APPENDIX A

GEMPAK PARAMETERS

This appendix contains a list of the GEMPAK parameters. Algorithms used in computing these parameters are also included. The following constants are used in the computations:

KAPPA	= Poisson's constant	= 2 / 7
G	= Gravitational constant	= 9.80616 m/sec/sec
GAMUSD	= Standard atmospheric lapse rate	= 6.5 K/km
RDGAS	= Gas constant for dry air	= 287.04 J/K/kg
PI	= Circumference / diameter	= 3.14159265

References for some of the algorithms:

Bolton, D., 1980: The computation of equivalent potential temperature., *Monthly Weather Review*, **108**, pp 1046-1053.

Miller, R.C., 1972: Notes on Severe Storm Forecasting Procedures of the Air Force Global Weather Central, *AWS Tech. Report 200*.

Wallace, J.M., P.V. Hobbs, 1977: *Atmospheric Science*, Academic Press, 467 pp.

TEMPERATURE PARAMETERS

TMPC - Temperature in Celsius

TMPF - Temperature in Fahrenheit

TMPK - Temperature in Kelvin

THTA - Potential temperature in Kelvin

THTK - Potential temperature in Kelvin

THTC - Potential temperature in Celsius

STHA - Surface potential temperature in Kelvin

STHK - Surface potential temperature in Kelvin

STHC - Surface potential temperature in Celsius

THTE - Equivalent potential temperature in Kelvin

STHE - Surface equivalent potential temperature in Kelvin

THTS - Saturation equivalent pot. temperature in Kelvin

STHS - Surface saturation equivalent pot. temperature in Kelvin

TVRK - Virtual temperature in Kelvin

TVRC - Virtual temperature in Celsius

TVRF - Virtual temperature in Fahrenheit

THTV - Virtual potential temperature in Kelvin

TMAX - Maximum 24 hour temperature in Celsius

TMIN - Minimum 24 hour temperature in Celsius

SSTC - Sea surface temperature in Celsius

LTMP - Surface lifted temperature

```
TMPC = ( TMPF - 32 ) * 5 / 9

TMPC = TMPK - 273.16

THTA = TMPK * ( 1000 / PRES ) ** KAPPA

STHA = TMPK * ( 1000 / PALT ) ** KAPPA

TVRK = TMPK * ( 1 + ( .001 * MIXR ) / .62197) ) / ( 1 + ( .001 * MIXR ) )

THTV = TVRK * ( 1000 / PRES ) ** KAPPA

THTE = THTM * EXP [ ( 3.376 / TLCL - .00254 ) * ( MIXR * ( 1 + .81 * .001 * MIXR ) ) ]
       THTM  = potential temperature for moist air
             = TMPK * ( 1000 / PRES ) ** E
       E     = 2. / 7. * ( 1 - ( .28 * .001 * MIXR ) )
       TLCL  = temperature at the LCL in Kelvin
    Bolton, MWR (1980)
```

MOISTURE PARAMETERS

DWPC - Dewpoint in Celsius

DWPF - Dewpoint in Fahrenheit

DWPK - Dewpoint in Kelvin

DPDC - Dewpoint depression in Celsius

DPDF - Dewpoint depression in Fahrenheit

DPDK - Dewpoint depression in Kelvin

MIXR - Mixing ratio in g/kg

MIXS - Saturated mixing ratio in g/kg

SMXR - Surface mixing ratio in g/kg

SMXS - Surface saturated mixing ratio in g/kg

RELH - Relative humidity in percent

TMWK - Wet bulb temperature in Kelvin

TMWC - Wet bulb temperature in Celsius

TMWF - Wet bulb temperature in Fahrenheit

VAPR - Vapor pressure in millibars

VAPS - Saturation vapor pressure in millibars

LHVP - Latent heat of vaporization in J/kg

PWTR - Precipitable water in mm

```
DPDx = TMPx - DWPx

MIXR = .62197 * ( E / ( PRES - E ) ) * 1000
       E      = VAPR * [ 1.001 + ( PRES - 100) / 900 * .0034 ]
       VAPR   = 6.112 * EXP ( ( 17.67 * DWPC ) / ( DWPC + 243.5 ) )
     Bolton, MWR (1980)

MIXS = .62197 * ( Es / ( PRES - Es ) ) * 1000
       Es     = VAPS * [ 1.001 + ( PRES - 100 ) / 900 * .0034 ]
       VAPS   = 6.112 * EXP ( ( 17.67 * TMPC ) / ( TMPC + 243.5 ) )
     Bolton, MWR (1980)
```

