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RAIL TRANSIT WINTERIZATION TECHNOLOGY AND SYSTEMS OPERATIONS STUDY

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SEPTEMBER 1980
FINAL REPORT

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16. Abstract

The severe winters of 77-78 and 78-79 caused all snowbelt transit systems to experience a variety of problems which resulted in impaired service ranging from system delays to complete system shutdowns. This report investigates the various problems encountered by the transit authorities and describes those measures which were used to combat the effects of severe winter weather. Summaries of both technological and operational measures as well as information on their effectiveness are included. Information was collected through interviews with transit system personnel and site visits. The conclusions are concerned with the measures and basic problems faced by transit authorities during severe winter weather. Recommendations are then provided on measures which UMTA and/or the transit authorities can support to minimize winter's impact on transit operations.

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16. Abstract

The severe winters of 1977-1978 and 1978-1979 caused all snowbelt transit systems to experience a variety of problems which resulted in impaired service ranging from system delays to complete system shutdowns. The scope of this report includes a summary of rail transit equipment problems encountered by transit authorities due to severe winter weather; hardware measures that have been implemented to combat the effects of severe winter weather; summaries of both technological and operational measures in current use by various transit systems, as well as information on their effectiveness; and an update of the 1978 Massachusetts Bay Transportation Authority (MBTA) study. Three background events preceded this study: 1) the 1978 study of rail transit's severe winter weather problems and some of the solutions undertaken by Alexander Kusko, Inc. (AKI) for the MBTA; 2) the severe winter experience suffered by the Chicago Transit Authority in 1978-1979; and 3) the formation of a special task force on rail transit snow and ice emergencies by the American Public Transit Authority. This study of rail transit winter technology was undertaken by AKI under a contract to Transportation Systems Center as a sequel to these three events, so that current knowledge of equipment and operating strategies for maintaining rail transit under severe winter conditions can be more widely disseminated to transit systems. Information for this study was collected through interviews with transit system personnel and site visits to eleven major transit authorities. The conclusions are concerned with the measures and basic problems faced by transit authorities during severe winter weather. Recommendations are then provided on measures which UMTA and/or the transit authorities can support to minimize winter's impact on transit operations.

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PREFACE

This report describes the various equipment problems encoutered by rail transit systems due to severe winter weather and the hardware measures that have been implemented to combat these problems. Details of the various operating strategies employed by rail transit systems to deal with winter weather are also provided. An update on the 1978 Winter MBTA Study is also included in this report.

The work described in this report was performed by Alexander Kusko, Inc. of Needham Heights, MA, under contract DOT/TSC-1773 for the U.S. Department of Transportation, Research and Special Programs Administration, Transportation Systems Center, Cambridge, MA, under the auspices of the U.S. Department of Transportation, Urban Mass Transportation Administration, Office of Technology Development and Deployment, Office of Rail and Construction Technology. Mr. Jason Baker of the Transit System Branch, Urban Systems Division of the Office of Ground Systems Directorate at the Transportation Systems Center provided many valuable suggestions as Project Manager of this project.

METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
in	inches	2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
		AREA		
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
		MASS (weight)		
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
		VOLUME		
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
		TEMPERATURE (exact)		
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
		AREA		
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
		MASS (weight)		
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
		VOLUME		
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
		TEMPERATURE (exact)		
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F

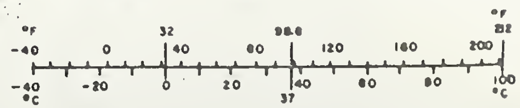

TABLE OF CONTENTS

1.0 INTRODUCTION

This report describes the various equipment problems encountered by rail transit systems due to severe winter weather and the hardware measures that have been implemented to combat these problems. The effectiveness of these various measures is described. Details of the various operating strategies employed by rail transit systems to deal with winter weather are also provided. An update on the 1978 Winter MBTA Study is also included in this report.

1.1 Background

Three background events preceded this study: (1) a 1978 study of rail transit's severe winter weather problems and some of the solutions was undertaken by Alexander Kusko, Inc. (AKI) for the the Massachusetts Bay Transportation Authority (MBTA); (2) the severe winter experience (1978-79) suffered by the Chicago Transit Authority (CTA); (3) the formation of a Special Task Force on Rail Transit Snow and Ice Emergencies by the American Public Transit Association (APTA).

This study of rail transit winter technology was undertaken by AKI under a contract to the U.S. Department of Transportation, Transportation Systems Center (DOT/ TSC), as a sequel to these three events, so that current knowledge of equipment and operating strategies for maintaining rail transit service under severe winter conditions can be more widely disseminated to transit systems.

The AKI study for the MBTA investigated their winter operations, defined problem areas and made recommendations for improvements that would reduce the effects of severe winter weather. The AKI report was published in December 1978.

During the severe winter of 1978-79, the CTA experienced major system shutdowns due to the excessive accumulation of snow in a short period of time. Most other snow belt transit properties also experienced some operational hardships during either the 1977-78 or 1978-79 winter seasons. As a result, the APTA Snow and Ice Emergency Task Force was formed to investigate the causes of these winter problems and examine the technology used to counteract them.

In August 1979 Alexander Kusko, Inc. was placed under contract to the U.S. Department of Transportation, Transportation Systems Center (DOT/TSC) to further examine rail transit winter problems, the equipment and operational procedures used to maintain service under severe winter weather, and to assess the effectiveness of current means for maintaining service.

1.2 Scope of Report

The scope of this report includes a summary of rail transit equipment problems due to winter storms, the hardware measures currently used to combat the effects of winter storms, special winter operation measures and strategies in current use by various transit systems, and an update on the 1978 MBTA study.

2.0 TRANSIT SYSTEMS VISITED

The following transit systems* were visited in order to collect the information for this report.

CTA	-	Chicago Transit Authority
GCRTA	-	Greater Cleveland Regional Transit Authority
LIRR	-	Long Island Railroad
MBTA	-	Massachusetts Bay Transportation Authority (Boston)
NYCTA	-	New York City Transit Authority
PATH	-	Port Authority Trans-Hudson Corporation (Jersey City, NJ)
PATCO	-	Port Authority Transit Corporation (Lindenwold, NJ)
RTA	-	Regional Transit Authority (Chicago, IL)
SEPTA	-	Southeastern Pennsylvania Transportation Authority (Philadelphia)
TTC	-	Toronto Transit Commission
WMATA	-	Washington Metropolitan Area Transit Authority

In addition to these transit systems, the Transportation Divisions of the General Electric Company and Westinghouse Electric Corporation were also visited to discuss winter problems related to traction motors. All of the above were visited during the interval from October 1979 through February 1980.

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*The abbreviations shown here for each transit system are used in the remainder of this report.

3.0 EQUIPMENT PROBLEMS DUE TO WINTER STORMS

Snow, ice, sleet, high winds and low temperatures are the ingredients of winter storms which quite often cause transit systems to experience a variety of equipment and operational problems. The problems which affect equipment are discussed in this section and are listed below:

- third rail or catenary icing
- traction motor failures
- door freeze-ups
- ice buildup on brakes
- air line freezing
- undercar snow contamination
- track switch freezing
- train stop freezing
- false operation of trip cock
- deep snow on tracks.

3.1 Third Rail or Catenary Icing

Icing of the third rail or catenary causes the power collector to lose electrical contact, which results in a disabled car or creates excessive arcing. Icing occurs when there is precipitation near the freezing temperature of water (32° F). A layer of ice forms and adheres to the third rail or trolley wire. The ice increases in thickness as the precipitation continues. Sleet storms cause the worst icing problems, but snow on the third rail, melted by rising daytime temperatures can readily freeze if the temperature then drops below the freezing point.

Usually, the icing problems on a catenary trolley wire system are not as severe as third rail icing, since the flexing motion of the trolley wire caused by the pantograph or trolley pole loosens and breaks off any ice that is not securely affixed to the wire.

Icing problems are encountered with an overriding third rail (collector shoe riding on top of the rail). An underriding third rail (collector shoe riding along the underside of the rail) does not lend itself to ice buildup.

3.2 Traction Motor Failures

Snow and water ingestion cause two types of problems with traction motors. The first or immediate problem is the reduction in creepage distances* in the commutator/brush holder area, which results in flashovers. The second or longer term problem occurs usually within two or three days of the ingestion. During this period, the ingested snow is thawed as a result of heat generated from the operation of the motor. This moisture can then be absorbed into any voids in the armature winding or field winding insulation, thus destroying the insulation integrity and grounding the winding. Usually, the field winding on the pole that is at the lowest elevation is the most susceptible to this type of failure, since it can collect the most moisture.

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*Creepage distance in an electric motor is the distance along the surface of an insulator from high voltage to ground potential.

Transit cars which experience traction motor short circuits in either the brush holders or the windings must be removed from service. The failed traction motors must then be removed from the car's truck and repaired. A limited number of spare traction motors are typically available as replacements for failed motors. However, under severe conditions one can expect to find an insufficient number of spare motors in reserve, forcing some cars out of service for longer periods until their motors can be repaired.

The ingestion of snow as described above may cause a traction motor field or armature winding to fail, but the motor must first be in a susceptible state. A susceptible state exists when the insulation is aged or cracked. The potential for a traction motor failure is created by any of the following conditions: (1) traction motor designs that do not permit sufficient water drainage: (2) cooling air filters and inlets that do not exclude water; and (3) transit systems that fail to adequately inspect, maintain and overhaul their traction motors and reimpregnate their armature and field windings on a reasonable schedule before cracking and aging of insulation has occurred.

3.3 Door Freeze-Ups

Ice forming in the door pockets or door tracks of transit cars can cause the doors to become inoperative. When doors will not open or close completely on command, delays in the schedule and possibly the removal of the car from passenger service will occur. The crew usually attempts to correct this situation, but if the doors cannot be closed most transit systems will off-load their cars rather than have a potential safety hazard. Most transit systems have their propulsion controls interlocked with the doors as a safety measure, so that no power can be applied to the traction motors unless all of the doors are secured.

Snow tracked into the car by passengers or snow that collects on the door threshold are usually the sources of the water which cause the icing problem. A heated car, or sun warming a side of the car, can melt the snow, which can then refreeze in the door track or pocket as the temperature drops.

3.4 Ice Buildup on Brakes

On cars using tread brakes, sleet or snow can collect between the brake shoe and the wheel tread during a storm, and then become compacted whenever the brakes are applied. This buildup reduces the braking friction and limits braking action and effectiveness. This condition can result in cars travelling beyond their designated station stops with the possibility of a collision.

Ice buildup on the brake mechanism linkages can also occur in adverse weather, causing the brake to "lock-up" in one position, resulting in obvious safety problems.

Once this condition is discovered the ice must be removed from the brake mechanisms before the vehicle can be used to safely transport passengers.

3.5 Air Line Freezing

The air in the pneumatic system of transit cars contains water vapor which can condense in the air lines under the right conditions. When the ambient temperature drops below 32°F, moisture in the line can freeze and either rupture the line or disable it by blocking the air flow. Typically, a pneumatic system is used to operate doors, brakes and propulsion and braking controls. With such systems out of service, the car would not be allowed to carry passengers and would have to be towed to the vehicle shop. The frozen air line would then be thawed and the water drained, or if the air line had ruptured it would be repaired or replaced.

3.6 Undercar Snow Contamination

Many of the propulsion and braking controls as well as auxiliary apparatus for transit cars are attached to the underside of the vehicle. Some of this equipment is installed in enclosures with either removable or hinged gasketed covers, secured by various means to protect the equipment inside from the elements.

Occasionally, these covers are not properly fastened and become loose. They may then unfasten and even fall off when the undercar equipment pushes against high accumulations of snow deposited between the tracks. Once the protection from the cover is lost, snow is introduced into the equipment enclosures and failures will most certainly result.

Motor-generator and motor-alternator sets located under the car, as well as motors for air conditioning, are subject to the same problems as the traction motors, if sufficient snow is ingested in these units.

3.7 Track Switch Freezing

When snow or ice accumulates around the track switch points or switch operating mechanisms, making them inoperable, service restrictions and delays occur. Switches are most susceptible to freeze-ups during the late night hours when revenue service is minimized or discontinued and the switches are not thrown as often.

The time required to clear the problem depends on the number of frozen switches, the size of the rail crew, the equipment available, and the ambient temperature.

3.8 Train Stop Freezing

Train stops are wayside mechanical safety devices used by most systems to activate the emergency brakes of a train whenever a train improperly enters an occupied section of track. The train stop is located outside the running rails. In the de-energized position it lies below the top of the running rail. When energized, due to block occupancy by a train, the arm is raised to several inches above the running rail to make contact with the trip cock arm of another train entering the block.

There are two possible failure modes that could occur as a result of a train stop freeze-up:

- frozen "down," when it should be "up" to signify an occupied block

- frozen "up," when it should be "down" to signify an unoccupied block.

When frozen "down," there is the possibility of a collison caused by a train improperly entering an occupied block and not being automatically stopped by the operation of the trip cock. When frozen "up," an undesired emergency stop occurs if the frozen condition is not known. When the frozen "up" condition is known, operators must go through elaborate procedures such as manually hooking the stop arm down and traveling at reduced speeds under central control supervision. These procedures are required to insure the safety of the passengers.

The time required to clear the problem depends on the number of frozen train stops, the number of men and equipment available, and the ambient temperatures.

3.9 False Operation of Trip Cock

The trip cocks are the mechanical devices attached to transit cars of some properties which are activated by the wayside train stops to cause the application of the emergency brakes. Trip cocks occasionally operate erroneously or make "false trips" when activated by deep snow along the right-of-way accumulated in the path of the trip cock arm. This false operation of the trip cock and the consequent emergency application of the brakes causes time-consuming delays and flat spots on the wheels. False tripping is reduced when the snow is cleared from the right-of-way in the path of the trip cock.

3.10 Deep Snow on Tracks

Once snow is allowed to accumulate to a predetermined height above the rail (dependent on the clearance of the under-car equipment above the rail), the passage of revenue cars is no longer possible. Trains could derail or become stalled, resulting in a line shutdown. The problems then multiply when the removal of passengers from snowbound trains is required under these adverse conditions.

Removal of snow from the tracks can take from several hours to several days depending on weather conditions, snow depth, the number and types of snow removal vehicles available and manpower resources.

4.0 HARDWARE MEASURES USED TO COMBAT EFFECTS OF WINTER STORMS

Transit systems have developed various equipment additions, modifications, and hardware measures to combat the problems described in Section 3.0. This section describes most, if not all of these hardware measures, and discusses their effectiveness. The hardware measures described in this section are:

- third rail heaters
- underriding third rail
- third rail sleet scrapers
- trolley wire sleet removers
- third rail deicing solutions
- third rail cover boards
- motor modifications for winter operation and effective motor maintenance programs
- switch heaters
- train stop heaters
- trip cock plows and shear pins
- diesel locomotives with plows
- snow plows and snow-blowers on work equipment
- jet snow-blowers
- special snow and ice fighting cars
- door heaters
- snow brakes
- snow fences
- collector shoe pressure
- underslung plows on revenue cars.

4.1 Third Rail Heaters

Third rail heaters have been effective in minimizing third rail icing problems on many transit systems. These ohmic heaters are used along the right-of-way with power ratings ranging from 50 to 200 watts per linear foot (W/ft). Several different types of heaters are used on transit systems. Three basic types of heater construction are used:

- tubular heaters - coiled nickel-chrome heating element inside a metal sheath with magnesium oxide insulation
- mineral insulated heaters - same as tubular heaters, except the heating element is straight wire, not coiled
- flexible strip heaters - coiled nickel-chrome heating element sandwiched between silicone rubber strips.

The tubular heaters are enclosed in a tubular sheath of either a circular cross section (Chromalox, Singer, Calrod or triangular cross section Chromalox).

The MI heaters (Nelson, Chromalox) have smaller outside diameters than tubular heaters and are limited to about 75 W/ft due to their straight element constuction.

The flexible strip heaters are typically 18 ft long for 600 V service. The nichrome heater element is arranged in a coil which is sandwiched and bonded between silicon rubber flat strips, using a fiberglass bonding grid. Typical width is one inch and a typical overall thickness is less than 0.1 inch. Wire thickness is typically 0.050 in.

The tubular heaters as shown in Fig. 4.1 are secured to the third rail web with metal clips, which allow for expansion. Contact with the third rail is made at the clips and possibly at other locations between the clips if no bowing of the heater occurs. Some installations add stainless steel shields on the exposed side of the heaters to minimize convection heat loss due to high winds. Others are investigating the installation of heaters inserted in steel pipes which are welded to the web area of the third rail as in Fig. 4.2. With this approach heat loss from the winds (convection) is greatly reduced.

The tubular heaters with triangular cross sections are applied with clips similar to the circular tubular heaters. The advantage of the triangular shape is that one flat side can make greater contact with the third rail to provide a better heat-conducting path than the tubular circular heater.

The MI heaters are installed with clips along the third rail and in grooves provided in the aluminum of composite rails. Sandwiching the heater between the third rail and the aluminum reduces heat loss by convection.

Fig. 4.1 PATCO Third Rail Heater Installation Using Circular Tubular Heaters

Fig. 4.2 TTC Experimental Third Rail Heater Installation Using Pipe Welded to the Third Rail to Contain the Heater Element

The silicone rubber flexible strip heater is cemented directly to the web of the third rail, after it is cleaned of scale. Such direct contact with the third rail assures excellent heat transfer. Also, the strip expands and contracts with the third rail. No restrictions are made on the strip heater length and the heating watts per linear foot can be selected by varying the heater element width and length for a given voltage.

For effective operation, the heaters should be turned on at least one hour before the winter storm begins to allow for the thermal lag of the third rail. This procedure will assure a sufficient rise in third rail temperature to melt ice and snow.

The MBTA has recently installed remote control for Red Line third rail heaters and plans to control Orange Line heaters in the same manner. PATCO controls third rail heaters from adjacent station platforms, while most other snow belt properties must manually energize each individual section of heaters on site. Remote or central control of heaters increases their effectiveness by reducing the activation time. Also, annunciator lights mounted on top of the heater control boxes at some transit properties can rapidly identify any defective heaters to the operators of passing trains. A typical arrangement of components in a heater control box is shown in Fig. 4.3.

The following problems have occurred with third rail heaters:

- The heater connection means have failed due to high voltage transients from passing trains, and excessive temperature rise due to loss of third rail contact.

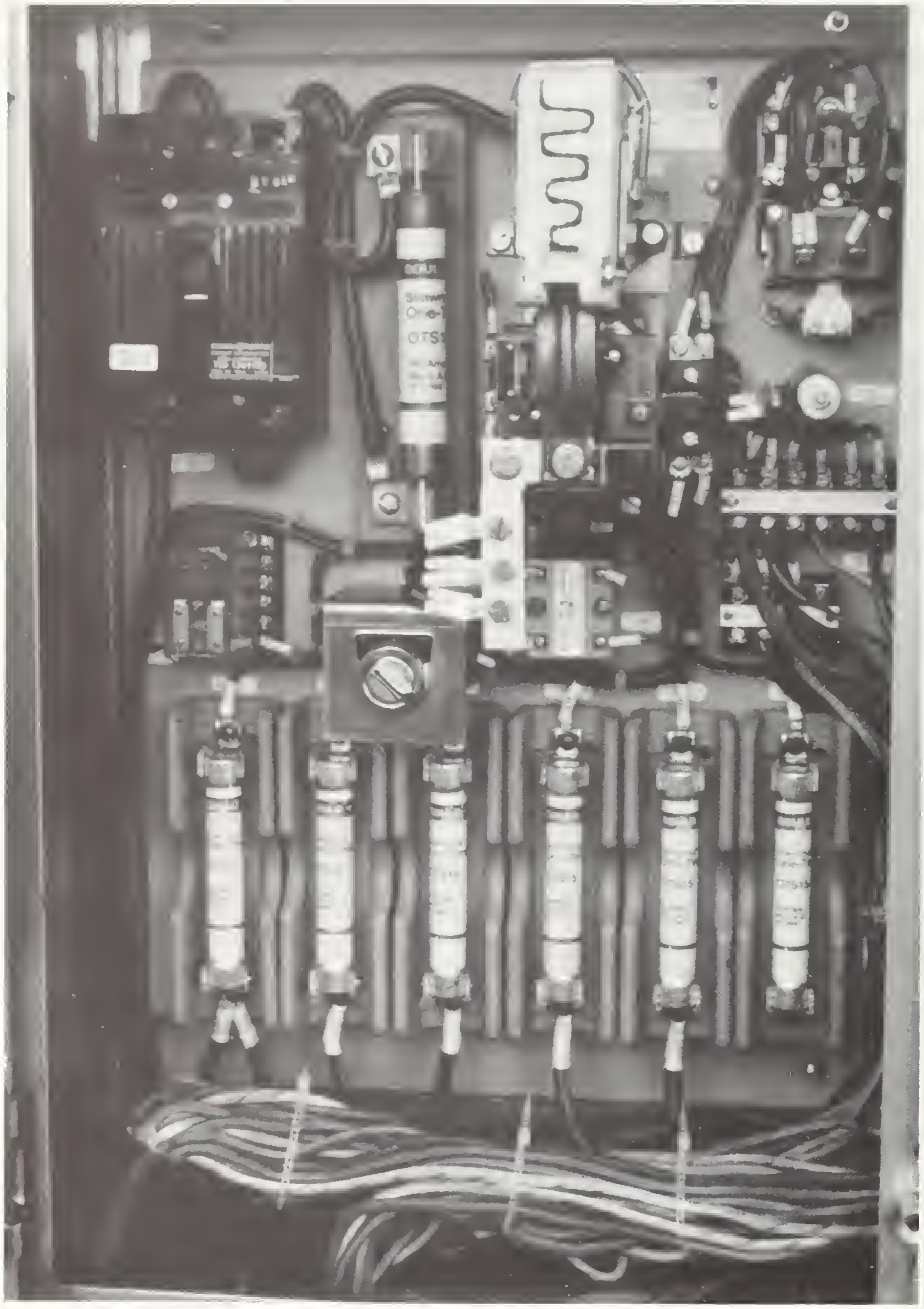

Fig. 4.3. MBTA Third Rail Heater Control Box

- The clips on some tubular heaters have restrained the free movement of the heaters, resulting in bowing.

- Moisture has entered the heater, resulting in grounding.

- Interference with rail communications circuits has occurred, due to improper connection of the heater ground lead.

Only three of the snow belt properties with third rail do not use third rail heaters. They are LIRR, WMATA and SEPTA. The LIRR had used third rail heaters, but has determined that they are not effective. WMATA and SEPTA believe they are too far south to justify the cost for third rail heaters. All of the other snow belt properties depend on third rail heaters as a necessary piece of hardware for protection against third rail icing and consequent electrical isolation of the car.

4.2 Underriding Third Rail

One little-used solution to third rail icing problems is an underridng third rail. SEPTA on their Market-Frankford Line and the Westchester County Division of the New York Metropolitan Transportation Authority on their Harlem and Hudson Lines (operated by Conrail), use an underriding third rail. SEPTA personnel do not recall ever having an icing problem with their third rail on the eight route miles of the Market-Frankford Line that runs above grade on an elevated structure. An insulated cover formed to the third rail provides protection for personnel as well as providing a path for water to flow down from the upper areas of the rail. Since no water is present on the third rail contact surface, ice does not form. An underriding third rail is shown in Fig. 4.4 and the corresponding collector shoe is shown in Fig. 4.5.

Fig. 4.4. SEPTA Underriding Third Rail on the Market-Frankford Line

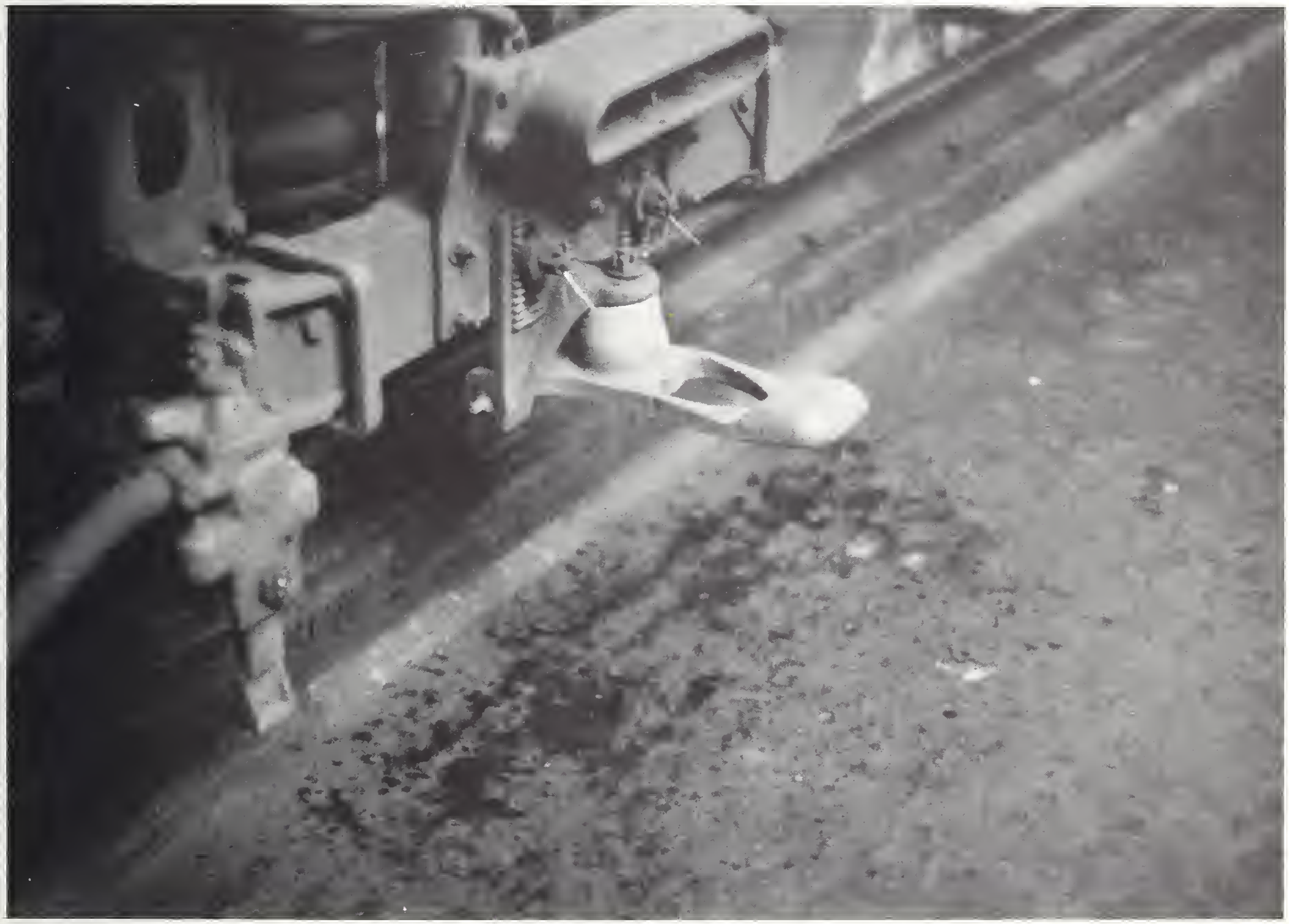

Fig. 4.5. SEPTA Underriding Third Rail Collector Shoe (right) and Trip Cock (left)

4.3 Third Rail Sleet Scrapers

Sleet (ice) scrapers are used by several transit properties to remove sleet and ice from the third rail. These scrapers are designed to apply pressure to the contact surface of the third rail to remove ice and sleet. The scraper unit can either be a modified collector shoe as in Figs. 4.6 and 4.7 or a separate unit mounted on a beam cantilevered off a truck as in Fig. 4.8 and 4.9. Collector shoes are modified for use as sleet scrapers by adding metal scraper blades, cutting tool bits and welded metal strips.

Scrapers have varying degrees of effectiveness, depending on scraper pressure against the third rail, ambient temperature, thickness of ice or sleet. The ice or sleet thickness depends on the time between ice or sleet formation and scraping, or the frequency of scraping.

TTC has performed tests on ice scrapers and has recently abandoned the use of ice scrapers on their system. (TTC now relies on their third rail heaters.) Their tests showed that no ice scraper could exert enough pressure to remove ice after it had frozen hard to the third rail. Other properties such as CTA and MBTA use ice scrapers extensively on their systems and are satisfied with their operation. These two properties do not use third rail cover boards and therefore can apply a direct downward force with their scrapers.

4.4 Trolley Wire Sleet Removers

Trolley wire sleet (ice) scrapers or sleet wheels are installed by several properties utilizing an overhead power supply system. Trolley pole sleet scrapers or sleet wheels replace the normally-used contact

Fig. 4.6. PATCO Ice Scraper Shoe

Fig. 4.7. LIRR Carbide-Tipped Ice Scraper Shoes

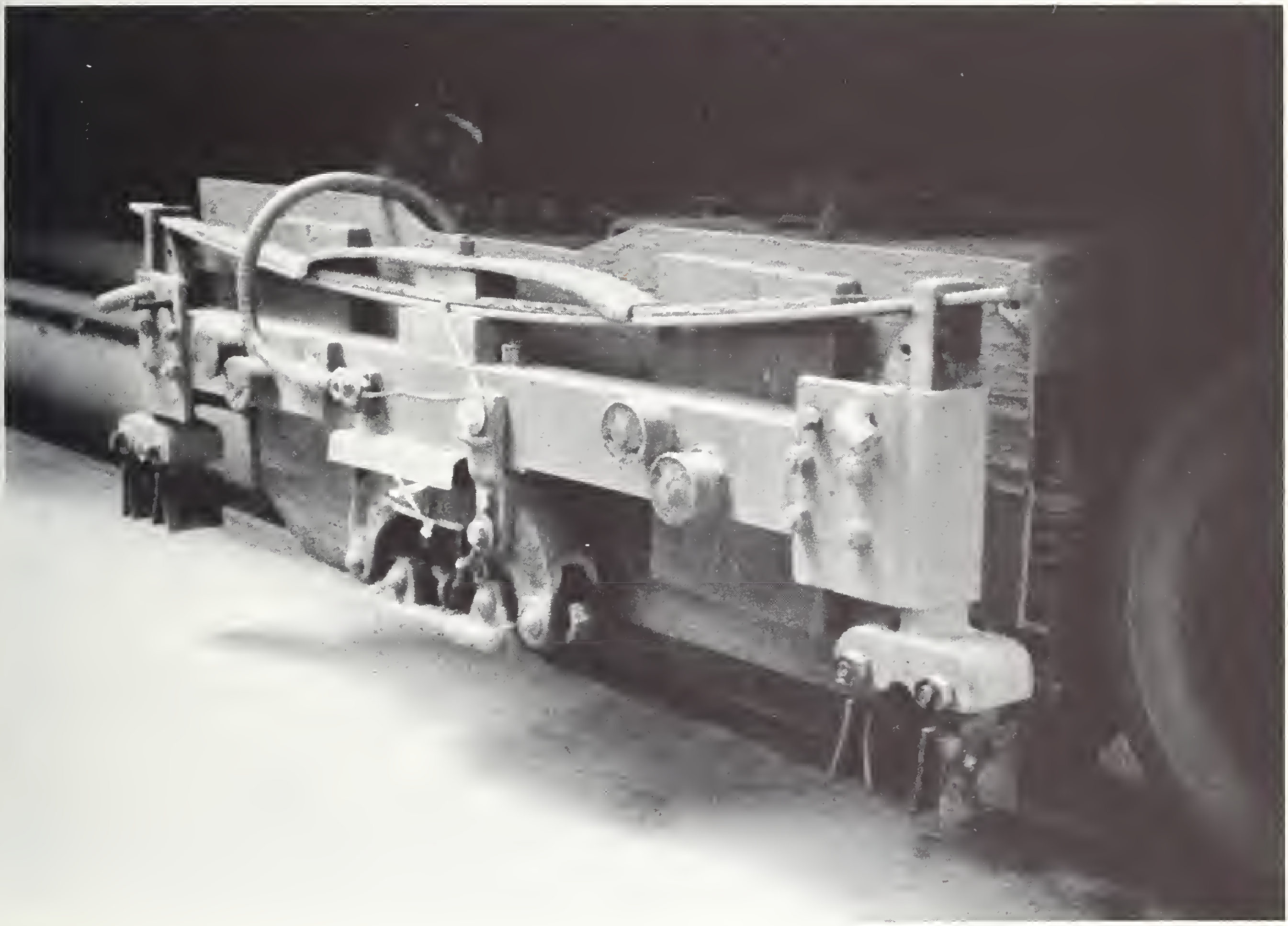

Fig. 4.8. CTA Third Rail Collector and Ice Scraper Assembly

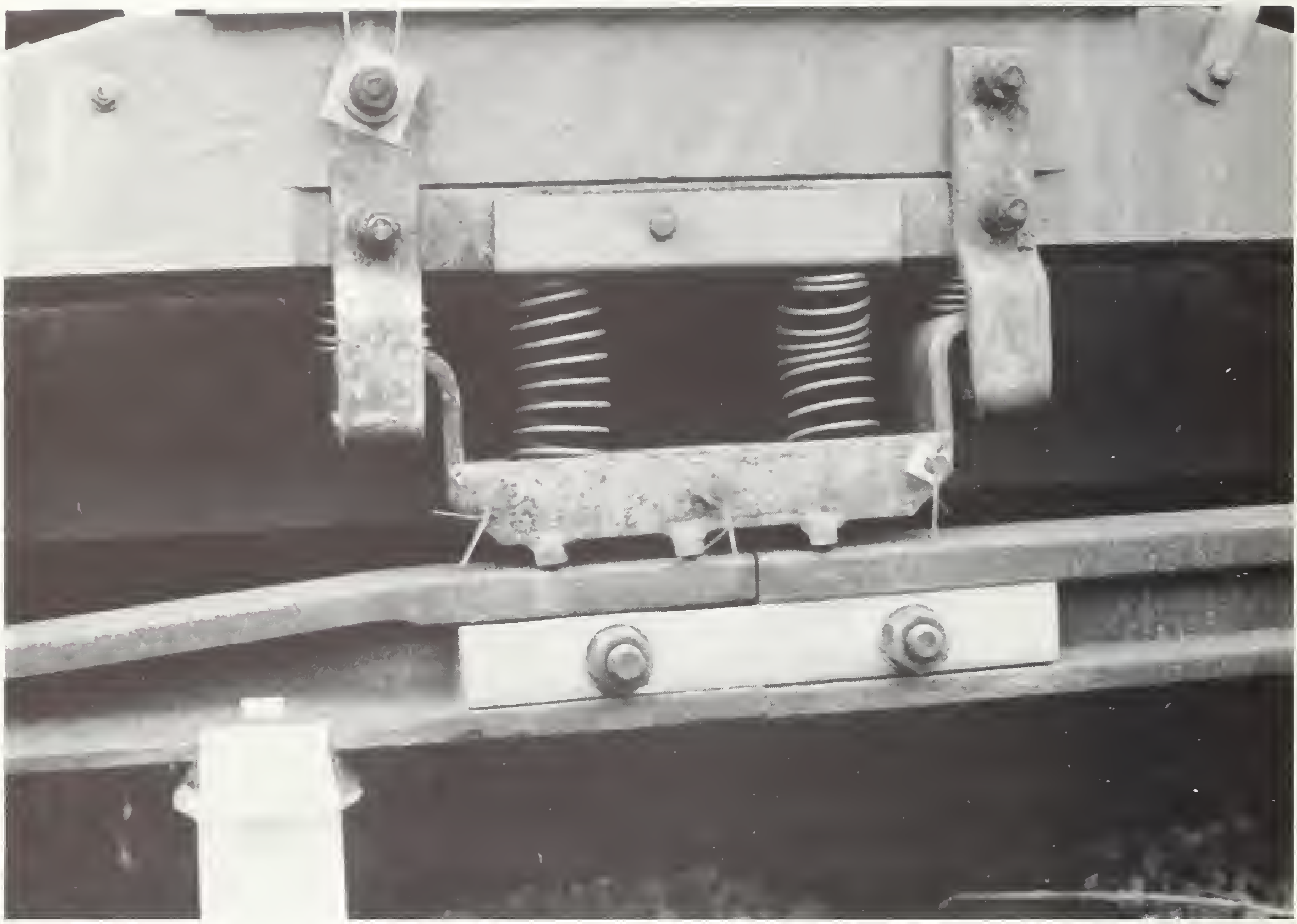

Fig. 4.9. MBTA Red Line Flatcar Ice Scraper

shoe or wheel in a trolley pole. The MBTA, using pantographs with their overhead power collecting systems, replace their normal shoe head with a head made up of steel runners. These shoe heads are current-carrying. GCRTA uses a non-current-carrying pantograph as in Fig. 4.10 equipped with steel runners to scrape ice. This pantograph is mounted on the second car of a married pair. Since these sleet removers tend to wear the trolley wire at a rate far greater than the normal contact material, they are only installed when the need arises and then promptly removed as soon as conditions allow.

4.5 Third Rail Deicing Solutions

Deicing solutions have been used by several properties with varying degrees of success. The two techniques concerning the application of a deicing solution used are 1) to coat the third rail periodically during the winter and 2) to coat the third rail in anticipation of sleet or icing conditions. The solutions used include ethylene glycol mixture, Penetone, a brine solution, and a sleet paste mixture made from graphite, ethylene glycol, and water.

In some cases, the application of these deicing solutions is accomplished by utilizing specially refitted work cars as in Fig. 4.11 which deposits the solution by means of a piping arrangement through special collector shoes as shown in Figs. 4.12 and 4.13. Other properties have sprayed the solution manually from slowly moving cars through a hand-held applicator. Some thicker solutions such as sleet paste require personnel to brush the solution directly onto the third rail as they walk along the track (CTA and SEPTA).

Fig. 4.10. GCRTA Pantograph Ice Scrapers

Fig. 4.11. SEPTA Pickling Car - Tank with Deicing Solution as well as Collector Shoes Designed to Dispense Solution onto Third Rail

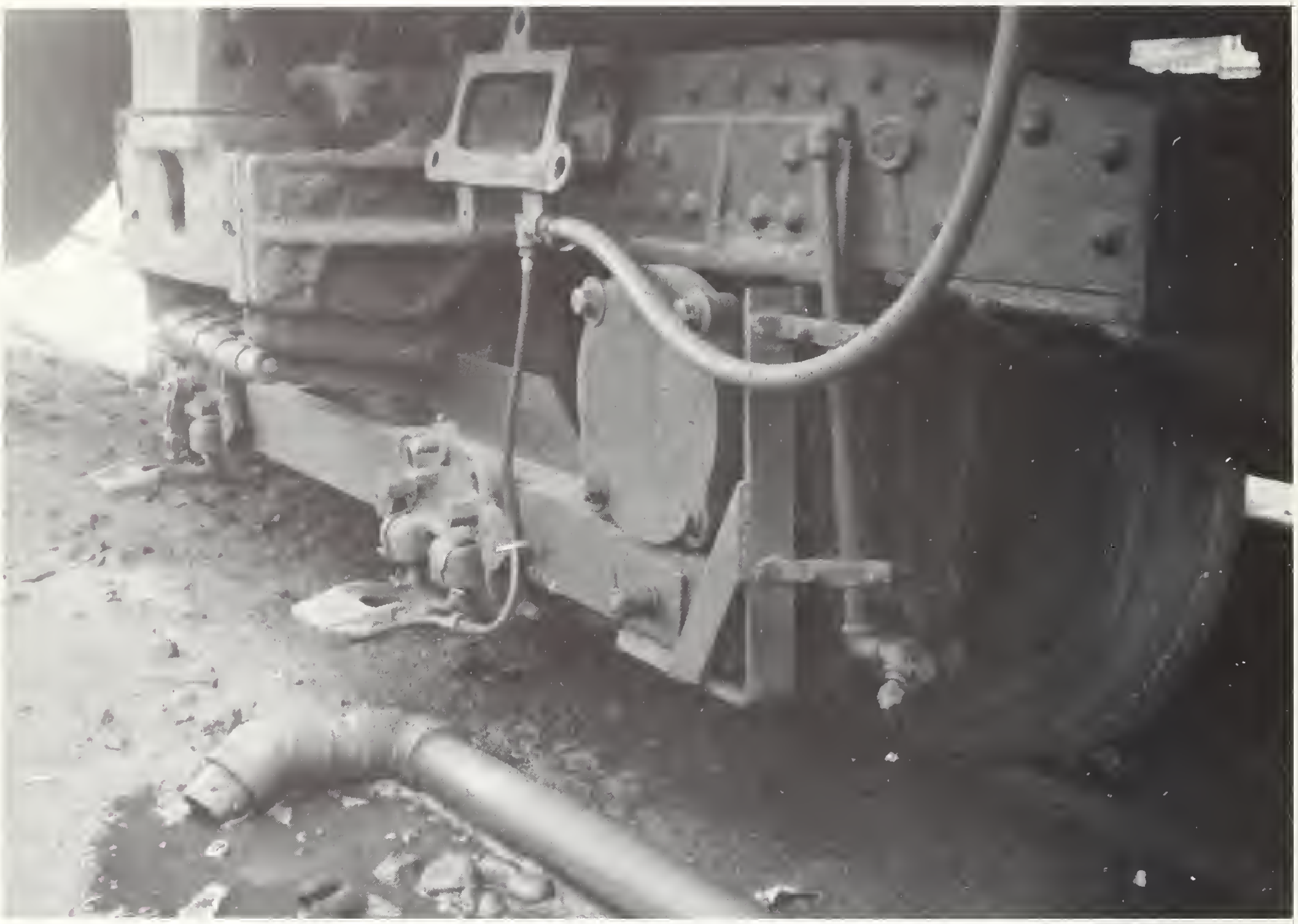

Fig. 4.12. LIRR Alcohol Car with Deicing Solution Dispenser Shoe

Fig. 4.13. LIRR Deicing Solution Dispenser Shoe (Underside)

The LIRR is convinced of the positive effectiveness of their deicing solution even though it must be reapplied frequently, while NYCTA has recently abandoned the use of their alcohol car for deicing application due to unconvincing results. No controlled testing of third rail deicing solutions has been made, so a final determination as to its worth is not possible at this time.

4.6 Third Rail Cover Boards

Third rail cover boards are installed by most transit properties for safety reasons. An additional benefit for their use is that they are somewhat effective in preventing sleet from accumulating on the third rail. However, any wind present during a sleet or snow storm minimizes the protection offered by a cover board. A typical installation is shown in Fig. 4.14.

While MBTA and CTA do not use cover boards, the other transit properties that do are unable to push their scraper blades onto the third rail with sufficient direct downward force for effective ice removal. Further, some cover board designs tend to trap snow, making snow removal by plowing or blowing difficult.

4.7 Winterized Traction Motors Through Design and Maintenance

Until the winters of '78 and '79, few transit properties were seriously concerned with the problem of widespread traction motor failures, when exposed to heavy winter storms. After those winters, several new traction motor maintenance procedures and hardware changes were implemented by some transit systems in response to this problem.

Fig. 4.14. SEPTA - Norristown High Speed Line with Cover Board over Third Rail. Third Rail on Both Sides of Track at Stations

Irish linen filters are now used by several properties during the winter period to cover the traction motor air cooling inlets so as to reduce snow ingestion. Filters are also inspected regularly to insure that excessive air blockage does not occur. Properties that use Irish linen filters believe their motors are less subject to failure due to snow ingestion, although no controlled testing has been performed to verify this.

Some traction motors that draw their cooling air from inlets above the motor have a severe water ingestion problem from wind blown snow packing around the inlet vents during high wind conditions which then melts and drips into the motor. GCRTA, who has had this problem, changed the positions of their air inlets to below the traction motors and secured the solid inspection cover to the top of them. This approach has eliminated direct water ingestion by the GCRTA traction motors.

The inspection covers on traction motors of some transit authorities are now bolted closed during the winter. It was found that the spring-loaded cover fasteners originally provided with the motor could be opened and even dislodged when the motor was dragged across deep unplowed snow along the right-of-way. Snow could then easily enter the traction motor, causing a failure. The bolted covers have eliminated this cause of snow ingestion.

Air inlet placement for self-ventilated traction motors, whether on the top, sides, or bottom, has usually been done by the traction motor designers to accommodate the particular truck manufacturer. Tests or studies to establish the best configuration for more reliable winter operations have not been undertaken. A typical traction motor configuration showing the air inlets is provided in Fig. 4.15.

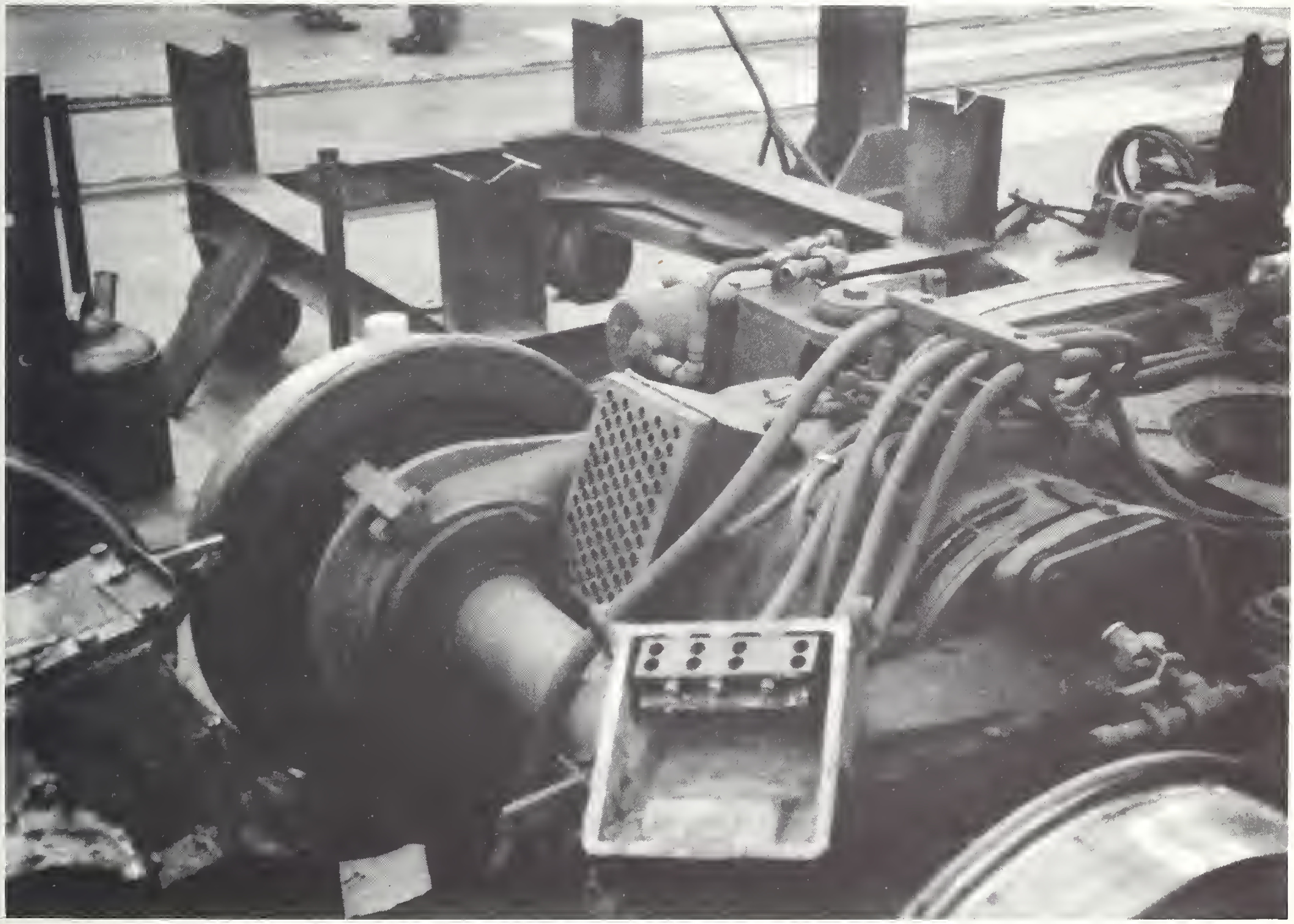

Fig. 4.15. PATCO Truck Showing Traction Motor Air Inlet Above Axle

Forced ventilation of traction motors, using a separate blower which draws air from either the top or the side of the car, has resulted in fewer traction motor failures than self-ventilated traction motors. The CTA has experience with two types of cars utilizing forced-ventilated traction motors, and they have indicated that forced ventilation cooling is an effective means of minimizing motor failures.

Another ventilation scheme proposed by one manufacturer is to blow the air through the traction motor after inertially separating the suspended particles from the clean air, using a U-shaped duct. Inertial separation has been used for other electric motors with success, but has not been tried with traction motors.

Traction motor maintenance procedures and maintenance schedules that are recommended by the manufacturer must be followed to prevent motors from being susceptible to failure due to snow ingestion. Motors whose windings are treated with a vacuum pressure impregnation (VPI) of epoxy resin every four to five years, or 200,000 miles of operation, are less apt to have a motor winding failure caused by snow ingestion than those motors whose windings are not treated at these recommended intervals. Most of the transit properties visited now include a VPI treatment during traction motor overhauls. Those properties that do not include the VPI treatment still have major traction motor problems during snowstorms. The VPI treatment fills voids in the winding insulation which would otherwise absorb moisture and degrade the insulation. The procedure must be repeated at the intervals stated above because the epoxy ages, dries out, and cracks after longer intervals.

During the winter months, the LIRR applies a metal band on the motor-alternator air cooling duct exit area to partially restrict air flow which results in less moisture being ingested. This should not degrade motor-alternator performance, since less cooling air should be required during the colder winter months. Manufacturers warn, however, that too restricted an air flow could result in overheating of motors. Since no one has established by design or test how much of the exit area can be safely blocked, this procedure may slowly "cook" motor insulation and reduce its service life.

4.8 Switch Heaters

Switch heaters as in Fig. 4.16 are used by transit systems as well as by railroads to prevent freeze-ups of track switches. These tubular ohmic heaters are used at the switch points and operating mechanism areas to provide protection against ice buildup. A new heater which blows hot air through a duct to the space between the switch points is being tested by both GCRTA and TTC. An installation of such a heater is shown in Fig. 4.17.

Arrangements for control of the heaters vary from property to property. Remote control at the Operations Center, remote control at local towers, and manual control on location are all in current use. GCRTA energizes their switch heaters at the onset of winter, and they remain on until spring. Other properties energize their heaters only when snow and icing conditions are predicted, and turn them off when no longer needed.

Fig. 4.16. PATCO Electric Switch Heater

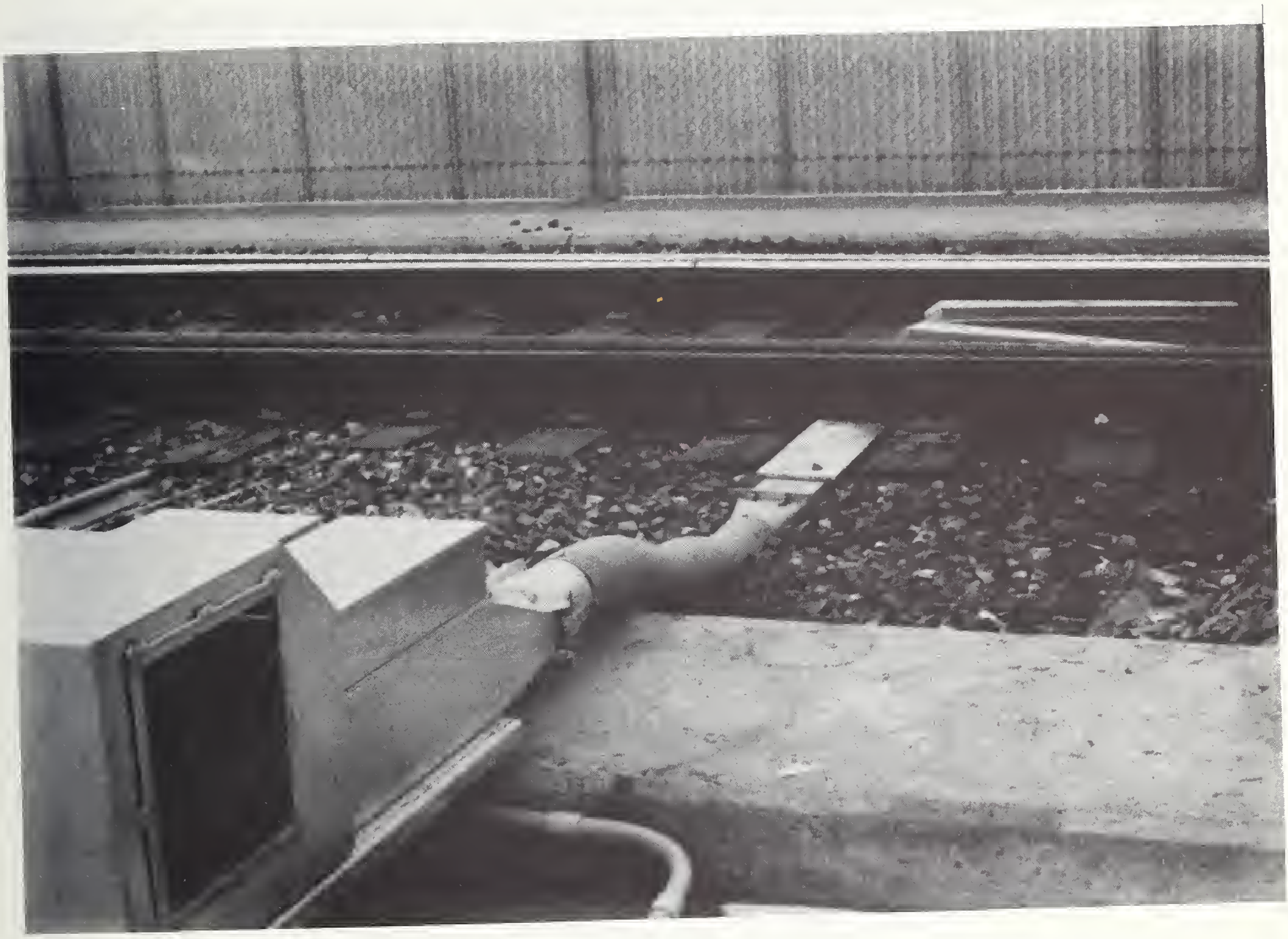

Fig. 4.17. TTC Hot Air Switch Heater and Ductwork

Switch heaters are effective in keeping switches operating through most winter storms. Problems with an occasional switch heater failure indicate that periodic inspections are necessary to increase reliability of operation.

Centrally controlled switch heaters presently use annunciator lights to indicate the position of the on/off switch for each heater section. However, this does not assure that the heater is actually working, since an open circuit would not be detected. Future designs should consider actuating the annunciator lights by means of heater current sensors to verify that the heaters are actually operating when turned on.

4.9 Train Stop Heaters

Train stop heaters are used on several properties to prevent the train stop operating mechanism from freezing up in one position or the other due to snow and ice accumulation. Heaters used are generally tubular, and are bent into a shape which accommodates and heats the train stop operating mechanism, as in Fig. 4.18. TTC is presently using a flat plate heating device, which is placed under the operating mechanism to melt any snow which might fall into the area.

The train stop heaters are effective in minimizing train stop freezing for most cases. Problems arise when failed heaters are not detected, so periodic inspection is necessary. Train stop heaters are controlled in a similar manner to switch heaters.

Fig. 4.18. PATH Train Stop and Tubular Heater

4.10 Trip Cock Plows and Shear Pins

Trip cock plows and trip cock shear pins reduce the chances of false emergency braking of trains due to excessive accumulation of packed snow along the train stop right-of-way. Trip cock plows are designed to clear a path in light or medium density snow in front of the car's trip arm, so that false actuation of the trip arm does not occur. Trip cock plows are generally made of a hard but flexible material, so that if a raised wayside train stop is encountered by the plows, no damage is sustained.

Some properties insert shear pins through a hole in the trip cock. Wooden wedges are used by other properties to restrict trip cock operation. These pins or wedges prevent the actuation of the trip cock when it encounters an accumulation of light snow in its path along the right-of-way. The trip cock acts as a snowplow during this type of operation. However, when the snow is hard packed, it will not be possible to prevent the inadvertent operation of the trip cock since the breakage of the shear pin or wedge would then occur.

4.11 Diesel Locomotives with Plows

The use of plow-equipped diesel locomotives by several properties provides them with a means for clearing snow from the right-of-way without dependence on the wayside electric power. Plows are generally "V" shaped when viewed from above, and are attached to both ends of the locomotive as shown in Fig. 4.19. The plows clear the tops of the running rails by four inches to allow for guard rails, so heavy

Fig. 4.19. TTC Diesel Locomotive with Plows on Both Ends

accumulation of snow is necessary for them to be effective. Use of plows occasionally results in the burying of the third rail and packing of snow into switch and train stop moving parts as the right-of-way is being cleared.

Since diesel locomotives do not depend on the third rail for power, they can tow trains to stations or to yards should third rail power be disrupted due to adverse weather. Some plows for locomotives have cutouts to clear above the third rail. Several properties believe a better plow could be designed which would lift the snow from the right-of-way and deposit it on the outside of the third rail.

