U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL WEATHER SERVICE
OFFICE OF SYSTEMS DEVELOPMENT
TECHNIQUES DEVELOPMENT LABORATORY

TDL OFFICE NOTE 92-8

THE AUTOMATED GENERATION OF TEMPERATURE PHRASES FOR THE INTERACTIVE COMPUTER WORDED FORECAST

James M. Kosarik, Mark A. Przybocki, Michael W. Cammarata,
James F. Wantz, Joseph Lang, and Matthew R. Peroutka

July 1992

THE AUTOMATED GENERATION OF TEMPERATURE PHRASES FOR THE INTERACTIVE COMPUTER WORDED FORECAST

James M. Kosarik, Mark A. Przybocki, Michael W. Cammarata,
James F. Wantz, Joseph Lang, and Matthew R. Peroutka

1. INTRODUCTION

The Techniques Development Laboratory (TDL) has been experimenting with the preparation of worded weather forecasts by computer for over 20 years (Glahn, 1970, 1979; Bermowitz, Heffernan, and Glahn, 1980; Bermowitz and Miller, 1984). Interpretation of direct numerical model output by statistical techniques provides a database of Model Output Statistics (MOS) forecasts for those weather elements normally contained in the public weather forecast. The database is analyzed by computer and text forecasts are automatically produced. Similar experiments have been conducted in Sweden (Lonnqvist, 1973) and Canada (Verret, 1990).

In support of the National Weather Service modernization, TDL has made extensive revisions and enhancements to an interactive version of the computer worded forecast known as the Interactive Computer Worded Forecast (ICWF). The aim of the ICWF is to provide forecasters with the mechanism for efficiently preparing the suite of forecast products normally issued by a National Weather Service Weather Forecast Office (WFO). With the ICWF, forecasters are able to interact with the database and modify forecast guidance as needed prior to submitting the database for product formatting.

For the current version of the ICWF, the forecast database has been redesigned to incorporate greater temporal and spatial resolution. In order to take advantage of this increased resolution, the text formatters have also been redesigned. This office note describes the new temperature phrase formatting routines for the public forecast products.

2. DESCRIPTION OF THE TEMPERATURE PHRASES

As many as two temperature phrases may be generated for each forecast period, a max/min phrase and an adjective phrase. A max/min phrase describes the maximum or minimum temperature forecast for the day or night (e.g., HIGH NEAR 90). If the maximum or minimum temperature does not occur during the forecast period (as might be the case with a 6-h forecast period), then the max/min phrase provides a general description of the temperature (e.g., TEMPERATURES RISING THROUGH THE 70S). The adjective phrase describes the weather in conversational terms, with regard to the effect on the senses and with an indirect reference to climatology (e.g., VERY COLD, or UNSEASONABLY WARM).

After the text phrases have been generated, they are merged into the forecast. The max/min phrase is usually a stand alone sentence which follows the description of the weather (e.g., TODAY...PARTLY SUNNY AND WARM. HIGH NEAR 90). The adjective phrase is usually merged into the description of the weather (e.g., PARTLY SUNNY AND WARM, or WINDY...VERY WARM AND HUMID) but may be a stand alone sentence.

3. SELECTING THE TEMPERATURE PHRASES

Selection of the appropriate temperature phrases involves an examination of the forecast maximum or minimum temperature and the 3-h temperature forecasts for the period. The selection process also includes a comparison of the forecast temperatures with the normal maximum or minimum and with the maximum or minimum observed during the previous day. The ICWF database contains forecasts of dry-bulb temperature and dewpoint temperature every 3 hours from an initial time (either 0000 UTC or 1200 UTC) through 60 hours. Forecasts of the maximum (minimum) temperature for each 12-h daytime (nighttime) forecast period are also contained in the database as are the observed maximum and minimum temperatures from the previous day. In addition, the ICWF has local climatological files which contain the normal maximum and minimum temperature for each day of the year for the various locations within the WFO's area of responsibility.

The forecast database can be initialized from MOS guidance or from the forecast database prepared by the previous shift at the forecast office. Updates can be introduced at any time by the meteorologist on shift or by using statistical guidance generated from the Local AWIPS MOS Program (LAMP) (Glahn, 1980; Unger et al., 1989).

The selection of the max/min phrase is a separate process from selecting the adjective phrase. The max/min phrase selection usually results in a "traditional" high (e.g., HIGH NEAR 70) or low (e.g., LOW IN THE LOWER 50S) phrase. This phrase is used in most geographic areas virtually every day and night of the year. The other types of max/min phrases are selected when the maximum or minimum temperature occurs at a climatologically abnormal time.

Each forecast office must set thresholds to define a window for the time of occurrence of the normal minimum and maximum temperature. If, after examining the 3-h temperature forecasts, it is determined that the maximum or minimum occurs outside of the window, then a max/min phrase is chosen which describes the abnormal diurnal temperature trace.

There are three max/min phrases that describe falling temperatures during the day, two phrases that describe rising temperatures at night, and one phrase which describes "NEARLY STEADY TEMPERATURES" through the period. The selection of the appropriate phrase is based on the degree of change in the abnormal diurnal temperature trace. An overnight rise in temperature of a few degrees may result in the selection of the phrase "TEMPERATURES STEADY OR SLOWLY RISING" whereas a dramatic rise in temperature would result in a phrase such as "EVENING LOW NEAR 20, THEN TEMPERATURES RISING TO THE UPPER 30S."

If the maximum or minimum does not occur during the forecast period (as might be the case with a 6-h forecast period), then a general max/min phrase is selected. The general max/min phrase describes an averaged temperature trend during the period (e.g., TEMPERATURES RISING THROUGH THE 70S). See Fig. 1 for a flow diagram depicting the selection process of the max/min phrase. Appendix I is a complete listing of the thresholds used in the selection of the temperature phrases. Appendix II describes the specific criteria for the selection of each max/min phrase.

