



Society of Automotive Engineers, Inc.
TWO PENNSYLVANIA PLAZA, NEW YORK, N.Y. 10001

AEROSPACE INFORMATION REPORT

AIR 1309

Issued May 1973
Revised

AIRCRAFT ENVIRONMENTAL FACTORS FOR DESIGN CONSIDERATION

1. PURPOSE

This Aerospace Information Report (AIR) sets forth the environmental factors representative of the majority of the airport locations in the Continental United States, Canada, and around the world. The report is intended to assist the design or specifying engineer in establishing performance specifications of available equipment against the environmental requirements for a geographical location.

2. SCOPE

This AIR is presented in two parts - the first part, to alert the engineer with respect to the environmental factors which he might have to consider - the second part, as tabular data and figures to which he can refer with respect to a specific geographical location.

3. ENVIRONMENTAL FACTORS

The following environmental situations demand attention with respect to any geographic location, whether consideration is with respect to a fixed or mobile facility.

- 3.1 Elevation: The performance of any engine or other air handling device is affected by the changes in density of air associated with changes in altitude and normally performance is reduced as altitude is increased.
- 3.2 Temperature: With respect to air handling devices, performance is reduced as ambient operating temperature increases - again because of changes in air density, but equally important are extreme low and extreme high temperature considerations. Diesel engines which depend upon the flash point of a fuel and air mixture under compression will not fire or ignite at temperatures less than +10° F (-12° C); therefore, start assist is mandatory. Batteries operating under 0° F lose capacity at the rate of approximately 1/2 volt per 5° F (2.8° C). Air handling devices including engines have increased performance as temperature goes down. On the opposite hand, air handling devices including engines reduce in performance as temperature goes up. In the case of gasoline engines, most engines are rated at 70° F (21° C) at sea level; most diesel engines are rated at 85° F (29° C) at 500 ft (152.5 m) above sea level; most air handling equipment is rated at 60° F (16° C) at sea level.

At extreme temperature conditions in either direction, lubricants, hydraulic fluids, rubber and synthetic rubber devices, plastics, and most chemical products demand consideration. Pre-heating of engine coolants, engine lubricants, hydraulic fluids, etc. may be mandatory for operation at low temperature conditions.

- 3.3 Humidity: Again air is involved. Humidity has negligible effect on engine performance but it does have profound effect on any device associated with the heating or cooling of air, particularly from a cooling standpoint. Humidity represents latent heat and moisture content. This creates a large part of the capacity required for any air conditioning system. Additionally, humidity can be a factor with respect to corrosion and starting capability as a result of severe condensation in the form of both water and frost.

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- 3.4 Precipitation: Precipitation has a negligible effect upon the performance of any device whether mobile or stationary except as ingestion of precipitation is concerned, condensation resulting therefrom, or with respect to mobility device.
- 3.5 Miscellaneous Environmental Conditions: In addition to the major environmental conditions set forth above, miscellaneous environmental conditions may require special considerations, namely:
- Exposure to heavy salt atmosphere as encountered in coastal areas
 - Fungus growth as encountered in tropical climates
 - Sand and dust particles as will be encountered in desert areas
 - Quality of fresh water available
 - Sunshine in the form of radiant energy as found under severe natural conditions
 - Precipitation rate
 - Wind effect
 - Shock and vibration forces incidental to handling and usage
 - Operation in a possible explosive or non-ventilated atmosphere

4. ENVIRONMENTAL DATA

- 4.1 General: The environmental data with respect to the geographic locations is set forth in Exhibit "A" attached. The specific locations listed in Exhibit "A" are identified in Figures 1, 2, and 3. Certain of the data listed in Exhibit "A" is as a result of averaging of conditions. More precise data for the Continental United States can be obtained by observing Figures 4 through 15.

Figure 16 provides wind chill data with respect to the effects of human exposure. Figure 16 is not to be construed as establishing parameters for the design or evaluation of equipment and is included in this AIR for informational purposes only.

