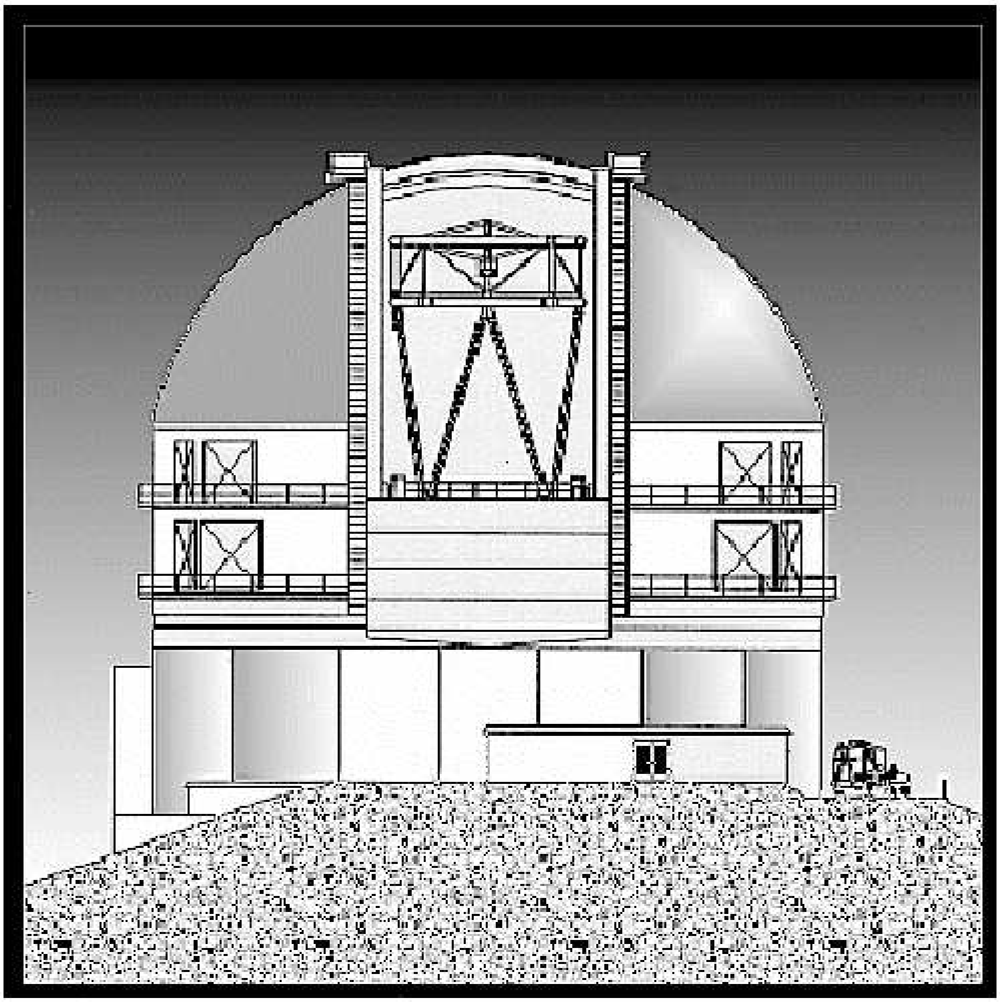
GEMINI
8-M Telescopes
Project

ICD-G0013
Revision B

Gemini Environmental Requirements



D. Montgomery/J. Robinson

October 8, 1996

Approved By: Systems Engineering ______________________

Group Manager ______________________

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ICD-G0013
REVISION CONTROL

Revision: A
Date: 7/12/96
Approved: See Cover Sheet
Description: Initial Release

Revision: B
Date: 10/8/96
Approved: See Cover Sheet
Description: (1) Changed operating specification to -5°C to +20°C as this covers 0% through 98% for Cerro Pachon cumulative distribution and 5% through 100% of Muan Kea cumulative distribution. (2) Added more complete temperature plots. (3) Changed temperature rate of change to 0.8°C/hr. (4) Added median air temperatures.

Introduction

This document will define the operating environment for the instruments and facility modules and how they must perform under these conditions. Three separate evironmental conditions are specified. The first is involved with transportation, the second with general site operations and the third with operating while mounted on the telescope. It is recognized that it may be difficult or prohibitively expensive to actually test instruments under all of these conditions. Where this is the case, these specifications can be used as a guide for the design and verified by analysis or experience with previous instruments. This document is little more than a description of the conditions experienced by existing instruments in transit or operating at either site.

