AD 636409

TECHNICAL REPORT
66-55-ES

SIMULTANEOUS OCCURRENCE OF HIGH TEMPERATURES AND HIGH DEW POINTS

by
Arthur V. Dodd

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UNITED STATES ARMY
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Earth Sciences Division
ES-25

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Arthur V. Dodd
Military Applications Branch
Earth Sciences Division

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Project Reference:
1V025001A129

ES-25

U.S. Army Materiel Command
U.S. ARMY NATICK LABORATORIES
Natick, Massachusetts

FOREWORD

Since World War II the importance of extreme environmental conditions to which military personnel and equipment are likely to be subjected has prompted continued research. The Earth Sciences Division of the United States Army Natick Laboratories and its predecessor organizations has had the primary responsibility for this research with the aim of determining realistic climatic limits for consideration in design of materiel. Past work reflected in Military Standard 210, "Climatic Extremes for Military Equipment," and Army Regulation 705-15, "Operation of Materiel under Extreme Conditions of Environment," must be reevaluated as new evidence becomes available which might dictate changes in recommended climatic limits.

This report is a study of the joint occurrence of high temperature and related dew point at 17 locations where temperatures equal to or greater than 109°F have been recorded. It is based on data furnished by the USAF Climatic Center, Asheville, N. C. From this information a judgment is made as to the dew points which should be specified in AR 705-15 to occur jointly with very high temperatures. This is one of several reports planned for the delimitation of high temperatures and high humidities on a world-wide basis.

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ABSTRACT

Available information on the joint occurrence of high temperatures and dew points are presented for 17 stations (7 in Asia, 7 in Africa, 2 in North America, and 1 in Australia) in order that the geographical distribution of high temperatures and associated humidities may be better known. This information will be used in a planned revision of AR 705-15 "Operation of Materiel under Extreme Conditions of Environment." On the basis of these data it appears that the natural occurrence of dew points higher than 75°F in conjunction with temperatures higher than 109°F is very infrequent and should not be specified for guidance in design and testing of Army materiel except possibly for items which may be used in limited areas of the Persian Gulf and Red Sea littorals where extremely high temperatures and humidities have been observed or are assumed to occur.

SIMULTANEOUS OCCURRENCE OF HIGH TEMPERATURES AND HIGH DEW POINTS

1. Background

Information on the association of high humidities and high temperatures is of importance to the military for several reasons. One of the most severe climatic stresses on human performance is the joint occurrence of high temperature and humidity. Military equipment is also adversely affected by these conditions. Air conditioning is necessary in the vicinity of heat-producing electronic equipment in today's Army, and when high humidity is associated with an extreme thermal load, the environmental control problems are severe.[2] Underestimating this thermal load leads to underdesign which is obviously unacceptable, while overestimating this thermal load is costly and leads to delays in item development and acceptance.

Army Regulation 705-15, "Operation of Materiel Under Extreme Conditions of Environment," specifies a high ambient temperature (4-6 feet above ground) of 120°F and a high dew point of 85°F for consideration in the preparation of documents indicating materiel requirements for hot-dry climatic conditions. These limits have been interpreted as occurring concurrently by some Army developing and testing agencies. Since the atmosphere's capacity to hold moisture increases rapidly with increasing temperature, it might be expected that the highest dew points occurred at the highest temperatures. Earlier studies have demonstrated that such is not the case however.[1,2] The highest dew points in hot areas are usually not associated with the highest temperatures. These earlier reports give no indication of the geographical distribution of high humidities at high temperatures, and it is the purpose of this report to present available information on the joint occurrence of high temperatures and dew points in the very hot areas of the world. This information is necessary for a planned revision of AR 705-15. Occurrence of a temperature of 109°F or higher has been selected to delimit the very hot areas of the world in this study.