4.2 Definitions and Symbols:

- AMAT - Average Maximum Temperature. This is the averaging of the highest temperature each day for the full year.
- AMIT - Average Minimum Temperature. This is an averaging of the lowest temperature each day for the full year.
- EMAT - Extreme Maximum Temperature. This is the highest temperature that could be expected any time during the year. (This is not a charting of Figure 11).
- EMIT - Extreme Minimum Temperature. This is the lowest temperature that could be expected any time during the year. (This is not a charting of Figure 12).
- HD - Humidity definition is concerned basically with the design point for air conditioning systems. The notation on Exhibit "A" is with respect to the prevalent wet bulb temperature during the hottest month.

H - High range, where the wet bulb temperature for design is above 78° F (25.6° C). Referring to Figure 13, a portion of the Southeast Coast of the U. S. and most of the Gulf Coast would fall into such a category.

M - Mid range, where the wet bulb temperature for design ranges between 75° and 78° F (24° and 25.6° C). This would cover most of the U. S. except certain of the arid areas of the West, the upper Mid-West, the Appalachian Valley, and upper New England.

L - Low range, for wet bulbs up to 75° F (24° C). Such a design point would be applicable to the arid portion of the West, the upper Mid-West, the Appalachian Valley, and Northern New England.

f. PRED - Precipitation definition.

IPY - Inches per year. This is the total number of inches of precipitation assuming that all precipitation can be expected in the form of rain.

DPY - Days per year. This is the total number of days per year that precipitation can be expected in the form of either rain or snow.

g. SD - Snow definition is based on the number of inches per year where measured snow was one inch or more.

Y - Yes, for a total yearly accumulation up to 15 inches (381 mm) but not normally an environmental factor for that location.

YH - Yes, for a total yearly accumulation between 16 and 30 inches (406 and 762 mm). Troublesome accumulations are likely.

YXH - Yes, extra heavy, with a yearly accumulation of above 30 inches (762 mm). Snow is definitely an environmental factor consideration.

N - No, not likely.

5. ACKNOWLEDGMENT

Appreciation is expressed to Conway Publication, Division of Conway Research, Inc., 2600 Apple Valley Road, Atlanta, Georgia 30319 for their permission to reproduce certain data from the 1963 edition of the "Weather Handbook". The subject matter of this AIR can be greatly expanded upon by reference to the above mentioned publication.

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SAE COMMITTEE AGE-2, CIVIL AIRCRAFT GROUND SUPPORT EQUIPMENT



FIGURE 1 - EXHIBIT "A" LOCATIONS



FIGURE 2 - EXHIBIT "A" LOCATIONS

- 5 -

The map displays the following locations across various continents:

- North America:** SVERDLOVSK, IRKUTSK, HARBIN, VLADIVOSTOK, ULAN BATOR, SEUL, TOKYO, ANKARA, BEIRUT, DAMASCUS, JERUSALEM, TEHRAN, BAGHDAD, KUWAIT CITY, KABUL, SRINAGAR, NEW DELHI, KARACHI, BOMBAY, CALCUTTA, CHITTAGONG, RANGOON, SINGAPORE, KUALA LUMPUR, SINGAPORE, JAKARTA, THULE, WHITEHORSE, EDMONTON, VANCOUVER, SASKATOON, CALGARY, REGINA, WINNIPEG, QUEBEC, MONTREAL, HALIFAX, OTTAWA, TORONTO.
- South America:** MARACAIBO, CARACAS, BOGOTA, GUAYAQUIL, LIMA, CUSCO, LA PAZ, ASUNCION, RIO DE JANEIRO, SANTIAGO, BUENOS AIRES, MONTEVIDEO.
- Europe:** TAMER, ALGER, TUNIS, CASABLANCA, SANTA CRUZ DE TENERIFE, TRIPOLI, CAIRO, KHARTOUM, DJIBOUTI, ADDIS ABABA, NAIROBI, DAR ES SALAAM, ELISABETHVILLE, SALISBURY, FRANCISTOWN, LOURENCO MARQUES, JOHANNESBURG, CAPE TOWN.
- Africa:** DAKAR, MALI, FREETOWN, MONROVIA, ACCRA, LAGOS, FORT-LAMY, KHARTOUM, DJIBOUTI, ADDIS ABABA, NAIROBI, DAR ES SALAAM, ELISABETHVILLE, SALISBURY, FRANCISTOWN, LOURENCO MARQUES, JOHANNESBURG, CAPE TOWN.
- Asia:** HARBIN, VLADIVOSTOK, ULAN BATOR, SEUL, TOKYO, ANKARA, BEIRUT, DAMASCUS, JERUSALEM, TEHRAN, BAGHDAD, KUWAIT CITY, KABUL, SRINAGAR, NEW DELHI, KARACHI, BOMBAY, CALCUTTA, CHITTAGONG, RANGOON, SINGAPORE, KUALA LUMPUR, SINGAPORE, JAKARTA, THULE, WHITEHORSE, EDMONTON, VANCOUVER, SASKATOON, CALGARY, REGINA, WINNIPEG, QUEBEC, MONTREAL, HALIFAX, OTTAWA, TORONTO.
- Oceania:** HAMILTON, NASSAU, GRAND TURK ISLAND, LA GUERITE, CAMP JACOB, ROSEAU, FORT-GE-FRANCE, BRIDGETOWN, SOUFRIERE, WILLEMSTAD, PIARCO AIRPORT, SAN JOSE, CRISTOBAL, GUATEMALA CITY, SAN SALVADOR, VERACRUZ, MEXICO CITY, MAZATLAN, MUNTERREY, HABANA, CIUDAD TRUJILLO, PORT-AU-PRINCE, KINGSTON.

FIGURE 3 - EXHIBIT "A" LOCATIONS

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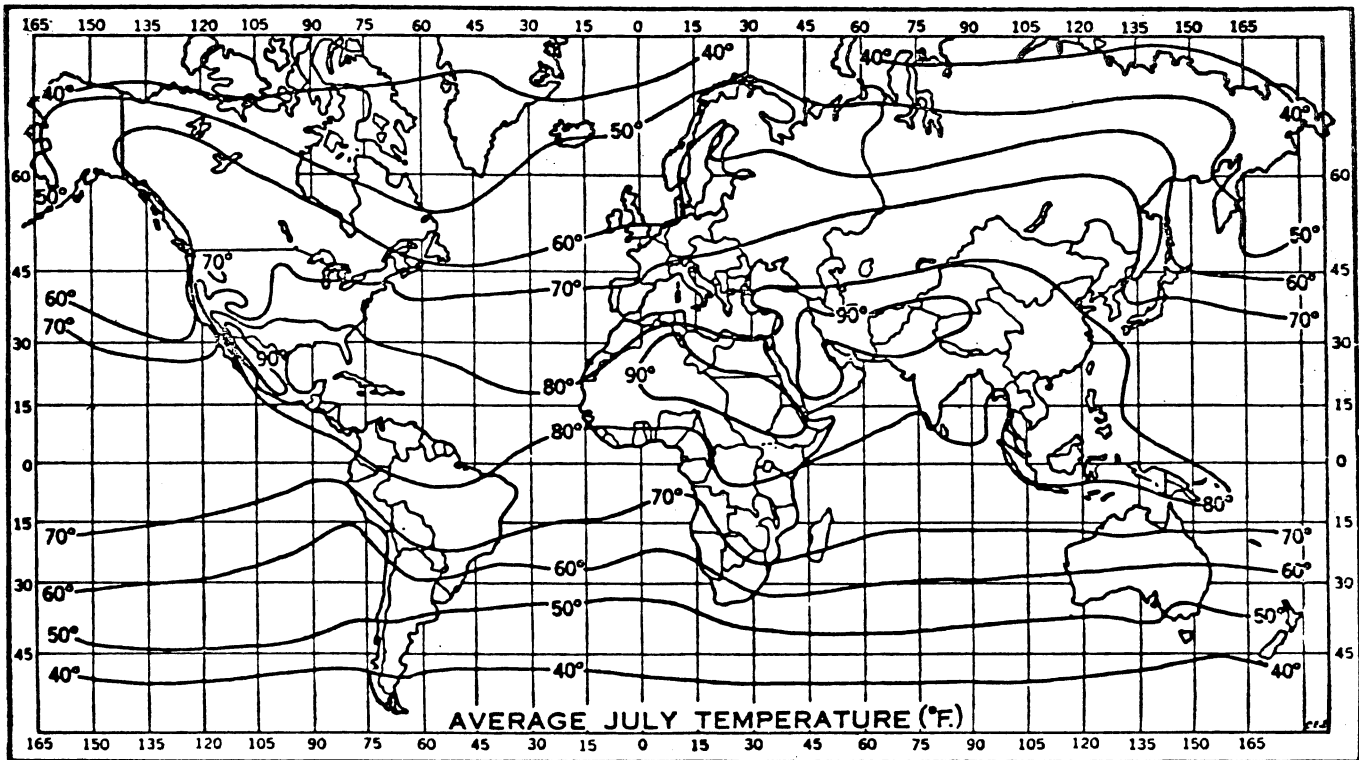


