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UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

51p.
tables
graphs
diagrams

22394 FINAL REPORT

Synopsis

This draft final report is provided to UNIDO to comply with the contract number2000/014P requirements. Herewith we also enclose our invoice referred to the contract which is upon UNIDO's receipt and acceptance of Draft Final Report.

Activities

Following activities were achieved during implementation of the contract.

Redesign of Prototypes

- Eight prototypes were redesigned as foreseen in the contract. To fulfill the new R134a ozone friendly refrigerant cooling system.
- The redesign of prototypes activities were focused mainly on Refrigeration load calculation to determine the proper size of compressor.
- Compressor sizing which is the heart of the refrigeration system circuit could be the main changes to the refrigeration system, and all other refrigeration component changes are proportional to the Compressor size and new refrigerant thermodynamic characteristics.

Training Programme

- A comprehensive course was conducted to make counterpart's experts with new technology of R134a ozone friendly refrigerant. Twenty hours of theorical course was the results of our training programme
- Practical work and prototype test operation was also considered to a part of our on the job training, because we believe that on the job training for making prototypes is the most important part of CFC-12 conversion programme

Making Prototypes

- Under our close supervision all six counterparts made 8 prototypes as foreseen in the contract. All prototypes were collected at IPEC premises for accomplish performance test.

- The prototypes were tested successfully and we found out that some of prototypes need to be modified to comply with R134a performance characteristics.
- The main changes that could be considered as the remarkable change to refrigeration system performance is that amount of refrigerant charge should be adjusted according to the new refrigeration system critera.

Testing Prototypes

- The prototypes were tested successfully at hot chamber for at least 24 hours each. All test results were analyzed and necessary advises were given to the counterpart to do necessary changes to the cooling system. The test sheets results are enclosed to this report to be as our main document for redesign of the prototypes,
- The performance tests are consist of three main part which should be implemented in accordance with ISO standard to determine the proper functionality of prototypes at desired ambient temperatur and environmental condition.
- The environmental condition is varied from prototype to prototypes. For this reason the hot chamber preparation and condition is changing all the time to fulfill the criteria setforth for the prototypes.
- We believe that the test results sheet could be a good guide for all counter parts to improve their prototype.

General

Based on information given in UNIDO's TOR, Lebanon has an area of 10,452 sq km with a population of 4.1808 million in 1997. The population density is approx. 400 persons per sq km. The urban population represents some 80 % of the total. GNP is approx. USD 1900 per capita in 1993 (USD 2250 in 1975 before the war). Agriculture accounts for 14% of GNP, industry 26% and service sector 60%. Lebanon depends entirely on imports for its ODS consumption. Lebanon ratified the Vienna Convention on March 30, 1993 (entered into force on June 28, 1993), Montreal Protocol on March 31, 1993 (entered into force on June 29, 1993), and London amendments on March 31, 1993 (entered into force on June 29, 1993).

The ratification of the Copenhagen amendments is still in process .The Country Programme (CP) for phasing out of ODS in Lebanon was prepared with the assistance of the National Working Committee on Ozone Depleting Substances,

established in 1994 at the Ministry of Environment. The CP is dated as of March 1995 and is being updated every year, and the statistic data on ODS consumption by different sub-sectors are updated every year and being reported to the concerned agencies and departments.

According to the clarifications of the Ministry of Environment, the imbalance between usage of CFC-12 for production and service is caused by the fact that in 1992-93 due to the post war situation in the country, local manufacturing of domestic and commercial refrigeration equipment was very low; import of refrigerators was also limited due to low financial capacity of the local market. Therefore during that time, the refrigeration equipment (domestic and commercial) repairing and recharging sub-sector was the major user of CFC-12, being very important from social point of view.

As a result of the progress of political and economic stabilization in Lebanon and in the region, the industrial and commercial scenario of ODS usage have been changed significantly in terms of ODS consumption redistribution within the relevant sectors and sub sectors, although the overall forecast-and tendency of total ODS consumption for 1995 - 2010 indicated in the Country Programme is valid.

The Country Programme was submitted to the Secretariat of the Multilateral Fund for presentation at the 17th Executive Committee Meeting, and it was reviewed and recommended for approval.

Due to a discrepancy in the accuracy of population data, provided by the country, the Ozone Secretariat classified Lebanon as non-Article 5 Party. Therefore, the Executive Committee decided at its 17th meeting, (decision 1 7/1) to defer the submission of the Country Programme of Lebanon and the projects included. By its decision VII/20, the 7th Meeting of the Parties decided, inter alia that in case of any discrepancy on the accuracy of the data, the data provided by the party to the Ozone Secretariat should be used. In compliance with this decision, the Ozone Secretariat reclassified Lebanon as a Party operating under Article 5.

The Country Programme is now being updated as of December 1998.In 1993, Lebanon imported and used 923.1 ODP Tonnes of ODS, equivalent to 0.24 Kg per capita compared to the year 1998, Lebanon imported and used 537 ODP Tonnes. The main substances used are CFC- 11, CFC-12, CFC-114, and CFC-115. It was forecasted that consumption will increase from the 1993 level of 923.1 ODP Tonnes to approx. 100.1 ODP Tonnes in 1995, since the economical

situation is more stable and that the war has ended and the country must be reconstructed rapidly. The total consumption may increase up to 2082 ODP Tonnes in the year 2010, if the Montreal Protocol is not implemented in Lebanon.
The Country Programme relies mainly on economic and other indirect measures for phasing-out ODS. Raising awareness and information dissemination will be the primary ways for the Government to promote phase-out. The Government is prepared to impose bans, duties and licenses to counter possible adverse developments. The Government expects to phase-out ODS by the year 2006.

In terms of technology and equipment employed the commercial refrigeration sector is very similar to the domestic appliance sector. The primary differences are in the size of equipment, which may be bigger in commercial applications, and the variety of products. Most companies manufacture several types of equipment for a wide range of applications, including the following:

- display and show cases for supermarkets and individual suppliers of food,
- upright and chest freezers for commercial application,
- different sizes of drinking water coolers,
- biological refrigerators and freezers,
- milk coolers,
- soft ice freezers,
- cooling chambers, cooling stores
- insulated panels for larger cold stores,
- window-type air conditioners and fan coil,
- refrigeration equipment for trucks

In common with the domestic refrigeration sub-sector ozone depleting substances are consumed in commercial applications for:

- Charging of new appliances with CFC-12, R-502 and R-22
- Refilling/topping up of appliances with CFC-12, R-502 and R-22 after repair work
- Insulation foam blowing using CFC-11

The commercial sector consumes approximately 35 MT of CFC-11 and 32 MT of CFC-12 annually. Due to the changing market conditions the number and types of products manufactured differ from year to year although the total consumption of CFCs is relatively stable.

A total of 40-50 small- and medium-size commercial refrigerator manufacturers were identified by the Ozone Unit and recognised up to now. Sleem Modern Ind., Ets Merhi for Refrigerators Ind., Uni Kitchen Co. Hassan Brothers Co., M.Traboulsi Establishment, International Center for Equipment and Promotion (IPEC) companies were selected as the first group to implement CFC phase out under an umbrella project for small- and medium-size companies in the commercial refrigerator manufacturing sector. This project has been approved at the 29th session of the ExCom and is under implementation.

All of the companies covered by this project are similar in nature and operate using similar manufacturing techniques. Similar to commercial refrigeration companies in other Article 5 countries production is generally on a batch and on order basis. Most companies manufacture a range of equipment, which can be tailored to suit the needs of the customer.

Production lines are generally in open plan factory units or workshops and consist of a series of workstations at which particular task can be carried out such as assembly, brazing, charging etc. Work, in progress is moved from one station to another using trolleys or conveyors. In the majority of cases production lines can be reconfigured to suit the particular production and market requirements. A brief overview of each of the companies is given in Table 1.
carefully checked against the specifications of refrigerated models actually
produced by each of the companies.

The companies have recognized the need to comply with the Montreal Protocol and have agreed to participate in Lebanon's ODS phase-out programme. The company is committed to phase out CFCs by converting their foaming equipment to HCFC-141b and adopting HFC- 134a as refrigerant. This project document describes the activities needed to carry out the phase out process. The conversion technology and expertise will be acquired from equipment, component and chemical suppliers and external foam and refrigeration experts. The impact on the plant/process due to the use of HCFC-141b as the blowing agent and HFC-134a as the refrigerant, would need to be addressed by implementing plant modifications and through the introduction of new equipment, components and processes, as below:

Foam

HCFC-141b has been chosen as an alternative blowing agent for the foaming operation consequently will result in the following:

a) New formulations suitable for HCFC-141b will be required. These will be available from existing chemical suppliers. No investments are foreseen for handling chemicals.

b) The use of new formulations will lead to a change in mixing ratios and increased viscosity, leading to reduced flow characteristics of the chemical mixture. The foaming reaction parameters will change. HCFC-141b based foam will have an increased thermal conductivity compared to foam produced with CFC-11.

c) The HCFC-141b based foam will have an increased molded density compared to the CFC-11 based foam, resulting in increased requirement of chemicals.

d) Technical assistance from external process experts and from chemical and equipment suppliers will need to be acquired, to implement the new formulations and to ensure smooth transition to the new technology.

e) Trials will be needed for the new equipment, process and products. This will cover the cost of chemicals, raw materials, consumables & utilities required during trials/commissioning.

f) The production personnel in the enterprise needs to be trained to be able to work with the new formulations and process.

Refrigeration

The conversion to HFC-134a as the replacement for CFC-12 will involve the following changes:

- Compressors suitable for HFC-134a will be required. These will be available from existing suppliers.
- The synthetic lubricants compatible with HFC -134a are highly sensitive to moisture and impurities in the system, as compared to CFC-12 system. The evacuation/charging process for HFC-134a and polyol-ester lubricant will need to ensure the required level of cleanliness and dryness in the system. To ensure this the following is proposed:
- The vacuum pumps will need to be suitable for use with HFC-134a. Of the existing vacuum pumps, 6 will be replaced.
- The existing refrigerant charging units are not suitable for use with HFC-134a and cannot be retrofitted, and will therefore be replaced with charging units suitable for HFC-134a duty.
- The design/sizing of the refrigeration system will need to be suitably changed, to ensure the viability of the process and to maintain the product standards for performance, such as:
- Up sizing the condensers and re engineering evaporators and condensers, so as to ensure the levels of cleanliness and contamination that can be tolerated with HFC-134a
- Lengthening of the capillary tubes.
- Use of filter-dryers with finer pores, suitable for use with HFC-134a
- The existing leak detectors are suitable for detecting CFC-12 only and will therefore need to be replaced with leak detectors suitable for detecting HFC-134a.