2. Data

The hottest areas of the world are also areas with inadequate climatic records. There are only a limited number of weather stations which take hourly observations in areas that experience very high temperatures and when a requirement exists for stations with concurrent temperature and humidity records, the number of stations is further decreased. In this report, temperature-dew point data for 17 stations are presented in Table II showing the frequency of occurrence of temperatures equal to or greater than 109°F or 110°F* in 2°F classes. For each 2°F class, the distribution

*In most cases the class intervals are 109°-110°F, 111°-112°F, etc., but in some cases they are 110°-111°F, 112°-113°F, etc.

of dew points is indicated by inclusion of the range of dew points and the median dew point. The bulk of the data were originally obtained from the United States Air Force Climatic Center at Asheville, North Carolina; some directly, and some by contract with C-E-I-R, Inc.[3,4] These data were summarized in 2°F temperature and dew point classes. Station locations are shown in Figure 1; latitude and longitude, station elevation, and periods of record are listed in Table I. At Yuma Proving Ground, data were hand-counted from the original hourly records of the Army Meteorological Team. They were available in 1°F classes. There is not complete uniformity in the manner in which temperatures and dew points are measured but it can be assumed that observations were taken at heights between 4 and 6 feet above the surface. More extreme values might occur closer to the surface.

Since the data for sixteen of the seventeen stations were available in 2°F temperature and dew point classes, the data at these stations can only be interpreted to the nearest 2°F. This must be kept in mind as Table II is interpreted. For example, from the first line of Table II at Abadan (port) in May, the dew point range is indicated as 40-71°F. The actual range, if the data were available in 1°F classes, is 40 or 41°F to 70 or 71°F. Similarly, the median dew point might be 56 or 57°F. It is not felt that this limitation in the data has any bearing on the conclusions reached in this report. Some judgment was necessary in selecting median values. Where an even number of observations were involved, the median was placed in the class where the arithmetic mean of the two middle observations fell.

3. Discussion of Data in Table II

a. Persian Gulf Stations

Concurrent temperature-dew point data at two locations near Abadan, Iran, are included in Table II. From the latitudes and longitudes of the two sites, it is evident that one is located near the airfield at Abadan, and the other is located in the port area, and is designated Abadan (port). There is a 3-year record of hourly observations at the airfield site during World War II. The record is more recent at the port site - 1949-1955, and the observations were frequent but not hourly with more observations during the day than at night. Because of the different periods of record and the differences in time of observations, a comparison of conditions at the two sites must be qualified. For example, at the port site in each month except May, there is a higher frequency of high temperatures, but this difference may be caused by the differences in period of record and time of observations, and not be real. The difference in dew point regimes at the two sites, however, is so great that it must be considered to represent a real condition.

Dew points at Abadan (port) are the highest in published records. Dew points above 85°F in July, August, and September associated with temperatures as high as 115°F, have not been reported at any other site. Since psychrometric errors usually result in dew points which are too high,[5] it is possible that these very high values at Abadan (port) are erroneous. It is also possible that the instrument shelter at the port site was placed so as to measure dew points which should not have been considered representative. Standard temperature and humidity observations should be taken at a height of at least 4½ feet above the ground. Closer to a heated surface temperatures will be higher, and if water is available as over a vegetative area, or a water surface, dew points will also be higher. It has been found that over a grass surface in the U. S., dew points one inch above the grass may be 8 to 12°F higher than dew points at a height of 5 feet.* The placement of instrument shelters, therefore, is very critical where there are local sources of water vapor. This is particularly true in very hot areas such as the Abadan area where evaporation is rapid.

Despite the possibilities of measurement errors, the differences in period of record, and the lack of information on the location of the instruments, the extreme differences in humidity measurements at the two sites at Abadan must be considered to indicate a real difference in dew points. Highest dew points at the port site are more than 20°F higher than dew points at the airfield site in July, August, and September. Even the median dew points for each temperature class average about 20°F higher. This is equivalent to saying that at instrument shelter height there is more than twice as much water vapor present at the port site, as at the airfield site. It is also an indication that everywhere on the immediate shore of the Persian Gulf very high summer dew points may be expected. The high humidity associated with the warm waters of the Persian Gulf, however, does not extend far inland and it is important to recognize the limited areal extent of these conditions. It is also important to recognize that any other bodies of water with high surface temperatures, may have high coastal dew points. This means, in all likelihood, that the coasts of the Gulf of Oman, the Gulf of Aden, and the Red Sea also are susceptible to these very high humidities, although supporting dew point frequency data have not been located.