FIGURE 4 - ISOTHERMS - JULY

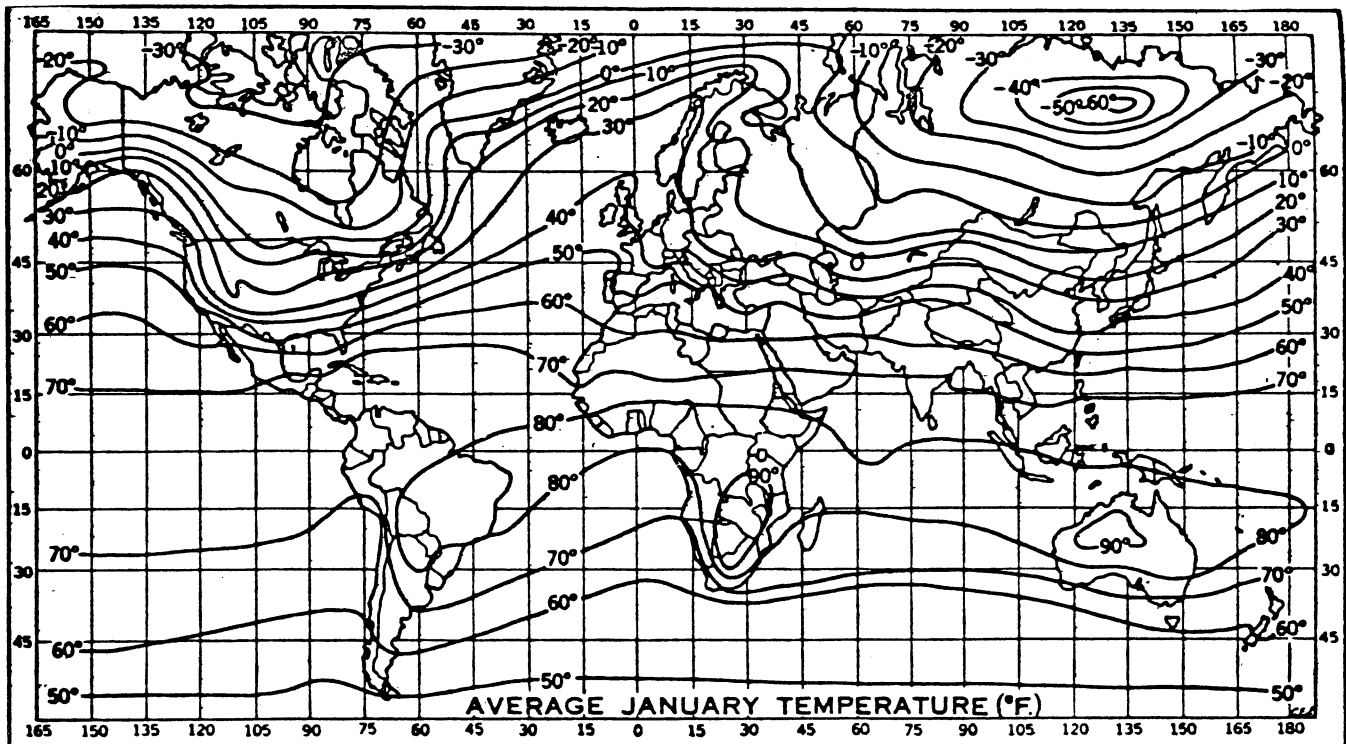


FIGURE 5 - ISOTHERMS - JANUARY