The selection of the adjective phrase results from a series of comparisons of the forecast maximum (minimum) to the departure from the normal maximum (minimum) and the change from yesterday's maximum (minimum). The detail level selected by the forecaster also contributes to the selection of the adjective phrase.

There are four detail levels for the adjective phrase. Detail level 1 contains the most descriptive information. Increasing detail levels produces a less descriptive phrase. For example, at detail level 1, the adjective phrase may be "UNSEASONABLY COLD;" at detail level 2, the phrase may simply be "COLD;" at detail level 3, the adjective phrase may be omitted altogether. Detail level 3 frequently omits the adjective phrase, and detail level 4 always omits the phrase.

Once the temperature comparisons have been completed and the detail level has been taken into account, the adjective is selected from a file of phrases. The adjective phrase file and the temperature phrase file are site specific and can be adjusted by the forecast office to suit operational needs. This technique is similar to the one described by Glahn (1978). Appendix III lists the criteria for the selection of each adjective phrase.

4. CONSTRUCTING THE TEMPERATURE PHRASES

Once the appropriate phrase has been selected, construction of the phrase can begin. Phrase construction is accomplished by piecing together a series of phrase parts. For example, for the traditional max/min temperature phrase a high/low phrase part (HIGH or LOW) describes whether a high or low temperature is being forecast. A max/min phrase part is the actual forecast maximum or minimum. (The max/min phrase part will normally be written as one of four categories--for instance, "NEAR 50" (50F), "LOWER 50S" (51-53F), "MID 50S" (54-56F), "UPPER 50S" (57-59F), or a specific range "50-55.") Punctuation phrase parts are included where necessary.

To construct the phrase, the high/low phrase part would be merged with the max/min phrase part, and a period would be added to generate the complete max/min phrase (e.g., HIGH NEAR 50.).

The traditional max/min temperature phrase (e.g., HIGH NEAR 80.) is based upon the forecast maximum or minimum temperature in the ICWF database. If an abnormal diurnal temperature trace occurs, a destination temperature is determined from the 3-h temperature forecasts in the ICWF database. In the phrase "EVENING LOW NEAR 20...THEN TEMPERATURES RISING TO NEAR 40," 40 is the destination temperature. The low of 20 is also taken from the 3-h temperature forecasts.

If most of the abnormal fall or rise in temperature occurs early in the period, then a mean hourly temperature during the normal time of occurrence of the maximum or minimum will be calculated and used as the destination temperature. This averaged hourly temperature minimizes the destination temperature error at any given time during the climatological normal time of occurrence of the max/min. For example, if the daytime temperature data at 3-h projections were:

6am	9am	Noon	3pm	6pm
46	32	35	36	32

the destination temperature would be formatted as "MID 30S" since the temperature fell significantly early in the morning and then recovered slightly during the afternoon.

REFERENCES

Bermowitz, R. J., M. M. Heffernan, and H. R. Glahn, 1980: Computer worded forecasts: An update. Preprints Eighth Conference on Weather Forecasting and Analysis, Denver, Amer. Meteor. Soc., 453-456.

Glahn, H. R., 1970: Computer-produced worded forecasts. Bull. Amer. Meteor. Soc., 51, 1126-1131.

_____, 1979: Computer worded forecasts. Bull. Am. Meteor. Soc., 60, 4-11.

_____, 1980: Plans for the development of a Local AFOS MOS Program (LAMP). Preprints Eighth Conference on Weather Forecasting and Analysis, Denver, Amer. Meteor. Soc., 320-305.

_____, 1978: Computer worded public weather forecasts. NOAA Technical Memorandum NWS TDL-67, National Oceanic and Atmospheric Administration, U.S. Department of Commerce, 24 pp.

Lonnqvist, O., 1973: Weather forecasts in tabulated and worded form by computer interpretation of forecast charts. J. Appl. Meteor., 12, 292-301.

Unger, D. A., W. L. Wolf., T. L. Chambers, and M. W. Cammarata, 1989: The Local AFOS MOS Program: Current status and plans. Preprints Eleventh Conference on Probability and Statistics in Atmospheric Sciences, Monterey, Amer. Meteor. Soc., 114-119.

Verret, R., 1990: Automated plain language composition of weather forecast "RAPELS." CMC Technical Document, No. 34, 26 pp.