1. Transportation/shipping environment.

The shipping environment are those conditions experienced when the module is shipped. The instrument and its components must remain undamaged after repeated cycles of these conditions. It is not a requirement that the instrument meet this specification in an assembled operational condition, a moderate level of work is acceptable at both ends of the shipping process (disassembly, packing, unpacking, assembly, etc). One of the design goals for the instrument should be to minimize this work.

Table 1: Transportation/shipping

Condition	**Requirement**
Altitude	sea level to 15,500m
Ambient air temp Induced by packing[1]	low diurnal limits (A1[1]) -25°C to -33°C high diurnal limits (C1[1]) 33°C to 71°C
Temperature shock	±35°C
Relative humidity	0% to 100% with condensation
Wind speed	0 to 67 m/sec
Gravity orientation	All orientations
Vibration[2]	PSD 0.015 g^2/Hz 10 to 40 Hz 0.00015 g^2/Hz @ 500Hz
Shock[3]	Peak acceleration 15g all axes
Cleanliness	Occasional wind blown dust, sand and insects

1. IAW MIL-STD-810E, July ‘89 section 501.3,502.3
2. IAW MIL-STD-810E, July ‘89 section 514.4
3. IAW MIL-STD-810E, July ‘89 section 516.2

2. Telescope Operations Environment.

The telescope operations environment are those conditions experienced under normal telescope operations including storage at the base and moutain facilities, handling onto the ISS, storage on the ISS and operating on the ISS and dissassembly from the ISS. After repeated cycles of the above conditions the module must meet its operating performance requirements with no intervention from the operations staff other than routine tasks (handling, connecting services, LN fill etc.)

Table 2: Telescope Operations Environment

Condition	**Requirement**
Altitude	sea level to 4300m
Ambient air temp	-15°C to +25°C
Ambient air temp step	±25°C
Ambient light	Night time observing conditions to normal laboratory lighting conditions
Relative humidity[2]	0% to 100% with condensation
Wind speed	0 to 33 m/sec external wind
Gravity orientation	All orientation
Vibration (minimum integrity)[1]	PSD 0.0008 g^2/Hz, 20-1000 Hz in all axes
Shock	Peak acceleration 10g
Seismic base acceleration	0.4g, 0.5 Hz to 100Hz, any axis
Seismic acceleration at cass	2.0g, 0.5 Hz to 100Hz, any axis
Mechanical Interface	ISS or handling cart
Cleanliness	Occasional wind blown dust, sand & insects

1. IAW MIL-STD-810E, July ‘89 section 514.4-39
2. Frequent low humidity levels increase the risk of electrostatic discharge damage to sensitive electronic devices.