The fact that the warm waters of the Persian Gulf influence dew point regimes is evident from consideration of the records at the two stations at Abadan. Sea surface temperatures of the Persian Gulf are highest late in the summer because of the normal lag in water temperatures from the solar regime. Average sea surface temperatures of the northern Persian Gulf increase from about 80°F in May to over 90°F in August. There also

*Observations at the U.S. Army Natick Laboratories.

is a general increase in dew points evident at both sites at Abadan from early summer to late summer consistent with the increase in sea surface temperature.

Dhahran, Saudi Arabia, also on the coast of the Persian Gulf, has been noted for its high humidities since it was an important U. S. air base during and after World War II. High dew points have also been observed at Dhahran but they were not associated with as high temperatures as at Abadan (port). In the 5-year record available at Dhahran, dew points above 70°F were associated with temperatures over 110°F only in August. Median dew points associated with temperatures over 110°F were below 60°F. In the earlier study of high humidity at high temperatures, a period of record from 1946-1948 was available for Dhahran. In this period a few dew points of 80-84°F were associated with temperatures of 110° to 112°F.

b. Indian Stations

Temperature-humidity records were available for Allahabad, Gaya, and New Delhi, India. The highest temperatures in India occur in May and June before the onset of the monsoon. The observations available for this study were taken during World War II. The highest dew point associated with a high temperature during the short period, 75°F, was observed at Gaya in May when the temperature was 110°F or 111°F. Gaya and Allahabad also experienced dew points above 70°F in June, but the highest dew point at New Delhi at a temperature of 110°F or higher, was 65°F. Pramanik and Hariharan have discussed the maximum dew points which can be e pected in India in connection with a study of maximum possible precipitation, and concluded that the maximum possible dew point in India is 90°F.[7] High dew points in India, however, are associated with the monsoon season when temperatures are much lower than 109°F.

c. African Stations

The most extensive area of the world with temperatures of 109°F or higher is the Sahara Desert. In this study records were available from stations which can be considered to be peripheral to the Sahara. There were two sites near Khartoum in the Sudan, two sites in Morocco, two sites in Algeria, and one site in Mauritania. No hourly occurrence of high temperature and dew point were available from the stations in the center of the desert. The highest dew point associated with a temperature of 109°F or higher at Khartoum (Wadi Seidna) in a 4-year record was 51°F. In an earlier record at Gordon College, about 50 miles farther south, the highest dew point associated with such high temperatures was 59°F. On the western side of the Sahara at Atar, Mauritania, the highest comparable dew point was 53°F. There is no indication that, anywhere between these stations, higher dew points occur concurrently with very high temperatures, except possibly in the immediate vicinity of a desert oasis. In the northern portion of the Sahara, Tindouf, Algeria, has a maximum dew point of

59°F associated with temperatures as high as 113° or 114°F. El Golea, Algeria, had a dew point of 67°F associated with a temperature of 109° or 110°F. Marrakech, Morocco, had a maximum dew point at high temperatures of 51°F, while Sidi Slimane, Morocco, had a comparable maximum dew point of 55°F. At all 7 African stations, median dew points for all high temperature classes were between 27° and 51°F.

No data were available for coastal stations on the Red Sea in Africa or Arabia. Stations such as Jidda, Arabia; Massawa, Ethiopia; and Djibouti, French Somaliland, are reported to have very high humidities associated with high temperatures, but no data were available to establish exactly how high these humidites may be. At all these stations, temperatures above 109°F have been reported in the summer months and dew points above 80°F would be expected near the very warm waters of the Red Sea. T. E. Lawrence[6] described conditions at Jidda as being comparable to "bath-heat ... that seems to belong to no other place." Undoubtedly, the most severe association of high humidity and high temperature in Africa are found along the Red Sea and Gulf of Aden coast, and an attempt will be made to obtain data for these areas to be included in a later report.

d. Other Stations

The remaining stations for which temperature-dew point data are available are widely scattered. Salala on the south coast of Arabia had a few observations in June with temperature equal to or greater than 110°F. The highest dew point associated with these temperatures was 44°F. At Salala upwelling of cold water moderates the temperature later in the summer.