SMXR = .62197 * (E / (PALT - E)) * 1000
E = VAPR * [1.001 + (PALT - 100) / 900 * .0034]
VAPR = 6.112 * EXP ((17.67 * DWPC) / (DWPC + 243.5))

SMXS = .62197 * (Es / (PALT - Es)) * 1000
Es = VAPS * [1.001 + (PALT - 100) / 900 * .0034]
VAPS = 6.112 * EXP ((17.67 * TMPC) / (TMPC + 243.5))

RELH = VAPR / VAPS * 100

(TMPK - TMWK) * Cp - (Rsat (TMWK) - RMIX) * LVAP = 0
Implicit equation solved by Newton's method for TMWK.
Cp - Specific heat at constant pressure
Rsat - Saturation mixing ratio at TMWK
RMIX - Mixing ratio
LVAP - Latent heat of vaporization

VAPR = 6.112 * EXP [(17.67 * DWPC) / (DWPC + 243.5)]
Bolton, MWR (1980)

VAPS = 6.112 * EXP [(17.67 * TMPC) / (TMPC + 243.5)]
Bolton, MWR (1980)

LHVP = (2.501 - .00237 * TMPC) * 10E6
Bolton, MWR (1980)

HEIGHT PARAMETERS

HGHT - Height in meters

HGTM - Height in meters

HGTK - Height in kilometers

HGTD - Height in decameters

HGFT - Height in feet (3.28084 * HGHT)

HGFH - Height in hundreds of feet

HGFK - Height in thousands of feet

HGML - Height in miles (6.2137E-04 * HGHT)

DHGT - Dry hydrostatic height in meters

MHGT - Moist hydrostatic height in meters

STDZ - Character standard height convention used on u.-a. charts

RSTZ - Numeric standard height convention used on u.-a. charts

For data below 500 mb, the standard height is the last three digits of the height. For data at and above 500 mb, the height is the last three digits of the height in decameters.

ZMSL, Z000, Z900, Z850, Z800 - Estimated height at a pressure level

DHGT and MHGT are computed using the hypsometric equation and integrating from the surface pressure to the desired level. DHGT (MHGT) is computed without (with) the influence of moisture.

```
DHGT = HB + ( RDGAS / G ) * LN ( PBOT / PTOP ) * TAVE
        HB     = height of the bottom of layer
        PBOT   = pressure at bottom of layer
        PTOP   = pressure at the top the layer
        TAVE   = average temperature of the layer

MHGT = HB + ( RDGAS / G ) * LN ( PBOT / PTOP ) * TVAVE
        HB     = height of the bottom of layer
        PBOT   = pressure at bottom of layer
        PTOP   = pressure at the top the layer
        TVAVE  = average virtual temperature of the layer

Zxxx = [ To * ( 1 - ( PRES / ALTM ) ** ( RDGAS * GAMUSD / G ) ] / GAMUSD
     Zxxx = height at the pressure level
                ZMSL : 1013.25 mb
                Z000 : 1000 mb
                Z900 : 900 mb
                Z850 : 850 mb
                Z800 : 800 mb
     To   = sea level temperature in U.S.  Std.  Atmos.  = 288 K
```

PRESSURE AND ALTIMETER PARAMETERS

PRES - Station pressure in millibars

PRES is the actual pressure at a level as reported with upper air data.

PMSL - Mean sea level pressure

PMSL is reported with surface data.

PALT - Surface pressure in millibars from ALTI

ALTI - Altimeter setting in inches of mercury

ALTI is reported with surface data.