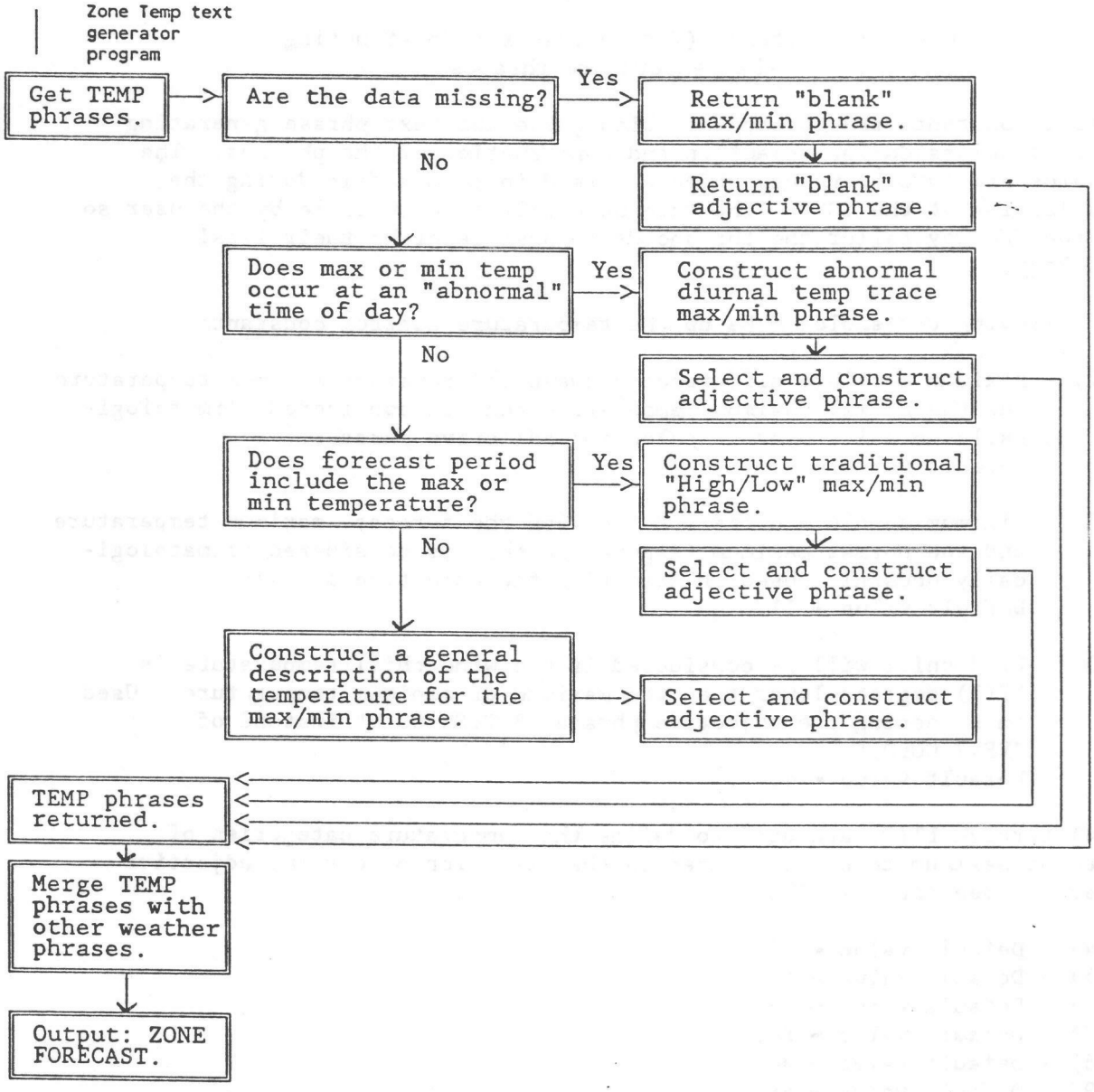


Figure 1. Data flow diagram--temperature phrase selection and construction.

APPENDIX I

Control Constants (Thresholds) for Constructing the Temperature Phrases

Control constants are thresholds which guide the text phrase generating software routines during selection and construction of the phrases. The thresholds are integer values which are read in from a file during the initialization of the ICWF. The threshold file is adjustable by the user so that each WFO may tailor the thresholds to best describe their local climatology.

The following thresholds make up the temperature control constants:

LT(1) - Maximum absolute difference between the forecast maximum temperature and the normal maximum temperature that is considered climatologically normal. Used in selecting adjective phrases.
Default value = 7.

LT(2) - Minimum absolute difference between the forecast maximum temperature and the normal maximum temperature that is considered climatologically unusual. Used in selecting the adjective phrases.
Default value = 11.

LT(3) - Wind chill will be considered if the wind chill temperature is LT(3) degrees lower than the maximum or minimum temperature. Used in selecting the adjective phrase "BITTER COLD" instead of "VERY COLD."
Default value = 40.

LT(4) through LT(9) are used to define the temperature categories of forecast maximum temperature used in the selection of daytime adjective phrases. See Appendix III.

LT(4) - Default value = 26.
LT(5) - Default value = 41.
LT(6) - Default value = 56.
LT(7) - Default value = 80.
LT(8) - Default value = 90.
LT(9) - Default value = 96.

LT(10)- Used in the case of an abnormal daytime temperature trace with an early morning high. Minimum difference between the destination temperature and the morning maximum temperature to construct the phrase "TEMPERATURES FALLING TO (destination temp)."
Default value = 6.

LT(11)- Used in the case of an abnormal daytime temperature trace with an early morning high. Minimum difference between the destination temperature and the morning maximum temperature to construct the phrase "EARLY MORNING HIGH (max)...THEN TEMPERATURES FALLING TO (destination temp)."
Default value = 11.

LT(12) through LT(17) are used to define the temperature categories of forecast minimum temperature used in the selection of nighttime adjective phrases. See Appendix III.

LT(12)- Default value = 1.
LT(13)- Default value = 16.
LT(14)- Default value = 31.
LT(15)- Default value = 51.
LT(16)- Default value = 61.
LT(17)- Default value = 80.

LT(18)- Used in the case of an abnormal nighttime temperature trace with an early evening low. Minimum difference between the evening minimum temperature and the destination temperature to construct the phrase "(time) LOW (min), THEN TEMPERATURES RISING TO (destination temp)." Default value = 8.

LT(19)- Dewpoint temperature at which the phrase "humid" may be used. In addition, the dry bulb temperature must be above LT(15) at night and LT(7) during the day.
Default value = 65.

LT(20)- Used in the case of an abnormal daytime temperature trace with an early morning high. Maximum difference between the destination temperature and the morning maximum temperature to construct the phrase "TEMPERATURES STEADY OR SLOWLY FALLING."
Default value = 3.

LT(21)- Used in the case of an abnormal nighttime temperature trace with an early evening low. Minimum difference between the destination temperature and the evening minimum temperature to construct the phrase "TEMPERATURES STEADY OR SLOWLY RISING."
Default value = 3.

LT(22)- Maximum difference between the minimum and maximum 3-h temperature forecast during the period to construct the phrase "TEMPERATURES NEARLY STEADY."
Default value = 3.

LT(23)- If the temperature phrase is "(time) HIGH (max)...THEN TEMPERATURES FALLING TO (destination temp)" is constructed and the destination temperature is below LT(23), then the adjective phrase will be "TURNING MUCH COLDER," otherwise the adjective phrase "TURNING COOLER" will be selected.
Default value = 50.