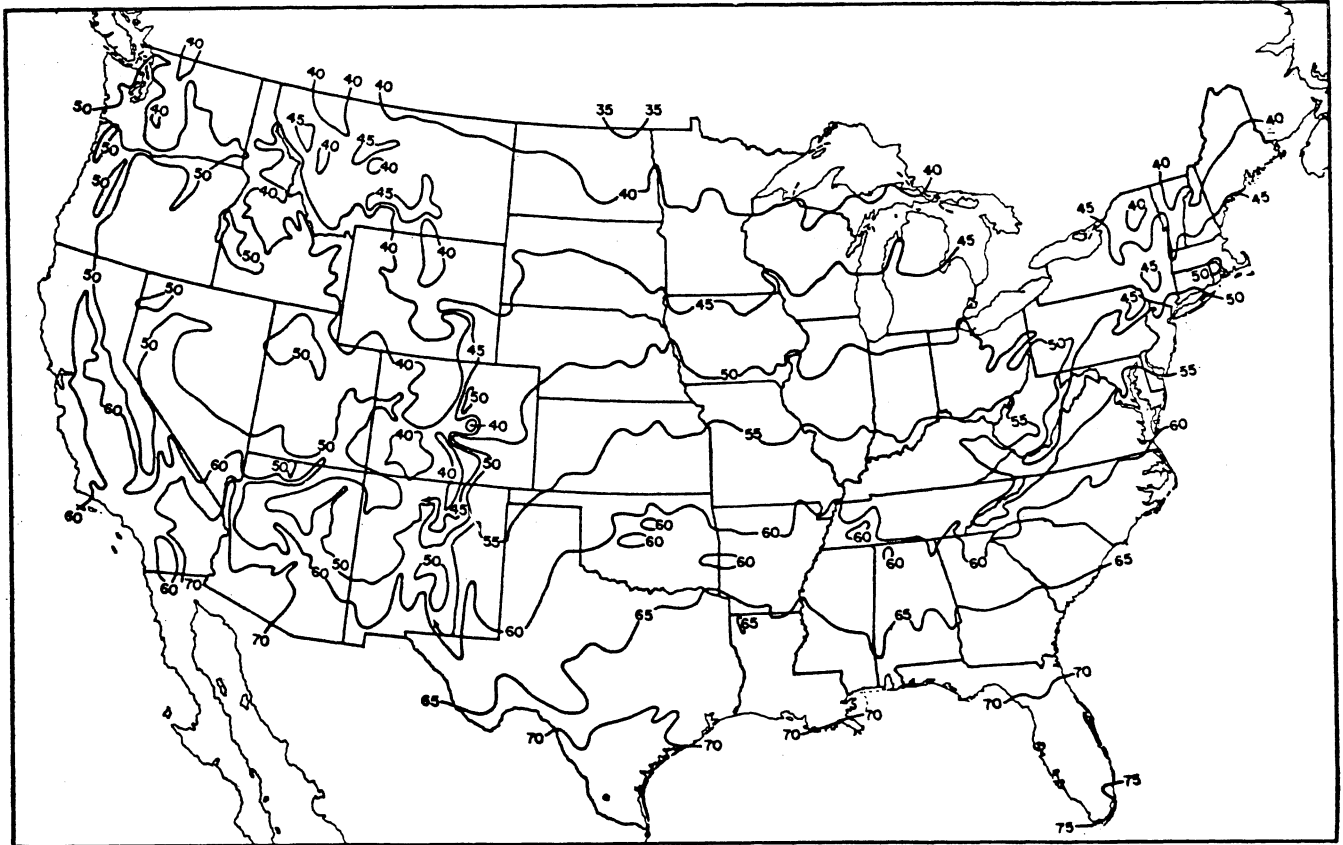


FIGURE 6 - AVERAGE ANNUAL TEMPERATURE - °F