4.12 Snow Plows and Snow Blowers on Work Equipment

Most transit properties have at least one vehicle capable of plowing or blowing snow from the track. Plows can be attached to most road/rail vehicles, tampers and other work vehicles. Their usefulness is limited by the same problems that plague the locomotive-mounted plows. The application of plows on work vehicles has generally been most successful on properties using trolley wire, since there is no concern for contact with the third rail or burying the third rail with packed snow dumped by the plow as it clears the right-of-way.

The smaller-than-standard wheels used on road/rail vehicles causes them to derail more readily on the switches and sharp turns of some transit properties. Road/rail vehicles are therefore generally restricted to clearing snow from yards, access ramps and parking lots rather than from mainline track. Examples of plows are provided in Figs. 4.20, 4.21, 4.22 and 4.23.

Fig. 4.20. SEPTA Shear Plow on Work Car

Fig. 4.21. LIRR Plow Car Pushed by Locomotive (Non-Electrified Territory)

Fig. 4.22. MBTA Green Line Snow Plow Vehicle

Fig. 4.23. MBTA Primary and Secondary Plows on Red Line Flat Car

The plows are generally shaped as a straight blade or as a "V" blade. The straight blades can be turned to push the snow on either side of the track. The "V" blade plows owned by some properties will remove snow from the running rails, but will push the snow to both sides of the track. Unfortunately, the third rail is on one of those sides. The proximity of the third rail to the running rails limits the allowable width of any plow, to prevent the plow blade from grounding the third rail, or knocking the third rail off its supporting insulators. Therefore, snow is often not plowed far enough away from the track on the third rail side. Instead, it forms a windrow or bank of packed snow alongside the running rail, especially on curves.

The MBTA has plows on some Red Line flat cars that have both primary and secondary blades, as shown in Fig. 4.23. The primary plow is an offset "V"-shaped blade, which has the limitations of other "V" plows, as described above. The secondary blade is truck-mounted, and is contoured to clear around the third rail. Truck mounting of the secondary blade allows the plow to operate much closer to the third rail without danger of contact, eliminating or reducing the windrow.

The ideally shaped plow would lift the snow up from the track and deposit it outside the third rail. While this ideal plow has yet to be designed, such a design is considered by some to be feasible.

Snow blowers mounted to special work cars and high rail vehicles eliminate the problem of covering the third rail, but are not able to remove snow that has accumulated around it. Examples of snow-blower attachments for work cars are provided in Figs. 4.24 and 4.25.

Fig. 4.24. MBTA Snow Blower Mounted to Blue Line Work Car

Fig. 4.25. MBTA Tamper with Snow-Blower Attachment

4.13 Jet Snow Blowers

Jet snow blowers are owned or leased by several transit properties. This type of vehicle has proven to be quite effective in removing snow from the right-of-way and yards of the LIRR. The jet blower is propelled by a diesel engine and uses a Westinghouse J34 jet engine for snow removal as shown in Fig. 4.26. The jet engine mounting is designed to allow rotation about the two axes normal to the jet axis. The operator directs the exhaust of the jet engine at the rails while controlling the vehicle speed, which is typically between two and five miles per hour while removing snow. Temperature and velocity of the exhaust jet are regulated by the rate of fuel consumption, which is nominally 200 gal/h. The vehicle is capable of travelling 20 or 30 mi/h when not blowing snow, depending upon the gear ratio chosen.

The vehicle can be hydraulically lifted, then manually rotated 180 degrees to change the direction of travel. NYCTA, another user of the jet blower, requires that this rotation procedure take place only at crossovers, so there is little possibility of third rail contact by the crew during the rotation procedure.

The jet exhaust can blow, vaporize, melt or glaze the snow, depending on the temperature of the exhaust, duration of the exhaust on one area, and the consistency and temperature of the snow.

Problems that have occurred with jet blowers are: (1) failure of the unit to start when required and (2) blowing loose ballast and debris away from the track by use of excessive exhaust velocity or aiming the jet

Fig. 4.26. NYCTA Jet Blower

axis down too far. These problems are usually corrected by better training of jet-blower operators.

The jet-blower operation is noisy, but most properties believe that this noise will be largely tolerated, since it will only be used under emergency snow conditions and is of relatively short duration at any one wayside location.

4.14 Special Snow and Ice Fighting Cars

Several transit properties have refitted older cars as special snow and ice fighting cars. Some of these vehicles are equipped to operate from a wayside dc power source, while others must be pushed by a diesel locomotive or another powered car connected to the wayside dc power source. Examples of these special vehicles are provided in Figs. 4.11, 4.20, 4.21, 4.22, 4.23, 4.24 and 4.27.

The snowfighting features of these vehicles include front and rear end plows, truck-mounted plows contoured around the third rail, underslung plows, wing plows, ice scrapers, third rail wire brushes, special third rail deicing solution-dispensing shoes along with an onboard reservoir of solution, dedicated motor-compressors direct high velocity air-through nozzles aimed at the third rail (mounted in alcohol cars of LIRR and NYCTA), rotary track brooms, scoop plows for the area between the third rail and running rails, and front-end mounted rotary snow blowers. One variation of one of the above features is an individual truck (shown in Fig. 4.28) with either a snow plow or snow blower mounted on it, which is pushed by a powered car.

Fig. 4.27. SEPTA Snow Fighting Car with Rotary Sweeper

Fig. 4.28. PATH - Individual Truck with a Snowplow Attachment

The vehicles containing the above features are generally older, heavier cars which have been modified from their initial role as revenue cars to become work cars. All of the features are somewhat effective in removing snow and ice from the rail right-of-way.

In general, only minimum amounts of money have been spent by rail transit properties for snow fighting apparatus and vehicles, including jet blowers, since only minimal service delays have occurred on most transit systems until the major storms of the recent past seasons. During the past decade, when snow was not causing delays, the money which could have been used to purchase snow fighting equipment was used for other operating purposes. Many transit personnel believe it is economically foolish to spend money on a vehicle that may be used only once in ten years.

4.15 Door Heaters

Door guide and door pocket heaters are installed on revenue cars of some transit properties to prevent ice from forming in the door tracks or door pockets. These heaters are found effective in minimizing door freezing problems and the delays in service which then would occur. Problems with failed heaters have occurred on several properties due to high levels of moisture in and around the heaters.

4.16 Snow Brakes

Several transit properties that utilize tread brakes on their revenue cars have added a snow brake feature to these tread brakes. When the snow brake feature is actuated, the tread brakes are energized to maintain a constant minimal air pressure of approximately 10 pounds per square inch in the brake cylinder. This minimal air pressure causes the brake shoe to lightly press against the wheel tread to generate sufficient heat to prevent the formation of ice between the wheel tread and the brake shoe. The snow brake feature is activated on command from the Operations Center. This activation is performed either by the operator or by maintenance personnel depending on the property. Snow brakes are de-activated after the snow and icing condition has passed. Occasionally, a snow brake remains activated on a car by error; as a result some additional war of the brake shoe occurs. The MBTA controls their snow brakes from one location through trainlined activation and de-activation of all snow brakes on a train.

4.17 Snow Fences

Snow fences are used by several properties where wayside conditions are favorable for their use. The University of Toronto has done studies for the TTC and developed models for evaluating the effectiveness of snow fence installations, with successful results. Snow fences have proven effective in minimizing the accumulation of drifting snow on the transit system right-of-way due to high cross-winds.

Snow fences require placement between 50 and 100 ft away from the track, and must be coordinated with the wind direction most prevalent during snowstorms. Freak snowstorms from an unusual direction will minimize the effectiveness of a snow fence, and may even deposit more snow on the right-of-way than with no snow fence.

4.18 Collector Shoe Pressure

Several properties have increased their collector shoe pressure on a continuous basis as a means for insuring better contact between the collector shoe and third rail during icing conditions. The increased pressure reduces the vulnerability to slight ice buildup on the third rail and does not significantly reduce collector shoe life. Two factors limit the increase allowable in collector shoe pressure:

- forces from too high a collector shoe pressure could push the third rail off of its supporting insulators

- space limitations limit the size of the collector spring, and therefore the maximum force or collector shoe pressure it can generate.

4.19 Underslung Plows on Revenue Cars

The CTA has installed underslung plows in 200 of their revenue cars. These plows are designed to prevent traction motors or any other undercarriage-mounted equipment from coming in contact with deep snow that has accumulated between the tracks. The initial design of these plows is shown in Fig. 4.29.

Fig. 4.29. CTA Underslung Snowplow for Revenue Cars

5.0 DEPLOYMENT AND EFFECTIVENESS OF VARIOUS HARDWARE MEASURES

This section of the report provides a summary of those properties where each of the various winter hardware measures are used, and how effective each property has found them. The results are presented in tabular form with a description of the findings in the text. A comparison of the various measures used to combat each of the three major winter problems also follows.

5.1 Where Used

Tables 5-1 through 5-8 have been assembled to explain which properties have installed certain hardware to combat the effects of winter weather. Additionally, the tables provide information on the extent of use, the ratings or any special conditions of use and whether the property believes the hardware worked as desired. Specific comments on the hardware are also provided where it is warranted.

5.2 Effectiveness

Each of the hardware measures described is designed to overcome a particular winter problem. For some of the major problems, transit properties have tried more than one approach. These approaches are equated here in terms of relative effectiveness, costs, ease of implementation and unwanted effects.

Table 5-1

Third Rail Heater Use By Transit Property

	Third rail heaters used	Prevent ice from forming	W/ft in use	Amount of third Rail heaters Installed	Other Comments
CTA	yes	yes	35	17,000 ft	Presently using MI cable - planning to install strip heaters - Presently uses local control
GCRTA	N/A	--	--	--	Overhead supply system
LIRR	yes	no	300 100	2,000 ft	Abandoned use of heaters, too many failures, were replacing 300 W/ft heaters with 100 W/ft as failures occurred-local control.
MBTA	yes	yes	50 70	37,000 ft	Remote control from Command Center for Red Line Planned for Orange Line also. Indicator light on control box.
NYCTA	yes	yes	200 70	20,000 ft	Changed from 200 W/ft tubular heaters to 70 W/ft strip heaters, some heaters thermostatically controlled others local control.
PATH	yes	yes	75	1 mile	Local control. Indicator light on control box.
PATCO	yes	yes	175	3 sections near stations and on bridge	Control of heaters from adjacent station platform.
RTA	N/A	--	--	--	Commuter rail service - no third rail.
SEPTA	no	--	--	--	Underriding third rail on Market Frankford Line - no icing problem. No heaters used on Norristown Line of Red Arrow Div., occasional icing problem areas - could use heaters.
TTC	yes	yes	15 30	6,000 ft	Calrod, MI and pipe enclosed in use. Test program underway at Wilson Yard. Local control.
WMATA	no	--	--	--	Says too costly to install on entire system.

Table 5-2

Third Rail or Trolley Wire Sleet Scraper Use By Transit Properties

	Rail or trolley wire sleet scrapers used	Built into the collector shoe	Effective in removing ice	force used in lbs	Other Comments
CTA	yes	no	yes	100	Ice scrapers are mounted from a beam which is attached to the trucks. Metal scraper blades have a 200 mi life.
GCRTA	yes	no	yes	25	Overhead system. Steel runners used on dummy pantograph for heavy rail and steel trolley shoes used on light rail system.
LIRR	yes	yes	yes	90-100	Carbide cutting bits secured to collector shoes.
MBTA	yes	no	yes	100	Older Orange Line cars use scrapers that are similar in design to CTA. An ice scraper provided by Hawker Siddeley on the new Orange Line cars is pneumatically operated.
NYCTA	no	--	--	--	None are used.
PATH	no	--	--	--	None are used.
PATCO	yes	yes	yes	60	Made from regular shoes with two angled welded beads on bottom.
RTA	N/ A	--	--	--	Commuter rail system.
SEPTA	yes/no	yes	yes	25	No scrapers are used to clear ice from the third rail. Use steel inserts in trolley poles (Red Arrow Div. -Light rail)
TTC	no	--	--	--	Abandoned use of scrapers after tests showed no scraper can apply enough pressure to remove ice.
WMATA	no	--	--	--	None are used.

Table 5-3

Third Rail Deicing Solution Use By Transit Properties

	Third Rail Deicing Solutions Used	How applied? M-Manually C-Though collector shoe O-Other from car	Are they applied in anticipation of a storm or at a regular interval throughout winter	Other Comments
CTA	yes	M/C	Both	A sleet paste described previously is applied manually while ethylene glycol is applied during a storm through special equip. onboard the snow fighting trains
GCRTA	N/A	--	--	Overhead system
LIRR	yes	C	Both	Applied at 1-2 week intervals and during storms.
MBTA	no	--		Relies on third rail heating and ice scrapers
NYCTA	yes	O	Both	Penetone is applied 2 or 3 times per season. An alcohol/fuel mixture is applied during storms from special cars
PATH	yes	C	Regular Intervals	Its effectiveness is questionable but its yearly cost is low
PATCO	yes	M	Applied twice prior to winter	Seems to help but has never been proven, used on bridge
RTA	N/A	--	--	Commuter railroad with diesel electric service
SEPTA	yes	C	During sleet or rail icing conditions	A special pickle car with a 5000 gal tank-dispenses a calcium chloride solution to the 3rd rail through a special collector shoe
TTC	yes	M	During several icing conditions	Ethlylene glycol is applied by hand through a 2 1/2 gal garden type sprayer-not too effective
WMATA	no	--	--	Has not been used

Table 5-4

Switch Heater Use By Transit Systems

	Are switch heaters used?	Do they prevent snow and ice buildup?	Are they remotely controlled?	W/ ft	Comments
CTA	yes	yes	some	300	Some controlled from Control Room and others have local control
GCRTA	yes	yes	no	300	Calrod heaters energized for the entire winter period Experimenting with hot air blowers for switch points
LIRR	yes	yes	no	500 250	Gas and calrod heaters are used
MBTA	yes	yes	yes	800-900 max.	Control is from the Operations Center
NYCTA	yes	yes	no	500	Mostly local control
PATH	yes	yes	no	75	Local control
PATCO	yes	yes	yes	350 500	The newer heaters are 500 W/ ft Central control of switch heaters
RTA	yes	yes	no	--	RTA is responsible for the rail commuter services in the Chicago area for railroads
SEPTA	yes	yes	no	300	Local control
TTC	yes	yes	yes	300	Electric calrod type heaters are used. Experiments with a hot air blower are underway
WMATA	yes	yes	yes	250	Controlled from Operations Center

Table 5-5

Train Stop and Trip Cock Winter Equipment Use By Transit Properties

	Are train stop heaters used?	Are trip arm plows used during winter storms?	Are restricting devices used in the tripcocks during storms?	Comments
CTA	yes	no	no	Calrod train stop heaters are used
GCRTA	no	yes on light rail	yes on rapid rail	Shear pins are inserted in the trip cock on the rapid rail service and an aluminum plow blade is used on light rail
LIRR	N/ A	N/ A	N/ A	None are used
MBTA	yes	yes	no	Wood splinters are used to plow snow in front of the trip cocks
NYCTA	no	no	yes	Wedges are placed in the trip cocks
PATH	yes	yes	no	A stiff rubber hose is used to plow snow in front of the trip cock
PATCO	N/ A	N/ A	N/ A	None are used
RTA	N/ A	N/ A	N/ A	None are used
SEPTA	yes	no	no	Calrod train stop heaters are being installed
TTC	yes	no	no	A new heating plate design is used to keep trip stops functioning
WMATA	N/ A	N/ A	N/ A	None are used

Table 5-6

Snow Fence Use By Transit Properties

	Are snow Fences used?	Are they effective?	Comments
CTA	yes	yes	Somewhat effective - requires wide right-of-way
GCRTA	no	--	Not used
LIRR	yes	yes	Somewhat effective - requires placement at a sufficient distance from the rails
MBTA	yes	yes	Somewhat effective
NYCTA	no	--	Not used
PATH	yes	yes	Removed but are now reinstalling during winter period
PATCO	no	--	Not used
RTA	no	--	Not used
SEPTA	no	--	Not used
TTC	yes	yes	Modeling tests have been performed to determine optimum location of fences
WMATA	no	--	Not used

Table 5-7

Vehicle Maintenance and Winter Equipment Use by Transit Systems

	Traction Motors		Doors	Brakes	Comments
	VPI treatment at overhaul	Irish linen filters	Are door heaters used to prevent icing?	Are snow brakes used to maximize braking effectiveness?	
CTA	yes	yes	yes	no	Major traction motor failures on 2200& 2400 cars forced ventilation used on series 2000 & 2600 cars minimum problem
GCRTA	no	yes	no	yes	Snow brakes and Irish linen filters are major factors during winter
LIRR	yes	yes	yes	no	Had major traction motor failures during 77-78 winter storms - instituted new programs
MBTA	no	no	no	yes	Snow brakes are a major winter factor for continued service
NYCTA	yes	yes	no	no	Coney Island Shop now prepared to overhaul traction motors
PATH	yes	yes	no	yes	Uses traction motor overhaul procedures including VPI. Puts several pounds pressure in brake cylinders during winter (snow brake)
PATCO	yes	yes	yes	no	High regard for vehicle maintenance
RTA	--	--	--	--	Diesel locomotives use forced ventilated traction motors
SEPTA	no	no	no	yes	Traction motor problems common in winter Winters are generally milder than most other areas
TTC	being installed	no	no	no	Major part of system is covered
WMATA	yes	no	no	no	Newer system in a generally milder winter

Table 5-8

Vehicles for Winter Operations Use by Transit Systems

	Are diesel loco. used on your system?	Are diesel loco. equipped with plows?	Are jet blowers used on your system?	Are any dedicated winter weather fighting cars used?	Are snow-plows or blowers mounted to any work cars during winter?*	Are high rail vehicles equipped with plows?	Are plows mounted to revenue cars?	Comments
CTA	no	--	no	yes	yes	no	yes	Planning to buy rotary snow-blowers
GCRTA	yes	yes	no	no	yes	yes	no	Overhead system so use of plows is not detrimental
LIRR	yes	yes	yes	yes	yes	no	no	Depends on jet blowers for yards & sections of track in 3rd rail territory
MBTA	no	--	yes	yes	yes	yes	no	Planning to buy a rotary snow-blower for Southwest Corridor cut Several special cars are used
NYCTA	yes	yes	yes	yes	yes	no	no	Has recently purchased 2 jet blowers for mainline use
PATH	yes	no	no	yes	yes	no	no	Snow train approach minimizes need for additional equipment
RTA	yes	yes	yes	no	no	no	no	Jet blowers are used in yards Diesel electric loco. used on mainline
SEPTA	no	--	no	yes	yes	yes	no	Several special cars are used
TTC	yes	yes	yes	no	yes	no	no	Has locomotive with a battery power besides diesel
WMATA	yes	yes	no	no	no	yes	no	Planning to purchase additional equipment

*Other than locomotives

5.2.1 Third Rail Icing

Several means are employed by transit properties to overcome third rail icing problems. They are:

- Third rail heaters
- Third rail sleet scrapers
- Deicing solutions.

Third rail heaters appear to be the best alternative for keeping ice from forming on the third rail, provided they are turned on at an early time and inspected regularly. However, most third rail heaters have higher relative costs of installation, maintenance and operation than the other approaches. Since no transit system heats its entire third rail, exposed portions of third rail which are not heated can still cause problems. Excessive clamping pressure causes heaters to bow and insufficient conductive surface results in thermal failure of the heater unit. Presently about 5-10 percent of third rail heaters installed must be replaced each year due to failures.

Ice scrapers are used on several systems to remove ice from the third rail. Ice must already be present for a scraper to be effective, and if weather conditions and the periodicity of scraping are such that a hard layer of ice is allowed to form, the scrapers may not apply enough force to remove the ice. Scraper blades have a life of about 200 miles of operation before they must be replaced. Some blades tend to break apart if not replaced when the metal scraping edges have worn down. Additional noise as well as flashing occurs during the use of ice scrapers.

Third rail deicing solutions are used by many transit properties, but their effectiveness appears to be just marginal. Collector shoes tend to remove the solution from the contact surface of the third rail shortly after application. The LIRR has been testing anti-bonding solutions which are designed to prevent ice from forming on the third rail but has not found any that are long lasting. The major reason most properties continue to apply deicing solutions is that the costs are low, especially for those properties with solution dispensing hardware on specially-equipped work cars.

5.2.2 Traction Motor Failures

The means available to reduce traction motor failures include:

- VPI insulation treatment during timely overhaul periods
- Filtering of intake air using Irish linen
- Repositioning of the inlet areas to minimize moisture ingestion
- Use of forced ventilation for the traction motors where air is drawn from above or on the side of the car.

The two independent options which best seem to protect the motor against failure due to snow ingestion are the VPI insulation treatment and forced ventilation. VPI treatment performed at regularly scheduled overhauls minimizes the chances of moisture absorption into the motor windings. Forced ventilation draws cleaner air for motor ventilation and would therefore minimize moisture ingestion.

Forced ventilation would reduce traction motor noise and increase traction motor ratings while having a higher initial cost and requiring additional equipment.

The other methods listed to protect traction motors approach the problem in a different manner. They restrict the air flow or try to draw air from a drier inlet position. Irish linen filters do reduce moisture ingestion through traction motors. However, if they are not inspected and removed when clogged or when warm weather occurs, excessive heating of the traction motors can occur resulting in a decrease of insulation life.

5.2.3 Snow on the Right-of-Way

Several methods of clearing the right-of-way from snow have been used by transit properties. They are:

- Snow plows on work cars
- Snow plows and third rail brushes on work cars
- Snow brooms or sweepers on work cars
- Snow plows on diesel locomotives
- Snow plows on diesel locomotives followed by a vehicle containing third rail compressed air blowers
- Snow plows on high rail equipment
- Jet snow blowers
- Snow plows pushed by powered units
- Snow blowers on high rail equipment.

The most effective method to remove deep snow from the right-of-way appears to be the jet snow blower. The jet snow blower is capable of clearing the area between the running rails, around the third rail and in switches and crossovers from snow. The snow is blown, vaporized, melted or glazed along the right-of-way depending upon the operating conditions. The need for a large amount of additional manual labor for snow clearing is eliminated with the use of a jet snow blower. The jet snow blower operates at a rate of 2 to 3 mi/h and has a high noise level. Fuel is used at a rate near 200 gal/h and the vehicle's cost is in the range of $100,000.

The next most effective vehicles in use contain an end-mounted-snow plow, used in conjunction with truck-mounted third rail brushes or third rail blowers. These vehicles perform two of the functions of a jet blower: clearing snow from above the running rails and clearing around the third rail. These vehicles do not remove snow down to the ties or from switches, crossovers and train stop areas. Their effectiveness on clearing the third rail is questionable, since the plow may move snow onto it, causing a windrow.

The vehicles containing only a plow or snow blower would be useful on systems with overhead trolley wire instead of third rail. When a plow is used on systems with third rail, snow usually is directed onto it. When snow is allowed to accumulate to such depths that revenue vehicles cannot pass and only simple plow-type equipment is available, this equipment should be employed to re-open the right of way. It should be noted that additional manual labor will then be required to remove the remaining snow, since the third rail, communications equipment, switches and crossovers will still be covered. High-rail equipment can be driven behind a stalled train to clear the tracks if the location is accessible, but it has the tendency to derail on switches and on the minimum radius curves existing on some transit properties.

6.0 DESCRIPTION OF WINTER EMERGENCY PLANS AND OPERATIONS

Each of the transit systems visited has established an overall strategy or plan of attack for altering their normal winter operations to combat severe weather conditions. Documented procedures, improved communications, and changes from their normal operational strategies form the elements of most winter emergency plans. The use of each of these measures and their effectiveness, as judged by the transit systems visited, are discussed in the sections which follow.

6.1 Winter Emergency Plans

Each transit system has composed some documentation on the procedures to be followed during a winter emergency. The most complete set of documentation has been compiled by NYCTA. Each division at NYCTA has its own manual, which is procedurally coordinated with the other divisions through a coded strategy indicating level of effort. In addition, the NYCTA manual contains information on the following areas:

- Names and home phone numbers of key personnel to be called into work.
- Inventories of winter supplies
- Ratings for winter conditions, and the level-of-effort required for each rating
- Locations of switch and third rail heaters.

- Locations of available undercover space for sheltered train storage

- Deployment site of snow and ice fighting equipment

- Operational procedures involving the following: train length, train snow schedule, Command Center, weather reporting, jet blower, diesel locomotives, trip cock wedges, express tracks, yard storage, snow fighting trains, polishing trains, doors, manned locations and winter training.

The CTA as of November 1979, had not formalized a snow plan; however, several memos have been written describing certain levels of action. A coded level of effort plan, based on a contracted weather forecasting service, is described. In addition, details of the following items are included in the plan:

- Alert personnel to snow emergency
- Arrange for sleet trains and crews
- Operational procedures involving the following: lengthened trains, shortened headways, increased communications, use of sleet scrapers and switch heaters, trains in yard, sleet paste, application of antifreeze solutions to flangeways.

The GCRTA winter operations document is written in a format which describes specific problems, then states the solutions which personnel should employ. The document also provides useful information in the following areas:

- Call-out personnel and early storm warning
- Inventory of winter equipment and supplies
- Vehicle storage
- Contracted snow removal
- Training of supervisors and personnel
- Operational strategies involving: frozen doors, shear pins, coupler covers, fan covers, Irish linen motor covers, snow trains, snowplows and sleet scrapers.

The LIRR describes its winter operation plan in a summary document formed from the experiences of the past year. Included in the plan are details on the following items:

- Call-in of supervisors to emergency assignments
- Establishment of Command Center
- Weather data collection
- Listing of Highway Department personnel, with telephone numbers, by town served
- Increased communications with media and passengers
- Deployment of snow equipment

- Inventory of winter supplies and equipment
- Traction motor overhauls
- Contracted snow removal
- Operational strategies involving: Irish linen filter motor covers, exhaust seals, diesel locomotives, plows, patrol trains, alcohol cars, extra trains, lengthened trains, revenue service shutdown, jet blowers, switch heaters, switches, scraper shoes and collector shoes.

The MBTA Winter Storm Plan is formed from supplements composed by each department. The plan includes information on the following items:

- Inventory and stockpiling of all necessary winter equipment components
- Testing of all switch heaters, train stop heaters, and third rail heaters
- Listing of highway personnel of towns served
- Operational procedures involving the following items: Storm Center, portable radio use, troublesome locations, temporary snow shovelers, storage of cars, wire jumpers for auxiliary power, snow brakes, ice scrapers, switch operations, splinters for plowing snow in front of trip cocks, lengthened trains, inspection, snow clearing, heater activation, car preparation, and snow fighting equipment locations.

The PATH winter emergency plan is divided into sections which establish the responsibilities of each division. The plan provides information in the following areas:

- Weather forecasts
- Implementation of weather-related operations
- Inventory of winter equipment
- Update of employee list
- Update of contractor list
- Inspection of winter equipment and check on operability
- Instruction of personnel
- Operational strategies which include: power jumper cables, scraper trains, train stops, air lines, switches, signals, switch heaters, third rail heaters, train stop heaters, snow blower, plows, diesel locomotive, brakes, couplers, lay-up heat, doors, trip cock plows and third rail deicing solution.

The PATCO snow plan is jointly written by the Operations, Car Equipment and Way and Power Departments. The plan includes information in the following areas:

- Employee call-in
- News media contact
- Center tower Command Center

- Train storage
- Inventory of winter supplies
- Operational strategies involving: lengthened trains, reduced headways, snow trains, ice shoes, plow, inspection and maintenance during storms, third rail heaters, switch heaters, operator reports.

The RTA does not have a winter plan for the commuter rail service within its area around Chicago. Rather, the individual commuter rail lines who are responsible for daily operations would be responsible for such winter plans.

SEPTA begins their snow plan document with a listing of names of key personnel (as well as their telephone numbers) for their snow emergency organization. The SEPTA plan also provides details in the following areas:

- Call-up of employees during a snow alert
- Employee and equipment deployment
- Passenger and public information, including schedule changes to accommodate closings of schools and business
- Storage of trains
- Operational strategies which involve: train length, additional trains, train stop cut-out procedure, brakes, trip plows, pilot trains, switch heaters, snow melters, doors, auxiliary equipment, air lines, and third rail shoes.

The different sections of the TTC winter operations plan are written through a coordinated effort by the Transportation, Equipment, and Plant Departments. The plan includes information in the following areas:

- Weather forecasts
- Increased inspection and testing of equipment
- Train storage
- Inventory of snow fighting supplies and equipment
- Storm clean-up
- Safety during snow and ice work
- Hiring temporary laborers for snow removal
- Deployment of equipment
- Operational strategies involving: switch heaters, third rail heaters, train stop heaters, locomotives, jet blower, snowplows, snow blower, brakes, pavement and stairway heaters, ice scrapers for overhead light rail and bus systems, air lines, water absorbing grease, doors and storm trains.

The standard operating procedure of WMATA contains a section on storm and snow operations and in addition their Rail Operations Department has a set of instructions for handling winter emergencies. Details included in the plan cover the following topics:

- Emergency Command Center
- Retention and call-in of employees
- Inventory of supplies and equipment
- Train storage
- Schedule changes due to early dismissal of government employees
- Operational strategies involving: extra trains, lengthened trains, switches, switch heaters, polishing trains, station personnel and snow plows.

6.2 Improved Communications

A major problem during the blizzards of 1977-78 and 1978-79 which affected transit system operations was poor communications between the transit authority and its employees, the revenue passengers, and the general public. Since that time, most transit authorities have taken measures to improve their communication links in all three of the above areas:

- Employee Communications

  The most common means of internal systems communication is through multi-channel radio. Transit properties with newer equipment have assigned separate channels for communications along each route or for each operating department. Supervisors are provided with portable radios and train crews have access to control cab radio equipment. Additionally, some transit properties install telephone equipment on station platforms and at crossover areas as a backup system in case radio communication is lost between the Command Center and train crews and other employees. Other properties have train phones which transmit their information to the Command Center through the rails.

In a winter storm, these communication links are used to report stalled trains, damaged equipment, icing conditions, drifting snow, status of operation for special winter vehicles, as well as many other conditions to the Command Center. Without good communications during a storm, greater delays in service and a higher possibility of a shutdown exist.

- Passenger Communications

  Most transit systems are now able to communicate with their revenue passengers through public address systems on the trains and at the station platforms. Some properties use these public address systems to provide bulletins to their passengers, at frequent intervals, to keep them informed of revised schedules and the conditions which are causing delays. Other transit properties assign personnel with megaphones to station platforms to inform passengers of service changes and answer other questions on service which the passengers may ask.

- Public Communications

  The Public Relations Departments of some transit properties are responsible for informing the general public on the current status of transit operations. Media links are established to make periodic announcements over radio and television. Recorded and updated status reports are provided at advertised telephone numbers to inform the public of system status and schedule changes. When some transit properties anticipate severe delays they invite media personnel to the Storm Control Center so a transfer of information concerning a change of system status can reach the public quickly.

6.3 Operational Strategies Employed Prior to Severe Winter Weather

In order to successfully overcome the problems of winter storms, a transit property must make sufficient preparations months in advance. This section deals with those preparations.

- Winter Operation Plan

  Transit properties should review and revise their winter operation plans on a yearly basis so new items can be added and practices no longer necessary can be deleted. The Snow Plan should contain information concerning personnel responsibilities, and the procedures to be followed for equipment use, as well as other applicable items listed in Section 3.1.

- List of Personnel

  Each property should have a prepared list of key supervisory personnel as well as a list of employees, all with home telephone numbers. When a winter emergency develops, calls can then be made quickly to personnel to report for work on predetermined assignments. These lists should be distributed to the appropriate supervisory personnel at the start of the winter season. It should be noted that a major cause of system delays and shutdown is that personnel cannot get to work once snow has accumulated, so it is important to call in some personnel before an anticipated storm.

- List of Highway Department Personnel

  The names and telephone numbers of Highway Department personnel responsible for snow removal in the local communities should be available in the Operations Center. This will allow faster mobilization of personnel and as a result, snow removal from station access roads will be quicker in the event that they should become blocked.

- Inventory of Winter Equipment and Supplies

  Most transit properties realize the importance of maintaining an adequate inventory of spare parts which include traction motors and motor generator-sets; and winter supplies which include shovels, brooms, ethylene glycol, rocksalt, alcohol, calcium chloride, Penetone, cots, pillows and blankets. The inventory should be sized to accommodate the needs of two successive snowstorms.

- <u>Phased Winter Plans</u>

  Three transit properties have established winter plans which contain four or five levels of action geared to the varying severity of winter weather, i.e., the temperature, and the type and amount of precipitation. The personnel in the Command Center communicates the plan of a selected level to the appropriate field personnel for implementation. Individual parts of the plan include train size and frequency, heater use, storage procedures and other items found in this section and in Section 3.4.

- <u>Snow-Equipment Deployment Plan</u>

  Some transit properties have major snow-fighting equipment which must be located near the area of its intended use. Snow-equipment deployment plans have been established by some transit properties to insure that the snow-fighting equipment owned by a property is dispersed to provide the most effective system coverage during a winter storm.

- <u>Training of Personnel</u>

  Work assignments during severe winter weather will typically remove an employee from his familiar work and surroundings and place him in an unfamiliar setting with different operating conditions, and sometimes with new duties. In order to effectively combat winter storms, personnel should be given additional training and instruction on the techniques and safety aspects of their storm-fighting roles.

- <u>Contracted Snow Removal</u>

  Where transit properties do not have a sufficient amount of equipment necessary to remove snow from roads in their yard and in shop areas, they must contract with others for this service. Arrangements with contractors for snow removal should occur before winter, and a listing with their telephone numbers should be made available. Contractors must understand that their first priority must be the transit authority when they are called.

- <u>Train Storage</u>

  Arrangements for the storage of trains not in use during severe winter weather should be made so that the maximum amount of protection is provided. All available under-cover space in tunnels or in shops should be determined, so that personnel can move as many trains as possible to protected locations at the prediction of snow, sleet or severe cold weather.

- <u>Winter Storm Command Center and Communications</u>

  An organized effort to overcome winter weather requires a central Command Center. Communications equipment should exist at this location for direct contact with all field personnel, as well as passengers and the general public. Key personnel representing the appropriate departments should be assigned to the Command Center.

- Weather Data

  Transit systems often employ private weather services to obtain additional weather data to supplement the weather predictions obtained from the National Weather Service. A private weather service can tailor the weather report to better fit the needs of a property by covering smaller zones. The CTA directly coordinates their winter storm warning status with information obtained from their contracted weather service. TTC and the LIRR subscribe to a weather alarm monitor radio service. The radio turns on automatically with each updated forecast, so personnel in the Command Center will immediately know of any changes. Finally, some systems rely on a combination of data sources which include observations of field conditions by tower and train crew personnel to inform the Command Center of the weather status. Appendix B contains a data base of the weather experienced by the snowbelt transit areas over a period of several years.

- Inspection and Operation of Winter Equipment

  One of the most basic winter preparations a transit property can make is to inspect and operate all of its winter-related equipment in the fall to insure that is is functioning properly. This check should include all plows, blowers, deicing applicators and related equipment, heaters, and other winter equipment.

- Hiring Procedures for Temporary Snow Laborers

  Procedures should be established to facilitate the hiring of temporary help during a winter storm emergency. Additional personnel are usually needed quickly, so special procedures which minimize the required paperwork for hiring are necessary. Temporary laborers should not be expected to work near live third rail, either in the yards or on the right-of-way.

- Snow Schedules

  Several properties have established a special snow schedule which is designed to prevent snow and ice buildup by increasing service during the non-peak hours of operation, including weekends and holidays. The personnel at the Command Center are responsible for implementing the snow schedule during severe weather.

- School and Business Early Dismissal Plans

  Some transit authorities have instituted planned schedule changes to be used in the event of early dismissals of schools and businesses during a winter storm. These plans are best developed in advance and in cooperation with the management of the major schools and businesses in the area. Problems in the past have developed when early dismissals occurred at off-peak hours with no change from the off-peak schedule. Station platforms and trains were filled beyond their safe capacity in some instances.

- <u>Equipment Preparations for Winter Operation</u>

  Several measures are employed by transit authorities to increase equipment reliability during winter operation. Some of these measures are described in the following paragraphs.

  Periodically, throughout the winter, some properties apply an ice-inhibiting solution to the third rail. The solution is most effective, and is usually reapplied at weekly intervals.

  Some properties install an Irish linen filter over the traction-motor cooling-air inlet. This restricts air flow and reduces moisture ingestion. The LIRR restricts air flow through motor-alternators by using a restrictive steel band to reduce the exhaust-duct cross-section.

- The LIRR has established throw positions for switch points at several critical locations which should be used during a winter storm. This predetermination of switch positions ensures that most service could continue even if switches were to freeze up.

  PATH stores special couplers at designated locations which can be used to couple their standard cars to diesel locomotives. This device allows a locomotive to pull a stalled and stranded train to a station area during a storm.

TTC fills certain air-operated valves with a water-absorbing grease for winter operations. The grease is capable of absorbing its weight in water, which minimizes the chances of the air lines freezing up and becoming blocked with ice.

6.4 Operational Strategies Employed during a Winter Emergency

Transit properties employ a variety of operating procedures and strategies during a winter storm in order to remain in operation. Most of these measures are discussed in the following paragraphs.

- Lengthen Trains and Decrease Headways

  The first measures put into use during a winter storm are to lengthen the trains and to decrease headways between the trains. Lengthening the trains results in more reliable power collection since an increased number of collector shoes are operating and making contact with the third rail or trolley wire. Decreasing the headways reduces the accumulations of snow or ice along the right-of-way, since the time interval for successive trains to pass over the same section of track is reduced. The passing of a train over a section of track causes the snow to be blown off the right-of-way and the ice on the third rail or trolley wire to be broken up by the pressure of collector shoes.

- <u>Operate Track Switch Heaters</u>

  During a severe winter storm it is critical for the track switches to function properly in order for service to continue. Most systems in the snow belt area use electric heaters to keep their switch points and operating mechanisms free of ice. Some properties can remotely energize some or all of their heaters when severe weather is imminent. Others must manually energize each heater section at its location along the right-of-way. The time required to energize the heaters is important since one to two hours is usually required for the track switch components to heat up sufficiently to prevent ice buildup once the heater is turned on. (GCRTA keeps their heaters energized all winter to insure they are on when needed.) Another measure used to keep switches functioning during a winter storm is to throw them at periodic intervals.

- <u>Keeping the Third Rails and Trolley Wires Free of Ice</u>

  Ice on a third rail or a trolley wire can disable a train and shut down a system. Most transit properties maintain a reliable wayside power system during a winter storm by use of one or more of the following measures to prevent ice buildup: (1) third rail heaters, (2) third rail scrapers on the revenue cars, and (3) applying third rail deicing solutions from work cars. Systems with trolley wire employ overhead ice scrapers.

If third rail heaters can be turned on one to two hours before an icing condition is predicted, the third rail should be heated adequately to prevent any ice from forming. This pre-storm activation of the heaters provides more effective heater performance. Third rail heaters are either remotely controlled or locally controlled along the right-of-way, depending on transit property and the particular line.

Sleet (ice) scrapers are capable of removing light deposits of ice from the third rail or trolley wire. Transit authorities which use these scrapers must insure that they are employed at the onset of an icing condition to maximize their effectiveness. Some systems have operating procedures which describe the conditions for scraper use. Most of these require authorization from the Command Center for a train crew to engage the scrapers.

Several properties apply deicing solutions to exposed third rail once the weather report indicates impending precipitation, i.e. snow or ice. Again, the time to apply the solution is before ice forms.

If none of the above measures are implemented in sufficient time and ice does form a thick layer, then manual scraping of the third rail or knocking of the trolley wire with wooden poles would be necessary for ice removal.

- Train Stop and Trip Cock Reliability Measures

  Train stop and trip cock operation has been described in Section 3.0 and will not be repeated here. Transit authorities must keep this emergency safety system operable to avoid reduced safety or severe service delays. Several measures, including shear pins and limiting wedges in the trip cocks, trip area plows mounted on vehicles, and train stop heaters located around the operating mechanism provide means for minimizing problems. Plows, wedges, and shear pins must be installed and the heaters energized at the report of impending storms to assure reliable operation of train stops and trip cocks.

  Occasionally, a freak storm is encountered without much warning and this emergency safety system becomes inoperable. Whenever this occurs, an emergency procedure is then employed which disables the trip cocks. This results in a slowdown of operations, since train movement must then be directed from the Command Center.

- Trains in Storage Yards

  During off-peak hours most trains are stored in yards. During a winter storm emergency situation, these cars are vulnerable to becoming stranded or disabled due to snow or ice accumulation and ingestion. Several measures are used by transit properties to minimize this possibility:

The first step is to move as many cars as possible under cover (tunnels or shop buildings). Other measures include rocking the trains in open yards, keeping auxiliary power on so cars can remain heated and illuminated, and operating the doors and brakes to prevent them from freezing into one position.

- Snow Brakes

Freezing of brakes during severe winter weather can cause major delays and a loss of braking capability. Several properties have installed snow brakes on their cars to prevent ice from forming between the wheel tread and the brake shoe. Once the snow brakes are engaged for a storm (upon orders of the Command Center) effective braking performance is maintained despite the adverse snow and ice conditions.

- Winter Patrol Trains and Snow Trains

During severe winter storms, and particularly during non-revenue hours, several transit properties dispatch patrol trains to travel on their system. Several alternate names are used for these trains including polishing trains, scraper trains, and pilot trains. These full length (or longer) revenue car trains are used to minimize the buildup of snow on the third rail or trolley wire and running rails. Long trains are used to obtain more polishing or scraping action between the third rail or trolley wire and the collector shoes. The NYCTA uses 20-car consists which have their traction power electrically trainlined. PATH uses nine-car consists (also having their traction power electrically trainlined) to form their patrol trains. The LIRR uses 10-car consists while GCRTA, PATCO, TTC and WMATA use six-car consists for their patrol trains.

Snow trains deployed by some transit properties during severe storms are composed of retired revenue cars specially modified for fighting snow and ice. CTA has six married pairs equipped with plows, ice scrapers, deicing solution equipment, rerailing equipment, traction motor cooling air ducted from inside the car, and a traction power trainline switch. Other properties have modified snow fighting cars with some similar features and some additional ones, such as third rail air blowers.

- Diesel Locomotives

Several properties own diesel locomotives and use them for their work trains. These vehicles have a distinct operating advantage during a severe winter storm, since they operate independently of the wayside power. Stalled or disabled revenue trains can be pushed or pulled to station areas or yards by diesels deployed strategically along the right-of-way. Most diesel locomotives are equipped with snowplows, so the running rails can be cleared of excessive snow accumulation. Since diesels are hard to start during cold weather, NYCTA places locomotives in heated barns when not in use, or if that is not possible, keeps one coupled pair running at idle speed when the other unit is shut down.

- Jet Blowers

Several transit properties have purchased jet snow blowers for use during excessive snow accumulation to minimize the time for snow clearing and to avoid shutdowns, if possible. The jet blowers have been used to clear yards and sections of mainline track with positive results. They are usually built with a turntable to allow for operation in either direction.

- Snow Plows and Snow Blowers

Several types of snow plows are used to clear snow which has accumulated along the right-of-way. These plows can improve system operation during periods of deep snow accumulation by reducing the exposure of the undercar equipment to the damaging effects of hard-packed snow. Underslung plows applied by CTA to 200 revenue cars are designed to clear the space between the running rails so that the car's traction motors will not be dragged over hard-packed deep snow. Other plows mounted on work vehicles belonging to other properties are used to keep the right-of-way open, as well as to minimize undercar equipment problems due to snow.

Snow blowers attached to several work vehicles are used for similar reasons as plows and offer the advantage of depositing the snow outside the third rail or into adjacent dump trucks.

- <u>Use of Alcohol on Doors and in Air Lines</u>

  When doors and air lines freeze up, cars must be removed from service until the condition is cleared. Alcohol applied to the door tracks and placed into the air lines absorbs moisture to minimize freezing problems. Alcohol is used on door tracks and is placed in the air lines during snow and ice conditions and whenever severe cold occurs.

- <u>Discontinued Service on Express Tracks</u>

  During major snowstorms, the space for depositing snow along the right-of-way is sometimes lacking. NYCTA sacrifices its express tracks for snow storage during these storms in order to maintain service on their local tracks. Express service is continued using the local tracks until the storm is over and the express tracks are cleared of snow.

- <u>Power Jumper Cables</u>

  Jumper cables connected between cars of a consist are used by PATH to trainline traction power for operations during major winter storms. The jumper cables provide power to those cars that have lost their collector shoe contact with the third rail, due to a layer of ice. In most cases, the ice on the third rail is not continuous for long distances, so service interference is minimized with this approach.

The MBTA uses jumpers or bugs in a different manner than PATH. When a car is stalled due to severe icing conditions, a jumper is connected between the collector shoe and a contact surface along the third rail, or between collector shoes of adjacent cars, so that auxiliary power can remain on in order to minimize other car icing problems, such as freezing doors and brakes.

- Employee Assignments during Storms

In order to maintain operations under winter storm conditions, transit properties must effectively use their personnel. Employees stationed at platform areas to inspect cars, clean doorways and perform minor maintenance during a storm can improve operations and provide a strategic margin in the number of functioning revenue cars. Other employees, positioned at the key interlockings during severe weather, can quickly clear snow from switches to minimize service disruptions. Most transit properties have upper limits (typically 10-to-16 hours) on the number of continuous hours an employee can work before he must be allowed to go home. Once these limits are reached, transit authorities must have additional crews available if the storm fighting effort is to continue.

7.0 SUMMARY OF WINTER OPERATIONS IN USE

A summary of the winter operations used by each transit authority is provided in Table 7-1 through 7-5. Tables 7-1 and 7-2 describe those measures included in the documented Snow Plans. Table 7-3 provides the communication measures available and those additional measures implemented during winter storms. Tables 7-4a and 7-4b summarize the operational strategies used by each property to prepare for winter storms. Table 7-5 describes those measures employed by each property during a winter storm. These measures are described in greater detail in Section 6.0.

Table 7-1

Items Included in Winter Emergency Plan

	CTA	GCRTA	LIRR	MBTA	NYCTA	PATH	PATCO	SEPTA	TTC	WMATA
Early dismissal schedule										X
Hiring temporary snow laborers				X					X	
Testing of winter equipment				X		X			X	
Increased communications	X		X	X			X	X		
List of highway dept. nos. for towns served			X	X						
Weather data Collection	X		X		X	X			X	
Establish Command Center			X	X	X		X			X
Training of supervisors and personnel		X			X	X			X	
Contracted snow removal		X	X			X				
Coordinated plan among departments					X					
Deployment plan of snow and ice fighting equipment	X		X	X	X			X	X	
Locations of available undercover space for trains		X		X	X		X	X	X	X
List of switch and third rail heater locations					X					
Winter condition and level of effort required	X		X		X	X				
Inventory of winter supplies		X	X	X	X	X	X		X	X
List of key personnel to alert	X	X	X	X	X	X	X	X		X

Table 7-2

Procedures Included in Winter Emergency Plan Involving Operational Strategy and Hardware Modifications

	CTA	GCRTA	LIRR	MBTA	NYCTA	PATH	PATCO	SEPTA	TTC	WMATA
Snow brakes				X		X		X	X	
Pneumatic system water drain & alcohol use					X	X		X	X	
Power jumper cables				X		X				
Switch operation			X	X	X	X				X
Equipment covers bolted down		X	X							
Deicing solutions	X					X		X		
Heaters for switches, 3d rail & train stops	X		X	X	X	X	X	X	X	X
Sleet scraper use	X	X	X	X			X		X	
Manned locations			X	X	X					
Doors -alcohol use & snow clearing		X			X	X		X	X	
Express track use for snow storage					X					
Trip cock protection measures		X		X	X	X		X		
Diesel Loco.			X		X	X			X	
Jet blower			X		X				X	
Yard storage	X			X	X			X		X
Polishing trains	X	X	X		X	X	X	X	X	X
Snow fighting trains & equipment		X	X	X	X	X	X		X	X
Reduced headways snow schedule	X		X		X		X	X		X
Increased train length	X		X	X	X		X	X		X

Table 7-3

Employed Measures of Improved Communication

	Two-way radios	Train phone	Portable radios	Wayside telephones	Public address systems	Station information from personnel	Frequent press releases to media	Special recorded messages	Media personnel invited Command Center	Communications with other local transit agencies	Closed circuit TV
CTA	X	X	X		X	X	X		X		
GCRTA	X		X	X	X						X
LIRR	X			X	X	X	X	X		X	
MBTA	X		X		X		X		X		
NYCTA	X		X		X						
PATH	X			X	X						
PATCO	X		X		X		X				X
SEPTA		X			X		X				
TTC		X	X		X						
WMATA	X		X		X						

Table 7-4a

Operational Strategies Employed Prior to Severe Winter Weather

	CTA	GCRTA	LIRR	MBTA	NYCTA	PATH	PATCO	SEPTA	TTC	WMATA
Weather data special source	X		X						X	
Command Center with communication	X		X	X	X		X			X
Train storage		X		X	X		X	X	X	X
Contracted snow removal		X	X			X				
Training of personnel		X			X	X			X	
Snow equipment deployment plan	X		X	X	X			X	X	
Winter plan with different phases of operation	X		X		X	X				
Inventory of winter equipment & supplies		X	X	X	X	X	X		X	X
List of highway dept. of towns served			X	X						
List of personnel	X	X	X		X	X	X	X		X
Winter operations plan	X	X	X	X	X	X	X	X	X	X

Table 7-4b

Operational Strategies Employed Prior to Severe Winter Weather

	Inspect & operate winter equipment	Hiring procedures for temporary labor	Snow schedule	School & business early dismissal plan	Ice inhibiting 3rd rail solution	Traction motor inlet covers	Fixing switch positions for storms	Couplers for towing by diesel	Water absorbing grease
CTA					X	X			
GCRTA						X			
LIRR					X	X	X		
MBTA	X	X							
NYCTA			X						
PATH	X				X			X	
PATCO						X			
SEPTA				X					
TTC	X	X							X
WMATA				X					

Table 7-5

Operational Strategies Employed During a Winter Emergency

	CTA	GCRTA	LIRR	MBTA	NYCTA	PATH	PATCO	SEPTA	TTC	WMATA
Auxiliary equipment reliability measures					X	X	X	X	X	
Pneumatic system moisture reduction				X	X			X	X	
Employee assignments during storms at critical locations			X	X	X		X	X		
Power jumper cables				X		X				
Discontinue service on express tracks					X					
Door operation	X	X	X	X	X			X		
Snowplows & snow blowers	X	X	X	X	X	X		X	X	
Jet blowers			X	X	X				X	
Diesel loco.		X	X		X					
Snow fighting trains	X		X		X					
Winter patrol trains	X	X	X		X	X	X		X	X
Snow brakes		X		X		X		X	X	
Trains in yards					X			X		X
Train stop & trip cock reliability measures	X	X		X	X	X		X	X	
Third rail and trolley wire reliability measures	X	X	X	X	X	X	X	X	X	
Switch reliability measures	X	X	X	X	X	X	X	X	X	X
Lengthen trains & decrease headways	X	X	X	X	X		X	X		X

8.0 UPDATE OF THE 1978 MBTA STUDY

As a result of the 1978 MBTA Winter Operations Study performed by Alexander Kusko, Inc., the MBTA implemented several of the proposed recommendations. The effectiveness of those measures implemented, as well as other measures that were undertaken, is reviewed below.

- Third Rail Heaters

  The MBTA has installed remote controls for activating third rail heaters on their Red Line, and plans for similar action on the Orange Line are underway. The advantage of remote control is that the heaters can be activated immediately following the decision to do so. In the past, crews were dispatched to the local controls along the right-of-way to manually turn on the heaters. A delay of one to two hours could occur before all heaters were energized.

- Third Rail Sleet Scrapers

  A new third rail sleet scraper has been applied to the new Orange Line cars recently purchased from Hawker Siddleley Ltd. of Canada. These sleet scrapers are pneumatically actuated from a valve on the side of the car; no springs are used with this design.

- <u>Jet Snow Blower</u>

  The MBTA has purchased two jet snow blowers for use on its Orange and Red Lines. The jet blowers are kept at the Wellington Shop and the Cabot Shop and will be used for clearing snow from the yards. Because of the mild 1979-80 winter, jet blowers were only used during their weekly inspections and tests.

- <u>Rotary Snow Blower</u>

  The MBTA is in the process of evaluating the use of a heavy duty rotary snow blower, primarily for the open cut of the Southwest Corridor right-of-way, which is a natural collector of snow. It is anticipated that the MBTA will monitor the demonstration and evaluation of the rail-mounted snow removal vehicle that CTA is in the process of acquiring. Once this vehicle is evaluated and the specification for the snow removal vehicle is updated, the MBTA may use this updated specification to solicit bids for a snow removal vehicle to fit their operating environment.

9.0 CONCLUSIONS AND RECOMMENDATIONS

The conclusions stated below are based on information described in this report, which was obtained during discussions with key personnel of the various snowbelt properties. A set of recommendations on winter technology and winter operations, directed at transit properties and governmental agencies, is also provided in this section.

9.1 Conclusions

The various problems caused by the 1977-78 and 1978-79 winter storms that affected rail transit system operations has resulted in an increased awareness of both the severe winter weather problems and the technology that is now available to provide solutions for some, if not all of these problems. The net effects of these problems varied in severity from minor delays in schedule to catastrophic system shutdowns. Most operating personnel from the transit systems visited believe that operations should be continued through all types of winter weather, since the public requires their services most during these severe conditions. If this philosophy is also representative of transit management, then each property must equip itself with the hardware necessary for continued operation under the most adverse winter weather.

No universal consensus exists on the effectiveness of any piece of hardware implemented to date. For instance, third rail heaters were found effective by a majority of transit properties, but had been abandoned by the LIRR, who found them to be ineffective. Only within the last few years has any testing of hardware been performed to optimize the equipment installed. No transit property wants to spend the taxpayer's money on marginally effective equipment, so such test programs are always worthwhile for determining which hardware is effective, which needs additional research, and which should be abandoned as ineffective.

The personnel of snowbelt transit systems, who must specify their equipment, should have access to knowledge and experience gained by other snowbelt properties regarding their winter hardware. This access is needed to gain insights based on similar equipment requirements, so that pitfalls can be avoided.

All transit properties realize that quick and effective action must be taken at the approach of a winter storm. However, varying degrees of departmental coordination exist at each transit authority. Occasionally, employees are unsure of a course of action and no reference guidelines exist. In order to effectively combat winter storms, a transit authority must function as a coordinated unit, since only limited resources are available. Personnel must know how to react to a situation so that action can be taken quickly at the first sign of a problem.

In conclusion, with current technology it is possible for a transit property to modify some equipment and install a sufficient amount of new equipment to successfully maintain revenue operations both during and after the severest of winter storms. The societal benefits of continued operations during severe storms must inevitably be weighed against the costs of such equipment. If it is decided to support such a commitment after a cost/benefit study has been made, then the costs will be more readily accepted by transit management after the positive net cost/benefit has been established.

The taxpayer who ultimately funds these winterization measures will be more supportive once the winter hardware measures are demonstrated to be successful in maintaining transit service under adverse weather conditions that otherwise would have surely shut down the system.

9.2 Recommendations

Recommendations are proposed here to improve rail transit operations under severe winter weather conditions. These recommendations are based on the results of this study, and cover improvements in the methods of removing ice and sleet from the third rail, other equipment improvements, and additional recommendations that will improve operations under severe winter weather.

As the CTA snow removal vehicle development program advances, we recommend that particular effort be made to incorporate the requirements of the other snowbelt properties into the updated vehicle specification, as far as is practical, so that a more universal and less site-specific vehicle will be developed. To this end, we also recommend that testing of the prototype vehicle on other snowbelt transit systems be encouraged.

Recommendations for Improving Third Rail Clearing Equipment

Of the six different methods (discussed earlier) currently used for clearing ice and/or snow from the third rail, only four should be considered further since they are capable of clearing both ice and snow. These four are: third rail heaters, ice/sleet scrapers, jet snow blowers, and deicing solutions. The other two methods, compressed air blowers and brushes or brooms, are not effective for removing ice on the third rail.

Additional testing of these four methods is required to determine (1) which are the most effective devices for each method, and (2) how do the most effective devices for each method compare with each other to keep the third rail free of ice and snow.

These tests should be conducted either at a snowbelt transit property or in a laboratory under simulated conditions, where feasible, to find the answers to these two questions. The scope of these tests is outlined below.

The specific recommendations for third rail clearing equipment are as follows:

- Third rail heater tests should be conducted to evaluate strip-type, tubular-type, and MI-type heaters in terms of:
  - watts per linear foot required for effective performance
  - use of insulation to reduce required watts per foot
  - costs to purchase and to install.

  Presently, transit properties use anywhere from 35 to 200 W/ft and no two systems have identical installations. Measures should also be considered to thermally insulate the side of the third rail exposed to the weather to minimize heat loss. Tests should be performed to develop an effective procedure for optimum use of ice scrapers in conjunction with third rail heaters. An evaluation of the methods for remote control of third rail heaters should be made, so that heater activation and de-activation, as well as positive verification of system status, is obtained.

- Ice/sleet scraper tests should be made to determine the best scraper blade material and the optimum scraper pressure on the third rail. Tests should take into account third rail structural and pressure spring limits, or other design limits, costs, and rail conditions which warrant scraper use, as well as optimally timed procedures for implementation. Determination of whether a separate truck-mounted ice scraper assembly or a modified collector shoe design will perform best should also be made.

