

**NOAA Technical Memorandum NWS WR-232**



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**FOG CLIMATOLOGY AT SPOKANE, WASHINGTON**

**Paul Frisbie  
National Weather Service Forecast Office  
Reno, Nevada**

**July 1995**

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# FOG CLIMATOLOGY AT SPOKANE, WASHINGTON

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## Abstract

*Fog climatology at Spokane, Washington is established to aid in the preparation of terminal aviation forecasts. Two software applications correlate specific surface weather to fog for parameters five winters of hourly surface observations. The programs only consider data when the spread between the temperature and dewpoint temperatures is 2°F or less. FOGGEG produces graphical outputs for fog probability versus temperature, wind speed, wind direction, barometric pressure, and time of day. FCSTFOG provides conditional probabilities of fog for LIFR, IFR, and MVFR conditions.*

*Fog and dense fog are most likely to occur under calm winds. For wind speeds under 11 kts, the most favorable wind direction is from the northeast. For wind speeds greater than 11 knots, the preferred direction is south or southwest. Fog rarely forms with a northwest wind. When temperatures are around 5°F, dense fog is possible with a dewpoint depression of 3 or 4°F. In this instance, the atmosphere is saturated with respect to ice, not water.*

## I. INTRODUCTION

Forecasting fog at the Spokane Airport (GEG) can be challenging to any forecaster, particularly during the winter. For the period 1961-1990, climatology shows an average of 37 dense fog days per year during November through February. Excluding periods of precipitation (except when drizzle and ice crystals are observed), fog occurs at Spokane 22 percent of the time. Dense fog forms 6 percent of the time. Since fog frequently occurs at Spokane and affects aviation, there is a need to better understand its formation and dissipation.

The intent of this study is to establish a fog climatology at Spokane for the purpose of preparing terminal aviation forecasts (FTs). When certain meteorological factors as expected, the forecaster may accurately predict fog and visibility in regards to LIFR, IFR, and MVFR conditions, as well as a no fog event. However, only visibility is used in this study without consideration of ceiling. In surface observations, the visibility requirements for fog

occurrence is 6 miles or less. When the visibility drops to a quarter mile or less, the fog is considered dense.

There are a number of reasons for dense fog at Spokane during the winter months. Foremost is that Spokane resides in a modified marine air mass during most of the winter. Other factors to consider include: 1) nocturnal radiational cooling; 2) warm air advection over a colder, possibly snow-covered surface; 3) adiabatic cooling (Spokane is upslope in a southwesterly flow); 4) evaporative cooling; and 5) any combination of the aforementioned possibilities.

There are occasions when Spokane does not reside in a marine air mass during the winter months. A dry continental air mass periodically will occupy the region after the passage of a modified arctic front. A mesoscale feature that modifies the air mass, although an infrequent occurrence, is the relatively dry chinook winds that develop off the Washington Cascades.



These winds may partially mix out the maritime air mass, but are uncommon and normally occur during periods of little precipitation.

The Spokane Airport sits in a prairie field on the western edge of the city and is not highly urbanized. Many small lakes and creeks are situated around the airport. Four miles northeast of the airport, Hangman Creek flows into the Spokane River, about 500 feet lower than the airport elevation. These rivers, creeks, and lakes supply moisture to the boundary layer. During the winter months, the Spokane River and Hangman Creek may not necessarily freeze over (occasionally, the river and creek will freeze), consequently, the Spokane River almost always continues to supply moisture to the air mass, even during periods of persistent freezing temperatures. Initially, fog forms and thickens along the river and creek. Once it reaches the prairie level of the airport, it spreads out. When the wind is from the northeast, the fog moves towards the airport.

The waste-to-energy plant, located just northeast of the airport, began operation in November 1991. The impact of the facility on visibility and fog, if any, is not understood. Because of this uncertainty, no consideration will be given to the waste-to-energy plant on fog formation. Therefore, the winter seasons of '91-'92 and '92-'93 are not included in the study.

## II. PROCEDURE

Five winters of hourly surface aviation observations were used for a period from November 1986 through February 1991 for a total of 14,400 observations. Hourly observation elements included in this study are visibility, obstruction to visibility, temperature, dewpoint, wind speed and direction, and barometric pressure.

Two programs have been developed utilizing the five-year database. The output from both programs only consider data when the dew-point

depression is  $\leq 2^\circ\text{F}$ . The first program, FOGGEG, graphs five plots; percentage of fog versus temperature, wind speed and direction, barometric pressure, and time of day. The second program, FCSTFOG, uses specific data input by the forecaster. The program's output is statistical guidance for expected meteorological conditions. All precipitation events, except drizzle, are excluded from any calculation.

The first program, FOGGEG, requires the user to enter the name of the desired datafile. After the user inputs the desired visibility range, the program executes and outputs the four graphs mentioned above. However, since some weather parameters occur more frequently than others, there are spikes in the dataset. To smooth the curve, a weighting function is assigned to each datapoint, for temperature, wind speed, wind direction, pressure, and time of day. Let  $x_i$  equal the chance of fog for a given meteorological datapoint defined by  $i$ ;  $x_i'$  represents the new weighted meteorological datapoint. Extreme values for temperature and pressure are thrown out of the dataset because of the small number of cases; the lower limit for consideration is 10 cases.

$$x_i' = \frac{x_{i-2} + 2 * x_{i-1} + 4 * x_i + 2 * x_{i+1} + x_{i+2}}{10}$$

Figures. 1 and 2 show conditional probabilities for dense fog and any fog, respectively, when the dew-point depression is  $\leq 2^\circ\text{F}$ . Both figures display five charts of probabilities versus temperature, wind direction, wind speed, surface pressure, and time of day.

The output from the second program, FCSTFOG, is used for statistical guidance. The program user enters meteorological parameters such as temperature (select a value that is expected to be representative for the time period), wind speed and direction, and time of day. Since meteorological parameters are not

steady state, the program allows for variance. For temperature, it considers  $\pm 3^\circ\text{F}$ . For wind speed, the variance is within 20 percent of the requested value; for wind direction the variance is  $\pm 30^\circ$ . The program also considers the time of day, since there is a diurnal variation in fog occurrence. After the program executes, the output displays probabilities for certain visibilities and, if fog occurs, conditional probabilities for those visibilities given. Again, the output is only valid if the temperature and dew-point temperature spread does not exceed  $2^\circ\text{F}$ !

Both programs accommodate the special condition of calm winds. In surface observations, calm winds have no direction since it is reported as "0000". There are no reported values for wind speeds of 1 or 2 knots; wind speeds less than 3 knots are entered as "0000". To allow for this, the first program treats wind speeds of 0, 1, and 2 knots as equals. Program FCSTFOG gives no variance for calm winds.

Given the following conditions:

1. Time of Day: AM
2. Wind Direction: 07  
(entered in tens of degrees)
3. Wind Speed: 6 (knots)
4. Temperature:  $32^\circ\text{F}$

The output from FCSTFOG would be:  
Number of Events: 198

	#	%
VSBY $\leq$ 1/4 MILE	28	46
1/4 MILE $<$ VSBY $<$ 1 MILE	10	17
1 MILE $\leq$ VSBY $<$ 3 MILE	7	11
3 MILE $\leq$ VSBY $\leq$ 5 MILE	13	22
VSBY = 6 MILE	3	4
ANY FOG		60
NO FOG		40

Climatology for the above weather conditions state that fog is probable; however, there is still a good chance for no fog. And if fog does occur, LIFR conditions are likely. The output should only be considered as statistical guidance, i.e., the

program does not weight any meteorological possibilities other than the parameters entered.

### III. DISCUSSION

The meteorological parameter with the greatest affinity to fog and dense fog is dew-point depression. The probability of fog decreases nearly by one-half with a  $1^\circ\text{F}$  increase in dew-point depression. Table 1 summarizes the fog and dew-point depression relationship. The vast majority of fog events occur when the dew-point depression is  $0 - 1^\circ\text{F}$ . Since values are rounded when reported, e.g., a temperature of  $32.5^\circ\text{F}$  and a dew-point temperature of  $32.4^\circ\text{F}$  will show a one degree difference, all cases with the dew-point depression  $\leq 2^\circ\text{F}$  are considered. Instances where the dew-point depression is  $\geq 2^\circ\text{F}$  constitutes a special scenario and will be discussed later. (All events and percentages exclude periods of precipitation, except drizzle and ice crystals.)

Table 2 stratifies fog occurrence with respect to wind speed and direction for all particular wind events. Table 3 is the same as Table 2, except it only applies for dew-point depressions  $\leq 2^\circ\text{F}$ . Referring to Table 2, fog is most likely to occur with calm winds (i.e. wind speeds less than 3 mph). Of the 749 calm wind observations, 43 percent are associated with fog. For winds 3-5 knots, fog occurrence is relatively similar among all wind directions with a maximum from the southeast (41 percent) and a minimum from the northwest (26 percent). For slightly higher winds (6-8 knots), fog is most likely to occur with a southwest wind (31 percent). The other wind directions are in the 20 percent to 28 percent range, except for the northwest wind (13 percent). The number of fog events drops off significantly with wind speeds greater than 8 knots with the best

chance when the wind is from the northeast (18 percent). Fog hardly ever occurs with a northwest wind with speeds greater than 8 knots (0 occurrences in 50 chances). For wind speeds in excess of 15 knots, fog occurrence is extremely rare and only occurs with a south or southwest wind.