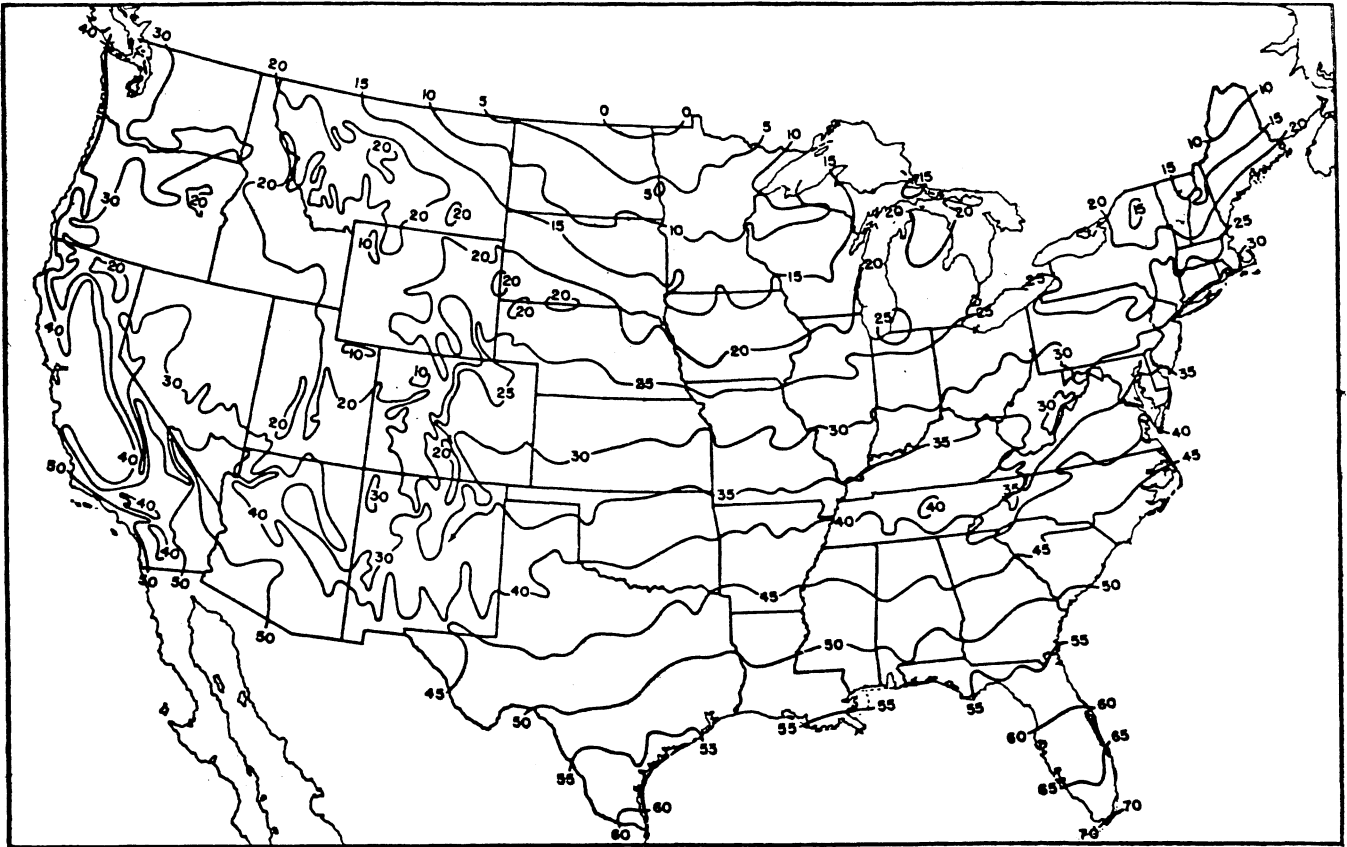


FIGURE 7 - AVERAGE JANUARY TEMPERATURE - °F