ALTM - Altimeter setting converted to millibars

SALT - Abbreviated standard altimeter setting

SMSL - Abbreviated mean sea level pressure in millibars

SALI - Abbreviated altimeter setting in inches of mercury

RMSL - First 3 digits left of decimal of PMSL * 10

RSLI - First 3 digits left of decimal of ALTI * 100

RSLT - First 3 digits left of decimal of ALTM * 10

PTND - Pressure tendency: graphics symbol with numeric change

PTSY - Graphics symbol for pressure tendency

P03C - 3-h numeric pressure change

```
PMSL = PRES * EXP ( ( G * SELV ) / ( RDGAS * TVAVE ) )
          SELV    = station elevation
          TVAVE  = average virtual temperature between station and sea level
                      = TVRK + ( DELTV / 2 )
          DELTV  = GAMUSD * SELV / 1000
       Wallace & Hobbs (1977)

PALT = ALTM * ( 1 - ( ( SELV / 1000 ) * GAMUSD / To ) ) **
                                          ( G / ( GAMUSD * RDGAS ) * 1000 )
           SELV   = station elevation in meters
           To        = sea level temperature in U.S.  Std.  Atmos.  = 288 K
       Wallace & Hobbs (1977)

ALTM = ALTI * ( 1013.25 / 29.921 )

SALT = MOD ( ALTM * 10, 1000 )
```

WINDS

UWND - U-component of the wind in meters/second

VWND - V-component of the wind in meters/second

UKNT - U-component of the wind in knots

VKNT - V-component of the wind in knots

DRCT - Wind direction in degrees

SPED - Wind speed in meters/second

SKNT - Wind speed in knots

PSPD - Packed direction and speed in meters/second (ddfff)

PKNT - Packed direction and speed in knots (ddfff)

GUST - Wind gusts in knots

GUMS - Wind gusts meters/second

WNML - Wind component toward a direction 90 degrees counter-clockwise from a specified direction.

WCMP - Wind component toward a specified direction

BARB - Barb feathered in m/s

BRBM - Barb feathered in m/s

BRBK - Barb feathered in knots

ARRW - Arrows scaled in m/s

ARRM - Arrows scaled in m/s

ARRK - Arrows scaled in knots

DARR - Wind direction arrows of uniform length

UWND = - SIN (DRCT) * SPED

VWND = - COS (DRCT) * SPED

DRCT = ATAN2 (-UWND, -VWND) * 180 / PI

SPED = SQRT (UWND ** 2 + VWND ** 2)

SPED = SKNT / 1.9438

```
PSPD = JDRCT * 100 + JSPED
        JDRCT = NINT ( DRCT / 5 )
        JSPED = NINT ( SPED )

PKNT = JDRCT * 100 + JSKNT
        JDRCT = NINT ( DRCT / 5 )
        JSKNT  = NINT ( SKNT )

WCMP = - COS ( DRCT - SPCD ) * SPED
          SPCD is the specified direction

WNML = - COS ( DRCT - ( SPCD - PI/2 ) ) * SPED
          SPCD is the specified direction
```

LIFTED CONDENSATION LEVEL (LCL)

TLCL - Temperature in Kelvin at the LCL from the given level

PLCL - Pressure in millibars at the LCL from the given level

```
TLCL = [1 / ( 1 / ( DWPK - 56 ) + LN ( TMPK / DWPK ) / 800 )] + 56
      Bolton, MWR (1980)

PLCL = PRES * ( TLCL / ( TMPC + 273.16 ) ) ** ( 1 / KAPPA )
      Poisson's equation
```

STABILITY INDICES

Note: Default depths given in the definitions below are preceded by an ! and may be changed using the in-line depth specification. dz in the definitions below defaults to the layer thickness in the sounding.