The relationship between wind direction and dense fog is different than for fog with any other visibility (Table 2). The best chance for dense fog occurs with calm winds (18 percent), similar to the above cases. Differences arise when there is wind. In the 3-5 knot range, the percentage difference between the extremes is threefold. The maximum (minimum) occurs with an east (south) wind with a percentage of 15 percent (5 percent). For the 6-8 knot range, fog occurrence is 9 percent (98 in 1129) from the northeast versus 2 percent from the southwest (9 in 433). For wind speeds between 9 and 11 knots, dense fog generally occurs when the wind is from the northeast (7 percent) and N (3 percent). In the 12 to 14 knot range, fog formation is relatively rare with the highest chance from a northeast (10 percent) or east wind (12 percent). In excess of 14 knots, fog development, although infrequent, does occur in a south (3 percent) or southwest wind (2 percent).

Table 3 illustrates more trends than Table 2. Dense fog is most likely to occur with east or northeast wind. With wind speeds 9 to 14 knots from the northeast, the chances of dense fog are between 10 to 20 percent. This may be indicative of mixing within the boundary layer and fog advecting from the Spokane River. Strong winds in excess of 14 knots inhibit any fog formation from any direction except in a south to southwest wind. This may reflect upslope fog as well as recent precipitation that saturates the boundary level.

Northwesterly winds have a drying effect on the air mass since there are hardly any observations with northwest wind exceeding 9 knots coinciding with a moist air mass. In any instance, the best chance for fog formation is with light and variable winds from any direction.

Another parameter to consider for fog at Spokane is time of day. The chances for fog and dense fog, regardless of dew-point depression, reaches a maximum at 7:00 a.m. (32 percent) and 8:00 a.m. (12 percent), respectively (Fig. 3). The least likely time was 4 p.m. when the chances drop to 13 percent and 2 percent for fog and dense fog, respectively. Table 4 summarizes time of day and fog. The likelihood of fog at sunrise is more than double that at sunset. For dense fog, the difference is significantly greater, in fact, six times greater at sunrise than sunset.

When the dew-point depression stays  $\leq 2^{\circ}\text{F}$ , the implication is significant. Table 5 shows that the chance of any fog is greatest at 12:00 p.m. than at any time in the day (see Fig. 2e). The best times for dense fog are between 1:00 a.m. to 12:00 p.m. with a peak at 8:00 a.m. From 12:00 p.m. to 1:00 a.m., the chances of dense fog are consistently between 10 to 15 percent. Table 4 shows a strong correlation between time of day and fog, but as Table 5 illustrates, if the dew-point depression remains within  $2^{\circ}\text{F}$ , then fog is likely to persist throughout the day.

Lesser correlations could be made with respect to temperature. Fifty-eight percent of the fog events occurred when the temperature is between  $26$  and  $35^{\circ}\text{F}$ . However, climatology for Spokane shows the temperatures are frequently within that range. Sixty-three percent of the dense fog events also occur within that temperature range. The chances of fog are greater than 20 percent for most

temperatures from 1 to 35°F. The chances of fog decreases with temperatures higher than 35°F; dense fog behavior is similar.

A correlation can be made between fog events and surface pressure by looking at Figs. 1d and 2d. Higher surface pressure may be indicative of subsidence; likewise, a lower surface pressure may signify positive vertical motion and no fog. However, Fig. 4 shows this may not always be the case; the best chance for fog development is with constant, steady pressure.

#### IV. DEW-POINT DEPRESSION GREATER THAN 2°F

This study relies heavily on the dew-point depression. With the presence of ice crystals, this relationship fails. Referring to Table 1, there are circumstances when dense fog occurs with a dew-point depression of either 3 or 4°F. This happens only about 3 percent of the time, and it would be easy to ignore these data as observational errors, rounded temperature values, or faulty instrumentation. Upon closer examination, the data depict a relatively rare phenomena at Spokane. The surface air mass may be saturated with respect to ice!

The equilibrium vapor pressure is less over ice than water at the same temperature. If ice crystals exist with a large number of supercooled (or undercooled) water droplets, the ice crystals grow by the diffusion of water vapor, such that the water droplets evaporate. The transfer of water vapor depends on the difference in equilibrium vapor pressure between water and ice. Temperatures most efficient for these processes are at about 7°F. This description is generally used to explain the Bergeron-Findeisen process and rain

initiation, but may justify dense fog events when the dew-point depression is greater than 2°F.

Table 1 revealed 20 dense fog events with a dew-point depression of 4°F. This phenomena occurred between December 23, 1987 through January 2, 1988. The temperature ranged between 0 to 6°F, ideal for vapor transfer from water to ice. Figure 5 shows the probability of fog and temperature specifically for a dew-point depression of 4°F. These particular dense fog events formed after clear days, and many times the observer reported partial obscuration of the sky. Hence, the fog layer was not very thick. Besides one occurrence each day on December 9 and 10, 1986 (the dew-point depression was 3°F), this phenomena did not occur at any other time during the five-year period. Since the phenomena rarely occurs, forecasting this event will be a challenge, especially if one used the dew-point depression to forecast fog.

Examination of the observations prove that the surface air mass is saturated with respect to ice, not water. For temperatures between 0 to 6°F and a dew-point depression of 4°F, the relative humidity with respect to water is 83 percent. Using the relationship below, one can calculate the relative humidity with respect to ice with  $S = 83$  percent (Table 6).

$$S_i = S \frac{e}{e_i}$$

$S$  and  $S_i$  are saturation with respect to water and ice, while  $e$  and  $e_i$  are the saturation vapor pressures (from the Smithsonian Meteorological Tables) with respect to water and ice.

Since ice crystals must be present for this phenomena to occur and are not easily detected by the forecaster, the aviation forecaster must recognize the possibility for dense fog formation with temperatures around 5°F and a dew-point depression of 3 or 4°F. This situation can recur as long as the air mass does not change.

## **V. OTHER FACTORS TO CONSIDER**

There are many factors that contribute to fog development that cannot be discerned on hourly surface observations or are not considered in the programs FCSTFOG and FOGGEG. These factors include the state of the ground, sky cover, and absolutely calm winds.

Ground conditions influence fog formation. Dry ground may inhibit fog development, whereas a moist ground contributes to a radiational fog may not develop because, as mentioned before, the saturation vapor pressure over ice is less than water (fog may still form with recently fallen snow since the boundary layer may remain saturated). The exception to the above statement is at a temperature at 32°F, when the saturation vapor pressure between water and ice is the same.

Clouds have a major role whether fog occurs since they may inhibit development. However, one cannot easily discern cloud cover from surface aviation observations. Fog partially, and sometimes completely, obscures the sky for an accurate cloud observation. ASOS observations only observe sky condition up to 12,000 ft, so forecasters will need to rely more on satellite interpretation skills. IR satellite loops and daytime visual pictures are helpful to resolve cloud types.

When calm winds are reported, how calm are they? Slight air movement is necessary for fog formation; this allows for the coldest air at the surface to mix upward. Absolute calm winds only create dew or frost. This characteristic is difficult to assess in surface aviation observations unless the forecaster communicates with the observer.

Radiosonde information is not incorporated in this study. Even though RADAT observations are included in hourly observations (at 0000 and 1200 UTC), it does not give enough data on the structure of the air mass. The upper-air sounding provides valuable clues related to subsidence, depth of the inversion layer, moisture distribution, etc. A fog forecast is incomplete without considering sounding information.

## **VI. CONCLUSION**

This study provides good statistical guidance for fog forecasting at Spokane, Washington. It should provide insight to the aviation forecaster on whether IFR conditions will prevail or forecasting MVFR will be sufficient. Foremost, the current synoptic conditions, cloud cover, state of the ground, etc., must be considered.

## **VII. ACKNOWLEDGMENTS**

I wish to thank Keith Meier, formerly of SSD, for review and suggestions on the paper. The author also acknowledges the support and encouragement of Ken Holmes, the former Meteorologist in Charge in Spokane, and Brad Colman, the Scientific Operations Officer (SOO) for NWSFO Seattle.