3. Instrument Operating Environment.

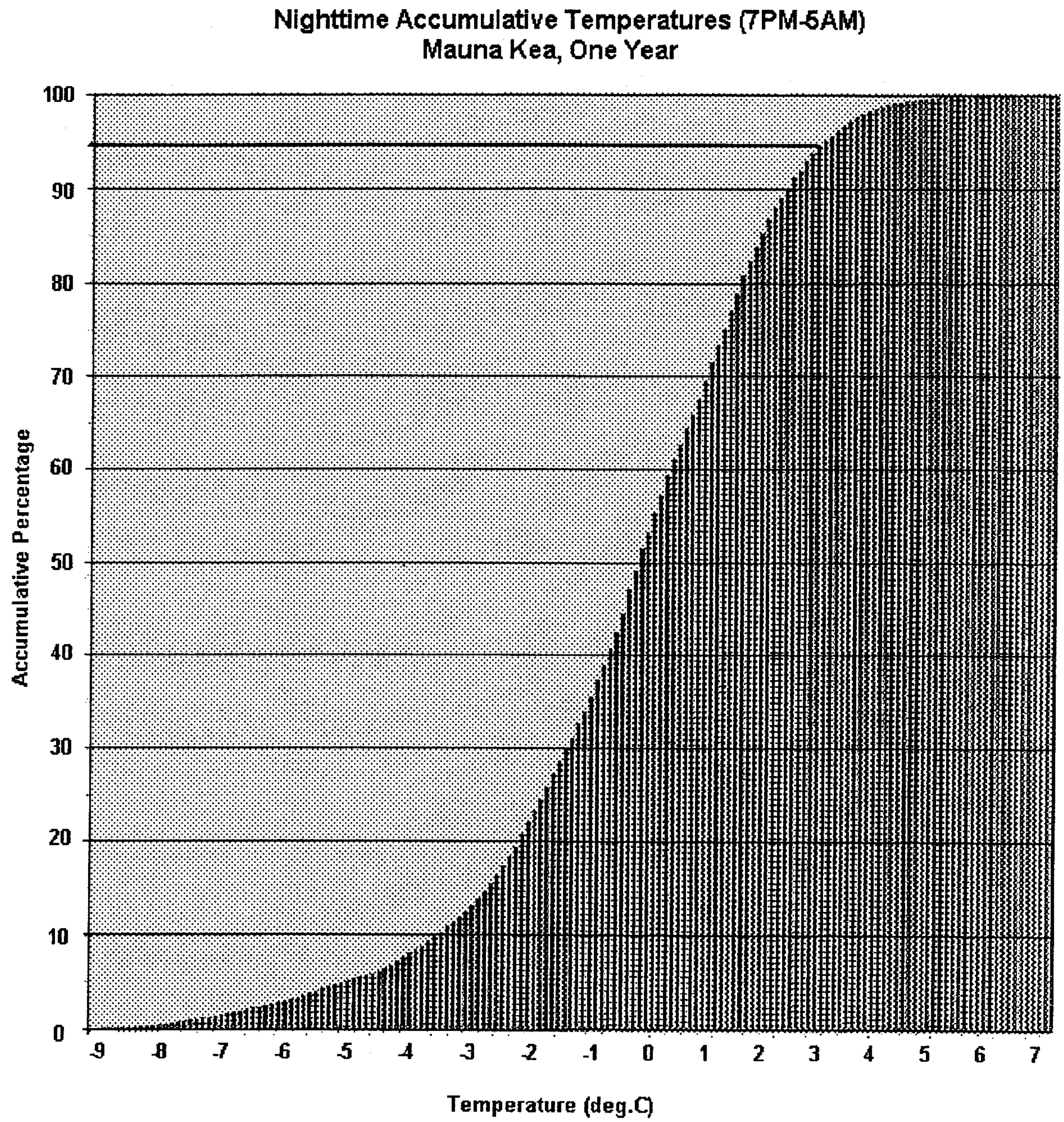
The instrument operating environment are those conditions experienced under normal telescope operations when the module is mounted on the ISS and in use. The instruments performance