BRCH - Bulk Richardson number

```
BRCH = CAPE / ( 0.5 * U**2 )
        CAPE   = Convective Available Potential Energy
        U      = magnitude of shear ( u2 - u1, v2 - v1 )
        u1,v1  = average u,v in the lowest !500 m
        u2,v2  = average u,v in the lowest !6000 m
```

BVFQ - Brunt-Vaisala frequency

```
BVFQ = SQRT ( ( G / THTA ) * STAB )
```

BVPD - Brunt-Vaisala period

```
BVPD = 2.  * PI / BVFQ
```

BVSQ - Brunt-Vaisala frequency squared

BVSQ = BVFQ ** 2

CAPE - Convective available potential energy

CAPE = GRAVTY * SUMP (DELZ * (THP - TH) / TH)
SUMP = sum over sounding layers for which (THP - TH) is greater than zero
THP = potential temperature of a parcel from the lowest !500 m of the atmosphere, raised dry adiabatically to the lcl and moist adiabatically thereafter
TH = potential temperature of the environment

CINS - Convective inhibition

CINS = - GRAVTY * SUMN (DELZ * (THP - TH) / TH)
SUMN = sum over sounding layers for which (THP - TH) is less than zero.
THP = potential temperature of a parcel from the lowest !500 m of the atmosphere, raised dry adiabatically to the lcl and moist adiabatically thereafter
TH = potential temperature of the environment

CTOT - Cross Totals index

CTOT = TD850 - T500
TD850 = Dewpoint in Celsius at 850 mb
T500 = Temperature in Celsius at 500 mb

EQLV - Equilibrium level

EQLV = level at which parcel undergoing moist adiabatic ascent ceases to be buoyant.

KINX - K index

KINX = (T850 - T500) + TD850 - (T700 - TD700)
T850 = Temperature in Celsius at 850 mb
T500 = Temperature in Celsius at 500 mb
TD850 = Dewpoint in Celsius at 850 mb
T700 = Temperature in Celsius at 700 mb
TD700 = Dewpoint in Celsius at 700 mb

LAPS - Temperature lapse rate in layer

LAPS = d (TMPK) / dz = d (TMPC) / dz

LCLP - Pressure in millibars at the LCL from the surface

LCLP = PRES * (LCLT / (TMPC + 273.16)) ** (1 / KAPPA)
Poisson's equation

LCLT - Temperature in Kelvin at the LCL from the surface

LCLT = [1 / (1 / (DWPK - 56) + LN (TMPK / DWPK) / 800)] + 56
Bolton, MWR (1980)

LFCV - Level of free convection

LFCV = level above which a parcel ascending moist adiabatically is buoyant.

LIFT - Lifted index

LIFT = T500 - Tparcel
T500 = Temperature in Celsius at 500 mb
Tparcel = 500 mb temperature in Celsius of a lifted parcel with the average pressure, temperature and dewpoint of the layer !100 mb above the surface

MLMR - Mean mixed layer MIXR

MLMR = Average MIXR in lowest !500 m

MLTH - Mean mixed layer THTA

MLTH = Average THTA in lowest !500 m

PWAT - Precipitable water (mm) for the entire sounding

RICH - Richardson number in layer

RICH = BFVQ ** 2 / SHRM ** 2

SEPA - Isentropic layer pressure thickness

SEPA = Pressure difference over isentropic layer !5 K deep

SHOW - Showalter index

SHOW = T500 - Tparcel
T500 = Temperature in Celsius at 500 mb
Tparcel = Temperature in Celsius at 500 mb of parcel lifted from 850 mb

SHRD - Wind shear direction in layer

SHRD = direction of [du/dz, dv/dz]

SHRM - Wind shear magnitude in layer

SHRM = magnitude of [du/dz, dv/dz]

STAB - THTA lapse rate in layer

STAB = d (THTA) / dz

STAP - THTA change with pressure

STAP = - d (THTA) / dp

SWET - SWEAT index

SWET = 12 * TD850 + 20 * TERM2 + 2 * SKT850 + SKT500 + SHEAR
TD850 = Dewpoint in Celsius at 850 mb
TERM2 = MAX (TOTL - 49, 0)
TOTL = Total totals index
SKT850= 850 mb wind speed in knots
SKT500= 500 mb wind speed in knots
SHEAR = 125 * [SIN (DIR500 - DIR850) + .2]
DIR500 = 500 mb wind direction
DIR850 = 850 mb wind direction