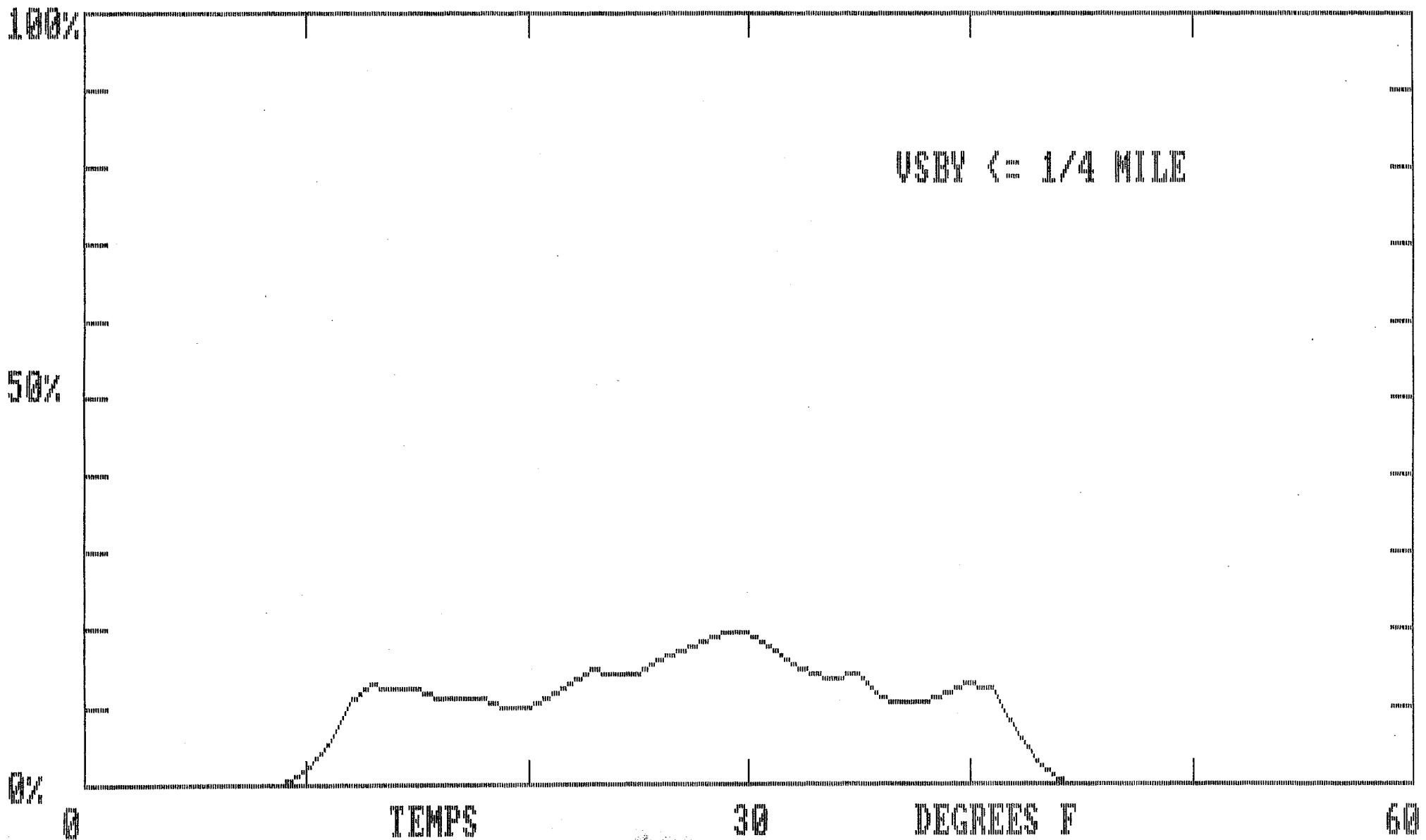


Figure 1a. Probability of Dense Fog versus Temperature

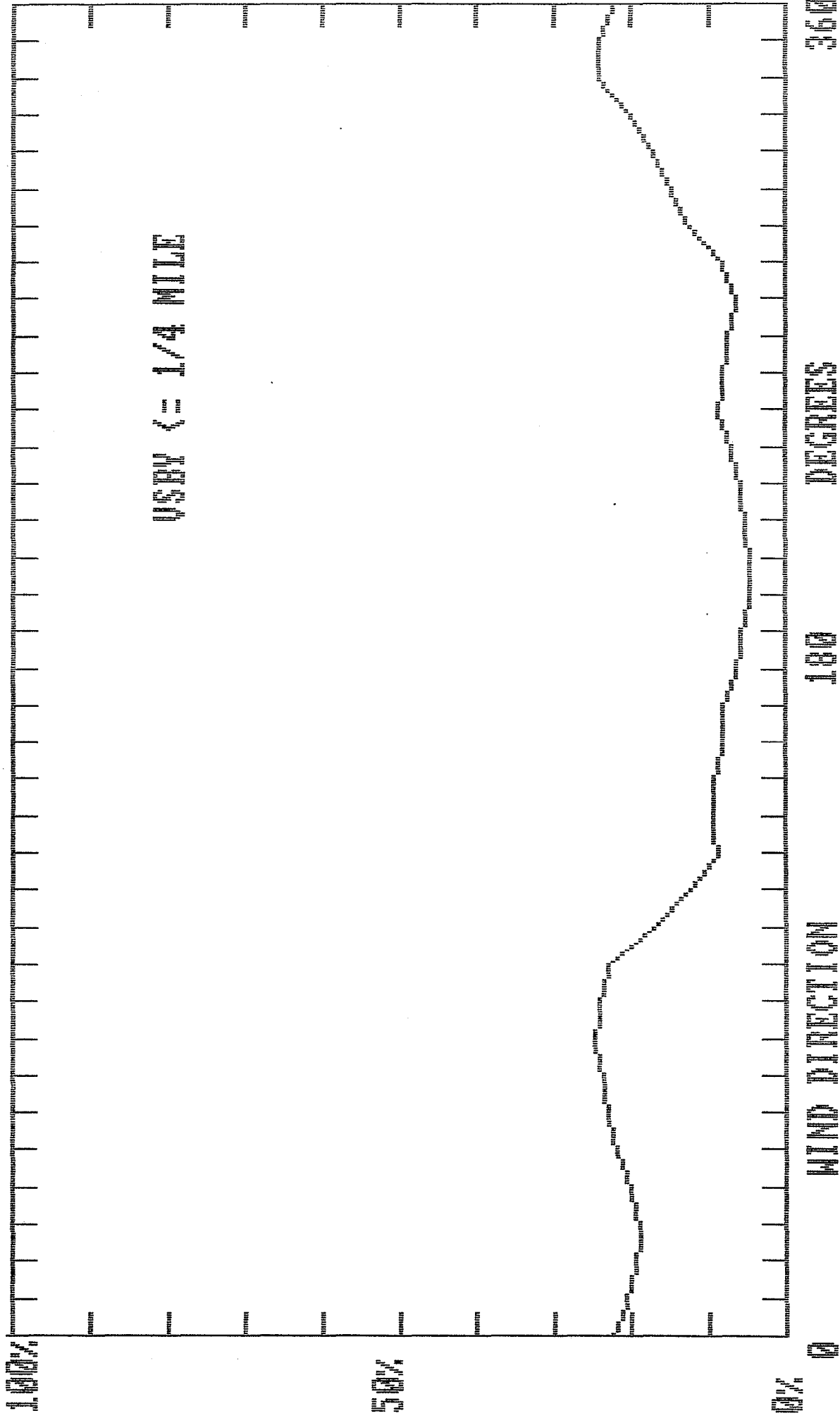


Figure 1b. Probability of Dense Fog versus Wind Direction

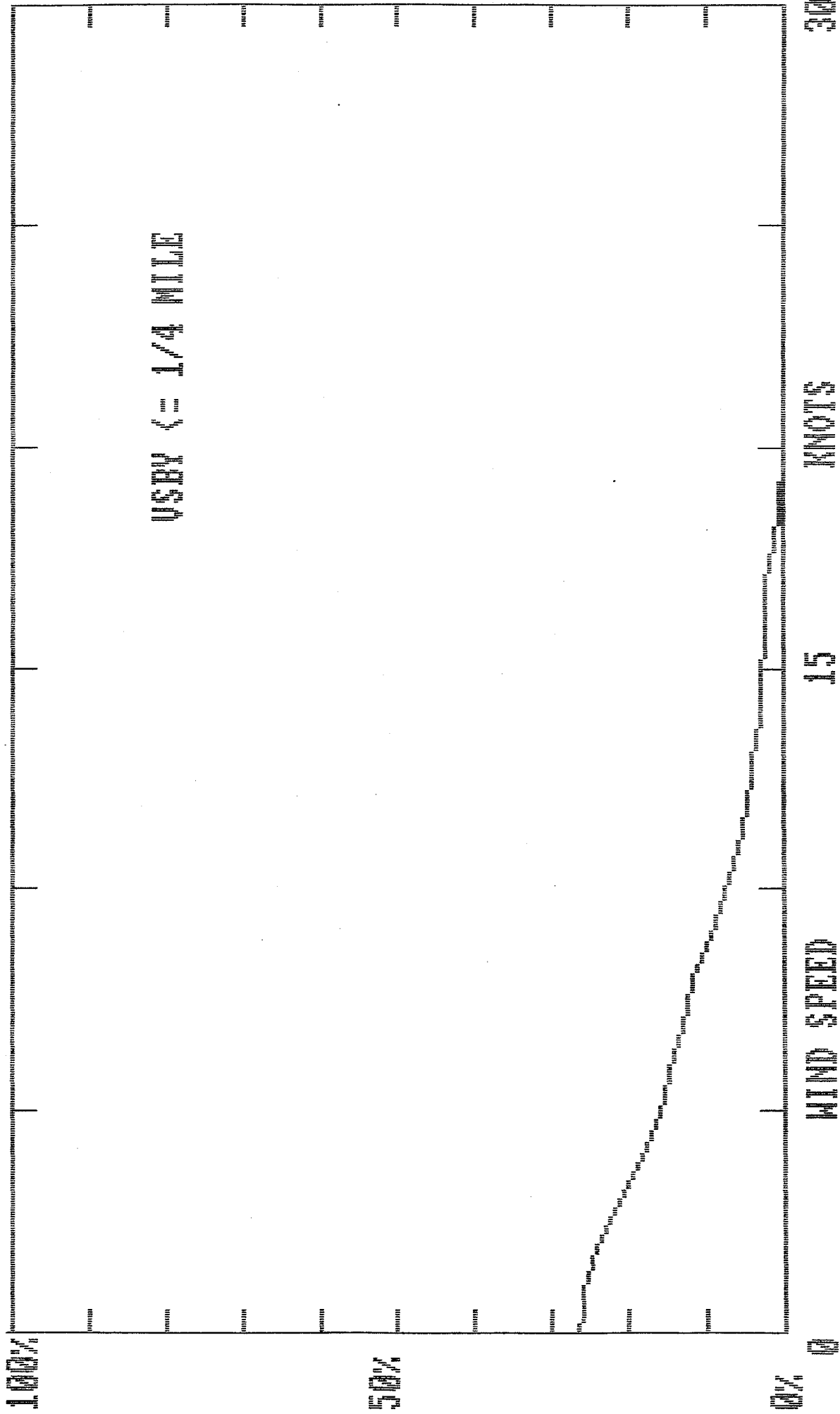