- Jet snow blower tests should be made to determine how effectively the jet snow blower can clear ice from the third rail in terms of operation speed for various conditions of ambient temperature and degree of third rail ice buildup. Also, if only ice is present (and not snow) on the right-of-way, tests should determine whether it is economical to operate the jet snow blower solely to remove third rail ice, as compared to the other methods for third rail ice removal discussed in this report.

- Tests of various deicing solutions such as ethylene glycol, Penetone, sleet paste, and an alcohol/oil mixture should be made to determine the temperature and icing conditions for which each solution is effective, the period of effectiveness of each solution once it is applied to the third rail, and the cost and manpower involved for each application. Determination of the most suitable means for application such as a special third rail deicing car with customized application shoes, should also be made.

- We further recommend that a comparison be made of the four methods (mentioned above) for keeping the third rail free of ice and snow. The results of these tests would be considered along with the following criteria:

    - Reliability of devices - measured in terms of the average mean-time-between-failures (MTBF).

- Initial cost to install - dollars per track mile.
- Cost to operate - typical costs of energy, manpower and materials per storm day, per track mile.
- Need for manpower to operate - man-hours per day per track mile.
- Vulnerability to misoperation through human error.

This assessment of the various methods to keep the third rail free of ice and snow during storms should then be documented in a report, showing the best approach to third rail ice removal, based on data from the recommended tests, plus an evaluation of each method against the criteria listed above. This report should then be made available to all snowbelt transit systems.

Recommendations for Other Equipment Improvements

Equipment failures due to moisture and extremely low temperatures are troublesome to transit properties and merit further development and testing to find their solutions. We recommend equipment improvements in the following areas:

- Traction Motor Ventilation Improvements
  Modify traction motor ventilation systems to reduce ingestion of moisture. Forced ventilation, including the drawing of drier cooling air from inside the car, is one approach which should be evaluated. The use of inertial filters to trap moisture is another known technique that is worth considering for self-ventilated traction motors.

- <u>Traction Motor Maintenance</u>

  Encourage snowbelt transit properties to perform necessary traction-motor overhaul maintenance as outlined by the manufacturer's recommendations. Overhauls which include vacuum pressure impregnation of the motor windings should typically be done every four years or every 200,000 miles to maintain a motor's resistance to short circuit failure due to ingested moisture.

- <u>Jet Snow Blower</u>

  Encourage snow belt transit properties to evaluate their need to purchase jet snow blowers for the rapid clearing of yards, since this device clears out ice around switches and third rails more thoroughly than other means, except for ohmic heaters.

- <u>Collector Shoes</u>

  Determine, by tests, the optimum collector shoe pressure for each snowbelt transit property with third rail for best operation under conditions of ice and sleet.

- <u>Doors</u>

  Consider redesign of door mechanisms so they are less likely to trap moisture and freeze up in severe cold. Heaters and mechanical designs that are less prone to freeze up with moisture should be developed, and results made available to equipment builders and transit properties.

- Brake and Control Air Lines

  Use of air dryers, moisture traps and drains, automatic drain valves with heater coils, and other means should be tested to determine which of these measures are the most effective means for preventing air line freeze-ups. Results of these tests should then be made available so they can be applied to existing and new equipment by the operating properties and the equipment builders.

- Wayside Power

  Consider the use of an overhead catenary or an under-riding third rail, instead of an overriding third rail, for all new transit systems which may be constructed in the snowbelt region.

Other Recommendations for Improving Winter Operations

Additional recommendations for improving winter operations that do not involve equipment improvements are made below:

- Winter Operations Manual

  Publication of an updated Winter Operations Manual by each snowbelt transit property should be undertaken before each winter season. The updated manuals would include all new pertinent information for winter operations.

- Personnel Instruction

  Instruction and training drills should be provided for personnel by all snowbelt transit properties to familiarize them with winter emergency operations equipment and procedures. These drills would increase their skills in the application of special procedures and equipment used solely for winter operations.

- Information and Equipment/Technique Data Base

  An information, equipment, and technique data base should be established by DOT or a permanent APTA Committee which could evolve from the Snow and Ice Task Force. An annual workshop and symposium on Winterization and Rail Transit is also recommended. It should be held each autumn to bring together interested personnel to discuss the latest work on winterization problems. The published proceedings should then be distributed to each rail transit property by the year's end.

  The equipment/technique data base should include the following:

  - Names, addresses, and telephone numbers of key personnel working on specific projects or winterization problems.
  - Manufacturers names and addresses, listed for various types of equipment.
  - Titles of reports and summarized results for winterization equipment evaluation studies.
  - Listing of special winter equipment owned by each transit property.

The data base should be updated whenever new data becomes available, and interested transit personnel should be periodically advised of recent updates.

The specific hardware recommendations are:

1. Support a third rail heater test program at a snowbelt transit property to determine the most satisfactory type of heater, the best installation arrangement and installation procedures, and the watts per foot required for effective performance at each locale. Measures should also be considered to thermally insulate the side of the third rail exposed to weather and to develop an effective procedure for optimum use of ice scrapers in conjunction with heaters.

2. Encourage the installation of remote or central control of third rail heaters, switch heaters, and train stop heaters so they can be energized when needed and turned off to save energy once they are no longer required. The use of feedback and annunciator systems to verify that heaters are actually working (not just turned on) should be a part of this effort.

3. Investigate alternative techniques for traction motor ventilation and filtering, such as forced ventilation and inertial separation of clean air. Encourage the use of those ventilation systems that are found to be the least susceptible to moisture ingestion.

4. Investigate the effectiveness of deicing solutions as immediate and seasonal measures to minimize third rail ice formation.

5. Support the purchase of jet snow blowers on transit systems for both yard and emergency main line use.

6. Support the design and development of an efficient snowplow which can effectively be used on a transit system with a third rail. Investigate the primary front plow and secondary truck-mounted plow contoured to the third rail as one approach.

7. Consider the use of an underriding third rail or overheat catenary/ trolley wire for all new systems planned for cities that experience severe winter weather.

8. Establish more universal compliance of maintenance shops with manufacturers' recommended schedules for traction motor overhauls. Incorporate those steps that will weatherproof motors to insure their integrity between overhauls. Support a study or test program to determine how much collector shoe pressure is required for improved contact reliability during icing conditions.

9. Evaluate the use and performance of a heavy duty vehicle for right-of-way snow removal, suitable for systems with third rail. Wayside restrictions for snow removal such as clearances and available sites for dumping snow must be considered in the design and evaluation of this vehicle.

APPENDIX A

New Technology

The work performed under this contract has disclosed several innovative means of utilizing existing technology in dealing with the hazards of winter operation by the various snow belt transit properties.

The introduction of the latest in the state-of-the-art of materials and equipment has greatly reduced the time needed to clear or keep clear the rights-of-way during inclement winter weather.

APPENDIX B

Weather Data for the Cities Corresponding to the Locations of Members of APTA Snow and Ice Task Force

Weather data for the cities in the United States is compiled by the National Climatic Center in Asheville, NC and the weather data for Toronto is compiled by the Fisheries and Environment, Canada.

Local Climatological Data

Annual Summary With Comparative Data

1978

BOSTON, MASSACHUSETTS

DEPARTMENT OF COMMERCE • UNITED STATES OF AMERICA •

Narrative Climatological Summary

Climate is the composite of numerous weather elements. Three important influences are responsible for the main features of Boston's climate. First, the latitude (42° N) places the city in the zone of prevailing west to east atmospheric flow in which are encompassed the northward and southward movements of large bodies of air from tropical and polar regions. This results in variety and changeability of the weather elements. Secondly, Boston is situated on or near several tracks frequently followed by systems of low air pressure. The consequent fluctuations from fair to cloudy or stormy conditions reinforce the influence of the first factor, while also assuring a rather dependable precipitation supply. The third factor, Boston's east-coast location, is a moderating factor affecting temperature extremes of winter and summer.

Hot summer afternoons are frequently relieved by the locally celebrated "sea-breeze," as air flows inland from the cool water surface to displace the warm westerly current. This refreshing east wind is more commonly experienced along the shore than in the interior of the city or the western suburbs. In winter, under appropriate conditions, the severity of cold waves is reduced by the nearness of the then relatively warm water. The average date of the last occurrence of freezing temperature in spring is April 8; the latest is May 3, 1874 and 1882. The average date of the first occurrence of freezing temperature in autumn is November 7; the earliest on record is October 5, 1881. In suburban areas, especially away from the coast, these dates are later in spring and earlier in autumn by up to one month in the more susceptible localities.

Boston has no dry season. For most years the longest run of days with no measurable precipitation does not extend much more than two weeks. This may occur at any time of year. Most growing seasons have several shorter dry spells during which irrigation for high-value crops may be useful.

Much of the rainfall from June to September comes from showers and thunderstorms. During the rest of the year, low pressure systems pass more or less regularly and produce precipitation on an average of roughly one day in three. Coastal storms, or "northeasters," are prolific producers of rain and snow. The main snow season extends from December through March. The average number of days with four inches or more of snowfall is four per season, and days with seven inches or more come about twice per season. Periods when the ground is bare or nearly bare of snow may occur at any time in the winter.

Relative humidity has been known to fall as low as 5% (May 10, 1962), but such desert dryness is very rare. Heavy fog occurs on an average of about two days per month with its prevalence increasing eastward from the interior of Boston Bay to the open waters beyond.

The greatest number of hours of sunshine recorded in any month was 390, or 86% of possible, in June 1912, while the least was 60 hours, or 21%, in December 1972.

Although winds of 32 m.p.h. or higher may be expected on at least one day in every month of the year, gales are both more common and more severe in winter.

noaa NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION / ENVIRONMENTAL DATA AND INFORMATION SERVICE / NATIONAL CLIMATIC CENTER ASHEVILLE, N.C.

Meteorological Data For The Current Year

Station: BOSTON, MASSACHUSETTS # 14739 GEN LOGAN INTERNATIONAL AP Standard time used: EASTERN Latitude: 42° 22' N Longitude: 71° 02' W Elevation (ground): 15 feet Year: 1978

Month	Temperature °F Averages Daily maximum	Daily minimum	Monthly	Extremes Highest	Date	Lowest	Date	Degree days Base 65 °F Heating	Cooling	Precipitation in inches Water equivalent Total	Greatest in 24 hrs.	Date	Snow, Ice pellets Total	Greatest in 24 hrs.	Date	Relative humidity, pct. Hour 01	Hour 07	Hour 13	Hour 19 (Local time)	Wind Resultant Direction	Speed m.p.h.	Average speed m.p.h.	Fastest mile Speed m.p.h.	Direction	Date	Percent of possible sunshine	Average sky cover, tenths, sunrise to sunset	Number of days Sunrise to sunset Clear	Partly cloudy	Cloudy	Precipitation .01 inch or more	Snow, Ice pellets 1.0 inch or more	Thunderstorms	Heavy fog, visibility ¼ mile or less	Temperature °F Maximum (b) 90° and above	32° and below	Minimum 32° and below	0° and below	Average station pressure mb Elev. 29 feet m.s.l.
JAN	35.6	21.3	28.5	58	9	10	11	1127	0	8.12	2.09	20-21	35.9	21.0	20	74	78	68	69	28	6.5	15.1	54	SW	26	50	6.5	8	7	16	15	5	1	2	0	15	28	0	1013.2
FEB	34.0	20.1	27.1	44	17	3	4	1057	0	2.87	2.65	6-7	27.2	23.6	6-7	67	69	52	59	32	8.8	12.8	61	NE	6	68	4.7	13	5	10	4	2	0	0	0	9	28	0	1013.9
MAR	42.7	29.6	36.2	60	21	10	5	885	0	2.46	0.82	3-4	16.1	9.2	3-4	66	68	54	60	29	5.8	12.2	35	NW	19	72	5.8	7	14	10	8	5	0	1	0	6	20	0	1014.9
APR	55.8	41.8	48.8	75	13	29	3	480	0	1.79	1.07	19-20	T	T	7	58	59	47	52	30	4.4	11.9	34	NW	2	66	6.2	9	8	13	9	0	2	1	0	0	1	0	1011.9
MAY	66.5	52.1	59.3	86	29	37	1	209	40	4.50	1.81	14-15	0.0	0.0		73	74	63	67	11	0.5	12.5	30	S	9	61	6.0	11	6	14	12	0	1	7	0	0	0	0	1015.2
JUN	77.5	59.0	68.3	89	28	52	15	18	122	1.53	0.37	19	0.0	0.0		76	73	56	60	24	4.9	11.6	29	SW	8	74	4.8	12	10	8	11	0	1	2	0	0	0	0	1014.2
JUL	80.6	63.5	72.1	99	23	56	5	11	237	1.48	0.81	4	0.0	0.0		74	73	54	61	23	3.7	11.4	26	SW	23	73	5.5	10	10	11	7	0	0	1	6	0	0	0	1014.2
AUG	78.2	65.0	71.6	93	14	55	25	11	221	4.62	1.94	6-7	0.0	0.0		81	83	65	76	25	1.7	9.2	23	W	29	54	6.8	6	11	14	12	0	4	2	3	0	0	0	1016.9
SEP	70.0	52.8	61.4	88	21	42	26	150	48	1.30	0.98	11-12	0.0	0.0		78	81	59	68	25	2.7	10.8	29	SW	11	74	4.1	15	9	6	7	0	1	0	0	0	0	0	1016.9
OCT	60.5	44.5	52.5	78	23	33	18	361	0	3.13	0.85	14	0.0	0.0		76	79	57	68	27	3.5	10.8	27	NW	23	54	4.8	14	8	9	9	0	0	2	0	0	0	0	1016.9
NOV	50.0	37.1	43.6	70	18	17	27	635	0	2.21	0.64	23-24	4.2	2.1	22	73	77	64	69	32	3.1	10.9	29	SW	14	52	6.1	9	6	15	12	2	0	2	0	2	9	0	1020.7
DEC	42.0	28.5	35.3	62	4	19	19	916	0	3.63	1.20	9-10	5.8	4.8	9-10	68	72	56	63	27	9.4	14.3	42	NW	26	60	5.6	10	9	12	10	2	1	0	0	2	23	0	1012.9
YEAR	57.8	42.9	50.4	99	JUL 23	3	FEB 4	5880	668	37.64	2.65	FEB 6-7	69.2	23.6	FEB 6-7	72	74	58	64	28	4.0	12.0	61	NE	FEB 6	65	5.6	124	103	138	116	16	11	20	9	34	109	0	1015.2

Normals, Means, And Extremes

Month	Temperatures °F Normal Daily maximum	Daily minimum	Monthly	Extremes Record highest	Year	Record lowest	Year	Normal Degree days Base 65 °F Heating	Cooling	Precipitation in inches Water equivalent Normal	Maximum monthly	Year	Minimum monthly	Year	Maximum in 24 hrs.	Year	Snow, Ice pellets Maximum monthly	Year	Maximum in 24 hrs.	Year	Relative humidity pct. Hour 01	Hour 07	Hour 13	Hour 19 (Local time)	Wind Mean speed m.p.h.	Prevailing direction	Fastest mile Speed m.p.h.	Direction	Year	Pct. of possible sunshine	Mean sky cover, tenths, sunrise to sunset	Mean number of days Sunrise to sunset Clear	Partly cloudy	Cloudy	Precipitation .01 inch or more	Snow, Ice pellets 1.0 inch or more	Thunderstorms	Heavy fog, visibility ¼ mile or less	Temperatures °F Max. (b) 90° and above	32° and below	Min. 32° and below	0° and below	Average station pressure mb. Elev. 29 feet m.s.l.
(a)				27		27					27		27		27		43		43		14	14	14	14	21	15	20	20		43	43	43	43	43	27	43	43	43	14	14	14	14	6
J	35.9	22.5	29.2	63	1974	-12	1957	1110	0	3.69	9.54	1958	0.89	1970	2.09	1978	35.9	1978	21.0	1978	66	67	58	61	14.2	NW	61	NW	1974	54	6.2	9	7	15	12	3	*	2	0	12	26	1	1014.5
F	37.5	23.3	30.4	68	1957	-4	1961	969	0	3.54	7.08	1969	1.15	1968	2.69	1969	41.3	1969	23.6	1978	64	67	57	60	14.0	WNW	61	NE	1978	56	6.1	8	7	13	11	3	*	2	0	9	24	*	1014.0
M	44.6	31.5	38.1	81	1977	6	1967	834	0	4.01	11.00	1953	1.48	1962	4.13	1968	31.2	1956	17.7	1960	67	68	57	61	13.9	NW	60	NE	1977	59	6.3	8	8	15	12	2	*	2	0	2	17	0	1014.1
A	56.5	40.8	48.6	94	1976	17	1954	492	0	3.49	7.82	1958	1.24	1966	2.31	1973	3.3	1967	3.1	1956	66	66	52	59	13.3	WNW	52	NW	1963	57	6.4	7	9	14	11	*	1	2	*	0	3	0	1012.3
M	67.1	50.1	58.6	93	1964	34	1956	218	20	3.47	13.39	1954	0.53	1964	5.74	1954	0.5	1977	0.5	1977	73	70	58	64	12.2	SW	50	NE	1967	59	6.5	6	11	14	11	0	2	3	*	0	0	0	1013.4
J	76.6	59.3	68.0	100	1952	46	1965	27	117	3.19	8.63	1959	0.48	1953	2.46	1960	0.0		0.0		78	74	59	67	11.3	SW	40	NW	1959	63	6.2	7	10	13	11	0	4	2	3	0	0	0	1014.1
J	81.4	65.1	73.3	102	1977	54	1965	0	260	2.74	8.12	1959	0.52	1952	2.42	1959	0.0		0.0		76	73	56	65	10.9	SW	46	N	1977	66	6.1	7	12	12	9	0	4	2	5	0	0	0	1013.8
A	79.3	63.3	71.3	102	1975	47	1965	8	203	3.46	17.09	1955	0.83	1972	8.40	1955	0.0		0.0		78	76	58	69	10.7	SW	45	SW	1971	66	5.7	9	11	11	10	0	4	2	3	0	0	0	1016.4
S	72.4	56.7	64.5	100	1953	38	1965	76	61	3.16	8.31	1954	0.35	1957	5.64	1954	0.0		0.0		80	79	61	72	11.2	SW	57	S	1960	64	5.5	10	9	11	9	0	2	2	1	0	0	0	1016.5
O	63.2	47.5	55.4	90	1963	28	1976	301	0	3.02	8.69	1962	0.96	1967	4.26	1962	T	1975	T	1975	75	76	57	67	12.1	SW	45	NW	1963	61	5.5	11	8	12	9	0	1	2	0	0	1	0	1017.0
N	51.7	38.7	45.2	77	1974	17	1978	594	0	4.51	8.18	1969	0.64	1976	3.33	1955	10.0	1938	8.0	1940	72	74	61	67	12.9	SW	54	NE	1968	51	6.4	8	7	15	11	*	*	2	0	*	7	0	1015.9
D	39.5	26.6	33.0	70	1966	-4	1962	992	0	4.24	9.74	1969	1.03	1955	4.17	1969	27.9	1970	13.0	1960	69	72	61	65	13.9	WNW	49	NW	1962	52	6.2	9	7	15	12	2	*	1	0	5	21	*	1015.0
YR	58.7	43.8	51.3	102	JUL 1977	-12	JAN 1957	5621	661	42.52	17.09	AUG 1955	0.35	SEP 1957	8.40	AUG 1955	41.3	FEB 1969	23.6	FEB 1978	72	72	58	65	12.6	SW	61	NE	FEB 1978	60	6.1	99	106	160	128	11	19	23	12	27	99	1	1014.8

Means and extremes above are from existing and comparable exposures. Annual extremes have been exceeded at other sites in the locality as follows: Highest temperature 104 in July 1911; lowest temperature -18 in February 1934; minimum monthly precipitation T in March 1915; fastest mile wind 87 S in September 1938.

(a) Length of record, years, through the current year unless otherwise noted, based on January data.
(b) 70° and above at Alaskan stations.
* Less than one half.
T Trace.

NORMALS - Based on record for the 1941-1970 period.
DATE OF AN EXTREME - The most recent in cases of multiple occurrence.
PREVAILING WIND DIRECTION - Record through 1963.
WIND DIRECTION - Numerals indicate tens of degrees clockwise from true north. 00 indicates calm.
FASTEST MILE WIND - Speed is fastest observed 1-minute value when the direction is in tens of degrees.

Average Temperature

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
1939	27.8	32.2	39.2	43.6	56.4	63.6	72.3	73.8	64.5	54.2	40.8	33.4	49.8
1940	23.0	29.8	33.1	43.6	56.2	63.1	71.6	68.4	63.3	30.6	42.9	34.3	48.5
1941	23.2	29.4	33.4	31.6	39.8	68.2	71.4	70.6	66.0	53.9	48.0	33.2	51.2
1942	28.6	27.0	40.8	49.7	60.8	67.4	71.1	70.7	64.6	33.8	43.5	28.6	30.7
1943	23.5	30.6	36.0	43.4	57.6	71.2	74.1	71.0	63.0	33.8	43.3	29.6	49.9
1944	31.0	29.6	34.1	44.6	63.2	67.0	73.8	74.7	63.0	33.8	43.2	30.8	50.9
1943	23.8	30.5	44.3	37.5	33.2	66.6	71.9	70.8	67.1	53.1	43.5	28.5	51.0
1946	28.4	27.6	47.2	46.2	38.0	67.5	70.8	67.8	63.8	38.4	47.8	34.8	51.7
1947	32.6	29.4	37.7	47.2	36.9	63.4	74.4	73.2	64.8	61.6	41.2	30.4	51.2
1948	23.4	26.6	38.0	48.0	35.0	63.6	74.5	73.7	63.7	54.2	49.6	36.3	50.7
1949	34.6	34.4	39.2	50.8	60.4	71.6	76.2	74.4	63.2	58.4	43.5	36.8	53.6
1950	36.2	28.0	39.7	46.8	33.8	69.1	73.5	70.9	61.5	36.3	47.8	33.5	31.3
#1931	34.0	34.7	39.1	31.0	39.1	66.0	74.0	70.7	63.6	54.8	42.6	35.0	52.2
1952	32.6	32.5	37.7	30.5	57.2	70.7	77.5	72.3	66.3	33.0	44.9	33.7	52.6
1953	34.7	33.0	39.1	48.9	58.4	70.5	73.2	72.0	66.3	36.2	48.6	40.2	33.6
1934	26.0	36.4	38.8	30.1	56.3	66.6	72.2	70.1	63.2	58.6	44.4	34.4	51.4
1933	28.5	32.0	37.8	49.2	62.8	66.8	77.2	74.5	64.5	53.1	41.9	26.6	51.4
1956	30.6	32.5	33.6	45.6	53.4	68.9	71.7	71.9	61.1	54.4	46.1	36.0	50.7
1957	23.4	34.7	39.1	49.4	59.9	71.3	74.1	69.3	67.3	34.6	47.2	40.0	32.3
1958	31.0	23.5	39.1	48.8	56.6	63.9	72.4	72.4	64.6	32.6	46.6	26.4	30.0
1939	28.7	26.7	37.0	49.0	62.6	64.6	74.7	74.1	68.1	33.1	44.4	36.3	51.8
1960	30.9	33.3	37.7	48.3	59.7	69.6	73.1	72.1	63.7	33.9	48.0	29.5	31.4
1961	23.0	31.6	34.9	43.3	56.3	68.9	72.1	72.5	69.0	37.3	44.6	32.8	31.0
1962	28.7	26.7	38.3	49.4	57.2	68.4	70.4	70.0	62.9	54.1	41.7	30.0	49.8
#1963	29.5	23.9	39.1	48.9	39.4	69.5	74.7	70.4	60.8	60.0	48.3	23.9	31.0
#1964	31.7	29.1	38.7	46.1	60.3	67.1	71.5	66.4	62.0	52.3	44.1	32.4	50.2
1963	23.4	28.0	33.8	44.2	59.5	67.4	71.0	70.5	62.5	32.8	42.1	36.1	49.6
1966	28.8	31.3	39.8	43.9	57.3	69.4	74.9	71.3	63.5	54.3	46.9	34.2	31.3
1967	33.1	26.4	33.2	44.9	51.7	67.2	73.0	70.9	62.7	53.8	40.1	33.0	49.5
1968	23.6	26.1	39.1	49.6	56.1	64.9	73.2	70.7	63.0	57.9	43.8	30.9	50.4
1969	29.3	29.5	35.4	30.6	58.5	69.3	71.0	74.3	63.7	54.3	44.9	33.4	31.2
1970	23.0	32.3	37.4	49.0	59.6	67.0	74.3	73.6	63.6	34.9	44.8	28.9	50.9
1971	23.8	30.5	34.7	43.1	33.7	69.1	73.4	73.4	68.0	59.8	43.1	36.3	51.2
1972	33.0	29.6	34.3	44.9	57.6	63.4	73.8	71.5	63.7	51.8	42.3	33.0	50.4
1973	31.4	30.1	49.3	49.9	57.0	70.0	74.3	74.8	64.4	53.6	43.8	39.6	53.0
1974	31.7	29.1	38.7	50.9	54.7	64.8	72.4	72.0	63.7	50.1	43.3	37.8	50.9
1973	34.9	32.1	36.9	43.1	61.5	67.5	73.9	72.9	63.9	37.3	51.8	34.4	52.8
1976	26.1	37.5	41.2	33.1	60.2	73.4	72.9	72.0	64.9	32.3	41.9	29.0	52.2
1977	23.3	30.7	44.7	51.3	62.6	67.4	74.9	73.4	64.4	53.3	48.1	34.2	52.3
1978	28.5	27.1	36.2	48.8	59.3	68.3	72.1	71.6	61.4	32.5	43.6	33.3	30.4
RECORD MEAN	28.8	29.2	37.8	47.0	57.8	67.1	72.6	70.8	64.0	54.1	43.5	32.6	50.4
MAX	36.3	36.8	44.4	33.1	66.4	73.8	80.9	78.8	71.9	62.1	50.6	39.6	58.2
MIN	21.2	21.5	29.5	38.9	49.1	58.3	64.2	62.7	56.0	46.1	36.3	25.6	42.3

Heating Degree Days

BOSTON, MA

Season	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	Total
1958-39	4	2	84	366	347	1190	1118	1063	862	476	142	92	3968
1959-60	1	7	79	319	611	883	1048	833	992	493	166	33	5489
1960-61	0	5	103	335	303	1094	1231	928	865	387	287	22	3960
1961-62	6	3	31	246	604	991	1118	1066	814	467	271	33	3672
1962-63	6	13	105	330	691	1078	1094	1087	798	477	196	38	5913
#1963-64	1	3	160	198	493	1207	1026	1033	808	359	187	57	5734
1964-63	14	26	140	380	620	1004	1220	1032	900	617	195	80	6228
1963-66	2	37	136	371	680	888	1115	936	776	366	238	46	5811
1966-67	0	1	86	327	533	930	921	1073	977	396	403	58	3926
1967-68	0	4	110	347	739	923	1214	1122	797	454	270	76	6056
1968-69	1	9	40	247	630	1050	1099	987	911	430	208	21	5639
1969-70	2	3	107	326	593	973	1295	909	846	473	184	52	5765
1970-71	0	0	66	314	398	1113	1269	962	868	386	287	23	6090
1971-72	0	2	37	169	631	882	985	1021	883	398	230	54	5332
1972-73	3	4	31	405	673	983	1033	971	666	430	238	24	5323
1973-74	0	2	94	289	370	782	1023	1000	809	429	335	77	3410
1974-73	0	2	102	458	387	836	925	918	866	390	162	59	5303
1973-76	0	8	70	239	393	941	1198	800	733	331	166	16	4897
1976-77	1	10	35	393	688	1108	1290	956	623	414	158	43	5739
1977-78	0	4	85	304	498	948	1127	1057	885	480	209	18	3613
1978-79	11	11	130	361	635	916							

Cooling Degree Days

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
1969	0	0	0	9	13	156	196	297	74	1	0	0	746
1970	0	0	0	0	25	118	294	273	91	9	0	0	810
1971	0	0	0	0	6	153	269	271	132	15	1	0	849
1972	0	0	0	0	26	74	279	213	79	0	0	0	671
1973	0	0	0	7	18	180	296	316	84	3	0	0	904
1974	0	0	0	10	22	81	235	226	68	1	3	0	646
1975	0	0	0	0	60	139	345	261	44	9	4	0	862
1976	0	0	0	43	23	276	231	231	61	8	0	0	895
1977	0	0	1	15	92	124	314	272	75	6	0	0	897
1978	0	0	0	0	40	122	237	221	48	0	0	0	668

Precipitation

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
1939	2.18	3.79	5.23	4.54	1.29	2.70	0.73	2.14	1.01	4.77	1.14	2.91	32.45
1940	1.68	4.78	3.83	4.58	3.28	1.80	3.17	0.85	2.32	0.76	6.24	2.76	36.03
1941	4.21	1.70	3.40	1.70	2.43	4.29	2.90	1.35	1.18	1.92	2.40	3.19	30.87
1942	3.69	3.43	7.01	1.59	2.11	4.24	4.14	2.09	1.96	2.78	4.69	4.72	42.47
1943	3.74	1.23	4.02	2.64	4.56	1.49	3.91	1.28	1.41	4.82	2.16	0.99	32.25
1944	2.03	2.13	3.92	3.52	0.23	5.33	1.61	1.79	5.36	2.58	5.68	2.63	37.07
1945	3.67	4.09	1.90	2.02	4.47	6.44	2.12	4.27	1.81	2.23	6.86	7.42	47.30
1946	4.18	3.00	1.50	2.62	4.91	2.76	2.22	9.92	2.04	0.34	0.98	3.60	38.07
1947	2.43	1.44	2.30	4.13	4.36	2.88	3.98	2.19	3.93	1.13	5.13	3.93	37.91
1948	3.11	2.08	3.14	2.62	5.37	4.50	4.53	1.24	0.67	4.84	5.16	1.25	40.51
1949	3.21	3.23	1.66	3.23	2.53	0.93	1.10	2.12	6.47	1.60	3.71	1.64	31.43
1950	3.86	3.81	2.99	2.38	1.55	1.10	1.43	3.14	0.89	1.99	6.17	3.47	32.70
#1951	4.04	3.71	4.41	3.06	4.81	4.31	2.13	3.25	2.00	3.98	6.60	4.09	46.97
1952	4.31	4.71	4.41	4.41	3.57	3.26	0.52	6.86	1.13	1.61	1.72	4.09	40.60
1953	6.28	4.14	11.00	6.04	5.06	0.48	2.76	1.81	2.50	4.91	7.66	3.09	57.73
1954	3.26	3.87	3.33	3.25	13.38	2.78	2.50	3.64	8.31	3.58	5.52	5.40	62.32
1953	0.92	4.11	5.42	4.12	0.99	3.52	4.28	17.09	2.40	6.94	5.68	1.03	56.30
1936	6.99	4.46	5.39	2.94	1.83	2.03	3.32	1.46	5.07	4.39	3.46	6.13	47.39
1937	2.47	1.34	3.38	3.78	3.63	1.62	0.64	1.71	0.33	2.67	5.73	6.58	33.92
1958	9.34	5.87	4.48	7.82	4.45	2.96	3.91	3.37	7.50	4.62	3.33	1.78	61.65
1959	2.72	3.45	5.81	4.44	1.24	8.63	8.12	2.93	0.63	4.60	4.20	4.64	51.41
1960	3.04	4.84	3.23	3.31	3.80	3.46	5.18	1.64	5.97	2.48	2.49	4.82	44.46
1961	2.92	4.94	4.71	6.59	4.51	1.67	3.29	3.17	7.04	2.46	3.18	3.46	47.84
1962	3.11	4.18	1.48	3.83	1.86	2.33	1.61	3.72	4.10	8.88	3.80	4.53	43.23
1963	3.13	2.60	4.39	1.48	2.86	1.92	1.72	1.67	3.03	1.23	7.74	3.03	34.84
1964	4.56	4.07	3.48	3.69	0.53	1.91	3.12	1.78	2.63	2.82	2.18	3.08	36.47
1965	2.64	3.17	2.22	2.32	0.93	2.99	0.53	1.48	2.01	1.59	2.08	1.73	23.71
1966	5.29	3.48	1.98	1.24	2.66	3.40	3.21	1.23	3.42	2.62	4.43	3.03	36.01
1967	2.28	4.03	4.67	4.83	7.32	3.48	2.47	5.74	2.00	0.96	3.39	6.42	47.60
1968	3.83	1.13	7.86	1.72	3.26	3.63	0.53	1.63	1.79	1.83	6.74	6.23	42.28
1969	2.26	7.08	2.63	4.37	1.96	0.63	2.98	1.89	4.42	1.64	8.18	9.74	47.78
1970	0.89	4.65	4.32	2.79	3.01	4.62	1.27	4.12	2.60	2.63	4.09	6.92	41.91
1971	1.88	3.03	3.08	2.92	3.72	1.74	2.84	1.39	1.53	2.16	6.74	2.40	33.67
1972	2.03	5.29	5.37	3.34	5.26	6.76	2.19	0.83	5.94	2.98	7.02	6.08	53.11
1973	3.12	2.13	2.20	5.63	3.76	4.68	4.83	2.78	1.93	2.71	1.74	7.40	42.73
1974	3.22	3.24	4.01	3.86	2.87	2.29	1.54	3.41	7.03	3.12	1.73	3.92	40.24
1975	5.70	3.37	2.74	2.40	1.78	2.10	2.33	5.52	3.49	4.41	5.13	4.80	43.79
1976	5.29	2.45	2.42	2.00	1.98	0.58	4.30	7.99	1.56	4.16	0.64	3.33	36.72
1977	4.41	2.40	4.76	4.07	3.52	2.49	2.21	2.91	4.03	4.63	2.54	6.20	44.17
1978	8.12	2.87	2.46	1.79	4.50	1.53	1.48	4.62	1.30	3.13	2.21	3.03	37.64
RECORD MEAN	3.64	3.48	3.82	3.33	3.23	3.12	3.14	3.61	3.22	3.24	3.84	3.69	41.50

Snowfall

Season	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	Total
1939-40	0.0	0.0	0.0	0.0	1.0	6.3	4.6	23.8	0.3	1.5	0.0	0.0	37.7
1940-41	0.0	0.0	0.0	T	8.5	4.5	20.4	1.3	13.1	0.0	T	0.0	47.8
1941-42	0.0	0.0	0.0	T	7	0.2	8.2	6.2	7.9	1.5	0.0	0.0	24.0
1942-43	0.0	0.0	0.0	0.0	T	6.8	26.4	4.3	8.0	T	0.0	0.0	45.7
1943-44	0.0	0.0	0.0	0.0	7	0.3	5.1	9.6	12.7	7	0.0	0.0	27.7
1944-43	0.0	0.0	0.0	0.0	1.2	6.9	24.3	26.3	0.5	0.0	T	0.0	59.2
1945-46	0.0	0.0	0.0	0.0	4.9	24.6	9.8	9.8	0.2	1.5	0.0	0.0	50.8
1946-47	0.0	0.0	0.0	0.0	7	4.9	4.0	9.0	0.9	0.6	0.0	0.0	19.4
1947-48	0.0	0.0	0.0	0.0	1.1	26.8	32.5	17.0	11.8	0.0	0.0	0.0	89.2
1948-49	0.0	0.0	0.0	0.0	1.1	3.3	13.7	6.9	9.9	0.0	0.0	0.0	37.1
1949-50	0.0	0.0	0.0	0.0	1.4	2.3	7.9	13.2	5.1	T	0.0	0.0	31.9
1930-51	0.0	0.0	0.0	0.0	7	2.7	13.9	9.2	3.9	0.0	0.0	0.0	29.7
#1931-52	0.0	0.0	0.0	0.0	7	8.4	10.7	19.1	1.4	0.0	0.0	0.0	39.6
1932-53	0.0	0.0	0.0	T	T	2.4	13.6	11.4	0.2	2.2	T	0.0	29.8
1933-34	0.0	0.0	0.0	0.0	7	T	19.2	1.9	0.4	2.1	0.0	0.0	23.6
1934-55	0.0	0.0	0.0	0.0	7	10.3	0.9	6.3	7.0	0.4	0.0	0.0	25.1
1935-56	0.0	0.0	0.0	0.0	2.3	1.8	7.7	14.3	31.2	3.2	0.0	0.0	60.9
1936-57	0.0	0.0	0.0	0.0	0.6	13.4	20.6	2.8	11.3	1.1	0.0	0.0	52.0
1937-58	0.0	0.0	0.0	T	0.1	T	6.6	23.9	12.0	2.1	7	0.0	44.7
1938-59	0.0	0.0	0.0	0.0	0.1	4.6	4.1	10.7	14.6	T	0.0	0.0	34.1
1939-60	0.0	0.0	0.0	0.0	0.6	3.5	10.2	2.3	22.3	T	0.0	0.0	40.9
1960-61	0.0	0.0	0.0	T	T	16.9	18.7	14.9	9.0	2.0	0.0	0.0	61.3
1961-62	0.0	0.0	0.0	T	0.9	11.4	2.5	28.7	1.1	0.1	0.0	0.0	44.7
1962-63	0.0	0.0	0.0	T	0.9	3.3	6.5	4.6	13.6	T	0.0	0.0	30.9
1963-64	0.0	0.0	0.0	T	0.0	17.7	14.4	23.2	7.7	7	0.0	0.0	63.0
1964-65	0.0	0.0	0.0	T	7	12.2	22.2	4.7	9.7	1.6	0.0	0.0	50.4
1963-66	0.0	0.0	0.0	0.0	7	2.3	26.4	12.1	3.3	T	7	0.0	44.1
1966-67	0.0	0.0	0.0	0.0	0.0	9.9	0.5	23.3	22.9	3.3	7	0.0	60.1
1967-68	0.0	0.0	0.0	0.0	2.2	14.7	17.7	3.4	6.8	0.0	0.0	0.0	44.8
1968-69	0.0	0.0	0.0	0.0	0.4	3.1	0.9	41.3	6.1	7	0.0	0.0	53.8
1969-70	0.0	0.0	0.0	T	7	12.6	7.4	10.3	18.2	0.1	0.0	0.0	48.8
1970-71	0.0	0.0	0.0	T	7	27.9	12.0	8.1	7.4	1.9	0.0	0.0	57.3
1971-72	0.0	0.0	0.0	0.0	2.8	7.9	7.8	16.3	12.1	0.4	0.0	0.0	47.3
1972-73	0.0	0.0	0.0	T	0.6	3.3	3.6	2.3	0.3	T	0.0	0.0	10.3
1973-74	0.0	0.0	0.0	0.0	0.0	7	16.0	17.8	0.1	3.0	0.0	0.0	36.9
1974-73	0.0	0.0	0.0	0.0	2.0	3.6	2.2	17.0	1.8	1.0	0.0	0.0	27.6
1975-76	0.0	0.0	0.0	T	0.1	19.3	15.0	1.4	10.8	7	0.0	0.0	46.6
1976-77	0.0	0.0	0.0	0.0	1.0	17.2	23.2	3.9	10.7	7	0.5	0.0	58.5
1977-78	0.0	0.0	0.0	0.0	0.7	3.2	33.9	27.2	16.1	7	0.0	0.0	85.1
1978-79	0.0	0.0	0.0	0.0	4.2	3.8							
RECORD MEAN	0.0	0.0	0.0	T	1.2	8.0	12.8	12.2	8.2	0.7	7	0.0	43.1

# Indicates a station move or relocation of instruments. See Station Location table.

Record mean values above are means through the current year for the period beginning in 1872 for temperature, 1871 for precipitation and 1936 for snowfall. Data are from City Office locations through 1935 and from Airport locations thereafter.

Local Climatological Data

Annual Summary With Comparative Data

1978

BUFFALO, NEW YORK

Narrative Climatological Summary

For nearly 75 years the National Weather Service Office at Buffalo was located downtown overlooking the waterfront. Instruments were exposed high above the ground level. On July 1, 1943, the office was moved to the Buffalo Airport. Roof exposures were maintained generally until August 1961 when radically lower levels were prescribed to meet aviation requirements. Vertical variability of many weather elements is much more pronounced than is the horizontal; hence, with the establishment of "ground" level exposures, discontinuity in the record has occurred.

The surrounding country is comparatively low and level to the west, gently rolling to the east and south, rising to pronounced hills within 12 to 18 miles, and to 1,000 feet above the level of Lake Erie at a point some 35 miles south-southeast of the City.

At the present location an escarpment of 50 to 100 feet lies east-west 1-1/2 miles to the north. The eastern end of Lake Erie is now nine miles to the west-southwest, while Lake Ontario lies 25 miles to the north, the two being connected by the Niagara River, which flows north-northwestward from the end of Lake Erie.

Buffalo is located near the mean position of the polar front. Its weather is varied and changeable, characteristic of the latitude. Wide seasonal swings of temperature from hot to cold are tempered appreciably by the proximity of Lakes Erie and Ontario. Lake Erie lies to the southwest, the direction of the prevailing wind. Wind flow throughout the year is somewhat higher due to this exposure. The vigorous interplay of warm and cold air masses during the winter and early spring months causes one or more windstorms. Precipitation is moderate and fairly evenly divided throughout the twelve months.

The spring season is cloudy and cooler than points not affected by the cold lake. Vegetation is retarded, a fact that protects it from late spring frosts. With heavy winter ice accumulations in the lake, typical spring conditions are delayed until late May or early June.

Summer comes suddenly in mid-June. Lake breezes temper the extreme heat of the summer season. Temperatures of 90° and above are infrequent. There is more summer sunshine here than in any other section of the state. Due to the stabilizing effects of Lake Erie, thunderstorms are relatively infrequent. Most of them are caused by frontal action. To the north and south of the City thunderstorms occur more often.

Autumn has long, dry periods and is frost free usually until mid-October. Cloudiness increases in November, continuing mostly cloudy throughout the winter and early spring. Snow flurries off the lake begin in mid-November or early December. Outbreaks of arctic air in December and on through the winter months produce locally heavy snowfalls from the lake. At the same time, temperatures of well below zero over Canada and the midwest are raised 10° to 30° in crossing the lakes. Only on rare occasions do polar air masses drop southward from eastern Hudson Bay across Lake Ontario without appreciable warming.

noaa NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION / ENVIRONMENTAL DATA AND INFORMATION SERVICE / NATIONAL CLIMATIC CENTER ASHEVILLE, N.C.

Meteorological Data For The Current Year

Station: BUFFALO, NEW YORK # 14733 GREATER BUFFALO INTL AIRPORT Standard time used: EASTERN Latitude: 42° 56' N Longitude: 78° 44' W Elevation (ground): 705 feet Year: 1978

Month	Temp °F Averages: Daily maximum	Daily minimum	Monthly	Extremes: Highest	Date	Lowest	Date	Degree days Base 65 °F: Heating	Cooling	Precip. Water equivalent: Total	Greatest in 24 hrs.	Date	Snow, Ice pellets: Total	Greatest in 24 hrs.	Date	Relative humidity, pct. Hour 01	Hour 07	Hour 13	Hour 19 (Local time)	Wind Resultant: Direction	Speed m.p.h.	Average speed m.p.h.	Fastest mile: Speed m.p.h.	Direction	Date	Percent of possible sunshine	Average sky cover, tenths, sunrise to sunset	Number of days Sunrise to sunset: Clear	Partly cloudy	Cloudy	Precipitation .01 inch or more	Snow, Ice pellets 1.0 inch or more	Thunderstorms	Heavy fog, visibility ¼ mile or less	Temperature °F Maximum (b) 90° and above	Maximum 32° and below	Minimum 32° and below	Minimum 0° and below	Average station pressure mb Elev 706 feet m.s.l
JAN	25.9	14.9	20.4	43	8	3	15	1376	0	6.29	0.84	20-21	56.5	9.4	20-21	85	87	79	83	23	6.5	16.5	60	S	26	16	9.5	0	2	29	27	15	0	4	0	24	30	0	988.8
FEB	22.0	8.9	15.5	32	25	-4	5	1378	0	1.36	0.41	6-7	21.7	6.2	6-7	88	87	77	84	22	6.6	11.6	26	SW	11	35	8.2	2	5	21	17	7	0	1	0	28	28	2	992.9
MAR	35.6	20.8	28.2	55	21	-2	2	1130	0	1.72	0.56	21	5.8	3.1	3-4	83	84	69	79	23	5.5	11.9	30	SW	19	46	7.9	3	6	22	13	2	0	3	0	10	27	1	991.2
APR	52.1	32.8	42.5	71	4	25	9	670	0	1.64	0.64	4-5	1.8	1.5	20-21	76	75	53	61	28	3.4	13.0	37	SW	1	50	7.3	4	8	18	12	0	1	1	0	0	13	0	989.2
MAY	66.1	49.7	57.4	89	27	26	1	282	52	3.95	1.50	16-17	0.1	0.1	1	82	80	58	66	20	3.5	11.6	32	SW	9	56	6.7	7	7	17	12	0	1	4	0	0	2	0	988.8
JUN	74.5	55.7	65.1	87	27	44	14	81	91	2.42	1.80	7-8	0.0	0.0		77	76	54	58	24	6.9	11.4	32	SW	18	70	6.0	6	12	12	8	0	3	0	0	0	0	0	990.9
JUL	80.1	60.7	70.4	91	20	50	12	14	189	1.48	1.07	26-27	0.0	0.0		78	77	51	55	23	4.5	10.8	30	SW	29	70	6.7	5	11	15	4	0	2	0	2	0	0	0	990.2
AUG	79.4	61.1	70.3	89	19	52	21	3	173	3.51	1.03	3-4	0.0	0.0		83	84	57	66	23	3.6	8.8	32	W	19	64	6.7	6	7	18	11	0	4	3	0	0	0	0	992.2
SEP	69.9	51.7	60.8	83	20	37	29	154	35	4.40	1.36	11-12	0.0	0.0		86	86	62	74	22	1.8	10.4	29	SW	15	60	6.2	7	11	12	13	0	6	1	0	0	0	0	992.6
OCT	57.3	41.7	49.5	73	11	27	17	472	0	3.72	1.04	25-26	T	T	8	81	84	63	75	23	5.2	10.7	32	SW	22	48	7.4	5	6	20	15	0	2	0	0	0	5	0	991.9
NOV	48.0	32.7	40.4	68	5	17	26	732	0	1.55	0.49	17-18	3.0	2.3	27	81	81	66	77	23	3.6	11.8	39	SW	18	41	7.6	5	7	18	8	1	0	0	0	4	14	0	994.6
DEC	37.1	23.6	30.4	56	4	2	29	1067	0	3.50	0.76	20-21	10.1	5.2	25	83	80	75	77	25	8.3	14.1	49	SW	4	23	9.1	0	2	29	22	2	0	0	0	9	26	0	989.2
YEAR	54.0	37.8	45.9	91	JUL 20	-4	FEB 5	7359	540	35.74	1.80	JUN 7-8	99.0	9.4	JAN 20-21	82	82	64	71	23	4.8	11.9	60	S	JAN 26	51	7.4	50	84	231	162	27	19	17	2	75	145	3	991.0

Normals, Means, And Extremes

Month	Temperatures °F Normal: Daily maximum	Daily minimum	Monthly	Extremes: Record highest	Year	Record lowest	Year	Normal Degree days Base 65 °F: Heating	Cooling	Precip. Water equivalent: Normal	Maximum monthly	Year	Minimum monthly	Year	Maximum in 24 hrs.	Year	Snow, Ice pellets: Maximum monthly	Year	Maximum in 24 hrs.	Year	Relative humidity pct. Hour 01	Hour 07	Hour 13	Hour 19 (Local time)	Wind: Mean speed m.p.h.	Prevailing direction	Fastest mile: Speed m.p.h.	Direction	Year	Pct. of possible sunshine	Mean sky cover, tenths, sunrise to sunset	Mean number of days Sunrise to sunset: Clear	Partly cloudy	Cloudy	Precipitation .01 inch or more	Snow, Ice pellets 1.0 inch or more	Thunderstorms	Heavy fog, visibility ¼ mile or less	Temperatures °F Max. (b) 90° and above	Max. 32° and below	Min. 32° and below	Min. 0° and below	Average station pressure mb. Elev. 706 feet m.s.l.
(a)				35		35					35		35		35		35		35		18	18	18	18	39	14	35	35		35	35	35	35	35	35	35	35	35	18	18	18	18	6
J	29.0	17.6	23.7	72	1950	-12	1957	1280	0	2.90	6.47	1959	1.03	1946	2.40	1957	68.3	1977	16.2	1966	78	79	73	77	14.6	WSW	91	SW	1950	33	8.4	1	7	23	20	7	*	2	0	18	29	2	990.0
F	31.0	17.7	24.4	64	1955	-20	1961	1137	0	2.55	5.80	1960	0.81	1968	2.31	1954	54.2	1956	14.5	1958	79	80	71	76	14.1	SW	70	SW	1946	39	8.2	2	5	21	17	6	*	2	0	16	26	2	990.1
M	39.0	25.2	32.1	81	1945	-4	1967	1020	0	2.85	5.59	1976	1.20	1967	2.14	1954	29.2	1959	15.8	1954	79	80	67	74	13.7	SW	68	W	1959	46	7.6	4	7	20	16	4	1	3	0	7	25	*	989.5
A	53.3	36.4	44.9	87	1957	12	1954	603	0	3.15	5.90	1961	1.27	1946	1.71	1977	15.0	1975	6.6	1975	75	76	58	64	13.0	SW	67	W	1957	53	7.1	5	8	17	14	1	2	2	0	1	12	0	989.8
M	64.3	45.9	55.1	90	1977	26	1947	321	14	2.97	6.39	1953	1.21	1965	2.03	1957	2.0	1945	2.0	1945	77	76	56	62	11.8	SW	63	SW	1950	58	6.7	6	9	16	13	*	3	2	*	0	1	0	988.4
J	75.1	56.3	65.7	95	1957	35	1945	56	79	2.23	6.06	1974	0.11	1955	3.04	1968	0.0		0.0		79	78	57	61	11.2	SW	56	NW	1954	66	6.2	6	12	12	10	0	5	1	1	0	0	0	989.5
J	79.3	60.7	70.1	94	1960	43	1945	12	170	2.93	6.43	1963	0.99	1972	3.38	1963	0.0		0.0		80	79	55	61	10.6	SW	59	NW	1953	69	6.0	7	13	11	10	0	6	1	1	0	0	0	990.1
A	77.0	59.1	68.4	99	1948	38	1965	33	138	3.53	10.67	1977	1.10	1948	3.88	1963	0.0		0.0		83	83	58	67	10.0	SW	56	SW	1944	66	6.0	7	12	12	11	0	6	1	*	0	0	0	992.3
S	70.0	52.3	61.6	98	1953	32	1963	136	36	3.29	8.99	1977	0.77	1964	3.63	1967	T	1956	T	1956	82	83	60	72	10.6	S	59	SW	1954	59	6.3	7	9	14	11	0	3	1	*	0	*	0	991.8
O	60.2	42.7	51.5	87	1951	20	1965	419	0	3.01	9.13	1954	0.30	1963	3.49	1945	3.1	1972	2.5	1972	80	82	61	73	11.4	S	63	SW	1954	52	6.5	7	8	16	11	*	2	1	0	0	3	0	992.6
N	46.1	33.5	39.8	80	1961	9	1971	756	0	3.74	6.37	1949	1.44	1944	2.51	1949	31.3	1976	19.9	1955	80	82	70	78	12.9	S	66	SW	1948	29	8.3	2	5	23	16	3	1	1	0	2	14	0	990.7
D	33.0	22.2	27.9	66	1966	-4	1975	1150	0	3.00	8.02	1977	0.69	1943	2.16	1945	60.7	1976	24.3	1945	81	82	75	79	13.5	WSW	60	S	1945	27	8.5	1	6	24	20	6	*	1	0	13	26	*	989.8
YR	55.0	39.1	47.1	99	AUG 1948	-20	FEB 1961	6927	437	36.11	10.67	AUG 1977	0.11	JUN 1955	3.88	AUG 1963	68.3	JAN 1977	24.3	DEC 1945	79	80	63	70	12.3	SW	91	SW	JAN 1950	52	7.2	55	101	209	169	27	30	19	2	58	136	5	990.4

Means and extremes above are from existing and comparable exposures. Annual extremes have been exceeded at other sites in the locality as follows: Lowest temperature -21 in February 1934; minimum monthly precipitation .05 in August 1876; maximum precipitation in 24 hours 4.28 in August 1893.

(a) Length of record, years, through the current year unless otherwise noted, based on January data.
(b) 70° and above at Alaskan stations.
* Less than one half.
T Trace.