If TD850 is negative, then TD850 is set to 0.
SHEAR is set to 0 if any of the following conditions are met:
wind direction at 850mb is < 130 or > 250
wind direction at 500mb is < 210 or > 310
DIR500 - DIR850 <= 0
SPD500 <= 15 or SPD850 <= 15
Miller (1972)

TOTL - Total Totals index

TOTL = (T850 - T500) + (TD850 - T500)
T850 = Temperature in Celsius at 850 mb
TD850 = Dewpoint in Celsius at 850 mb
T500 = Temperature in Celsius at 500 mb

VTOT - Vertical Totals index

VTOT = T850 - T500
T850 = Temperature in Celsius at 850 mb
T500 = Temperature in Celsius at 500 mb

CLOUD PARAMETERS

Cloud coverage may be defined using a cloud code, short code, fractional coverage or numeric value. The valid values of these parameters ordered from least to greatest cloud coverage, are:

Cloud Coverage	Cloud xCLD	Short	Fractional xCLO	Numeric CLCx	Symbol CFRT
missing		-	0.00	0	-
clear	CLR	C	0.00	1	0
thin scattered	-SCT	-S	0.25	6	2
scattered	SCT	S	0.40	2	3
thin broken	-BKN	-B	0.60	7	5
broken	BKN	B	0.75	3	6
thin overcast	-OVC	-O	0.90	8	7
overcast	OVC	O	1.00	4	8
thin obscured	-X	-X	0.00	9	0
obscured	X	X	1.00	5	9

The following lists the GEMPAK parameter definitions with an example using the sample AIRWAYS cloud report:

```
22SCT   80-BKN   250OVC
```

Note that the character x may be replaced by L, M, or H, indicating low, mid or high clouds. Also note that the character T indicates the value of the parameter at the level of maximum cloud coverage.

xCLD - Character cloud coverage code
Examples: LCLD = SCT
MCLD = -BKN
HCLD = OVC

TCLD - xCLD at maximum cloud coverage
Example: TCLD = OVC

xCLO - Fractional cloud coverage
Examples: LCLO = 0.400
MCLO = 0.600
HCLO = 1.000

TCLO - xCLO at maximum cloud coverage
Example: TCLO = 1.00

CLCx - Numeric cloud coverage
Examples: CLCL = 2
CLCM = 7
CLCH = 4

CLCT - CLCx at maximum cloud coverage
Example: CLCT = 4

The next two parameters combine cloud coverage values from the three cloud levels.

CLDS - Combined cloud coverage short code from three levels
Example: CLDS = S-BO

CMBC - Combined cloud coverage numeric from three levels
Example: CMBC = 274

The next set of parameters are combined cloud height and cloud coverage.

CLHx - Cloud height in hundreds of feet
Examples: CLHL = 22.
CLHM = 80.
CLHH = 250.

CLDx - Combined cloud height and short code
Examples: CLDL = 22S
CLDM = 80-B
CLDH = 250O

CLDT - CLDx at maximum coverage level
Example: CLDT = 250O

COMx - Numeric combined cloud height and coverage combined as
CLHx * 10 + CLCx
Examples: COML = 222.
COMM = 807.
COMH = 2504

Note: In the case when the sky is partially obscured, the value of 10000 is added on to the lowest reporting level. For example, if AIRWAYS report is -X M5 BKN 19 BKN, COML would equal 10053.

COMT - COMx at maximum coverage level
Example: COMT = 2504.

The next two parameters combine the cloud height and coverage allowing up to three reports which do not necessarily correspond to low, middle and high level clouds. These parameters allow a means of storing cloud reports where there may be more than one report at a single level.

CHCx - Numeric combined cloud height and coverage combined as
CLHx * 10 + CLCx, where x is the cloud report group number from 1 to 3.
Examples: CHC1 = 222.
CHC2 = 807.
CHC3 = 2504

Note: In the case when the sky is partially obscured, the value of 10000 is added on to the first reporting level. For example, if AIRWAYS report is -X M5 BKN 19 BKN, CHC1 would equal 10053.