Technical Specification of the Product Model Uni-Kitchen-11	
Description	Technical Specification
Name of products, Model Number	Up right Refrigerator Unikitchen, -11
Cooling System, Direct cooling (Defrost) In-Direct Cooling (No-Frost)	Direct cooling
Working Temperature, (Ambient Temp.)	30
Relative Humidity %	70%
Dimension a) Overall Dimension, LxHxW b) Upper Compartment, LxHxW c) Lower Compartment, LxHxW	75x200x150
Wall Thickness, for Foam Injection a) Freezer Side wall Thickness b) Refrigerator Side wall Thickness	10 cm
Product Internal Temperature a) Freezer b) Refrigerator	-6 to 0
Evaporating Temperature or Evaporator Surface temperature	-10
Product Internal Volume Liter a) Freezer b) Refrigerator c) Net	1404
Compressor Manufacture, and Model	Hermetic Danfoss, SC12B
Compressor Cooling Capacity in Watt According to Desired Evaporating Temperature	350
Compressor Power Input	360
Compressor Mounting Place	Upper roof
Condenser Type, Material, Length, and Diameter	Fan Coil, Aluminum & Copper 2x9
Evaporator Type, Material, Length, and Diameter	Fin and Tube, Aluminum & Copper 20 Mt., 16mm Dim
Capillary Tube Type, Material, Length, and Diameter	225 cm, 0.54 mm Dim
Dryer, Type and Weight	Selica gel, 30 gr.
P.U. Foam Type, Density, Mixture Ratio %, (Polyol + R11+ ISO)	Polystyrene
Refrigerant "R12 " Charge Weight	1200 gr
Gasket Type and Material	PVC
Glass Thickness	8 mm
Double Glass Thickness	Double
Inner Liner Type and Material	Aluminum
Thermostat Type and Range of Setting	Defrost
Working Voltage, Hz, Starting Current, etc	220 Volt, 50 Hrtz.

Technical Specification of the Product Model Merhi N/A	
Description	Technical Specification
Name of products, Model Number	Up-Right refrigerator Merhi Est.
Cooling System, Direct cooling (Defrost) In-Direct Cooling (No-Frost)	Direct cooling
Working Temperature, (Ambient Temp.)	35
Relative Humidity %	70%
Dimension d) Overall Dimension, LxHxW e) Upper Compartment, LxHxW f) Lower Compartment, LxHxW	150x75x180
Wall Thickness, for Foam Injection c) Freezer Side wall Thickness d) Refrigerator Side wall Thickness	7.5 cm
Product Internal Temperature c) Freezer d) Refrigerator	+5
Evaporating Temperature or Evaporator Surface temperature	-10
Product Internal Volume Liter d) Freezer e) Refrigerator f) Net	1305
Compressor Manufacture, and Model	Hermetic, Asperra, FG187A
Compressor Cooling Capacity in Watt According to Desired Evaporating Temperature	390
Compressor Power Input	400
Compressor Mounting Place	Upper roof
Condenser Type, Material, Length, and Diameter	Fan Coil, Copper 3x5
Evaporator Type, Material, Length, and Diameter	Fin and Tube, Copper 18 Mt., 5/8" Dim
Capillary Tube Type, Material, Length, and Diameter	400 cm, 0.64 mm Dim
Dryer, Type and Weight	Selica gel, 32 gr.
P.U. Foam Type, Density, Mixture Ratio %, (Polyol + R11+ ISO)	Polystyrene
Refrigerant "R12 " Charge Weight	1200 gr
Gasket Type and Material	PVC
Glass Thickness	6 mm
Double Glass Thickness	Double
Inner Liner Type and Material	Aluminum
Thermostat Type and Range of Setting	Defrost

Working Voltage, Hz, Starting Current, etc	220 Volt, 50 Hrtz.

Technical Specification of the Product Model **Sleem Modern Industris**	
Description	Technical Specification
Name of products, Model Number	Up-Right refrigerator
Cooling System, Direct cooling (Defrost) In-Direct Cooling (No-Frost)	Direct cooling
Working Temperature, (Ambient Temp.)	32
Relative Humidity %	70%
Dimension g) Overall Dimension, LxHxW h) Upper Compartment, LxHxW i) Lower Compartment, LxHxW	150x75x225
Wall Thickness, for Foam Injection e) Freezer Side wall Thickness f) Refrigerator Side wall Thickness	7 cm
Product Internal Temperature e) Freezer f) Refrigerator	+5
Evaporating Temperature or Evaporator Surface temperature	-10
Product Internal Volume Liter g) Freezer h) Refrigerator i) Net	1325
Compressor Manufacture, and Model	Hermetic, Danfoss, SC21B
Compressor Cooling Capacity in Watt According to Desired Evaporating Temperature	550
Compressor Power Input	600
Compressor Mounting Place	Upper roof
Condenser Type, Material, Length, and Diameter	Fan Coil, Copper 2x9
Evaporator Type, Material, Length, and Diameter	Fin and Tube, Copper 10 Mt., ½" Dim
Capillary Tube Type, Material, Length, and Diameter	225 cm, 0.48 mm Dim
Dryer, Type and Weight	Selica gel, 20 gr.
P.U. Foam Type, Density, Mixture Ratio %, (Polyol + R11+ ISO)	Polystyrene
Refrigerant "R12 " Charge Weight	1200 gr
Gasket Type and Material	PVC
Glass Thickness	6 mm
Double Glass Thickness	Double
Inner Liner Type and Material	Aluminum
Thermostat Type and Range of Setting	Defrost

Working Voltage, Hz, Starting Current, etc	220 Volt, 50 Hrtz.

Technical Specification of the Product Model IPEC VR-80	
Description	Technical Specification
Name of products, Model Number	Up-Right refrigerator
Cooling System, Direct cooling (Defrost) In-Direct Cooling (No-Frost)	Direct cooling
Working Temperature, (Ambient Temp.)	32
Relative Humidity %	70%
Dimension j) Overall Dimension, LxHxW k) Upper Compartment, LxHxW l) Lower Compartment, LxHxW	75x75x200
Wall Thickness, for Foam Injection g) Freezer Side wall Thickness h) Refrigerator Side wall Thickness	7 cm
Product Internal Temperature g) Freezer h) Refrigerator	+3
Evaporating Temperature or Evaporator Surface temperature	-10
Product Internal Volume Liter j) Freezer k) Refrigerator l) Net	1125
Compressor Manufacture, and Model	Hermetic, Danfoss, FC10B
Compressor Cooling Capacity in Watt According to Desired Evaporating Temperature	370
Compressor Power Input	390
Compressor Mounting Place	Upper roof
Condenser Type, Material, Length, and Diameter	Fan Coil, Firgabohn 16 rows
Evaporator Type, Material, Length, and Diameter	Fin and Tube, Firgaboln Aluminum
Capillary Tube Type, Material, Length, and Diameter	450 cm, 0.44 mm Dim
Dryer, Type and Weight	Cylindrical, Danfoss 100 gr.
P.U. Foam Type, Density, Mixture Ratio %, (Polyol + R11+ ISO)	R11 PU foam
Refrigerant "R12 " Charge Weight	1000 gr
Gasket Type and Material	PVC
Glass Thickness	6 mm
Double Glass Thickness	N/A
Inner Liner Type and Material	Aluminum

Thermostat Type and Range of Setting	Defrost
Working Voltage, Hz, Starting Current, etc	220 Volt, 50 Hrtz.

Technical Specification of the Product Model Traboulsi Water Cooler TRA-WC-35	
Description	Technical Specification
Name of products, Model Number	Water Cooler
Cooling System, Direct cooling (Defrost) In-Direct Cooling (No-Frost)	Direct cooling
Working Temperature, (Ambient Temp.)	32
Relative Humidity %	70%
Dimension m) Overall Dimension, LxHxW n) Upper Compartment, LxHxW o) Lower Compartment, LxHxW	25 cm Dim, 40 cm Height
Wall Thickness, for Foam Injection i) Freezer Side wall Thickness j) Refrigerator Side wall Thickness	5 cm
Product Internal Temperature i) Freezer j) Refrigerator	Water outlet temperature 5 C Water Inlet Temp. 20 C
Evaporating Temperature or Evaporator Surface temperature	-10
Product Internal Volume Liter m) Freezer n) Refrigerator o) Net	Water Storage Tank 35 Liters
Compressor Manufacture, and Model	Hermetic, Electrolux, P14
Compressor Cooling Capacity in Watt According to Desired Evaporating Temperature	280
Compressor Power Input	300
Compressor Mounting Place	Bottom
Condenser Type, Material, Length, and Diameter	Fan Coil, 2x10
Evaporator Type, Material, Length, and Diameter	Copper Tube Round the Water Storage Tank
Capillary Tube Type, Material, Length, and Diameter	400 cm, 8 mm outer Dim
Dryer, Type and Weight	Cylindrical, 20 gr.
P.U. Foam Type, Density, Mixture Ratio %, (Polyol + R11+ ISO)	R11 PU foam
Refrigerant "R12 " Charge Weight	450 gr
Gasket Type and Material	N/A
Glass Thickness	N/A
Double Glass Thickness	N/A

Inner Liner Type and Material	N/A
Thermostat Type and Range of Setting	Defrost
Working Voltage, Hz, Starting Current, etc	220 Volt, 50 Hrtz.