LT(24)- Maximum fall (rise) in the forecast 3-h temperature at a projection in order to still select the phrase "TEMPERATURES STEADY OR SLOWLY RISING (FALLING)." For example, a "TEMPERATURES STEADY OR SLOWLY RISING" phrase would still be chosen if the temperature fell LT(24) degrees or less providing the LT(25) and LT(21) thresholds are still met.
Default value = 1.

LT(25)- Maximum number of hours that the temperature forecast may fall (rise) during the forecast period in order to still construct the phrase "TEMPERATURES STEADY OR SLOWLY RISING (FALLING)." For example, if the temperature rose for LT(25) hours or less, the phrase "TEMPERATURES STEADY OR SLOWLY FALLING" would still be selected, providing LT(24) and LT(21) or LT(20) thresholds are still met.
Default value = 3.

LT(26)- Used in the case of an abnormal nighttime temperature trace with an early evening low. Minimum difference between the destination temperature and the evening minimum temp to construct the phrase "TEMPERATURES RISING TO (destination temp)."
Default value = 6.

LT(27)- Used in the case of an abnormal nighttime temperature trace with an early evening low. Minimum difference between the destination temperature and the evening minimum temperature to construct the phrase "(time) LOW (min), THEN TEMPERATURES RISING TO destination)."
Default value = 11.

LT(28)- Climatological earliest projection in a daytime period that a maximum temperature will occur. Assume four 3-h projections per period (1200 UTC to 0000 UTC). Choose from projections 1 to 4. For example, assuming a forecast period of from 6 a.m. to 6 p.m., there are four projections at 3-h intervals. Projection 1 corresponds to 9 a.m., projection 2 to 12 noon, projection 3 to 3 p.m., and projection 4 to 6 p.m. If the climatological earliest time of occurrence for the maximum temperature is 12 noon, then projection 2 would be selected for LT(28).
Default value = 2.

LT(29)- Climatological latest projection in a daytime period that a maximum temperature will occur. Assume four 3-h projections per period (1200 UTC to 0000 UTC). Choose from projections 1 to 4.
Default value = 4.

LT(30)- Climatological earliest projection in a period that a minimum temperature will occur. Assume four 3-hour projections per period (0000 UTC to 1200 UTC). Choose from projections 1 to 4.
Default value = 3.

LT(31)- Climatological latest projection in a period that a minimum temperature will occur. Assume four 3-h projections per period (0000 UTC to 1200 UTC). Choose from projections 1 to 4.
Default value = 4.

LT(32)- Maximum number of hours the forecast temperature may fall (rise) during a sub-period (period shorter than 12 hours) for using the phrase "STEADY OR SLOWLY FALLING/RISING."
Default value = 1.

LT(33)- Maximum number of degrees the forecast temperature may fall (rise) during a sub-period for using the phrase "STEADY OR SLOWLY FALLING/RISING."
Default value = 1.

LT(34)- Minimum length in hours of a forecast sub-period before attempting to identify temperature trends. If a trend cannot be determined or the number of hours is less than LT(34), then a sub-period phrase "TEMPERATURES MAINLY IN THE XXS" will be generated.
Default value = 3.

LT(35)- Minimum number of degrees that the temperature must fall or rise during a forecast sub-period to include the word "QUICKLY" to describe the fall or rise.
Default value = 30.

LT(36)- If the forecast maximum or minimum temperature is less than or equal to LT(36) degrees from a temperature divisible by 10 (e.g., 40, 50, etc.), then the temperature phrase for a forecast sub-period will read "TEMPERATURE AROUND X0."
Default value = 2.

APPENDIX II

Criteria for Max/Min Phrase Selection

A max/min phrase describes the maximum or minimum temperature forecast for the forecast period. A max/min phrase is selected and constructed for each forecast period. There are eight unique max/min phrases.

For phrases 1-6 below, the maximum or minimum temperature occurs at a climatologically abnormal time (e.g., temperatures fall during the day). Projections LT(28) and LT(29) define the normal time of occurrence of the maximum temperature. Projections LT(30) and LT(31) define the normal time of occurrence of the minimum temperature. After examining the criteria listed below, one of the six max/min phrases will be selected to describe the abnormal diurnal temperature trace.

For phrase 7, the forecast period does not include the climatological normal time of occurrence of the maximum or minimum temperature (e.g., a forecast for only the morning period). A general phrase will be constructed that reflects the temperature trace during the period (e.g., TEMPERATURES RISING THROUGH THE 70S).

Phrase 8 describes a normal temperature trace which yields a traditional high or low phrase (e.g., LOW IN THE LOWER 40S). This is the phrase used most often with typical daytime and nighttime forecast periods.

The selection of the max/min phrase is based in part on the temperature data meeting specific thresholds. These thresholds consist of time requirements and temperature boundaries. These temperature phrase thresholds are described in Appendix I.

Listed below are criteria for selecting the max/min temperature phrases:

Phrase 1. (time) HIGH (max), THEN TEMPERATURES FALLING TO (destination temp).

1) The forecast period must be a daytime forecast period and must contain at least some part of the normal time of maximum temperature and 6 or more hours prior to that time.
2) The maximum temperature must occur at least 3 hours before projection LT(28).
3) The maximum temperature minus the destination temperature must be greater than a threshold temperature, LT(11) degrees. If the temperature recovers later in the period, the average 3-h temperature during the normal time of occurrence of the maximum must still meet this threshold.

Phrase 2. TEMPERATURES FALLING TO (destination temp).

1) The forecast period must be a daytime forecast period and must contain at least some part of the normal time of maximum temperature and 6 or more hours prior to that time.
2) The maximum temperature must occur at least 3 hours before projection LT(28).

3) The maximum temperature minus the destination temperature must be greater than a threshold temperature, LT(10) degrees. If the temperature recovers later in the period, the average 3-h temperature during the normal time of occurrence of the max must still meet the control constant threshold.