Cloncurry, Australia, is the only station in Australia with a joint temperature-humidity record where temperatures equal to or greater than 109°F have been observed. The highest dew point reported during periods of high temperatures at Cloncurry was 69°F, but dew points are usually much lower. Median dew points for each high temperature class range from 37° to 50°F, and a dew point as low as 27°F was reported at a temperature of 113°F. Conditions at Cloncurry are probably representative of conditions in the hot interior of the Australian continent.

The two remaining stations are Hermosillo, Mexico; and Yuma Proving Ground, Arizona. These two sites are located near the southwest coast of the North American continent within a few hundred miles of each other. Yuma is definitely the warmest of the two sites with temperatures equal to or greater than 110°F, 2.7% of the time in July in comparison to 0.5% of the time at Hermosillo. Yuma also has a much greater range in dew points from values as low as 4°F at a temperature of 113°F in June to a dew point of 70°F at a temperature of 110°F in July. The comparable range at Hermosillo is from 40°F to 63°F. Part of the difference in dew point

range is due to the longer (10 year) record at Yuma in comparison to the record (3 years) at Hermosillo. Since Yuma Proving Ground is the principal United States Army hot desert testing area, it is important to note that conditions found in all except the most extreme hot areas of the world can be experienced there. Yuma had a lower dew point associated with high temperatures than any other station in this study, and the 70°F dew point associated with a temperature of 110°F is almost as high as any dew point found associated with high temperatures outside of the Persian Gulf area. At Yuma, moisture content in the air is normally low in May and June, and higher in July and August. In the last week of June or first week of July, humid air originating over the warm Gulf of Mexico and the Caribbean Sea, normally reaches the Yuma area. Military testing of items which are affected by high humidity should be planned for July or August at Yuma, while items particularly susceptible to damage from very low humidities should be tested before the end of June.

4. Conclusions and Recommendations

This study was undertaken to determine how high are dew points which are associated with extremely high temperatures. Extremely high temperatures have been defined as temperatures of 109°F and higher measured in a standard manner 4½ - 6 feet above the ground. At these temperatures it has been found that dew points above 75°F (also 4½ - 6 feet above the ground) are rare except at stations near the warm waters of the Persian Gulf. It is assumed that high dew points at high temperatures also occur near the warm waters of the Gulf of Oman, the Gulf of Aden, and the Red Sea. At Abadan on the northern coast of the Persian Gulf, dew points as high as 92° or 93°F have been reported concurrent with temperatures of 109°F to 114°F at the port site, but their validity is questionable. Farther inland in the Abadan area dew points were lower.

In view of the localized nature of dew points above 75°F associated with temperatures of 109°F or higher, it would appear that any design criteria calling for dew points above 75°F in association with temperatures of 109°F or higher, should be specified as applying to the coastal areas of the Red Sea and Persian Gulf. The association of a temperature of 120°F with a dew point of 85°F, referred to in the first paragraph of this report, is unrealistic. It is significant that even in the extremely hot and humid Abadan area no dew point of 85°F was associated with a temperature of 120°F or higher. If such a condition has ever occurred in a natural situation it is very rare and not documented. Interpretation of AR 705-15 in this manner should be discouraged. Specification of a dew point of 75°F concurrent with temperatures above 109°F would be more realistic.

The procedure in this study has been to select temperatures of 109°F and higher, and consider the distribution of dew points associated with these temperatures. This eliminates from consideration humid tropical

areas where temperatures above 100°F are rare. It also eliminates monsoon areas such as Southeast Asia where temperatures above 100°F but lower than 109°F occasionally occur in the pre-monsoon season. In order that the high dew points which occur in these tropical areas can be considered, it is recommended that a companion study to this report be undertaken. Data from stations with high dew points of 75° or 80°F, or higher, should be selected and the temperature range and median temperatures at these high dew points should be determined.