Figure 1c. Probability of Dense Fog versus Wind Speed



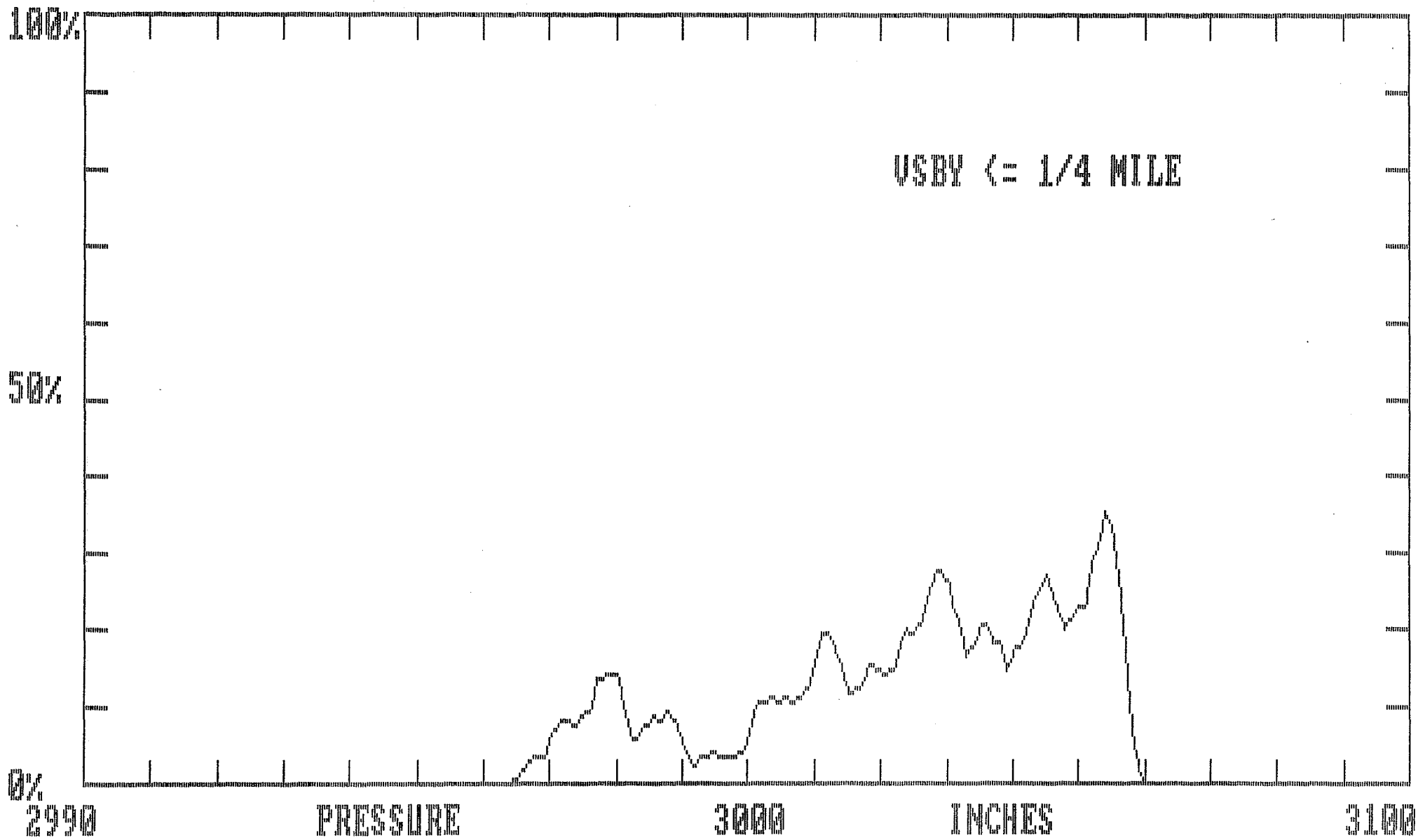


Figure 1d. Probability of Dense Fog versus Surface Pressure

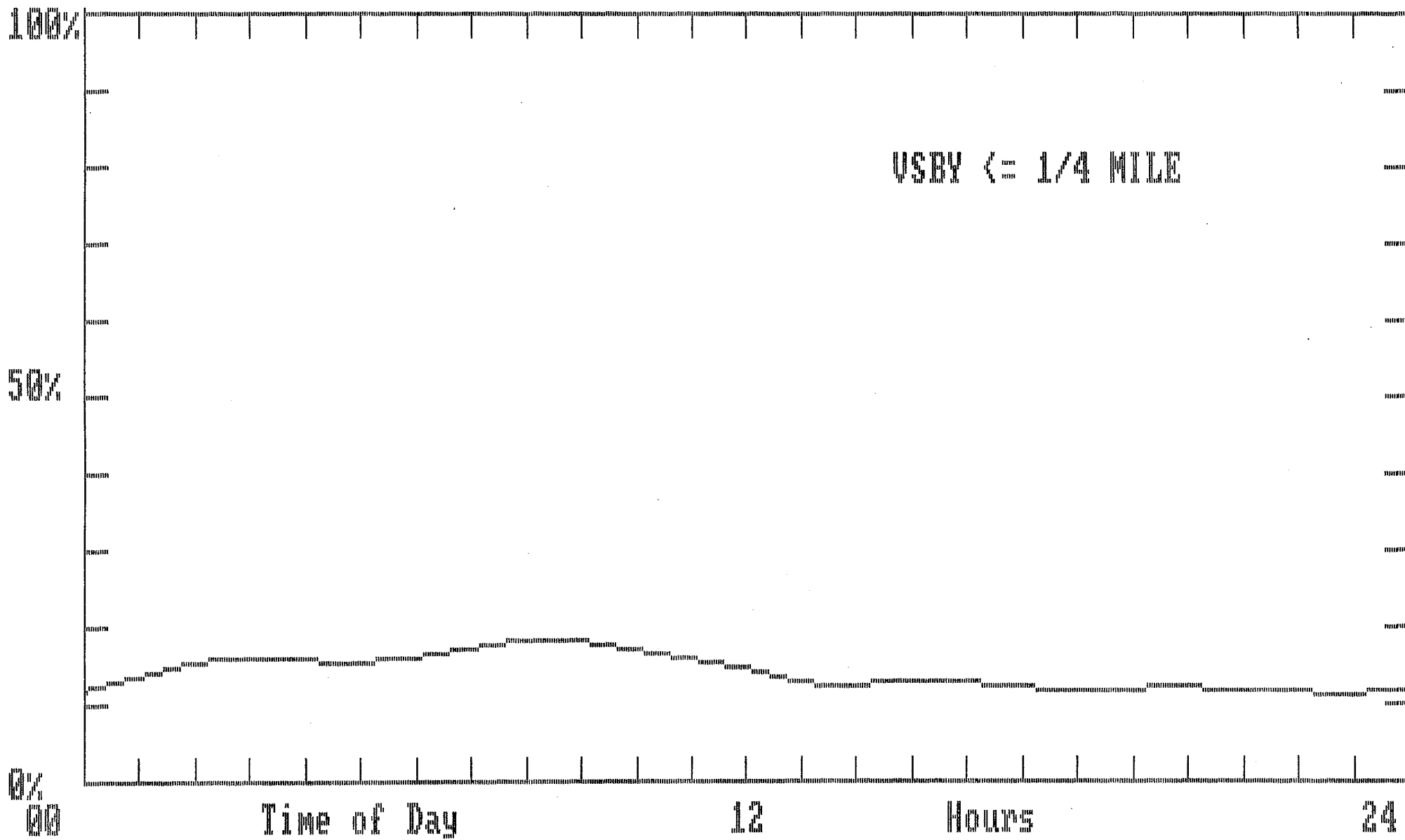


Figure 1e. Probability of Dense Fog versus Time of Day