requirements must be met under these conditions. These conditions also include the testing of the instrument on its handling cart at the telescope and at the base facilities.

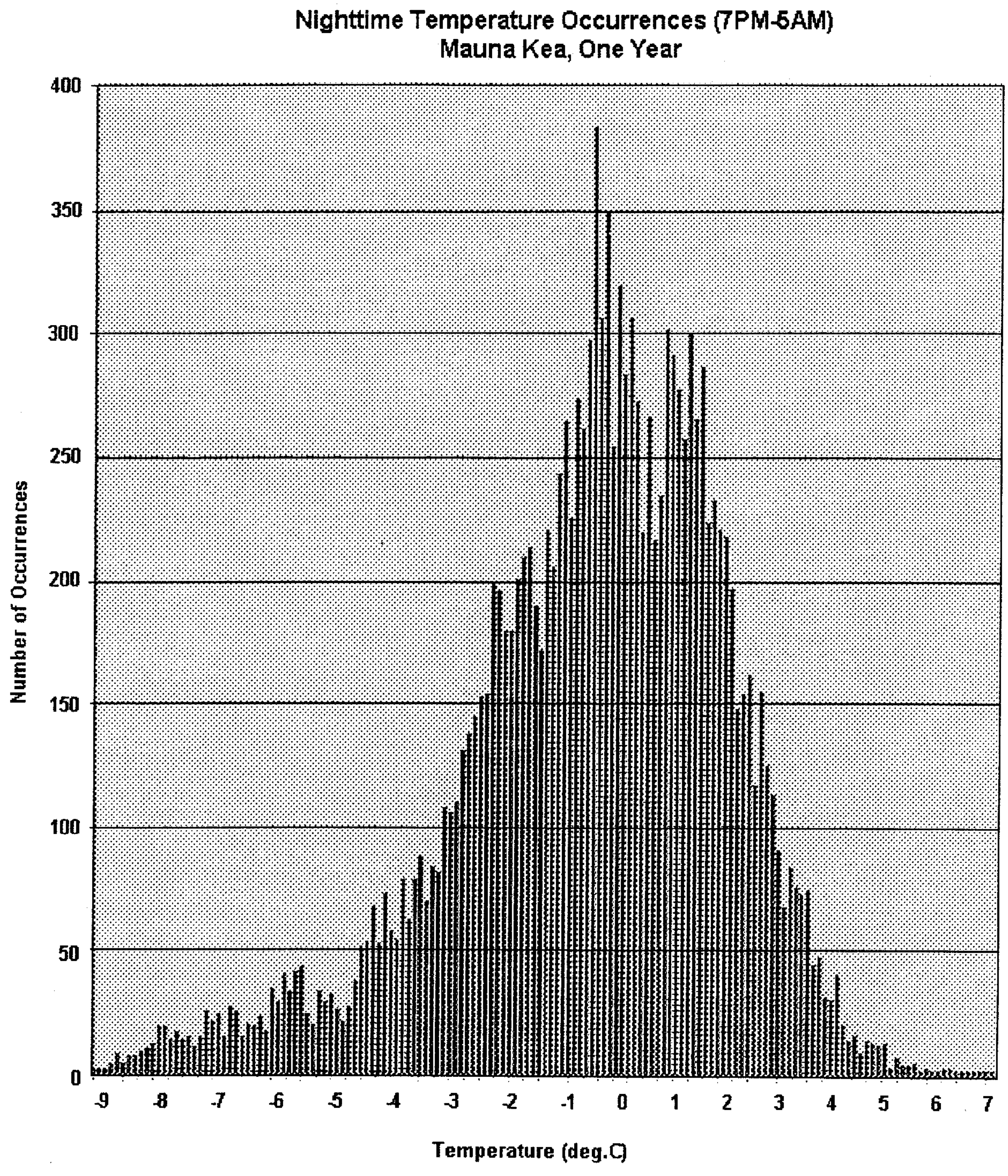
Table 3: Instrument operating environment