NORMALS - Based on record for the 1941-1970 period.
DATE OF AN EXTREME - The most recent in cases of multiple occurrence.
PREVAILING WIND DIRECTION - Record through 1963.
WIND DIRECTION - Numerals indicate tens of degrees clockwise from true north. 00 indicates calm.
FASTEST MILE WIND - Speed is fastest observed 1-minute value when the direction is in tens of degrees

Average Temperature

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
1939	26.3	27.4	30.3	39.0	55.6	65.7	70.5	72.0	62.8	52.0	38.0	32.3	47.7
1940	18.1	25.0	27.0	40.2	55.0	63.0	69.6	69.6	61.0	49.0	39.2	32.8	45.6
1941	24.5	25.6	26.2	48.2	54.6	66.0	72.1	67.8	65.1	52.8	43.8	35.8	48.2
1942	24.2	20.9	36.1	46.8	56.4	65.7	68.0	67.8	62.0	55.2	40.3	25.2	47.2
#1943	21.2	25.8	30.3	36.9	51.8	65.7	71.6	68.8	60.8	48.4	37.5	26.6	45.4
1944	29.7	25.1	30.0	41.1	65.4	67.1	72.4	71.8	65.6	50.2	42.0	25.4	48.5
1945	16.2	26.2	44.4	49.8	50.7	64.0	70.2	69.8	64.2	49.8	40.9	25.6	47.5
1946	27.4	24.7	44.5	44.4	55.0	63.9	71.2	66.0	64.4	56.6	44.4	31.5	49.5
1947	29.9	21.4	29.9	45.4	52.8	65.8	68.6	75.2	64.0	59.8	38.0	28.3	48.1
1948	18.6	25.2	35.0	48.8	55.2	65.2	72.0	70.2	64.9	49.6	47.1	32.4	48.5
1949	31.2	31.8	35.6	45.5	57.6	72.2	74.3	71.6	58.8	57.2	38.0	33.3	50.4
1950	33.0	24.8	28.3	39.9	57.3	65.0	69.0	68.6	60.7	54.7	39.0	27.1	47.5
1951	28.5	27.4	35.3	45.0	57.5	66.3	70.4	68.5	61.3	54.6	34.3	30.6	48.3
1952	28.5	29.1	33.5	48.2	55.9	67.3	74.3	70.1	65.1	46.5	42.9	33.3	49.2
1953	31.3	30.7	36.6	44.0	56.4	67.5	71.6	70.5	65.0	54.3	43.9	34.6	50.4
1954	23.5	33.1	32.9	47.3	54.5	68.2	69.6	66.9	62.3	53.9	41.7	28.7	48.5
1955	24.8	27.9	35.8	51.0	59.4	66.8	76.0	73.8	62.0	54.0	38.7	25.1	49.4
1956	24.6	28.3	30.6	45.0	55.1	66.4	68.9	69.0	58.9	55.3	42.0	34.2	47.9
1957	20.6	30.8	35.9	48.8	54.7	69.1	69.8	67.3	62.4	50.1	40.8	34.8	48.7
1958	25.1	20.4	34.5	48.2	54.0	61.9	71.3	68.9	62.1	52.2	41.8	22.3	46.9
1959	22.3	24.2	31.0	46.0	60.2	66.8	72.8	74.8	66.6	52.6	38.6	32.3	49.1
#1960	26.5	27.2	24.1	48.4	58.1	65.8	69.1	69.0	64.3	50.6	42.9	21.6	47.3
1961	18.5	26.5	34.2	39.8	55.1	65.4	69.7	69.6	68.4	54.5	40.8	29.7	47.4
1962	22.6	21.3	32.5	44.9	60.9	64.9	68.2	68.1	58.4	51.5	37.1	25.1	46.5
1963	18.9	18.8	35.4	44.2	52.9	66.7	70.2	64.3	57.1	57.1	43.6	23.4	46.1
1964	29.3	23.5	34.0	46.9	59.2	65.7	73.1	64.9	60.4	48.1	42.1	29.5	48.1
1965	23.6	25.8	30.0	41.2	59.6	64.3	67.6	67.8	65.5	47.8	40.0	34.3	47.1
1966	20.4	24.9	34.7	45.3	52.2	67.4	71.4	68.5	58.7	48.8	41.5	28.6	46.7
1967	29.8	20.6	30.9	46.1	50.1	72.5	71.2	68.1	60.7	51.9	36.3	33.0	47.6
1968	19.9	20.7	35.7	49.2	53.4	64.8	71.2	69.4	66.1	55.5	40.7	26.8	47.6
1969	25.0	24.6	30.9	46.8	54.4	64.4	70.5	71.2	62.2	51.0	39.1	24.8	47.1
1970	17.6	24.8	30.1	46.9	57.3	66.0	71.0	70.2	64.0	54.5	41.6	27.4	47.6
1971	20.9	27.0	29.8	41.8	54.5	67.6	68.7	67.8	65.4	58.7	39.1	33.5	47.9
1972	23.5	22.0	30.1	41.1	59.1	62.6	71.0	67.7	62.8	46.2	36.0	30.8	46.3
1973	27.6	22.9	42.4	46.9	54.5	68.2	72.3	71.8	61.7	54.3	40.8	29.0	49.4
1974	27.1	22.3	35.0	46.2	55.1	65.6	69.9	69.9	59.6	49.2	40.2	31.7	47.5
1975	30.1	29.1	30.8	39.3	62.1	68.0	72.3	69.7	58.3	53.1	46.9	28.3	49.0
1976	19.7	31.8	37.2	46.5	53.6	68.4	67.8	67.5	60.1	46.3	34.1	22.0	46.5
1977	15.4	24.6	39.8	47.0	60.3	64.4	72.0	68.1	62.6	49.6	43.3	27.9	47.8
1978	20.4	15.5	28.2	42.5	57.4	65.1	70.4	70.5	60.8	49.5	40.4	30.4	45.9
RECORD MEAN	24.3	24.5	32.4	43.4	54.7	64.7	70.3	68.9	62.5	51.7	40.0	29.5	47.3
MAX	31.3	31.4	39.5	51.5	63.1	72.4	78.0	76.8	70.5	59.1	46.7	35.3	54.6
MIN	18.4	17.8	25.2	35.2	46.2	57.0	62.6	61.0	54.5	44.3	33.1	25.6	39.9

Heating Degree Days

Season	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	Total
1958-59	2	19	124	398	687	1318	1317	1154	1050	562	216	63	6887
1959-60	1	1	111	388	784	1004	1168	1088	1258	494	255	48	6600
#1960-61	16	10	77	441	660	1359	1435	1072	952	749	385	90	7226
1961-62	30	17	76	323	722	1089	1310	1216	1002	609	195	66	6655
1962-63	9	26	213	418	832	1231	1420	1288	907	618	370	57	7386
1963-64	20	72	240	241	635	1282	1099	1198	955	555	204	98	6579
1964-65	5	68	176	518	680	1097	1277	1092	1080	706	186	100	6985
1965-66	25	46	122	528	742	942	1374	1114	931	648	401	68	6956
1966-67	7	19	199	495	700	1124	1086	1259	1047	560	457	4	6957
1967-68	12	26	162	403	855	985	1395	1281	901	469	552	84	6921
1968-69	11	29	58	374	722	1180	1235	1125	1052	540	525	102	6751
1969-70	15	16	147	433	769	1240	1459	1121	1076	552	255	66	7147
1970-71	6	6	93	328	695	1161	1361	1057	1085	691	327	36	6846
1971-72	11	29	87	207	771	971	1218	1237	1070	707	187	112	6602
1972-73	16	33	115	576	860	1054	1152	1175	696	542	518	24	6555
1973-74	2	14	171	326	720	1107	1167	1187	989	555	565	51	6652
1974-75	2	0	187	483	738	1024	1077	1001	1053	764	175	32	6556
1975-76	3	15	197	368	535	1134	1400	958	853	557	558	40	6418
1976-77	15	35	180	573	921	1328	1580	1123	775	544	207	90	7371
1977-78	5	40	110	473	646	1146	1376	1578	1150	670	282	81	7537
1978-79	14	5	154	472	732	1067							

Cooling Degree Days

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
1969	0	0	0	0	1	88	192	212	69	6	0	0	568
1970	0	0	0	16	21	106	197	175	72	12	0	0	599
1971	0	0	0	0	9	119	136	122	107	15	0	0	508
1972	0	0	0	0	12	48	210	125	57	0	0	0	450
1973	0	0	0	6	2	126	233	230	78	3	0	0	678
1974	0	0	0	0	7	71	163	158	29	0	0	0	428
1975	0	0	0	0	90	129	238	171	3	5	0	0	634
1976	0	0	0	8	7	149	109	119	40	0	0	0	432
1977	0	0	0	12	68	78	228	142	45	0	1	0	574
1978	0	0	0	0	52	91	189	175	35	0	0	0	540

Precipitation

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
1939	2.90	3.50	2.94	2.46	1.97	1.75	1.51	3.79	3.12	1.85	0.53	3.00	29.50
1940	2.47	3.71	2.35	2.31	3.51	4.44	1.48	3.12	3.72	1.15	4.58	5.37	36.01
1941	2.36	2.05	2.01	1.69	1.11	0.82	3.37	1.06	0.87	2.40	3.06	1.36	22.16
1942	5.25	4.26	3.79	2.16	3.75	0.76	2.42	2.45	5.40	3.12	4.26	5.01	38.63
#1943	1.98	2.30	2.44	3.72	3.52	2.77	1.75	2.59	3.45	4.01	2.57	0.69	51.77
1944	1.23	2.92	2.91	4.62	2.87	3.95	1.04	6.17	3.63	1.11	1.44	3.85	35.72
1945	5.71	3.04	4.26	3.15	2.84	2.55	3.97	1.18	4.88	5.87	3.95	5.07	44.47
1946	1.03	2.47	1.61	1.27	3.59	2.05	2.75	4.35	3.24	5.72	2.79	2.79	31.64
1947	4.65	1.59	2.05	3.95	4.85	4.01	3.54	1.80	2.11	0.66	4.01	1.96	35.16
1948	1.99	2.94	3.24	2.81	3.12	3.07	2.58	1.10	5.74	4.74	4.01	2.05	37.59
1949	2.71	2.64	2.52	2.42	2.09	1.17	3.15	5.27	3.10	1.67	6.37	5.68	56.79
1950	5.01	4.26	3.23	2.46	2.16	2.04	3.12	4.12	1.95	2.36	4.83	1.84	37.38
1951	2.65	2.96	4.57	4.03	2.01	4.48	3.50	1.36	2.52	1.87	4.47	5.35	37.75
1952	3.75	2.07	2.51	2.56	3.91	1.13	1.28	5.12	2.72	0.68	2.89	2.57	29.14
1953	2.81	1.46	3.76	2.24	6.59	0.98	3.60	5.21	3.09	0.52	4.94	5.08	35.88
1954	2.94	3.72	5.24	3.95	1.55	2.57	2.08	2.45	2.20	9.15	3.52	5.83	44.78
1955	2.61	2.47	4.60	3.35	1.65	0.11	2.13	4.81	2.97	8.12	4.20	2.82	39.79
1956	2.12	3.33	5.25	3.69	4.61	0.99	3.54	5.89	3.95	0.86	2.88	4.82	41.95
1957	4.92	1.65	2.23	4.86	4.03	2.92	2.97	1.11	3.84	1.12	5.30	3.76	38.69
1958	3.81	4.78	1.36	5.95	1.79	2.91	1.49	3.16	4.59	1.40	3.49	1.66	34.59
1959	6.47	3.45	3.87	3.21	2.10	1.94	1.98	4.78	2.52	4.93	3.58	3.98	42.81
1960	3.90	5.80	2.35	2.34	4.05	2.48	1.89	5.75	1.20	1.89	2.94	2.57	35.16
1961	1.41	2.63	2.59	5.90	3.01	3.66	3.02	4.03	2.53	2.41	3.30	2.62	37.11
1962	2.78	2.65	1.23	2.25	2.36	2.80	1.89	3.00	3.14	1.90	1.78	2.77	28.55
1963	1.51	1.05	2.19	2.77	2.22	0.61	6.43	8.04	1.20	0.30	5.07	1.83	53.20
1964	2.12	1.09	3.72	5.36	2.91	1.55	2.57	5.02	0.77	1.89	2.09	2.58	29.67
1965	3.27	2.99	1.97	1.99	1.21	1.50	3.69	4.12	2.37	5.07	4.69	2.60	35.47
1966	3.74	2.11	2.78	2.06	1.36	1.97	4.92	3.60	2.65	0.95	4.50	2.25	32.87
1967	1.18	1.59	1.20	2.60	3.69	2.50	1.57	4.04	6.36	4.78	3.13	2.16	34.60
1968	2.18	0.81	2.67	1.78	3.30	4.45	1.19	5.35	5.65	3.03	4.47	3.42	38.26
1969	3.85	0.97	1.62	4.16	3.75	5.51	3.83	2.48	2.04	2.77	4.09	3.09	56.16
1970	2.06	1.74	1.72	2.54	2.87	2.55	4.02	2.01	4.55	4.20	5.20	3.25	34.71
1971	1.46	3.03	2.07	1.48	1.56	4.25	4.50	4.45	1.88	1.57	3.07	3.61	52.91
1972	2.17	5.44	3.99	2.99	3.64	6.06	0.99	4.19	5.06	2.96	4.28	3.86	41.65
1973	2.03	1.98	3.27	5.56	2.99	1.68	3.68	2.98	1.44	4.27	4.07	4.89	36.84
1974	2.44	2.19	3.19	3.15	5.36	5.86	1.80	5.64	2.42	1.75	5.38	3.15	36.31
1975	2.11	2.93	2.92	1.86	3.51	3.65	2.34	8.49	2.44	1.13	2.77	4.58	38.55
1976	5.19	3.45	5.59	4.01	4.70	3.36	5.65	1.65	5.39	5.61	2.11	3.83	46.52
1977	3.38	1.59	2.42	5.60	1.39	2.79	3.64	10.67	8.99	2.61	4.45	8.02	55.55
1978	6.29	1.36	1.72	1.84	3.95	2.42	1.48	3.51	4.40	3.72	1.55	5.50	55.74
RECORD MEAN	5.10	2.71	2.75	2.69	2.89	2.76	2.91	3.18	3.02	3.05	3.22	5.23	35.49

Snowfall

Season	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	Total
1939-40	0.0	0.0	0.0	T	0.5	8.7	27.6	20.2	15.7	5.1	0.0	0.0	77.8
1940-41	0.0	0.0	0.0	T	17.5	12.1	17.3	23.1	9.3	T	0.0	0.0	79.3
1941-42	0.0	0.0	0.0	T	5.0	7.8	31.0	28.0	13.7	4.1	0.0	0.0	89.6
#1942-43	0.0	0.0	0.0	T	8.7	26.7	16.9	17.7	10.4	5.1	T	0.0	85.5
1943-44	0.0	0.0	0.0	1.5	15.6	1.7	3.4	24.6	10.5	2.7	0.0	0.0	58.0
1944-45	0.0	0.0	0.0	0.0	3.9	35.1	50.6	23.5	5.8	T	2.0	0.0	120.7
1945-46	0.0	0.0	0.0	T	25.2	51.1	10.7	23.5	T	T	0.0	0.0	110.5
1946-47	0.0	0.0	0.0	0.0	T	11.9	13.0	22.2	13.5	4.0	0.8	0.0	65.4
1947-48	0.0	0.0	0.0	0.0	9.9	4.3	14.5	7.0	4.2	T	T	0.0	39.9
1948-49	0.0	0.0	0.0	T	1.3	7.0	11.8	5.2	14.3	0.5	0.0	0.0	40.1
1949-50	0.0	0.0	0.0	0.0	28.6	9.5	14.8	19.5	13.7	2.8	0.0	0.0	88.7
1950-51	0.0	0.0	T	0.0	15.2	22.3	13.7	12.5	7.9	T	0.0	0.0	71.4
1951-52	0.0	0.0	0.0	T	17.7	31.6	16.8	8.9	7.4	0.6	0.0	0.0	83.0
1952-53	0.0	0.0	0.0	0.4	11.2	16.1	8.0	11.9	5.5	2.8	0.0	0.0	55.9
1953-54	0.0	0.0	0.0	0.0	22.7	10.9	16.2	12.6	26.5	1.2	T	0.0	89.9
1954-55	0.0	0.0	0.0	1.0	0.7	31.2	28.5	12.0	11.1	0.5	0.0	0.0	84.8
1955-56	0.0	0.0	0.0	T	26.0	20.3	17.7	14.3	23.1	5.8	T	0.0	105.2
1956-57	0.0	0.0	T	0.0	16.2	35.6	36.6	3.1	10.2	12.0	0.0	0.0	113.7
1957-58	0.0	0.0	0.0	T	19.2	4.8	31.1	54.2	11.2	4.2	0.0	0.0	124.7
1958-59	0.0	0.0	0.0	0.0	15.5	19.0	38.4	14.0	29.2	0.4	T	0.0	114.5
1959-60	0.0	0.0	0.0	T	12.2	14.2	18.3	49.5	19.5	1.9	T	0.0	115.6
1960-61	0.0	0.0	0.0	1.0	15.9	31.9	23.5	11.9	5.1	15.1	T	0.0	102.4
1961-62	0.0	0.0	0.0	T	5.6	30.2	26.2	28.2	6.7	4.5	0.0	0.0	101.4
1962-63	0.0	0.0	0.0	2.0	2.5	30.2	31.5	15.5	7.7	0.3	0.1	0.0	89.8
1963-64	0.0	0.0	0.0	0.0	3.1	24.0	13.7	14.6	12.8	3.5	0.0	0.0	71.5
1964-65	0.0	0.0	0.0	T	5.4	15.2	19.2	9.4	17.5	4.2	0.0	0.0	70.9
1965-66	0.0	0.0	0.0	1.2	12.2	7.0	48.0	15.2	11.4	3.2	0.1	0.0	98.3
1966-67	0.0	0.0	0.0	0.0	10.0	12.1	11.6	19.8	10.8	0.6	1.2	0.0	66.1
1967-68	0.0	0.0	0.0	T	19.7	10.4	19.1	11.7	10.6	0.1	0.0	0.0	71.6
1968-69	0.0	0.0	0.0	T	11.6	11.7	31.2	12.8	8.0	5.1	0.0	0.0	78.4
1969-70	0.0	0.0	0.0	1.0	22.1	23.4	58.0	21.9	12.6	1.5	T	0.0	120.5
1970-71	0.0	0.0	0.0	0.0	2.6	52.5	17.2	19.4	22.6	2.9	0.0	0.0	97.0
1971-72	0.0	0.0	0.0	0.0	18.7	12.9	27.6	31.4	14.1	5.2	0.0	0.0	109.9
1972-73	0.0	0.0	0.0	5.1	18.9	19.8	9.9	16.1	8.5	2.4	0.1	0.0	78.8
1973-74	0.0	0.0	0.0	0.0	5.0	23.1	19.7	22.8	12.9	7.1	0.1	0.0	88.7
1974-75	0.0	0.0	0.0	T	22.1	25.6	11.0	16.5	7.6	15.0	0.0	0.0	95.6
1975-76	0.0	0.0	0.0	T	5.5	27.3	21.6	8.3	17.3	2.5	T	0.0	82.5
1976-77	0.0	0.0	0.0	0.2	51.3	60.7	68.3	22.7	15.5	2.2	0.5	0.0	199.4
1977-78	0.0	0.0	0.0	T	15.0	53.4	56.5	21.7	5.8	1.8	0.1	0.0	154.5
1978-79	0.0	0.0	0.0	T	5.0	10.1							
RECORD MEAN	0.0	0.0	T	0.3	12.9	22.4	25.9	18.2	12.0	5.1	0.1	0.0	92.9

# Indicates a station move or relocation of instruments. See Station Location table.

Record mean values above are means through the current year for the period beginning in 1874 for temperature, 1871 for precipitation and 1944 for snowfall. Data are from City Office locations through June 1943 and from Airport locations thereafter.

Local Climatological Data

Annual Summary With Comparative Data

1978

CHICAGO, ILLINOIS

O'HARE INTERNATIONAL AIRPORT

DEPARTMENT OF COMMERCE ★ UNITED STATES OF AMERICA ★

Narrative Climatological Summary

Chicago is along the southwest shore of Lake Michigan and occupies a plain which, for the most part, is only some tens of feet above the lake. Lake Michigan averages 579 feet above m.s.l. Natural water drainage over most of the City would be into Lake Michigan, and from areas west of the City is into the Mississippi River System. But actual drainage over most of the City is artificially channeled also into the Mississippi system.

Topography does not significantly affect air flow in or near the City except that lesser frictional drag over Lake Michigan causes winds to be frequently stronger along the lakeshore, and oftan permits air masses moving from the north to reach shore areas an hour or more before affecting western parts of the City.

Chicago is in a region of frequently changeable weather. The climate is predominately continental, ranging from relatively warm in summer to relatively cold in winter. However, the continentality is partially modified by Lake Michigan, and to a lesser extent by other Great Lakes. In late autumn and winter, air masses that are initially vary cold often reach the City only after being tempered by passage over one or more of the lakes. Similarly, in late spring and summer, air masses reaching the City from the north, northeast, or east are cooler because of movement over the Great Lakes. Very low winter temperatures most often occur in air that flows southward to the west of Lake Superior before reaching the Chicago area. In summer the higher temperatures are with south or southwest flow and are therefore not influenced by the iakes, the only modifying effect being a local lake breeze. Strong south or southwest flow may overcome the lake breeze and cause high temperatures to extend over the entire City.

During the warm season, when the lake is cold relative to land, there is frequently a lake breeze that reduces daytime temperature near the shore, sometimes by 10° or more below temperatures farther inland. When the breeze off the lake is light this effect usually reaches inland only a mile or two, but with stronger on-shore winds the whole City is cooled. On the other hand, temperatures at night are warmer near the lake so that 24-hour averages on the whole are only slightly different in various parts of the City and suburbs.

In summer a combination of high temperature and humidity may develop, usually building up progressively over a period of several days when winds continue out of the south or southwest, becoming oppressive for one or perhaps several days, then ending abruptly with a shift of winds to northwest or northerly. The change may be preceded or accompanied by thundershowers. High relative humidity often results from wind flow off the lake, but the air is then cooler and not oppressive.

At the O'Hare International Airport temperatures of 96° or higher occur in about half the summers, while about half the winters have a minimum as low as -15°. The average date of the first temperature as low as 32° in the fall is October 12 and the average date of the temperature as low as 32° in the spring is April 29 (1959-1972 data). However, temperatures this low have been recorded as early as September 28 in autumn, and as late as May 29 in spring. Normal daily maan temperatures are below 32° for 96 days during winter. The normal heating season is from mid-September to early Juna. Ninety-four percent of the normal heating load is between October 1 and April 30, and 55 percent during the winter months of December through February. The normal air-conditioning season lasts from about mid-June to early September.

Precipitation falls mostly from air that has passed over the Gulf of Mexico. But in winter there is sometimes snowfall, light inland but locally heavy near the lakeshore, with Lake Michigan as the principal moisture source. The heavy lakeshore snow occurs when initially colder air moves from the north with a long trajectory over Lake Michigan and impinges on the Chicago lakeshore. In this situation the air mass is warmed and its moisture content increased up to a height of several thousand feet. Snowfall is produced by upward currents that become stronger, because of frictional effects, when the air moves from the lake onto land. This type of snowfall therefore tends to be heavier and to extend farther inland in south-shore areas of the City and in Indiana suburbs, where the angle between wind-flow and shoreline is greatest. The effect of Lake Michigan, both on winter temperatures and lake-produced snowfall, is enhanced by non-freezing of much of the lake during the winter, even though areas and harbors are often ice-choked. This type of local heavy snowfall may occur once or a few times in a normal season.

Summer thundershowers are often locally heavy and variable; parts of the City may receive substantial rainfall and other parts none. Longer periods of continuous precipitation are mostly in autumn, winter, and spring. About one-half the precipitation in winter, and about 10% of the yearly total precipitation, falls as snow. Snowfall from month to month and year to year is greatly variable. There is a 50 percent likelihood that the first and last 1-inch snowfall of a season will occur by December 5 and March 20, respectively. The corresponding dates for the first and last 3-inch snowfall are December 24 and March 2. Freezing rain sometimes occurs but is usually light. During the cold season slight melting and refreezing of precipitation is a fairly common hazard to highway traffic.

Channeling of winds between tall buildings often causes locally stronger gusts in the central business area. Also winds are often locally more brisk along the shoreline; otherwise the nickname "windy city" is a misnomer, because the average wind speed is not greater than in many other parts of the United States.

Fog is infrequent. Visibility is much more often restricted by local air pollution, a condition that is worst during the heating season, but which continues throughout the year because of extensive industrial activity. For much of the time in autumn, winter, and spring, smoke and other air pollution is carried away by winds, sometimes rapidly, but on some occasions when there is little or no wind the pollution accumulates, especially during night and early morning hours. Summertime air pollution is less, partly because of lesser output, but also because of better vertical dispersal; on the other hand, on many summer days surface wind flow converges into the City, preventing or lessening horizontal outflow at the ground.

The amount of sunshine is moderate in summer and quite low in winter. A considerable amount of cloudiness, especially in winter, is locally produced by lake effect. Days in summer with no sunshine are rare. The total sunshine in December, partly because of shorter days, is only a little over one-third the July total.

noaa NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION / ENVIRONMENTAL DATA AND INFORMATION SERVICE / NATIONAL CLIMATIC CENTER ASHEVILLE, N.C.

Meteorological Data For The Current Year

Station: CHICAGO, ILLINOIS # 94846 O HARE INTERNATIONAL AIRPORT Standard time used: CENTRAL Latitude: 41° 59' N Longitude: 87° 54' W Elevation (ground): 658 feet Year: 1978

Month	Temperature °F Averages Daily maximum	Temperature °F Averages Daily minimum	Temperature °F Averages Monthly	Temperature °F Extremes Highest	Date	Extremes Lowest	Date	Degree days Base 65 °F Heating	Degree days Cooling	Precipitation in inches Water equivalent Total	Water equivalent Greatest in 24 hrs.	Date	Snow, Ice pellets Total	Snow, Ice pellets Greatest in 24 hrs.	Date	Relative humidity, pct. Hour 00 (Local time)	Hour 06	Hour 12	Hour 18	Wind Resultant Direction	Resultant Speed m.p.h.	Average speed m.p.h.	Fastest mile Speed m.p.h.	Fastest mile Direction	Fastest mile Date	Percent of possible sunshine	Average sky cover, tenths, sunrise to sunset	Number of days Sunrise to sunset Clear	Partly cloudy	Cloudy	Precipitation .01 inch or more	Snow, Ice pellets 1.0 inch or more	Thunderstorms	Heavy fog, visibility ¼ mile or less	Temperature °F Maximum (b) 90° and above	Maximum 32° and below	Minimum 32° and below	Minimum 0° and below	Average station pressure mb Elev. 674 feet m.s.l.
JAN	23.3	8.1	15.7	39	7	-9	30	1521	0	1.48	0.58	25-26	21.9	7.2	25-26	74	73	69	71	29	6.0	12.1	33	28	26		6.5	11	1	19	12	7	0	1	0	26	29	9	995.3
FEB	24.8	8.7	16.8	37	24	-4	19	1346	0	0.43	0.15	1-2	7.9	2.2	1-2	78	79	66	71	29	4.6	10.3	29	33	5		6.9	7	4	17	10	4	0	0	0	26	28	3	997.0
MAR	39.6	24.1	31.9	78	31	-3	5	1020	0	1.16	0.52	24-25	4.5	2.5	2-3	82	84	61	69	31	2.1	11.5	31	21	18		7.0	4	10	17	9	3	1	0	0	9	25	1	993.2
APR	58.3	36.6	47.5	73	7	28	22	518	0	3.94	1.13	5-6	0.2	0.2	2	76	80	58	57	04	3.2	12.5	35	25	11		6.7	7	9	14	10	0	5	1	0	0	6	0	990.9
MAY	68.3	48.2	58.3	88	31	29	2	264	60	2.80	1.09	12-13	0.0	0.0		74	79	59	58	04	1.6	11.5	33	19	11		6.0	9	8	14	11	0	4	2	0	0	2	0	989.2
JUN	78.7	56.4	67.6	89	11	42	13	46	132	6.36	2.05	17-18	0.0	0.0		74	78	56	56	20	3.7	9.8	28	28	17		6.2	6	13	11	9	0	7	0	0	0	0	0	991.5
JUL	81.2	62.7	72.0	90	20	52	31	1	227	4.61	2.11	1-2	0.0	0.0		82	84	65	68	18	1.2	9.0	26	32	26		6.3	5	14	12	11	0	7	1	1	0	0	0	990.9
AUG	82.7	62.1	72.4	92	15	49	4	4	243	1.96	0.64	15	0.0	0.0		83	88	59	60	20	3.3	8.2	40	25	19		5.5	10	12	9	10	0	6	0	1	0	0	0	992.9
SEP	80.2	57.3	68.8	95	8	43	28	59	181	6.88	3.00	16-17	0.0	0.0		81	86	58	61	21	2.4	8.9	28	09	13		4.7	12	11	7	9	0	5	0	6	0	0	0	992.9
OCT	61.7	41.0	51.4	80	21	31	24	418	2	1.08	0.30	25	0.0	0.0		77	00	54	64	23	4.3	10.6	25	02	16		6.2	6	12	13	10	0	0	0	0	0	4	0	993.2
NOV	49.4	32.2	40.8	78	5	11	30	718	0	2.24	0.54	12-13	5.2	4.5	26-27	79	82	68	75	25	2.6	11.0	33	24	17		6.8	6	8	16	13	2	0	1	0	3	16	0	995.3
DEC	33.3	18.3	25.8	43	3	-10	10	1206	0	4.41	1.08	30-31	35.3	10.1	31	80	82	75	77	24	5.0	12.1	29	30	13		6.9	9	4	18	14	7	1	6	0	10	31	2	991.2
YEAR	56.8	38.0	47.4	95	SEP 8	-10	DEC 10	7121	845	37.35	3.00	SEP 16-17	75.0	10.1	DEC 31	78	81	62	66	25	2.0	10.6	40	25	AUG 19		6.3	92	106	167	128	23	36	12	8	74	141	15	992.8

Normals, Means, And Extremes

Month	Temperatures °F Normal Daily maximum	Normal Daily minimum	Normal Monthly	Extremes Record highest	Year	Record lowest	Year	Normal Degree days Base 65 °F Heating	Cooling	Precipitation in inches Water equivalent Normal	Maximum monthly	Year	Minimum monthly	Year	Maximum in 24 hrs.	Year	Snow, Ice pellets Maximum monthly	Year	Maximum in 24 hrs.	Year	Relative humidity pct. Hour 00 (Local time)	Hour 06	Hour 12	Hour 18	Wind Mean speed m.p.h.	Prevailing direction	Fastest mile Speed m.p.h.	Fastest mile Direction	Fastest mile Year	Pct. of possible sunshine	Mean sky cover, tenths, sunrise to sunset	Mean number of days Sunrise to sunset Clear	Partly cloudy	Cloudy	Precipitation .01 inch or more	Snow, Ice pellets 1.0 inch or more	Thunderstorms	Heavy fog, visibility ¼ mile or less	Temperatures °F Max. (b) 90° and above	Max. 32° and below	Min. 32° and below	Min. 0° and below	Average station pressure mb. Elev. 674 feet m.s.l.
(a)				20		20					20		20		20		20		20		20	20	20	20	20		20	20			20	20	20	20	20	20	20	20	20	20	20	20	6
J	31.1	14.7	22.9	61	1967	-20	1966	1305	0	1.70	4.11	1965	0.27	1961	2.00	1960	25.1	1967	18.1	1967	75	76	68	71	11.6		47	28	1971		6.8	7	6	18	11	3	*	2	0	19	29	7	993.0
F	34.3	17.8	26.1	71	1976	-17	1967	1089	0	1.30	2.70	1960	0.12	1969	1.47	1974	21.5	1967	8.4	1967	74	76	65	68	11.5		45	25	1967		6.9	6	6	16	10	2	*	2	0	13	26	3	992.3
M	44.0	26.7	35.7	80	1963	-8	1962	908	0	2.52	5.91	1976	0.90	1968	1.85	1972	24.7	1965	10.6	1970	76	78	61	65	11.8		54	01	1964		7.2	5	9	17	13	2	2	3	0	4	21	*	989.9
A	59.4	38.2	48.8	87	1977	13	1975	486	0	3.38	6.28	1960	0.97	1971	2.76	1976	11.1	1975	10.9	1975	71	76	55	57	12.1		54	24	1965		6.7	6	9	15	12	*	5	1	0	*	8	0	991.0
M	69.7	47.0	58.4	93	1977	24	1966	240	35	3.41	7.14	1970	1.61	1967	2.91	1966	1.6	1966	1.6	1966	73	76	54	54	10.6		52	34	1962		6.2	7	10	14	11	0	5	1	1	0	1	0	989.2
J	79.1	57.0	68.1	97	1971	36	1972	45	138	4.15	7.94	1967	1.68	1959	3.09	1967	0.0		0.0		74	79	55	55	9.1		41	24	1970		5.9	8	11	11	10	0	7	1	4	0	0	0	989.6
J	83.1	60.7	71.9	98	1977	40	1965	7	221	3.46	5.27	1973	1.18	1977	2.89	1962	0.0		0.0		78	81	57	57	8.1		52	32	1959		5.5	9	13	9	10	0	6	1	5	0	0	0	991.3
A	82.3	59.9	71.1	96	1964	41	1965	18	207	2.73	7.37	1975	0.51	1969	3.56	1975	0.0		0.0		80	85	57	61	8.1		46	32	1960		5.6	9	12	10	8	0	5	1	4	0	0	0	993.0
S	75.4	52.0	63.7	99	1960	28	1974	90	51	3.01	11.44	1961	0.55	1966	3.00	1978	T	1967	T	1967	81	84	58	63	8.7		58	23	1959		5.9	9	9	12	10	0	5	*	2	0	*	0	993.0
O	65.5	42.0	53.8	91	1963	19	1962	360	12	2.32	6.55	1969	0.16	1964	4.62	1969	6.6	1967	6.6	1967	76	81	55	64	9.8		48	20	1971		5.8	9	9	13	9	*	2	1	*	0	5	0	994.0
N	48.3	30.1	39.2	78	1978	1	1976	774	0	2.10	4.74	1966	0.65	1976	1.76	1968	10.4	1959	5.8	1975	77	81	64	70	11.0		51	23	1958		7.1	6	7	17	10	1	1	2	0	2	17	0	992.5
D	35.0	19.2	27.1	67	1970	-17	1960	1175	0	1.64	5.37	1971	0.23	1962	2.13	1971	35.3	1978	11.0	1969	79	80	71	70	11.0		46	26	1970		7.9	5	7	19	11	3	1	2	0	12	26	3	991.6
YR	59.0	38.8	48.9	99	SEP 1960	-20	JAN 1966	6497	664	31.72	11.44	SEP 1961	0.12	FEB 1969	4.62	OCT 1969	35.3	DEC 1978	18.1	JAN 1967	76	79	60	63	10.3		58	23	SEP 1959		6.4	86	108	171	125	11	38	16	16	59	131	13	991.7

Means and extremes above are from existing and comparable exposures. Annual extremes have been exceeded at other sites in the locality as follows: Highest temperature 105 in July 1934; lowest temperature -23 in December 1872; maximum monthly precipitation 14.17 in September 1961; minimum monthly precipitation 0.06 in February 1877; maximum monthly snowfall 42.5 in January 1918; fastest mile of wind 87 from Northeast in February 1894.

(a) Length of record, years, through the current year unless otherwise noted, based on January data.
(b) 70° and above at Alaskan stations.
* Less than one half.
T Trace.

NORMALS - Based on record for the 1941-1970 period.
DATE OF AN EXTREME - The most recent in cases of multiple occurrence.
PREVAILING WIND DIRECTION - Record through 1963.
WIND DIRECTION - Numerals indicate tens of degrees clockwise from true north. 00 indicates calm.
FASTEST MILE WIND - Speed is fastest observed 1-minute value when the direction is in tens of degrees.

Average Temperature

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
1958											41.4	20.5	
1959	16.2	24.3	35.8	47.5	64.8	71.1	73.3	77.2	67.3	50.1	31.8	34.4	49.5
1960	26.8	24.6	24.4	52.1	57.7	66.6	72.1	73.7	68.4	54.0	41.7	23.5	48.5
1961	20.3	31.4	38.0	45.3	54.8	67.4	71.1	70.9	65.6	53.6	39.9	25.3	48.5
1962	16.8	24.4	35.5	48.8	65.0	67.9	69.2	71.8	60.7	55.8	40.1	23.2	48.1
1963	11.5	16.9	39.8	50.9	56.3	69.0	72.1	68.5	64.8	60.5	41.9	13.3	47.1
1964	27.7	26.6	33.7	49.1	62.7	69.0	72.1	67.7	65.3	48.0	41.4	24.7	48.9
1965	21.4	24.5	26.6	46.6	61.7	64.9	69.4	68.0	63.8	53.2	40.3	35.3	47.9
1966	16.3	26.1	39.6	45.2	55.4	68.5	74.5	69.6	62.5	51.4	42.5	27.1	48.1
1967	27.7	19.8	36.5	48.4	53.8	69.8	68.4	66.2	61.7	52.9	37.5	30.3	47.7
1968	23.8	23.6	42.7	52.3	57.0	70.2	72.0	73.7	65.5	54.7	40.0	27.8	50.3
1969	21.1	29.9	34.4	50.8	60.4	64.3	73.0	73.9	65.3	51.8	38.3	28.0	49.3
1970	16.3	26.1	34.8	51.7	61.9	69.4	74.7	72.9	65.2	55.4	40.7	30.8	50.0
1971	18.9	28.2	35.0	48.6	57.2	78.5	71.5	72.0	69.7	61.7	41.7	34.2	51.0
1972	19.6	23.6	34.0	44.8	61.0	65.7	73.6	73.8	65.5	49.5	37.7	23.9	47.6
1973	28.2	28.7	44.0	48.1	54.8	71.1	74.7	74.6	66.0	57.9	41.9	28.1	51.5
1974	24.8	27.4	38.6	52.3	56.8	65.5	73.6	70.0	60.5	52.8	40.6	30.2	49.4
1975	27.5	26.2	34.1	45.3	62.3	70.5	75.5	76.3	61.4	55.8	47.2	31.5	50.9
1976	19.9	35.2	42.8	52.3	55.9	70.1	74.0	70.8	62.7	48.5	32.4	19.4	48.6
1977	10.7	26.9	44.9	55.0	67.2	69.3	77.5	71.9	66.0	51.5	40.0	24.2	50.4
1978	15.7	16.8	31.9	47.5	58.5	67.6	72.0	72.4	68.8	51.4	40.8	25.8	47.4
RECORD													
MEAN	20.6	25.6	36.2	48.9	59.1	68.6	72.7	71.8	64.6	53.5	40.0	26.7	49.0
MAX	28.4	33.6	44.6	58.9	69.9	79.4	82.9	82.0	75.0	63.9	48.2	34.1	58.4
MIN	12.7	17.5	27.8	38.9	48.3	57.7	62.5	61.6	54.2	43.0	31.7	19.3	39.6

Heating Degree Days

CHICAGO, IL
O'HARE AIRPORT

Season	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	Total
1958-59					701	1375	1509	1131	897	523	133	25	
1959-60	2	0	85	454	988	941	1175	1164	1247	407	243	53	6759
1960-61	2	3	54	346	691	1282	1377	935	830	640	332	53	6545
1961-62	15	11	126	360	747	1723	1489	1128	970	504	147	50	6770
1962-63	6	1	179	310	740	1291	1655	1339	776	425	281	59	7062
1963-64	16	24	86	176	684	1598	1149	1106	963	479	139	63	6483
1964-65	10	52	140	521	699	1240	1345	1134	1185	545	157	77	7113
1965-66	12	53	110	370	733	915	1502	1079	782	587	371	53	6567
1966-67	1	12	127	420	669	1170	1148	1257	878	491	362	19	6554
1967-68	39	53	160	395	827	1068	1274	1192	682	376	257	28	6351
1968-69	14	12	59	355	740	1146	1355	976	941	419	204	124	6345
1969-70	4	0	75	423	794	1138	1506	1086	929	418	168	44	6585
1970-71	2	0	85	307	725	1055	1422	1026	923	484	262	14	6300
1971-72	7	3	64	154	693	948	1405	1197	954	602	178	80	6285
1972-73	15	10	109	481	811	1269	1135	1012	645	503	311	0	6301
1973-74	0	0	72	244	687	1139	1240	1046	812	383	266	63	5952
1974-75	0	1	176	384	724	1072	1160	1078	951	643	152	30	6371
1975-76	1	0	147	303	531	1033	1392	859	681	611	285	17	5660
1976-77	0	9	119	522	973	1408	1679	1060	616	332	115	41	6874
1977-78	0	8	42	413	741	1254	1521	1346	1020	518	264	46	7173
1978-79	1	4	59	418	718	1206							

Cooling Degree Days

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
1971	0	0	0	0	27	275	213	228	213	59	0	0	1015
1972	0	0	0	0	64	106	289	289	72	0	0	0	820
1973	0	0	0	5	3	189	308	301	108	32	0	0	946
1974	0	0	0	10	21	83	274	162	48	12	0	0	610
1975	0	0	0	0	76	203	532	358	46	24	1	0	1040
1976	0	0	0	36	6	178	286	196	56	8	0	0	766
1977	0	0	0	39	191	178	595	229	76	0	0	0	1108
1978	0	0	0	0	60	132	227	243	181	2	0	0	845

Precipitation

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
1958											1.85	0.72	
1959	1.91	1.66	3.39	2.24	3.44	1.68	5.18	2.05	1.91	4.04	2.57	1.99	32.04
1960	5.07	2.70	1.17	3.02	2.46	4.06	4.27	5.46	1.39	1.35	0.81	0.46	28.20
1961	0.27	0.88	4.01	2.47	2.03	4.20	3.69	1.34	11.44	3.34	1.76	1.35	36.78
1962	2.39	1.18	1.33	1.14	3.38	2.13	5.27	1.62	1.50	0.89	0.71	0.23	21.77
1963	0.84	0.36	2.26	4.88	1.92	2.30	4.09	2.75	2.88	0.28	2.00	0.75	25.27
1964	0.72	0.52	3.45	5.22	2.26	2.86	4.25	1.95	3.96	0.16	2.90	1.51	29.74
1965	4.11	1.18	3.06	3.68	2.36	3.44	3.66	6.40	5.05	1.57	1.47	3.32	39.08
1966	1.09	1.75	2.64	6.28	4.77	2.95	2.19	1.00	0.55	2.16	4.74	1.88	32.00
1967	2.22	1.82	2.30	5.97	1.61	7.94	1.87	2.60	2.45	3.89	2.19	2.41	35.27
1968	1.77	0.87	0.90	2.31	2.99	4.15	2.05	5.52	3.88	1.04	3.70	2.77	31.73
1969	1.62	0.12	1.93	4.02	3.17	7.76	3.45	0.51	3.01	6.55	1.11	1.18	34.41
1970	0.82	0.59	2.12	4.29	7.14	7.14	4.08	1.50	8.69	2.48	2.78	1.77	45.40
1971	0.93	1.94	1.54	0.97	2.25	2.62	3.57	5.97	2.39	0.72	1.32	5.37	27.57
1972	1.01	0.75	3.45	4.77	3.02	3.55	4.97	6.97	8.14	2.92	3.05	2.89	45.47
1973	1.24	1.38	3.91	4.99	5.69	2.87	5.27	0.67	6.01	2.86	1.50	3.71	38.10
1974	3.29	2.11	2.40	4.27	5.09	4.69	2.96	2.60	1.47	1.88	2.47	2.12	35.55
1975	5.69	2.48	2.02	5.50	3.02	5.07	2.19	7.37	0.80	1.90	2.53	3.05	39.62
1976	0.85	1.87	5.91	4.05	4.05	2.93	1.44	1.29	1.49	1.41	0.65	0.64	26.56
1977	0.55	0.71	3.67	2.82	1.88	5.12	1.18	5.39	6.07	1.36	2.05	1.96	32.56
1978	1.48	0.43	1.16	3.94	2.80	6.56	4.61	1.96	6.88	1.08	2.24	4.41	37.35
RECORD													
MEAN	1.69	1.26	2.63	3.73	3.16	4.19	3.51	5.03	4.00	2.09	2.11	2.12	33.52

Snowfall

Season	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	Total
1958-59					0.4	10.7	15.6	2.2	2.9	0.6	0.0	0.0	
1959-60	0.0	0.0	0.0	0.5	10.4	6.9	3.5	17.3	15.5	7	7	0.0	51.7
1960-61	0.0	0.0	0.0	0.0	0.1	4.2	3.0	6.5	2.4	6.9	0.0	0.0	25.1
1961-62	0.0	0.0	0.0	T	2.0	10.7	18.6	10.0	5.7	0.7	0.0	0.0	47.7
1962-63	0.0	0.0	0.0	T	0.3	2.3	16.8	8.4	7.5	T	0.0	0.0	35.5
1963-64	0.0	0.0	0.0	0.0	T	8.9	1.6	5.9	19.8	7	0.0	0.0	36.2
1964-65	0.0	0.0	0.0	0.0	2.3	11.1	11.7	11.5	24.7	T	0.0	0.0	61.3
1965-66	0.0	0.0	0.0	T	0.2	6.6	15.5	4.3	0.7	7	1.6	0.0	28.9
1966-67	0.0	0.0	0.0	T	0.5	8.4	25.1	21.5	8.8	5.4	7	0.0	67.7
1967-68	0.0	0.0	7	6.6	2.4	2.9	10.6	3.8	1.5	0.1	0.0	0.0	27.7
1968-69	0.0	0.0	0.0	0.0	0.7	10.9	5.7	2.5	4.7	0.0	7	0.0	22.3
1969-70	0.0	0.0	0.0	0.0	2.0	19.5	9.5	6.3	11.8	7.2	0.0	0.0	56.1
1970-71	0.0	0.0	0.0	0.0	0.2	2.7	10.0	1.4	8.0	0.8	T	0.0	25.1
1971-72	0.0	0.0	0.0	0.0	1.3	0.2	7.6	7.7	16.8	3.3	0.0	0.0	36.9
1972-73	0.0	0.0	0.0	0.1	0.9	11.2	0.5	9.3	5.4	0.2	7	0.0	25.6
1973-74	0.0	0.0	0.0	0.0	7	18.8	7.4	9.6	1.4	7	0.0	0.0	37.2
1974-75	0.0	0.0	0.0	0.0	1.0	9.4	3.5	8.2	4.5	11.1	0.0	0.0	37.7
1975-76	0.0	0.0	0.0	0.0	6.4	6.8	10.0	1.6	1.9	0.8	7	0.0	27.5
1976-77	0.0	0.0	0.0	1.6	0.5	6.5	7.2	4.0	4.9	T	0.0	0.0	24.7
1977-78	0.0	0.0	0.0	0.0	5.2	12.7	21.9	7.9	4.5	0.2	0.0	0.0	52.4
1978-79	0.0	0.0	0.0	0.0	5.2	35.3							
RECORD													
MEAN	0.0	0.0	T	0.4	2.0	9.8	10.2	7.5	7.5	1.8	0.1	0.0	39.3

# Indicates a station move or relocation of instruments. See Station Location table.

Record mean values above are means through the current year for the period beginning in 1958.

Local Climatological Data

Annual Summary With Comparative Data

1978

CLEVELAND, OHIO

Narrative Climatological Summary

Cleveland is on the south shore of Lake Erie in Northeast Ohio. Metropolitan Cleveland has a lake frontage of 31 miles. The surrounding terrain is generally level except for an abrupt ridge on the eastern edge of the City which rises some 500 feet above the shore terrain. The Cuyahoga River which flows through a rather deep but narrow north-south valley bisects the City of Cleveland.

Cleveland's climate is continental in character but with strong modifying influences by Lake Erie. West to northerly winds blowing off Lake Erie tend to lower daily high temperatures in summer and raise temperatures in winter. Temperatures at Hopkins Airport which is 5 miles south of the lakeshore average from 2 to 4°F higher than the lakeshore in summer, while overnight low temperatures average from 2 to 4°F lower than the lakefront during all seasons. When winds are from directions other than those outlined above, the presence of the lake has little effect upon temperatures in Cleveland.

In this area, summers are moderately warm and humid with occasional days when temperatures exceed 90°F; winters are reasonably cold and cloudy with an average of five days with sub-zero temperatures. Weather changes occur every few days from the passing of cold or warm fronts and their associated centers of high and low pressures.

The daily range in temperature is usually greatest in late summer and least in winter. Annual extremes in temperature normally occur soon after June 21 and December 22. Maximum temperatures below freezing occur most often in December, January and February. Coldest month of record is January 1977. In that month, the maximum temperature failed to reach 32°F, and sub-zero lows were recorded on 14 days. Temperatures of 100°F or higher are rare. The warmest month of record is July 1955. In that month daily highs exceeded 89°F on 16 days.

On the average freezing temperatures in fall are first recorded in October while the last freezing temperature in spring normally occurs in May.

As is characteristic of continental climates, precipitation varies widely from year to year; however, it is normally abundant and well distributed throughout the year with spring being the wettest season. Showers and thundershowers account for most of the rainfall during the growing season. Thunderstorms are most frequent from April through August. Snowfall may fluctuate widely from the annual mean of about 50 inches. For example, during the period 1899-1977, as little as 8.8 inches of snow fell during the winter of 1918-1919 while 80.9 inches fell during the winter of 1909-1910. Mean annual snowfall increases from west to east in Cuyahoga County ranging from about 45 inches in the west to more than 90 inches in the extreme east.

Damaging winds of 50 mph or greater are uaually associated with thunderstorms. The tornado, one of the most destructive of all atmospheric storms, is characterized by a violently rotating column of air which is nearly always observable as a "funnel cloud." It frequently leaves great destruction over a narrow path and is usually accompanied by heavy rain and hail and often by lightning and thunder. Ohio averages about 14 tornadoes per year and during the period 1900-1975, 14 tornadoes were reported in Cuyahoga County.

noaa NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION / ENVIRONMENTAL DATA AND INFORMATION SERVICE / NATIONAL CLIMATIC CENTER ASHEVILLE, N.C.

Meteorological Data For The Current Year

Station: CLEVELAND, OHIO # 14820 CLEVELAND HOPKINS INTL AIRPORT Standard time used: EASTERN Latitude: 41° 25' N Longitude: 81° 52' W Elevation (ground): 777 feet Year: 1978

Month	Temperature °F Averages Daily maximum	Daily minimum	Monthly	Extremes Highest	Date	Lowest	Date	Degree days Base 65 °F Heating	Cooling	Precipitation in inches Water equivalent Total	Greatest in 24 hrs.	Date	Snow, Ice pellets Total	Greatest in 24 hrs.	Date
JAN	28.3	11.9	20.1	48	8	0	23	1387	0	3.67	1.10	7-8	42.8	10.5	20-21
FEB	26.7	6.8	16.8	36	28	-4	4	1343	0	0.48	0.13	13	10.8	4.0	5-6
MAR	41.6	23.1	32.4	70	31	-4	2	1005	0	2.17	0.56	14	3.5	1.8	3
APR	58.2	35.8	47.0	83	10	26	22	534	0	3.02	0.87	19-20	0.2	0.2	21
MAY	69.6	49.2	59.4	89	29	30	3	218	53	3.01	0.63	8-9	0.0	0.0	
JUN	80.0	58.0	69.0	93	27	43	14	43	170	3.30	1.91	25-26	0.0	0.0	
JUL	82.3	62.0	72.2	96	22	48	12	7	237	2.40	0.98	2-3	0.0	0.0	
AUG	82.9	63.0	73.0	92	19	51	5	2	256	3.58	1.53	9	0.0	0.0	
SEP	80.3	58.1	69.2	95	8	41	29	43	177	3.68	1.13	30	0.0	0.0	
OCT	63.2	43.2	53.2	80	22	31	29	362	3	3.23	0.74	5-6	0.0	0.0	
NOV	53.3	35.0	44.2	74	5	21	30	620	0	1.19	0.32	17	1.9	1.5	27
DEC	41.2	26.1	33.7	59	4	12	10	965	0	2.96	0.81	3-4	2.5	0.9	26
YEAR	59.0	39.4	49.2	96	JUL 22	-4	MAR 2	6529	896	32.69	1.91	JUN 25-26	61.7	10.5	JAN 20-21

Month	Relative humidity, pct. Hour 01	Hour 07	Hour 13	Hour 19 (Local time)	Wind Resultant Direction	Speed m.p.h.	Average speed m.p.h.	Fastest mile Speed m.p.h.	Direction	Date	Percent of possible sunshine	Average sky cover, tenths, sunrise to sunset	Number of days Sunrise to sunset Clear	Partly cloudy	Cloudy	Precipitation .01 inch or more	Snow, Ice pellets 1.0 inch or more	Thunderstorms	Heavy fog, visibility ¼ mile or less	Temperature °F Maximum (b) 90° and above	32° and below	Minimum 32° and below	0° and below	Average station pressure mb Elev. 805 feet m.s.l.
JAN	88	87	82	85	24	5.5	12.9	53	22	26	14	8.9	2	3	26	21	9	0	2	0	22	29	1	987.8
FEB	87	87	77	79	26	3.9	8.4	23	03	13	53	7.1	4	10	14	12	4	0	4	0	26	28	5	991.2
MAR	83	88	71	76	26	2.4	10.6	35	16	14	41	8.0	2	7	22	14	2	0	4	0	7	23	1	988.5
APR	77	79	58	66	33	2.1	11.4	35	27	1	61	6.8	7	5	18	13	0	3	0	0	0	12	0	986.8
MAY	84	82	62	66	19	0.8	9.2	28	25	9	48	6.8	8	6	17	15	0	4	2	0	0	2	0	985.8
JUN	79	78	55	57	23	2.8	8.9	36	20	26	64	5.9	9	10	11	10	0	4	0	3	0	0	0	988.8
JUL	84	81	62	63	22	2.2	8.8	20	23	27	53	6.7	4	15	12	7	0	3	1	6	0	0	0	987.8
AUG	85	87	60	68	23	2.4	7.9	28	22	16	56	7.0	5	7	19	7	0	4	0	5	0	0	0	990.2
SEP	84	86	56	67	22	2.4	8.9	24	19	14	66	5.1	10	12	8	7	0	5	0	4	0	0	0	989.8
OCT	78	82	58	71	22	4.8	10.0	23	23	27	42	6.9	9	3	19	15	0	0	1	0	0	2	0	990.5
NOV	78	81	63	71	21	4.2	10.5	35	23	17	40	7.9	4	6	20	9	1	0	0	0	0	10	0	992.6
DEC	75	77	66	70	22	8.1	13.4	30	22	15	42	8.5	1	7	23	15	0	0	0	0	6	28	0	988.2
YEAR	82	83	64	70	23	3.1	10.1	53	22	JAN 26	50	7.1	65	91	209	145	16	23	14	18	61	134	7	989.0

Normals, Means, And Extremes

Month	Temperatures °F Normal Daily maximum	Daily minimum	Monthly	Extremes Record highest	Year	Record lowest	Year	Normal Degree days Base 65 °F Heating	Cooling	Precipitation in inches Water equivalent Normal	Maximum monthly	Year	Minimum monthly	Year	Maximum in 24 hrs.	Year	Snow, Ice pellets Maximum monthly	Year	Maximum in 24 hrs.	Year
(a)				37		37					37		37		37		37		37	
J	33.4	20.3	26.9	73	1950	-19	1963	1181	0	2.56	7.01	1950	0.36	1961	2.33	1959	42.8	1978	10.5	1978
F	35.0	20.8	27.9	69	1961	-15	1963	1039	0	2.18	4.64	1950	0.46	1978	2.33	1959	20.7	1942	10.6	1973
M	44.1	28.1	36.1	83	1945	-5	1948	896	0	3.05	6.07	1954	0.78	1958	2.76	1948	26.3	1954	14.9	1954
A	58.0	38.5	48.3	88	1942	10	1964	501	0	3.49	6.61	1961	1.18	1946	2.24	1961	14.5	1943	7.6	1957
M	68.4	48.1	58.3	92	1959	25	1966	244	37	3.49	6.04	1947	1.00	1963	3.73	1955	2.1	1974	2.1	1974
J	78.2	57.5	67.9	101	1944	31	1972	40	127	3.28	9.06	1972	1.17	1967	4.00	1972	0.0		0.0	
J	81.6	61.2	71.4	103	1941	41	1968	9	208	3.45	6.47	1969	1.23	1952	2.87	1969	0.0		0.0	
A	80.4	59.6	70.0	102	1948	41	1965	17	172	3.00	8.96	1975	0.53	1969	3.07	1947	0.0		0.0	
S	74.2	53.5	63.9	101	1953	32	1942	95	62	2.80	6.37	1945	0.74	1964	2.26	1969	T	1976	T	1976
O	63.6	43.9	53.8	90	1946	22	1969	354	7	2.57	9.50	1954	0.61	1952	3.44	1954	8.0	1962	6.7	1962
N	48.6	34.4	41.6	82	1950	3	1976	702	0	2.76	6.44	1950	0.80	1976	2.23	1958	22.3	1950	15.0	1950
D	36.4	24.1	30.3	69	1971	-11	1976	1076	0	2.36	5.60	1951	0.71	1958	2.06	1974	30.3	1962	12.2	1974
YR	58.5	40.8	49.7	103	JUL 1941	-19	JAN 1963	6154	613	34.99	9.50	OCT 1954	0.36	JAN 1961	4.00	JUN 1972	42.8	JAN 1978	15.0	NOV 1950

Month	Relative humidity pct. Hour 01	Hour 07	Hour 13	Hour 19 (Local time)	Wind Mean speed m.p.h.	Prevailing direction	Fastest mile Ø Speed m.p.h.	Direction	Year	Pct. of possible sunshine	Mean sky cover, tenths, sunrise to sunset	Mean number of days Sunrise to sunset Clear	Partly cloudy	Cloudy	Precipitation .01 inch or more	Snow, Ice pellets 1.0 inch or more	Thunderstorms	Heavy fog, visibility ¼ mile or less	Temperatures °F Max. (b) 90° and above	32° and below	Min. 32° and below	0° and below	Average station pressure mb. Elev. 805 feet m.s.l.
(a)	18	18	18	18	37	14	36	36		35	37	37	37	37	37	37	37	37	18	18	18	18	6
J	75	77	70	72	12.5	SW	68	SW	1959	31	8.2	3	5	23	16	4	*	2	0	16	28	3	988.1
F	75	77	68	71	12.3	S	65	W	1956	38	7.9	3	5	20	15	4	1	2	0	13	25	2	987.6
M	75	78	65	70	12.4	W	74	W	1948	44	7.5	4	7	20	16	3	2	2	0	5	21	*	986.4
A	72	76	57	61	11.8	S	65	W	1951	53	6.9	5	8	17	14	1	4	1	0	*	10	0	987.3
M	77	78	58	60	10.3	S	68	SW	1957	59	6.5	6	10	15	13	*	5	1	*	0	1	0	985.5
J	80	80	59	62	9.4	S	57	SW	1958	65	6.0	7	11	12	11	0	7	1	2	0	*	0	986.6
J	82	82	58	62	8.7	S	65	W	1956	67	5.6	9	12	10	10	0	6	1	3	0	0	0	987.6
A	84	86	60	66	8.3	S	61	W	1956	64	5.5	9	12	10	9	0	5	1	2	0	0	0	989.6
S	81	85	61	70	9.1	S	65	S	1953	60	5.8	9	9	12	10	0	3	1	1	0	0	0	989.1
O	77	80	60	69	10.0	S	43	W	1946	54	6.0	9	8	14	11	*	2	1	0	0	3	0	990.4
N	76	79	67	72	12.0	S	59	W	1948	31	7.9	3	6	21	15	2	1	1	0	1	12	0	988.8
D	75	77	71	76	12.3	S	49	SW	1971	27	8.3	2	6	23	16	4	*	1	0	11	25	1	987.7
YR	77	79	63	67	10.8	S	74	W	MAR 1948	52	6.8	69	99	197	156	18	36	13	8	47	125	6	987.9

Means and extremes above are from existing and comparable exposures. Annual extremes have been exceeded at other sites in the locality as follows: Maximum monthly precipitation 9.77 in June 1902; minimum monthly precipitation 0.17 in August 1881; maximum precipitation in 24 hours 4.97 in September 1901; maximum snowfall in 24 hours 17.4 in November 1913; fastest mile of wind 78 from Southwest in May 1940.

(a) Length of record, years, through the current year unless otherwise noted, based on January data.
(b) 70° and above at Alaskan stations.
* Less than one half.
T Trace.

NORMALS - Based on record for the 1941-1970 period.
DATE OF AN EXTREME - The most recent in cases of multiple occurrence.
PREVAILING WIND DIRECTION - Record through 1963.
WIND DIRECTION - Numerals indicate tens of degrees clockwise from true north. 00 indicates calm.
FASTEST MILE WIND - Speed is fastest observed 1-minute value when the direction is in tens of degrees.

Ø Through May 1977.