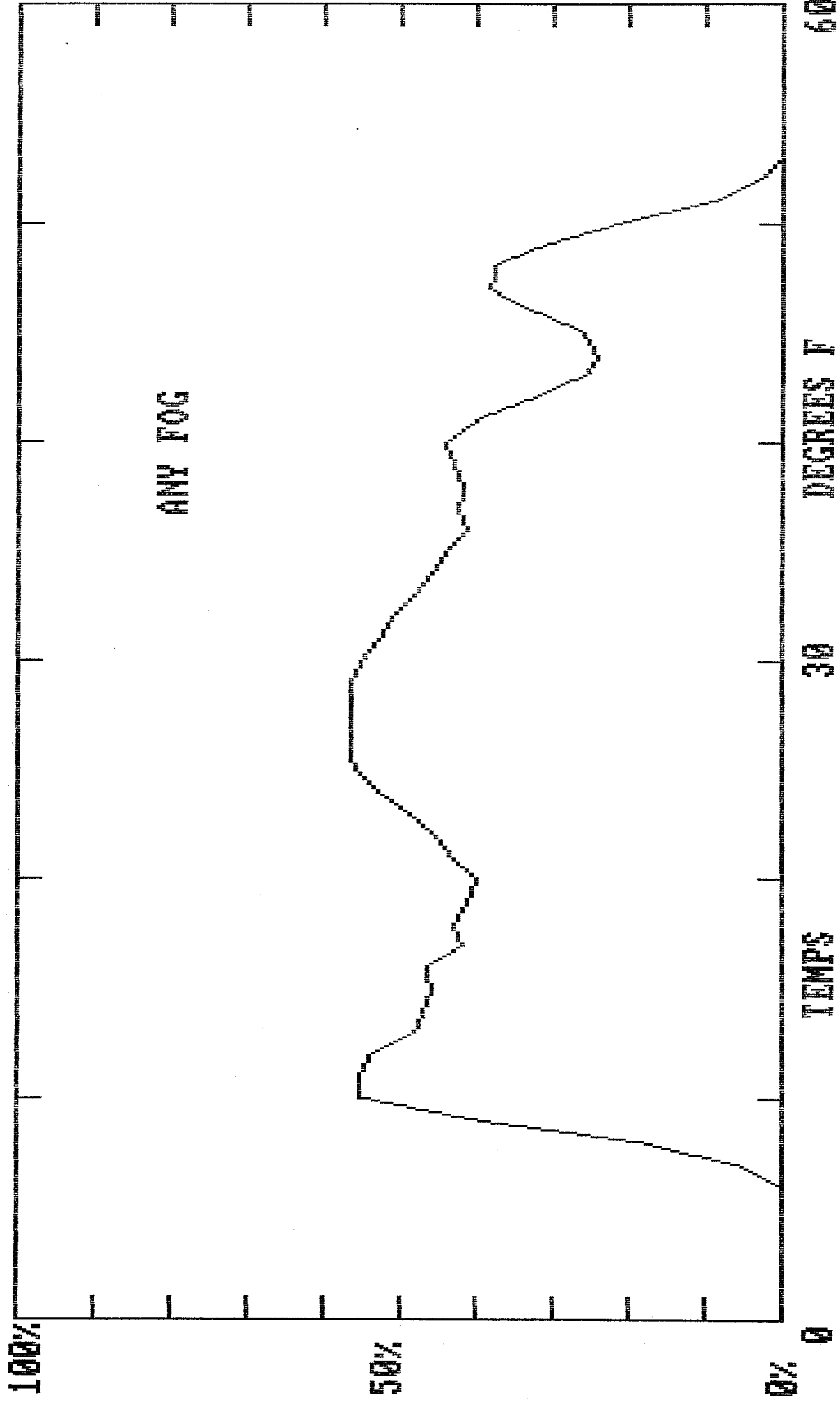


Fig 2a. Probability of Fog versus Temperature

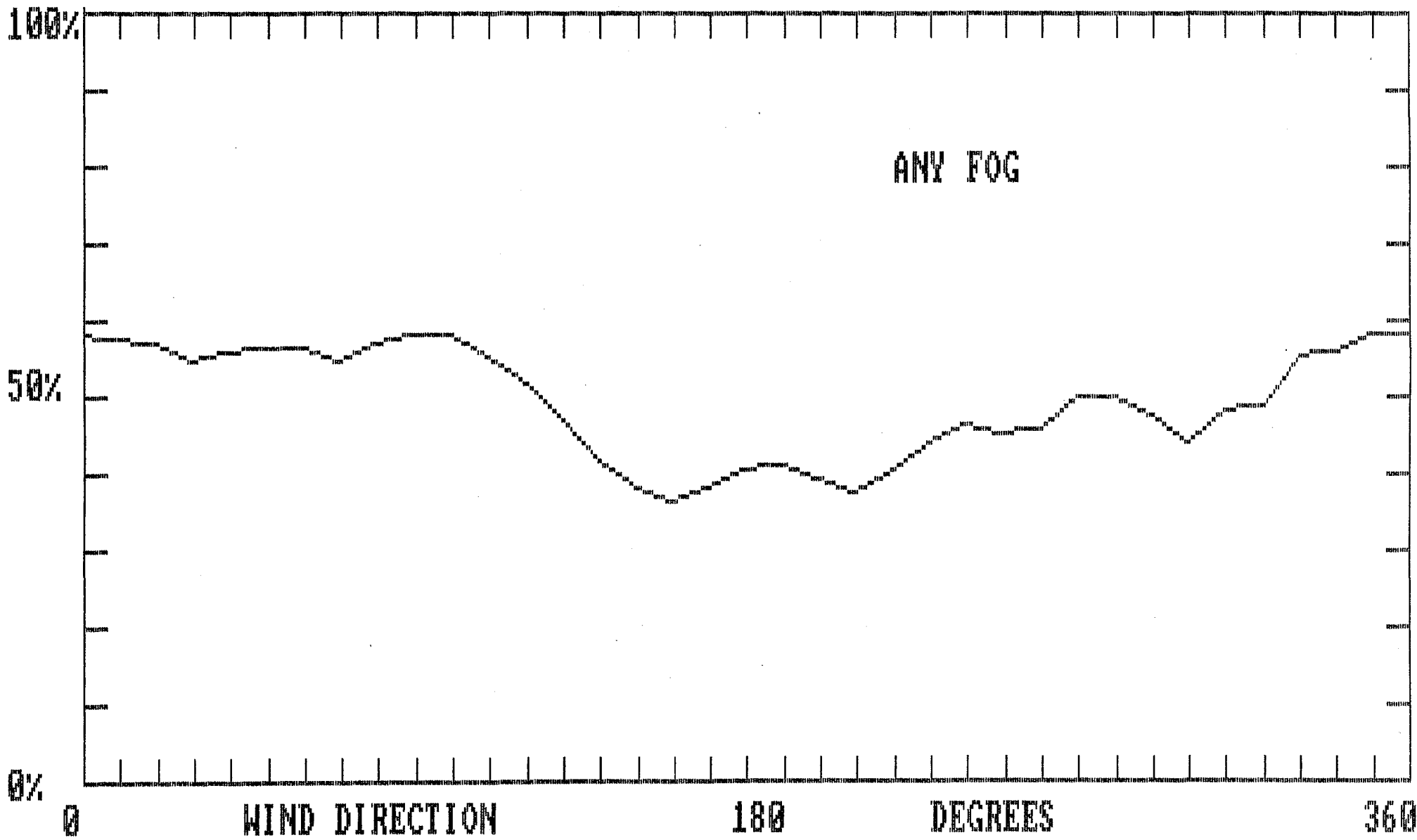


Fig 2b. Probability of Fog versus Wind Direction

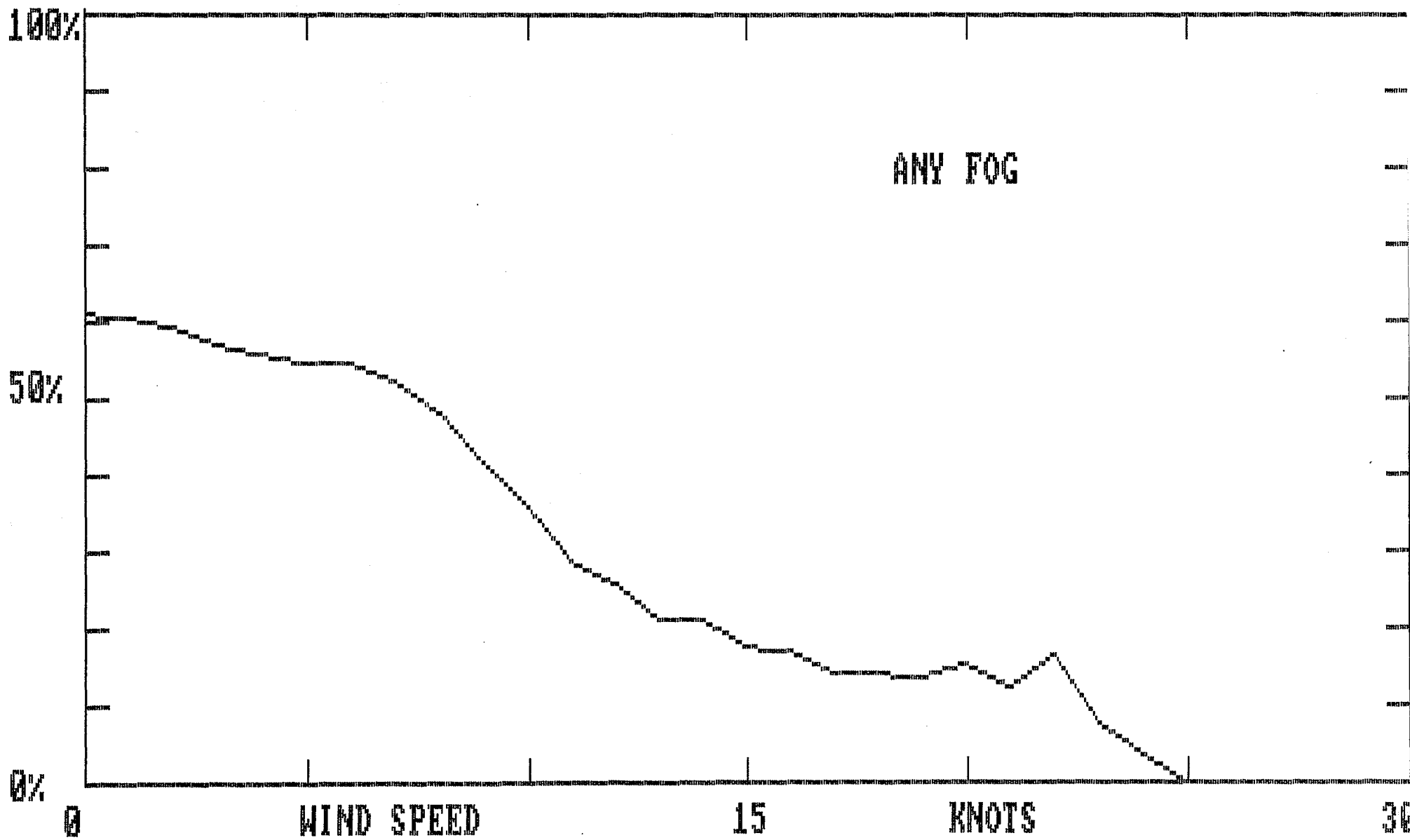


