will be listed. Check to see that VERDIR and VERccc files exist. If they are missing supply them from the backup disk or rerun VERCREAT. Rerun COLLATE.

12- "COLLATE:WPVM ERROR" — The error occurred while writing and/or storing the PVM product into the AFOS database. If the PVM file exists on DPO delete it. There should be five blocks of space on DPO for this file. Rerun COLLATE.

13- "COLLATE:WAVM ERROR" — Same as 12 only for AVM matrix product.

14- "COLLATE:TRMIT ERROR" — Probable cause is that the cccVERccc key has been deleted from the data base. Add key to database and store:cccVERccc file into database.

15- "COLLATE:WRITING VERIT" — Probable cause is that the VERIT file has been deleted or its contents have been destroyed. Restore VERIT from backup or rerun VERCREAT. Rerun COLLATE.

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