Average Temperature

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
1939	32.5	32.0	37.5	45.5	61.4	71.2	73.2	73.2	67.4	56.2	41.8	35.9	52.3
1940	19.6	28.9	31.0	43.2	56.0	69.0	73.8	71.6	63.0	54.0	41.8	36.7	49.0
#1941	29.6	26.6	30.5	52.0	62.2	70.6	75.2	70.7	67.8	56.4	43.2	36.9	51.8
1942	27.3	24.2	39.2	52.6	62.0	70.6	73.8	71.0	64.1	54.7	42.6	26.8	50.7
1943	26.8	29.0	34.1	43.2	58.1	73.7	74.0	71.8	62.6	51.8	39.3	28.4	49.6
1944	32.0	29.5	33.8	44.9	65.6	72.4	74.0	74.1	65.0	53.0	43.2	25.6	51.1
1945	18.8	29.4	48.6	52.0	54.1	66.6	71.7	72.0	66.9	51.8	43.2	25.2	50.0
1946	29.4	30.4	49.5	48.4	57.7	68.2	72.3	68.0	66.8	59.6	46.0	34.0	52.5
1947	32.7	22.6	31.8	46.8	56.2	67.0	70.0	77.8	66.6	61.4	38.2	31.5	50.2
1948	20.0	28.6	38.9	52.6	56.6	68.3	74.4	71.8	66.4	50.1	47.0	33.8	50.7
1949	34.8	34.2	37.1	47.4	61.8	73.9	77.6	73.4	60.0	59.2	41.3	34.2	52.9
1950	36.8	29.2	33.0	42.9	60.7	68.1	70.9	70.6	64.5	57.6	37.4	25.1	49.7
1951	29.9	29.9	38.1	46.8	60.9	69.1	73.6	70.3	62.9	57.8	35.7	30.4	50.5
1952	32.2	32.1	36.7	50.1	58.0	73.3	76.5	72.0	65.6	49.2	44.0	34.9	52.1
1953	33.6	33.7	40.0	45.5	61.9	71.5	74.4	73.5	65.6	57.4	45.2	34.1	53.0
1954	28.5	36.9	35.1	54.6	57.4	72.1	73.1	71.3	67.8	56.2	42.6	32.1	52.3
1955	26.9	30.8	38.6	55.9	62.7	67.9	79.1	76.1	67.2	54.8	38.7	28.4	52.3
#1956	27.6	31.3	36.0	45.9	57.8	68.7	71.7	71.7	61.2	58.7	42.7	38.0	50.9
1957	23.0	33.0	38.1	50.7	59.1	70.3	72.1	70.2	64.9	51.8	42.8	36.1	51.0
1958	28.2	23.2	35.5	51.4	58.7	64.4	73.5	70.4	64.9	55.1	44.5	23.3	49.4
1959	24.0	29.1	36.5	49.8	64.3	70.0	73.3	76.1	68.9	54.3	39.1	36.0	51.8
#1960	31.3	29.5	24.0	51.0	56.8	65.8	67.6	69.8	65.0	51.0	42.4	22.9	48.1
1961	21.6	31.6	40.0	43.4	54.3	65.0	71.3	70.9	68.5	56.8	42.5	29.7	49.7
1962	23.9	26.0	33.8	47.4	65.0	67.9	69.4	70.2	62.0	54.6	42.4	25.9	49.0
1963	18.0	17.5	39.1	48.4	54.7	67.8	71.3	66.7	60.3	59.4	43.9	21.9	47.4
1964	29.8	25.5	37.1	48.8	60.7	67.5	72.2	67.5	63.5	49.2	44.2	32.2	49.8
1965	27.2	28.0	31.7	45.6	63.2	66.9	69.0	68.7	67.4	51.3	42.5	37.4	49.9
1966	21.9	26.7	37.8	46.2	54.2	68.9	72.7	68.8	60.9	50.3	42.8	30.5	48.5
1967	32.4	25.9	37.2	49.7	52.3	71.7	69.7	68.8	61.7	54.0	38.6	34.7	49.7
1968	23.0	22.6	37.6	49.4	54.4	66.5	70.0	71.7	63.9	52.1	42.4	30.0	48.6
1969	25.4	27.9	34.3	49.4	58.6	65.5	72.4	71.8	63.6	51.9	40.2	27.2	49.0
1970	18.9	27.2	33.8	50.2	62.7	69.8	71.9	69.9	66.0	54.4	41.6	32.2	49.9
1971	21.4	27.9	31.6	43.2	56.5	71.0	69.5	68.9	67.7	59.9	41.4	38.1	49.8
1972	27.3	25.7	34.8	46.0	58.6	62.7	71.4	68.9	63.8	49.1	39.6	34.5	48.5
1973	30.4	27.9	46.5	50.2	56.7	70.4	72.6	73.2	66.3	57.7	44.6	34.3	52.6
1974	32.0	27.8	39.6	51.3	56.4	66.2	72.2	70.4	59.9	51.2	42.9	31.7	50.1
1975	31.9	30.4	34.6	41.8	62.3	69.8	71.3	72.5	58.6	53.8	47.0	32.0	50.5
1976	21.6	36.0	45.0	49.1	55.3	69.5	71.6	68.4	61.1	48.1	33.7	23.3	48.6
1977	11.0	25.0	42.7	51.4	61.8	63.3	73.1	69.6	65.4	52.6	45.4	29.2	49.3
1978	20.1	16.8	32.4	47.0	59.4	69.0	72.2	73.0	69.2	53.2	44.3	33.7	49.2
RECORD MEAN	27.2	27.7	36.0	47.1	58.2	67.9	72.2	70.6	64.4	53.7	41.4	31.2	49.9
MAX	34.1	35.0	43.7	55.7	67.0	76.6	80.5	78.9	73.1	61.9	48.3	37.4	57.7
MIN	20.3	20.4	28.3	38.5	49.4	59.2	63.8	62.5	56.1	45.5	34.9	25.0	42.0

Heating Degree Days

CLEVELAND, OH

Season	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	Total
1958-59	0	21	80	314	608	1288	1261	998	877	451	133	43	6082
#1959-60	0	0	70	348	769	894	1039	1023	1262	430	265	58	6166
1960-61	38	7	67	427	671	1299	1336	930	771	640	341	95	6622
1961-62	19	3	74	258	668	1085	1264	1085	958	547	124	43	6128
1962-63	10	17	151	331	674	1206	1452	1327	793	500	328	52	6841
1963-64	30	32	152	191	627	1326	1084	1139	859	481	179	80	6180
1964-65	3	46	117	463	617	1009	1165	1032	1025	576	130	64	6267
1965-66	24	49	67	418	671	852	1328	1067	837	562	346	53	6274
1966-67	6	15	162	457	655	1063	1000	1087	858	461	393	17	6169
1967-68	21	19	137	351	784	934	1295	1224	845	459	328	59	6456
1968-69	26	34	93	414	672	1080	1220	1032	946	471	234	100	6322
1969-70	1	7	121	406	736	1166	1425	1052	960	462	154	39	6529
1970-71	9	12	80	337	696	1009	1344	1032	1031	650	277	16	6494
1971-72	9	13	63	168	704	929	1160	1133	930	564	196	124	5992
1972-73	32	27	95	465	752	937	1067	1033	569	470	254	3	5704
1973-74	3	9	73	234	605	946	1015	1035	777	419	280	49	5445
1974-75	2	5	176	423	660	1026	1021	962	934	691	154	38	6092
1975-76	5	4	187	345	532	1015	1336	836	614	493	309	25	5701
1976-77	0	28	150	519	932	1286	1672	1113	689	423	166	115	7093
1977-78	4	26	60	378	592	1103	1387	1343	1005	534	218	43	6693
1978-79	7	2	43	367	620	965							

Cooling Degree Days

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
1969	0	0	0	10	41	120	237	223	84	10	0	0	725
1970	0	0	0	22	89	189	230	171	121	10	0	0	832
1971	0	0	0	0	22	198	158	143	152	19	0	0	692
1972	0	0	0	1	5	63	239	157	64	0	0	0	529
1973	0	0	0	13	7	168	244	273	119	17	0	0	841
1974	0	0	0	14	18	91	231	180	30	3	2	0	569
1975	0	0	0	0	75	187	206	241	6	5	0	0	720
1976	0	0	3	23	14	167	214	138	39	2	0	0	600
1977	0	0	4	22	74	73	262	175	84	0	9	0	703
1978	0	0	0	0	93	170	237	256	177	3	0	0	894

Precipitation

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
1939	2.43	2.99	2.77	2.80	1.48	3.25	1.53	0.72	2.93	1.84	1.24	1.17	25.15
1940	1.35	3.24	2.59	3.95	3.60	3.68	0.96	3.82	1.83	1.39	2.19	4.07	32.67
#1941	1.85	1.35	1.28	1.13	2.41	2.79	3.34	3.23	1.49	3.22	1.11	1.76	24.96
1942	1.79	3.98	3.47	2.80	3.70	4.09	4.09	3.50	3.08	2.81	3.30	2.94	39.55
1943	1.88	2.58	2.95	3.43	4.64	4.02	5.37	2.50	3.53	3.40	1.21	1.02	36.45
1944	1.30	1.66	3.12	3.86	3.26	3.04	1.29	3.68	3.50	0.94	1.85	2.43	29.93
1945	1.21	1.67	4.19	3.66	3.61	4.41	3.11	1.61	6.37	4.20	1.86	1.36	37.20
1946	0.79	1.81	1.70	1.18	5.06	5.14	1.26	1.71	1.88	3.51	2.08	1.65	27.97
1947	4.44	0.75	4.15	4.38	6.04	6.07	4.69	5.19	2.51	1.92	2.01	1.84	43.99
1948	1.66	2.19	5.81	3.24	4.39	3.95	3.73	4.47	2.49	2.86	3.46	2.71	40.96
1949	3.61	2.39	2.64	2.78	4.18	1.63	4.21	3.59	2.87	1.04	2.73	3.30	34.99
1950	7.01	4.64	4.27	5.90	3.22	3.77	5.15	1.81	3.84	1.73	6.44	2.60	50.38
1951	3.72	3.70	4.80	2.69	2.60	3.25	3.47	2.45	4.49	1.53	5.85	5.60	44.22
1952	5.02	2.19	3.29	3.81	2.74	1.48	1.23	1.98	3.02	0.61	2.49	2.70	30.56
1953	4.04	1.21	2.05	2.82	4.00	3.30	3.08	3.87	1.57	1.28	2.32	2.62	32.16
1954	3.12	2.88	6.07	5.36	1.04	1.38	1.49	3.16	1.98	9.50	1.34	2.33	39.65
1955	2.22	2.69	5.59	3.72	5.00	2.68	2.50	3.82	1.61	5.88	2.87	0.96	39.54
#1956	2.75	3.23	4.60	3.61	5.49	4.14	3.74	5.14	1.56	0.85	1.14	2.70	38.95
1957	2.03	1.40	1.50	5.78	4.60	5.85	3.25	2.30	2.62	2.64	2.27	3.38	37.62
1958	1.49	0.96	0.78	3.31	2.14	4.67	4.82	3.98	3.62	1.63	4.76	0.71	32.87
1959	4.61	4.24	2.14	4.70	4.71	1.82	4.32	1.85	3.07	3.57	2.96	2.39	40.38
1960	2.33	1.87	2.06	2.78	3.56	3.01	3.33	6.95	1.84	1.02	2.07	1.09	31.91
1961	0.36	3.23	3.20	6.61	1.31	2.95	4.30	4.28	2.35	2.15	2.78	1.84	35.36
1962	2.83	1.85	1.73	1.78	1.91	2.95	3.42	1.30	4.39	3.60	2.77	3.05	31.58
1963	1.06	0.73	2.83	2.41	1.00	1.93	1.88	1.70	2.00	0.71	1.33	1.05	18.63
1964	1.45	1.49	5.21	4.87	3.02	2.06	3.37	3.82	0.74	1.78	0.92	2.67	31.40
1965	4.45	3.00	1.66	1.83	2.29	3.05	3.01	3.58	2.53	2.55	1.89	2.07	31.91
1966	1.53	2.31	2.26	3.61	2.21	1.83	3.89	3.48	1.66	1.18	5.16	2.84	31.96
1967	0.97	2.35	2.08	3.12	3.82	1.17	1.90	1.85	2.08	2.11	2.88	2.46	26.79
1968	3.27	0.79	2.07	2.25	4.08	2.32	3.58	1.82	3.36	2.90	4.35	3.94	34.73
1969	2.84	0.75	1.82	4.49	5.73	4.61	6.47	0.53	4.92	1.90	2.86	2.46	39.38
1970	1.28	1.35	2.32	2.64	2.95	4.98	4.14	0.92	3.16	3.98	3.69	2.25	33.66
1971	1.35	3.69	2.01	1.24	3.29	3.79	3.72	0.91	4.27	1.61	2.02	3.90	31.80
1972	1.95	2.01	2.97	3.40	3.74	9.06	4.44	6.38	4.91	1.64	4.58	3.26	48.34
1973	1.62	2.40	3.48	3.40	4.79	6.72	2.94	3.11	2.69	3.95	2.62	3.53	41.25
1974	2.56	2.43	3.88	3.64	4.78	3.57	1.90	3.29	3.06	1.19	4.72	4.86	39.88
1975	3.06	3.20	3.47	1.31	3.23	4.10	2.54	8.96	3.35	1.73	2.09	3.77	40.81
1976	3.38	3.97	3.11	2.17	2.94	3.64	3.48	3.50	3.71	2.54	0.80	1.57	34.81
1977	1.29	1.38	4.49	3.56	1.02	4.91	3.94	3.92	2.52	1.93	3.62	3.51	36.09
1978	3.67	0.48	2.17	3.02	3.01	3.30	2.40	3.58	3.68	3.23	1.19	2.96	32.69
RECORD MEAN	2.54	2.34	2.87	2.80	3.13	3.34	3.39	2.99	3.11	2.59	2.62	2.46	34.18

Snowfall

Season	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	Total
1939-40	0.0	0.0	0.0	T	0.4	3.9	17.1	14.9	13.4	5.3	0.0	0.0	55.0
#1940-41	0.0	0.0	0.0	T	3.9	6.0	15.2	14.2	7.0	0.0	0.0	0.0	46.3
1941-42	0.0	0.0	0.0	0.0	0.5	3.1	5.6	20.7	8.8	0.4	0.0	0.0	39.1
1942-43	0.0	0.0	T	T	3.5	9.4	11.8	11.7	10.1	14.5	T	0.0	61.0
1943-44	0.0	0.0	0.0	T	5.8	6.9	4.8	14.2	11.2	2.3	0.0	0.0	45.2
1944-45	0.0	0.0	0.0	0.0	3.9	28.9	18.7	8.6	3.9	T	0.0	0.0	64.0
1945-46	0.0	0.0	0.0	T	1.3	18.2	6.1	9.1	1.8	T	0.0	0.0	36.5
1946-47	0.0	0.0	0.0	0.0	T	8.8	10.7	11.4	20.9	T	T	0.0	51.8
1947-48	0.0	0.0	0.0	0.0	4.2	3.4	12.0	4.0	7.1	0.3	0.0	0.0	31.0
1948-49	0.0	0.0	0.0	T	T	5.7	7.1	3.6	13.2	0.9	0.0	0.0	30.5
1949-50	0.0	0.0	0.0	0.0	16.0	7.6	3.7	13.8	10.1	3.0	0.0	0.0	54.2
1950-51	0.0	0.0	0.0	0.0	22.3	11.7	17.5	10.6	14.5	0.6	0.0	0.0	77.2
1951-52	0.0	0.0	0.0	T	18.8	22.1	9.3	8.6	9.0	7.8	0.0	0.0	75.6
1952-53	0.0	0.0	0.0	0.P	0.5	8.4	12.5	4.2	5.0	4.3	0.0	0.0	35.7
1953-54	0.0	0.0	0.0	T	8.4	6.0	13.2	14.7	26.3	T	T	0.0	68.6
1954-55	0.0	0.0	0.0	6.4	0.2	11.6	9.4	7.8	13.9	T	0.0	0.0	49.3
#1955-56	0.0	0.0	0.0	T	8.7	9.8	14.1	8.9	10.7	2.0	T	0.0	54.2
1956-57	0.0	0.0	0.0	0.0	7.4	11.4	12.8	3.1	8.4	13.2	T	0.0	56.3
1957-58	0.0	0.0	0.0	2.8	2.5	7.5	4.4	9.4	4.6	0.2	0.0	0.0	31.1
1958-59	0.0	0.0	0.0	T	7.4	9.7	14.0	5.8	14.6	T	T	0.0	51.5
1959-60	0.0	0.0	0.0	T	7.2	5.3	2.8	14.6	19.5	0.5	T	0.0	49.9
1960-61	0.0	0.0	0.0	T	4.7	14.1	6.0	6.8	1.4	5.1	T	0.0	38.1
1961-62	0.0	0.0	0.0	T	0.9	4.3	6.0	16.2	8.9	1.0	0.0	0.0	37.3
1962-63	0.0	0.0	0.0	8.0	T	30.3	12.4	13.4	10.4	0.3	0.1	0.0	74.9
1963-64	0.0	0.0	0.0	0.0	0.1	14.1	16.9	15.7	8.5	0.5	0.0	0.0	55.8
1964-65	0.0	0.0	0.0	T	1.0	8.7	13.6	15.6	12.9	0.4	0.0	0.0	52.2
1965-66	0.0	0.0	0.0	T	1.2	1.2	15.3	10.1	7.0	2.5	T	0.0	37.3
1966-67	0.0	0.0	0.0	0.0	8.8	10.9	2.0	18.5	7.3	0.1	0.0	0.0	47.6
1967-68	0.0	0.0	0.0	0.1	9.1	2.8	14.5	8.9	7.7	0.2	T	0.0	43.3
1968-69	0.0	0.0	0.0	T	6.8	8.3	5.8	5.6	9.0	1.5	T	0.0	37.0
1969-70	0.0	0.0	0.0	0.6	6.6	17.4	10.5	6.6	11.5	0.2	T	0.0	53.4
1970-71	0.0	0.0	T	T	5.2	6.0	8.6	14.3	16.6	0.7	0.0	0.0	51.4
1971-72	0.0	0.0	0.0	0.0	5.3	1.9	15.0	14.8	6.3	2.3	0.0	0.0	45.6
1972-73	0.0	0.0	0.0	5.5	7.8	15.2	9.8	20.4	8.3	0.9	0.6	0.0	68.5
1973-74	0.0	0.0	0.0	T	3.3	13.8	8.9	16.9	7.1	6.4	2.1	0.0	58.5
1974-75	0.0	0.0	0.0	1.6	5.3	24.1	9.7	9.9	15.2	1.2	0.0	0.0	67.0
1975-76	0.0	0.0	0.0	0.0	5.6	13.1	21.5	6.8	5.8	1.6	T	0.0	54.4
1976-77	0.0	0.0	T	1.6	8.9	16.3	21.1	9.6	4.2	1.7	0.0	0.0	63.4
1977-78	0.0	0.0	0.0	T	9.7	23.1	42.8	10.8	3.5	0.2	0.0	0.0	90.1
1978-79	0.0	0.0	0.0	0.0	1.9	2.5							
RECORD MEAN	0.0	0.0	T	0.7	5.7	11.4	11.6	11.0	9.9	2.1	0.1	0.0	52.5

# Indicates a station move or relocation of instruments. See Station Location table.

Record mean values above are means through the current year for the period beginning in 1871 for temperature and precipitation, 1942 for snowfall. Data are from City Office locations through May 1941 and from Airport locations thereafter.

Local Climatological Data

Annual Summary With Comparative Data

1978

DETROIT, MICHIGAN

METROPOLITAN AIRPORT

DEPARTMENT OF COMMERCE * UNITED STATES OF AMERICA *

Narrative Climatological Summary

Detroit and the immediate suburbs, including nearby urban areas in Canada, occupy an area approximately 20 miles in radius. Complete weather records, made within a few miles of the urban center until 1966, are listed with subsequent temperature and precipitation records for Detroit City Airport. Complete data are now gathered at Metropolitan Airport, near the southwest edge of the urban area. These are listed with earlier partial records from that vicinity. Data for the Windsor Airport, near the southeast edge of the metropolitan complex, are published by the Atmospheric Environment Service of Canada.

The waterway, consisting of the Detroit and St. Clair Rivers, Lake St. Clair, and the west end of Lake Erie, lies at an elevation of 568 to 580 feet above sea level. Nearly flat land slopes up gently from the water's edge northwestward for about 10 miles and then gives way to increasingly rolling terrain. The Irish Hills, parallel to and about 40 miles northwest of the waterway, have tops 1,000 to 1,250 feet above sea level. On the Canadian side of the waterway the land is relatively level.

The slope of the land dries northwest winds and has an opposite effect on southeast winds. Northwest winds in winter bring snow flurries to all of Michigan. Flurries build up snow accumulations in many places, but in Detroit they rarely cause enough snow to be measured. Summer showers moving from the northwest also weaken and sometimes dissipate as they approach Detroit. On the other hand, much of the heaviest precipitation in winter comes from southeast winds, and this may be heavier in the Detroit area, especially to the northwest of the City, than in other places affected by the same storms.

Detroit's climate is controlled by (1) its location with respect to major storm tracks and (2) the influence of the Great Lakes. The normal wintertime storm track is south of the City, and most passing storms bring periods of snow or rain. In summer most storms pass to the north, often with brief showers in the area and occasionally with heavy thundershowers or damaging winds. The Great Lakes smooth out most climatic extremes. Precipitation is distributed evenly through all months of the year. The most pronounced lake effect occurs in the colder part of the winter. Arctic air moving across the lakes is warmed and moistened. Cold waves approaching from the northern plains are much reduced in intensity. But the price is an excess of cloudiness and very little sunshine in the winter.

Summers in Detroit are warm and sunny. Brief showers usually occur every few days, but often fall on only part of the metropolitan area. Extended periods of drought are unusual. Each year sees two or three series of days with temperatures in the nineties. The highest temperatures are often accompanied by high humidity. Most summer days are quite comfortable, and air conditioning is required only intermittently. In winter skies are cloudy and temperatures average near the freezing point. Day to day changes are not large. The mercury drops to near or a little below zero once or twice each year. Winter storms may bring rain, snow, or both. Freezing rain and sleet are not unusual. Most wintertime precipitation is more or less steady and continues for several hours. Snowstorms average about 3 inches, but heavier amounts accumulate several times each year.

Local climatic variations are due largely to (1) the immediate effect of Lake St. Clair and (2) the urban "heat island." On warm days in late spring or early summer, lake breezes often lower afternoon temperatures by 10° to 15° in the eastern part of the City and the northeastern suburbs. Less pronounced local lake effects occur at other times of the year. The urban effect shows up mostly at night. Comparative readings show nearly uniform maximum temperatures over the metropolitan area. Minimum readings at Metropolitan Airport, in a semi-rural area, average 2.3° lower than those at City Airport, in a typical residential area, and 4.1° lower than those in downtown Detroit. On humid summer nights or on very cold winter nights, the difference can exceed 10°.

The growing season averages 180 days in length, and has ranged from 145 days to 205 days. Average date of the last freezing temperature is April 23; average date of the first freezing temperature is October 21. A freeze has occurred as late as May 12, and as early as September 23. The cold waters of the Great Lakes inhibit plant growth in the spring until all danger of frost is past, and warm waters delay autumn frosts, making the climate particularly favorable for orchards and small fruit growing.

Air pollution comes primarily from heavy industry spread along both shores of the waterway from Port Huron to Toledo. The most intense source of pollution is along the west bank of the Detroit River from just southwest of the downtown area to opposite Grosse Ile. Although the amount of contamination is very large, air motions both horizontal and vertical are usually sufficient to keep it from becoming a major hazard.

noaa NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION / ENVIRONMENTAL DATA AND INFORMATION SERVICE / NATIONAL CLIMATIC CENTER ASHEVILLE, N.C.

Meteorological Data For The Current Year

Station: DETROIT, MICHIGAN # 94847 METROPOLITAN AIRPORT Standard time used: EASTERN Latitude: 42° 14' N Longitude: 83° 20' W Elevation (ground): 633 feet Year: 1978

Month	Temperature °F: Averages: Daily maximum	Daily minimum	Monthly	Extremes: Highest	Date	Lowest	Date	Degree days Base 65 °F: Heating	Cooling	Precipitation in inches: Water equivalent: Total	Greatest in 24 hrs.	Date	Snow, Ice pellets: Total	Greatest in 24 hrs.	Date	Relative humidity, pct.: Hour 01	Hour 07	Hour 13	Hour 19 (Local time)	Wind: Resultant: Direction	Speed m.p.h.	Average speed m.p.h.	Fastest mile: Speed m.p.h.	Direction	Date	Percent of possible sunshine	Average sky cover, tenths, sunrise to sunset	Number of days: Sunrise to sunset: Clear	Partly cloudy	Cloudy	Precipitation .01 inch or more	Snow, Ice pellets 1.0 inch or more	Thunderstorms	Heavy fog, visibility ¼ mile or less	Temperature °F: Maximum: (b) 90° and above	32° and below	Minimum: 32° and below	0° and below	Average station pressure mb Elev. 664 feet m.s.l.
JAN	26.4	12.7	19.6	37	26	0	23	1400	0	3.16	1.48	25-26	29.6	7.8	26	78	79	71	75	30	4.1	10.3	42	NW	9	46	8.2	4	3	24	13	8	0	3	0	25	31	1	992.2
FEB	25.6	6.9	16.3	34	25	-3	4	1357	0	0.45	0.14	24-25	5.3	1.9	5	76	79	64	66	28	4.3	9.5	25	NE	13	65	5.8	9	10	9	7	2	1	1	0	27	28	3	995.9
MAR	37.9	22.1	30.0	65	31	-4	2	1077	0	2.05	0.73	20-21	2.5	1.5	3	75	79	62	67	30	2.6	9.7	31	W	14	53	7.2	6	5	20	15	1	0	2	0	8	26	1	993.2
APR	56.9	34.0	45.5	72	29	25	22	580	0	2.49	0.63	6	0.3	0.3	21	71	74	52	57	36	1.9	10.8	42	NW	1	61	6.3	10	4	16	12	0	5	2	0	0	13	0	991.2
MAY	70.4	48.1	59.3	88	29	26	1	235	63	3.58	0.93	30	0.0	0.0		79	79	54	59	11	0.8	8.3	34	W	9	61	6.0	8	9	14	12	0	3	0	0	0	3	0	989.5
JUN	79.4	54.1	66.8	91	29	42	14	65	122	2.69	1.15	25-26	0.0	0.0		78	77	52	49	25	2.8	7.4	33	S	26	74	5.7	9	11	10	10	0	4	1	3	0	0	0	992.2
JUL	82.2	59.9	70.6	96	26	43	12	17	200	1.97	0.73	26	0.0	0.0		79	82	53	57	26	1.4	7.2	39	W	26	61	6.1	7	13	11	6	0	4	0	7	0	0	0	991.5
AUG	83.3	60.5	71.9	90	19	52	4	0	221	1.73	0.87	7	0.0	0.0		81	86	49	54	24	2.6	6.5	31	SW	16	77	6.3	7	8	16	6	0	1	1	2	0	0	0	993.6
SEP	79.2	55.7	67.5	97	8	39	28	73	154	1.82	0.52	14	0.0	0.0		81	88	53	62	25	1.5	7.3	51	SW	11	69	5.1	10	12	8	9	0	6	1	6	0	0	0	993.2
OCT	60.8	39.6	50.2	76	21	26	24	452	0	2.49	0.98	15-16	0.0	0.0		83	89	56	69	25	4.0	9.6	34	W	5	53	6.4	8	7	16	11	0	2	0	0	0	5	0	993.6
NOV	49.1	31.8	40.5	74	5	10	29	728	0	2.41	0.83	17	6.1	4.5	26-27	86	86	69	74	25	2.7	12.2	40	SW	17	40	6.9	7	6	17	11	1	0	3	0	2	16	0	995.9
DEC	36.3	21.5	28.9	54	3	1	28	1112	0	2.81	0.80	30-31	6.6	2.6	9-10	81	83	71	80	25	6.0	11.8	34	W	13	33	7.8	3	7	21	16	2	0	5	0	8	29	0	991.2
YEAR	57.3	37.2	47.3	97	SEP 8	-4	MAR 2	7096	760	27.65	1.48	JAN 25-26	50.4	7.8	JAN 26	79	82	59	64	27	2.4	9.2	51	SW	SEP 11	59	6.5	88	95	182	128	14	26	19	18	70	151	5	992.8

Normals, Means, And Extremes

Month	Temperatures °F: Normal: Daily maximum	Daily minimum	Monthly	Extremes: Record highest	Year	Record lowest	Year	Normal Degree days Base 65 °F: Heating	Cooling	Precipitation in inches: Water equivalent: Normal	Maximum monthly	Year	Minimum monthly	Year	Maximum in 24 hrs.	Year	Snow, Ice pellets: Maximum monthly	Year	Maximum in 24 hrs.	Year	Relative humidity pct.: Hour 01	Hour 07	Hour 13	Hour 19 (Local time)	Wind: Mean speed m.p.h.	Prevailing direction	Fastest mile: Speed m.p.h.	Direction	Year	Pct. of possible sunshine	Mean sky cover, tenths, sunrise to sunset	Mean number of days: Sunrise to sunset: Clear	Partly cloudy	Cloudy	Precipitation .01 inch or more	Snow, Ice pellets 1.0 inch or more	Thunderstorms	Heavy fog, visibility ¼ mile or less	Temperatures °F: Max.: (b) 90° and above	32° and below	Min.: 32° and below	0° and below	Average station pressure mb. Elev. 664 feet m.s.l.
(a)				20		20					20		20		20		20		20		20	20	20	20	20	5	12	12		13	20	20	20	20	20	20	20	20	20	20	20	20	6
J	31.9	17.3	24.6	62	1965	-18	1976	1252	0	1.91	3.63	1965	0.27	1961	1.72	1967	29.6	1978	7.8	1978	78	79	70	74	11.7	WSW	50	SW	1974	39	7.5	4	7	20	13	3	*	3	0	17	29	4	992.3
F	34.3	18.8	26.6	65	1976	-12	1976	1075	0	1.75	2.87	1976	0.15	1969	1.23	1965	17.4	1962	10.3	1965	76	78	64	69	11.6	WSW	52	SW	1967	47	7.1	5	7	16	11	3	1	2	0	13	26	2	992.3
M	43.6	26.7	35.3	77	1977	-4	1978	921	0	2.47	4.48	1973	0.92	1960	1.28	1976	16.1	1965	9.2	1973	75	79	62	66	11.8	WSW	52	SW	1975	50	7.2	5	7	19	13	2	2	3	0	5	23	*	990.9
A	58.1	37.3	47.7	89	1977	17	1964	519	0	3.22	5.40	1961	0.92	1971	1.97	1965	7.4	1961	4.2	1961	75	78	55	59	11.6	WSW	47	SW	1975	55	6.7	7	7	16	12	1	4	1	0	*	10	0	991.8
M	69.1	47.0	58.1	92	1977	25	1966	244	30	3.31	5.88	1968	1.15	1965	2.87	1968	T	1976	T	1976	77	79	54	57	10.3	WSW	43	W	1975	60	6.3	7	10	14	11	0	4	1	*	0	1	0	989.6
J	79.4	57.2	68.3	99	1971	36	1972	36	135	3.42	6.60	1960	2.12	1959	2.62	1960	0.0		0.0		80	81	55	58	9.1	SW	87	SW	1973	64	5.9	8	11	11	11	0	6	1	3	0	0	0	990.3
J	83.4	61.1	72.3	102	1977	41	1965	5	232	3.10	6.02	1969	0.59	1974	3.19	1966	0.0		0.0		81	82	52	57	8.6	SW	56	W	1977	68	5.5	9	13	9	9	0	6	1	5	0	0	0	991.5
A	82.0	59.5	70.8	97	1964	40	1964	16	196	3.28	7.83	1975	1.06	1969	3.21	1964	0.0		0.0		84	87	55	63	8.3	SW	36	NW	1971	69	5.6	9	12	10	9	0	5	2	3	0	0	0	993.5
S	74.8	52.3	63.6	98	1976	29	1974	95	53	2.16	5.83	1961	0.63	1960	2.07	1961	0.0		0.0		84	88	57	67	8.9	SW	51	SW	1978	59	6.3	8	10	12	10	0	4	1	1	0	*	0	993.2
O	64.1	42.1	53.1	91	1963	17	1974	377	8	2.48	4.87	1967	0.35	1964	2.11	1959	T	1976	T	1976	80	85	56	68	9.6	WSW	34	W	1978	53	6.1	8	9	14	9	0	1	3	*	0	5	0	994.4
N	47.8	32.3	40.1	77	1968	9	1969	747	0	2.32	3.31	1968	0.79	1976	1.52	1968	11.8	1966	5.6	1977	80	83	66	74	11.1	SW	43	SW	1975	32	7.7	4	7	19	11	1	*	2	0	2	17	0	992.6
D	35.4	21.5	28.5	66	1966	-9	1977	1132	0	2.27	6.00	1965	0.46	1960	3.71	1965	34.9	1974	19.2	1974	80	81	72	77	11.3	SW	50	W	1972	29	7.9	3	7	21	14	3	*	3	0	12	27	1	991.7
YR	58.7	39.4	49.1	102	JUL 1977	-18	JAN 1976	6419	654	31.69	7.83	AUG 1975	0.15	FEB 1969	3.71	DEC 1965	34.9	DEC 1974	19.2	DEC 1974	79	82	60	66	10.3	SW	87	SW	JUN 1973	54	6.7	77	107	181	134	13	33	22	12	49	139	7	992.0

(a) Length of record, years, through the current year unless otherwise noted, based on January data.
(b) 70° and above at Alaskan stations.
* Less than one half.
T Trace.

NORMALS - Based on record for the 1941-1970 period.
DATE OF AN EXTREME - The most recent in cases of multiple occurrence.
PREVAILING WIND DIRECTION - Record through 1963.
WIND DIRECTION - Numerals indicate tens of degrees clockwise from true north. 00 indicates calm.
FASTEST MILE WIND - Speed is fastest observed 1-minute value when the direction is in tens of degrees.

Average Temperature

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
1939	27.8	28.0	35.5	45.4	62.6	71.8	73.3	71.6	66.4	32.9	38.2	35.0	50.7
1940	20.0	27.5	29.0	42.4	56.8	69.7	73.8	70.4	63.0	52.5	37.4	32.2	47.9
1941	26.4	25.8	30.7	52.7	62.6	70.5	74.5	71.2	67.3	35.2	42.4	35.4	31.2
#1942	25.6	22.8	38.1	52.8	60.3	66.8	73.8	70.4	62.6	53.4	40.2	24.6	49.6
1943	21.2	28.9	34.0	43.4	57.4	74.2	74.4	72.2	61.4	50.6	38.2	27.2	48.6
1944	30.4	28.9	37.2	44.2	64.6	73.4	74.6	73.0	63.8	52.8	42.1	24.4	50.7
1945	18.0	27.8	48.1	31.8	33.0	65.2	70.2	71.0	66.4	30.2	41.1	23.4	48.9
#1946	28.5	27.3	47.0	48.8	56.6	67.5	73.0	67.3	63.1	57.8	43.0	31.6	51.2
1947	28.6	21.7	30.8	44.9	53.5	66.2	70.4	77.0	63.3	60.4	36.6	28.2	48.6
1948	18.6	24.8	34.6	51.6	56.6	67.8	74.0	72.5	66.6	49.6	44.8	31.0	49.4
1949	31.2	30.2	35.6	48.2	61.0	73.8	76.9	72.6	56.0	37.4	38.3	32.4	51.4
1950	31.8	26.0	30.4	41.4	39.2	67.4	71.2	69.6	62.8	55.6	33.6	23.3	47.9
1951	27.1	27.0	34.0	45.7	60.3	68.1	72.6	66.3	61.3	55.0	33.5	27.1	48.6
1952	28.5	26.5	34.6	46.7	57.7	72.4	76.3	71.8	64.6	47.4	41.8	33.4	50.6
1953	29.6	31.2	37.9	44.2	60.7	71.8	74.0	73.6	64.2	36.8	42.7	32.3	51.6
1954	23.4	33.5	33.5	30.5	55.3	71.6	72.0	70.1	63.2	53.6	40.7	29.3	50.1
1955	23.3	28.0	35.7	55.0	62.0	68.4	78.6	75.6	63.1	34.3	36.6	26.8	51.0
1956	25.3	28.0	32.9	45.7	56.8	66.9	71.3	71.1	60.2	57.3	40.0	33.9	49.4
1957	19.8	30.1	36.6	48.9	37.2	69.2	73.5	70.4	63.1	30.5	39.9	33.6	49.4
#1958	26.3	22.4	36.6	46.6	38.8	63.9	72.5	70.6	63.3	54.3	41.6	21.4	48.5
1959	19.9	25.0	39.9	47.9	61.3	68.6	72.6	73.6	66.0	51.0	35.2	33.5	49.2
1960	27.8	27.4	25.6	49.6	57.9	66.2	66.5	70.9	66.2	52.6	42.2	23.6	48.3
1961	21.7	30.6	39.0	42.6	54.7	66.3	72.1	71.1	67.6	54.6	40.1	28.5	49.1
1962	21.5	22.3	33.3	44.4	63.0	68.3	69.4	68.6	60.3	53.7	39.0	24.2	47.5
1963	13.8	17.4	34.8	47.4	56.0	68.2	71.5	66.8	60.2	58.2	42.5	20.9	46.8
1964	28.1	23.9	34.3	47.6	60.9	66.2	72.9	63.3	60.7	46.3	41.2	28.1	48.1
1965	24.7	25.9	30.1	45.1	62.4	66.8	69.2	68.0	63.3	48.2	40.5	33.0	48.3
1966	20.4	27.4	37.1	44.4	51.9	68.4	73.3	69.1	62.2	51.0	41.8	28.7	48.0
1967	29.3	23.8	38.9	48.0	51.9	70.4	69.0	67.3	60.4	50.7	33.2	30.9	47.7
1968	20.9	24.3	38.2	30.9	56.1	68.4	71.7	72.5	63.3	53.3	41.0	28.1	49.3
1969	23.1	28.2	33.5	49.4	57.4	64.7	73.2	73.1	64.8	51.4	37.9	26.4	48.6
1970	16.6	24.4	32.6	49.3	60.9	68.4	72.6	72.1	64.5	34.2	40.0	29.0	48.8
1971	20.7	27.4	32.0	45.2	56.4	70.8	69.6	70.3	66.6	58.5	38.5	33.3	49.1
1972	23.8	24.6	37.6	44.6	60.3	64.2	71.2	69.1	63.0	47.3	37.4	29.4	47.3
1973	28.8	23.9	43.3	48.8	55.5	69.9	72.6	72.9	64.9	36.2	41.4	28.7	50.7
1974	26.5	23.6	35.7	46.2	53.2	65.9	72.3	72.3	59.7	48.8	40.6	28.6	48.2
1975	28.3	27.3	32.5	40.9	62.8	69.0	72.2	72.3	59.1	52.9	46.8	29.1	49.3
1976	16.2	33.3	40.4	50.0	56.4	70.6	72.7	70.2	62.1	47.4	33.3	21.5	48.1
1977	12.8	25.2	41.3	32.4	64.4	65.5	75.8	70.6	63.1	47.9	40.3	25.3	48.9
1978	19.6	16.3	30.0	43.3	59.3	66.8	70.6	71.9	67.5	50.2	40.3	28.9	47.3
RECORD MEAN	22.3	23.3	34.6	47.3	58.2	67.7	71.7	70.3	63.3	51.8	39.8	28.1	48.3
MAX	30.0	33.2	43.4	57.8	69.6	79.1	83.0	81.7	74.4	62.4	47.6	34.9	58.1
MIN	13.0	17.4	24.4	34.7	46.8	56.2	60.4	59.3	52.6	41.1	31.9	21.2	38.8

Heating Degree Days

DETROIT, MI
METROPOLITAN AIRPORT

Season	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	Total
#1958-59	1	12	105	333	686	1346	1390	1113	958	305	175	44	6868
1959-60	0	1	109	435	889	972	1147	1084	1215	470	233	49	6602
1960-61	8	0	59	378	677	1280	1333	949	803	668	324	63	6544
1961-62	4	3	74	329	742	1124	1342	1190	978	558	170	26	6336
1962-63	8	10	177	358	776	1239	1520	1320	866	524	295	49	7162
1963-64	11	34	158	221	670	1363	1139	1128	943	319	172	88	6448
1964-65	4	82	175	566	710	1137	1239	1088	1074	391	131	43	6842
1965-66	18	48	128	510	729	927	1377	1046	860	612	406	53	6714
1966-67	0	13	136	427	688	1119	1097	1148	894	503	406	9	6442
1967-68	32	26	158	457	886	1030	1360	1173	823	416	275	29	6883
1968-69	3	17	71	384	714	1137	1289	1024	972	464	259	102	6436
1969-70	0	0	63	418	804	1189	1491	1130	993	479	168	49	6814
1970-71	8	8	108	356	742	1105	1368	1047	1015	588	278	22	6628
1971-72	13	6	72	213	788	977	1272	1163	997	608	174	91	6376
1972-73	24	28	113	539	822	1096	1115	1103	667	480	289	3	6279
1973-74	0	10	96	276	702	1119	1189	1152	901	476	308	54	6283
1974-75	0	2	189	495	726	1123	1129	1043	996	714	142	41	6600
1975-76	4	0	178	375	337	1107	1413	914	737	473	269	6	6033
1976-77	1	13	134	560	938	1341	1609	1106	721	395	122	85	7006
1977-78	1	17	85	324	729	1218	1400	1357	1077	580	235	65	7288
1978-79	17	0	73	457	728	1112							

Cooling Degree Days

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
1969	0	0	0	1	28	98	260	259	91	4	0	0	741
1970	0	0	0	17	50	161	249	236	100	12	0	0	823
1971	0	0	0	0	14	203	161	177	128	17	0	0	702
1972	0	0	0	0	36	73	222	160	39	0	0	0	530
1973	0	0	0	3	2	136	241	261	104	11	0	0	778
1974	0	0	0	8	10	91	237	237	36	1	0	0	620
1975	0	0	0	0	82	171	233	232	7	6	0	0	731
1976	0	0	0	30	10	182	246	182	53	3	0	0	706
1977	0	0	0	23	108	107	341	198	94	0	0	0	873
1978	0	0	0	0	63	122	200	221	154	0	0	0	760

Precipitation

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
1939	1.96	4.33	2.28	3.74	1.01	4.17	1.84	1.22	2.33	1.51	0.78	0.78	26.20
1940	1.21	1.88	1.46	2.53	3.85	4.31	1.87	5.22	1.32	2.84	2.39	2.96	31.34
1941	1.14	0.37	1.34	1.66	2.88	3.90	2.06	2.87	0.83	3.71	2.17	1.24	24.17
#1942	1.92	1.81	3.31	1.56	5.13	6.49	5.05	3.86	1.79	3.83	3.41	3.40	41.38
1943	2.25	1.94	2.24	4.08	7.88	2.64	3.93	2.57	2.78	1.51	2.41	0.40	34.63
1944	1.31	1.65	3.02	3.48	3.28	2.58	1.80	3.14	2.07	0.58	1.77	1.93	26.83
1945	0.63	1.48	3.83	3.26	7.18	4.22	1.82	1.81	3.37	3.71	1.30	1.77	34.45
1946	1.23	1.58	2.42	0.80	4.66	4.97	1.18	2.41	2.26	3.17	1.98	2.29	28.97
#1947	2.94	0.38	2.29	6.73	6.93	2.30	1.70	8.71	3.61	2.26	1.72	1.84	41.43
1948	1.13	2.30	4.14	2.91	3.60	2.98	2.99	1.21	2.64	0.95	4.19	2.13	31.21
1949	2.86	2.69	2.77	2.26	2.46	1.61	4.19	4.72	2.73	3.84	1.03	3.55	34.73
1950	4.17	3.97	3.08	5.52	2.12	2.77	2.68	2.70	2.18	2.92	3.79	2.40	38.30
1951	1.63	3.03	3.18	2.54	3.31	3.34	4.83	2.76	1.51	4.03	3.41	3.93	37.36
1952	3.63	1.33	2.76	3.58	2.91	1.33	1.92	1.86	1.26	1.67	3.54	2.11	28.12
1953	1.80	0.80	3.04	2.88	1.41	2.73	2.98	2.83	1.96	0.50	0.73	1.63	23.36
1954	1.74	4.41	4.36	2.61	1.74	3.41	1.62	1.15	3.30	6.13	1.48	1.62	33.50
1955	1.78	2.41	2.34	2.53	2.91	1.97	2.71	1.72	1.28	3.77	3.47	1.07	27.86
1956	0.93	2.40	2.38	3.96	4.33	4.87	2.93	4.37	0.69	0.67	2.13	1.93	31.43
1957	1.81	1.88	1.16	4.82	2.23	3.11	3.93	1.74	2.00	4.44	2.08	3.41	32.68
#1958	0.59	0.44	0.30	1.96	1.18	2.03	3.96	1.89	3.21	1.53	2.70	0.44	20.25
1959	2.76	1.99	2.41	4.43	3.20	2.12	1.90	4.57	3.39	4.14	2.99	2.76	36.69
1960	2.68	2.23	0.92	1.80	2.76	6.60	2.19	2.37	0.43	2.31	1.14	0.46	25.91
1961	0.27	2.06	2.34	5.40	2.21	3.17	3.57	7.30	5.83	1.13	2.80	1.20	37.28
1962	1.98	2.39	1.08	2.93	1.63	2.94	5.08	3.10	3.41	2.30	1.34	1.13	29.31
1963	0.85	0.67	2.77	2.30	4.09	2.59	1.92	1.44	1.42	0.57	1.27	1.12	21.01
1964	2.20	0.68	2.98	4.13	1.72	3.84	1.11	7.70	1.31	0.35	0.80	1.92	28.74
1965	3.53	2.54	3.59	3.30	1.15	2.28	2.38	6.94	1.91	3.89	1.49	6.00	39.10
1966	0.61	1.64	2.62	2.63	2.18	4.16	5.24	5.03	1.31	1.15	3.13	4.53	34.45
1967	2.34	1.28	1.03	3.67	1.63	4.23	2.83	2.01	1.96	4.87	2.77	5.19	33.83
1968	2.30	1.48	2.04	1.71	5.88	4.99	5.14	1.85	1.87	1.09	3.31	3.59	33.23
1969	2.83	0.15	1.62	3.77	3.74	4.26	6.02	1.06	0.68	1.41	2.46	1.33	29.33
1970	1.11	0.86	2.62	3.32	3.01	3.90	3.30	2.73	1.63	1.91	2.73	1.61	28.75
1971	1.03	2.68	1.59	0.92	1.97	2.17	1.93	1.62	2.72	1.01	1.34	3.79	22.79
1972	1.28	1.00	2.35	3.63	2.68	3.30	2.21	3.07	3.40	2.24	3.19	3.11	31.66
1973	1.63	1.08	4.48	1.42	3.72	4.86	4.66	1.67	1.82	2.01	3.21	3.51	34.09
1974	3.26	2.87	4.20	2.75	3.49	2.38	0.59	2.95	2.22	0.81	2.86	4.00	31.88
1975	2.90	2.65	1.66	2.50	2.82	2.39	1.98	7.83	3.18	1.29	2.39	3.00	34.59
1976	1.91	2.87	4.24	3.13	3.26	3.26	1.47	1.68	3.66	2.01	0.76	0.79	29.09
1977	0.98	1.64	3.37	4.17	2.40	3.16	3.28	2.23	4.23	1.37	2.88	2.97	32.88
1978	3.16	0.43	2.05	2.46	3.58	2.69	1.97	1.73	1.82	2.49	2.41	2.81	27.65
RECORD MEAN	1.99	1.64	2.52	3.02	2.86	3.45	2.94	3.44	2.42	1.92	2.27	2.74	31.21

Snowfall

Season	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	Total
1942-43							16.8	3.0	3.0	3.8	0.0	0.0	
1943-44	0.0	0.0	0.0	T	0.9	1.0	3.0	10.9	4.8	0.7	0.0	0.0	21.3
1944-45	0.0	0.0	0.0	0.0	T	12.2	11.5	6.5	T	T	T	0.0	30.2
1945-46	0.0	0.0	0.0	0.0	T	3.2	6.8	8.4	T	0.0	0.0	0.0	20.4
#1946-47	0.0	0.0	0.0	0.0	T	3.6	5.1	4.8	5.0	2.1	T	0.0	20.6
1947-48	0.0	0.0	0.0	0.0	3.9	11.1	4.5	3.5	2.9	0.1	T	0.0	26.0
1948-49	0.0	0.0	0.0	T	T	3.5	1.8	4.3	1.4	0.3	0.0	0.0	11.3
1949-50	0.0	0.0	0.0	T	3.3	3.1	7.6	12.7	8.3	T	0.0	0.0	39.0
1950-51	0.0	0.0	0.0	0.0	9.2	8.6	13.2	4.2	5.4	1.5	T	0.0	40.1
1951-52	0.0	0.0	0.0	0.0	10.1	25.1	14.4	4.1	3.8	0.7	0.0	0.0	58.2
1952-53	0.0	0.0	0.0	T	T	4.8	10.5	0.9	0.8	1.6	0.0	0.0	18.6
1953-54	0.0	0.0	0.0	0.0	2.4	6.4	5.9	12.1	15.0	T	T	0.0	41.8
1954-55	0.0	0.0	0.0	0.2	2.9	6.2	3.0	8.7	3.9	T	0.0	0.0	26.9
1955-56	0.0	0.0	0.0	T	6.2	3.0	9.1	10.9	12.4	2.9	0.0	0.0	44.5
1956-57	0.0	0.0	0.0	0.0	5.8	6.0	15.5	3.8	2.5	3.9	0.0	0.0	39.5
1957-58	0.0	0.0	0.0	T	2.1	5.5	3.0	3.7	2.6	0.4	0.0	0.0	17.3
#1958-59	0.0	0.0	0.0	0.0	4.5	4.7	13.4	3.0	6.8	T	0.0	0.0	32.4
1959-60	0.0	0.0	0.0	T	9.6	7.1	4.9	14.1	9.6	0.1	T	0.0	45.4
1960-61	0.0	0.0	0.0	0.0	0.6	4.9	3.7	5.0	0.5	7.4	T	0.0	22.1
1961-62	0.0	0.0	0.0	T	T	4.5	5.1	17.4	2.6	0.5	0.0	0.0	30.1
1962-63	0.0	0.0	0.0	T	T	17.3	9.2	8.3	2.8	T	T	0.0	37.4
1963-64	0.0	0.0	0.0	0.0	T	8.9	5.3	7.7	11.5	0.8	0.0	0.0	34.2
1964-65	0.0	0.0	0.0	T	4.3	7.2	11.7	17.3	16.1	2.5	0.0	0.0	59.1
1965-66	0.0	0.0	0.0	T	0.4	1.6	8.4	3.9	2.5	1.8	0.0	0.0	18.6
1966-67	0.0	0.0	0.0	0.0	11.8	14.9	5.4	11.0	5.8	1.7	0.0	0.0	50.6
1967-68	0.0	0.0	0.0	T	1.4	4.5	11.8	2.8	10.0	0.1	0.0	0.0	30.6
1968-69	0.0	0.0	0.0	T	T	3.9	6.3	2.3	2.3	0.3	0.0	0.0	17.1
1969-70	0.0	0.0	0.0	T	3.9	10.0	10.9	9.4	6.7	4.2	T	0.0	45.1
1970-71	0.0	0.0	0.0	0.0	1.7	9.8	8.7	3.9	8.7	0.6	0.0	0.0	33.4
1971-72	0.0	0.0	0.0	0.0	4.2	2.6	7.9	9.3	2.5	2.5	0.0	0.0	29.0
1972-73	0.0	0.0	0.0	T	7.1	12.3	2.4	12.8	10.1	0.1	T	0.0	45.0
1973-74	0.0	0.0	0.0	0.0	0.1	16.4	14.1	11.2	5.7	1.7	T	0.0	49.2
1974-75	0.0	0.0	0.0	T	7.7	34.9	4.9	7.5	4.5	3.6	0.0	0.0	63.1
1975-76	0.0	0.0	0.0	0.0	6.5	19.8	15.1	4.9	7.5	2.1	T	0.0	55.9
1976-77	0.0	0.0	0.0	T	1.4	9.8	14.7	3.0	12.3	0.7	0.0	0.0	43.9
1977-78	0.0	0.0	0.0	0.0	7.4	16.6	29.6	5.3	2.5	0.3	0.0	0.0	61.7
1978-79	0.0	0.0	0.0	0.0	6.1	6.6							
RECORD MEAN	0.0	0.0	0.0	T	3.7	10.8	9.7	8.1	6.6	1.6	T	0.0	40.3

# Indicates a station move or relocation of instruments. See Station Location table.

Record mean values above are means through the current year for the period beginning in 1959. Data are from Cooperative locations through 1946 for temperature and through February 1947 for precipitation, then from Willow Run through 1958, and from Metropolitan Airport beginning with 1959.

Local Climatological Data

Annual Summary With Comparative Data

1978

NEWARK, NEW JERSEY

Narrative Climatological Summary

Terrain in vicinity of the station is flat and rather marshy. To the northwest are ridges oriented roughly in a SSW to NNE direction. They rise to an elevation of about 200 feet at four and one-half to five miles and to 500 to 600 feet at seven to eight miles. All winds between WNW and NNW are downslope and therefore are subject to some adiabatic temperature increase. This effect is evident in the rapid improvement which normally occurs with shift of wind to westerly following a coastal storm or front passage. The drying effect of the downslope winds accounts for the relatively few local convectional thunderstorms occurring at the station. Easterly winds, particularly SE, bring into play the ocean influence on the temperature.

Temperature falls of from 5 to 15 degrees, depending on the season, are not uncommon when the wind backs from southwesterly to southeasterly. Periods of very hot weather, lasting as long as a week, are associated with a WSW flow of air which has a long trajectory over land on the left of the Bermuda high pressure system. Extremes of cold are related to rapidly moving outbreaks of cold air which travel southeastward from the Hudson Bay region. Temperatures of zero or below are experienced in one winter out of four. Average dates of the last occurrence in spring and the first occurrence in autumn, of temperatures as low as 32° are April 7 and November 2, respectively.

A considerable amount of the annual precipitation is realized from the Northeasters of the Atlantic coast. These storms, more typical of the fall and winter, generally last for a minimum of two days and commonly produce between one and two inches of precipitation. Storms producing 4 inches or more of snow occur on the average of twice a winter with a maximum frequency of five. Snowstorms producing falls of eight inches or more have occurred in one-half the winters. As many as three such storms have been experienced in one winter. The average sea level pressure is 30.02 inches with extremes of 31.02 inches and 28.69 inches.

noaa NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION / ENVIRONMENTAL DATA AND INFORMATION SERVICE / NATIONAL CLIMATIC CENTER ASHEVILLE, N.C.

Meteorological Data For The Current Year

Station: NEWARK, NEW JERSEY INTERNATIONAL AIRPORT # 14734 Standard time used: EASTERN Latitude: 40° 42' N Longitude: 74° 10' W Elevation (ground): 7 feet Year: 1978

Month	Temperature °F: Averages: Daily maximum	Daily minimum	Monthly	Extremes: Highest	Date	Lowest	Date	Degree days Base 65 °F: Heating	Cooling	Precipitation in inches: Water equivalent: Total	Greatest in 24 hrs.	Date	Snow, ice pellets: Total	Greatest in 24 hrs.	Date	Relative humidity, pct.: Hour 01 (Local time)	Hour 07	Hour 13	Hour 19
JAN	33.8	20.5	27.2	59	9	10	10	1168	0	7.76	1.94	19-20	27.4	17.8	19-20	80	86	67	73
FEB	32.5	18.5	25.5	40	25	9	5	1099	0	2.26	1.47	6-7	25.3	18.8	6-7	77	83	58	65
MAR	46.0	31.0	38.5	69	21	10	5	814	0	4.58	2.66	26-27	10.5	7.4	3	70	72	54	60
APR	60.1	41.9	51.0	82	1	31	3	411	0	2.60	2.03	19-20	T	T	3	61	62	42	48
MAY†	68.9	52.1	60.5	90	20	36	1	190	59	7.97	2.61	24-25	0.0	0.0		79	80	63	69
JUN†	80.6	62.5	71.6	93	19	49	14	13	217	2.05	0.71	7-8	0.0	0.0		71	68	51	54
JUL	83.1	67.0	75.1	98	23	56	4	6	325	4.99	2.54	3-4	0.0	0.0		71	72	52	56
AUG	83.9	69.4	76.7	91	17	61	26	0	367	7.30	3.52	6-7	0.0	0.0		82	81	61	68
SEP	74.7	57.4	66.1	88	7	45	29	66	105	4.23	1.88	18-19	0.0	0.0		80	80	57	65
OCT	66.8	48.2	57.5	83	13	38	18	239	15	1.64	0.61	26-27	0.0	0.0		74	77	48	62
NOV†	55.8	41.7	48.8	73	6	24	27	481	0	2.66	0.83	23-24	2.6	2.6	27	73	77	57	64
DEC	45.3	30.8	38.1	70	4	18	29	830	0	5.37	2.08	8-9	T	T	27	71	74	53	61
YEAR	61.0	45.1	53.1	98	JUL 23	9	FEB 5	5317	1088	53.41	3.52	AUG 6-7	65.8	18.8	FEB 6-7	74	76	55	62

Month	Wind: Resultant: Direction	Resultant: Speed m.p.h.	Average speed m.p.h.	Fastest mile: Speed m.p.h.	Direction	Date	Percent of possible sunshine	Average sky cover, tenths, sunrise to sunset	Number of days: Sunrise to sunset: Clear	Partly cloudy	Cloudy	Precipitation .01 inch or more	Snow, ice pellets 1.0 inch or more	Thunderstorms	Heavy fog, visibility ¼ mile or less	Temperature °F: Maximum: (b) 90° and above	32° and below	Minimum: 32° and below	0° and below	Average station pressure mb (Elev. 30 feet m.s.l.)
JAN	27	5.5	12.2	32	24	10		6.5	8	7	16	12	5	0	3	0	19	28	0	1014.9
FEB	32	6.6	9.9	30	02	6		5.1	11	7	10	6	4	0	0	0	13	28	0	1015.9
MAR	31	4.6	10.8	25	31	4		6.5	7	10	14	8	2	1	1	0	6	13	0	1016.6
APR	31	5.4	12.0	32	31	5		6.1	7	11	12	6	0	1	0	0	0	1	0	1012.9
MAY†	03	1.1	9.6	†26	30	21		7.2	6	8	17	13	0	3	5	1	0	0	0	1014.2
JUN†	26	3.3	9.6	†26	30	14		5.0	12	11	7	11	0	3	0	3	0	0	0	1015.6
JUL	24	2.0	9.3	28	27	27		6.5	5	12	14	9	0	3	1	8	0	0	0	1015.2
AUG	23	1.4	7.5	24	29	12		7.0	7	5	19	11	0	7	1	4	0	0	0	1016.9
SEP	31	1.7	8.3	24	31	19		5.6	7	13	10	9	0	2	1	0	0	0	0	1018.0
OCT	26	2.0	8.1	25	32	23		4.6	12	10	9	10	0	2	0	0	0	0	0	1018.3
NOV†	34	3.3	8.9	†26	30	25		6.9	7	4	19	8	1	0	4	0	0	4	0	1021.0
DEC	28	7.4	12.3	38	31	18		6.0	10	8	13	17	0	0	1	0	2	19	0	1015.9
YEAR	29	3.2	9.9	38	31	DEC 18		6.1	99	106	160	115	12	22	17	16	40	93	0	1016.3

† DATA CORRECTED AFTER PUBLICATION OF THE MONTHLY ISSUE.