Technical Specification of the Product Model Hassan Bros	
Description	Technical Specification
Name of products, Model Number	Up-Right refrigerator
Cooling System, Direct cooling (Defrost) In-Direct Cooling (No-Frost)	Direct cooling
Working Temperature, (Ambient Temp.)	35
Relative Humidity %	70%
Dimension p) Overall Dimension, LxHxW q) Upper Compartment, LxHxW r) Lower Compartment, LxHxW	150x75x200
Wall Thickness, for Foam Injection k) Freezer Side wall Thickness l) Refrigerator Side wall Thickness	5 cm
Product Internal Temperature k) Freezer l) Refrigerator	+5
Evaporating Temperature or Evaporator Surface temperature	-10
Product Internal Volume Liter p) Freezer q) Refrigerator r) Net	1211
Compressor Manufacture, and Model	Hermetic, Asperra 6187
Compressor Cooling Capacity in Watt According to Desired Evaporating Temperature	280
Compressor Power Input	310
Compressor Mounting Place	Upper roof
Condenser Type, Material, Length, and Diameter	Fan Coil, Aluminum 2x6 rows
Evaporator Type, Material, Length, and Diameter	Fin and Tube, Aluminum 22 Mt. ½" Dim
Capillary Tube Type, Material, Length, and Diameter	2800 cm, 0.49 mm Dim
Dryer, Type and Weight	Cylindrical, American PM .
P.U. Foam Type, Density, Mixture Ratio %, (Polyol + R11+ ISO)	R11 PU foam 37%+13%+50%
Refrigerant "R12 " Charge Weight	1.2 kg
Gasket Type and Material	PVC

Glass Thickness	N/A
Double Glass Thickness	N/A
Inner Liner Type and Material	Aluminum
Thermostat Type and Range of Setting	Defrost
Working Voltage, Hz, Starting Current, etc	220 Volt, 50 Hrtz.

Technical Specification of the Product Model **Hassan Bros. Display Cabinet**	
Description	Technical Specification
Name of products, Model Number	Display Cabinet
Cooling System, Direct cooling (Defrost) In-Direct Cooling (No-Frost)	Direct cooling
Working Temperature, (Ambient Temp.)	35
Relative Humidity %	70%
Dimension s) Overall Dimension, LxHxW t) Upper Compartment, LxHxW u) Lower Compartment, LxHxW	125x110x200
Wall Thickness, for Foam Injection m) Freezer Side wall Thickness n) Refrigerator Side wall Thickness	5 cm
Product Internal Temperature m) Freezer n) Refrigerator	+5
Evaporating Temperature or Evaporator Surface temperature	-10
Product Internal Volume Liter s) Freezer t) Refrigerator u) Net	1001
Compressor Manufacture, and Model	Hermetic, Asperra, 6215
Compressor Cooling Capacity in Watt According to Desired Evaporating Temperature	370
Compressor Power Input	390
Compressor Mounting Place	Bottom
Condenser Type, Material, Length, and Diameter	Fan Coil, 3x9
Evaporator Type, Material, Length, and Diameter	Fin and Tube, Aluminum 28 Mt. ½" Dim
Capillary Tube Type, Material, Length, and Diameter	270 cm, 0.49 mm Dim
Dryer, Type and Weight	Cylindrical, American PM 30 gr.
P.U. Foam Type, Density, Mixture Ratio %, (Polyol + R11+ ISO)	R11 PU foam 37%+13%+50%
Refrigerant "R12 " Charge Weight	1500 gr

Gasket Type and Material	PVC
Glass Thickness	10 mm
Double Glass Thickness	N/A
Inner Liner Type and Material	Aluminum
Thermostat Type and Range of Setting	Defrost
Working Voltage, Hz, Starting Current, etc	220 Volt, 50 Hrtz.

Technical Specification of the Product Model **Traboulsi Display Cabinet**	
Description	Technical Specification
Name of products, Model Number	Display Cabinet
Cooling System, Direct cooling (Defrost) In-Direct Cooling (No-Frost)	Direct cooling
Working Temperature, (Ambient Temp.)	35
Relative Humidity %	70%
Dimension v) Overall Dimension, LxHxW w) Upper Compartment, LxHxW x) Lower Compartment, LxHxW	140x100x200
Wall Thickness, for Foam Injection o) Freezer Side wall Thickness p) Refrigerator Side wall Thickness	5 cm
Product Internal Temperature o) Freezer p) Refrigerator	+5
Evaporating Temperature or Evaporator Surface temperature	-10
Product Internal Volume Liter v) Freezer w) Refrigerator x) Net	500
Compressor Manufacture, and Model	Hermetic, Asperra,
Compressor Cooling Capacity in Watt According to Desired Evaporating Temperature	370
Compressor Power Input	390
Compressor Mounting Place	Bottom
Condenser Type, Material, Length, and Diameter	Fan Coil, 3x10
Evaporator Type, Material, Length, and Diameter	Fin and Tube, Aluminum 18 Mt. 16 mm
Capillary Tube Type, Material, Length, and Diameter	220 cm, 0.42 mm Dim
Dryer, Type and Weight	Cylindrical, Caster 30 gr.
P.U. Foam Type, Density, Mixture Ratio %, (Polyol + R11+ ISO)	R11 PU foam 37%+13%+50%

Refrigerant "R12 " Charge Weight	1200 gr
Gasket Type and Material	PVC
Glass Thickness	10 mm
Double Glass Thickness	N/A
Inner Liner Type and Material	Aluminum
Thermostat Type and Range of Setting	Defrost
Working Voltage, Hz, Starting Current, etc	220 Volt, 50 Hrtz.

Refrigeration Load Calculation
Display Cabinet Hassan Bros Model HB-1000 DC

Heat Leaks Through Side Walls by Conduction $Q = UA\Delta T$						
Description	Side Walls	Back Panel	Front	Top	Bottom	Total
Dimension	(30*30+ 60*110+ 40*70)*2	85*200+ 40*140	G= 80*200 S= 30*200+ 140*40	30*200	110*20 0	
Surface Area Sq. Mt.	1.95	2.26	1.6 1.16	0.6	2.2	
Ambient Temp. °C	32	32	32	32	42	
Inside Temp. °C	5	5	5	5	5	
"ΔT", Temp. Difference	27	27	27	27	37	
"X", Cm. Insulation Thickness	5	5	1 glass 20 air 5 Foam	5	5	
"K", R141b PU Foam Thermal Conductivity Watt/Sq.Mt. °K	0.0184	0.0184	Foam = 0.0184 Air = 0.025 Glass = 0.721	0.0184	0.0184	
"U" Heat Resistance Coefficient Factor	0.35	0.35	0.35 = foam & 1.06 air +glass	0.35	0.35	
Q= UAΔT	18.4	21.4	11+45.8	5.7	28.5	130.8

1- Cyclopentane PU foam 0.0195 $W/Mt.\circ K$
2- R11 PU Foam 0.017 $W/Mt.\circ K$
3- R141b PU foam 0.0184 $W/Mt.\circ K$
4- Still Air at atmospheric pressure and 0 °C = 0.025 $W/Mt.\circ K$
5- High Vacuum Air = 00058 $W/Mt.\circ K$
6- Glass 0.721 $W/Mt.\circ K$
7- Glass Wool 0.0418 $W/Mt.\circ K$
8- Hard Woods 0.112/0.160 $W/Mt.\circ K$

Product Load Calculation	
Product to be loaded	Display Cabinet for Lamb
Product Mass Load Kg	100
C_1= Product Specific Heat Above Freezing Point J/Kg K	3200
C_2= Product Specific Heat Below Freezing Point J/Kg K	N/A
h = Latent Heat of Fusion	N/A
Product Initial Temp.	29
Product Final Temp.	5
Temperature Difference K	24
$Q_1 = m. C_1 \Delta T$	(100x3200x24)86400 =89
$Q_2 = m. C_2 \Delta T$	N/A
$Q_3 = m. h$	N/A
$Q_{total} = Q_1 + Q_2 + Q_3 = 267 + 0 + 0$	89 Watt

Miscellanies Heat Load

a) Air Change = V. N . H

Where

V = Appliance Internal Volume = 1000
N = Number of Air Change Per Day = 20
H = Heat Removed From Cubic Meter of Air = 75000 Jul/Sec

(1.000x20x75000)/86400 = 17.4

b) Gasket

$$Q = U \cdot L \cdot \Delta T$$

Where

U = Heat resistance of PVC Gasket = 0.07 watt/ Mt. K
L = Gasket Length Mt.
ΔT = Temperature Difference K

$$Q = 0.07 \times 12 \times 27 = 23$$

c) Electromotor Power Consumption = Watts = N/A
d) Florescent Lamp = Watts = 20

$Q_{Grand\ Total}$ = Heat transferred through side walls + Product Load + Miscellanies Heat Load + Safety Factor