Condition	**Requirement**
Altitude	sea level to 4300m
Ambient air temp	-5°C to +20°C[1]
Median air temp	0°C Mauna Kea 9°C Cerro Pachon
Ambient air temp rate of change	±0.8°C/hour[2]
Relative humidity[3]	0% to 90%
Wind speed	0 to 5 m/sec
Gravity component limits (components vary continuously and in discrete steps)	X axis ±1g Y axis ±1g Z axis -1g to 0g[4]
Vibration	PSD $1x10^{-5}$ g^2/Hz, 20-1000Hz, 6db/oct drop-off to 2000Hz
Mechanical Interface	ISS or handling cart
Cleanliness	Occasional wind blown dust, sand & insects

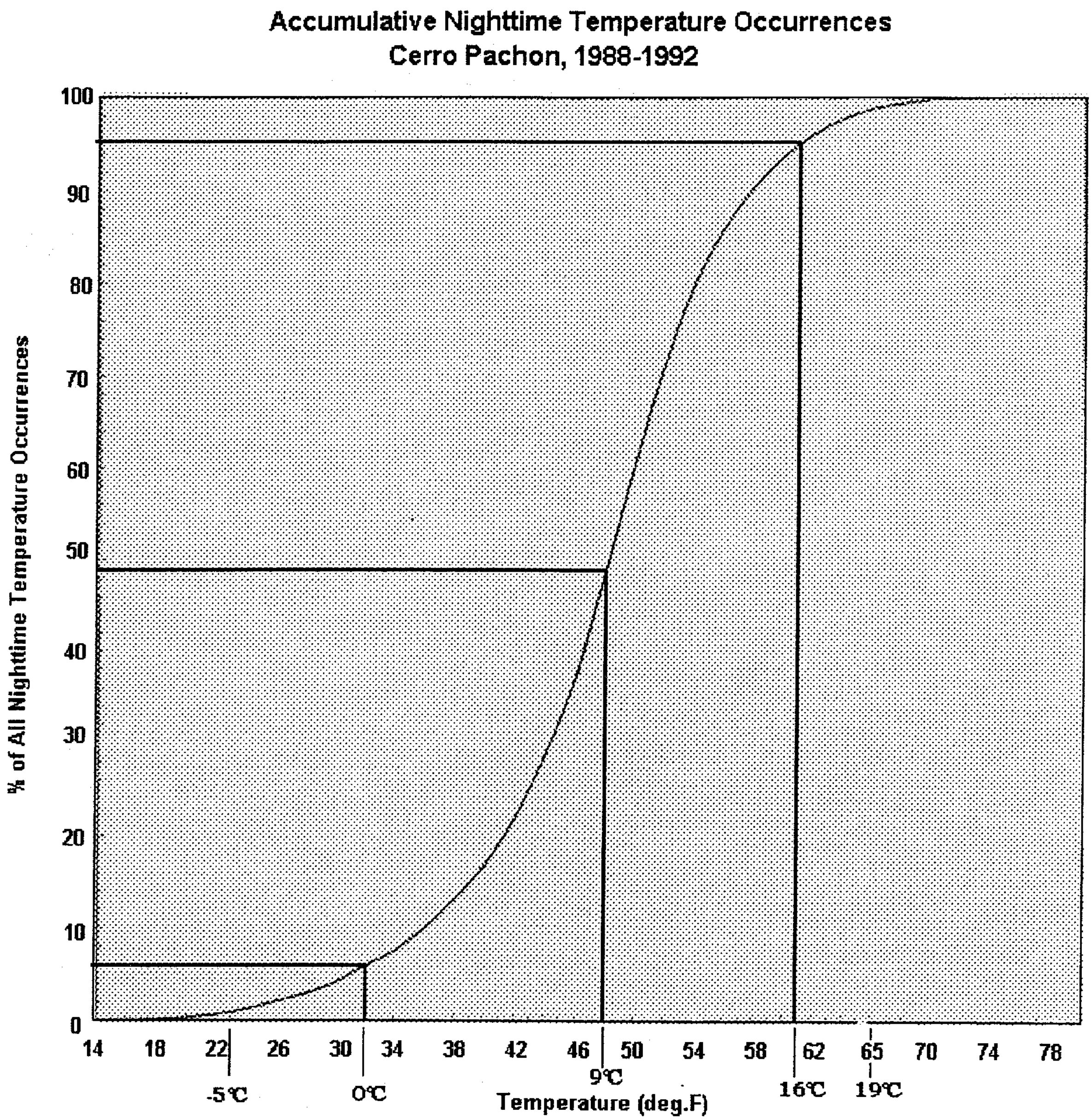
1. This represents the total nocturnal temperature ranges for Mauna Kea and Cerro Pachon (except for lower 5% of Mauna Kea). If needed, instruments intended for one site may use a more limited temperature range given in the site specific data attached, allowing for a site specific focus adjustment.
2. This represents nocturnal rate of change for the Cerro Pachon site. Any instrument being designed exclusively for the Mauna Kea site may obtain a waiver to meet ±0.2°C/hour if the larger rate of change is a problem.
3. Frequent low humidity levels increase the risk of electrostatic discharge damage to sensitive electronic devices.
4. Facility module Z axis gravity orientation is -1g+0g in operation. Co-ord system is the Optical Support Structore Co-ordinate System.