5. References

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TABLE I

LIST OF STATIONS

Station	Latitude	Longitude	Elevation (feet)	Period of Record	Time of Observations
Abadan (port), Iran	30°20'N	48°18'E	10	Frequent but not hourly observations between 1946 and 1955	
Abadan, Iran	30°22'N	48°14'E	9	Dec 43-Dec 45	Hourly
Allahabad, India	25°26'N	81°50'E	322	Jun 42-Sep 45	Hourly
Atar, Mauritania	20°28'N	13°02'W	711	Apr 43-Sep 45	Hourly
Cloncurry, Australia	21°14'S	140°30'E	616	Oct 42-Nov 44	Hourly
Dhahran, Saudi Arabia	26°17'N	50°09'E	71	Sep 53-Aug 58	Hourly
El Golea, Algeria	30°35'N	02°50'E	1306	Jan 32-Oct 34 Jan 35-Mar 35 May 35-Dec 36	07, 13, 18 LST
Gaya, India	24°45'N	84°57'E	371	Nov 42-Jan 46	Hourly
Hermosillo, Mexico	29°05'N	110°58'W	692	Frequent but not hourly observations between 1949 and 1953	
Khartoum, Sudan Gordon College	15°36'N	32°33'E	1247	Jan 24-Dec 26 Jan 31-Dec 32	08, 14, 20 LST
Khartoum, Sudan Wadi Seidna	15°50'N	32°32'E	1261	Nov 42-Jul 45	Hourly
Marrakech, Morocco	31°39'N	08°01'W	1509	Jan 43-Jan 46	Hourly
New Delhi, India	28°35'N	77°12'S	760	Jul 42-Feb 46	Hourly
Salala, Oman & Muscat	17°03'N	54°06'E	55	Apr 43-May 45	Hourly
Sidi Slimane, Morocco	34°10'N	05°55'W	220	Jan 53-Dec 57	Hourly
Tindouf, Algeria	27°41'N	08°09'W	1453	Mar 43-Jun 45	Hourly
Yuma Test Station Arizona	32°50'N	114°23'W	324	Aug 51-Sep 58 Jul 61-Sep 64	Hourly

TABLE II

Dew Points Associated with Temperatures of 109°F or Higher
Frequency, Range, and Median

ABADAN, IRAN (port)

	°F	%*	Dew Point Range	°F** Median
May	109	2.0	40-71	56
	111	0.8	42-63	58
	113	0.4	48-63	54
	115	0.1	48-57	52
Jun	109	15.7	40-69	58
	111	9.4	38-69	54
	113	4.3	42-69	56
	115	1.7	42-69	50
	117	0.4	42-59	50
	119	#	56-57	56.5
	121	#	52-53	52.5
Jul	109	24.4	38-87	66
	111	16.0	34-87	67
	113	9.2	36-89	72
	115	4.3	50-89	71
	117	2.1	48-85	72
	119	0.4	68-86	81
Aug	109	28.2	36-93	62
	111	18.9	34-93	60
	113	10.9	36-93	60
	115	3.9	38-79	58
	117	0.7	42-79	66
	119	0.4	60-61	60.5
	121	#	62-63	62.5
Sep	109	11.5	34-87	62
	111	7.0	28-85	61
	113	3.3	34-85	60
	115	0.9	38-81	72
	117	0.2	54-59	57
	119	#	58-59	58.5

*Percent of observations with temperatures above indicated value

**Median dew point at indicated temperature

#Less than 0.05 percent

TABLE II (cont)

Dew Points Associated with Temperatures of 109°F or Higher
Frequency, Range, and Median

ABADAN, IRAN

	°F	%	Dew Point Range	°F Median
May	109	3.8	25-55	39
	111	2.2	25-51	37
	113	1.2	25-51	37
	115	0.3	29-37	33
	116	#	25	25
Jun	110	15.9	23-59	43
	112	10.7	25-59	40
	114	6.4	27-53	39
	116	2.8	31-49	35
	117	0.6	25-43	34
Jul	109	14.5	35-59	47
	111	9.0	35-61	45
	113	5.4	33-53	45
	115	2.5	27-51	43
	117	1.2	27-41	39
	119	0.7	37-39	38
	121	0.5	35-41	39
	122	0.2	35-37	36
Aug	109	19.3	32-70	44
	111	13.7	28-70	42
	113	6.5	28-64	40
	115	2.3	30-60	38
	117	0.4	30-50	47
	118	#	38	38
Sep	109	11.0	25-67	47
	111	8.4	27-59	43
	113	5.3	23-61	41
	115	2.3	29-55	38
	117	0.8	27-59	41
	118	#	51	51