Fig:2c. Probability of Fog versus Wind Speed

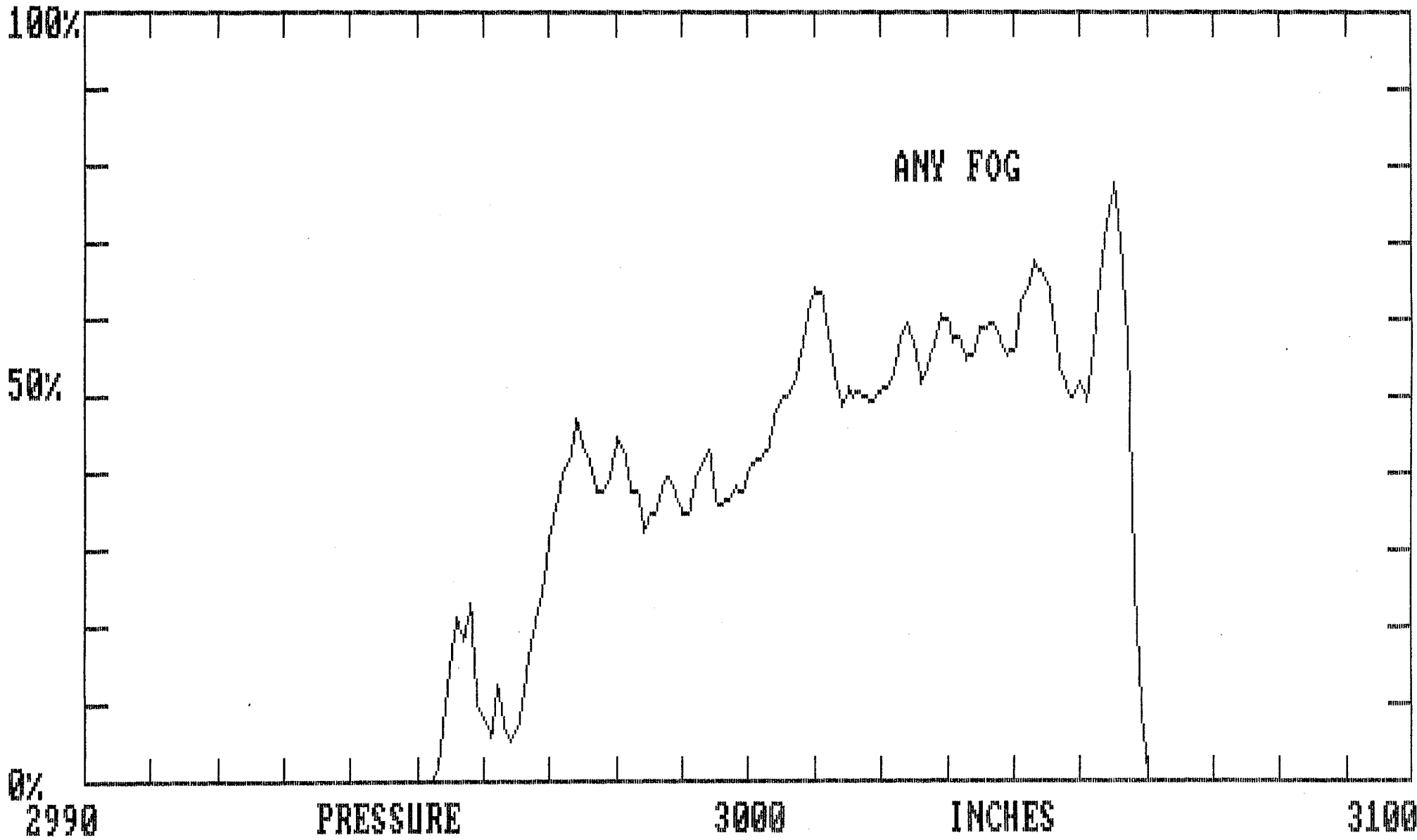


Figure 2d. Probability of Fog versus Surface Pressure.

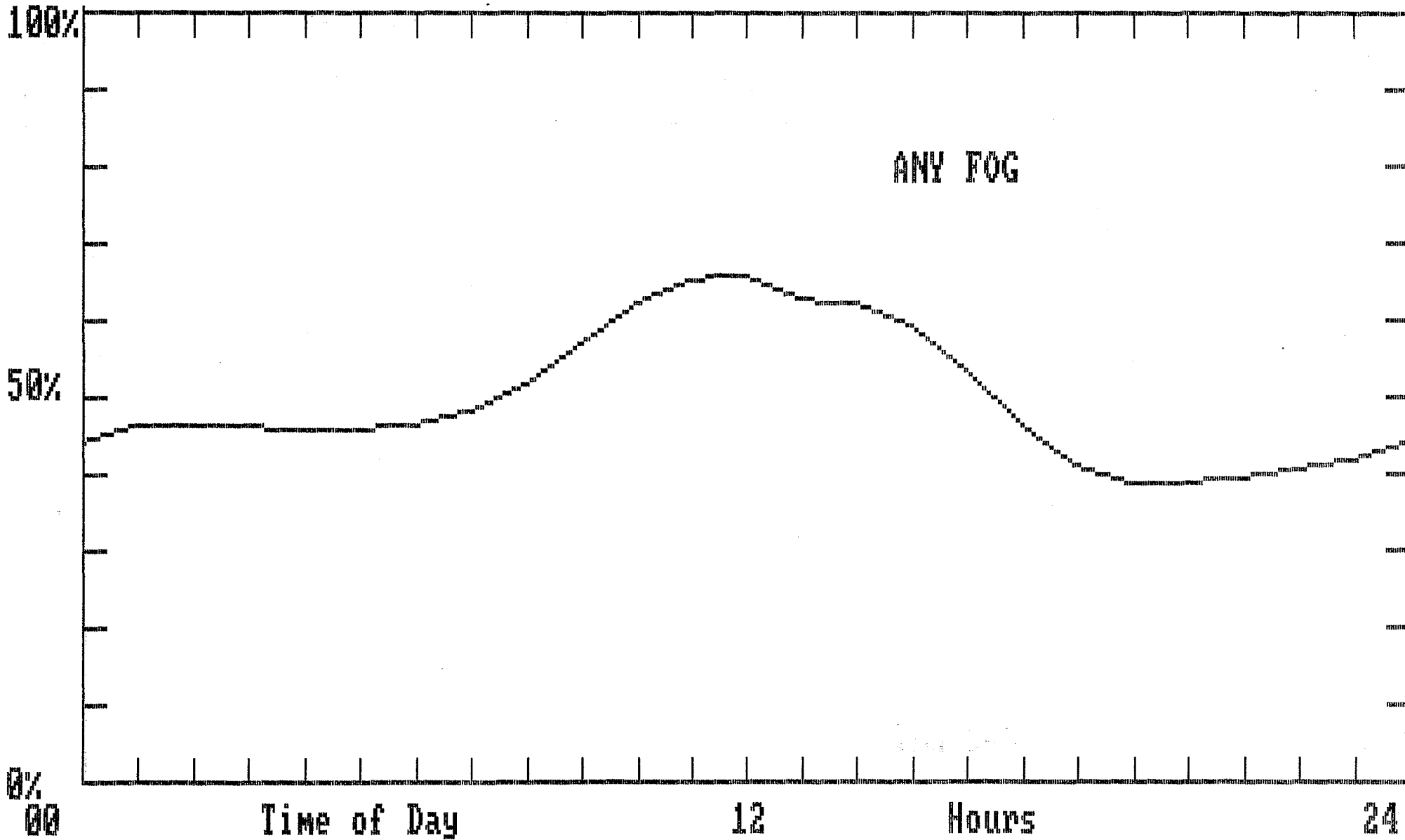


Figure 2e. Probability of Fog versus Time of Day.