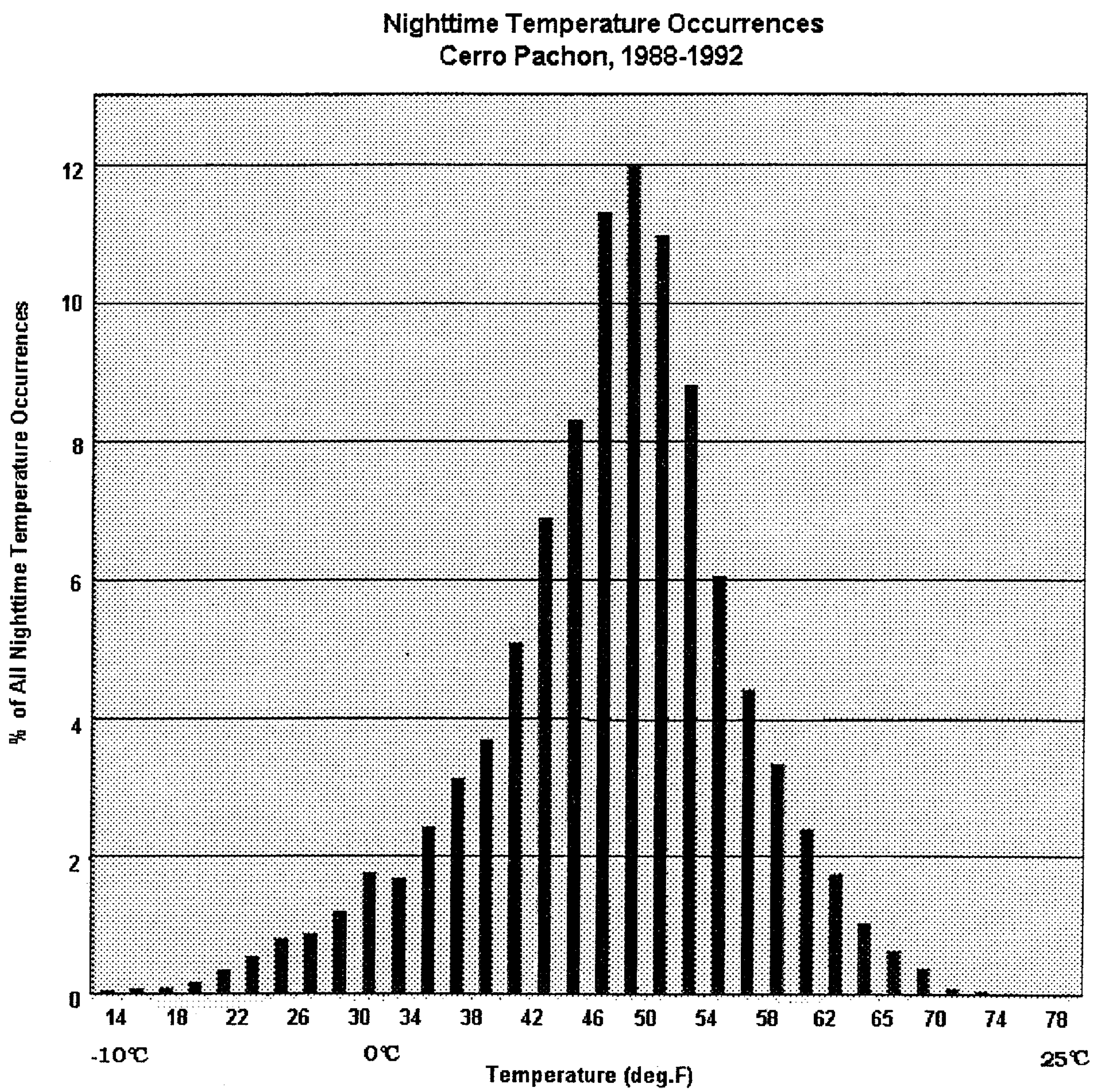
MAUNA KEA AMBIENT AIR TEMPERATURE DATA

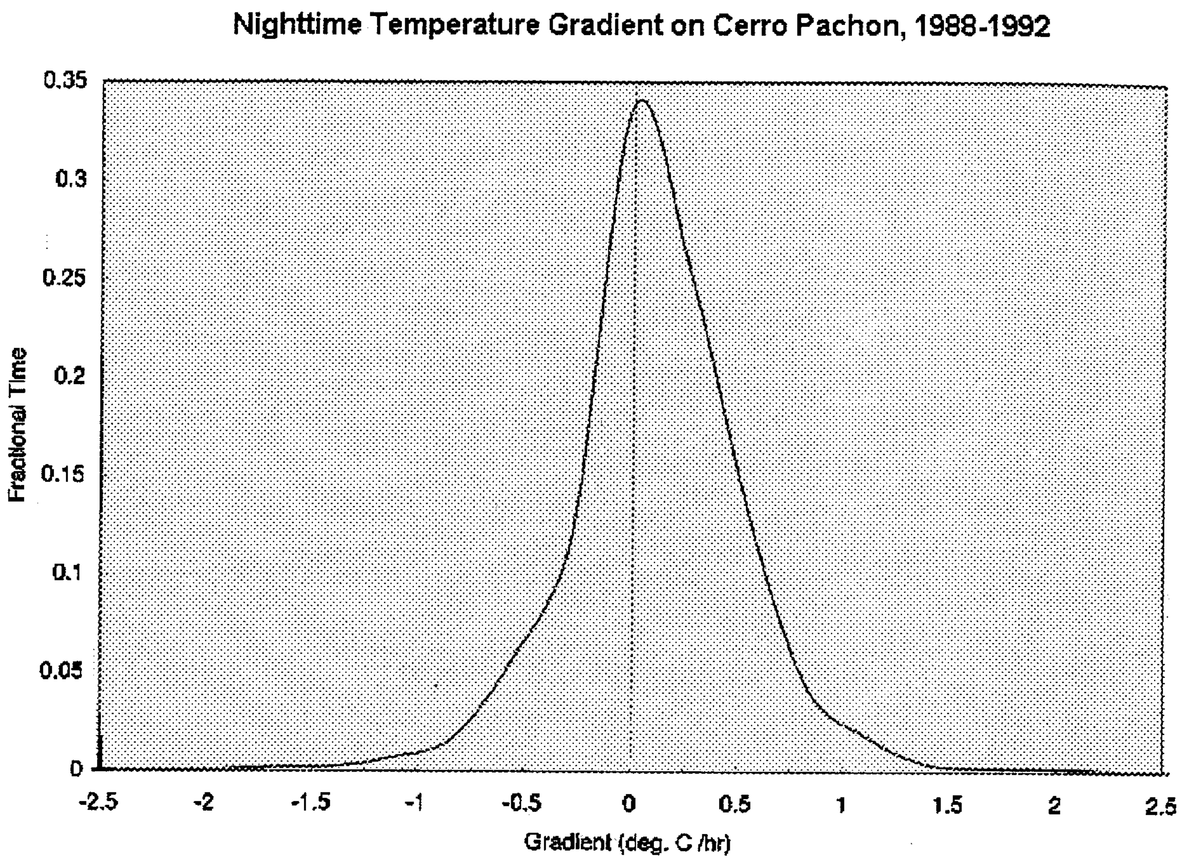


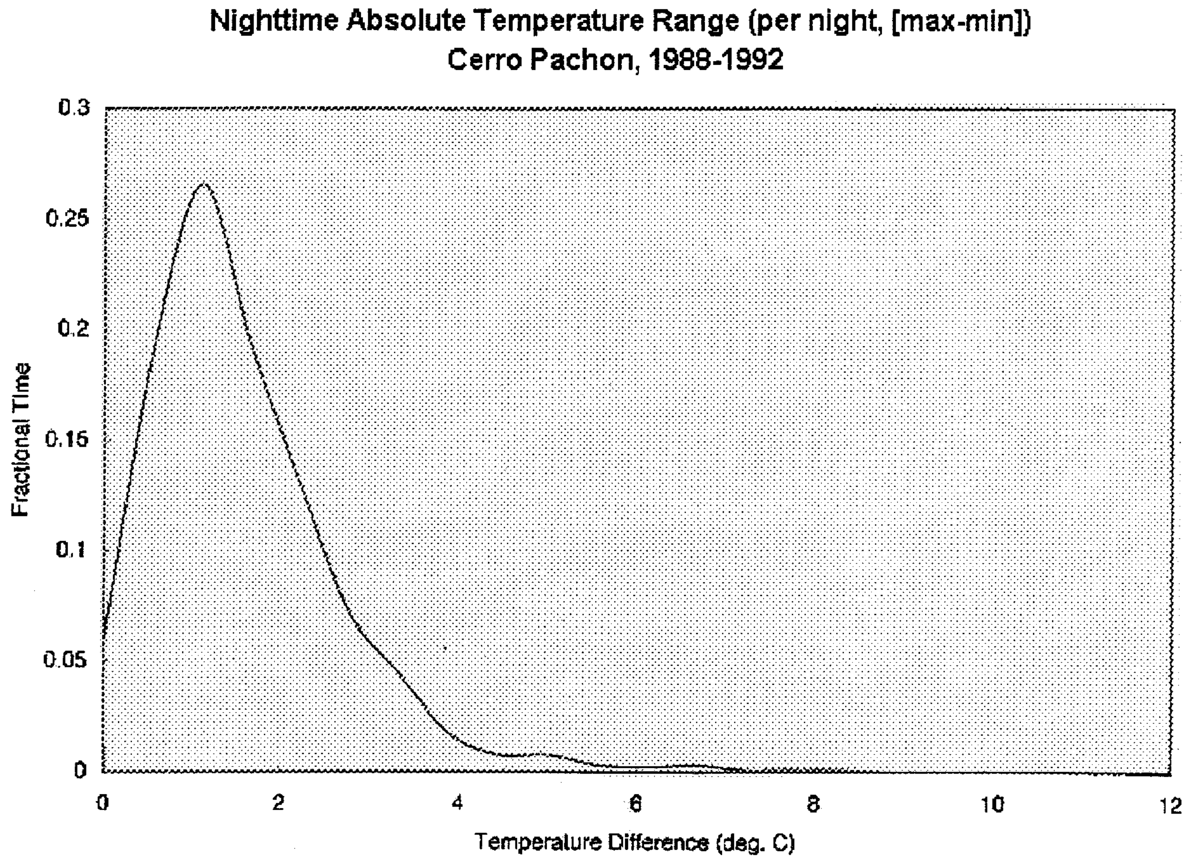

Nighttime Temperature Occurrences (7PM-5AM)
Mauna Kea, One Year
Number of Occurrences
400
350
300
250
200
150
100
50
0
-9
-8
-7
-6
-5
-4
-3
-2
-1
0
1
2
3
4
5
6
7
Temperature (deg.C)