$Q_{Grand\ Total} = (130.8 + 89 + 17.4 + 23 + 20) + 20\% = 336$

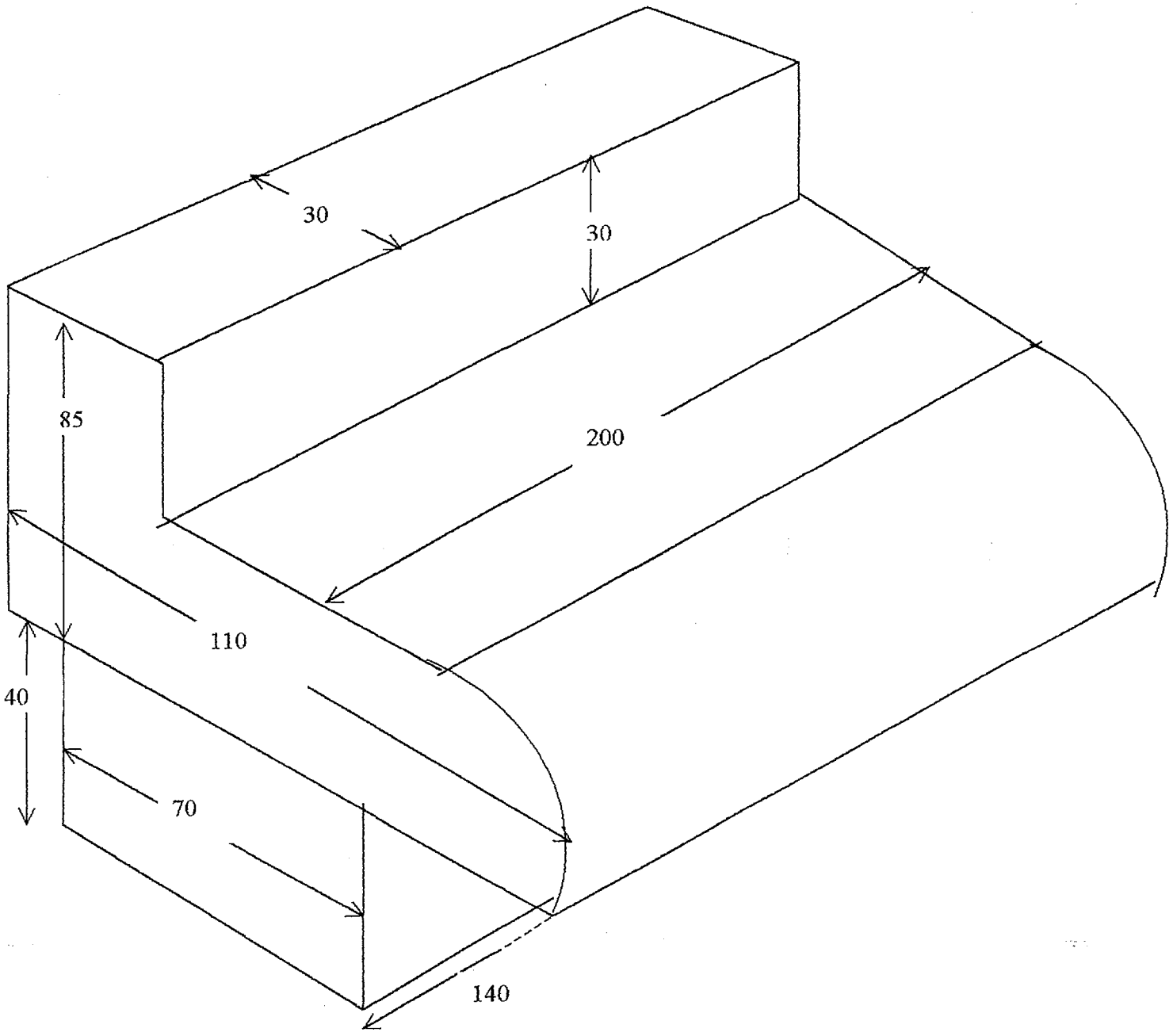
Compressor with C.O.P = 0.90

Compressor Size = 336 ÷ 0.90 = 373 Watt

Q grand total is the total cooling capacity required to be produced by evaporator to compensate the total heat gain. From this figure we can assume and find compressor cooling capacity with regard to its C.O.P specified in manufacturer catalogue.

The cooling capacity of Compressor is directly dependent on Evaporating temperature inside the evaporator tubes. Therefore we have to take into our consideration the above factors during selection of suitable compressor.

For this prototype we should select an R134a compressor which can deliver 373 watts to the refrigeration system at – 10 C evaporating temperature and with respect to compressor C.O.P.



Refrigeration Load Calculation
Display Cabinet Trboulsi Est. Model TDC-500

Heat Leaks Through Side Walls by Conduction $Q = UA\Delta T$						
Description	Side Walls	Back Panel	Front	Top	Bottom	Total
Dimension	(100*30+ 40*30+ 40*80)*2	180*40+ 60*200	G= 140*190 +40*190 S= 30*200	30*200	100* 200	
Surface Area Sq. Mt.	1.16	1.92	3.42+ 0.6	0.6	2.0	
Ambient Temp. °C	32	32	32	32	42	
Inside Temp. °C	5	5	5	5	5	
"ΔT", Temp. Difference	27	27	27	27	37	
"X", Cm. Insulation Thickness	5	5	1 glass 20 air 5 Foam	5	5	
"K", R141b PU Foam Thermal Conductivity Watt/Sq.Mt. °K	0.0184	0.0184	Foam = 0.0184 Air = 0.025 Glass = 0.721	0.0184	0.0184	
"U" Heat Resistance Coefficient Factor	0.35	0.35	0.35 = foam & 1.06 air +glass	0.35	0.35	
Q= UAΔT	10.9	18.1	97.9+5.7	5.7	2.6	140.9

9- Cyclopentane PU foam 0.0195 $W/Mt.\circ K$
10-R11 PU Foam 0.017 $W/Mt.\circ K$
11-R141b PU foam 0.0184 $W/Mt.\circ K$
12-Still Air at atmospheric pressure and 0 °C = 0.025 $W/Mt.\circ K$
13-High Vacuum Air = 00058 $W/Mt.\circ K$
14-Glass 0.721 $W/Mt.\circ K$
15-Glass Wool 0.0418 $W/Mt.\circ K$
16-Hard Woods 0.112/0.160 $W/Mt.\circ K$

Product Load Calculation	
Product to be loaded	Display Cabinet for Lamb
Product Mass Load Kg	100
C_1= Product Specific Heat Above Freezing Point J/Kg K	3200
C_2= Product Specific Heat Below Freezing Point J/Kg K	N/A
h = Latent Heat of Fusion	N/A
Product Initial Temp.	29
Product Final Temp.	5
Temperature Difference K	24
$Q_1 = m. C_1 \Delta T$	(100x3200x24)86400 =89
$Q_2 = m. C_2 \Delta T$	N/A
$Q_3 = m. h$	N/A
$Q_{total} = Q_1 + Q_2 + Q_3 = 267 + 0 + 0$	89 Watt

Miscellanies Heat Load

e) Air Change = V. N . H

Where

V = Appliance Internal Volume = 500
N = Number of Air Change Per Day = 20
H = Heat Removed From Cubic Meter of Air = 75000 Jul/Sec

(0.5x20x75000)/86400 = 8.7

f) Gasket

$$Q = U \cdot L \cdot \Delta T$$

Where

U = Heat resistance of PVC Gasket = 0.07 watt/ Mt. K
L = Gasket Length Mt.
ΔT = Temperature Difference K

Q = 0.07 x 12 x 27 = 23

g) Electromotor Power Consumption = Watts = N/A
h) Florescent Lamp = Watts = 20

$Q_{Grand\ Total}$ = Heat transferred through side walls + Product Load + Miscellanies Heat Load + Safety Factor

$Q_{Grand\ Total}$ = (140.9 + 89 + 8.7 +23 +20)+ 20% = 337.9

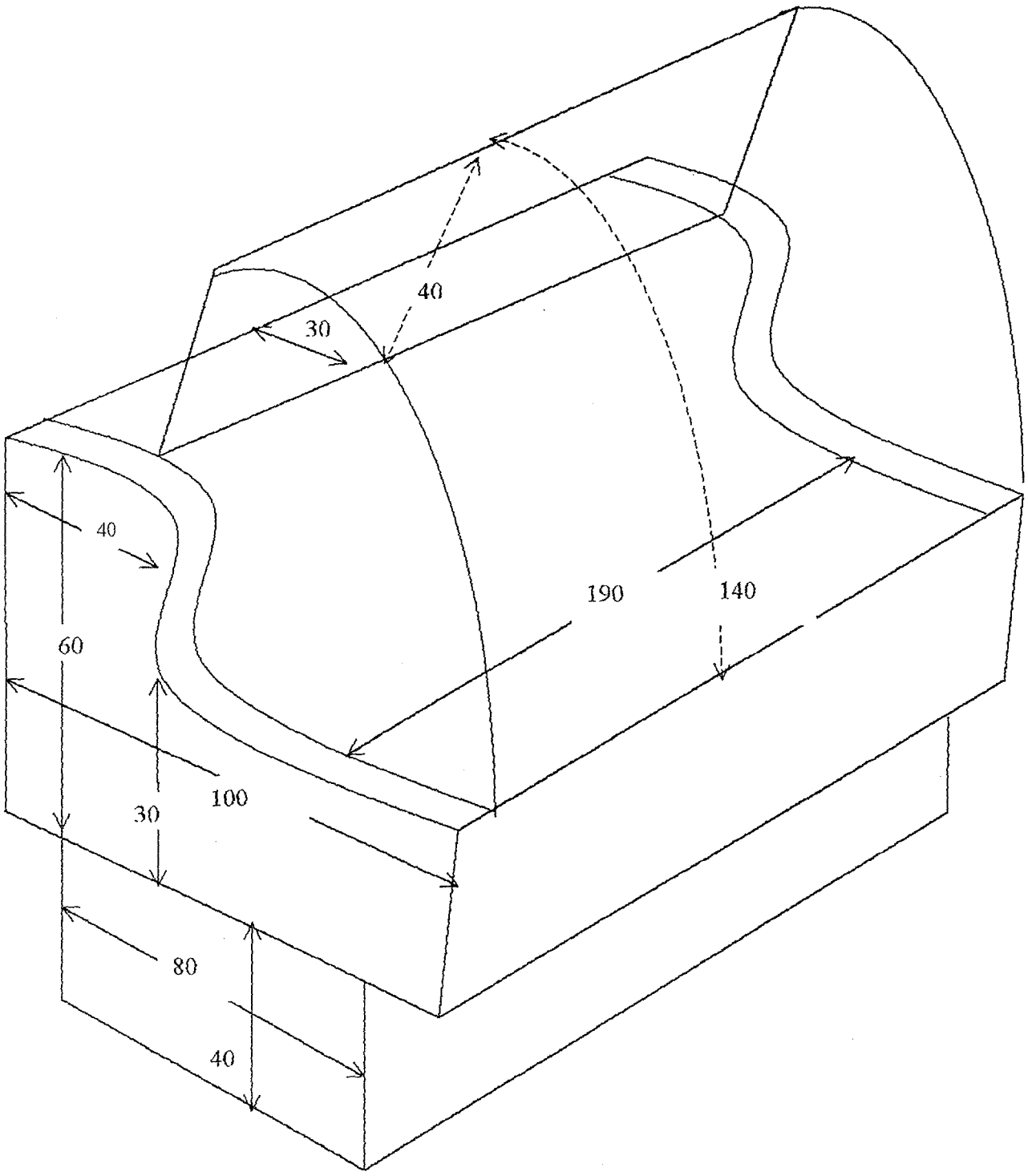
Compressor with C.O.P = 0.90

Compressor Size = 337.9 ÷ 0.90 = 375 Watt

Q grand total is the total cooling capacity required to be produced by evaporator to compensate the total heat gain. From this figure we can assume and find compressor cooling capacity with regard to its C.O.P specified in manufacturer catalogue.

The cooling capacity of Compressor is directly dependent on Evaporating temperature inside the evaporator tubes. Therefore we have to take into our consideration the above factors during selection of suitable compressor.

For this prototype we should select an R134a compressor which can deliver 375 watts to the refrigeration system at – 10 C evaporating temperature and with respect to compressor C.O.P.