Normals, Means, And Extremes

Month	Temperatures °F: Normal: Daily maximum	Daily minimum	Monthly	Extremes: Record highest	Year	Record lowest	Year	Normal Degree days Base 65 °F: Heating	Cooling	Precipitation in inches: Water equivalent: Normal	Maximum monthly	Year	Minimum monthly	Year	Maximum in 24 hrs.	Year	Snow, ice pellets: Maximum monthly	Year	Maximum in 24 hrs.	Year
(a)				37		37					37		37		25		37		37	
J	38.5	24.3	31.4	74	1950	-2	1977	1042	0	2.91	7.76	1978	0.81	1955	1.94	1978	27.4	1978	17.8	1978
F	40.2	24.9	32.6	76	1949	-7	1943	907	0	2.95	4.47	1950	1.22	1968	2.45	1961	25.4	1967	20.0	1961
M	48.8	32.4	40.6	89	1945	6	1943	756	0	3.93	8.49	1953	1.12	1966	2.66	1978	26.0	1956	17.0	1956
A	61.2	42.2	51.7	93	1976	23	1954	399	0	3.44	6.41	1958	0.90	1963	2.03	1978	4.1	1957	4.1	1957
M	71.0	52.1	61.9	98	1962	33	1947	143	47	3.60	8.12	1948	0.52	1964	4.11	1968	T	1977	T	1977
J	81.1	61.6	71.4	102	1952	43	1945	0	197	2.99	6.45	1975	0.07	1949	2.31	1973	0.0		0.0	
J	85.6	67.2	76.4	105	1966	52	1945	0	353	4.03	8.02	1975	0.89	1966	3.40	1971	0.0		0.0	
A	83.7	65.5	74.6	103	1948	48	1976	0	298	4.27	11.84	1955	0.50	1964	7.84	1971	0.0		0.0	
S	77.0	58.6	67.8	105	1953	35	1947	34	118	3.44	10.28	1944	0.95	1951	5.27	1971	0.0		0.0	
O	66.9	48.1	57.5	92	1949	28	1969	243	11	2.82	8.20	1943	0.21	1963	3.04	1973	0.3	1952	0.3	1952
N	54.2	38.2	46.2	85	1950	12	1955	564	0	3.61	11.53	1977	0.51	1976	7.22	1977	3.1	1967	3.1	1967
D	41.5	27.4	34.5	72	1946	-1	1942	946	0	3.46	7.24	1973	0.27	1955	2.14	1973	29.1	1947	26.0	1947
YR	62.5	45.2	53.9	105	JUL 1966	-7	FEB 1943	5034	1024	41.45	11.84	AUG 1955	0.07	JUN 1949	7.84	AUG 1971	29.1	DEC 1947	26.0	DEC 1947

Month	Relative humidity pct.: Hour 01 (Local time)	Hour 07	Hour 13	Hour 19	Wind: Mean speed m.p.h.	Prevailing direction	Fastest mile: Speed m.p.h.	Direction	Year	Pct. of possible sunshine	Mean sky cover, tenths, sunrise to sunset	Mean number of days: Sunrise to sunset: Clear	Partly cloudy	Cloudy	Precipitation .01 inch or more	Snow, ice pellets 1.0 inch or more	Thunderstorms	Heavy fog, visibility ¼ mile or less	Temperatures °F: Max.: (b) 90° and above	32° and below	Min.: 32° and below	0° and below	Average station pressure mb. (Elev. 30 feet m.s.l.)
(a)	13	13	13	13	35	22	30	30			37	37	37	37	37	37	37	37	13	13	13	13	6
J	71	74	59	65	11.2	NE	45	25	1951		6.4	8	8	15	11	2	*	2	0	11	24	*	1016.3
F	69	73	56	61	11.5	NW	46	23	1965		6.3	7	8	13	10	2	*	2	0	6	22	0	1015.4
M	66	69	52	57	12.0	NW	43	27	1950		6.3	8	9	14	11	1	1	2	0	1	13	0	1015.1
A	63	63	45	51	11.3	WNW	50	27	1951		6.3	7	9	14	11	*	2	1	*	0	2	0	1013.7
M	71	70	52	58	10.0	SW	50	32	1963		6.5	7	10	14	12	0	4	2	1	0	0	0	1013.6
J	74	72	54	60	9.3	SW	55	07	1952		6.9	7	11	12	10	0	5	1	4	0	0	0	1014.5
J	72	71	51	58	8.8	SW	45	18	1950		6.9	7	12	12	10	0	6	1	8	0	0	0	1014.4
A	75	75	53	61	8.6	SW	46	09	1955		6.0	8	11	12	9	0	5	1	6	0	0	0	1016.5
S	77	78	55	64	8.9	SW	51	05	1960		5.7	10	9	11	8	0	2	1	1	0	0	0	1016.9
O	75	78	53	64	9.3	SW	48	11	1954		5.4	11	9	12	8	0	1	2	0	0	1	0	1017.9
N	73	77	57	65	10.1	SW	82	09	1950		6.3	9	8	14	10	*	*	2	0	*	6	0	1017.2
D	73	75	61	66	10.8	SW	55	32	1962		6.4	8	8	15	11	2	*	2	0	4	19	0	1016.4
YR	72	73	54	61	10.1	SW	82	09	NOV 1950		6.2	96	111	158	122	7	25	19	20	22	87	*	1015.7

Means and extremes above are from existing and comparable exposures. Annual extremes have been exceeded at other sites in the locality as follows: Lowest temperature -14 in February 1934; maximum monthly precipitation 22.48 in August 1843 (early cooperative location); minimum monthly precipitation 0.07 in June 1949.

(a) Length of record, years, through the current year unless otherwise noted, based on January data.
(b) 70° and above at Alaskan stations.
* Less than one half.
T Trace.

NORMALS - Based on record for the 1941-1970 period.
DATE OF AN EXTREME - The most recent in cases of multiple occurrence.
PREVAILING WIND DIRECTION - Record through 1963.
WIND DIRECTION - Numerals indicate tens of degrees clockwise from true north. 00 indicates calm.
FASTEST MILE WIND - Speed is fastest observed 1-minute value when the direction is in tens of degrees.

Average Temperature

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
1939	51.4	56.4	59.2	47.8	64.0	72.1	74.8	76.5	66.8	55.5	42.0	35.1	53.5
1940	23.7	32.2	54.4	45.8	59.9	68.4	74.3	70.0	64.0	51.8	45.6	37.1	50.4
#1941	29.0	50.6	55.4	56.2	65.0	70.6	75.0	71.9	68.0	58.5	47.4	36.9	55.6
1942	29.2	29.4	42.5	53.0	64.8	70.4	75.7	72.6	66.6	56.8	45.0	30.0	55.0
1943	29.8	32.9	58.8	45.9	61.9	75.4	75.8	74.5	65.7	53.6	45.2	51.2	52.3
1944	52.6	32.0	36.7	48.2	65.6	71.4	77.8	76.2	68.2	54.5	44.3	50.6	53.2
1945	24.0	32.9	50.6	55.2	58.8	70.8	74.1	72.4	69.6	54.2	46.0	29.0	53.1
1946	52.4	51.0	48.8	50.2	61.4	69.4	75.0	70.8	69.2	60.0	49.2	57.0	54.5
1947	56.5	28.2	57.6	50.2	59.9	67.8	75.5	75.6	67.6	61.0	45.2	32.9	55.0
1948	24.4	29.3	41.8	50.3	60.0	69.4	76.7	74.7	68.4	55.0	50.8	55.8	55.0
1949	37.6	58.2	42.5	53.2	62.4	75.6	79.6	76.2	65.0	61.6	44.2	58.3	56.0
1950	40.3	51.5	36.2	48.4	58.7	70.5	75.2	72.8	64.1	58.5	47.0	55.5	55.1
1951	55.4	55.5	41.7	52.8	62.8	69.6	75.1	74.2	67.1	57.9	42.1	57.2	54.4
1952	35.8	55.7	59.9	53.9	60.1	73.4	79.2	74.1	68.2	53.2	46.5	57.1	54.8
1953	36.6	57.5	42.9	51.4	62.8	72.7	77.2	74.6	69.0	58.8	47.3	39.2	55.9
1954	29.7	59.9	41.3	55.1	59.6	71.1	76.2	72.3	66.9	60.4	44.8	55.2	54.2
1955	50.7	54.2	41.4	53.3	64.7	68.9	80.5	77.7	67.1	58.8	43.5	29.3	54.2
1956	52.0	56.0	56.9	47.8	58.9	71.9	73.1	75.7	64.0	57.2	46.1	59.9	53.1
1957	28.0	36.4	49.0	55.3	62.9	73.8	77.3	73.0	69.5	55.6	48.3	59.1	54.9
1958	31.7	27.8	40.4	53.0	59.2	67.5	76.7	74.9	67.4	55.0	47.4	29.2	52.5
1959	31.4	31.6	40.3	55.5	65.7	71.6	76.7	77.6	71.5	59.9	45.5	58.0	55.3
1960	34.4	56.3	35.9	54.8	62.2	72.3	74.9	75.1	67.9	57.3	48.5	50.0	54.0
1961	26.6	55.8	41.2	48.6	59.7	71.9	77.3	75.8	74.5	59.5	47.4	55.8	54.4
1962	50.8	50.3	42.0	52.9	64.3	72.5	75.9	72.9	64.7	57.3	43.9	51.1	53.0
1963	29.6	27.6	42.5	52.6	61.1	72.0	77.0	74.0	64.0	61.[illegible]	49.7	29.3	53.4
1964	34.3	31.9	42.6	49.1	65.4	71.2	76.0	73.9	68.9	55.[illegible]	49.4	55.9	54.6
#1965	28.3	52.4	59.0	50.0	67.3	71.8	75.7	74.5	68.4	54.0	44.4	58.8	53.7
1966	50.4	33.2	41.7	48.2	59.3	73.8	79.6	76.5	66.6	55.5	48.9	36.5	54.2
1967	36.9	29.4	57.6	50.9	54.3	72.0	74.2	75.5	66.6	56.4	42.2	58.3	52.7
1968	27.8	29.9	43.1	54.0	59.6	69.7	78.2	76.9	70.7	59.7	45.7	52.5	54.0
1969	31.3	51.3	58.8	54.6	64.1	72.8	74.2	77.3	67.5	56.2	45.5	33.1	53.9
1970	24.2	53.0	39.0	51.9	64.6	70.9	77.2	77.3	70.6	59.5	49.1	35.3	54.4
1971	27.3	35.2	41.2	51.4	60.6	74.8	77.8	76.0	71.8	63.2	46.2	41.4	55.6
1972	55.4	31.3	40.5	50.0	63.0	68.8	77.9	75.9	69.8	53.3	44.8	59.7	54.2
1973	55.5	33.3	48.6	54.2	60.4	74.6	78.7	79.6	71.0	60.3	48.8	39.4	57.0
1974	35.4	51.9	45.4	56.5	62.7	70.1	77.1	76.5	66.6	53.9	47.5	38.9	55.0
1975	56.9	55.1	59.7	47.3	65.8	71.6	76.9	75.1	64.3	59.1	51.7	55.4	54.9
1976	26.8	59.3	44.0	55.2	61.1	73.6	74.9	74.4	66.5	52.6	59.9	29.1	55.1
1977	20.9	52.8	46.8	53.7	65.4	70.3	78.2	75.1	68.0	54.5	47.1	35.[illegible]	55.9
1978	27.2	25.5	38.5	51.0	60.5	71.6	75.1	76.7	66.1	57.5	48.8	58.1	55.1
RECORD MEAN	51.5	32.5	40.7	51.3	61.9	71.2	76.3	74.7	67.5	56.9	46.0	55.[illegible]	53.8
MAX	38.6	40.1	48.8	60.6	71.6	80.7	85.5	85.6	76.6	66.[illegible]	53.8	42.[illegible]	62.5
MIN	24.4	24.8	32.5	41.9	52.2	61.7	67.0	65.7	58.4	47.[illegible]	38.1	27.[illegible]	45.2

Heating Degree Days

NEWARK, NJ

Season	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	Total
1958-59	0	0	37	323	520	1103	1036	928	761	343	101	27	5179
1959-60	0	0	39	233	578	832	940	827	959	322	114	0	4844
1960-61	0	0	14	247	485	1079	1165	814	729	487	169	5	5212
1961-62	0	0	21	200	526	960	1052	963	705	393	120	7	4947
1962-63	0	7	81	250	840	1046	1091	1041	691	368	164	4	5585
1963-64	0	0	108	159	454	1100	946	955	687	473	88	21	4971
#1964-65	1	0	40	278	461	895	1133	905	799	442	55	17	5026
1965-66	0	11	50	339	610	807	1066	882	717	500	212	14	5208
1966-67	0	0	65	286	480	876	864	991	842	425	531	5	5163
1967-68	0	1	56	288	677	823	1148	1012	676	325	167	12	5184
1968-69	0	0	0	193	575	1003	1039	938	804	317	101	2	4976
1969-70	0	0	49	284	575	984	1255	892	796	390	97	5	5327
1970-71	0	0	24	199	472	914	1160	827	732	402	155	7	4892
1971-72	0	1	14	95	569	724	909	969	757	444	95	19	4592
1972-73	0	0	22	356	599	776	906	882	504	339	163	1	4548
1973-74	0	0	16	166	479	787	909	921	661	275	127	12	4353
1974-75	0	0	64	341	521	802	864	852	775	524	84	6	4811
1975-76	0	1	59	195	400	915	1177	758	645	338	141	17	4624
1976-77	0	4	56	561	745	1107	1361	895	565	352	89	24	5577
1977-78	0	0	50	319	527	975	1168	1099	814	411	190	13	5566
1978-79	6	0	66	230	481	850							

Cooling Degree Days

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
1969	0	0	0	15	80	245	293	390	131	17	0	0	1169
1970	0	0	0	4	94	187	584	387	201	53	0	0	1290
1971	0	0	0	0	25	307	405	350	222	46	12	0	1365
1972	0	0	5	4	41	142	406	347	175	3	0	0	1121
1973	0	0	0	20	26	296	432	459	205	28	0	0	1466
1974	0	0	0	28	64	172	381	361	115	1	3	0	1125
1975	0	0	0	0	117	211	575	321	46	20	10	0	1100
1976	0	0	0	50	50	281	517	505	110	6	0	0	1099
1977	0	0	6	18	111	191	414	321	146	1	0	0	1208
1978	0	0	0	0	59	217	525	367	105	15	0	0	1088

Precipitation

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
1939	3.53	5.08	4.55	4.00	0.78	4.06	1.71	3.83	1.14	4.20	1.41	1.45	56.54
1940	2.52	2.77	4.77	5.95	8.10	5.60	2.65	4.56	3.51	2.32	5.76	3.11	47.40
#1941	3.15	2.82	2.59	2.93	0.98	4.59	4.08	6.20	0.14	2.03	2.87	3.92	56.30
1942	5.27	2.49	5.54	1.15	2.43	5.59	5.86	8.46	5.55	2.43	4.53	4.37	49.27
1943	2.80	1.99	3.61	2.50	6.16	3.12	4.64	5.89	2.65	8.20	2.36	1.47	43.38
1944	4.45	2.46	6.45	4.85	1.55	5.52	2.43	2.29	10.28	2.55	7.41	2.96	51.00
1945	2.94	2.96	2.65	2.89	5.53	4.17	6.15	2.62	5.98	3.35	5.01	4.33	48.56
1946	1.68	1.46	5.16	1.20	7.28	5.25	5.85	5.21	4.15	1.03	1.57	2.38	40.20
1947	5.32	2.59	2.19	5.51	5.38	5.69	2.25	4.82	5.98	2.20	7.37	5.78	46.87
1948	4.58	2.29	3.74	5.53	8.12	6.19	6.88	4.55	1.14	1.89	2.96	5.84	51.27
1949	6.35	5.69	1.95	4.15	4.01	0.07	2.95	2.66	5.06	1.59	1.15	2.47	56.06
1950	2.42	5.92	5.98	1.96	2.58	2.35	5.41	6.05	1.75	1.42	5.07	4.66	41.57
1951	4.06	3.62	5.83	5.12	5.16	2.65	4.83	2.56	0.95	4.21	6.75	4.85	48.59
1952	4.92	2.35	4.94	6.01	5.96	6.01	4.11	6.68	5.62	0.89	5.41	4.40	55.50
1953	5.57	2.75	8.49	6.07	4.21	1.79	2.77	1.91	1.25	3.50	1.56	3.85	43.72
1954	1.56	2.07	5.58	2.58	5.66	0.85	1.45	6.57	5.80	1.75	4.79	2.89	56.95
1955	0.81	2.89	4.06	2.25	2.50	2.94	1.14	11.84	2.29	6.70	3.06	0.27	40.55
1956	1.50	4.47	6.29	5.04	2.45	5.31	4.99	5.08	2.10	5.83	3.98	5.22	42.26
1957	1.77	2.77	2.73	5.45	1.87	1.54	1.51	2.64	3.80	2.13	5.13	5.74	55.08
1958	5.55	4.54	4.51	6.41	3.76	5.66	4.55	2.59	3.60	5.48	1.97	1.45	45.47
1959	2.40	1.89	4.09	2.05	1.47	3.60	2.49	6.94	2.45	4.22	5.94	4.17	39.71
1960	2.79	4.11	2.98	5.09	4.11	1.07	6.59	4.61	6.23	2.79	2.41	5.89	44.47
1961	5.54	5.97	4.96	5.28	5.55	2.46	7.95	4.22	1.49	2.06	2.64	3.65	45.37
1962	2.56	4.25	5.55	5.44	1.46	5.89	2.54	5.75	5.53	5.72	4.59	2.39	40.85
1963	2.19	2.16	5.92	0.90	2.57	2.01	2.24	1.95	5.94	0.21	5.68	1.97	29.52
1964	5.12	2.59	2.27	5.56	0.52	5.09	4.74	0.50	1.30	1.55	2.08	4.10	35.42
1965	2.86	2.91	2.81	2.60	1.23	1.23	1.75	2.87	2.20	2.51	1.48	1.86	26.09
1966	2.29	4.41	1.12	5.01	4.86	0.49	0.89	5.08	7.86	5.78	5.06	3.01	57.86
1967	1.15	5.00	5.86	2.84	3.57	5.31	7.53	5.55	1.35	2.87	2.35	4.65	44.01
1968	1.71	1.22	5.59	2.24	6.28	4.37	1.87	2.41	2.48	2.02	4.38	4.32	56.89
1969	1.47	2.68	5.53	3.51	2.73	2.53	7.11	2.24	6.63	1.75	2.80	4.97	41.95
1970	0.87	3.49	3.42	3.52	2.64	2.41	3.68	3.91	1.83	2.36	4.41	2.05	34.39
1971	2.74	4.44	3.29	1.55	3.65	1.48	6.98	10.63	7.88	2.96	3.86	1.51	50.77
1972	2.26	4.01	5.09	3.08	6.02	6.02	4.70	2.50	1.03	4.83	8.42	4.10	49.86
1973	5.65	5.39	3.63	5.77	3.56	4.03	5.63	5.36	5.59	5.55	1.29	7.24	46.29
1974	2.84	1.44	4.11	2.37	5.49	5.60	1.31	7.17	5.76	1.85	0.80	4.02	58.76
1975	3.99	2.56	2.94	2.29	3.27	6.40	8.02	4.56	9.00	5.24	3.67	2.91	52.65
1976	5.04	2.52	2.33	2.50	4.12	1.54	5.91	2.98	2.50	5.07	0.51	2.17	55.19
1977	1.55	2.77	5.67	3.16	1.31	5.89	1.51	4.29	5.99	3.53	11.53	4.77	47.97
1978	7.76	2.26	4.58	2.60	7.97	2.05	4.99	7.30	4.23	1.64	2.66	5.37	53.41
RECORD MEAN	5.21	2.87	3.90	3.36	3.58	3.29	5.86	4.53	3.81	2.97	3.48	3.37	42.03

Snowfall

Season	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	Total
1939-40	0.0	0.0	0.0	0.0	T	2.1	5.5	10.5	4.3	1.4	0.0	0.0	21.6
1940-41	0.0	0.0	0.0	T	1.5	3.6	13.2	6.2	14.5	0.0	0.0	0.0	59.0
#1941-42	0.0	0.0	0.0	0.0	T	1.0	5.7	0.6	3.1	3.5	0.0	0.0	13.9
1942-43	0.0	0.0	0.0	0.0	7	6.7	10.7	4.1	5.1	T	0.0	0.0	26.6
1943-44	0.0	0.0	0.0	0.0	T	T	6.3	10.5	4.9	1.5	0.0	0.0	23.2
1944-45	0.0	0.0	0.0	0.0	T	6.8	15.5	7.5	7	T	0.0	0.0	29.6
1945-46	0.0	0.0	0.0	0.0	2.9	16.5	3.5	6.4	T	0.0	0.0	0.0	29.5
1946-47	0.0	0.0	0.0	0.0	0.0	2.3	5.9	20.5	4.5	7	0.0	0.0	55.0
1947-48	0.0	0.0	0.0	0.0	7	29.1	16.4	15.0	4.0	0.0	0.0	0.0	62.5
1948-49	0.0	0.0	0.0	0.0	7	20.7	6.1	8.0	6.4	0.0	0.0	0.0	41.2
1949-50	0.0	0.0	0.0	0.0	0.4	1.5	0.5	7.2	0.4	0.7	0.0	0.0	10.7
1950-51	0.0	0.0	0.0	0.0	T	3.4	5.1	0.9	1.5	0.0	0.0	0.0	10.9
1951-52	0.0	0.0	0.0	0.0	T	4.9	3.7	2.1	6.0	T	0.0	0.0	16.7
1952-53	0.0	0.0	0.0	0.3	0.9	8.2	3.7	0.4	0.8	0.0	0.0	0.0	14.3
1953-54	0.0	0.0	0.0	0.0	2.4	7	10.6	0.6	T	0.4	0.0	0.0	14.0
1954-55	0.0	0.0	0.0	0.0	T	T	3.1	7.1	3.5	7	0.0	0.0	13.7
1955-56	0.0	0.0	0.0	0.0	2.2	3.8	2.4	2.4	26.0	3.4	7	0.0	40.2
1956-57	0.0	0.0	0.0	0.0	T	1.5	7.8	8.8	2.1	4.1	0.0	0.0	24.1
1957-58	0.0	0.0	0.0	T	T	16.2	6.3	16.5	19.5	7	0.0	0.0	58.3
1958-59	0.0	0.0	0.0	0.0	T	5.3	2.2	1.0	8.2	1.1	0.0	0.0	17.8
1959-60	0.0	0.0	0.0	0.0	0.4	9.1	5.6	5.2	19.0	T	0.0	0.0	37.3
1960-61	0.0	0.0	0.0	T	0.0	24.0	22.2	23.3	4.0	7	0.0	0.0	73.5
1961-62	0.0	0.0	0.0	0.0	0.8	13.2	1.0	13.1	1.5	T	0.0	0.0	29.6
1962-63	0.0	0.0	0.0	T	0.5	7.8	7.5	5.6	2.5	7	0.0	0.0	21.7
1963-64	0.0	0.0	0.0	0.0	7	10.7	15.5	15.0	4.0	T	0.0	0.0	45.2
1964-65	0.0	0.0	0.0	0.0	0.0	3.9	16.1	1.8	4.6	0.7	0.0	0.0	27.1
1965-66	0.0	0.0	0.0	T	0.0	7	10.2	8.6	7	0.0	0.0	0.0	18.8
1966-67	0.0	0.0	0.0	0.0	0.0	12.6	1.3	25.4	18.0	7	0.0	0.0	57.3
1967-68	0.0	0.0	0.0	0.0	3.1	3.9	4.6	0.6	1.7	0.0	0.0	0.0	13.9
1968-69	0.0	0.0	0.0	0.0	0.4	4.7	1.1	16.5	5.9	0.0	0.0	0.0	28.6
1969-70	0.0	0.0	0.0	0.0	T	8.5	9.1	5.5	4.3	7	0.0	0.0	27.4
1970-71	0.0	0.0	0.0	0.0	0.0	2.9	15.2	1.1	4.2	2.2	0.0	0.0	23.6
1971-72	0.0	0.0	0.0	0.0	T	0.4	3.1	12.3	1.0	7	0.0	0.0	16.8
1972-73	0.0	0.0	0.0	T	T	T	0.7	0.6	0.6	T	0.0	0.0	1.9
1973-74	0.0	0.0	0.0	0.0	0.0	2.1	6.8	8.1	5.1	0.5	0.0	0.0	20.4
1974-75	0.0	0.0	0.0	0.0	T	1.2	1.4	12.7	1.1	7	0.0	0.0	16.4
1975-76	0.0	0.0	0.0	0.0	T	2.4	7.2	6.1	4.2	T	0.0	0.0	19.9
1976-77	0.0	0.0	0.0	0.0	T	6.7	10.8	5.8	1.7	T	T	0.0	25.0
1977-78	0.0	0.0	0.0	0.0	1.5	0.2	27.4	25.3	10.5	T	0.0	0.0	64.9
1978-79	0.0	0.0	0.0	0.0	2.6	T							
RECORD MEAN	0.0	0.0	0.0	T	0.5	6.5	7.5	8.3	5.1	0.5	T	0.0	28.4

# Indicates a station move or relocation of instruments. See Station Location table.

Record mean values above are means through the current year for the period beginning in 1931 for temperature and precipitation, 1942 for snowfall.

Local Climatological Data

Annual Summary With Comparative Data

1978

NEW YORK, N. Y.

LA GUARDIA FIELD

Narrative Climatological Summary

New York City, in area exceeding 300 square miles, is located on the Atlantic coastal plain at the mouth of the Hudson River. The terrain is diversified by numerous waterways; all but one of the City's five boroughs are situated on islands. Elevations range from less than 50 feet over most of Manhattan, Brooklyn and Queens to almost 300 feet in the northern Manhattan and the Bronx, and over 400 feet in Staten Island. Extensive suburban areas on Long Island, and in Connecticut, New York State and New Jersey border the city on the east, north, and west. About 30 miles to the west and northwest, hills rise to about 1500 feet and to the north in upper Westchester County to 800 feet. To the southwest and to the east are the low-lying land areas of the New Jersey coastal plain and of Long Island, whose south shore borders on the Atlantic.

The New York Metropolitan area is close to the path of most storm and frontal systems which move across the North American continent. Therefore, weather conditions affecting the city most often approach from a westerly direction. New York City can thus experience higher temperatures in summer and lower ones in winter than would otherwise be expected in a coastal area. However, the frequent passage of weather systems often helps reduce the length of both warm and cold spells, and is also a major factor in keeping periods of prolonged air stagnation to a minimum.

Although continental influence predominates, oceanic influence is by no means absent. During the summer local sea breezes - winds blowing onshore from the cool water surface - often moderate the afternoon heat. As would be expected, the effect of the sea breeze diminishes inland. On winter mornings, ocean temperatures which are warm relative to the land reinforce the effect of the city heat island and minimum temperatures are often 10 to 20 degrees lower in the inland suburbs than in the central city. The relatively warm water temperatures also delay the advent of winter snows and make heavy snowfalls rare before late December. Conversely, the lag in warming of water temperatures keeps spring temperatures relatively cool. One year-round measure of the ocean's influence is the small average daily variation in temperature; another is the average length of the frost-free season - more than 200 days.

Precipitation is moderate and distributed fairly evenly throughout the year. Most of the rainfall from May through October comes from thunderstorms. It is therefore usually of brief duration and sometimes intense. Heavy rains of long duration associated with tropical storms occur infrequently in late summer or fall. For the other months of the year precipitation is more likely to be associated with widespread storm areas, so that day-long rain, snow or a mixture of both is more common. Precipitation accompanying winter storms sometimes starts as snow, later changes to rain and perhaps briefly back to snow before ending. Coastal storms, occurring most often in the fall and winter months, produce on occasion considerable amounts of precipitation and have been responsible for record rains, snows, and high winds.

The average annual precipitation is reasonably uniform within the city but is higher in the northern and western suburbs and less on eastern Long Island. Annual snowfall totals also show a consistent increase to the north and west of the city with lesser amounts along the south shores and the eastern end of Long Island, reflecting the influence of the ocean waters. Relative humidity averages about the same over the metropolitan area except again that the immediate coastal areas are more humid than inland locations.

Local Climatological Data is published for three locations in New York City: Central Park, La Guardia Airport and John F. Kennedy International Airport. Other nearby locations for which it is published are: Newark, New Jersey and Bridgeport, Connecticut.

noaa NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION / ENVIRONMENTAL DATA AND INFORMATION SERVICE / NATIONAL CLIMATIC CENTER ASHEVILLE, N.C.

Meteorological Data For The Current Year

Station: NEW YORK, NEW YORK # 14732 LA GUARDIA AIRPORT Standard time used: EASTERN Latitude: 40° 46' N Longitude: 73° 54' W Elevation (ground): 11 feet Year: 1978

Month	Temperature °F: Averages: Daily maximum	Daily minimum	Monthly	Extremes: Highest	Date	Lowest	Date	Degree days Base 65 °F: Heating	Cooling	Precipitation in inches: Water equivalent: Total	Greatest in 24 hrs.	Date	Snow, Ice pellets: Total	Greatest in 24 hrs.	Date	Relative humidity, pct.: Hour 01 (Local time)	Hour 07	Hour 13	Hour 19
JAN	34.3	23.2	28.8	59	9	14	10	1119	0	6.11	1.92	25-26	16.6	11.0	19-20	65	66	62	59
FEB	31.5	22.3	26.9	41	25	10	5	1061	0	0.92	0.63	6-7	18.7	14.0	6-7	55	61	53	53
MAR	44.8	32.3	38.6	62	23	14	5	812	0	2.14	1.07	26-27	7.9	5.8	3	57	62	52	52
APR	58.1	42.4	50.3	80	1	30	3	436	0	1.55	1.42	19-20	0.0	0.0		55	59	40	46
MAY	67.1	52.0	59.6	87	20	38	1	203	44	6.15	2.98	14-15	0.0	0.0		72	76	60	66
JUN	78.0	61.9	70.0	89	19	51	14	16	172	1.30	0.52	7-8	0.0	0.0		65	68	53	54
JUL	80.7	66.9	73.8	95	23	56	5	5	286	3.79	2.32	3-4	0.0	0.0		65	69	52	56
AUG	81.4	69.4	75.4	90	17	61	26	0	326	4.01	2.51	6-7	0.0	0.0		75	78	63	67
SEP	72.8	57.8	65.3	84	12	46	29	72	86	3.53	1.25	12	0.0	0.0		71	74	56	60
OCT	63.0	48.4	55.7	76	23	39	24	287	5	1.41	0.62	26-27	0.0	0.0		63	68	52	57
NOV	53.8	42.5	48.2	67	6	26	27	498	0	2.24	0.83	17-18	2.3	2.3	27	64	68	58	59
DEC	44.2	31.8	38.0	67	4	19	29	831	0	4.90	1.87	8-9	0.2	0.2	9	63	65	55	59
YEAR	59.1	45.9	52.5	95	JUL 23	10	FEB 5	5340	919	40.85	2.98	MAY 14-15	45.7	14.0	FEB 6-7	65	68	55	57

Month	Wind: Resultant: Direction	Speed m.p.h.	Average speed m.p.h.	Fastest mile: Speed m.p.h.	Direction	Date	Percent of possible sunshine	Average sky cover, tenths, sunrise to sunset	Number of days: Sunrise to sunset: Clear	Partly cloudy	Cloudy	Precipitation .01 inch or more	Snow, Ice pellets 1.0 inch or more	Thunderstorms	Heavy fog, visibility ¼ mile or less	Temperature °F: Maximum: (b) 90° and above	32° and below	Minimum: 32° and below	0° and below	Average station pressure mb Elev. 31 feet m.s.l.
JAN	29	6.3	14.9	43	SE	9		6.5	9	7	15	12	5	0	2	0	17	27	0	1015.2
FEB	33	8.4	12.1	36	NE	6		4.9	12	7	9	6	4	0	0	0	17	28	0	1016.3
MAR	32	5.1	12.4	34	W	19		6.5	6	10	15	8	2	0	2	0	7	12	0	1016.9
APR	31	5.6	12.8	36	NW	14		6.2	7	10	13	8	0	2	1	0	0	1	0	1013.2
MAY	06	1.4	10.9	33	NE	15		6.9	7	9	15	13	0	2	2	0	0	0	0	1014.9
JUN	26	3.4	10.6	29	NW	13		4.8	13	10	7	8	0	3	0	0	0	0	0	1015.9
JUL	23	1.9	11.0	36	SW	27		5.2	12	11	8	8	0	1	0	3	0	0	0	1015.6
AUG	27	0.2	10.1	25	NE	25		6.9	6	8	17	13	0	6	1	1	0	0	0	1017.6
SEP	32	1.3	10.4	23	NE	19		4.8	13	10	7	10	0	1	0	0	0	0	0	1018.3
OCT	28	2.9	10.9	33	NW	23		4.3	16	9	6	9	0	1	0	0	0	0	0	1018.6
NOV	35	3.5	10.9	30	NW	25		6.6	9	4	17	9	1	0	0	0	0	3	0	1021.3
DEC	29	8.0	13.5	43	W	17		5.7	9	12	10	11	0	0	0	0	5	17	0	1016.3
YEAR	30	3.4	11.7	43	W	DEC 17		5.8	119	107	139	115	12	16	8	4	46	88	0	1016.7

Normals, Means, And Extremes

Month	Temperatures °F: Normal: Daily maximum	Daily minimum	Monthly	Extremes: Record highest	Year	Record lowest	Year	Normal Degree days Base 65 °F: Heating	Cooling	Precipitation in inches: Water equivalent: Normal	Maximum monthly	Year	Minimum monthly	Year	Maximum in 24 hrs.	Year	Snow, Ice pellets: Maximum monthly	Year	Maximum in 24 hrs.	Year
(a)				17		17					39		36		38		34		34	
J	37.7	20.4	32.1	68	1967	-1	1977	1020	0	2.88	6.11	1978	0.76	1970	2.17	1976	18.3	1948	11.0	1978
F	39.2	27.0	33.1	68	1976	-2	1963	893	0	3.10	5.76	1960	0.92	1978	2.90	1941	21.5	1947	17.4	1961
M	47.1	34.1	40.6	78	1977	10	1967	756	0	3.98	8.73	1953	0.87	1966	3.25	1953	18.9	1958	15.3	1960
A	59.3	44.0	51.7	91	1976	25	1972	399	0	3.56	7.36	1961	1.21	1942	2.52	1958	6.4	1956	6.4	1956
M	69.9	53.7	61.8	95	1962	38	1978	145	46	3.36	8.15	1970	0.43	1964	3.02	1968	T	1977	T	1977
J	79.4	63.6	71.5	97	1964	46	1972	0	199	2.89	8.15	1972	0.03	1949	3.67	1973	0.0		0.0	
J	84.1	69.3	76.7	107	1966	56	1972	0	363	3.85	12.33	1975	0.69	1954	3.82	1971	0.0		0.0	
A	82.1	67.6	74.9	97	1973	52	1976	0	307	4.48	16.05	1955	0.24	1964	7.11	1955	0.0		0.0	
S	75.2	60.9	68.1	94	1965	44	1974	30	123	3.15	9.63	1975	0.62	1941	4.52	1969	0.0		0.0	
O	65.1	51.0	58.1	85	1967	30	1969	224	10	2.96	9.09	1943	0.06	1963	3.58	1972	1.2	1962	1.2	1962
N	53.2	41.3	47.3	79	1974	18	1976	531	0	3.77	9.92	1972	0.31	1976	4.46	1977	4.0	1953	4.0	1953
D	41.0	30.1	35.6	67	1978	3	1962	911	0	3.63	7.70	1973	0.31	1955	3.44	1941	26.8	1947	22.8	1947
YR	61.1	47.4	54.3	107	JUL 1966	-2	FEB 1963	4909	1048	41.61	16.05	AUG 1955	0.03	JUN 1949	7.11	AUG 1955	26.8	DEC 1947	22.8	DEC 1947

Month	Relative humidity pct.: Hour 01 (Local time)	Hour 07	Hour 13	Hour 19	Wind: Mean speed m.p.h.	Prevailing direction	Fastest mile: Speed m.p.h.	Direction	Year	Pct. of possible sunshine	Mean sky cover, tenths, sunrise to sunset	Mean number of days: Sunrise to sunset: Clear	Partly cloudy	Cloudy	Precipitation .01 inch or more	Snow, Ice pellets 1.0 inch or more	Thunderstorms	Heavy fog, visibility ¼ mile or less	Temperatures °F: Max.: (b) 90° and above	32° and below	Min.: 32° and below	0° and below	Average station pressure mb. Elev. 31 feet m.s.l.
(a)	16	15	16	16	30	14	29	29			30	30	30	30	38	34	30	30	16	16	16	16	6
J	63	65	57	58	13.8	WNW	68	NE	1958		6.4	8	8	15	11	2	*	2	0	11	23	*	1016.5
F	61	63	54	56	13.9	WNW	64	NE	1958		6.3	8	7	13	10	2	*	1	0	7	21	*	1015.7
M	63	66	54	56	14.1	NW	60	NW	1959		6.4	7	9	15	11	1	1	1	0	1	11	0	1015.3
A	61	64	48	53	12.9	NW	59	W	1963		6.2	7	10	13	11	*	2	1	*	0	1	0	1013.9
M	68	69	52	58	11.5	NE	52	NW	1955		6.4	7	11	13	12	0	3	2	1	0	0	0	1013.9
J	72	72	55	61	10.8	S	54	NW	1952		6.1	7	11	12	10	0	4	1	3	0	0	0	1014.7
J	70	71	52	60	10.3	S	59	NW	1954		6.0	7	13	11	9	0	5	1	5	0	0	0	1014.6
A	73	74	54	62	10.1	S	63	NW	1958		5.9	8	12	11	10	0	5	*	3	0	0	0	1016.9
S	72	74	56	63	10.6	S	70	NE	1960		5.7	9	10	11	8	0	2	*	1	0	0	0	1017.2
O	69	72	54	61	11.6	SW	66	SE	1954		5.4	11	9	11	8	*	1	1	0	0	*	0	1018.1
N	66	69	57	61	12.6	WNW	68	N	1953		6.4	7	9	14	10	*	*	1	0	*	4	0	1017.3
D	66	67	60	62	13.5	WNW	56	NW	1951		6.4	8	9	14	11	1	*	1	0	5	17	0	1016.7
YR	67	69	54	59	12.2	WNW	70	NE	SEP 1960		6.1	94	118	153	120	7	24	13	12	24	76	*	1015.9

Means and extremes above are from existing and comparable exposures. Annual extremes have been exceeded at other sites in the locality as follows: Lowest temperature -7 in February 1943.

(a) Length of record, years, through the current year unless otherwise noted, based on January data.
(b) 70° and above at Alaskan stations.
* Less than one half.
T Trace.

NORMALS - Based on record for the 1941-1970 period.
DATE OF AN EXTREME - The most recent in cases of multiple occurrence.
PREVAILING WIND DIRECTION - Record through 1963.
WIND DIRECTION - Numerals indicate tens of degrees clockwise from true north. 00 indicates calm.
FASTEST MILE WIND - Speed is fastest observed 1-minute value when the direction is in tens of degrees.

Average Temperature

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
1941	30.8	31.0	35.6	55.5	63.5	71.3	75.1	74.7	70.4	61.7	50.1	39.5	35.0
1942	31.5	29.8	45.4	53.6	65.4	70.9	76.3	73.9	68.7	39.0	47.5	51.9	34.3
1943	31.0	34.8	40.1	46.7	62.5	76.4	76.4	76.1	67.6	56.4	45.8	34.3	34.0
1944	34.8	33.5	37.9	48.5	63.8	71.9	78.4	77.5	69.6	56.9	46.0	35.0	34.5
1945	25.9	33.9	49.8	55.4	59.1	71.1	75.2	74.0	70.2	56.5	47.2	30.8	34.1
1946	35.6	31.2	48.5	30.0	61.4	69.9	75.4	71.4	70.2	61.9	30.6	38.5	55.2
1947	37.0	29.5	38.8	49.9	59.3	68.2	75.7	75.7	68.9	65.3	44.7	34.2	35.7
1948	25.9	30.7	41.2	30.2	39.4	69.5	77.2	75.5	70.0	56.4	32.4	38.4	53.9
1949	38.6	38.9	42.5	53.1	62.6	73.5	79.4	76.6	66.1	62.9	46.4	39.7	36.7
1950	41.2	32.4	36.6	48.1	38.4	70.4	75.0	73.2	64.9	60.2	48.5	35.6	55.8
1951	36.8	36.6	42.5	33.6	62.9	70.0	76.6	75.1	68.6	59.3	44.0	39.0	55.4
1952	36.7	36.5	40.5	54.8	60.8	74.1	80.4	75.4	70.1	35.8	48.9	39.0	36.2
1953	38.0	38.8	45.4	52.3	65.4	73.6	77.6	76.1	70.3	60.7	30.2	41.7	37.2
1954	31.5	40.2	42.1	53.9	60.3	71.7	76.8	75.5	68.3	62.3	46.9	36.5	33.3
1955	31.4	35.2	42.1	33.3	63.2	70.0	80.9	78.7	68.7	61.2	45.0	30.6	33.2
1956	32.8	37.1	38.0	48.4	38.9	72.4	74.2	75.0	65.8	58.6	47.6	41.6	34.2
1957	29.1	37.8	42.4	55.2	65.4	74.5	77.6	74.0	70.2	56.9	30.0	41.1	33.8
1958	32.3	28.0	40.7	52.7	39.1	67.5	76.9	75.6	68.4	56.0	48.8	30.0	53.0
1959	31.6	32.1	40.1	35.4	65.1	71.6	76.9	78.1	72.5	58.8	46.1	39.2	55.5
1960	34.5	36.6	35.9	34.1	62.6	72.2	75.3	73.1	68.0	38.5	30.4	31.8	34.4
1961	27.9	36.7	40.9	48.6	58.6	71.5	76.0	75.3	75.6	60.0	48.1	35.4	34.4
#1962	32.2	30.8	41.1	31.5	65.6	72.7	73.8	72.6	64.7	37.5	45.6	31.2	32.9
1963	29.3	28.0	41.5	32.2	60.6	70.9	76.2	75.0	65.3	61.4	30.8	30.5	33.5
1964	34.4	32.6	42.8	49.7	63.6	71.3	76.1	75.8	68.1	35.4	49.9	36.7	34.7
1965	30.2	34.2	40.2	30.7	67.1	72.5	76.6	75.7	70.3	35.9	45.9	39.6	54.9
1966	31.8	34.5	42.0	48.6	39.0	74.0	80.8	77.7	68.3	36.6	49.2	36.8	33.0
1967	38.2	30.6	37.8	49.7	53.0	71.8	75.3	75.7	66.5	37.2	42.7	38.6	53.1
1968	26.8	29.1	42.3	34.0	59.4	69.2	77.2	73.9	70.6	39.8	46.4	35.5	33.7
1969	30.9	31.4	39.1	35.9	62.9	70.9	75.2	76.0	67.7	36.5	46.1	33.8	33.3
1970	26.0	32.7	38.4	31.1	62.6	70.5	77.1	77.5	70.4	39.2	49.6	36.2	34.3
1971	28.8	36.0	39.8	49.6	39.4	72.1	76.1	74.8	70.9	62.4	44.5	40.0	34.3
1972	34.2	30.6	37.8	47.6	59.7	63.8	74.6	73.6	67.8	32.2	43.1	38.5	32.1
1973	35.1	32.5	43.0	33.0	58.9	72.7	76.8	77.5	69.3	60.1	48.7	39.4	35.7
1974	35.6	31.9	41.7	34.2	39.9	68.9	76.8	75.7	66.2	35.8	47.8	39.5	34.3
1975	37.1	35.5	39.6	47.1	64.3	69.7	75.7	74.1	64.5	39.4	32.6	37.1	34.7
1976	28.8	40.7	44.8	55.6	61.5	74.1	75.8	73.0	67.5	54.5	43.0	30.7	34.3
1977	22.3	33.2	43.7	52.6	64.1	69.4	77.2	74.8	67.2	54.8	47.3	33.7	53.7
1978	28.8	26.9	38.6	30.3	59.6	70.0	75.8	75.4	63.3	35.7	48.2	38.0	32.3
RECORD MEAN	32.2	35.5	41.5	31.6	61.6	71.3	76.5	73.2	68.5	58.2	47.5	36.3	34.3
MAX	38.1	39.4	48.5	39.7	69.9	79.4	84.2	82.5	75.7	65.1	55.5	41.9	61.3
MIN	26.2	27.1	34.0	45.4	53.3	63.1	68.8	67.8	61.3	51.2	41.4	30.6	47.4

Heating Degree Days

NEW YORK, NY
La GUARDIA FIELD

Season	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	Total
1958-59	0	0	26	296	478	1076	1029	916	765	531	107	27	3071
1959-60	0	0	32	244	561	791	937	817	959	354	98	0	4775
1960-61	0	0	11	218	432	1022	1142	784	759	490	202	3	5040
#1961-62	0	0	22	181	501	910	1006	932	735	412	129	7	4835
1962-63	0	7	80	237	633	1059	1100	1028	720	578	169	8	3599
1963-64	0	0	83	136	421	1065	944	938	680	432	88	16	4821
1964-65	2	0	52	290	444	872	1072	858	763	426	47	14	4840
1965-66	0	5	26	260	563	780	1021	846	703	484	214	17	4945
1966-67	0	0	39	256	469	866	823	960	839	454	308	5	3019
1967-68	0	1	56	267	662	812	1181	1054	698	525	176	14	3219
1968-69	0	0	9	196	554	969	1031	955	793	356	111	2	4930
1969-70	0	0	49	272	562	939	1204	896	821	414	118	6	3501
1970-71	0	0	26	200	456	886	1117	807	774	433	179	11	4911
1971-72	0	1	17	108	612	768	943	987	837	520	164	43	3002
1972-73	4	0	37	389	655	815	920	904	613	371	193	4	4905
1973-74	0	0	30	167	485	785	903	919	713	331	186	27	4546
1974-75	0	0	63	341	312	785	858	819	778	529	103	14	4802
1975-76	0	4	56	188	572	837	1118	695	618	320	134	14	4576
1976-77	0	2	56	324	654	1061	1316	885	391	377	113	28	5587
1977-78	0	0	59	500	324	901	1119	1061	812	636	203	16	5440
1978-79	3	0	72	287	498	831							

Cooling Degree Days

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
1969	0	0	0	8	55	186	258	346	135	14	0	0	1002
1970	0	0	0	2	54	180	382	395	196	27	0	0	1236
1971	0	0	0	0	12	229	332	308	199	52	6	0	1138
1972	0	0	0	2	8	77	311	274	129	0	0	0	801
1973	0	0	0	14	16	242	372	397	164	24	0	0	1229
1974	0	0	0	16	53	149	371	338	104	0	4	0	1017
1975	0	0	0	0	87	160	338	295	46	20	9	0	935
1976	0	0	0	44	51	295	544	322	119	3	0	0	1158
1977	0	0	0	10	93	166	387	311	130	0	0	0	1097
1978	0	0	0	0	44	172	286	526	86	3	0	0	919

Precipitation

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
1941	3.47	3.32	2.88	2.37	2.30	4.04	3.88	3.17	0.62	1.80	3.17	4.24	37.26
1942	2.79	2.87	6.91	1.21	2.43	3.46	7.65	7.34	2.83	2.06	3.56	4.86	48.21
1943	2.26	1.67	4.12	2.26	4.29	2.32	3.49	4.19	1.60	9.09	2.29	1.42	39.00
1944	5.74	2.14	6.62	5.16	1.22	3.28	3.47	3.69	8.04	3.26	3.95	3.38	49.93
1945	2.22	2.97	2.47	3.06	4.94	3.08	4.60	2.83	5.46	1.84	3.90	3.03	44.40
1946	1.94	2.06	3.97	1.73	3.38	4.24	4.71	6.81	4.10	0.91	1.64	2.42	40.13
1947	5.17	2.83	2.42	5.04	4.23	2.75	3.90	4.62	2.83	2.36	6.19	3.99	44.33
1948	4.38	2.50	3.38	3.23	7.42	3.93	3.02	3.84	1.17	1.61	2.72	3.31	46.71
1949	3.77	3.75	1.63	3.77	4.32	0.03	3.91	5.11	3.91	1.89	1.05	2.16	33.48
1950	2.50	4.20	3.25	1.92	2.47	2.40	3.41	4.88	2.02	2.13	6.61	3.00	42.79
1951	4.27	4.03	6.98	2.36	3.46	2.64	3.89	2.97	1.01	4.42	7.92	3.25	51.40
1952	5.31	2.61	3.30	6.38	3.61	5.85	4.66	6.44	2.45	0.86	2.95	4.57	31.33
1953	3.50	2.36	8.73	6.06	4.37	1.77	4.65	3.03	1.88	3.23	2.58	4.81	31.19
1954	1.91	1.89	3.80	3.44	3.68	1.48	0.69	7.86	3.25	2.29	3.97	4.42	42.68
1955	0.85	3.16	4.75	2.73	1.82	2.02	0.82	16.03	2.75	7.14	4.30	0.31	46.88
1956	1.75	4.84	4.76	3.31	2.39	2.76	4.15	5.06	2.11	4.94	2.89	4.07	41.21
1957	1.86	2.20	2.43	3.70	2.92	1.64	1.32	2.45	4.40	3.75	4.17	5.25	38.03
1958	3.23	3.47	4.04	7.24	4.72	2.61	5.89	3.63	4.08	6.88	1.97	1.56	31.34
1959	2.38	2.01	4.70	2.38	1.70	4.76	3.37	4.17	1.42	4.68	4.13	5.00	41.19
1960	2.77	3.76	3.36	2.81	3.39	1.99	9.27	3.88	7.61	2.45	2.71	3.19	31.17
1961	3.20	4.10	5.10	7.36	3.97	2.76	3.47	3.37	1.95	2.03	2.49	3.52	43.52
1962	2.59	4.08	2.61	2.69	1.05	4.27	1.38	5.09	3.02	2.38	3.96	2.05	35.13
1963	2.18	2.46	3.23	1.60	1.78	1.45	1.79	4.24	3.59	0.06	7.52	2.15	31.77
1964	4.22	2.39	2.14	3.12	0.43	2.85	4.56	0.24	1.78	1.68	1.65	4.25	31.31
1965	2.93	3.24	1.94	2.75	1.35	1.14	1.34	2.02	1.26	1.44	1.29	1.47	22.17
1966	2.36	4.29	0.87	2.31	3.78	1.44	1.12	1.74	5.07	3.75	2.44	2.54	31.69
1967	1.06	2.36	3.77	2.91	3.52	3.13	3.02	7.03	1.39	2.06	2.39	3.82	43.06
1968	1.67	1.37	4.77	2.59	4.67	6.16	2.39	3.19	1.84	1.95	5.15	5.80	39.53
1969	0.95	2.59	3.06	4.57	2.52	4.20	8.35	2.64	7.35	1.69	3.06	3.30	46.26
1970	0.76	5.24	3.16	2.36	2.02	2.36	1.18	2.68	1.70	1.45	4.39	1.86	27.56
1971	2.27	4.10	3.08	2.08	3.37	2.21	6.32	8.38	4.93	5.32	4.39	1.55	46.19
1972	2.02	4.80	4.12	3.19	6.83	8.15	3.47	0.94	1.65	4.91	9.92	4.66	34.68
1973	5.47	3.02	3.47	7.17	4.21	6.79	4.90	2.32	2.63	2.73	1.34	7.70	49.93
1974	2.78	1.28	4.45	2.94	3.82	2.31	1.45	6.07	6.90	2.05	1.01	6.38	41.60
1975	4.30	3.20	2.81	2.77	3.79	7.19	12.35	5.60	9.65	5.36	3.92	5.69	60.79
1976	3.42	2.94	2.30	2.43	3.87	2.74	1.00	5.95	2.82	4.62	0.31	2.45	36.63
1977	2.02	2.15	6.37	2.93	1.82	3.36	1.53	4.48	4.80	3.84	8.30	4.86	48.84
1978	6.11	0.92	2.14	1.93	8.15	1.30	3.79	4.01	3.93	1.41	2.24	4.90	40.83
RECORD MEAN	3.02	3.04	3.91	3.48	3.60	5.19	3.95	4.48	3.47	5.08	3.81	3.81	42.84

Snowfall

Season	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	Total
1943-44	0.0	0.0	0.0	0.0	T	7	3.6	10.1	4.6	3.7	0.0	0.0	22.0
1944-45	0.0	0.0	0.0	T	T	7.1	14.3	9.2	T	7	0.0	0.0	30.6
1945-46	0.0	0.0	0.0	0.0	3.1	17.5	3.4	8.3	7	0.0	0.0	0.0	32.1
1946-47	0.0	0.0	0.0	0.0	0.0	2.5	3.0	21.5	6.5	T	0.0	0.0	33.3
1947-48	0.0	0.0	0.0	0.0	T	26.8	18.3	14.9	4.2	0.0	0.0	0.0	64.2
1948-49	0.0	0.0	0.0	0.0	T	22.5	7.5	11.9	5.0	T	0.0	0.0	46.7
1949-50	0.0	0.0	0.0	0.0	0.4	1.3	0.4	12.0	0.9	0.7	0.0	0.0	13.7
1950-51	0.0	0.0	0.0	0.0	0.1	3.0	3.4	2.6	1.3	0.0	0.0	0.0	14.6
1951-52	0.0	0.0	0.0	0.0	T	5.6	2.8	3.7	6.6	T	0.0	0.0	16.7
1952-53	0.0	0.0	0.0	T	1.7	4.2	4.9	0.9	1.8	T	0.0	0.0	13.5
1953-54	0.0	0.0	0.0	0.0	4.0	7	13.1	0.2	7	7	0.0	0.0	17.5
1954-55	0.0	0.0	0.0	0.0	0.0	0.2	2.4	6.0	2.7	0.0	0.0	0.0	11.3
1955-56	0.0	0.0	0.0	0.0	0.6	2.6	1.2	2.4	17.7	6.4	0.0	0.0	30.9
1956-57	0.0	0.0	0.0	0.0	T	1.2	8.1	5.7	1.5	8.4	0.0	0.0	21.9
1957-58	0.0	0.0	0.0	0.0	T	11.0	8.8	12.5	18.9	0.5	0.0	0.0	31.5
1958-59	0.0	0.0	0.0	0.0	T	5.0	2.2	0.8	10.8	1.3	0.0	0.0	18.1
1959-60	0.0	0.0	0.0	0.0	0.2	8.6	2.0	5.9	18.8	T	0.0	0.0	33.3
1960-61	0.0	0.0	0.0	T	0.0	15.5	15.5	21.3	3.8	0.6	T	0.0	36.3
1961-62	0.0	0.0	0.0	0.0	0.4	8.2	0.4	11.5	0.7	T	0.0	0.0	18.0
1962-63	0.0	0.0	0.0	1.2	1.1	5.3	6.9	3.0	2.4	T	0.0	0.0	18.1
1963-64	0.0	0.0	0.0	0.0	T	11.6	10.2	8.8	3.2	T	0.0	0.0	35.8
1964-65	0.0	0.0	0.0	0.0	0.0	5.1	11.9	2.5	3.1	0.7	0.0	0.0	21.1
1965-66	0.0	0.0	0.0	T	T	7	9.3	9.8	T	T	0.0	0.0	19.1
1966-67	0.0	0.0	0.0	0.0	0.0	7.6	0.9	20.0	14.9	T	0.0	0.0	45.4
1967-68	0.0	0.0	0.0	0.0	2.2	5.4	3.2	1.5	2.2	0.0	0.0	0.0	14.3
1968-69	0.0	0.0	0.0	0.0	T	4.9	1.4	18.5	4.0	0.0	0.0	0.0	28.8
1969-70	0.0	0.0	0.0	0.0	T	8.1	7.4	4.2	4.6	7	0.0	0.0	24.3
1970-71	0.0	0.0	0.0	0.0	0.0	1.9	10.4	0.5	2.3	1.0	0.0	0.0	15.9
1971-72	0.0	0.0	0.0	0.0	T	T	2.2	17.2	2.7	0.1	0.0	0.0	22.2
1972-73	0.0	0.0	0.0	T	T	7	0.9	1.0	T	T	0.0	0.0	1.9
1973-74	0.0	0.0	0.0	0.0	0.0	2.2	6.4	7.8	2.2	0.5	0.0	0.0	15.9
1974-75	0.0	0.0	0.0	0.0	T	0.4	1.8	9.1	0.4	T	0.0	0.0	11.7
1975-76	0.0	0.0	0.0	0.0	T	5.0	6.1	4.8	2.8	0.0	0.0	0.0	16.7
1976-77	0.0	0.0	0.0	0.0	T	4.9	10.9	5.8	0.4	7	T	0.0	22.0
1977-78	0.0	0.0	0.0	0.0	T	0.5	16.6	18.7	7.9	0.0	0.0	0.0	43.3
1978-79	0.0	0.0	0.0	0.0	2.5	0.2							
RECORD MEAN	0.0	0.0	0.0	T	0.3	5.7	6.7	8.6	4.8	0.6	T	0.0	26.9

# Indicates a station move or relocation of instruments. See Station Location table.

Record mean values above are means through the current year for the period beginning in 1941 for temperature and precipitation, 1945 for snowfall.