CHDx - Combined cloud height and short code

Examples: CHD1 = 22S
CHD2 = 80-B
CHD3 = 250O

The following set of cloud parameters is the numeric WMO codes which are reported by airways data.

CFRL - Fraction of celestial dome covered by all low and mid level clouds from WMO Code 2700

CTYL - Low-level cloud genera from WMO Code 0513

CTYM - Mid-level cloud genera from WMO Code 0513

CTYH - High-level cloud genera from WMO Code 0513

CBAS - Cloud base height from WMO Code 1000

CSYL - Cloud graphics symbol for CTYL

CSYM - Cloud graphics symbol for CTYM

CSYH - Cloud graphics symbol for CTYH

CSYT - Cloud graphics symbol for first level reporting clouds

CFRT - Cloud coverage number from CLCT (maximum clouds)

SKYC - Cloud coverage graphics symbol for CFRT

SKYM - Sky coverage symbol with wind barbs in m/s

SKYK - Sky coverage symbol with wind barbs in knots

WEATHER CODES

WCOD - Character weather code

WNUM - Numeric weather code

The weather code WCOD may also be accessed as WTHR. The weather number consists of 3 parts, A, B, C where WNUM = A * 80 * 80 + B * 80 + C. Each part corresponds to one of the values:

0 (no value)	
1 R (mod rain)	41
2 L (mod drizzle)	42
3 S (mod snow)	43
4 A (mod hail)	44
5 T (thunder)	45
6 H (haze)	46
7 K (smoke)	47
8 D (dust)	48
9 F (fog)	49 ZR- (lt frz rain)
10	50 ZR+ (hvy frz rain)
11	51 RW- (lt rain shwr)
12	52 RW+ (hvy rain shwr)
13 R- (lt rain)	53 ZL- (lt freezing drizzle)
14 R+ (hvy rain)	54 ZL+ (hvy freezing drizzle)
15 ZR (mod frz rain)	55 SW- (lt snow shwr)
16 RW (mod rain shwr)	56 SW+ (hvy snow shwr)
17 L- (lt drizzle)	57 IP- (lt ice pellets)
18 L+ (hvy drizzle)	58 IP+ (hvy ice pellets)
19 ZL (frz drizzle)	59 SG- (lt snow grains)
20 S- (lt snow)	60 SG+ (hvy snow grains)
21 S+ (hvy snow)	61 SP- (lt snow pellets)
22 SW (mod snow shwr)	62 SP+ (hvy snow pellets)
23 IP (mod ice pellet)	63 IPW (mod ice pellet shwr)
24 SG (mod snow grain)	64 IC- (lt ice crystals)
25 SP (mod snow pellet)	65 IC+ (hvy ice crystals)
26 A- (lt hail)	66 TRW (mod thunder shwr)
27 A+ (hvy hail)	67
28 T- (lt thunder)	68
29 T+ (hvy thunder)	69
30 IF (ice fog)	70
31 GF (ground fog)	71
32 BS (blowing snow)	72
33 BD (blowing dust)	73
34 BY (blowing spray)	74
35 BN (blowing sand)	75 IPW- (lt ice pellet shwr)
36 IC (mod ice crystals)	76 IPW+ (hvy ice pellet shwr)
37 IN (ice needles)	77 TRW- (lt rain thunder shwr)
38 AP (small hail)	78 TRW+ (hvy rain thunder shwr)
39 KH (smoke, haze)	79
40	

The following correspond to a single character code:

-1 TORNA (tornado)	-3 WATER(water spout)
-2 FUNNE (funnel cloud)	

WTHR - Character weather codes for W604 data

W604 - Numeric weather codes used for 604 data

0 =	22 = L+	44 = R+S
1 = T	23 = SP	45 = RS-
2 = R	24 = SG	46 = RS+
3 = S	25 = BY	47 = ZL-
4 = F	26 = BN	48 = ZL+
5 = H	27 = BD	49 = TSW
6 = K	28 = IF	50 = TSW-
7 = L	29 = RS	51 = TSW+