40
30
40
190
140
60
100
30
80
40

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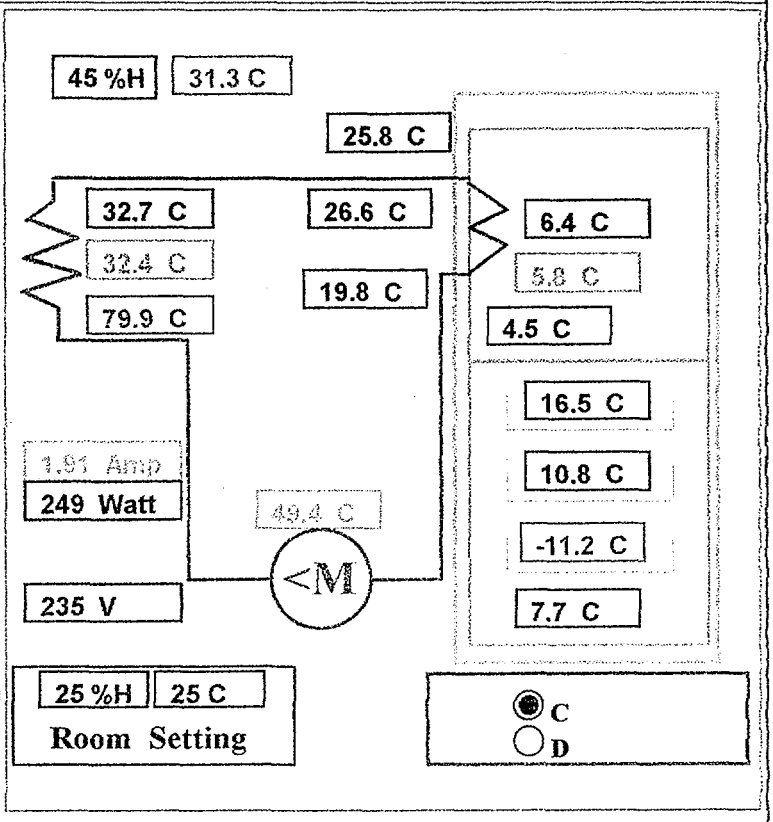
TestDate: **20IC/RC/TE ST:1** *Report No.:* ( ) - Page 2

PageTestName: *Cycling Performance Test ReportDate:* 2000/06/27 09:40

Page Result :

1 - Page Test Time	*4 Hours*
2 - Working Percent	*56 %On*
3 - Energy (Accord to page)	*1.306 kwh*
4 - Zoom Time	*6:59 Hour*
5 - Compr Current	*1.91 Amp*
6 - Evaprator Mean Temp	*7.8 C*
7 - Cabin Mean Temp	*5.3 C*
8 - Crisp Temp	*7.7 C*
9 - Compr Temp	*49.4 C*
10- Condensor In Temp	*79.9 C*
11- Condensor Out Temp	*32.7 C*
12- Condition	*31.3 C 45 %H*
13- Volt	*Max=237 Mean=234 Min=226*
14-	
15-	
16-	
17-	



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IPEC Company HotRoom

TestDate: **20IC/RC/TE ST:1** *Report No.:* Spec & Remark
TestName: *Cycling Performance Test* *ReportDate:* 2000/06/27 09:40

Total Result :

1 - Total Test Time	*12 Hours*
2 - Working Percent	*58 %On*
3 - Energy	*1.311 kwh*
4 - Zoom Time	*11:04 Hour*
5 - Compr Current	*0.27 Amp*
6 - Evaprator Mean Temp	*8.9 C*
7 - Cabin Mean Temp	*9 C*
8 - Crisp Temp	*7.2 C*
9 - Compr Temp	*48.2 C*
10- Condensor In Temp	*31.5 C*
11- Condensor Out Temp	*21.5 C*
12- Condition	*28.9 C 58 %H*
13- Volt	*Max=237 Mean=228 Min=204*
14-	
15-	
16-	
17-	

Product Spec :

1 - File Name	*ICRCTEST.K1*
2 - Test Kind G	*SLIM CO*
3 - Product Serial	-
4 - Product Name	*STAND*
5 - Product Model	*M150*
6 - Product Capacity	*300 LIT*
7 - Compressor Name	*DANFOSS*
8 - Compressor Model	*SG15G*
9 - Compressor Power	*1/2 HP*
10- Compressor Amper	-
11- Thermostat No.	*0 'C*
12- Thermostat Type	*PRODIGY*
13-	
14-	

Technical Manager: ***ICRC***

Lab Chief : ***GEORGE NAKHOUL***

Lab Specialist: ***CHADI***

Remarks :

Remark1:Prototype
Remark2 :Salim
Remark3 :UNDP

Remark :

Sleem Prototype.

sign :

Industrial Control Research Center HotRoom Ver 5

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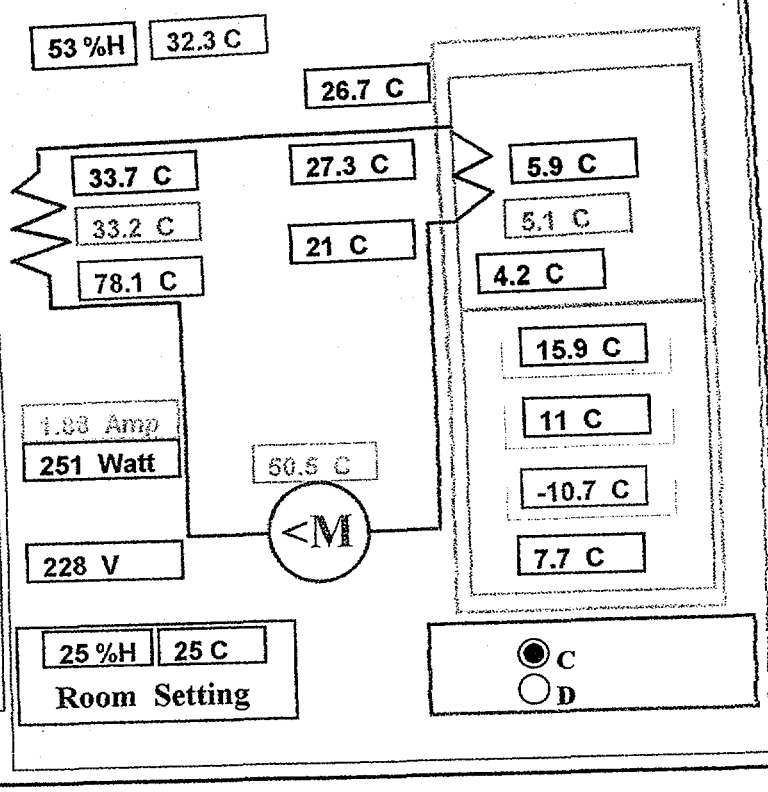
Report No.: ( ) - Page 1

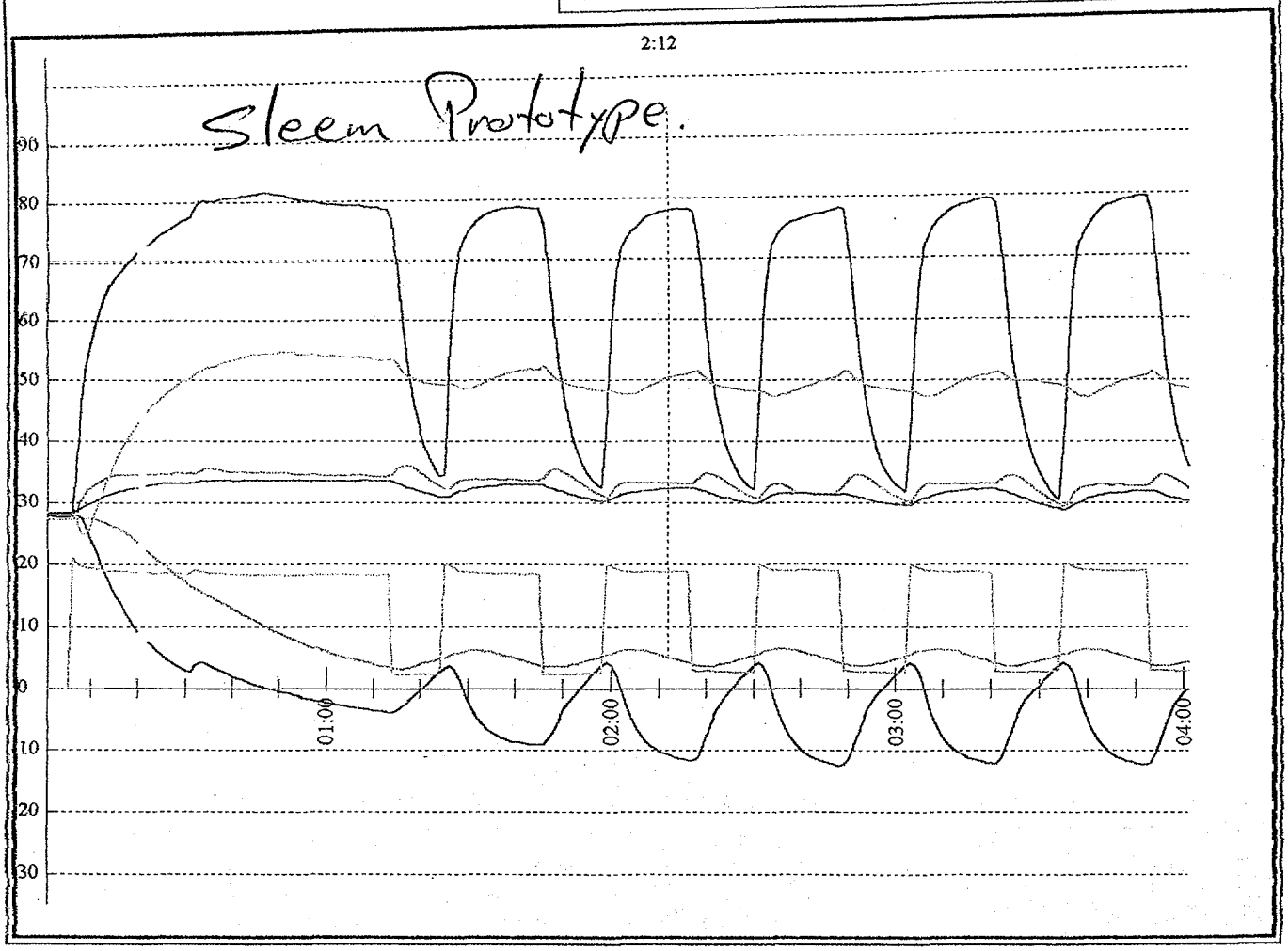
TestDate: 20IC/RC/TE ST:1 ReportDate: 2000/06/27 09:40