Local Climatological Data

Annual Summary With Comparative Data

1978

PHILADELPHIA, PENNSYLVANIA

Narrative Climatological Summary

The Appalachian Mountains to the west and the Atlantic Ocean to the east have a moderating effect on climate. Sustained periods of very high or very low temperatures seldom last for more than 3 or 4 days as conditions change fairly rapidly. Below zero and above 100 degree readings are relatively rare. On those occasions when the area becomes engulfed with maritime air during the summer months, high humidity can add to the discomfort of seasonably warm temperatures.

Precipitation is fairly evenly distributed throughout the year with maximum amounts during the late summer months. Much of the summer rainfall is in connection with local thunderstorms and is variable in amount in different parts of the City, due in part to the higher elevations in the western and northern sections. Snowfall amounts often are considerably larger in the northern suburbs than in the central and southern parts of the City. In many cases, the precipitation will change from snow to rain within the City. Single storms of 10 inches or more occur about every five years. The maximum amount of 21.0 inches fell on December 25-26, 1909.

The prevailing wind direction for the summer months is from the southwest, while northwesterly winds prevail during the winter. The annual prevailing direction is from the west-southwest. Destructive velocities are comparatively rare and occur mostly in gustiness during summer thunderstorms. High winds occurring in the winter months, as a rule, come with the advance of cold air after the passage of a deep low pressure system. Only rarely have hurricanes in the vicinity caused widespread damage, then primarily through flooding.

Flood stages in the Schuylkill River normally occur about twice a year. Flood stages seldom last over 12 hours and usually occur after excessive thunderstorms. Flooding rarely occurs on the Delaware River.

noaa NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION / ENVIRONMENTAL DATA AND INFORMATION SERVICE / NATIONAL CLIMATIC CENTER ASHEVILLE, N.C.

Meteorological Data For The Current Year

Station: PHILADELPHIA, PENNSYLVANIA # 13739 INTERNATIONAL AIRPORT Standard time used: EASTERN Latitude: 39° 53' N Longitude: 75° 15' W Elevation (ground): 5 feet Year: 1978

Month	Temperature °F Averages Daily maximum	Daily minimum	Monthly	Extremes Highest	Date	Lowest	Date	Degree days Base 65 °F Heating	Cooling	Precipitation in inches Water equivalent Total	Greatest in 24 hrs.	Date	Snow, Ice pellets Total	Greatest in 24 hrs.	Date	Relative humidity, pct. Hour 01 (Local time)	Hour 07	Hour 13	Hour 19	Wind Resultant Direction	Speed m.p.h.	Average speed m.p.h.	Fastest mile Speed m.p.h.	Direction	Date	Percent of possible sunshine	Average sky cover, tenths, sunrise to sunset	Number of days Sunrise to sunset Clear	Partly cloudy	Cloudy	Precipitation .01 inch or more	Snow, Ice pellets 1.0 inch or more	Thunderstorms	Heavy fog, visibility ¼ mile or less	Temperature °F Maximum (b) 90° and above	Maximum 32° and below	Minimum 32° and below	Minimum 0° and below	Average station pressure mb Elev. 28 feet m.s.l.
JAN	35.1	20.8	28.0	61	9	11	24	1139	0	8.86	2.24	19-20	23.4	13.0	19-20	69	73	61	64	30	5.6	13.1	46	S	26	49	6.5	6	10	15	12	5	0	2	0	15	29	0	1015.9
FEB	32.1	17.2	24.7	41	25	9	16	1121	0	1.35	0.73	6-7	19.0	12.6	6-7	62	65	51	57	33	7.3	9.9	32	N	7	66	4.7	13	6	9	7	4	0	0	0	16	28	0	1016.9
MAR	47.1	30.9	39.0	72	21	8	5	797	0	4.31	1.76	26-27	12.1	6.5	3	68	72	55	60	32	3.9	10.7	30	NW	15	57	6.5	7	8	16	12	3	1	2	0	6	13	0	1016.9
APR	61.5	39.7	50.6	81	1	30	9	423	0	1.76	1.12	19-20	T	T	3	63	65	40	46	33	4.3	11.6	32	SW	1	54	6.4	8	10	12	8	0	2	1	0	0	2	0	1013.2
MAY	70.7	52.1	61.4	89	31	34	1	161	57	6.01	2.48	23-24	0.0	0.0		77	76	59	65	09	1.4	10.3	30	NW	1	39	7.4	5	5	21	15	0	5	1	0	0	0	0	1014.2
JUN	82.8	62.3	72.6	93	19	48	14	10	244	1.75	0.48	21	0.0	0.0		76	72	51	55	27	4.0	9.7	27	N	5	64	5.1	11	11	8	11	0	6	0	5	0	0	0	1015.9
JUL	84.3	66.8	75.6	99	23	56	5	5	338	5.27	3.67	3-4	0.0	0.0		81	79	59	64	24	2.2	9.2	27	NW	27	53	5.9	10	10	11	10	0	3	0	8	0	0	0	1015.6
AUG	86.8	71.5	79.2	93	17	64	21	0	447	6.04	2.39	27-28	0.0	0.0		82	80	60	68	23	1.6	8.2	34	SW	9	49	7.1	4	8	19	12	0	9	1	11	0	0	0	1017.3
SEP	78.2	58.8	68.5	91	7	44	29	41	153	1.59	0.55	18-19	0.0	0.0		80	81	55	66	01	0.7	8.3	21	NE	12	66	5.0	10	12	8	8	0	4	2	1	0	0	0	1018.0
OCT	66.0	45.0	55.5	81	13	33	18	296	8	1.20	0.71	16-17	0.0	0.0		85	89	55	72	28	2.4	6.2	27	N	24	67	4.5	13	9	9	8	0	1	4	0	0	0	0	1018.6
NOV	55.9	39.9	47.9	68	14	25	27	507	0	2.20	0.86	27-28	2.5	2.5	27	78	79	57	67	36	2.7	8.3	25	NW	25	45	7.2	7	2	21	11	1	0	4	0	0	3	0	1021.0
DEC	47.3	29.9	38.6	68	4	18	29	811	0	5.61	2.04	8-9	T	T	20	66	70	50	58	29	6.1	10.4	41	NW	25	58	6.1	10	7	14	12	0	2	0	0	0	18	0	1017.3
YEAR	62.3	44.6	53.5	99	JUL 23	8	MAR 5	5311	1247	45.95	3.67	JUL 3-4	57.0	13.0	JAN 19-20	74	75	54	62	31	2.8	9.8	46	S	JAN 26	55	6.0	104	98	163	126	13	33	17	25	37	93	0	1016.7

Normals, Means, And Extremes

Month	Temperatures °F Normal Daily maximum	Normal Daily minimum	Normal Monthly	Extremes Record highest	Year	Record lowest	Year	Normal Degree days Base 65 °F Heating	Cooling	Precipitation in inches Water equivalent Normal	Maximum monthly	Year	Minimum monthly	Year	Maximum in 24 hrs.	Year	Snow, Ice pellets Maximum monthly	Year	Maximum in 24 hrs.	Year	Relative humidity pct. Hour 01 (Local time)	Hour 07	Hour 13	Hour 19	Wind Mean speed m.p.h.	Prevailing direction	Fastest mile Speed m.p.h.	Direction	Year	Pct. of possible sunshine	Mean sky cover, tenths, sunrise to sunset	Mean number of days Sunrise to sunset Clear	Partly cloudy	Cloudy	Precipitation .01 inch or more	Snow, Ice pellets 1.0 inch or more	Thunderstorms	Heavy fog, visibility ¼ mile or less	Temperatures °F Max. (b) 90° and above	Max. 32° and below	Min. 32° and below	Min. 0° and below	Average station pressure mb. Elev. 28 feet m.s.l.
(a)				37		37					36		36		32		36		36		19	19	19	19	38	23	38	38		36	38	38	38	38	38	38	38	38	19	19	19	19	6
J	40.1	24.4	32.3	74	1950	-5	1963	1014	0	2.81	8.86	1978	0.45	1955	2.27	1968	23.4	1978	13.2	1961	70	73	59	65	10.4	WNW	61	NE	1958	51	6.6	7	8	16	11	2	*	3	0	9	26	*	1017.3
F	42.2	25.5	33.9	74	1949	-4	1961	871	0	2.62	5.43	1971	1.33	1977	1.96	1966	19.0	1978	13.0	1958	68	70	56	60	11.1	NW	59	NW	1956	54	6.3	7	8	13	9	2	*	3	0	6	23	*	1016.2
M	51.2	32.5	41.9	87	1945	7	1943	716	0	3.69	6.27	1953	0.68	1966	2.39	1968	13.4	1958	10.0	1958	68	71	53	58	11.5	N	56	NW	1955	56	6.4	8	8	15	11	1	1	2	0	1	15	0	1015.5
A	63.5	42.3	52.9	94	1976	24	1969	367	0	3.29	6.68	1973	1.13	1963	2.76	1970	4.3	1971	4.3	1971	67	68	47	53	11.1	SW	59	SW	1958	57	6.4	7	9	14	10	*	2	1	*	0	3	0	1014.4
M	74.1	52.3	63.2	96	1962	28	1966	122	67	3.35	7.41	1948	0.47	1964	2.48	1978	T	1963	T	1963	76	75	53	58	9.7	WSW	56	SW	1957	57	6.5	6	11	14	11	0	4	1	1	0	*	0	1013.8
J	83.0	61.6	72.3	100	1964	44	1977	0	223	3.70	7.88	1973	0.11	1949	4.62	1973	0.0		0.0		81	78	55	62	8.9	WSW	73	NW	1958	62	6.2	7	11	12	10	0	5	1	4	0	0	0	1014.9
J	86.8	66.7	76.8	104	1966	51	1966	0	366	4.09	8.33	1969	0.64	1957	4.26	1969	0.0		0.0		81	79	54	63	8.2	WSW	47	W	1959	62	6.1	7	12	12	9	0	5	1	7	0	0	0	1014.9
A	84.8	64.7	74.8	101	1955	45	1965	0	304	4.11	9.70	1955	0.49	1964	5.68	1971	0.0		0.0		82	81	55	66	7.9	SW	67	E	1955	62	5.9	8	11	12	9	0	5	1	6	0	0	0	1016.9
S	78.4	57.8	68.1	100	1953	35	1963	38	131	3.03	8.78	1960	0.44	1968	5.45	1960	0.0		0.0		82	83	56	69	8.3	SW	49	NE	1960	60	5.7	10	9	11	8	0	2	2	2	0	0	0	1017.1
O	67.9	46.9	57.4	96	1941	25	1969	249	13	2.53	5.21	1943	0.09	1963	3.78	1966	T	1972	T	1972	80	82	53	68	8.9	WSW	66	SW	1954	60	5.5	11	8	12	7	*	1	4	0	0	2	0	1018.4
N	55.5	36.9	46.2	81	1974	15	1976	564	0	3.39	9.06	1972	0.32	1976	3.99	1977	8.8	1953	8.7	1953	74	77	55	66	9.7	WSW	60	SW	1958	52	6.3	7	9	14	9	*	1	2	0	*	10	0	1017.9
D	43.2	27.2	35.2	72	1951	1	1942	924	0	3.32	7.23	1969	0.25	1955	2.04	1978	18.8	1966	14.0	1960	72	74	59	67	10.1	WNW	47	NW	1958	50	6.5	8	8	15	10	1	*	3	0	5	22	0	1017.1
YR	64.2	44.9	54.6	104	JUL 1966	-5	JAN 1963	4865	1104	39.93	9.70	AUG 1955	0.09	OCT 1963	5.68	AUG 1971	23.4	JAN 1978	14.6	DEC 1960	75	76	55	63	9.7	WSW	73	NW	JUN 1958	58	6.2	93	112	160	116	6	27	24	20	21	100	*	1016.2

Means and extremes above are from existing and comparable exposures. Annual extremes have been exceeded at other sites in the locality as follows: Highest temperature 106 in August 1918; lowest temperature -11 in February 1934; maximum monthly precipitation 12.10 in August 1911; maximum precipitation in 24 hours 5.89 in August 1898; maximum monthly snowfall 31.5 in February 1899; maximum snowfall in 24 hours 21.0 in December 1909; fastest mile of wind 88 from North in July 1931.

(a) Length of record, years, through the current year unless otherwise noted, based on January data.
(b) 70° and above at Alaskan stations.
* Less than one half.
T Trace.

NORMALS - Based on record for the 1941-1970 period.
DATE OF AN EXTREME - The most recent in cases of multiple occurrence.
PREVAILING WIND DIRECTION - Record through 1963.
WIND DIRECTION - Numerals indicate tens of degrees clockwise from true north. 00 indicates calm.
FASTEST MILE WIND - Speed is fastest observed 1-minute value when the direction is in tens of degrees.

Average Temperature

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
1939	34.4	39.4	41.7	50.4	66.4	73.2	76.2	77.8	69.2	57.6	44.9	38.1	55.8
#1940	25.3	34.8	37.5	48.2	62.4	71.4	77.2	72.0	67.4	54.3	46.4	40.4	53.1
1941	30.7	30.7	36.2	57.9	65.0	71.6	76.1	73.1	69.7	61.0	47.4	38.3	54.8
1942	30.5	30.8	43.8	54.9	67.1	72.5	77.2	73.1	68.3	57.2	45.4	30.9	54.3
1943	31.8	34.1	41.9	46.8	63.3	76.8	76.4	76.4	66.4	54.0	43.9	32.8	53.7
1944	34.0	35.8	38.9	49.4	67.4	72.2	78.4	75.4	68.6	54.7	45.6	32.2	54.2
#1945	24.8	33.8	51.2	56.4	60.2	71.5	76.0	74.1	70.9	57.2	48.6	29.8	54.5
1946	33.8	34.5	49.8	51.8	63.3	69.2	75.2	70.7	69.4	60.2	49.1	38.0	55.4
1947	38.3	28.4	37.8	52.7	62.0	69.7	75.4	75.8	68.2	62.8	43.6	34.2	54.1
1948	26.0	31.8	43.8	52.0	62.0	71.2	76.4	74.6	67.7	55.2	50.9	37.4	54.1
1949	39.8	39.2	43.9	53.4	64.4	74.6	80.0	76.2	65.6	61.8	45.8	39.0	57.0
1950	43.2	33.8	38.6	49.2	61.0	71.1	75.4	73.7	64.5	59.5	47.3	34.2	54.3
1951	36.0	36.4	43.1	53.6	63.6	71.3	77.0	74.9	68.3	60.2	42.5	38.7	55.4
1952	37.3	38.2	41.2	55.5	61.7	74.7	80.1	75.2	68.5	53.8	46.7	38.5	55.9
1953	38.0	38.9	45.1	53.1	65.3	73.2	77.9	75.3	69.4	59.6	46.7	39.4	56.8
1954	31.7	41.2	42.3	56.3	61.2	72.9	77.9	73.5	69.1	61.2	45.4	36.0	55.7
1955	32.6	36.1	44.4	55.9	66.1	69.2	81.4	78.1	68.0	59.1	44.0	30.5	55.5
1956	32.1	37.6	38.8	49.9	60.9	72.3	75.6	74.1	65.2	57.7	46.3	41.7	54.2
1957	29.2	37.4	42.3	54.2	63.5	74.9	76.6	73.2	69.2	54.1	47.8	39.4	55.1
1958	31.8	28.2	39.9	54.2	61.2	67.8	77.4	73.4	65.9	55.7	46.6	29.4	52.6
#1959	31.6	33.9	41.3	54.8	66.4	72.2	75.9	76.5	70.6	60.1	45.2	38.2	55.5
1960	34.2	35.4	32.7	56.7	61.2	70.6	73.3	74.5	67.3	54.8	45.5	27.6	52.8
1961	25.0	34.0	43.1	49.8	58.6	69.9	75.6	73.5	71.5	55.7	45.2	31.0	52.7
1962	30.0	30.4	40.5	52.0	64.1	71.7	72.0	72.0	63.1	56.3	42.1	31.0	52.1
1963	27.5	26.5	42.9	52.5	60.2	70.4	76.0	71.2	62.8	57.1	48.0	27.9	51.9
1964	35.0	31.8	42.7	50.8	65.1	72.4	76.6	72.2	67.2	52.6	47.1	37.5	54.1
1965	29.2	33.2	37.6	49.0	65.5	70.0	74.1	73.1	69.2	53.7	44.2	37.0	55.0
1966	29.1	31.5	42.9	47.8	59.5	72.1	77.9	74.8	65.2	53.1	46.8	35.5	53.0
1967	36.0	29.0	38.5	51.7	55.9	72.1	76.6	75.1	67.0	56.8	42.8	38.5	53.3
1968	28.9	30.4	44.4	54.6	59.7	71.2	77.1	77.8	69.4	58.1	45.6	32.3	54.1
1969	29.8	32.0	39.7	55.3	64.6	75.4	75.1	75.2	67.2	55.0	44.4	33.5	55.8
1970	24.5	33.1	38.2	51.5	64.9	71.6	76.9	76.7	72.0	60.1	48.2	35.8	54.5
1971	27.8	36.1	40.7	51.6	60.9	74.3	77.4	75.3	71.6	63.5	46.1	41.6	55.6
1972	35.1	32.4	40.7	49.7	63.6	68.7	77.1	76.0	69.2	52.7	43.6	39.9	54.1
1973	34.4	33.6	47.2	53.4	60.3	74.6	77.9	78.8	70.7	59.2	48.0	38.6	56.4
1974	35.9	31.7	43.3	55.8	62.4	70.3	76.9	76.8	68.1	54.8	48.5	39.4	55.3
1975	37.3	35.8	41.2	48.7	66.6	72.2	76.6	77.1	66.6	61.2	52.7	36.9	56.1
1976	28.7	40.9	46.3	56.6	62.7	75.2	75.3	74.8	67.3	52.5	39.9	30.3	54.2
1977	20.0	33.6	48.8	57.2	65.8	68.6	77.8	76.2	69.9	54.3	46.4	32.6	54.3
1978	28.0	24.7	39.0	50.6	61.4	72.6	75.6	79.2	68.5	55.5	47.9	38.6	55.5
RECORD MEAN	32.9	33.7	41.7	52.3	63.0	71.9	76.6	74.7	68.4	57.4	46.2	36.1	54.6
MAX	39.9	41.2	50.0	61.6	72.5	81.1	85.3	83.1	76.9	66.0	53.8	42.9	62.9
MIN	25.8	26.2	33.4	42.9	53.4	62.0	67.9	66.3	59.8	48.7	38.6	29.2	46.2

Heating Degree Days

Season	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	Total
1958-59	0	0	64	296	547	1096	1030	884	721	311	91	24	5064
#1959-60	0	0	46	246	589	823	947	850	997	274	129	5	4906
1960-61	0	0	25	312	577	1150	1232	862	672	452	214	15	5511
1961-62	0	0	45	283	593	1049	1078	963	748	408	133	7	5307
1962-63	0	4	109	272	681	1048	1159	1072	680	375	175	12	5587
1963-64	0	7	118	242	502	1144	985	955	685	424	76	13	5151
1964-65	0	2	51	377	532	847	1107	883	839	475	66	26	5205
1965-66	0	18	41	342	614	862	1110	931	693	509	207	21	5348
1966-67	0	0	83	362	538	908	893	1001	817	396	280	6	5284
1967-68	0	0	55	271	660	814	1112	995	633	505	170	7	5022
1968-69	0	0	14	234	576	1008	1084	918	782	290	84	2	4992
1969-70	0	0	54	316	611	970	1247	890	821	399	92	0	5400
1970-71	0	0	29	191	499	899	1145	802	746	394	140	3	4848
1971-72	0	0	17	78	576	719	920	941	748	450	86	26	4562
1972-73	0	0	24	378	635	775	940	874	547	359	176	1	4707
1973-74	0	0	18	196	507	810	897	926	667	292	128	11	4452
1974-75	0	0	40	313	500	786	852	812	732	483	66	4	4594
1975-76	0	0	45	157	372	866	1120	692	572	307	119	13	4258
1976-77	0	2	42	387	743	1069	1390	873	505	258	73	36	5378
1977-78	0	0	24	328	558	998	1139	1121	797	423	161	10	5559
1978-79	5	0	41	296	507	811							

Cooling Degree Days

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
1969	0	0	0	0	77	259	319	323	126	15	0	0	1128
1970	0	0	0	3	100	204	376	367	247	46	0	0	1343
1971	0	0	0	0	19	292	394	326	223	37	14	0	1305
1972	0	0	3	0	47	143	381	344	153	3	0	0	1074
1973	0	0	0	16	35	294	404	435	193	23	0	0	1400
1974	0	0	0	24	55	179	373	372	145	5	12	0	1165
1975	0	0	0	0	121	224	366	380	98	42	12	0	1243
1976	0	0	0	64	58	326	326	315	115	7	0	0	1211
1977	0	0	10	32	104	150	402	355	175	3	6	0	1237
1978	0	0	0	0	57	244	338	447	153	8	0	0	1247

Precipitation

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
1939	4.46	6.12	4.32	6.40	1.91	4.45	2.19	6.90	1.91	4.30	1.26	1.18	45.40
#1940	0.96	2.90	4.10	6.06	4.89	2.52	1.82	7.87	4.58	2.38	4.24	2.53	44.85
1941	2.88	1.76	2.56	2.62	1.01	4.51	7.16	3.95	0.88	1.64	2.27	3.91	35.15
1942	2.49	2.84	5.27	1.14	1.87	1.74	5.19	8.93	2.52	3.26	3.44	4.36	45.05
1943	3.25	1.89	2.92	2.61	5.63	4.03	3.94	0.65	1.69	5.21	3.72	1.23	36.77
1944	2.99	1.93	5.46	4.69	2.25	3.23	1.05	2.78	5.82	1.81	4.71	2.80	39.52
#1945	2.86	3.35	1.72	2.89	3.85	3.77	8.86	3.75	3.96	1.90	5.69	4.02	46.62
1946	1.39	1.77	2.94	1.65	6.09	6.69	6.37	3.26	2.83	1.24	2.01	2.33	38.35
1947	3.63	2.02	2.22	6.58	7.22	5.15	2.12	3.63	2.71	2.13	5.23	1.80	44.46
1948	4.68	2.84	3.76	3.92	7.41	4.94	1.89	5.95	2.09	1.53	4.79	5.26	49.06
1949	6.06	3.55	2.77	2.35	5.91	0.11	4.25	4.53	4.10	2.74	1.08	3.03	40.48
1950	1.85	3.41	4.68	2.10	3.89	2.56	5.80	4.29	2.59	2.16	5.22	2.12	40.47
1951	3.83	3.24	4.52	2.49	4.00	4.17	2.24	0.89	1.73	3.33	5.83	5.48	41.75
1952	4.75	1.98	5.37	5.22	4.85	2.59	3.04	6.32	3.05	0.49	4.91	3.27	45.84
1953	5.01	2.44	6.27	4.81	5.85	4.97	3.98	2.47	1.74	4.38	1.93	4.28	48.13
1954	1.95	1.37	3.71	3.75	2.40	2.59	1.24	4.86	3.26	2.40	3.87	2.66	34.04
1955	0.45	2.49	4.80	1.93	0.91	4.06	1.04	9.70	1.71	4.53	1.16	0.25	33.03
1956	2.30	4.64	4.65	2.68	3.84	3.86	4.61	2.79	3.75	3.47	5.71	3.70	46.00
1957	1.67	2.81	3.24	4.22	1.21	2.41	0.64	3.38	3.10	2.05	2.98	4.49	32.20
1958	3.93	4.64	4.97	4.19	3.65	5.13	5.98	6.20	2.55	3.85	2.05	1.13	47.87
1959	2.03	1.60	3.55	2.25	0.80	5.28	7.48	3.73	1.33	3.41	3.29	3.62	38.37
1960	3.11	3.44	1.96	2.92	3.65	0.71	5.52	3.19	8.78	2.79	1.92	3.16	41.15
1961	3.16	3.13	5.17	4.82	3.38	2.95	5.96	3.42	2.41	1.83	2.04	2.78	41.05
1962	2.95	3.51	3.91	3.69	1.85	7.40	2.30	6.58	2.77	0.95	4.60	2.11	42.62
1963	2.31	2.19	3.94	1.13	1.06	2.88	3.13	3.35	6.44	0.09	6.67	1.76	34.95
1964	3.92	2.89	1.96	5.27	0.47	0.21	3.83	0.49	2.42	1.73	1.64	5.13	29.88
1965	2.35	2.18	3.19	2.33	1.23	2.65	3.22	4.05	3.02	2.02	1.05	1.85	29.34
1966	2.82	4.30	0.68	4.35	2.95	0.41	2.35	1.63	8.70	5.12	2.36	4.33	40.00
1967	1.67	1.82	4.53	2.17	3.49	4.12	7.11	7.08	2.96	2.00	1.99	5.88	44.82
1968	2.90	1.40	4.98	1.57	5.17	5.89	2.00	1.24	0.44	3.15	4.17	2.54	35.45
1969	1.57	1.88	1.92	1.68	3.30	7.31	8.33	2.66	4.38	1.13	1.97	7.23	45.36
1970	0.74	2.08	3.83	6.12	2.57	4.60	2.75	3.99	0.82	3.66	4.71	3.27	39.14
1971	2.15	5.45	2.58	1.84	4.10	1.01	4.84	9.61	5.83	3.84	5.37	1.21	47.79
1972	2.34	5.09	2.69	4.08	4.11	5.79	2.62	3.76	1.12	3.77	9.06	5.20	49.63
1973	3.93	2.96	3.52	6.68	4.14	7.88	2.39	2.03	3.39	2.16	0.64	6.34	46.06
1974	2.95	2.14	4.91	2.77	3.21	4.43	2.08	3.83	4.68	1.93	0.81	4.04	37.78
1975	4.00	2.91	4.68	2.97	4.99	7.57	6.32	2.21	7.21	3.24	3.14	2.89	52.13
1976	4.50	1.66	2.38	2.06	4.35	3.42	4.04	2.17	2.44	4.30	0.32	1.63	35.27
1977	2.61	1.33	4.19	5.59	0.70	5.33	1.47	8.70	3.44	3.11	7.76	5.19	49.42
1978	8.86	1.35	4.31	1.76	6.01	1.75	5.27	6.04	1.59	1.20	2.20	5.61	45.95
RECORD MEAN	3.22	3.07	3.52	3.29	3.35	3.65	4.08	4.53	3.38	2.79	3.11	3.23	41.22

Snowfall

Season	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	Total
1939-40	0.0	0.0	0.0	0.0	0.4	2.9	2.9	11.7	3.2	1.2	0.0	0.0	22.3
1940-41	0.0	0.0	0.0	2.7	T	2.9	6.2	8.9	11.3	0.0	0.0	0.0	31.5
1941-42	0.0	0.0	0.0	0.0	0.0	0.5	5.3	2.0	2.5	T	0.0	0.0	10.3
#1942-43	0.0	0.0	0.0	0.0	0.0	5.2	2.3	1.0	7.8	T	0.0	0.0	16.3
1943-44	0.0	0.0	0.0	0.0	T	T	3.2	4.7	7.8	T	0.0	0.0	15.7
1944-45	0.0	0.0	0.0	0.0	T	1.5	11.7	7.9	0.0	0.0	0.0	0.0	21.1
1945-46	0.0	0.0	0.0	0.0	0.2	13.4	1.8	3.3	0.0	0.0	0.0	0.0	18.7
1946-47	0.0	0.0	0.0	0.0	0.0	T	3.2	17.8	2.7	0.0	0.0	0.0	23.7
1947-48	0.0	0.0	0.0	0.0	T	7.6	9.9	12.8	1.4	0.0	0.0	0.0	31.7
1948-49	0.0	0.0	0.0	0.0	0.0	7.6	3.4	7.4	0.9	T	0.0	0.0	19.3
1949-50	0.0	0.0	0.0	0.0	T	T	0.7	1.2	T	T	0.0	0.0	1.9
1950-51	0.0	0.0	0.0	0.0	1.8	0.2	2.4	0.2	T	0.0	0.0	0.0	4.6
1951-52	0.0	0.0	0.0	0.0	T	5.7	4.0	T	6.5	0.0	0.0	0.0	16.2
1952-53	0.0	0.0	0.0	T	0.6	2.0	5.1	2.0	7.1	T	0.0	0.0	16.8
1953-54	0.0	0.0	0.0	0.0	8.8	T	13.3	0.2	0.3	T	0.0	0.0	22.6
1954-55	0.0	0.0	0.0	0.0	0.0	T	2.7	6.8	2.6	0.0	0.0	0.0	12.1
1955-56	0.0	0.0	0.0	0.0	2.9	1.1	7.0	1.1	10.9	T	0.0	0.0	23.0
1956-57	0.0	0.0	0.0	0.0	T	0.2	4.7	1.8	1.2	T	0.0	0.0	7.9
1957-58	0.0	0.0	0.0	T	T	7.8	3.7	16.9	13.4	T	0.0	0.0	41.8
1958-59	0.0	0.0	0.0	0.0	T	0.3	3.3	T	1.5	T	0.0	0.0	5.1
1959-60	0.0	0.0	0.0	0.0	T	5.7	0.8	3.1	12.2	T	0.0	0.0	21.8
1960-61	0.0	0.0	0.0	0.0	0.0	17.5	19.7	11.8	0.1	T	0.0	0.0	49.1
1961-62	0.0	0.0	0.0	0.0	3.2	5.2	1.1	12.5	7.2	T	0.0	0.0	29.2
1962-63	0.0	0.0	0.0	T	T	9.5	6.1	4.7	0.2	0.0	T	0.0	20.5
1963-64	0.0	0.0	0.0	0.0	T	8.0	7.4	12.4	5.1	T	0.0	0.0	32.9
1964-65	0.0	0.0	0.0	0.0	T	2.6	11.9	2.2	6.5	3.0	0.0	0.0	26.2
1965-66	0.0	0.0	0.0	T	0.0	T	16.0	11.4	T	T	0.0	0.0	27.4
1966-67	0.0	0.0	0.0	0.0	T	18.8	0.6	18.4	6.4	0.1	0.0	0.0	44.3
1967-68	0.0	0.0	0.0	0.0	4.9	5.6	1.5	1.7	2.2	0.0	0.0	0.0	15.9
1968-69	0.0	0.0	0.0	0.0	0.4	3.1	1.9	9.5	8.8	0.0	0.0	0.0	23.7
1969-70	0.0	0.0	0.0	0.0	0.2	7.5	7.5	2.7	2.4	T	0.0	0.0	20.3
1970-71	0.0	0.0	0.0	T	0.0	1.1	7.7	0.8	4.4	4.3	0.0	0.0	18.3
1971-72	0.0	0.0	0.0	0.0	T	0.1	3.2	8.2	0.3	0.4	0.0	0.0	12.2
1972-73	0.0	0.0	0.0	T	T	T	T	T	T	T	0.0	0.0	T
1973-74	0.0	0.0	0.0	0.0	T	4.6	4.1	12.1	T	T	0.0	0.0	20.8
1974-75	0.0	0.0	0.0	0.0	T	0.8	3.9	6.6	2.3	T	0.0	0.0	15.6
1975-76	0.0	0.0	0.0	0.0	0.0	1.1	6.4	3.1	6.9	0.0	0.0	0.0	17.5
1976-77	0.0	0.0	0.0	0.0	T	2.8	15.7	0.2	T	0.0	0.0	0.0	18.7
1977-78	0.0	0.0	0.0	0.0	0.2	0.2	23.4	19.0	12.1	T	0.0	0.0	54.9
1978-79	0.0	0.0	0.0	0.0	2.5	T							
RECORD MEAN	0.0	0.0	0.0	T	0.7	3.9	6.1	6.3	3.9	0.2	T	0.0	21.1

# Indicates a station move or relocation of instruments. See Station Location table.

Record mean values above are means through the current year for the period beginning in 1874 for temperature, 1872 for precipitation, and 1943 for snowfall. Temperature, degree days, and precipitation: Data are from City Office locations through December 1940 (except through June 1940 for degree days); from Southwest Airport (later named International Airport) through June 1945; from 2nd and Chestnut Streets (Bourse Building for precipitation) through November 1945; and from International Airport locations thereafter.
Precipitation totals for 1941 and 1942 are based on an observational day ending at 1:30 a.m.
Snowfall: Data are from City Office locations through 1942 and from International Airport locations thereafter except that data for November 1945 are from 2nd and Chestnut Streets.

Local Climatological Data

Annual Summary With Comparative Data

1978

PITTSBURGH, PENNSYLVANIA
GREATER PITTSBURGH AIRPORT

Narrative Climatological Summary

Pittsburgh lies at the foothills of the Allegheny Mountains at the confluence of the Allegheny and Monongahela Rivers which form the Ohio. The city is a little over a hundred miles southeast of Lake Erie. It has a humid continental type of climate modified only slightly by its nearness to the Atlantic Seaboard and the Great Lakes.

The predominant type of air which influences the climate of Pittsburgh has a polar continental source in Canada and moves in upon the region by way of tracks which vary from almost due north from the Hudson Bay region to a long westerly trajectory resulting from polar outbreaks into the Rockies which progress eastward. There are frequent invasions of air from the Gulf of Mexico during the summer season with resulting spells of warm humid weather. During the winter season air from the Gulf occasionally reaches as far north as Pittsburgh and causes the normal alternate periods of freezing and thawing. The last killing frost in spring will usually occur about April 21 and the first in autumn near October 20, to give an average growing season of about 180 days. There is a wide variation in the time of the first and last frosts over a radius of 25 miles from the center of Pittsburgh due to terrain differences.

Precipitation is distributed well throughout the year. During the winter months about a fourth of the precipitation occurs as snow and there is about a 50% chance of measurable precipitation on any day. Thunderstorms occur normally during all months except the midwinter ones, and have a maximum frequency in midsummer. The first appreciable snowfall is generally late in November and usually the last occurs early in April. Snow lies on the ground in the suburbs an average of about 33 days during the year.

Seven months of the year, April through October, have sunshine more than 50% of the possible time. During the remaining five months cloudiness is heavier because the track of migratory storms from west to east is closer to the area and because of the frequent periods of cloudy, showery weather associated with morthwest winds from across the Great Lakes. Cold air drainage induced by the many hills leads to the frequent formation of early morning fog which may be quite persistent in the river valleys during the colder months.

Rises from the tributary streams cause occasional flooding at Pittsburgh. Serious inconvenience is occasioned by the Ohio River reaching the flood stage of 25 feet about once each year. Significant flooding, or a 30-foot stage, occurs about once each three years.

noaa NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION / ENVIRONMENTAL DATA AND INFORMATION SERVICE / NATIONAL CLIMATIC CENTER ASHEVILLE, N.C.

Meteorological Data For The Current Year

Station: PITTSBURGH, PENNSYLVANIA # 94823 GREATER PITTSBURGH INTL AP Standard time used: EASTERN Latitude: 40° 30' N Longitude: 80° 13' W Elevation (ground): 1137 feet Year: 1978

Month	Temperature °F Averages Daily maximum	Daily minimum	Monthly	Extremes Highest	Date	Lowest	Date	Degree days Base 65 °F Heating	Cooling	Precipitation in inches Water equivalent Total	Greatest in 24 hrs.	Date	Snow, Ice pellets Total	Greatest in 24 hrs.	Date	Relative humidity, pct. Hour 01 (Local time)	Hour 07	Hour 13	Hour 19	Wind Resultant Direction	Resultant Speed m.p.h.	Average speed m.p.h.	Fastest mile Speed m.p.h.	Fastest mile Direction	Fastest mile Date	Percent of possible sunshine	Average sky cover, tenths, sunrise to sunset	Number of days Sunrise to sunset Clear	Partly cloudy	Cloudy	Precipitation .01 inch or more	Snow, Ice pellets 1.0 inch or more	Thunderstorms	Heavy fog, visibility ¼ mile or less	Temperature °F Maximum (b) 90° and above	Maximum 32° and below	Minimum 32° and below	Minimum 0° and below	Average station pressure mb Elev. 1225 feet m.s.l.
JAN	29.0	16.1	22.6	49	8	1	23	1307	0	6.25	1.43	19-20	40.2	12.4	19-20	80	80	71	75	25	6.1	11.9	52	23	26	16	8.9	1	4	26	25	9	1	3	0	21	28	0	972.2
FEB	28.6	13.2	20.9	38	25	3	20	1229	0	0.54	0.11	6-7	5.4	1.1	6-7	75	82	64	62	29	4.9	8.0	23	25	25	47	6.5	7	8	13	12	1	0	0	0	22	28	0	974.6
MAR	44.7	29.1	36.9	70	21	5	2	860	0	1.65	0.42	25-26	4.0	1.9	3-4	69	77	60	61	28	2.8	10.1	28	27	21	26	8.3	0	9	22	13	2	0	1	0	7	16	0	972.9
APR	61.8	40.1	51.0	62	10	29	9	412	0	2.25	0.45	2-3	0.2	0.2	21	63	67	46	51	31	3.8	11.1	31	26	1	43	6.7	6	8	16	11	0	4	0	0	0	4	0	971.2
MAY	70.1	50.3	60.2	68	27	30	1	209	69	4.26	1.20	23-24	0.0	0.0		71	78	55	57	28	1.4	8.6	32	27	9	32	6.5	8	5	18	14	0	1	2	0	0	2	0	970.9
JUN	80.8	58.0	69.4	93	27	42	14	38	178	4.11	1.51	7-8	0.0	0.0		75	76	52	56	26	3.3	7.7	25	29	12	43	6.1	6	15	9	11	0	9	1	1	0	0	0	974.6
JUL	82.4	63.6	73.0	95	22	49	12	4	260	2.15	1.01	2-3	0.0	0.0		76	78	55	61	23	1.5	7.1	24	32	14	28	6.8	5	10	16	8	0	4	2	5	0	0	0	973.6
AUG	80.4	62.3	71.4	87	19	52	21	3	207	3.65	0.89	5-6	0.0	0.0		89	92	65	74	24	1.6	6.7	23	28	19	33	6.8	4	12	15	11	0	2	2	0	0	0	0	975.6
SEP	76.2	56.2	66.2	87	8	35	29	80	122	2.64	1.44	12	0.0	0.0		91	92	59	73	27	1.9	5.9	18	20	21	51	4.5	12	12	6	9	0	6	2	0	0	0	0	975.6
OCT	59.4	38.8	49.1	73	22	29	18	485	0	3.42	0.94	13-14	0.0	0.0		89	93	62	72	25	3.5	8.3	21	27	26	50	5.6	11	7	13	15	0	1	0	0	0	5	0	975.6
NOV	51.1	34.8	43.0	69	6	23	29	656	0	1.62	0.59	26-27	2.3	2.2	26-27	86	90	75	79	27	1.7	8.2	25	25	18	28	7.6	5	6	19	10	1	0	5	0	0	12	0	977.3
DEC	40.9	24.5	32.7	61	8	7	11	993	0	5.24	1.76	8-9	3.2	1.6	9	75	80	66	73	24	5.5	10.8	30	26	4	29	7.4	6	6	19	13	1	0	3	0	7	28	0	972.9
YEAR	58.8	40.6	49.7	95	JUL 22	1	JAN 23	6276	836	37.78	1.76	DEC 8-9	55.3	12.4	JAN 19-20	78	82	61	66	26	2.9	8.7	52	23	JAN 26	36	6.8	71	102	192	152	14	28	21	6	57	123	0	973.9

Normals, Means, And Extremes

Month	Temperatures °F Normal Daily maximum	Normal Daily minimum	Normal Monthly	Extremes Record highest	Year	Record lowest	Year	Normal Degree days Base 65 °F Heating	Cooling	Precipitation in inches Water equivalent Normal	Maximum monthly	Year	Minimum monthly	Year	Maximum in 24 hrs.	Year	Snow, Ice pellets Maximum monthly	Year	Maximum in 24 hrs.	Year	Relative humidity pct. Hour 01 (Local time)	Hour 07	Hour 13	Hour 19	Wind Mean speed m.p.h.	Prevailing direction	Fastest mile Speed m.p.h.	Fastest mile Direction	Fastest mile Year	Pct. of possible sunshine	Mean sky cover, tenths, sunrise to sunset	Mean number of days Sunrise to sunset Clear	Partly cloudy	Cloudy	Precipitation .01 inch or more	Snow, Ice pellets 1.0 inch or more	Thunderstorms	Heavy fog, visibility ¼ mile or less	Temperatures °F Max. (b) 90° and above	Max. 32° and below	Min. 32° and below	Min. 0° and below	Average station pressure mb. Elev. 1225 feet m.s.l.
(a)				26		26					26		26		26		26		26		19	19	19	19	26	11	26	26		26	26	26	26	26	26	26	26	26	19	19	19	19	6
J	35.4	20.8	28.1	68	1972	-18	1963	1144	0	2.79	6.25	1978	1.06	1967	1.43	1978	40.2	1978	14.0	1966	73	76	66	67	10.8	WSW	52	23	1978	35	8.0	3	6	22	17	4	*	2	0	15	27	3	973.2
F	37.3	21.3	29.3	69	1954	-9	1963	1000	0	2.35	5.98	1956	0.51	1969	2.30	1975	24.2	1972	12.3	1960	70	74	62	63	10.9	WSW	58	26	1967	39	7.8	3	6	19	14	3	*	1	0	11	25	1	972.4
M	47.2	29.0	38.1	80	1977	-1	1960	834	0	3.60	6.10	1967	1.14	1969	2.00	1964	21.3	1960	14.7	1962	69	74	58	59	11.1	WSW	48	25	1954	45	7.6	4	6	21	16	2	2	1	0	4	19	*	971.6
A	60.9	39.4	50.2	87	1970	15	1977	444	0	3.40	7.61	1964	0.48	1971	2.15	1964	5.9	1961	3.9	1953	66	72	50	52	10.7	WSW	46	27	1974	49	7.2	4	8	18	13	*	4	1	0	*	9	0	972.3
M	70.8	48.7	59.8	91	1962	26	1970	208	46	3.63	6.36	1968	1.21	1965	2.44	1971	3.1	1966	3.1	1966	72	76	51	54	9.3	WSW	42	25	1957	52	6.9	5	9	17	12	*	5	1	*	0	1	0	971.0
J	79.5	57.7	68.6	96	1971	34	1972	26	134	3.48	5.08	1974	0.90	1967	1.93	1955	0.0		0.0		77	79	52	57	8.2	WSW	40	27	1957	58	6.4	5	12	13	11	0	7	1	2	0	0	0	972.7
J	82.5	61.3	71.9	99	1954	42	1963	7	221	3.84	7.43	1958	1.82	1965	2.97	1971	0.0		0.0		80	82	53	59	7.5	WSW	51	25	1956	59	6.4	5	13	13	11	0	7	2	3	0	0	0	973.6
A	80.9	59.4	70.2	97	1953	40	1965	16	177	3.15	7.56	1975	0.78	1957	3.06	1956	0.0		0.0		82	86	56	62	7.1	WSW	46	29	1963	58	6.2	7	12	12	10	0	6	2	1	0	0	0	975.5
S	74.9	52.7	63.8	97	1954	31	1959	98	62	2.52	5.42	1972	0.74	1964	2.25	1975	0.0		0.0		82	86	57	66	7.6	WSW	32	02	1960	59	6.1	8	10	12	9	0	3	2	1	0	0	0	974.9
O	63.9	42.4	53.2	87	1959	16	1965	372	7	2.52	8.20	1954	0.16	1963	3.56	1954	1.8	1972	1.8	1972	76	81	54	62	8.5	WSW	35	27	1959	54	6.1	9	8	14	10	*	1	2	0	0	4	0	975.6
N	49.4	33.3	41.3	82	1961	-1	1958	711	0	2.47	4.70	1972	0.90	1976	1.38	1961	11.0	1958	10.5	1958	75	79	63	68	10.0	WSW	45	29	1969	39	7.7	4	6	20	13	1	*	2	0	2	14	*	974.4
D	37.3	23.6	30.5	72	1971	-7	1976	1070	0	2.48	5.24	1978	0.40	1955	1.76	1978	21.2	1974	12.5	1974	74	76	67	70	10.6	WSW	48	25	1968	30	8.2	3	5	23	17	3	*	2	0	11	25	1	972.6
YR	60.0	40.8	50.4	99	JUL 1954	-18	JAN 1963	5930	647	36.23	8.20	OCT 1954	0.16	OCT 1963	3.56	OCT 1954	40.2	JAN 1978	14.7	MAR 1962	75	78	57	62	9.4	WSW	58	26	FEB 1967	49	7.1	60	101	204	153	14	36	18	7	42	124	5	973.3

Means and extremes above are from existing and comparable exposures. Annual extremes have been exceeded at other sites in the locality as follows:
AIRPORT - Highest temperature 102 in July 1936; maximum monthly precipitation 10.25 in June 1951; maximum snowfall in 24 hours 17.5 in November 1950.
CITY OFFICE - Highest temperature 103 in July 1936; lowest temperature -20 in February 1899; minimum monthly precipitation 0.06 in October 1874; and maximum precipitation in 24 hours 4.08 in September 1876.

Temperature data may be suspect for the period November 1977 through July 1978 due to intermittent instrument problems.

(a) Length of record, years, through the current year unless otherwise noted, based on January data.
(b) 70° and above at Alaskan stations.
* Less than one half.
T Trace.

NORMALS - Based on record for the 1941-1970 period.
DATE OF AN EXTREME - The most recent in cases of multiple occurrence.
PREVAILING WIND DIRECTION - Record through 1963.
WIND DIRECTION - Numerals indicate tens of degrees clockwise from true north. 00 indicates calm.
FASTEST MILE WIND - Speed is fastest observed 1-minute value when the direction is in tens of degrees.

PITTSBURGH, PA
GREATER PITTSBURGH INT'L AIRPORT

Average Temperature

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
1939	33.2	34.0	40.0	47.2	64.0	71.4	71.3	73.5	67.8	53.3	40.4	34.5	52.8
1940	17.4	29.8	33.6	44.6	59.4	69.4	73.4	70.8	62.3	53.0	41.2	38.1	49.6
1941	28.6	26.0	31.4	57.0	62.0	70.4	74.4	70.8	67.5	58.4	44.7	37.1	52.3
1942	29.0	25.6	41.0	54.6	63.0	70.8	73.9	70.7	64.8	53.5	42.6	28.2	51.6
1943	30.6	31.6	37.6	44.2	61.1	74.6	73.2	71.7	63.2	51.2	39.5	29.4	50.7
1944	32.8	32.3	38.0	48.4	69.0	71.4	73.8	72.2	64.6	53.0	42.6	27.6	52.0
1945	22.0	31.9	51.2	54.4	56.4	68.5	73.0	72.2	67.4	52.6	43.4	26.8	51.6
1946	32.2	32.4	51.2	50.0	59.9	68.5	73.0	67.4	67.1	58.8	46.8	36.2	53.6
1947	36.2	22.1	32.6	52.0	58.7	68.5	70.0	76.6	66.3	62.0	39.2	32.6	51.4
1948	21.7	32.8	43.9	54.7	59.8	70.0	73.8	71.8	66.2	50.7	49.0	33.2	52.4
1949	38.0	37.8	40.6	47.6	62.6	73.0	76.4	73.4	61.0	59.6	42.2	36.0	54.2
1950	40.8	32.4	34.8	43.9	62.2	68.8	70.6	70.7	63.9	57.4	38.3	27.5	51.1
1951	33.0	33.3	39.7	49.2	62.2	70.3	73.9	71.4	64.5	57.9	37.4	34.6	52.3
#1952	33.0	34.9	38.9	52.1	59.0	72.6	75.8	72.1	65.6	49.2	44.6	34.7	52.9
1953	36.2	35.1	40.6	46.8	62.8	70.2	73.1	71.9	64.6	55.3	44.2	34.7	53.0
1954	29.6	37.1	36.8	53.8	56.2	69.4	72.2	69.9	66.8	55.3	41.3	30.4	51.8
1955	27.0	31.4	40.3	56.1	62.1	65.1	76.9	74.2	66.1	53.3	38.9	28.9	51.7
1956	27.7	34.0	37.2	47.0	58.5	67.7	70.3	70.8	60.4	56.7	42.0	39.4	51.0
1957	25.0	34.6	39.7	52.7	60.9	70.4	71.8	70.0	64.8	49.6	42.7	35.3	51.3
1958	27.4	22.7	36.1	51.2	58.6	64.2	73.0	69.6	63.1	52.3	44.0	23.0	48.8
#1959	25.3	31.8	37.0	51.3	63.9	68.6	72.7	74.9	68.3	53.8	39.0	34.8	51.8
1960	30.7	28.7	26.0	54.0	57.5	66.5	68.6	71.2	66.1	53.5	43.1	23.4	49.1
1961	22.2	32.3	41.3	44.0	55.2	63.1	70.3	71.2	68.5	53.3	42.8	31.3	50.0
1962	26.2	28.3	36.3	48.4	65.3	69.3	70.1	70.8	58.6	53.3	41.1	24.1	49.4
1963	21.1	19.3	40.7	49.0	56.5	67.2	70.8	67.7	61.3	58.8	43.7	22.4	48.2
1964	31.4	27.0	40.0	51.7	62.7	67.9	72.3	67.1	63.7	50.4	45.5	34.0	51.1
1965	28.2	28.4	33.2	49.0	65.9	66.9	69.9	69.1	64.7	48.1	41.3	37.5	50.4
1966	23.1	30.3	40.9	47.9	56.1	70.4	75.6	71.1	61.3	50.8	42.8	31.4	50.1
1967	32.3	25.6	40.2	52.2	54.3	73.0	71.5	68.8	61.1	52.3	36.8	34.8	50.3
1968	23.4	22.2	40.4	51.2	54.7	66.9	72.4	71.8	64.8	52.2	41.3	27.6	49.1
1969	26.7	29.3	34.3	51.7	60.2	69.3	72.7	69.7	63.0	52.9	39.2	26.7	49.7
1970	20.7	27.7	35.3	52.5	63.9	68.2	71.6	71.6	67.8	54.9	42.2	32.1	50.7
1971	23.7	30.4	34.3	46.0	56.6	71.4	70.2	69.6	68.5	59.5	40.4	38.8	50.8
1972	29.6	26.3	36.4	48.5	61.8	63.8	71.2	70.6	65.3	48.4	39.3	37.2	49.9
1973	29.7	28.8	48.3	49.3	56.4	70.9	73.2	73.2	66.5	56.1	44.1	33.3	52.5
1974	34.0	29.9	41.2	51.8	58.3	65.2	73.1	72.8	62.2	52.4	43.9	32.5	51.4
1975	32.6	32.1	36.3	44.3	63.0	67.8	72.8	73.0	58.8	53.3	46.3	32.9	51.1
1976	23.5	37.2	45.2	50.6	55.6	68.4	67.4	65.3	59.9	43.9	33.1	23.9	48.0
1977	11.4	26.9	43.7	50.8	63.0	63.8	71.8	68.1	64.7	50.5	43.6	31.1	49.3
1978	22.6	20.9	36.9	51.0	60.2	69.4	73.0	71.4	66.2	49.1	43.0	32.7	49.7
RECORD MEAN	30.3	31.3	40.0	51.1	61.9	70.5	74.4	72.7	66.5	55.0	43.1	33.5	52.5
MAX	37.9	39.4	48.9	61.2	72.4	80.7	84.4	82.6	76.5	64.7	50.8	40.4	61.7
MIN	22.7	23.1	31.0	40.9	51.4	60.2	64.4	62.7	56.5	45.3	35.4	26.5	43.3

Heating Degree Days

Season	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	Total
#1958-59	4	20	117	393	625	1295	1224	924	861	407	130	54	6054
1959-60	1	0	73	374	776	927	1055	1045	1203	357	250	32	6093
1960-61	15	0	47	357	648	1284	1321	907	729	627	311	73	6314
1961-62	17	2	71	302	666	1039	1197	1020	873	513	100	18	5818
1962-63	11	12	216	363	707	1263	1354	1273	747	479	271	45	6743
1963-64	21	22	139	196	634	1315	1035	1095	769	395	116	63	5800
1964-65	1	51	99	447	577	954	1134	1018	920	476	63	53	5793
1965-66	9	40	99	518	702	848	1293	963	741	510	289	34	6046
1966-67	2	6	156	433	659	1033	1007	1097	765	387	332	4	5883
1967-68	10	13	140	391	840	931	1284	1232	738	406	313	60	6384
1968-69	8	31	34	400	703	1152	1181	988	944	394	182	35	6072
1969-70	0	8	127	383	770	1183	1370	1039	908	390	127	31	6336
1970-71	5	1	69	318	678	1013	1277	961	949	562	264	6	6103
1971-72	1	6	41	184	729	807	1093	1112	881	469	128	96	5567
1972-73	20	11	63	508	767	853	1087	1006	508	474	264	2	5563
1973-74	2	8	55	274	621	978	957	978	729	403	223	54	5282
1974-75	0	0	124	384	630	1001	997	916	881	617	116	48	5714
1975-76	0	0	192	362	554	989	1278	801	605	453	301	24	5559
1976-77	15	59	139	587	953	1268	1655	1060	638	436	138	102	7090
1977-78	11	41	78	442	583	1043	1307	1229	860	412	209	38	6253
1978-79	4	3	80	485	636	993							

Cooling Degree Days

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
1969	0	0	0	2	42	170	245	162	72	14	0	0	707
1970	0	0	0	21	100	133	215	213	162	11	0	0	855
1971	0	0	0	0	13	204	171	158	153	17	0	0	716
1972	0	0	0	0	34	68	219	192	76	0	0	0	589
1973	0	0	0	10	5	185	264	269	108	5	0	0	846
1974	0	0	0	13	19	66	258	247	45	5	4	0	657
1975	0	0	0	0	60	137	248	257	12	7	0	0	721
1976	0	0	1	25	14	134	99	73	12	0	0	0	358
1977	0	0	3	14	83	75	231	141	72	0	4	0	623
1978	0	0	0	0	69	178	260	207	122	0	0	0	836