TABLE II (cont)

Dew Points Associated with Temperatures of 109°F or Higher
Frequency, Range, and Median

ALLAHABAD, INDIA

	°F	%	Dew Point Range	°F Median
May	110	14.8	38-66	50
	112	7.4	40-62	52
	114	3.6	44-60	51
	115	1.4	44-56	52
Jun	109	8.9	47-73	61
	111	4.6	37-69	54
	113	2.6	41-63	52
	114	1.0	41-57	51

ATAR, MAURITANIA

	°F	%	Dew Point Range	°F Median
Jun	109	6.3	21-49	39
	111	2.4	23-47	39
	113	0.5	35-43	39
	114	#	27	27
Jul	110	4.1	33-49	39
	112	1.7	33-47	39
	114	0.4	23-37	33
	115	#	31	31
Aug	109	1.9	29-53	45
	111	#	51	51
	113	-	-	-
	114	-	-	-

CLONCURRY, AUSTRALIA

	°F	%	Dew Point Range	°F Median
Jan	110	2.8	35-63	50
	112	1.1	31-59	44
	113	0.5	27-55	37
Dec	109	1.8	29-69	41
	111	0.8	33-49	43
	112	0.2	47-49	48

TABLE II (cont)

Dew Points Associated with Temperatures of 109°F or Higher
Frequency, Range, and Median

DHAHRAN, SAUDI ARABIA

	°F	%	Dew Point Range	°F Median
Jun	110	4.2	35-65	51
	112	1.5	39-59	51
	114	0.2	41-57	49
Jul	110	6.0	43-65	55
	112	2.2	43-63	53
	114	0.7	43-57	51
	116	0.3	43-51	45
	117	#	53	53
Aug	110	6.8	37-73	57
	112	3.1	37-71	53
	114	1.7	43-69	58
	116	0.7	45-71	59

HERMOSILLO, MEXICO

	°F	%	Dew Point Range	°F Median
Jun	109	0.7	40-61	48
Jul	109	0.5	52-63	56
	111	0.1	58-59	58.5
	113	#	56-57	56.5
Aug	109	0.3	40-61	51
	113	#	58-59	58.5

EL GOLEA, ALGERIA

	°F	%	Dew Point Range	°F Median
Jun	109	3.1	28-51	42
	111	1.3	42-51	46
	113	0.4	14-47	28
Jul	109	7.3	22-55	41
	111	2.7	24-63	38
	113	0.7	38-51	44
Aug	109	7.5	36-67	43
	111	4.5	42-55	50
	113	2.8	30-51	42
	115	1.5	42-53	47
	119	0.2	48-49	48.5

TABLE II (cont)

Dew Points Associated with Temperatures of 109°F or Higher
Frequency, Range, and Median

GAYA, INDIA

	°F	%	Dew Point Range	°F Median
May	110	11.8	31-75	48
	112	6.2	33-67	47
	114	2.1	43-57	47
	116	0.8	41-55	50
Jun	110	1.9	51-73	65
	112	0.6	47-73	68
	113	#	65	65

KHARTOUM, SUDAN
Gordon College

	°F	%	Dew Point Range	°F Median
Apr	109	2.2	30-83	49
	111	0.4	42-49	45
May	109	6.9	28-49	42
	111	2.1	38-49	44
	113	0.8	40-47	43
	115	0.2	38-39	38.5
Jun	109	6.6	02-57	40
	111	1.3	34-49	38
	113	0.2	50-51	50.5
Jul	109	0.6	38-49	44

KHARTOUM, SUDAN
Wadi, Seidna

	°F	%	Dew Point Range	°F Median
Jul	109	1.2	35-51	39
	111	0.4	37-43	38
	112	#	39	39