PageTestName: Cycling Performance Test

Page Result :

1 - Page Test Time	4 Hours
2 - Working Percent	66 %On
3 - Energy (Accord to page)	1.377 kwh
4 - Zoom Time	2:12 Hour
5 - Compr Current	1.88 Amp
6 - Evaprator Mean Temp	7.1 C
7 - Cabin Mean Temp	5.4 C
8 - Crisp Temp	7.7 C
9 - Compr Temp	50.5 C
10- Condensor In Temp	78.1 C
11- Condensor Out Temp	33.7 C
12- Condition	32.3 C 53 %H
13- Volt	Max=237 Mean=222 Min=204
14-	
15-	
16-	
17-	





Industrial Control Research Center HotRoom Ver 3

Printing In Labaratory Of
IPEC Company HotRoom

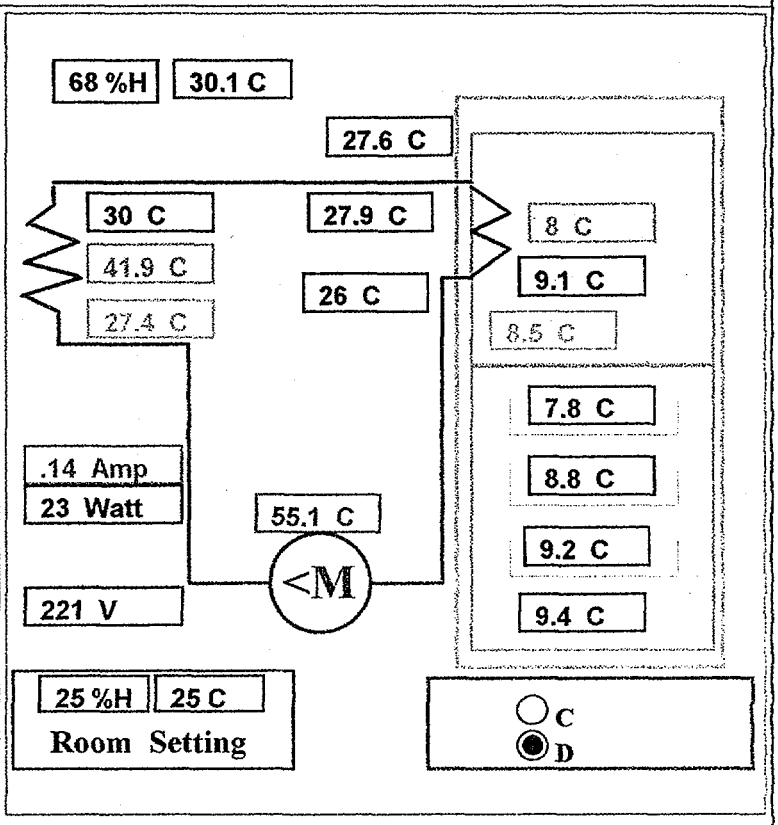
IPEC Company HotRoom

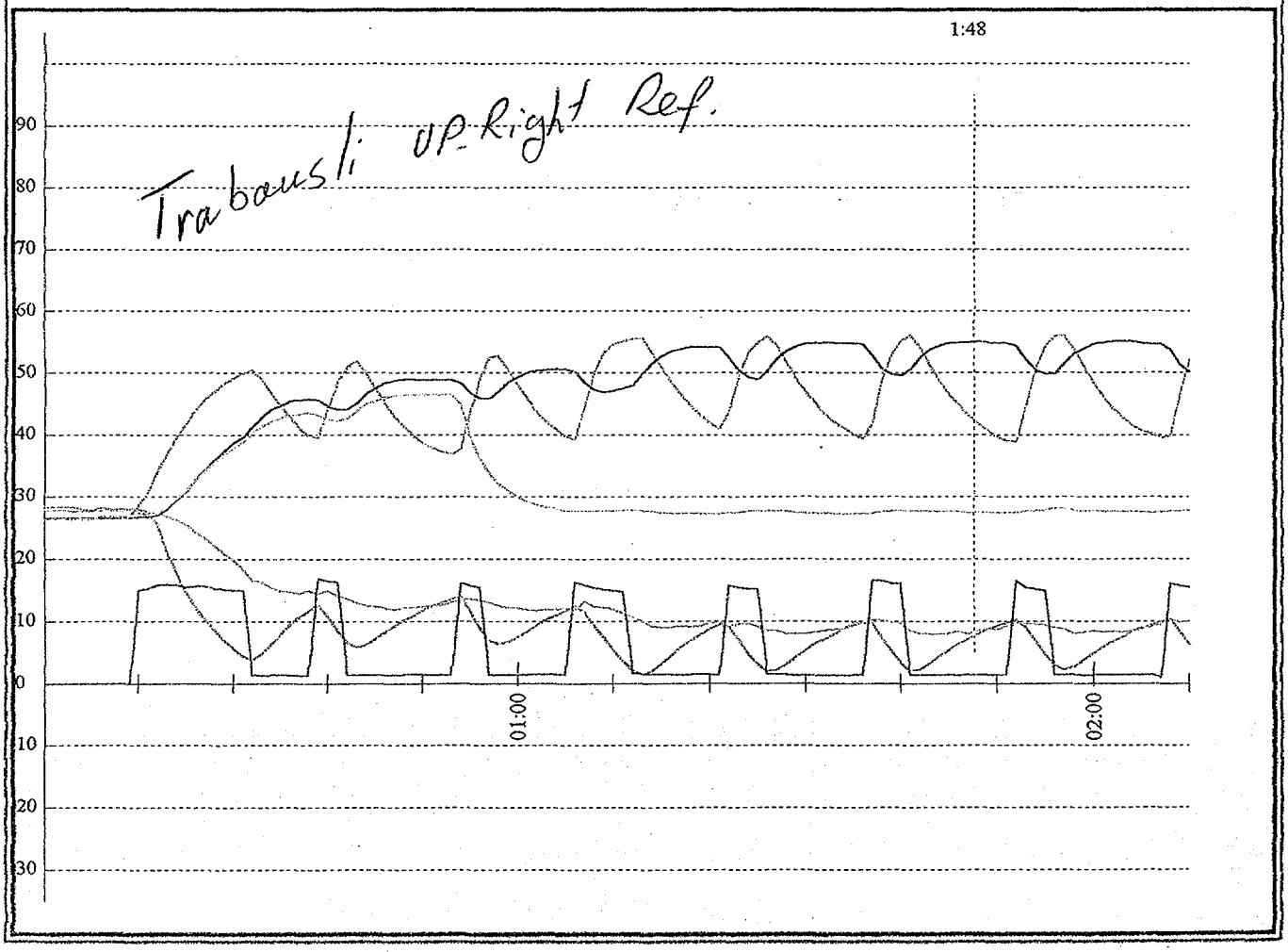
TestDate: **2000/06/24 08:12** *Report No.:* ( ) - Page 1

PageTestName: *Cycling Performance* *ReportDate:* 2000/06/26 13:28

Page Result :

1 - Page Test Time	*2 Hours*
2 - Working Percent	*32 %On*
3 - Energy (Accord to page)	*0.779 kwh*
4 - Zoom Time	*1:48 Hour*
5 - Compr Current	*0.14 Amp*
6 - Evaprator Mean Temp	*8.8 C*
7 - Cabin Mean Temp	*8.6 C*
8 - Crisp Temp	*9.4 C*
9 - Compr Temp	*55.1 C*
10- Condensor In Temp	*27.4 C*
11- Condensor Out Temp	*30 C*
12- Condition	*30.1 C 68 %H*
13- Volt	*Max=229 Mean=224 Min=215*
14-	
15-	
16-	
17-	