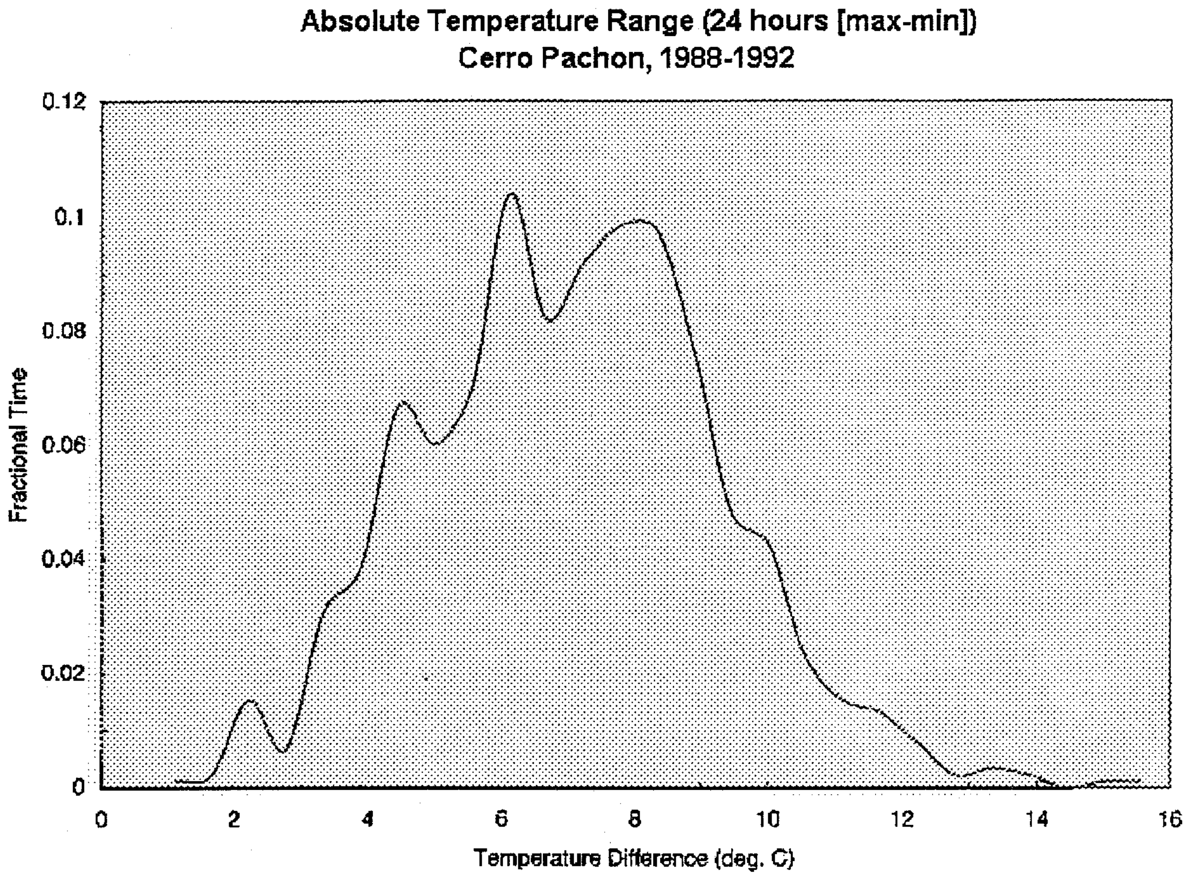
Cerro Pachon Ambient Air Temperature Data




Nighttime Temperature Occurrences
Cerro Pachon, 1988-1992
% of All Nighttime Temperature Occurrences
0
2
4
6
8
10
12
14
18
22
26
30
34
38
42
46
50
54
58
62
65
70
74
78
-10℃
0℃
25℃
Temperature (deg.F)


Nighttime Temperature Gradient on Cerro Pachon, 1988-1992
Fractional Time
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
-2.5
-2
-1.5
-1
-0.5
0
0.5
1
1.5
2
2.5
Gradient (deg. C /hr)


Nighttime Absolute Temperature Range (per night, [max-min])
Cerro Pachon, 1988-1992
Fractional Time
0.3
0.25
0.2
0.15
0.1
0.05
0
0
2
4
6
8
10
12
Temperature Difference (deg. C)


Absolute Temperature Range (24 hours [max-min])
Cerro Pachon, 1988-1992
Fractional Time
0.12
0.1
0.08
0.06
0.04
0.02
0
0
2
4
6
8
10
12
14
16
Temperature Difference (deg. C)