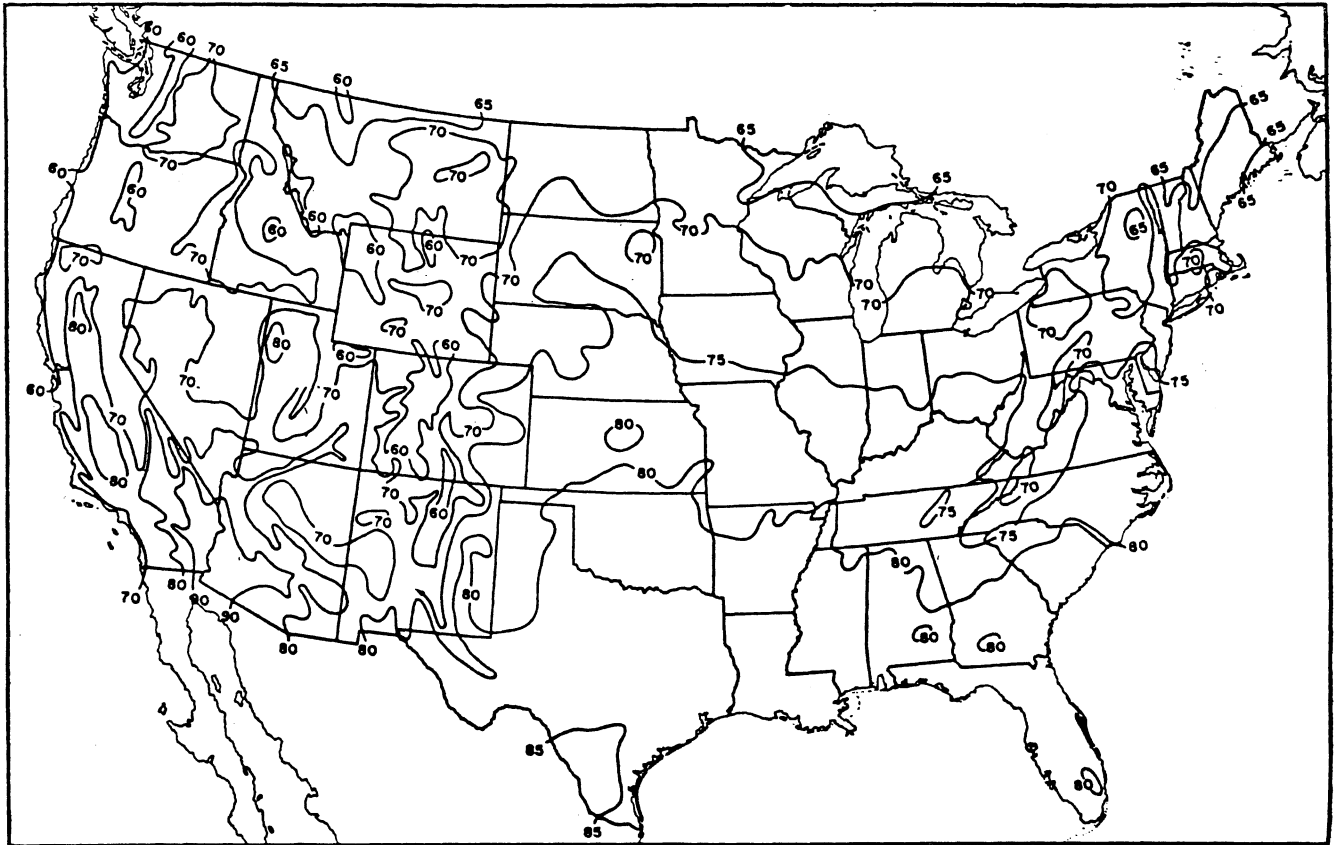


FIGURE 8 - AVERAGE JULY TEMPERATURE - °F