Phrase 3. TEMPERATURES STEADY OR SLOWLY FALLING

1) The forecast period must be a daytime forecast period and must contain at least some part of the normal time of maximum temperatures and 6 or more hours prior to that time.
2) The maximum temperature must occur at least 3 hours before projection LT(28).
3) The maximum temperature minus the temperature at the end of the period must be greater than LT(20) degrees and must not increase during the period more than LT(24) degrees for LT(25) total hours.

Phrase 4. (time) LOW (min), THEN TEMPERATURES RISING TO (destination temp).

1) The forecast period must be a nighttime forecast period and must contain at least some part of the normal time of minimum temperatures and 6 or more hours prior to that time.
2) The minimum temperature must occur at least 3 hours before projection LT(30).
3) The destination temperature minus the minimum temperature must be greater than a threshold temperature, LT(26) degrees. If the temperature falls later in the period, the average 3 hour temperature during the normal time of occurrence of the minimum must still meet this threshold.

Phrase 5. TEMPERATURES STEADY OR SLOWLY RISING.

1) The forecast period must be a nighttime forecast period and must contain at least some part of the normal time of minimum temperatures and 6 or more hours prior to that time.
2) The minimum temperature must occur at least 3 hours before projection LT(30).
3) The minimum temperature minus the temperature at the end of the period must be greater than LT(21) degrees and must not fall during the period more than LT(24) degrees for LT(25) total hours.

Phrase 6. TEMPERATURES NEARLY STEADY.

1) The difference between the maximum and minimum 3-h temperatures during the period must be less then LT(22) degrees.

Phrase 7. TEMPERATURES (RISING/FALLING THROUGH/INTO) (MAINLY IN) THE (destination temp).

1) No other climatological abnormal diurnal temperature trace occurs.
2) The forecast period must end before the end of the normal time of occurrence of the maximum or minimum temperatures (generally used for period lengths of less than 12 hours, e.g., a forecast for the morning or evening).

Phrase 8. HIGH/LOW (min/max).

1) Standard max/min temperature phrase selected if no abnormal diurnal temperature trace occurs.

APPENDIX III

Selection of Temperature Adjective Phrases

There are two temperature adjective phrase files, one for a daytime forecast period and one for a nighttime forecast period. The appropriate file is accessed and the adjective phrase is selected and retrieved after the calculation of a key number.

The key number is a four digit integer. Each of the four digits represents one of four temperature comparisons. The comparisons and calculations of the key number for the daytime and nighttime files are explained below.

The thresholds that control the calculation of the key number and the selection of the adjective phrase are contained in the temperature phrase threshold file (see Appendix I).

The maximum or daytime adjective phrase file:

Digit

1 The first digit of the four digit identifying key number (variable K) corresponds to the maximum temperature category that the forecast daytime high falls into. The maximum temperature thresholds are specified by the forecast office in the temperature threshold file. There are seven categories; therefore, K may take on the values K = 1 to 7.

K = 1: Forecast Maximum Temperature $\geq$ LT(9)
K = 2: LT(9) > Forecast Maximum Temperature $\geq$ LT(8)
K = 3: LT(8) > Forecast Maximum Temperature $\geq$ LT(7)
K = 4: LT(7) > Forecast Maximum Temperature $\geq$ LT(6)
K = 5: LT(6) > Forecast Maximum Temperature $\geq$ LT(5)
K = 6: LT(5) > Forecast Maximum Temperature $\geq$ LT(4)
K = 7: Forecast Maximum Temperature < LT(4)

2 The second digit of the four digit identifying key number (variable L) corresponds to the departure from the normal maximum temperature. There are two thresholds that must be specified by the forecast office in the temperature threshold file. There are five categories since the departure from normal may be positive or negative, therefore L may take on the values L = 1 to 5.

L = 1: Departure from normal $\leq$ -LT(2)
L = 2: -LT(2) < Departure from normal < -LT(1)
L = 3: -LT(1) $\leq$ Departure from normal $\leq$ LT(1)
L = 4: LT(2) $\geq$ Departure from normal > LT(1)
L = 5: Departure from normal > LT(2)

3 The third digit of the four digit identifying key number (variable M) corresponds to the change in the maximum temperature from yesterday. Two thresholds must be specified by the Forecast Office yielding five categories (including negative and positive changes), M = 1 to 5. The category M = 6 is used when yesterday's maximum is missing.

M = 1: Change > LT(11)
M = 2: LT(11) ≥ Change > LT(10)
M = 3: -LT(10) ≤ Change ≤ LT(10)
M = 4: -LT(11) ≤ Change < -LT(10)
M = 5: Change < -LT(11)
M = 6: Yesterdays maximum temperature is missing.

4 The fourth digit of the four digit identifying key number (variable IT) represents the detail level corresponding to the specified phrase. Presently, detail levels are limited to IT = 1 to 4.

IT = 1: For detail level 1.
IT = 2: For detail level 2.
IT = 3: For detail level 3.
IT = 4: For detail level 4. Detail level four omits all temperature adjectives.

Selection of the adjective phrase used to describe the temperature at night is the same as the selection process for the daytime temperature adjective except that a different adjective phrase file is accessed and different thresholds are used.

The minimum or nighttime adjective phrase file:

Digit

1 The first digit of the four digit identifying key number (variable K) corresponds to the minimum temperature category that the forecast nighttime low falls into. The minimum temperature thresholds are specified by the forecast office in the temperature threshold file. There are seven categories, therefore K may take on the values K = 1 to 7.

K = 1: Forecast Minimum Temperature ≥ LT(17)
K = 2: LT(17) > Forecast Minimum Temperature ≥ LT(16)
K = 3: LT(16) > Forecast Minimum Temperature ≥ LT(15)
K = 4: LT(15) > Forecast Minimum Temperature ≥ LT(14)
K = 5: LT(14) > Forecast Minimum Temperature ≥ LT(13)
K = 6: LT(13) > Forecast Minimum Temperature ≥ LT(12)
K = 7: Forecast Minimum Temperature < LT(12)

2 The second digit of the four digit identifying key number (variable L) corresponds to the departure from the normal minimum. There is one threshold that must be specified in the temperature threshold file by the forecast office. There are 3 categories since the departure can be negative or positive.