Precipitation

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
1939	2.89	4.32	2.86	3.16	1.48	4.99	2.73	1.25	2.58	3.14	0.53	1.66	31.59
1940	0.88	3.31	4.18	5.26	4.14	6.23	4.16	4.44	2.59	0.88	2.92	2.62	41.61
1941	2.98	0.80	1.97	1.36	3.52	4.42	4.22	6.55	1.00	3.55	2.27	1.73	34.37
1942	1.54	2.18	4.31	3.08	4.41	3.99	4.15	2.77	3.40	3.91	2.55	5.61	41.90
1943	2.93	1.72	3.26	2.38	5.63	1.89	7.99	1.89	0.71	3.58	1.58	1.14	34.70
1944	1.26	2.46	5.50	3.24	2.97	4.60	3.70	4.32	1.21	2.96	2.35	6.16	40.53
1945	3.02	2.78	5.97	3.81	5.06	3.65	2.74	2.50	10.08	2.39	3.79	2.41	48.20
1946	1.12	2.43	2.53	1.15	4.10	4.93	2.70	2.11	1.27	3.47	0.99	2.45	29.25
1947	3.54	1.32	1.51	2.51	3.78	4.04	4.89	1.42	1.52	1.19	3.09	1.19	30.00
1948	2.04	1.90	3.69	6.03	3.17	6.05	2.83	2.90	1.27	3.14	2.60	3.25	38.87
1949	3.95	2.62	3.14	2.57	2.26	3.04	5.04	2.22	1.80	1.79	1.92	3.43	33.78
1950	5.67	3.74	3.88	2.29	4.61	5.86	4.09	2.63	3.53	1.53	7.29	3.26	48.38
1951	4.90	2.77	4.54	4.86	2.06	10.25	3.48	0.55	2.71	1.45	3.75	3.83	45.15
#1952	4.69	2.89	4.64	3.96	5.35	3.79	2.04	4.08	1.45	0.98	1.73	2.19	37.72
1953	3.07	1.14	3.03	3.91	5.89	3.68	2.18	3.00	1.66	0.89	1.33	1.43	31.21
1954	2.34	1.53	4.28	3.11	1.88	3.79	2.43	2.92	1.80	8.20	1.00	2.70	36.00
1955	1.34	3.24	3.69	2.61	2.59	3.20	3.61	6.77	1.75	2.79	2.89	0.40	34.88
1956	1.90	5.98	5.28	4.31	5.90	4.19	4.25	5.07	1.93	1.50	1.03	3.35	44.69
1957	1.65	1.33	2.02	4.58	2.73	4.07	3.97	0.78	4.06	1.74	2.50	4.22	33.67
1958	3.17	1.11	1.87	3.42	4.82	2.74	7.43	3.71	4.52	0.97	2.47	1.10	37.33
1959	3.99	2.15	2.11	3.35	2.56	3.70	4.25	4.04	1.34	5.94	2.43	2.78	38.62
1960	3.01	3.16	2.06	1.37	5.62	2.72	3.46	3.55	1.84	1.64	1.22	1.64	31.29
1961	1.95	3.13	3.48	5.21	2.80	4.21	5.53	2.11	1.98	2.58	3.41	1.71	38.10
1962	2.33	3.55	3.83	3.03	1.87	1.82	2.44	2.57	4.69	2.11	1.53	1.83	31.62
1963	1.96	2.09	5.28	2.39	1.57	2.40	3.45	2.31	1.40	0.16	2.54	1.24	26.79
1964	2.55	1.73	4.96	7.61	1.77	3.84	4.48	1.79	0.74	1.42	2.74	4.26	37.89
1965	3.84	2.98	3.16	1.79	1.21	2.31	1.82	3.26	4.07	2.82	2.35	0.63	30.24
1966	4.52	3.23	1.88	3.73	2.76	1.72	2.70	5.13	1.92	1.38	3.39	1.70	34.06
1967	1.06	2.54	6.10	4.41	5.21	0.90	4.54	2.67	1.61	2.03	3.07	2.22	36.38
1968	2.83	0.79	4.53	2.33	6.36	2.38	2.36	3.97	3.08	2.13	2.07	3.24	36.07
1969	2.02	0.51	1.14	2.91	1.89	3.74	4.52	2.96	0.91	2.59	2.44	3.95	29.58
1970	1.61	1.92	3.35	3.09	4.36	4.61	3.89	1.55	2.77	4.80	2.64	3.29	37.88
1971	2.29	4.04	3.20	0.48	3.87	1.41	6.82	1.25	3.86	0.84	1.94	3.24	33.22
1972	1.84	3.64	3.68	4.37	1.38	5.08	2.98	1.79	5.42	2.15	4.70	3.04	40.07
1973	2.03	1.80	3.86	4.69	5.87	3.12	2.16	3.40	3.56	4.43	2.65	2.15	39.74
1974	3.47	2.10	3.72	3.26	5.35	5.08	3.30	2.93	4.42	1.12	3.06	4.02	41.83
1975	3.34	4.64	4.62	2.27	1.84	4.58	4.38	7.56	5.06	3.46	1.77	2.90	46.42
1976	3.25	1.74	4.45	1.24	1.99	3.37	4.72	1.25	3.30	3.76	0.90	1.81	31.78
1977	2.06	0.87	4.12	3.26	2.57	2.85	3.38	2.66	3.13	2.44	2.59	3.27	33.20
1978	6.23	0.54	1.65	2.25	4.26	4.11	2.13	3.65	2.64	3.42	1.62	5.24	37.78
RECORD MEAN	2.92	2.47	3.30	3.09	3.31	3.70	3.97	3.17	2.65	2.50	2.36	2.73	36.17

Snowfall

Season	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	Total
1939-40	0.0	0.0	0.0	T	T	5.2	8.9	22.7	7.9	2.6	T	0.0	47.3
1940-41	0.0	0.0	0.0	T	0.3	2.4	12.3	8.5	15.3	0.0	0.0	0.0	38.8
1941-42	0.0	0.0	0.0	0.0	T	T	5.5	9.4	18.3	1.0	0.0	0.0	34.2
1942-43	0.0	0.0	0.0	T	1.8	11.6	14.3	5.8	10.6	2.3	T	0.0	46.6
1943-44	0.0	0.0	0.0	T	3.0	1.4	0.3	8.5	9.8	1.7	0.0	0.0	24.7
1944-45	0.0	0.0	0.0	0.0	T	26.0	19.2	3.8	1.3	T	0.0	0.0	50.3
1945-46	0.0	0.0	0.0	T	0.6	17.1	6.1	4.7	0.1	T	0.0	0.0	28.6
1946-47	0.0	0.0	0.0	0.0	0.0	5.3	3.5	23.1	4.6	T	T	0.0	36.5
1947-48	0.0	0.0	0.0	0.0	0.6	2.6	15.7	9.5	2.5	T	0.0	0.0	30.9
1948-49	0.0	0.0	0.0	T	0.8	6.5	4.9	1.5	6.1	1.3	0.0	0.0	21.1
1949-50	0.0	0.0	0.0	0.0	5.1	0.8	0.2	5.4	10.6	0.2	0.0	0.0	22.3
1950-51	0.0	0.0	0.0	0.0	32.3	21.0	12.4	2.7	8.4	5.2	0.0	0.0	82.0
1951-52	0.0	0.0	0.0	T	7.9	13.1	3.8	5.0	11.2	4.7	0.0	0.0	45.7
#1952-53	0.0	0.0	0.0	0.5	1.5	7.7	4.5	1.1	6.8	4.9	T	0.0	27.0
1953-54	0.0	0.0	0.0	0.0	3.9	1.9	6.7	4.7	6.6	0.1	T	0.0	23.9
1954-55	0.0	0.0	0.0	T	1.0	7.3	6.7	8.3	3.2	T	0.0	0.0	26.5
1955-56	0.0	0.0	0.0	T	6.5	2.6	7.3	3.2	14.5	3.3	0.0	0.0	37.4
1956-57	0.0	0.0	0.0	0.0	3.4	11.2	9.3	4.3	7.3	2.2	0.0	0.0	37.7
1957-58	0.0	0.0	0.0	1.3	1.0	4.9	12.9	7.4	8.7	1.5	0.0	0.0	37.9
1958-59	0.0	0.0	0.0	0.0	11.0	8.0	13.7	2.2	7.6	3.1	0.0	0.0	45.5
1959-60	0.0	0.0	0.0	T	4.3	11.5	2.2	21.8	21.3	1.1	0.0	0.0	62.2
1960-61	0.0	0.0	0.0	0.1	2.6	20.8	22.7	22.5	1.4	5.9	T	0.0	76.0
1961-62	0.0	0.0	0.0	T	2.2	5.6	4.0	8.6	19.1	3.6	0.0	0.0	43.1
1962-63	0.0	0.0	0.0	1.8	T	11.9	12.7	20.4	4.5	0.3	1.8	0.0	53.4
1963-64	0.0	0.0	0.0	T	5.8	16.4	20.3	13.7	6.1	0.3	0.0	0.0	62.6
1964-65	0.0	0.0	0.0	T	1.6	6.1	10.6	10.4	13.3	0.2	0.0	0.0	42.2
1965-66	0.0	0.0	0.0	0.2	0.2	1.8	24.6	6.9	8.5	2.7	3.1	0.0	48.0
1966-67	0.0	0.0	0.0	0.0	5.1	7.8	4.5	21.7	20.0	0.5	0.0	0.0	59.6
1967-68	0.0	0.0	0.0	T	10.1	7.9	15.4	6.1	11.0	T	0.0	0.0	50.5
1968-69	0.0	0.0	0.0	T	2.7	13.3	6.5	4.0	3.9	0.0	T	0.0	30.4
1969-70	0.0	0.0	0.0	0.4	7.9	20.6	12.6	13.0	16.1	0.1	0.0	0.0	70.7
1970-71	0.0	0.0	0.0	T	0.1	10.1	12.1	20.6	16.8	0.2	0.0	0.0	59.9
1971-72	0.0	0.0	0.0	0.0	10.5	0.7	4.9	24.2	9.8	1.8	0.0	0.0	51.9
1972-73	0.0	0.0	0.0	1.8	6.1	2.9	3.4	6.1	4.6	1.4	T	0.0	26.3
1973-74	0.0	0.0	0.0	0.0	0.8	4.8	4.9	2.2	2.3	1.6	T	0.0	16.6
1974-75	0.0	0.0	0.0	T	2.6	21.2	10.1	13.9	9.8	1.1	0.0	0.0	58.7
1975-76	0.0	0.0	0.0	0.0	1.9	3.8	21.8	3.3	4.3	0.5	0.0	0.0	35.6
1976-77	0.0	0.0	0.0	T	6.6	7.9	26.5	6.4	0.9	1.3	T	0.0	49.6
1977-78	0.0	0.0	0.0	T	3.3	9.1	40.2	5.4	4.0	0.2	0.0	0.0	62.2
1978-79	0.0	0.0	0.0	0.0	2.3	3.2							
RECORD MEAN	0.0	0.0	0.0	0.2	4.0	8.6	12.4	10.1	8.9	1.5	0.2	0.0	45.9

# Indicates a station move or relocation of instruments. See Station Location table.

Record mean values above are means through the current year for the period beginning in 1875 for temperature, 1872 for precipitation, and 1953 for snowfall. Data are from City Office locations through 1934 and from Airport locations thereafter.

ANNUAL METEOROLOGICAL SUMMARY
SOMMAIRE MÉTÉOROLOGIQUE ANNUEL

for/pour TORONTO CITY, ONTARIO YEAR/ANNÉE 1977

METEOROLOGICAL DATA FOR THE YEAR / DONNÉES MÉTÉOROLOGIQUE POUR L'ANNÉE

NOTE: The following units are used throughout this summary —
Temperature: Degrees and tenths Celcius (°C)
Degree Day: Difference of Daily Mean Temperature from 18.0°C
Rain: Millimetres and tenths (mm)
Snow: Centimetres and tenths (cm)
Total Precipitation: Millimetres and tenths (mm)
Wind Speed: Kilometres per hour (km/h)
Wind Direction: Direction (true north) from which the wind is blowing.
Barometric Pressure: Kilopascals and hundredths (kPa)
Sunshine: Hours and tenths of bright sunshine.

AVIS: Unités Utilisées —
Température:Degrés et dixième Celsius (°C)
Degré Jour: Différence entre la température moyenne du jour et 18.0°C
Pluie: Millimetres et dixièmes (mm)
Neige: Centimetres et dixièmes (cm)
Précipitation Totale: Millimetres et dixièmes (mm)
Vitesse du vent: Kilomètres par heure (km/h)
Direction du vent: Direction (nord géographique) d'ou le vent souffle.
Pression Barométrique: Kilopascals et centièmes (kPa)
Insolation: Nombre d'heures et dixièmes d'insolation effective

MONTH MOIS	TEMPERATURE / TEMPÉRATURE										DEGREE DAYS DEGRÉS JOURS	
	MEAN / MOYENNE			NORMAL / NORMALE			EXTREME / EXTRÊME					
	MAXIMUM	MINIMUM	MONTHLY MENSUELLES	MAXIMUM	MINIMUM	MEAN MOYENNE	MAXIMUM MAXIMALE	DATE	MINIMUM MINIMALE	DATE	BELOW 18.0°C AU DESSOUS DE 18.0°C	NORMAL NORMALE
JAN/JAN	-5.7	-12.4	-9.1	-1.1	-7.7	-4.4	0.0	25	-23.1	18	838.6	694.4
FEB/FÉV	-0.7	- 6.9	-3.8	-0.3	-7.3	-3.8	6.5	24	-18.7	6	610.3	615.0
MAR/MAR	7.7	0.2	4.0	4.2	-2.9	0.6	22.6	29	- 9.1	24	432.6	539.0
APR/AVR	13.4	4.4	8.9	11.9	3.2	7.6	28.1	13	- 8.5	8	274.6	313.4
MAY/MAI	21.7	11.2	16.5	17.9	8.4	13.2	33.1	28	2.0	9	95.0	157.8
JUN/JUIN	23.2	13.9	18.6	24.2	14.1	19.2	30.3	17	5.6	8	34.0	31.7
JUL/JUIL	26.6	18.0	22.3	26.8	16.8	21.8	36.8	20	13.8	27	2.1	3.7
AUG/AOÛT	24.5	16.3	20.4	25.9	16.2	21.1	29.8	28	9.4	20	14.6	7.4
SEPT/SEP	20.0	14.3	17.2	21.6	12.3	17.0	29.1	1	8.8	29	50.8	70.0
OCT/OCT	13.6	6.9	10.3	15.3	7.1	11.2	19.3	4	1.1	17	240.0	212.0
NOV/NOV	8.3	3.4	5.9	7.8	1.8	4.8	19.4	3	-8.3	27	363.5	394.8
DEC/DÉC	0.6	- 4.4	-1.9	1.2	-4.8	-1.8	12.6	1	-15.6	11	616.9	613.5
YEAR ANNÉE	12.8	5.4	9.1	13.0	4.8	8.9	36.8	July 20	-23.1	Jan. 18	3573.0	3652.7

MONTH MOIS	PRECIPITATION / PRÉCIPITATIONS													
	MONTHLY / MENSUELLES			NORMAL / NORMALE			EXTREME / EXTRÊME							
							RAIN / PLUIE				SNOW / NEIGE			
	RAINFALL HAUTEUR DE PLUIE	SNOWFALL HAUTEUR DE NEIGE	TOTAL	RAIN PLUIE	SNOW NEIGE	TOTAL	6 HRS	DATE	24 HRS	DATE	6 HRS	DATE	24 HRS	DATE
JAN/JAN	0.3	70.5	57.0	25.1	37.1	62.5	N/A	-	0.3	24	N/A	-	15.2	9
FEB/FÉV	21.8	6.2	27.7	23.1	33.3	56.6			9.4	12			2.0	9
MAR/MAR	63.0	22.6	86.4	42.2	23.6	65.5			30.0	12			11.9	18
APR/AVR	80.6	1.9	82.5	60.2	7.4	67.3			28.5	22			1.3	7
MAY/MAI	25.1	0.0	25.1	72.6	0.3	72.9			14.7	31			-	-
JUN/JUIN	90.0	0.0	90.0	63.0	0.0	63.0			25.4	28			-	-
JUL/JUIL	139.5	0.0	139.5	80.0	0.0	80.8			53.6	6			-	-
AUG/AOÛT	123.7	0.0	123.7	67.3	0.0	67.3			28.5	5			-	-
SEPT/SEP	157.4	0.0	157.4	61.2	0.0	61.2			59.9	24			-	-
OCT/OCT	60.7	0.0	60.7	61.0	0.5	61.5			28.5	8			-	-
NOV/NOV	127.5	5.8	133.3	57.2	10.2	67.3			60.2	7			5.8	27
DEC/DÉC	68.5	67.6	127.9	35.1	28.7	64.0			25.2	13			24.6	8
YEAR ANNÉE	958.1	174.6	* 1111.2	648.8	141.1	789.9	N/A	-	60.2	Nov 7	N/A	-	24.6	Dec 8

* Most Precipitation Since 1878.

for/pour TORONTO CITY, ONTARIO YEAR/ANNÉE: 1977

METEOROLOGICAL DATA FOR THE YEAR / DONNÉES MÉTÉOROLOGIQUE POUR L'ANNÉE

SNOWFALL DAILY

DATE	JAN JAN	FEB FEV	MAR MAR	APR AVR	MAY MAI	JUN JUIN	JUL JUIL	AUG AOÛT	SEPT SEP	OCT OCT	NOV NOV	DEC DEC
1	TR	TR										
2	TR	TR										
3	2.0	0.8										
4		0.5		0.3								TR
5	TR		TR	0.3								19.1
6	2.8		TR	TR								1.0
7	TR		TR	1.3								TR
8	2.0	TR										24.6
9	15.2	2.0										1.3
10	13.7											
11	TR											8.6
12	1.0	TR									TR	6.1
13	9.9	0.8									TR	
14	2.3											
15	TR											
16	TR	TR	TR									
17	0.8		TR									
18	0.5	0.3	11.9									TR
19		TR										
20	TR		5.6									5.1
21	TR	TR										0.8
22		TR	5.1									
23	0.3	1.0	TR									
24	2.8	0.3	TR									TR
25	2.5	TR									TR	TR
26	2.0										TR	
27	2.0	TR									5.8	
28	10.4	0.5									TR	TR
29	TR											1.0
30	TR											TR
31	0.3											TR

ANNUAL METEOROLOGICAL SUMMARY
SOMMAIRE MÉTÉOROLOGIQUE ANNUEL

for/pour TORONTO CITY, ONTARIO   YEAR/ANNÉE 1977

METEOROLOGICAL DATA FOR THE YEAR/DONNÉES MÉTÉOROLOGIQUE POUR L'ANNÉE

NUMBER OF DAYS WITH: NOMBRE DE JOURS AVEC:	JAN JAN	FEB FÉV	MAR MAR	APR AVR	MAY MAI	JUN JUIL	JUL JUIL	AUG AOÛT	SEPT SEP	OCT OCT	NOV NOV	DEC DÉC	YEAR ANNÉE
MEASURABLE RAIN PLUIE, MESURABLE	1	5	6	8	11	13	9	16	15	6	13	9	112
RAIN (Trace or More) PLUIE (Trace ou davantage)	1	6	8	13	15	15	11	18	17	13	16	11	144
MEASURABLE SNOW NEIGE, MESURABLE	17	8	3	3	0	0	0	0	0	0	1	9	41
SNOW (Trace or More) NEIGE (Trace ou davantage)	28	18	10	4	0	0	0	0	0	0	6	17	83
MEASURABLE PRECIPITATION PRÉCIPITATION, MESURABLE	17	10	9	9	11	13	9	16	15	6	14	15	144
PRECIPITATION (Trace or More) PRÉCIPITATION (Trace ou davantage)	28	19	17	14	15	15	11	18	17	13	21	23	211
THUNDERSTORMS ORAGES	N/A												
HAIL GRÊLE	N/A												
ICE PELLETS GRANULES DE GLACE	N/A												
FREEZING PRECIPITATION PRÉCPITATION VERGLACANTE	N/A												
FOG* BROUILLARD*	N/A												
MAXIMUM TEMPERATURE TEMPÉRATURE MAXIMALE 30°C OR MORE/OU PLUS	0	0	0	0	1	1	5	0	0	0	0	0	7
MAXIMUM TEMPERATURE TEMPÉRATURE MAXIMALE 0°C OR LESS/OU MOINS	31	13	3	1	0	0	0	0	0	0	2	12	62
MINIMUM TEMPERATURE TEMPERATURE MINIMALE 0°C OR LESS/OU MOINS	31	26	15	5	0	0	0	0	0	0	8	24	109
MINIMUM TEMPERATURE TEMPERATURE MINIMALE −15°C OR LESS/OU MOINS	12	1	0	0	0	0	0	0	0	0	0	1	14

*NOTE: Fog is only counted when the visibility is restricted to ½ mile or less
AVIS: On ne compte les phénomènes de brouillard que lorsque la visibilité est ½ mille ou moins

ANNUAL METEOROLOGICAL SUMMARY
SOMMAIRE MÉTÉOROLOGIQUE ANNUEL

for/pour Toronto City Ontario

YEAR/ANNÉE: 1977

MONTHLY AND ANNUAL EXTREMES OF RECORD / EXTRÊMES MENSUELLES ET ANNUELLES AUX REGISTRES

MONTH MOIS	TEMPERATURE / TEMPÉRATURE								PRECIPITATION / PRÉCIPITATIONS					
	ABSOLUTE MAXIMUM ABSOLU	YEAR ANNÉE	ABSOLUTE MINIMUM ABSOLU	YEAR ANNÉE	HIGHEST MONTHLY MEAN MOYENNE MENSUELLE MAXIMALE	YEAR ANNÉE	LOWEST MONTHLY MEAN MOYENNE MENSUELLE MINIMALE	YEAR ANNÉE	GREATEST MONTHLY PRECIPITATION MENSUELLE MAXIMALE	YEAR ANNÉE	LEAST MONTHLY PRECIPITATION MENSUELLE MINIMALE	YEAR ANNÉE	GREATEST MONTHLY SNOWFALL NEIGE MENSUELLE MAXIMALE	YEAR ANNÉE
JAN/JAN	16.1	1967	-32.8	1859	1.9	1932	-12.1	1857	173.7	1932	15.5	1872	110.7	1871
FEB/FÉV	14.2	1976	-31.7	1855	0.4	1954	-12.6	1875	132.3	1900	7.4	1877	117.1	1846
MAR/MAR	26.7	1946	-26.7	1868	6.2	1945	-8.1	1885	177.8	1870	10.7	1962	158.5	1870
APR/AVR	32.2	1842	-15.0	1923	10.4	1955	0.8	1874	154.7	1929	2.5	1881	32.8	1857
MAY/MAI	34.4*	1962	-3.9*	1854	16.9	1975	8.6	1867	238.5	1894	9.9	1920	7.9	1875
JUN/JUIN	36.7	1964	-2.2	1842	22.4	1919	14.1	1857	205.5	1870	1.5	1949	TR	1859*
JUL/JUIL	40.6	1936	3.9	1843	25.5	1921	17.8	1884	206.8	1841	7.4	1954	-	-
AUG/AOÛT	38.9	1918	4.4	1855	24.1	1959	16.2	1866	206.8	1915	TR	1876	-	-
SEPT/SEP	37.8	1953	-2.2	1842	20.3	1961	12.2	1848	248.2	1843	5.8	1844	TR	1918
OCT/OCT	30.0	1963	-8.9	1844	14.6*	1947	5.7	1841	154.9	1954	9.1	1963	30.5	1844
NOV/NOV	23.9	1950	-20.6	1875	8.5	1975	-2.4	1873	147.1	1966	2.8	1904	57.2	1950
DEC/DÉC	16.1	1875	-30.0	1933	2.3	1923	-8.3	1876	152.7	1852	11.9	1845	96.5	1872
YEAR ANNÉE	40.6	1936	-32.8	1859	10.2	1953	4.8	1875	1272.5	1843	605.4	1933	312.1	1870

PERIOD OF RECORD/PÉRIOD DE REGISTRE: 1840-1977

* first of one or more occurrences.

Local Climatological Data

Annual Summary With Comparative Data

1978

WASHINGTON, D.C.

NATIONAL AIRPORT

Narrative Climatological Summary

Washington lies at the western edge of the middle Atlantic coastal plain, about 50 miles east of the Blue Ridge Mountains and 35 miles west of Chesapeake Bay at the junction of the Potomac and Anacostia Rivers. Elevations range from a few feet above sea level to about 400 feet in parts of the northwest section of the city.

Observational records have been kept continuously since November 1870. Since June 1941, the official observations have been taken at Washington National Airport. Significant temperature differences within the metropolitan area are not unusual. Average minimum temperatures at some locations are 8° lower than official airport readings. Minimum temperatures for the airport are highest for the area since the airport is located near the center of the urban heat island. Variations in the average maximum temperatures over the metropolitan area are usually less than 5°. Rainfall and snowfall amounts at the airport are less than an average for the area; some locations average 5 inches more precipitation than the airport per annum.

Summers are warm and humid and winters mild; generally pleasant weather prevails in the spring and autumn. The coldest weather occurs in late January and early February. The warmest weather occurs late in July. There are no well pronounced wet and dry seasons. Thunderstorms, during the summer months, often bring sudden and heavy rain showers and may be attended by damaging winds, hail, or lightning. On June 9, 1929, a violent local thunderstorm was accompanied by wind gusts up to 100 m.p.h. Two severe hailstorms with resultant damage of $100,000 or more are recorded, one in April 1938 and the other in May 1953. Tornadoes rarely occur, but three rather destructive ones have been recorded - one in April 1923 and one in November 1927; the resulting damage was $100,000 or more in each case. In April 1973 a tornado struck in the vicinity of suburban Fairfax, Virginia causing an estimated $15,000,000 damage.

Tropical disturbances occasionally, during their northward passage, influence Washington's weather mainly with high winds and heavy rainfall, but extensive damage from wind and tidal flooding is rare.

With the passage of Hurricane Hazel on October 15, 1954, the peak gust of wind reached 98 m.p.h., but only 1.73 inches of rainfall was recorded. Hurricane Connie, August 12-13, 1955, produced 6.60 inches of rainfall but the peak wind was only 58 m.p.h. During June 21-22, 1972, Hurricane Agnes produced 7.52 inches of rain at Washington National Airport. Flooding from the rains of Agnes caused 16 deaths in the greater metropolitan area and damage totaled $300,000,000 in Virginia, Maryland, Delaware and the District of Columbia.

In recent years, urban flooding caused by locally heavy rains has become a major problem. The most critical flooding is associated with the Alexandria portion of Four Mile Run in nearby Virginia but other streams in the Metropolitan Area are flooding with increasing frequency.

Occasional overflows from the Potomac River result from heavy rain over the basin, at times augmented by melting snow. In a few cases during cold winters ice forms on the river and in spring flooding is caused by ice gorges when the ice breaks up. The river is in tidewater and above normal tides associated with hurricane or severe storms along the coast cause flooding at times. Major floods occurred in June 1972, October 1954 and 1942, April 1937, March 1936 and August 1933. In 1954 and 1933 the flooding resulted mainly from high tides caused by hurricane winds. In 1942 the flooding was a combination of heavy rain and tidal flooding. In the other cases the flooding resulted mainly from heavy rain in the Potomac basin.

Snow accumulations of more than 10 inches are relatively rare. Usually the melt-off is rapid, but snow depths of 3 or more inches make driving hazardous, and slows or halts traffic. Schools may be closed and community activities may be temporarily disorganized, but usually conditions improve within a day or two. The first significant snow accumulation of a season is often the most disruptive.

The greatest recorded snowfall from a single storm was 28 inches. This is known as the Knickerbocker Storm and occurred in two days of January 1922. The snowfall accumulation collapsed the roof of the Knickerbocker Theater and resulted in the loss of many lives. Snowfalls of this magnitude are rare.

Records of the past 20 years show the average date of the last freezing temperature in the spring to be March 29 and the latest April 16. The average date of the first freezing temperature in the fall is November 10 and the earliest October 20.

noaa NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION / ENVIRONMENTAL DATA AND INFORMATION SERVICE / NATIONAL CLIMATIC CENTER ASHEVILLE, N.C.

Meteorological Data For The Current Year

Station: WASHINGTON, D. C. # 13743 WASHINGTON NATIONAL AIRPORT Standard time used: EASTERN Latitude: 38° 51' N Longitude: 77° 02' W Elevation (ground): 10 feet Year: 1978

Month	Temperature °F Averages Daily maximum	Daily minimum	Monthly	Extremes Highest	Date	Lowest	Date	Degree days Base 65 °F Heating	Cooling	Precipitation in inches Water equivalent Total	Greatest in 24 hrs.	Date	Snow, Ice pellets Total	Greatest in 24 hrs.	Date	Relative humidity, pct. Hour 01 (Local time)	Hour 07	Hour 13	Hour 19
JAN	39.4	25.5	32.5	62	9	10	10	1001	0	7.11	2.03	25-26	10.3	4.6	13	63	65	53	56
FEB	38.3	24.5	31.4	54	25	18	7	933	0	0.42	0.20	5-6	3.8	2.2	5-6	58	61	45	51
MAR	52.3	36.4	44.4	79	21	16	5	633	0	4.48	2.41	25-26	8.3	4.1	3	59	65	49	51
APR	68.1	47.3	57.7	88	1	40	16	219	10	1.38	0.62	18-19	0.0	0.0		54	57	38	39
MAY	74.5	57.1	65.8	88	26	42	2	86	117	5.13	1.51	14-15	0.0	0.0		74	73	57	62
JUN	86.4	67.0	76.7	97	27	54	14	0	358	2.43	0.73	26-27	0.0	0.0		73	70	49	58
JUL	87.0	70.6	78.8	100	23	62	13	0	434	4.28	1.79	2-3	0.0	0.0		80	81	59	65
AUG	88.7	73.8	81.3	93	29	65	22	0	514	5.85	2.03	30-31	0.0	0.0		85	86	62	70
SEP	82.0	65.1	73.6	94	19	50	29	9	274	1.01	0.54	12	0.0	0.0		74	76	53	62
OCT	69.1	49.7	59.4	85	23	40	25	192	25	1.16	0.58	5-6	0.0	0.0		70	74	47	56
NOV	59.9	44.4	52.2	76	6	34	29	378	0	2.31	0.89	26-27	3.1	3.1	26-27	71	75	56	62
DEC	51.6	34.6	43.1	74	8	22	29	671	0	4.00	0.93	24	T	T	20	63	69	48	54
YEAR	66.4	49.7	58.1	100	JUL 23	10	JAN 10	4122	1732	39.56	2.41	MAR 25-26	25.5	4.6	JAN 13	69	71	51	57

Month	Wind Resultant Direction	Resultant Speed m.p.h.	Average speed m.p.h.	Fastest mile Speed m.p.h.	Fastest mile Direction	Fastest mile Date	Percent of possible sunshine	Average sky cover, tenths, sunrise to sunset	Number of days Sunrise to sunset Clear	Partly cloudy	Cloudy	Precipitation .01 inch or more	Snow, Ice pellets 1.0 inch or more	Thunderstorms	Heavy fog, visibility ¼ mile or less	Temperature °F Maximum (b) 90° and above	Maximum 32° and below	Minimum 32° and below	Minimum 0° and below	Average station pressure mb Elev. 65 feet m.s.l.
JAN	30	5.7	11.0	55	SW	26	41	6.9	6	7	18	12	3	0	2	0	3	27	0	1015.6
FEB	33	6.6	10.0	36	NW	6	60	5.0	12	5	11	5	2	0	0	0	3	26	0	1016.9
MAR	33	4.6	11.2	45	NW	19	54	6.8	7	5	19	10	2	2	0	0	0	10	0	1015.9
APR	32	3.5	11.7	40	SW	1	65	6.4	7	11	12	8	0	1	0	0	0	0	0	1012.5
MAY	04	1.0	9.4	27	E	4	52	6.8	8	7	16	12	0	2	0	0	0	0	0	1012.5
JUN	24	2.8	10.3	49	NW	27	78	4.8	13	11	6	11	0	7	0	7	0	0	0	1015.2
JUL	20	1.5	9.0	26	W	8	72	5.4	12	10	9	10	0	3	0	13	0	0	0	1014.2
AUG	20	2.6	8.1	47	SE	5	70	6.6	6	10	15	13	0	7	0	15	0	0	0	1015.9
SEP	17	0.9	8.6	24	NW	19	74	4.6	13	10	7	5	0	2	0	4	0	0	0	1016.6
OCT	27	2.2	9.4	30	NW	27	70	4.4	14	9	8	8	0	2	0	0	0	0	0	1017.6
NOV	36	2.1	8.1	26	NW	24	39	6.9	7	6	17	10	1	0	2	0	0	0	0	1020.0
DEC	26	4.3	10.4	40	NW	17	54	5.6	9	10	12	9	0	0	0	0	0	13	0	1016.6
YEAR	30	2.1	9.8	55	SW	JAN 26	62	5.9	114	101	150	113	8	26	4	39	6	76	0	1015.8

Normals, Means, And Extremes

Month	Temperatures °F Normal Daily maximum	Normal Daily minimum	Normal Monthly	Extremes Record highest	Year	Record lowest	Year	Normal Degree days Base 65 °F Heating	Cooling	Precipitation in inches Water equivalent Normal	Maximum monthly	Year	Minimum monthly	Year	Maximum in 24 hrs.	Year	Snow, Ice pellets Maximum monthly	Year	Maximum in 24 hrs.	Year
(a)				37		37					37		37		35		35		35	
J	43.5	27.7	35.6	79	1950	2	1977	911	0	2.62	7.11	1978	0.31	1955	2.13	1976	21.3	1966	13.8	1966
F	46.0	28.6	37.3	82	1948	4	1961	776	0	2.45	5.71	1961	0.42	1978	1.77	1971	19.0	1967	14.4	1958
M	55.0	35.2	45.1	89	1945	11	1943	617	0	3.33	7.43	1953	0.64	1945	3.43	1958	17.1	1960	7.9	1960
A	67.1	45.7	56.4	95	1976	24	1950	265	7	2.86	5.97	1952	0.26	1942	3.08	1970	0.6	1972	0.6	1972
M	76.6	55.7	66.2	97	1969	34	1947	72	109	3.68	10.69	1953	1.06	1963	4.32	1953	T	1963	T	1963
J	84.6	64.6	74.6	101	1952	47	1972	0	288	3.48	11.53	1972	1.21	1976	7.19	1972	0.0		0.0	
J	88.2	69.1	78.7	103	1954	55	1943	0	425	4.12	11.06	1945	0.93	1966	4.69	1970	0.0		0.0	
A	86.6	67.6	77.1	100	1953	51	1963	0	375	4.67	14.31	1955	0.55	1962	6.39	1955	0.0		0.0	
S	80.2	61.0	70.6	100	1953	39	1963	14	182	3.08	12.36	1975	0.20	1967	5.31	1975	0.0		0.0	
O	69.6	49.7	59.8	94	1954	29	1969	190	29	2.66	8.18	1942	T	1963	4.98	1955	T	1974	T	1974
N	57.2	38.8	48.0	86	1974	16	1955	510	0	2.90	6.70	1963	0.37	1965	2.63	1971	6.9	1967	6.9	1967
D	45.2	29.5	37.4	75	1946	1	1942	856	0	3.04	6.54	1969	0.22	1955	2.86	1977	16.2	1962	11.4	1957
YR	66.7	47.8	57.3	103	JUL 1954	1	DEC 1942	4211	1415	38.89	14.31	AUG 1955	T	OCT 1963	7.19	JUN 1972	21.3	JAN 1966	14.4	FEB 1958

Month	Relative humidity pct. Hour 01 (Local time)	Hour 07	Hour 13	Hour 19	Wind Mean speed m.p.h.	Prevailing direction	Fastest mile Speed m.p.h.	Fastest mile Direction	Fastest mile Year	Pct. of possible sunshine	Mean sky cover, tenths, sunrise to sunset	Mean number of days Sunrise to sunset Clear	Partly cloudy	Cloudy	Precipitation .01 inch or more	Snow, Ice pellets 1.0 inch or more	Thunderstorms	Heavy fog, visibility ½ mile or less	Temperatures °F Max. (b) 90° and above	Max. 32° and below	Min. 32° and below	Min. 0° and below	Average station pressure mb. Elev. 65 feet m.s.l.
(a)	18	18	18	18	30	13	30	30		30	30	30	30	30	37	35	30	30	18	18	18	18	6
J	66	68	54	58	10.0	NW	56	NW	1957	49	6.5	8	7	16	11	2	*	2	0	5	23	0	1016.7
F	63	67	51	55	10.4	S	57	SW	1961	53	6.3	8	6	14	8	1	*	2	0	2	19	0	1015.6
M	63	68	49	52	10.9	NW	60	E	1951	56	6.4	8	8	15	11	1	1	1	0	*	9	0	1014.6
A	64	67	46	49	10.5	S	56	N	1952	58	6.3	7	9	14	10	0	2	1	1	0	1	0	1013.8
M	72	72	51	57	9.3	S	50	NW	1977	58	6.3	7	11	13	11	0	4	*	2	0	0	0	1012.8
J	76	75	52	60	8.8	S	57	NW	1954	64	5.9	8	11	11	9	0	5	*	8	0	0	0	1013.7
J	76	75	52	61	8.2	S	54	E	1951	63	5.9	8	12	11	10	0	6	*	13	0	0	0	1013.9
A	78	79	54	63	8.0	S	49	NE	1955	63	5.7	10	9	12	9	0	5	*	10	0	0	0	1015.8
S	78	80	55	65	8.2	S	56	SE	1952	62	5.5	10	9	11	8	0	2	*	4	0	0	0	1015.8
O	75	78	51	62	8.6	SSW	78	SE	1954	60	5.2	12	7	12	7	0	1	2	*	0	1	0	1017.3
N	70	73	52	60	9.2	S	60	E	1952	52	6.1	9	8	13	8	*	*	1	0	*	5	0	1017.1
D	68	71	56	61	9.5	NW	62	SW	1957	47	6.4	9	6	16	9	1	*	2	0	2	17	0	1016.2
YR	71	73	52	58	9.3	S	78	SE	OCT 1954	58	6.0	104	103	158	111	5	29	12	37	9	75	0	1015.3

Means and extremes above are from existing and comparable exposures. Annual extremes have been exceeded at other sites in the locality as follows: Highest temperature 106 in July 1930+; lowest temperature -15 in February 1899; maximum monthly precipitation 17.45 in September 1934; maximum precipitation in 24 hours 7.31 in August 1928; maximum monthly snowfall 35.2 in February 1899; maximum snowfall in 24 hours 25.0 in January 1922.

(a) Length of record, years, through the current year unless otherwise noted, based on January data.
(b) 70° and above at Alaskan stations.
* Less than one half.
T Trace.

NORMALS - Based on record for the 1941-1970 period.
DATE OF AN EXTREME - The most recent in cases of multiple occurrence.
PREVAILING WIND DIRECTION - Record through 1963.
WIND DIRECTION - Numerals indicate tens of degrees clockwise from true north. 00 indicates calm.
FASTEST MILE WIND - Speed is fastest observed 1-minute value when the direction is in tens of degrees.

Average Temperature

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
1939	37.8	42.3	46.4	53.4	68.0	75.4	76.2	78.8	71.0	58.4	46.0	40.1	57.8
1940	26.9	37.1	40.7	50.8	64.4	74.8	77.5	73.4	66.8	55.7	48.2	42.8	54.8
#1941	34.8	53.9	59.8	60.6	66.8	73.2	77.0	75.4	72.4	64.4	50.1	41.4	57.5
1942	34.4	54.1	46.8	58.2	68.4	74.0	78.6	74.8	70.3	59.8	47.6	36.4	56.8
1943	35.8	58.2	44.6	51.1	66.9	78.8	78.0	78.6	67.6	56.4	46.8	56.6	56.6
1944	37.2	37.8	42.6	53.4	70.8	74.6	78.2	75.8	70.6	56.6	47.4	34.2	56.6
#1945	30.8	38.4	55.5	59.4	65.0	74.4	76.4	74.8	72.8	57.6	49.3	32.9	57.1
#1946	36.8	39.2	55.0	56.0	65.2	72.4	76.2	72.6	70.0	61.4	51.8	41.4	58.0
#1947	41.7	51.4	40.0	57.2	64.6	71.6	75.5	79.0	69.8	64.5	46.2	36.6	56.5
#1948	28.8	56.8	48.0	55.9	64.6	74.0	78.0	75.8	69.4	56.2	51.4	40.2	56.6
1949	42.8	43.8	46.6	55.0	66.0	75.1	81.0	77.6	67.1	65.4	48.1	41.9	59.0
1950	48.0	58.7	41.7	52.4	64.5	73.9	76.2	75.6	66.9	61.0	47.9	55.6	56.9
1951	39.3	38.6	45.6	55.9	64.9	73.4	78.7	76.8	70.3	62.1	44.1	40.9	57.6
1952	40.7	41.1	43.3	57.0	64.2	76.9	80.5	76.2	68.9	55.3	48.2	58.9	57.6
1953	40.7	42.6	47.5	56.1	70.1	74.6	79.6	76.3	69.7	60.5	48.1	40.9	58.9
1954	35.9	43.5	44.5	59.6	62.6	74.4	78.8	75.2	73.3	62.0	45.2	37.1	57.7
1955	35.4	57.8	47.1	58.2	67.1	70.2	82.1	78.5	69.9	59.6	45.5	33.6	57.1
1956	34.5	41.1	45.2	53.6	63.6	73.3	75.6	75.0	66.6	59.0	46.1	44.2	56.3
1957	32.9	41.4	45.8	59.2	67.2	76.6	79.2	75.7	71.9	55.4	49.6	41.4	58.0
1958	34.4	51.2	41.4	57.1	65.2	71.2	79.1	75.4	69.1	59.1	49.9	32.9	55.5
1959	54.9	39.0	45.4	58.5	69.8	76.0	78.5	80.5	73.2	62.2	46.8	42.0	58.9
#1960	38.2	38.3	55.6	61.2	65.7	74.1	77.0	78.5	71.3	58.7	48.5	31.0	56.3
1961	29.8	38.3	47.6	52.0	62.2	75.2	78.6	77.6	74.8	59.5	50.2	36.4	56.7
1962	34.6	54.6	44.2	56.3	68.7	73.8	75.3	76.8	67.0	60.3	44.9	33.2	55.8
1963	31.4	51.0	48.5	57.8	64.9	73.7	77.6	75.4	66.5	61.2	49.8	51.1	55.7
1964	36.3	56.9	47.5	54.1	68.1	76.0	79.1	75.5	69.9	55.1	51.0	39.9	57.5
1965	33.4	56.8	41.4	51.8	69.1	72.6	78.2	77.2	72.6	57.5	49.5	41.5	56.8
1966	32.4	56.2	47.5	52.7	65.0	76.0	80.9	78.7	68.6	57.0	49.5	57.6	56.8
1967	41.0	54.0	45.0	57.6	60.0	74.7	77.2	76.2	68.0	57.9	45.0	59.9	56.4
1968	31.4	54.3	49.7	58.0	65.7	74.1	79.9	79.2	72.0	61.3	50.0	36.6	57.5
1969	34.2	56.9	43.0	58.7	68.4	77.1	79.5	76.3	70.1	58.8	47.2	36.3	57.2
1970	50.0	57.1	41.9	55.3	68.3	75.2	79.2	79.0	75.0	62.5	49.3	39.7	57.7
1971	51.3	59.1	45.2	55.0	63.7	75.9	78.3	76.7	73.0	64.7	48.2	45.5	57.9
1972	38.5	56.5	45.6	54.1	64.6	70.2	77.5	75.9	71.0	56.0	46.8	43.6	56.7
1973	37.6	57.0	51.1	56.0	62.8	77.1	79.2	79.9	74.3	63.3	51.6	41.9	59.3
1974	42.9	39.2	49.2	58.3	65.1	71.5	79.0	78.4	70.2	57.3	50.9	43.1	58.8
1975	40.9	40.6	45.2	53.6	69.7	76.4	79.3	80.1	68.5	63.2	54.4	40.5	59.4
1976	33.9	46.9	51.3	59.9	65.0	77.6	78.4	76.7	70.4	55.4	43.0	35.5	57.9
1977	25.4	38.8	52.7	60.1	69.4	74.3	80.9	78.8	73.9	59.0	51.8	38.1	58.6
1978	32.5	51.4	44.6	57.7	65.8	76.7	78.8	81.3	73.6	59.4	52.2	45.1	58.1
RECORD MEAN	55.7	57.8	46.0	56.3	68.8	74.5	78.5	77.1	70.5	59.5	48.5	58.4	57.4
MAX	43.3	46.5	55.1	66.8	75.7	83.8	87.5	85.8	79.4	69.0	57.2	45.9	66.3
MIN	28.0	29.5	56.8	45.8	55.9	65.1	69.5	68.3	61.5	49.9	59.8	50.8	48.4

Heating Degree Days

Season	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	Total
1958-59	0	0	24	203	447	987	926	721	601	222	39	8	4176
1959-60	0	0	28	195	545	706	824	766	905	200	103	0	4270
#1960-61	0	0	7	212	489	1048	1081	740	536	399	125	6	4641
1961-62	0	0	16	181	459	882	932	848	642	302	60	0	4322
1962-63	0	0	59	182	599	981	1034	946	505	245	87	1	4639
1963-64	0	0	70	129	449	1042	882	810	536	339	94	4	4315
1964-65	0	0	29	300	415	771	974	785	724	395	27	24	4444
1965-66	0	1	18	236	458	723	1001	800	535	374	99	11	4256
1966-67	0	0	41	266	462	863	735	859	611	249	178	3	4227
1967-68	0	0	34	240	592	773	1033	886	471	216	87	0	4332
1968-69	0	0	0	162	645	875	949	780	671	208	40	0	4130
1969-70	0	0	18	228	525	883	1077	773	713	294	56	0	4565
1970-71	0	0	17	131	464	777	1034	722	670	294	85	2	4196
1971-72	0	0	12	61	518	597	815	817	599	326	56	21	3822
1972-73	0	0	8	278	543	654	843	777	423	286	109	0	3921
1973-74	0	0	4	105	399	708	677	716	490	228	85	4	3416
1974-75	0	0	26	250	446	674	740	677	608	345	24	0	3790
1975-76	0	0	20	102	328	752	956	524	415	236	80	0	3413
1976-77	0	0	11	306	652	907	1221	729	389	188	32	3	4438
1977-78	0	0	1	196	406	829	1001	933	633	219	86	0	4304
1978-79	0	0	9	192	378	671							

Cooling Degree Days

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
1969	0	0	0	24	151	367	458	360	180	59	1	0	1580
1970	0	0	0	10	166	311	449	442	324	60	0	0	1762
1971	0	0	0	0	52	337	422	372	258	60	22	0	1523
1972	0	0	5	9	50	184	395	346	195	8	2	0	1186
1973	0	0	2	21	67	371	448	469	288	57	3	0	1706
1974	0	0	4	33	96	205	441	422	192	17	27	0	1437
1975	1	0	0	12	177	344	448	475	132	50	15	0	1654
1976	0	4	1	92	86	383	424	370	179	15	0	0	1554
1977	0	0	10	49	177	289	496	434	274	18	15	0	1762
1978	0	0	0	10	117	358	434	514	274	25	0	0	1732

Precipitation

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
1939	3.41	5.71	2.89	3.70	0.41	4.55	2.01	3.22	6.90	4.06	1.40	2.20	40.54
1940	2.12	2.77	5.42	6.19	3.10	0.86	5.73	5.00	1.34	2.15	5.26	2.27	40.21
#1941	3.04	0.92	2.57	2.73	1.58	4.38	5.57	2.30	0.93	0.99	0.58	5.28	26.87
1942	2.19	1.55	3.87	0.26	5.51	3.73	4.51	11.61	2.64	8.18	1.92	4.25	48.02
1943	2.57	2.02	3.86	2.88	5.50	2.50	1.79	0.57	1.88	3.13	4.21	1.25	31.56
1944	2.56	2.51	4.83	2.98	1.11	2.77	5.62	6.01	4.97	2.59	5.14	2.97	41.46
1945	2.69	2.80	0.64	3.13	3.06	5.51	11.06	2.62	3.93	1.54	4.24	4.71	45.53
1946	1.88	2.32	1.67	1.93	6.99	1.40	3.14	5.75	2.72	2.77	1.53	1.72	53.62
1947	3.81	1.27	1.02	2.48	4.44	6.86	3.47	1.81	4.70	1.23	4.20	1.36	36.65
1948	4.57	1.67	3.66	5.05	8.87	5.44	4.31	9.00	3.19	5.09	6.00	4.69	57.54
1949	5.08	2.68	3.42	1.94	6.33	2.42	4.22	4.09	5.49	5.27	0.94	1.98	39.86
1950	1.91	2.72	4.17	1.86	5.76	5.14	5.11	7.32	6.73	5.59	2.87	2.72	47.90
1951	2.18	2.65	2.92	3.49	2.74	6.69	5.25	1.75	2.67	1.67	4.79	4.54	41.34
1952	4.48	1.77	5.76	5.97	4.73	3.06	4.46	5.20	4.06	0.66	6.33	2.95	47.45
1953	4.13	2.35	7.43	4.77	10.69	2.98	2.72	3.48	4.07	5.73	1.50	3.32	51.17
1954	2.30	0.85	3.47	5.30	2.98	1.24	1.70	3.15	0.63	4.06	1.78	2.82	28.28
1955	0.51	5.13	3.70	2.87	5.58	2.76	2.52	14.51	0.65	6.46	1.63	0.22	41.44
1956	1.99	2.82	3.53	2.06	2.17	2.66	5.88	1.94	3.70	2.62	2.81	3.02	55.20
1957	2.61	2.75	2.23	2.73	1.40	3.02	1.05	2.44	3.57	2.49	2.87	5.62	52.78
1958	2.51	4.14	5.85	4.92	2.77	5.21	7.15	6.49	2.57	2.35	2.04	1.62	45.62
1959	2.21	1.51	2.20	4.01	2.89	5.35	4.38	2.87	2.05	2.43	2.22	3.26	55.38
1960	2.66	3.33	2.08	3.15	4.35	2.85	4.61	4.13	4.17	2.54	0.99	2.43	36.99
1961	3.12	5.71	4.18	5.24	2.57	4.84	5.95	6.51	1.02	2.37	1.75	2.88	41.94
1962	1.59	3.65	3.83	2.90	5.46	2.44	1.63	0.55	2.64	1.93	5.12	3.33	33.07
1963	1.86	1.94	5.43	0.99	1.06	6.87	1.95	7.21	5.61	T	6.70	1.72	39.34
1964	3.98	5.58	2.53	4.57	1.46	1.30	1.87	1.89	5.07	1.54	1.42	2.87	29.48
1965	2.73	1.89	4.57	1.65	1.72	1.88	2.98	4.44	2.12	2.52	0.37	0.47	26.94
1966	3.95	5.57	1.44	5.33	2.74	2.02	0.93	1.67	6.87	4.72	1.50	5.28	36.02
1967	1.35	2.37	5.49	0.80	4.27	1.51	5.24	9.17	0.20	1.77	2.10	5.93	38.15
1968	1.97	0.80	5.66	1.53	4.23	7.40	1.31	3.98	2.97	5.17	5.62	2.22	36.83
1969	1.69	2.08	1.60	1.71	1.20	3.46	9.44	6.98	5.07	1.14	2.59	6.54	45.30
1970	1.24	2.69	2.82	5.55	2.79	2.80	8.12	1.09	1.57	2.05	5.77	3.33	39.62
1971	1.86	5.44	1.93	2.10	6.80	1.72	4.97	7.18	2.48	6.12	5.76	1.66	46.02
1972	2.45	5.27	2.27	3.99	4.78	11.53	3.43	2.82	1.27	3.56	6.05	4.55	51.97
1973	2.26	2.68	2.97	4.19	5.59	2.11	2.68	4.41	1.58	1.71	0.97	6.05	54.98
1974	2.66	0.95	4.21	2.26	4.57	5.40	1.15	5.77	4.39	1.13	1.24	4.45	55.96
1975	5.09	1.56	5.53	2.13	4.71	2.15	7.16	5.54	12.56	2.38	2.05	4.04	50.50
1976	3.56	1.55	2.51	1.17	3.57	1.21	4.54	2.15	7.23	7.76	0.85	1.99	58.07
1977	1.50	0.66	2.17	2.66	1.73	3.28	4.06	4.74	0.32	5.35	4.81	4.86	56.14
1978	7.11	0.42	4.48	1.58	5.13	2.43	4.28	5.85	1.01	1.16	2.51	4.00	59.56
RECORD MEAN	2.71	2.46	5.34	2.79	3.88	5.44	4.11	4.71	5.30	2.92	2.93	5.23	39.82

Snowfall

Season	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	Total
1939-40	0.0	0.0	0.0	0.0	0.4	4.4	15.3	4.3	0.4	0.5	0.0	0.0	25.3
1940-41	0.0	0.0	0.0	1.5	T	T	3.2	2.0	11.2	0.0	0.0	0.0	17.9
1941-42	0.0	0.0	0.0	0.0	0.0	0.2	1.8	0.1	11.5	0.0	0.0	0.0	13.6
1942-43	0.0	0.0	0.0	0.0	0.0	5.7	6.2	0.7	7.9	T	0.0	0.0	20.5
#1943-44	0.0	0.0	0.0	0.0	T	0.1	2.0	2.5	T	T	0.0	0.0	4.6
1944-45	0.0	0.0	0.0	0.0	T	1.5	2.8	3.0	T	0.0	0.0	0.0	7.3
1945-46	0.0	0.0	0.0	0.0	T	10.3	6.8	4.5	T	0.0	0.0	0.0	21.6
1946-47	0.0	0.0	0.0	0.0	0.0	2.2	4.1	10.3	3.4	0.0	0.0	0.0	20.0
1947-48	0.0	0.0	0.0	0.0	T	3.6	12.1	7.7	T	0.0	0.0	0.0	23.4
1948-49	0.0	0.0	0.0	0.0	T	4.4	7.4	4.0	T	0.0	0.0	0.0	15.8
1949-50	0.0	0.0	0.0	0.0	T	T	0.5	T	3.1	T	0.0	0.0	3.6
1950-51	0.0	0.0	0.0	0.0	1.6	3.8	0.8	3.0	1.0	0.0	0.0	0.0	10.2
1951-52	0.0	0.0	0.0	0.0	T	4.8	1.6	T	3.8	0.0	0.0	0.0	10.2
1952-53	0.0	0.0	0.0	0.0	1.7	2.0	1.3	0.2	3.1	T	0.0	0.0	8.3
1953-54	0.0	0.0	0.0	0.0	6.7	T	11.3	T	T	0.0	0.0	0.0	18.0
1954-55	0.0	0.0	0.0	T	0.0	0.1	2.5	4.2	T	0.0	0.0	0.0	6.8
1955-56	0.0	0.0	0.0	0.0	2.3	0.5	4.5	T	4.0	0.0	0.0	0.0	11.3
1956-57	0.0	0.0	0.0	0.0	T	0.2	10.1	1.6	2.2	0.1	0.0	0.0	14.2
1957-58	0.0	0.0	0.0	T	0.3	12.0	0.5	17.2	10.6	0.0	0.0	0.0	40.4
1958-59	0.0	0.0	0.0	0.0	T	0.9	4.0	T	T	T	0.0	0.0	4.9
1959-60	0.0	0.0	0.0	0.0	T	T	T	7.2	17.1	0.0	0.0	0.0	24.3
1960-61	0.0	0.0	0.0	0.0	T	8.7	13.6	18.0	T	T	0.0	0.0	40.3
1961-62	0.0	0.0	0.0	0.0	1.3	1.2	2.0	6.5	4.0	0.0	0.0	0.0	15.0
1962-63	0.0	0.0	0.0	0.0	T	16.2	2.1	2.0	1.1	0.0	T	0.0	21.4
1963-64	0.0	0.0	0.0	0.0	T	6.4	8.9	11.7	6.2	0.4	0.0	0.0	33.6
1964-65	0.0	0.0	0.0	0.0	0.2	0.5	9.1	1.9	5.4	0.0	0.0	0.0	17.1
1965-66	0.0	0.0	0.0	0.0	0.0	0.2	21.5	6.9	T	0.0	0.0	0.0	28.6
1966-67	0.0	0.0	0.0	0.0	T	16.1	1.5	19.0	0.7	0.0	[illegible]	0.0	37.1
1967-68	0.0	0.0	0.0	0.0	6.9	6.3	2.8	2.4	5.0	0.0	0.0	0.0	21.4
1968-69	0.0	0.0	0.0	0.0	T	T	0.2	2.2	6.7	0.0	0.0	0.0	9.1
1969-70	0.0	0.0	0.0	0.0	T	6.8	5.6	3.6	T	0.0	0.0	0.0	14.0
1970-71	0.0	0.0	0.0	0.0	T	5.2	4.8	0.3	1.4	T	0.0	0.0	11.7
1971-72	0.0	0.0	0.0	0.0	1.4	0.1	0.5	14.4	T	0.6	0.0	0.0	16.8
1972-73	0.0	0.0	0.0	T	T	0.0	T	0.1	T	T	0.0	0.0	0.1
1973-74	0.0	0.0	0.0	0.0	0.0	11.0	1.5	4.2	T	T	0.0	0.0	16.7
1974-75	0.0	0.0	0.0	T	T	0.1	6.6	5.8	0.3	T	0.0	0.0	12.8
1975-76	0.0	0.0	0.0	0.0	0.0	0.4	0.1	0.9	0.8	0.0	0.0	0.0	2.2
1976-77	0.0	0.0	0.0	0.0	0.8	0.6	9.7	0.0	0.0	T	0.0	0.0	11.1
1977-78	0.0	0.0	0.0	0.0	0.1	0.2	10.5	3.8	8.3	0.0	0.0	0.0	22.7
1978-79	0.0	0.0	0.0	0.0	3.1	T							
RECORD MEAN	0.0	0.0	0.0	T	0.8	3.6	4.9	4.8	2.5	T	T	0.0	16.6

# Indicates a station move or relocation of instruments. See Station Location table.

Record mean values above are means through the current year for the period beginning in 1872 for temperature, 1871 for precipitation, and 1944 for snowfall. Temperature, precipitation, and heating degree day data are from City Office sites through June 1941 and from Airport sites thereafter. Snowfall data are from City Office sites through 1943 and from Airport sites thereafter.

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