8 = R+	30 = TRW	52 = TRW-
9 = R-	31 = TR-	53 = TRW+
10 = S+	32 = TR+	54 = TRWA
11 = S-	33 = TS-	55 = R-S-
12 = RW	34 = TS+	56 = R-S+
13 = SW	35 = ZR-	57 = R+S-
14 = TR	36 = ZR+	58 = R+S+
15 = TS	37 = SW-	59 = TRW+A
16 = ZL	38 = SW+	60 = TRW-A
17 = ZR	39 = SG-	61 = TORNA
18 = IP	40 = SG+	62 = FUNNE
19 = GF	41 = RW-	63 = WATER
20 = BS	42 = RW+	
21 = L-	43 = R-S	

WTMO - Character WMO weather code

WWMO - Numeric WMO weather code

WSYM - Graphics weather symbol corresponding to WWMO

The transformation is:

0 =	34 = BD+	67 = ZR
1 =	35 = BD+	68 = R-S-
2 =	36 = BS	69 = RS
3 =	37 = BS+	70 = S-
4 = K	38 = BS	71 = S-
5 = H	39 = BS+	72 = S
6 = D	40 =	73 = S
7 = BD	41 = F	74 = S+
8 = BD	42 = F	75 = S+
9 = BD	43 = F	76 = IN
10 = F-	44 = F	77 = SG
11 = GF	45 = F	78 = S-
12 = GF	46 = F	79 = IP
13 =	47 = F	80 = RW-
14 =	48 = F	81 = RW
15 =	49 = F	82 = RW+
16 =	50 = L-	83 = RW-SW-
17 = T	51 = L-	84 = RWSW
18 = Q	52 = L-	85 = SW-
19 = FUNNE	53 = L	86 = SW
20 =	54 = L+	87 = SP-
21 =	55 = L+	88 = SP
22 =	56 = ZL-	89 = A-
23 =	57 = ZL	90 = A
24 =	58 = R-L-	91 = R-
25 =	59 = RL	92 = R
26 =	60 = R-	93 = RS
27 =	61 = R-	94 = R+S+
28 =	62 = R	95 = TRW-
29 =	63 = R	96 = TRW-A
30 = BD	64 = R+	97 = TRW+
31 = BD	65 = R+	98 = TD
32 = BD	66 = ZR-	99 = TRW+A
33 = BD+		

WASH - Asheville surface data weather code

RWSH - Numeric Asheville surface data

The data are stored using 7-digits as 1234.567. The column digits have the following translation:

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7
0 = None	0 = None	0 = None	0 = None	0 = None	0 = None	0 = None
1 = R-	1 = None	1 = S-	1 = SW-	1 = IP-	1 = F	1 = K
2 = R	2 = None	2 = S	2 = SW	2 = IP	2 = IF	2 = H
3 = R+	3 = None	3 = S+	3 = SW+	3 = IP+	3 = GF	3 = KH
4 = RW-	4 = L-	4 = SP-	4 = None	4 = None	4 = BD	4 = D
5 = RW	5 = L	5 = SP	5 = None	5 = A	5 = BN	5 = BS
6 = RW+	6 = L+	6 = SP+	6 = None	6 = None		6 = T
7 = ZR-	7 = ZL-	7 = none	7 = SG-	7 = None		7 = T+
8 = ZR	8 = ZL	8 = IC	8 = SG	8 = AP		8 = TOR
9 = ZR+	9 = ZL+		9 = SG+			9 = Q

PWTH - Character past weather WMO code or graphics symbol for it

PWWM - Numeric past weather WMO code

The past weather WMO numeric codes are:

0 = Cloud covering less than 1/2 sky
1 = Cloud covering more than 1/2 during part of
period and less than 1/2 sky during part
2 = Cloud covering more than 1/2 sky
3 = Sandstorm, duststorm or blowing snow
4 = Fog, ice fog, thick haze or thick smoke
5 = Drizzle
6 = Rain
7 = Snow, rain and snow mixed or ice pellets
8 = Showers
9 = Thunderstorm with or without precipitation

The translation is:

0	=		5	=	L
1	=		6	=	R
2	=		7	=	S
3	=	BD	8	=	RW
4	=	F	9	=	T

STATION PARAMETERS

STID - Character station identifier

STNM - Station number

STNM is the 5-digit WMO identifier for upper air data; 6 digits for surface data, usually the WMO identifier with a zero appended.