L = 1: departure from normal < -LT(18)
L = 2: -LT(18) ≤ departure from normal ≤ LT(18)
L = 3: departure from normal > LT(18)

3 The third digit of the four digit identifying key number (variable M) corresponds to the change in the minimum temperature from yesterday. There is one threshold that must be specified in the temperature threshold file by the forecast office. There are 3 categories

(M = 1 to 3) since each departure can be negative or positive, and a fourth category (M = 4) when yesterday's minimum is missing.

M = 1: change $<$ -LT(27)
M = 2: -LT(27) $\leq$ change $\leq$ LT(27)
M = 3: change $>$ LT(27)
M = 4: Value of yesterday's min temp = missing parameter

4 The fourth digit of the four digit identifying key number (variable IT) represents the detail level corresponding to the specified phrase. Presently, detail levels are limited to IT = 1 to 4.

IT = 1: For detail level 1.
IT = 2: For detail level 2.
IT = 3: For detail level 3.
IT = 4: For detail level 4. Detail level four omits all temperature adjectives.

After the key number has been identified, the phrase is selected. When the phrase is selected, a phrase type number is returned. This number provides grammatical information about the phrase and determines whether the phrase will be emphasized over other phrases when merged into the body of the forecast.

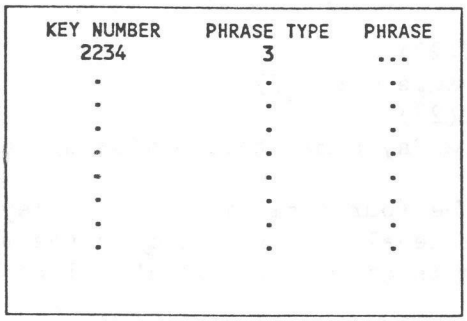
PHRASE TYPE

0 - No adjective phrase is selected.
1 - An adjective phrase (no emphasis) which is used as an adjective grammatically (e.g., WARM).
2 - An adjective phrase (no emphasis) that is used as a noun grammatically (e.g., SEASONABLE TEMPERATURES).
3 - An adjective phrase describing a non-standard temperature trace (emphasized).
4 - An adjective phrase that is emphasized and is used as an adjective grammatically (e.g., VERY HOT).
5 - An adjective phrase that is emphasized and is used as a noun grammatically (e.g., RECORD COLD).

Figs. 2 through 5 contain the default adjective phrases with the corresponding key numbers and phrase type numbers. Shown below is a guide to interpreting the tables. Detailed information regarding the key number and phrase types is presented on the preceding pages of this Appendix.

TEMPERATURE ADJECTIVE TABLE CELL

sample



KEY NUMBER - Four digit identifying number for each phrase. Composed as follows:

1st digit - Maximum/minimum temperature category.
2nd digit - Departure from normal category.
3rd digit - Change in maximum/minimum temperature from yesterday.
4th digit - Detail level.

For some categories of maximum/minimum temperature, departure from normal, and change from yesterday, phrases are not generated and the corresponding key numbers will not appear in the figure.

PHRASE TYPE - An integer used to provide information regarding grammar and emphasis.

PHRASE - A phrase which describes the forecast temperature.

TEMPERATURE FORECAST

	< -8	-LT(18) to LT(18)	> 8
> 80		1321 1 HOT 1322 1 HOT 1331 1 HOT 1332 1 HOT	
LT(17) 62-80	2111 1 COOLER 2121 1 COOL 2131 1 NOT AS COOL	2311 1 NOT AS WARM 2321 1 WARM 2331 1 WARM	
LT(16) 52-61	3111 1 COOLER 3121 1 COOL 3131 1 NOT AS COLD	3311 1 NOT AS WARM 3321 1 WARM 3331 1 WARM	
LT(15) 32-51	4111 1 COLDER 4112 1 COLDER 4121 4 VERY COOL 4122 4 VERY COOL 4132 1 NOT AS COLD	4311 1 NOT AS WARM 4321 1 MILD 4331 1 MILD	
LT(14) 17-31	5111 1 COLDER 5112 1 COLDER 5121 1 COLD 5122 1 COLD 5132 1 NOT AS COLD	5311 4 COLDER 5321 1 MILD 5331 1 MILD	
LT(13) 2-16	6111 4 MUCH COLDER 6112 4 MUCH COLDER 6121 1 COLD 6122 1 COLD 6131 1 NOT SO BITTER COLD 6132 1 NOT SO BITTER COLD	6311 1 COLDER 6312 1 COLDER	
LT(12) ≤ 1	7111 4 VERY COLD 7112 4 VERY COLD 7121 4 VERY COLD 7122 4 VERY COLD 7131 1 NOT SO BITTER COLD 7132 1 NOT SO BITTER COLD	7311 1 COLDER 7312 1 COLDER	

DEPARTURE FROM NORMAL

Figure 2. Minimum temperature descriptors for detail levels 1 and 2, as a function of forecast temperature, departure from normal, and change from the day before. No phrases are generated under detail levels 3 and 4. Ranges corresponding to default values of the LT( ) parameters are indicated for each box in the table. All temperatures are in degrees F. Note that for departures of 8°F or less (2nd digit of 4 digit key number equals 2), adjective phrases are not generated.