MARRAKECH, MOROCCO

	°F	%	Dew Point Range	°F Median
Jul	110	1.4	35-51	43
	112	0.8	33-41	34
	113	0.2	39-43	41

TABLE II (cont)

Dew Points Associated with Temperatures of 109°F or Higher
Frequency, Range, and Median

NEW DELHI, INDIA

	°F	%	Dew Point Range	°F Median
May	110	5.1	31-57	45
	112	2.5	35-51	43
	113	0.8	37-51	45
Jun	110	3.1	37-65	49
	112	1.0	39-53	44
	113	0.2	41-51	46

SALALA, MUSCAT & OMAN

	°F	%	Dew Point Range	°F Median
Jun	110	0.2	40-44	42
	112	#	34	34
	113	#	32	32

SIDI SLIMANE, MOROCCO

	°F	%	Dew Point Range	°F Median
Aug	110	0.8	41-55	49
	112	0.2	45-51	48
	113	#	47	47

TINDOUF, ALGERIA

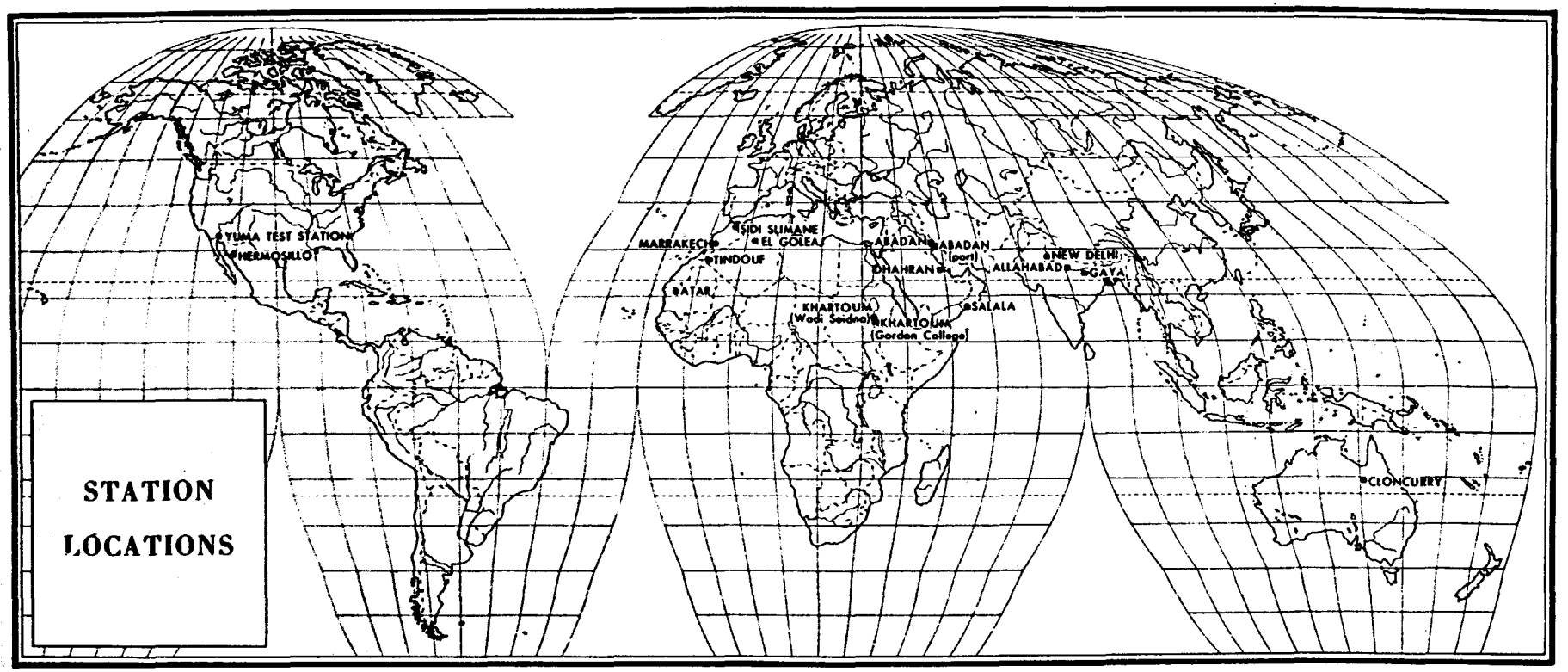
	°F	%	Dew Point Range	°F Median
Jul	109	15.7	26-54	38
	111	10.3	28-50	38
	113	7.1	28-48	38
	115	3.6	28-46	36
	116	0.5	30-38	34
Aug	109	13.6	27-53	43
	111	7.6	29-59	45
	113	3.5	25-59	47
	115	1.2	37-55	48
	116	0.2	43-47	45