SLAT - Station latitude in degrees

SLON - Station longitude in degrees; West longitude is negative

SELV - Station elevation in meters

RANG - Range in kilometers (specialized use)

AZIM - Azimuth in kilometers (specialized use)

LATI - Latitude in degrees from range/azimuth

LONG - Longitude in degrees from range/azimuth

LATI and LONG are calculated from the RANG and AZIM using equations developed for AOIPS/RADPAK.

DELT - Delta time in seconds (specialized use)

MODEL OUTPUT STATISTICS

MXMN - Maximum or minimum temperature in Fahrenheit

PP06 - Probability of precipitation fcst in a 6-hr period

PP12 - Probability of precipitation fcst in a 12-hr period

QP06 - Quantitative precipitation fcst in a 6-hr period

1 = 0.01 - 0.09 inches
2 = 0.10 - 0.24 inches
3 = 0.25 - 0.49 inches
4 = 0.50 - 0.99 inches
5 = 1.00 - 1.99 inches

QP12 - Quantitative precipitation fcst in a 12-hr period

1 through 5 same as QP06
6 = greater than or equal to 2.00 inches

TS06 - Unconditional probability of thunderstorms occurring in a 6-hr period

TS12 - Unconditional probability of thunderstorms occurring in a 12-hr period

TC06 - Unconditional probability of severe weather occurring in a 6-hr period

TC12 - Unconditional probability of severe weather occurring in a 12-hr period

PCPT - Categorical forecast of precipitation

0 = R = rain
1 = S = snow
2 = Z = freezing

POZP - Conditional probability of freezing precipitation (not included during the warm season)

POSN - Conditional probability of snow (not included during the warm season)

SN06 - Categorical forecast of snow amount falling in a 6-hr period

0 = no snow
1 = trace - less than 2 inches
2 = greater than or equal to 2 inches

SN12 - Categorical forecast of snow amount falling in a 12-hr period (not included during the warm season)

0 and 1 same as SN06
2 = 2 to less than 4 inches
4 = 4 to less than 6 inches
6 = greater than 6 inches

FCIG - Categorical forecast of ceiling height conditions

1 = less than 200 feet
2 = 200 - 400 feet
3 = 500 - 900 feet
4 = 1000 - 3000 feet
5 = 3100 - 6500 feet
6 = 6600 - 12,000 feet
7 = greater than 12,000 feet

FVIS - Categorical forecast of visibility conditions

1 = less than 0.5 miles
2 = 0.5 - 0.875 miles
3 = 1.0 - 2.75 miles
4 = 3.0 - 5.0 miles
5 = greater than 5.0 miles

OVIS - Categorical forecast in plain language of obstructions to vision

0 = N = neither fog or haze
1 = F = fog
2 = H = haze

MISCELLANEOUS PARAMETERS

VSBY - Visibility in statute miles

VSBK - Visibility in kilometers

PnnI - Precipitation over last nn hours in inches

nn = 03, 06, 09, 12, 18 or 24

PnnM - Precipitation over last nn hours in millimeters

nn = 03, 06, 09, 12, 18 or 24

SNOW - Snow depth in inches

HAIL - Hail flag

HLSZ - Hail size in centimeters

WHGT - Wave height in meters

WPER - Wave period in seconds

DDEN - Density of dry air in kg/(m**3)

PSYM - Montgomery stream function in m**2/(100*s**2)

HEAT - Heat index in Fahrenheit

HMTR - Humiture (apparent temperature) in Fahrenheit

WCEQ - Wind chill equivalent temperature in Fahrenheit

TEXT - Undecoded data

SPACING PARAMETERS

BLNK - Plot a blank, not accounted for in FILTER

SPAC - Plot a space, accounted for in FILTER