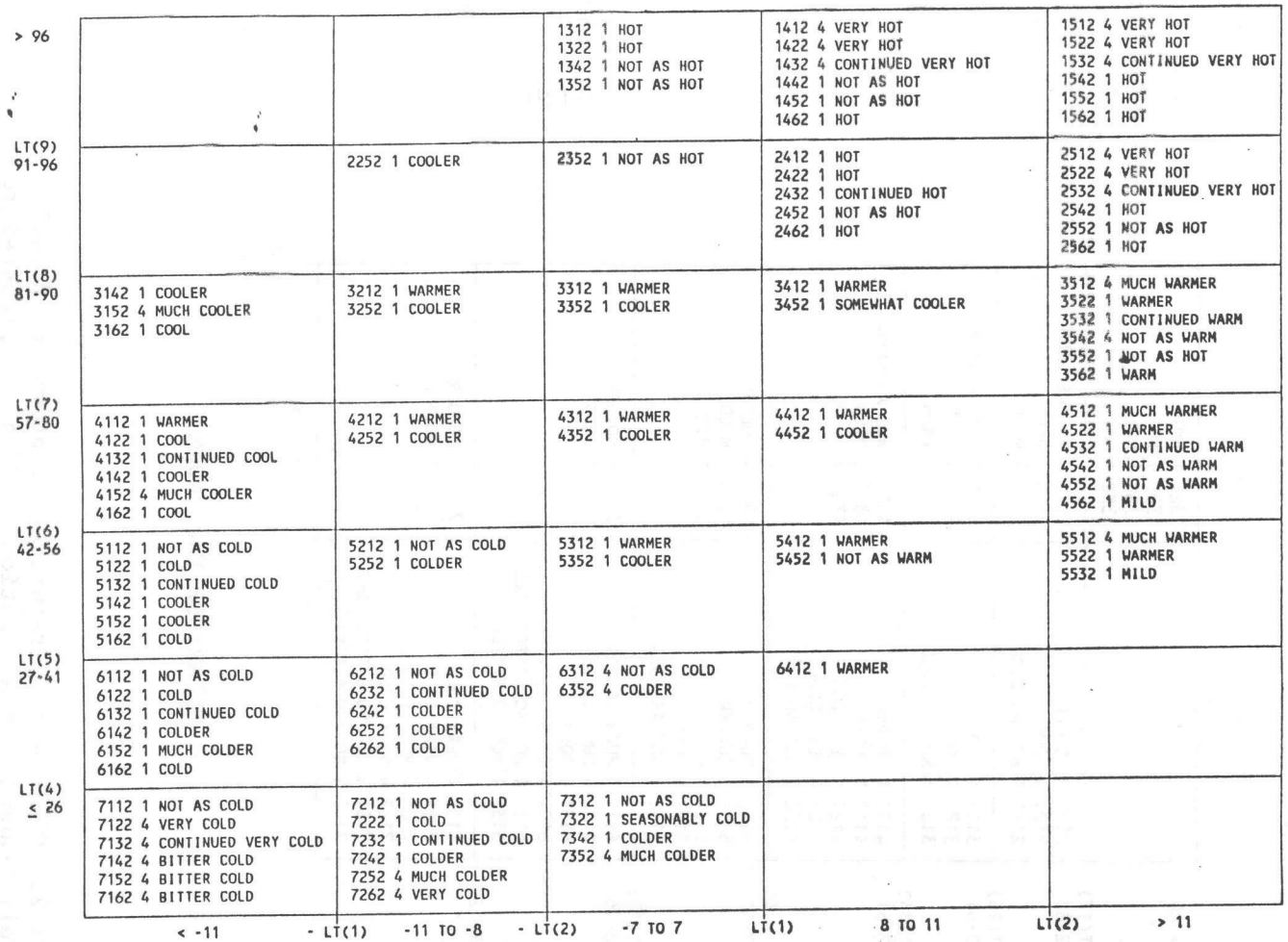


Figure 3. Maximum temperature descriptors for detail level 1 as a function of forecast temperature, departure from normal, and change from the day before. Ranges corresponding to default values of the LT( ) parameters are indicated for each box in the table. All temperatures are in degrees F.