TABLE II (cont)

Dew Points Associated with Temperatures of 109°F or Higher
Frequency, Range, and Median

YUMA PROVING GROUND, ARIZONA

	°F	%	Dew Point Range	°F Median
May	110	#	33	33
	111	#	33	33
Jun	110	1.9	16-67	42
	111	1.1	19-58	36
	112	0.7	13-51	37
	113	0.4	4-60	39
	114	0.2	11-46	36
	115	#	12-16	14
	116	#	37	37
Jul	110	2.7	19-70	54
	111	1.6	13-65	49
	112	1.1	35-66	51
	113	0.6	38-65	48
	114	0.4	42-62	49
	115	0.2	45-59	55
	116	#	45-47	46
	117	#	44-47	46
Aug	110	1.2	30-65	52
	111	0.4	35-58	52
	112	0.2	38-57	47
	113	#	38-39	38
	114	#	42-46	44
Sep	110	0.6	27-60	48
	111	0.2	29-58	53
	112	#	27-54	47


STATION
LOCATIONS
YUMA TEST STATION
HERMOSILLO
MARRAKECH
SIDI SLIMANE
EL GOLEA
TINDOUF
ATAR
ABADAN
ABADAN
(port)
DHAHRAN
ALLAHABAD
NEW DELHI
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SALALA
KHARTOUM
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Figure - 1

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1 ORIGINATING ACTIVITY (Corporate author) U.S. Army Natick Laboratories Natick, Massachusetts	2a REPORT SECURITY CLASSIFICATION Unclassified 2b GROUP

3 REPORT TITLE

SIMULTANEOUS OCCURRENCE OF HIGH TEMPERATURES AND HIGH DEW POINTS

4 DESCRIPTIVE NOTES (Type of report and inclusive dates)

5 AUTHOR(S) (Last name, first name, initial)

DODD, Arthur V.

6 REPORT DATE June 1966	7a TOTAL NO OF PAGES 17	7b NO OF REFS 7
8a CONTRACT OR GRANT NO b PROJECT NO 1V025001A129 c d	9a ORIGINATOR'S REPORT NUMBER(S) 66-55-ES 9b OTHER REPORT NO(S) (Any other numbers that may be assigned this report) ES-25	

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11 SUPPLEMENTARY NOTES	12 SPONSORING MILITARY ACTIVITY U.S. Army Natick Laboratories Natick, Massachusetts

13 ABSTRACT

Available information on the joint occurrence of high temperatures and dew points are presented for 17 stations (7 in Asia, 7 in Africa, 2 in North America, and 1 in Australia) in order that the geographical distribution of high temperatures and associated humidities may be better known. This information will be used in a planned revision of AR 705-15, "Operation of Materiel under Extreme Conditions of Environment." On the basis of these data, it appears that the natural occurrence of dew points higher than 75°F in conjunction with temperatures higher than 109°F is very infrequent and should not be specified for guidance in design and testing of Army materiel except possibly for items which may be used in limited areas of the Persian Gulf and Red Sea littorals where extremely high temperatures and humidities have been observed or are assumed to occur.

DD FORM 1 JAN 64 1473

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14 KEY WORDS	LINK A ROLE	LINK A WT	LINK B ROLE	LINK B WT	LINK C ROLE	LINK C WT
Dew Point	6,7		9			
Temperature	6,7		9			
High	0		0			
Testing	4		4			
Military equipment	4		4			
Armed Forces operations	4		4			
Coincidence			8			

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