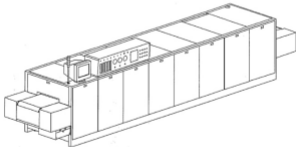


OWNER'S MANUAL

MODEL: 7K12-72C36-8RH
SERIAL NUMBER: 8025
MANUFACTURED FOR: Evergreen Solar
SHIP DATE: July 2005



SIERRATHERM

PRODUCTION FURNACES INC.

PROCUREMENT SPECIFICATION

SierraTherm SERIES 7500

MODEL 7K12-76C36-8RH

INFRARED DIFFUSION FURNACE

1. General Description

This specification describes a multiple zone, electrically heated, conveyor furnace capable of operating to 950 degrees centigrade. The furnace includes a controlled air atmosphere system for the primary application of the rapid thermal diffusion of a phosphorus diffusion source into silicon solar cells.

2. General Specification Overview

	Inch	MM
A. Transport Width:	12	305
B. Heated Length:	76	1930
C. Graduated Cooling Length:	36	914
D. Clearance Above Conveyor:	1.0	25
E. Dimensions:		
Entry Table:	12	305
Exit Table:	13	330
Overall Length:	149	3783
Height:	60	1524
Width:	48	1220
Conveyor Height:	36	914
Leveling Range:	± 1	25
F. Conveyor Speed Range:		
Minimum	1.0/min	25/min
Maximum	10/min	254/min
G. Number of Heated Zones:	8	
H. Atmosphere:	Air	
I. Input Power:	240 VAC 3 Phase Delta 50/60 Hz 65 KVA Max	
J. Approximate Weight:	5,000 lbs. (4540 Kg)	

3. Heated Section

- A. **Nominal operating temperature:** Ambient to 950 degrees centigrade.
- B. **Heating method:** Fast response heating section with Type T-3 tubular quartz tube I-R lamps located above and below the conveyor rollers.
- C. **Insulation:** Multi-Layered, thermally optimized, graded, insulation provides efficient thermal stability, cool external panel surfaces and minimal heat loss. Low mass refractory materials are utilized throughout the heated chamber resulting in rapid heat-up and cool-down times and maximum thermal responsiveness. High temperature glazing is applied to all interior chamber surfaces to ensure a clean, stable processing environment.

4. Furnace Layout

		Inch	MM	KVA
A.	Entrance, including atmosphere inlet	10	254	
B.	Exhaust Burnout Extractor	2	51	
	Zone 1	4	102	5.2
	Zone 2	4	102	5.2
	Zone 3	15	381	10.4
	Zone 4	15	381	10.4
	Zone 5	15	381	10.4
	Zone 6	15	381	10.4
	Zone 7	4	102	5.2
	Zone 8	4	102	5.2
C.	Insulated Exit	5	127	
D.	Water Cooled Section with atmosphere inlet and exit gas curtain	10	254	
E.	Free Cooling	2	51	
F.	Fan Cooling Section	18	457	
G.	Door to Door Process Chamber Length:	123	3125	

Note 1:

Top to bottom power trim shall be provided in all 8 zones.

Note 2:

An element continuity system shall be provided in all 8 zones.

Note 3:

Shadow walls formed with 1/2-inch thick ceramic fiber-board are positioned between each zone for isolation and provides 1-inch clearance above the belt.

Note 4:

The cooling method for the Water Cooling Section is facility water, @ 1.5GPM (20 PSI minimum pressure differential between inlet & outlet). The water cooling system includes temperature readout and High/Low process alarms through the MicroTherm controller, and a flow switch which activates an audible and visual alarm in the event of low flow conditions.

5. Loading/Unloading Tables

Inch MM

A. Load/Unload Tables

Width:	48	1220
Length:	12	305

Note 1:

Tables shall be provided with ceramic rollers driven from the furnace drive system and at the same speed.

Note 2:

The product shall not contact any metallic surface throughout the entire conveyor length.

6. Conveyor System

- A. Conveyor Type: Ceramic rollers
- B. Roller Material: Fused Silica
- C. Conveyor Loading: 5kg/m²
- D. Conveyor Speed: 1-10 inches (25-254 mm) per minute
- E. Speed Control: Microprocessor controlled, closed loop, digital feedback, ± 0.1% accuracy

7. Temperature Control System

The furnace is controlled with a MicroTherm temperature control system. The MicroTherm is a high performance, single board computer with full PID and control for up to 16 furnace channels. Each furnace zone is monitored and controlled using a type N thermocouple in the center of each heated zone. The MicroTherm incorporates closed loop conveyor speed control accurate to $\pm 0.1\%$.

Note:

All thermocouples shall be housed in a closed end ceramic protection tube.

8. User Interface System

A Pentium-based PC with a 15" flat panel monitor is provided for user interface. The User Interface Computer communicates with the Temperature Controller on a high speed serial link. A complete description of the User Interface features is described in a separate specification.

9. Over Temperature Safety Protection

The furnace is supplied with a redundant over temperature safety protection system which incorporates an additional type N thermocouple in the center of each controlled zone.

10. Atmosphere Control System

A. The following flow meters supply air to the process chamber:

	SCFH	LPM
1. Entry Curtain	0-600	0-230
2. Pre-heat Atmosphere Inlet	0-600	0-230
3. High-heat Atmosphere Inlet	0-600	0-230
4. Exit Curtain	0-600	0-230

B. Exhaust Extractor: 0-80 PSIG (5.4 Bar)

Note 1:

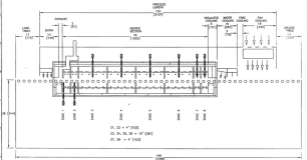
The furnace is supplied with a variable flow, air powered, exhaust burnout extractor, located before Zone 1. An exhaust condition monitor is provided for the extractor.

Note 2:

An audible alarm, and visual indicator is provided and will activate in the event of low pressure in the air supply line.

II. Operating Instruction Manuals

- A. The furnace is supplied with two copies of instruction manuals covering all phases of installation, operation, and maintenance procedures.



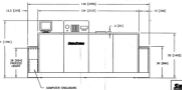
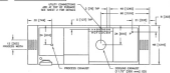
21, 22 = 7" (178)
 23, 24, 25, 26 = 10" (254)
 27, 28 = 7" (178)

1. OVERSHOOT IN HEIGHT (mm)

		SIERRATHERM PRODUCTION DIVISION 700 W. 10TH STREET SPARKS, NV 89411 (775) 350-1000	
		DATE: 10/19/00 DRAWN BY: J. PROCTOR CHECKED BY: J. PROCTOR	REV: 001
FURNACE LAYOUT 7XXX-76C36-8LR(RH)		PART NO: 6-90-75103 REV: A	

UNIT: STANDARD ELECTRICAL

REV.	DATE	BY	CHK
1	10/10/00	J. J. [unclear]	[unclear]
2	10/10/00	[unclear]	[unclear]



- NOTES:**
1. SEE SHEET 2 FOR WIRING CONNECTIONS AND EQUIPMENT SCHEDULES.
 2. SEE SHEET 3 FOR MOUNTING REQUIREMENTS.

Standard

STANDARD ELECTRICAL UNIT
 12'-0" (3048 mm) x 12'-0" (3048 mm)
 220 VAC

REV.	DATE	BY	CHK
1	10/10/00	J. J. [unclear]	[unclear]
2	10/10/00	[unclear]	[unclear]

7K12-76036-BUR (R4)
 OUTLINE & UTILITY
 CONNECTIONS
 220 VAC
 4-90-75102