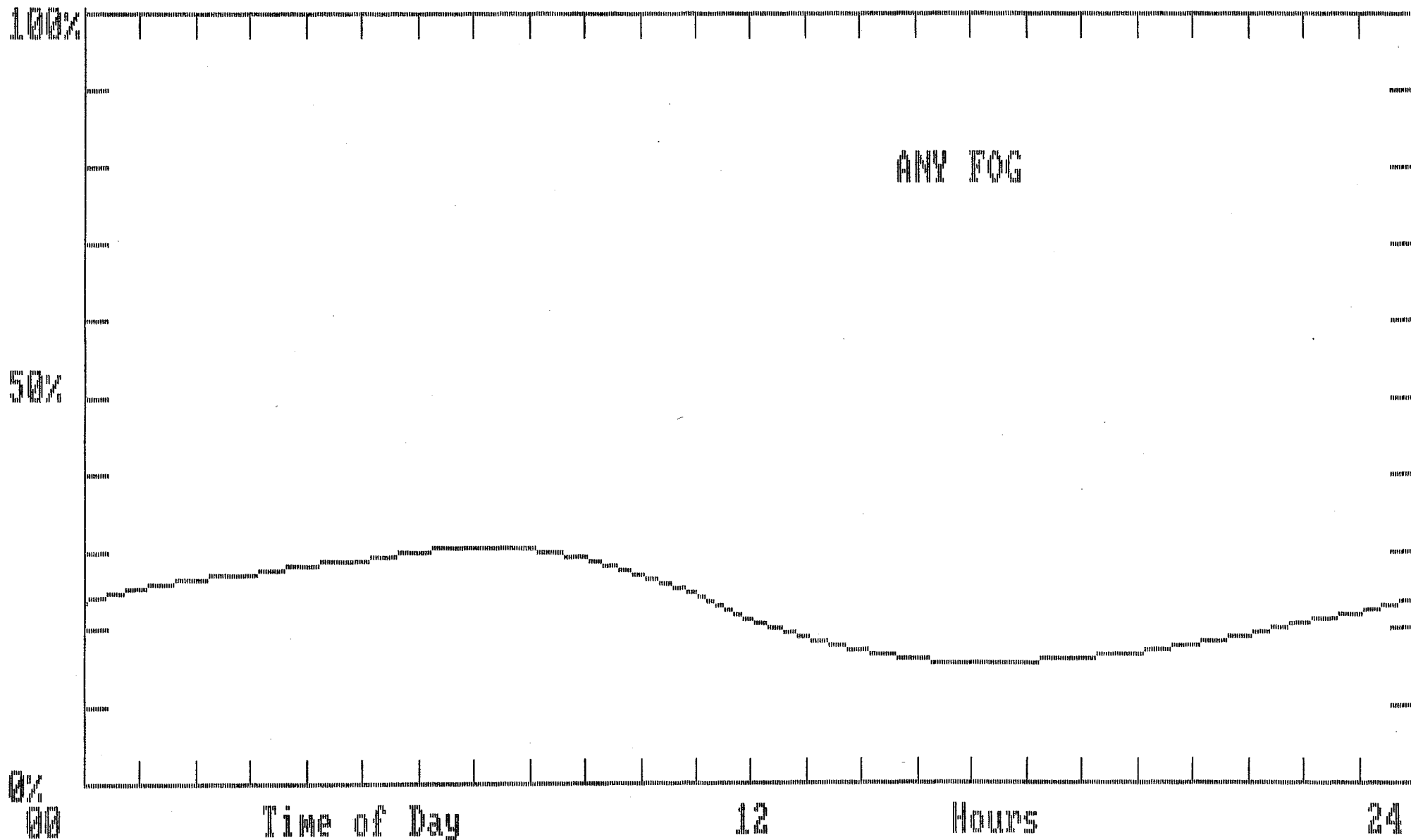


Figure 3. Probability of Fog versus Time of Day Regardless of Dewpoint Depression



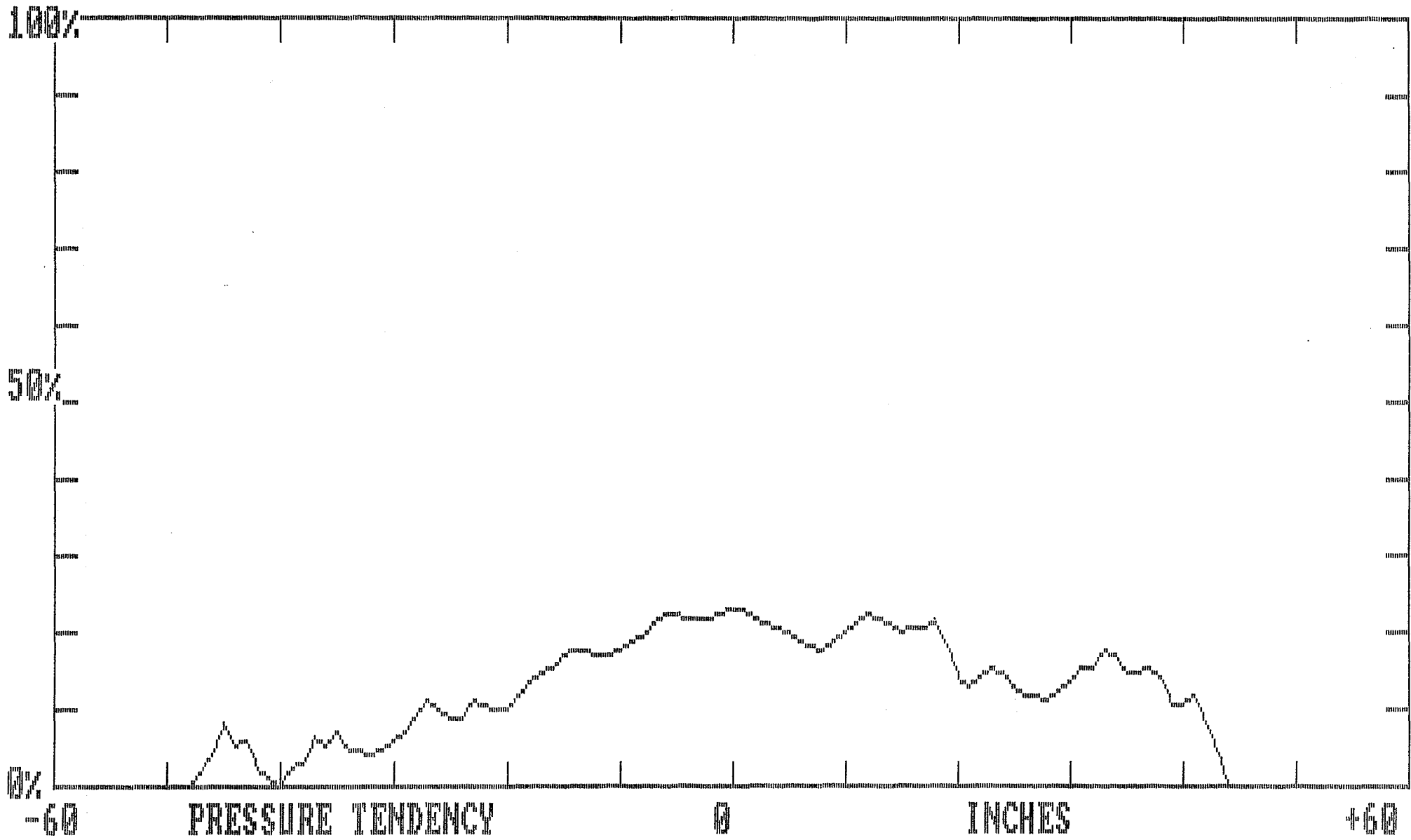


Figure 4. Probability of Fog versus 12-hour Pressure Tendency.