TEMPERATURE FORECAST

	< -11 (- LT(1))	-11 TO -8 (- LT(2))	-7 to 7	8 TO 11 (LT(1))	> 11 (LT(2))
> 96	1111 1 WARMER 1121 1 WARMER 1141 1 NOT AS HOT 1151 1 NOT AS HOT	1211 1 WARMER 1221 1 WARMER 1241 1 NOT AS HOT 1251 1 NOT AS HOT	1311 1 HOT 1321 1 HOT 1341 1 NOT AS HOT 1351 1 NOT AS HOT	1411 4 VERY HOT 1421 4 VERY HOT 1431 4 CONTINUED VERY HOT 1441 1 NOT AS HOT 1451 1 NOT AS HOT 1461 1 HOT	1511 4 VERY HOT 1521 4 VERY HOT 1531 4 CONTINUED VERY HOT 1541 1 HOT 1551 1 HOT 1561 1 HOT
LT(9) 91-96	2111 1 WARMER 2121 1 WARMER 2141 1 NOT AS HOT 2151 1 NOT AS HOT	2211 1 WARMER 2221 1 WARMER 2241 1 COOLER 2251 1 COOLER	2311 1 WARMER 2351 1 NOT AS HOT	2411 1 HOT 2421 1 HOT 2431 1 CONTINUED HOT 2441 1 HOT 2451 1 NOT AS HOT 2461 1 HOT	2511 4 VERY HOT 2521 4 VERY HOT 2531 4 CONTINUED VERY HOT 2541 1 HOT 2551 1 NOT AS HOT 2561 1 HOT
LT(8) 81-90	3111 1 NOT AS COOL 3121 1 NOT AS COOL 3141 1 COOLER 3151 4 MUCH COOLER 3161 1 COOL	3211 1 WARMER 3221 1 WARM 3231 1 WARM 3241 1 COOLER 3251 1 COOLER	3311 1 WARMER 3351 1 COOLER	3411 1 WARMER 3421 1 WARMER 3431 1 CONTINUED WARM 3451 1 SOMEWHAT COOLER 3461 4 VERY WARM	3511 4 MUCH WARMER 3511 4 MUCH WARMER 3511 4 MUCH WARMER 3521 1 WARMER 3521 1 WARMER
LT(7) 57-80	4111 1 WARMER 4121 1 COOL 4131 1 CONTINUED COOL 4141 1 COOLER 4151 4 MUCH COOLER 4161 1 COOL	4211 1 WARMER 4221 1 COOL 4231 1 COOL 4241 1 COOLER 4251 1 COOLER 4261 1 COOL	4311 1 WARMER 4321 1 MILD 4341 1 COOLER 4351 1 COOLER	4411 1 WARMER 4421 1 MILD 4431 1 MILD 4441 1 MILD 4451 1 COOLER	4511 1 MUCH WARMER 4511 1 MUCH WARMER 4511 1 MUCH WARMER 4521 1 WARMER 4521 1 WARMER 4531 1 CONTINUED WARM
LT(6) 42-56	5111 1 NOT AS COLD 5121 1 COLD 5131 1 CONTINUED COLD 5141 1 COLDER 5151 1 COLDER 5161 1 COLD	5211 1 NOT AS COLD 5221 1 COOL 5231 1 CONTINUED COLD 5241 1 COLDER 5251 1 COLDER 5261 1 COOL	5311 1 WARMER 5321 1 MILD 5331 1 COOL 5341 1 COOLER 5351 1 COOLER 5361 1 COOL	5411 1 WARMER 5421 1 WARMER 5431 1 MILD 5441 1 NOT AS WARM 5451 1 NOT AS WARM	5511 4 MUCH WARMER 5511 4 MUCH WARMER 5511 4 MUCH WARMER 5521 1 WARMER 5521 1 WARMER 5531 1 MILD
LT(5) 27-41	6111 1 NOT AS COLD 6121 1 COLD 6131 1 CONTINUED COLD 6141 1 COLDER 6151 4 MUCH COLDER 6161 1 COLD	6211 1 NOT AS COLD 6221 1 COLD 6231 1 CONTINUED COLD 6241 1 COLDER 6251 1 COLDER 6261 1 COLD	6311 4 NOT AS COLD 6321 1 COOL 6341 1 COOL 6351 4 COLDER	6411 1 WARMER 6421 1 WARMER 6431 1 MILD 6441 1 NOT AS WARM 6451 1 NOT AS WARM 6461 1 MILD	6511 1 WARMER 6521 1 WARMER 6531 2 CONTINUED MILD 6541 1 MILD 6551 1 NOT AS WARM 6561 1 MILD
LT(4) ≤ 26	7111 1 NOT AS COLD 7121 4 VERY COLD 7131 4 CONTINUED VERY COLD 7141 4 BITTER COLD 7151 4 BITTER COLD 7161 4 BITTER COLD	7211 1 NOT AS COLD 7221 1 COLD 7231 1 CONTINUED COLD 7241 1 COLDER 7251 4 MUCH COLDER 7261 4 VERY COLD	7311 1 NOT AS COLD 7321 4 SEASONABLY COLD 7331 1 SEASONABLY COLD 7341 1 COLDER 7351 4 MUCH COLDER	7411 1 WARMER 7421 2 MODERATING TEMPERATURES 7441 1 COLDER 7451 1 COLDER	7511 1 WARMER 7521 1 MILD 7531 1 MILD 7541 1 NOT AS WARM 7551 1 NOT AS WARM 7561 1 MILD

DEPARTURE FROM NORMAL

Figure 4. Maximum temperature descriptors for detail level 2 as a function of forecast temperatures, departure from normal, and change from the day before. Ranges corresponding to default values of the LT( ) parameters are indicated for each box in the table. All temperatures are in degrees F.

TEMPERATURE FORECAST

	< -11	- LT(1) -11 TO -8	- LT(2) -7 TO 7	LT(1) 8 TO 11	LT(2) > 11
> 96			1313 1 HOT	1413 4 VERY HOT 1423 4 VERY HOT	1513 4 VERY HOT 1523 4 VERY HOT 1533 4 CONTINUED VERY HOT 1563 1 HOT
LT(9) 91-96			2313 1 WARMER	2413 1 HOT	2513 4 VERY HOT 2523 4 VERY HOT 2533 4 CONTINUED VERY HOT 2543 1 HOT 2553 1 NOT AS HOT 2563 1 HOT
LT(8) 81-90		3253 1 COOLER	3313 1 WARMER	3413 1 WARMER	3513 4 MUCH WARMER 3523 1 WARMER 3533 1 CONTINUED 3543 4 NOT AS WARM 3553 1 NOT AS HOT 3563 1 WARM
LT(7) 57-80		4253 1 COOLER		4413 1 WARMER	4513 1 MUCH WARMER
LT(6) 42-56	5113 1 NOT AS COLD 5123 1 COLD 5133 1 CONTINUED COLD 5143 1 COLDER 5153 1 COLDER 5163 1 COLD	5253 1 COLDER	5353 1 COOLER		5513 4 MUCH WARMER
LT(5) 27-41	6113 1 NOT AS COLD 6123 1 COLD 6133 1 CONTINUED COLD 6143 1 COLDER 6153 4 MUCH COLDER 6163 1 COLD	6253 1 COLDER			
LT(4) ≤ 26	7113 1 NOT AS COLD 7123 4 VERY COLD 7133 4 CONTINUED VERY COLD 7143 4 BITTER COLD 7153 4 BITTER COLD 7163 4 BITTER COLD	7243 1 COLDER 7253 4 MUCH COLDER	7313 1 NOT AS COLD 7353 4 MUCH COLDER		

DEPARTURE FROM NORMAL

Figure 5. Maximum temperature descriptors for detail level 3 as a function of forecast temperatures, departure from normal, and change from the day before. Ranges corresponding to default values of the LT( ) parameters are indicated for each box in the table. All temperatures are in degrees F.