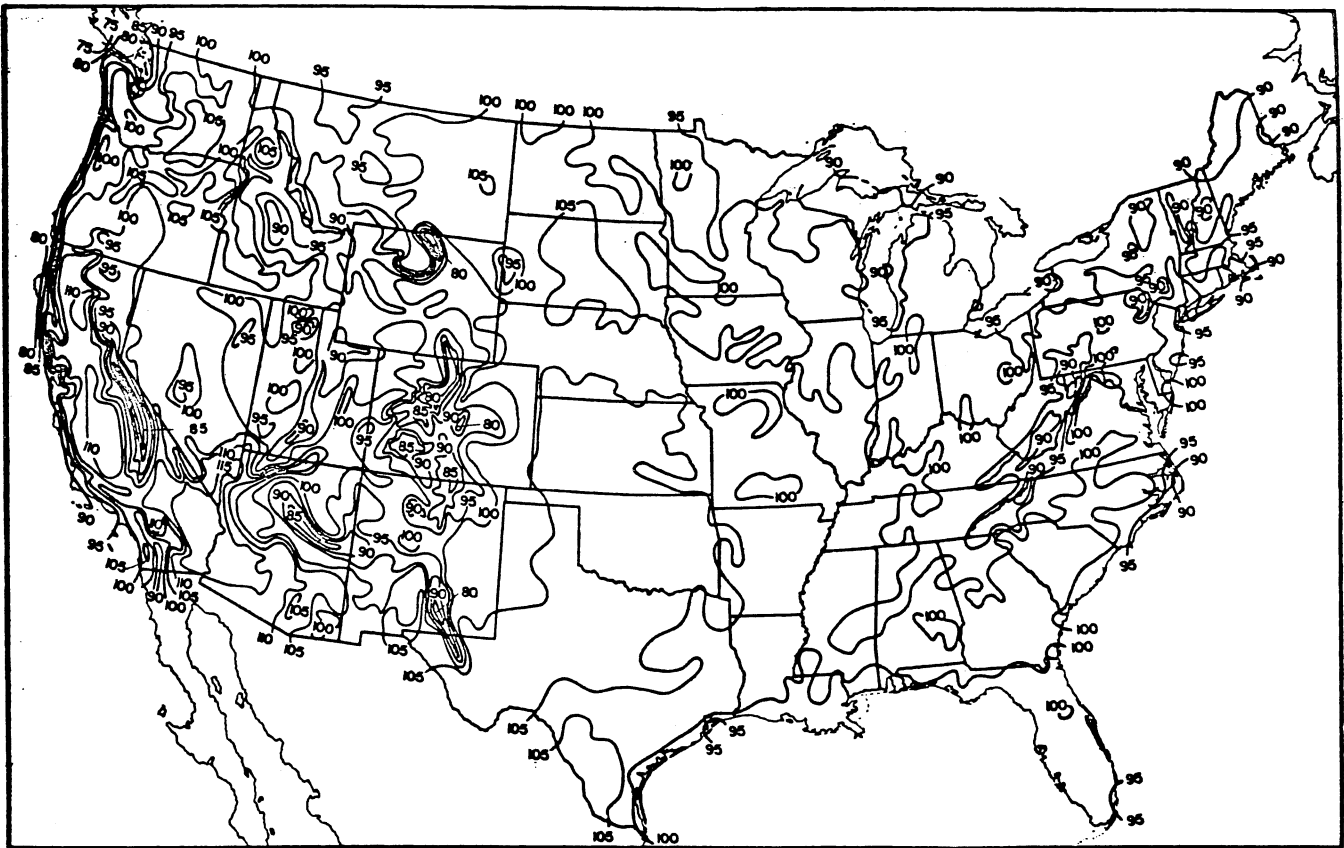


FIGURE 9 - AVERAGE ANNUAL MAXIMUM TEMPERATURE - °F