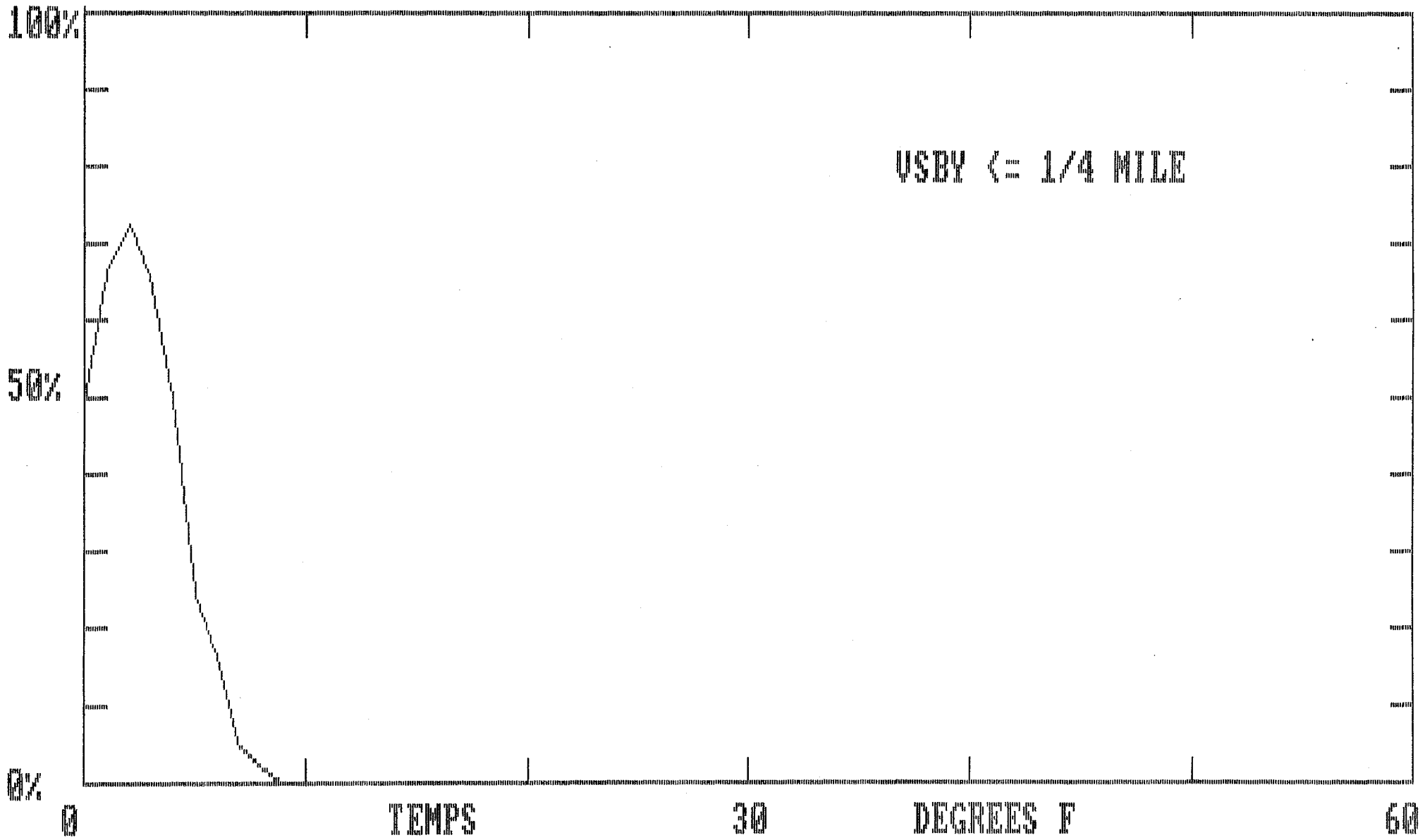


Figure 5. Probability of Dense Fog versus Temperature with Dewpoint Depression of 4°F.

**TABLE 1**

<u>Dew Depression</u>	<u># of Events</u>	<u>Fog</u>	<u>%</u>	<u>Dense Fog</u>	<u>%</u>
0	1294	1093	84	429	33
1	1774	888	50	170	10
2	1785	434	24	62	3
3	1357	158	12	36	3
4	1039	56	5	20	2
5	848	10	1	0	0

**TABLE 2**  
Fog probabilities Relative to Wind Speed and Direction

Calm						
# of Cases	749					
Fog (%)	319 (43%)					
Dense Fog (%)	137 (18%)					
		<u>3-5(kts)</u>	<u>6-8(kts)</u>	<u>9-11(kts)</u>	<u>12-14(kts)</u>	<u>&gt;15(kts)</u>
<b>North (340-020)</b>						
# of Cases	564	382	72	36	26	
Fog (%)	186(33%)	87(23%)	7(10%)	0(0%)	0(0%)	
Dense Fog (%)	62(11%)	25(7%)	2(3%)	0(0%)		
<b>Northeast (030-060)</b>						
# of Cases	854	1129	299	78	145	
Fog (%)	267(31%)	288(26%)	53(18%)	8(10%)	0(0%)	
Dense Fog (%)	89(10%)	98(9%)	20(7%)	3(4%)	0(0%)	
<b>East (070-110)</b>						
# of Cases	436	227	50	16	7	
Fog (%)	157(36%)	56(%)	8(16%)	2(12%)	0(0%)	
Dense Fog (%)	64(15%)	16(7%)	0(0%)	1(6%)	0(0%)	
<b>Southeast (120-150)</b>						
# of Cases	288	422	239	105	56	
Fog (%)	117(41%)	103(24%)	17(7%)	0(0%)	0(0%)	
Dense Fog (%)	20(7%)	24(6%)	4(2%)	0(0%)	0(0%)	
<b>South</b>						
# of Cases	427	434	370	439	776	
Fog (%)	149(35%)	196(28%)	80(15%)	25(7%)	14(3%)	
Dense Fog (%)	23(5%)	22(3%)	12(2%)	3(1%)	1(<0.5%)	
<b>Southwest</b>						
# of Cases	306	164	114	64	125	
Fog (%)	99(32%)	33(20%)	16(14%)	1(2%)	0(0%)	
Dense Fog (%)	30(10%)	5(3%)	1(1%)	0(0%)	0(0%)	
<b>West (250-290)</b>						
# of Cases	306	164	114	64	125	
Fog (%)	99(32%)	33(20%)	16(14%)	1(2%)	0(0%)	
Dense Fog (%)	30(10%)	5(3%)	1(1%)	0(0%)	0(0%)	
<b>Northwest (300-340)</b>						
# of Cases	154	70	29	13	8	
Fog (%)	40(26%)	9(13%)	0(0%)	0(0%)	0(0%)	
Dense Fog (%)	13(8%)	3(4%)	0(0%)	0(0%)	0(0%)	

TABLE 3

Dense Fog Probabilities Relative to Wind Speed and Direction

Calm						
# of Cases	441					
Fog (%)	271(61%)					
Dense Fog (%)	34(8%)					
		<u>3-5(kts)</u>	<u>6-8(kts)</u>	<u>9-11(kts)</u>	<u>12-14(kts)</u>	<u>&gt;15(kts)</u>
<b>North (340-020)</b>						
# of Cases	302	132	9	0	0	
Fog (%)	173(57%)	81(61%)	6(67%)	0(0%)	0(0%)	
Dense Fog (%)	23(8%)	11(8%)	2(22%)	0(0%)	0(0%)	
<b>Northeast (030-060)</b>						
# of Cases	472	477	90	11	0	
Fog (%)	248(53%)	280(59%)	52(58%)	7(64%)	0(0%)	
Dense Fog (%)	43(9%)	38(8%)	10(11%)	2(18%)	0(0%)	
<b>East (070-110)</b>						
# of Cases	257	96	19	6	0	
Fog (%)	146(57%)	53(55%)	8(42%)	2(33%)	0(0%)	
Dense Fog (%)	24(9%)	9(9%)	0(0%)	0(0%)	0(0%)	
<b>Southeast (120-150)</b>						
# of Cases	165	200	76	19	4	
Fog (%)	104(63%)	96(48%)	16(21%)	0(0%)	0(0%)	
Dense Fog (%)	4(2%)	12(6%)	1(1%)	0(0%)	0(0%)	
<b>South (160-200)</b>						
# of Cases	239	373	215	93	91	
Fog (%)	131(55%)	183(49%)	73(34%)	20(22%)	12(13%)	
Dense Fog (%)	10(4%)	6(2%)	2(1%)	0(0%)	0(0%)	
<b>Southwest (210-240)</b>						
# of Cases	133	220	141	123	99	
Fog (%)	81(61%)	126(57%)	45(32%)	31(25%)	12(12%)	
Dense Fog (%)	3(2%)	2(1%)	0(0%)	0(0%)	1(1%)	
<b>West (250-290)</b>						
# of Cases	144	67	36	6	3	
Fog (%)	71(49%)	30(45%)	14(39%)	1(17%)	0(0%)	
Dense Fog (%)	3(2%)	1(1%)	0(0%)	0(0%)	0(0%)	
<b>Northwest (300-340)</b>						
# of Cases	69	24	1	0	0	
Fog (%)	34(49%)	8(33%)	0(0%)	0(0%)	0(0%)	
Dense Fog (%)	4(6%)	2(8%)	0(0%)	0(0%)	0(0%)	

TABLE 4

Relates Fog and Dense Fog with Time of Day  
Regardless of Dewpoint Depression

<u>Hour</u>	<u>Event</u>	<u>Fog</u>	<u>%</u>	<u>Dense Fog</u>	<u>%</u>
1	500	130	26	34	7
2	501	136	27	45	9
3	495	134	27	46	9
4	464	138	28	46	9
5	499	146	29	46	9
6	499	150	30	47	9
7	496	158	32	52	10
8	489	150	31	60	12
9	489	153	31	45	9
10	490	132	27	32	7
11	488	121	25	26	5
12	492	102	21	17	3
13	491	81	17	11	2
14	493	69	14	9	2
15	493	66	14	10	2
16	501	64	13	12	2
17	497	68	14	16	3
18	505	72	14	18	4
19	501	74	15	19	4
20	511	87	17	27	5
21	502	94	19	24	5
22	499	102	21	27	5
23	504	106	21	26	5
24	506	121	24	30	6

**TABLE 5**

Relates Fog and Dense Fog Events to Time of Day  
With Dewpoint Depression  $\leq 2$  F

<u>Hour</u>	<u>Event</u>	<u>Fog</u>	<u>%</u>	<u>Dense Fog</u>	<u>%</u>
1	248	122	49	29	12
2	264	126	48	42	16
3	258	122	47	40	16
4	258	123	48	39	15
5	290	137	47	40	14
6	296	137	46	41	14
7	297	146	49	67	16
8	279	142	49	47	16
9	247	141	57	44	18
10	187	121	65	30	16
11	151	106	70	25	17
12	110	80	73	16	15
13	99	65	66	11	11
14	84	56	67	9	11
15	78	53	68	10	13
16	99	55	56	11	11
17	137	63	43	15	11
18	168	68	40	18	11
19	187	72	93	19	10
20	204	80	39	27	13
21	208	85	41	23	11
22	220	96	44	25	11
23	241	98	41	23	10
24	243	112	46	27	11

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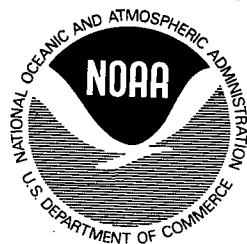
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