Industrial Control Research Center HotRoom Ver 5

Printing in Labaratory Of
IPEC Company HotRoom

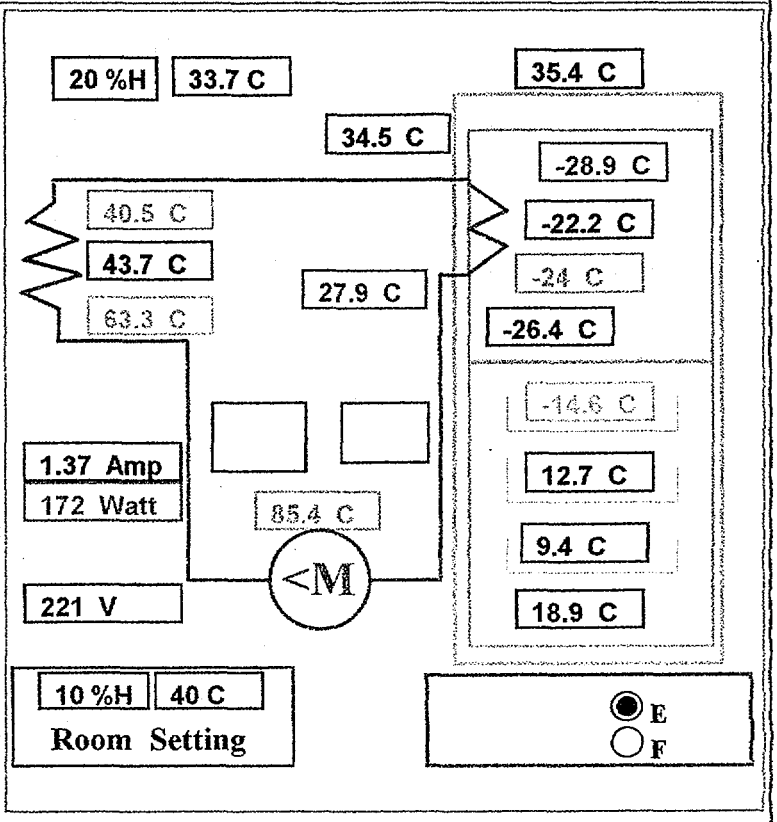
IPEC Company HotRoom

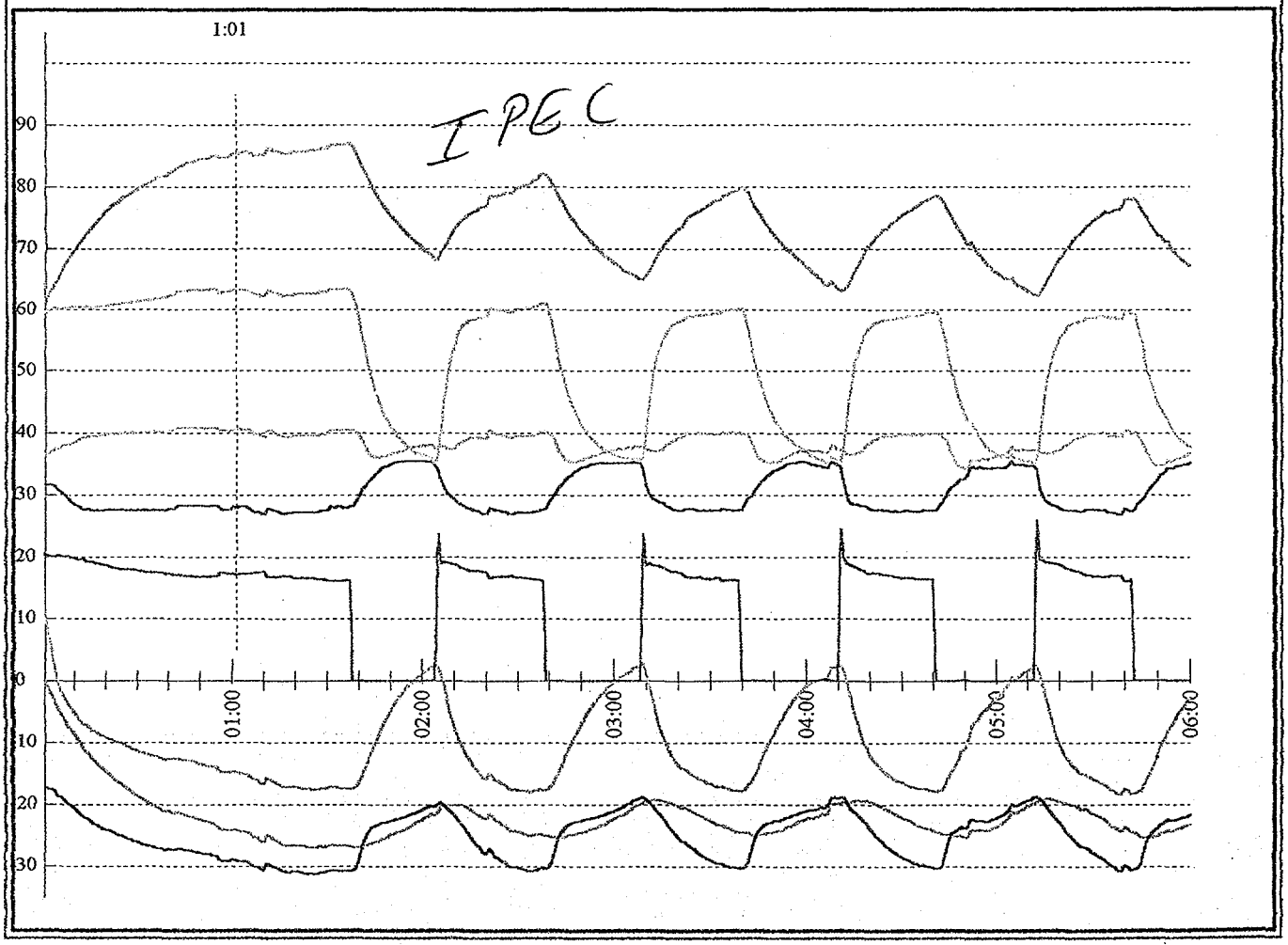
TestDate: **2000/06/24 08:12** Report No.: ( ) - Page 1

PageTestName: *Cycling Performance* ReportDate: 2000/06/26 09:02

Page Result :

1 - Page Test Time	*6 Hours*
2 - Working Percent	*61 %On*
3 - Energy (Accord to page)	*2.243 kwh*
4 - Zoom Time	*1:01 Hour*
5 - Compr Current	*1.37 Amp*
6 - Evaprator Mean Temp	*-25.3 C*
7 - Cabin Mean Temp	*2.5 C*
8 - Crisp Temp	*18.9 C*
9 - Compr Temp	*85.4 C*
10- Condensor In Temp	*63.3 C*
11- Condensor Out Temp	*40.5 C*
12- Condition	*33.7 C 20 %H*
13- Volt	*Max=225 Mean=222 Min=217*
14-	
15-	
16-	
17-	





Industrial Control Research Center HotRoom Ver 5

Printing In Labaratory Of
IPEC Company HotRoom

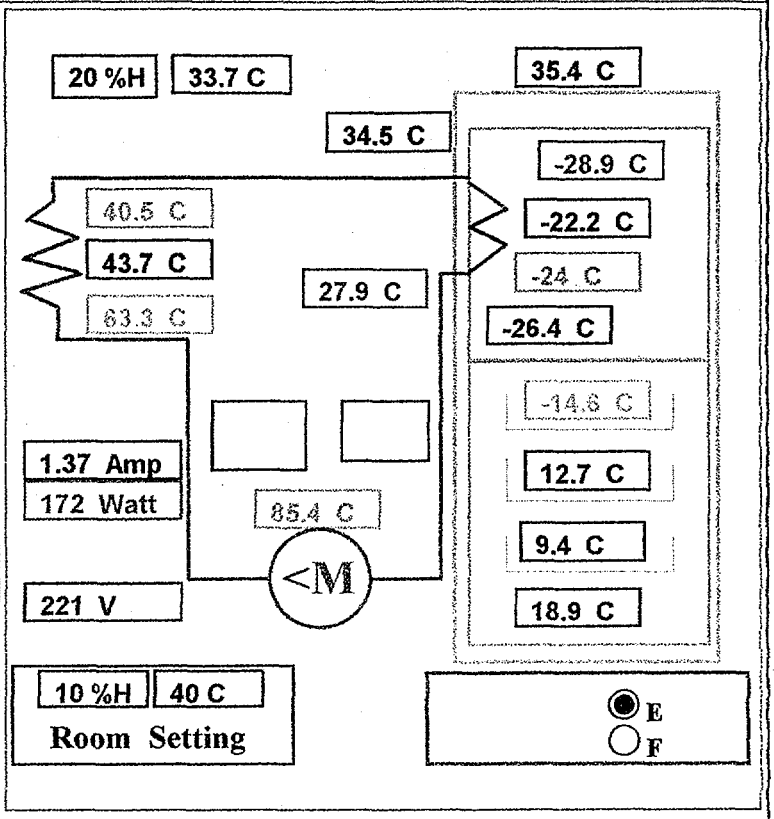
IPEC Company HotRoom

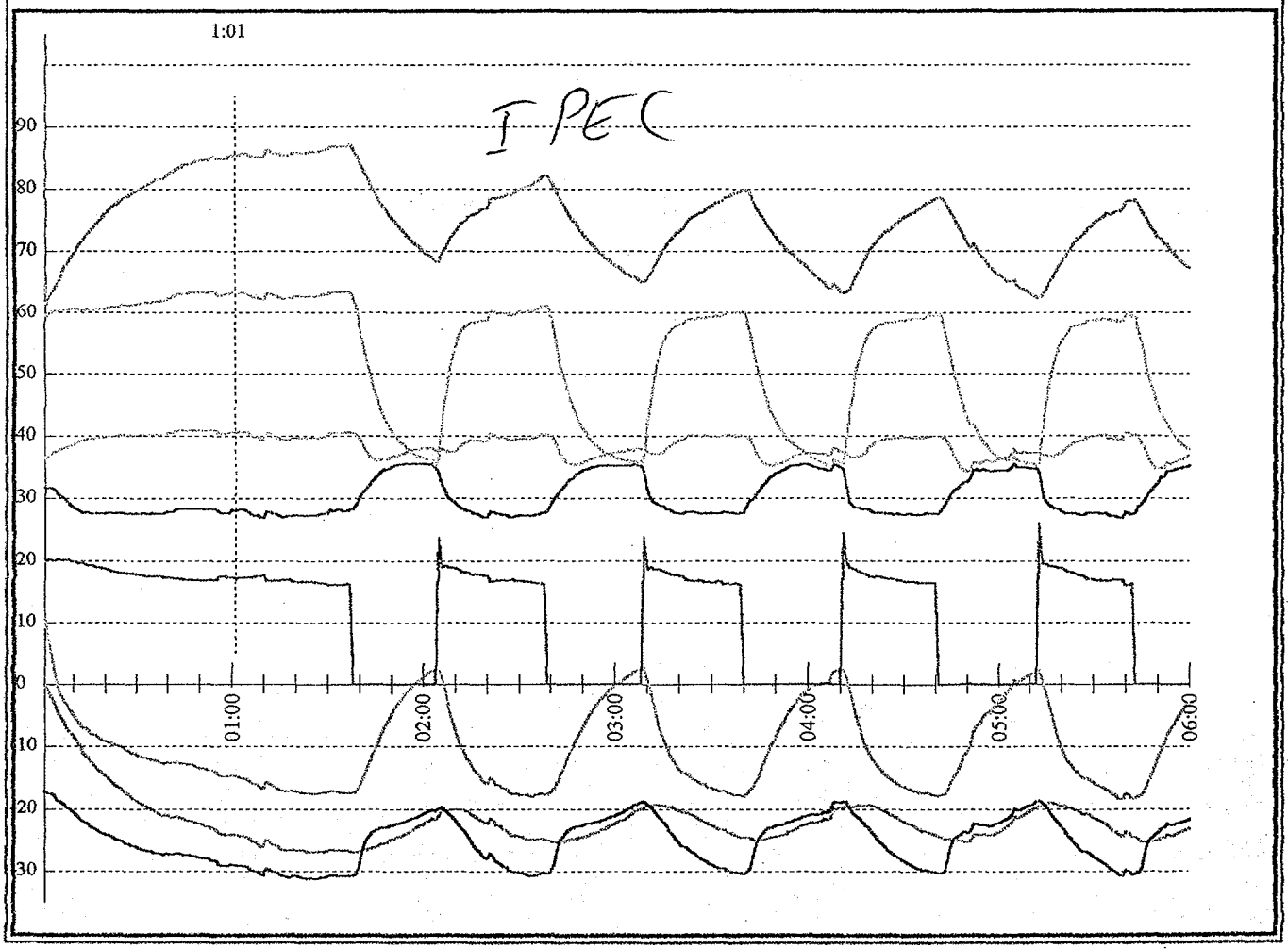
TestDate: **2000/06/24 08:12** *Report No.:* ( ) - Page 1

PageTestName: *Cycling Performance* *ReportDate:* 2000/06/26 09:02

Page Result :

1 - Page Test Time	*6 Hours*
2 - Working Percent	*61 %On*
3 - Energy (Accord to page)	*2.243 kwh*
4 - Zoom Time	*1:01 Hour*
5 - Compr Current	*1.37 Amp*
6 - Evaprator Mean Temp	*-25.3 C*
7 - Cabin Mean Temp	*2.5 C*
8 - Crisp Temp	*18.9 C*
9 - Compr Temp	*85.4 C*
10- Condensor In Temp	*63.3 C*
11- Condensor Out Temp	*40.5 C*
12- Condition	*33.7 C 20 %H*
13- Volt	*Max=225 Mean=222 Min=217*
14-	
15-	
16-	
17-	





Industrial Control Research Center HotRoom Ver 5

Printing in Labaratory Of
IPEC Company HotRoom

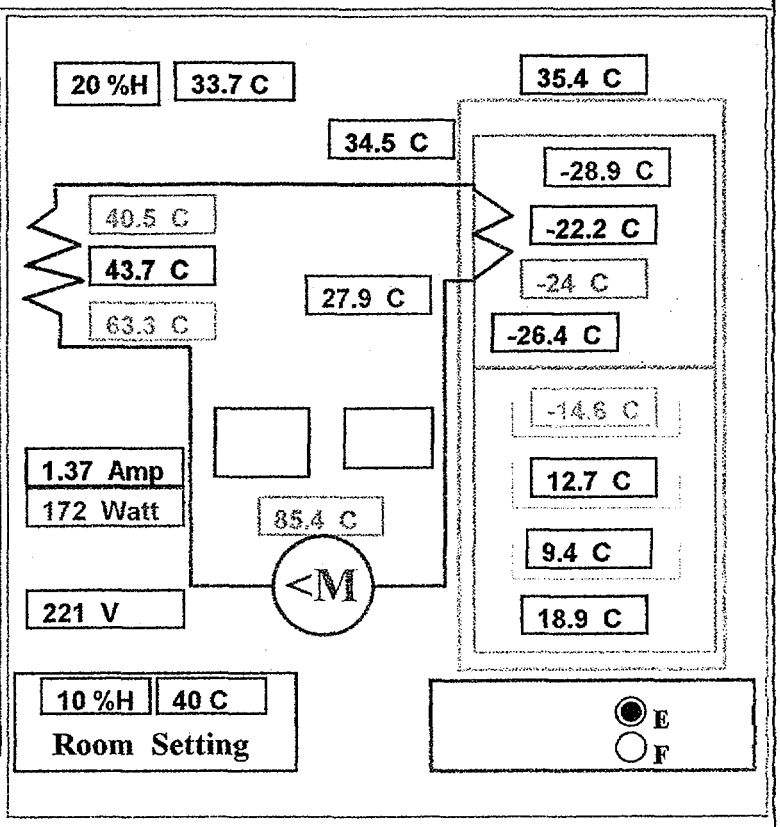
IPEC Company HotRoom

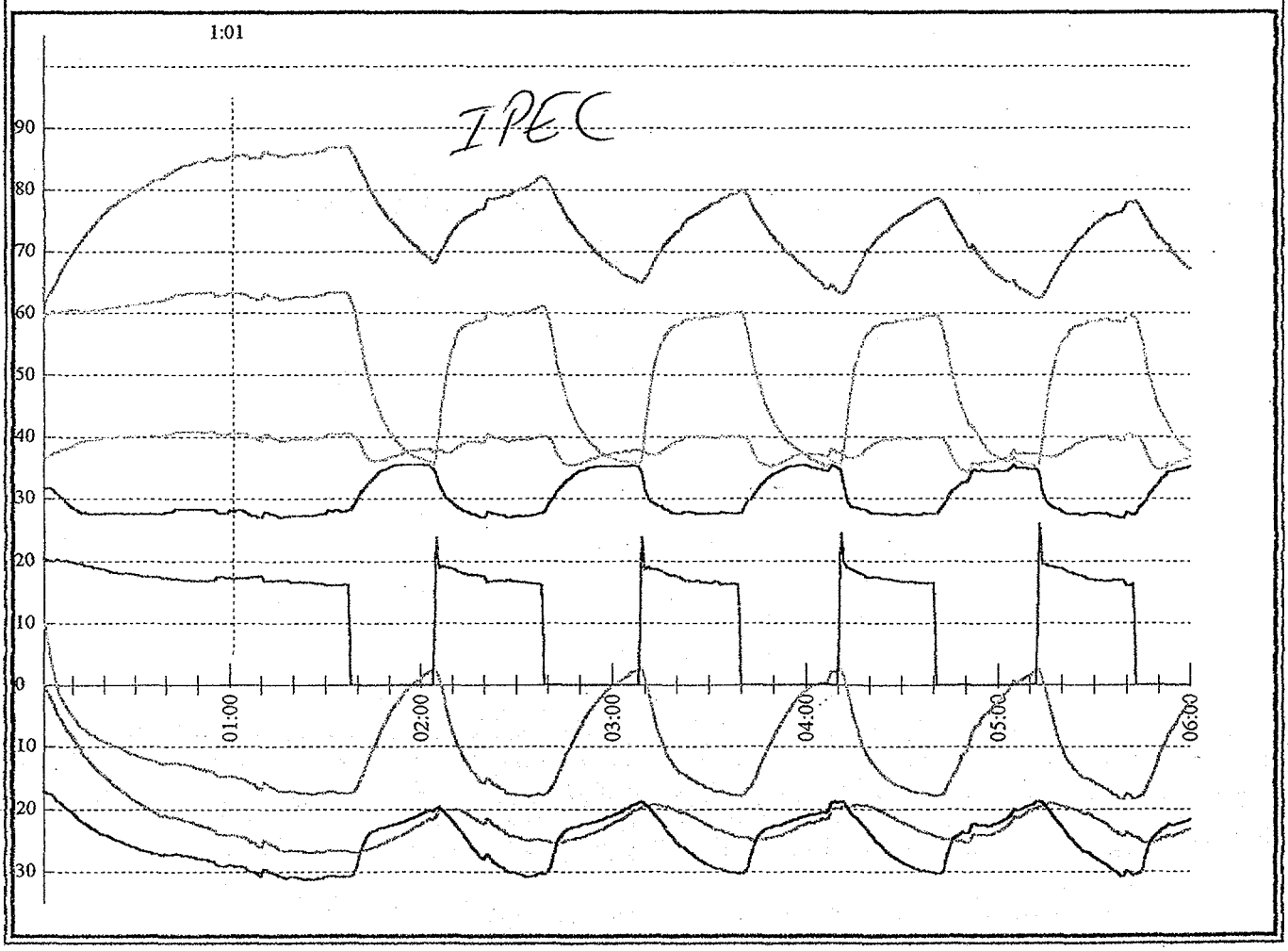
TestDate: **2000/06/24 08:12** *Report No.:* ( ) - Page 1

PageTestName: *Cycling Performance* *ReportDate:* 2000/06/26 09:02

Page Result :

1 - Page Test Time	*6 Hours*
2 - Working Percent	*61 %On*
3 - Energy (Accord to page)	*2.243 kwh*
4 - Zoom Time	*1:01 Hour*
5 - Compr Current	*1.37 Amp*
6 - Evaprator Mean Temp	*-25.3 C*
7 - Cabin Mean Temp	*2.5 C*
8 - Crisp Temp	*18.9 C*
9 - Compr Temp	*85.4 C*
10- Condensor In Temp	*63.3 C*
11- Condensor Out Temp	*40.5 C*
12- Condition	*33.7 C 20 %H*
13- Volt	*Max=225 Mean=222 Min=217*
14-	
15-	
16-	
17-	





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Printing In Labaratory Of
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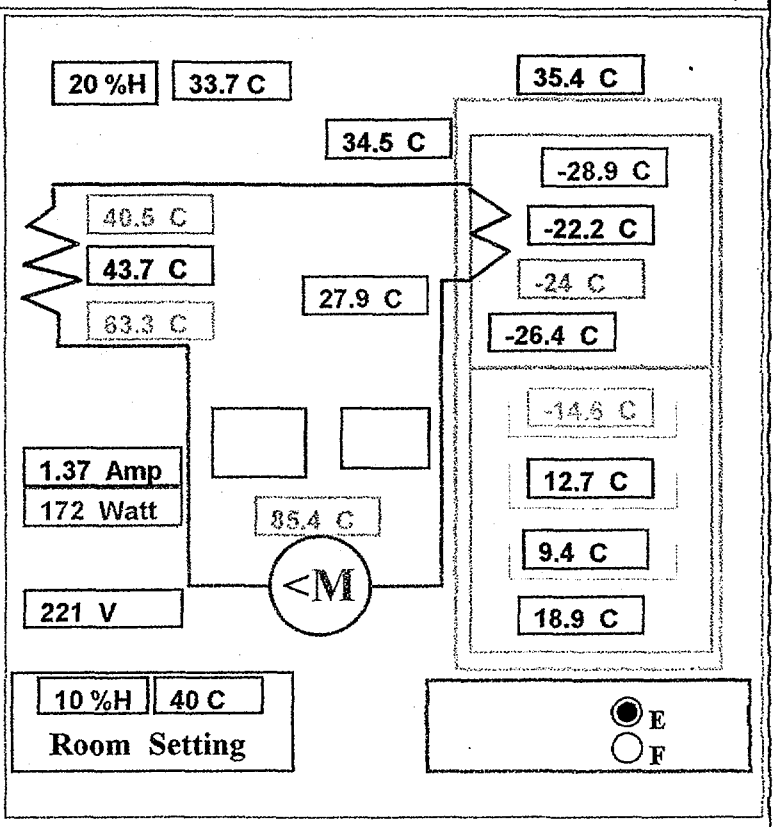
IPEC Company HotRoom

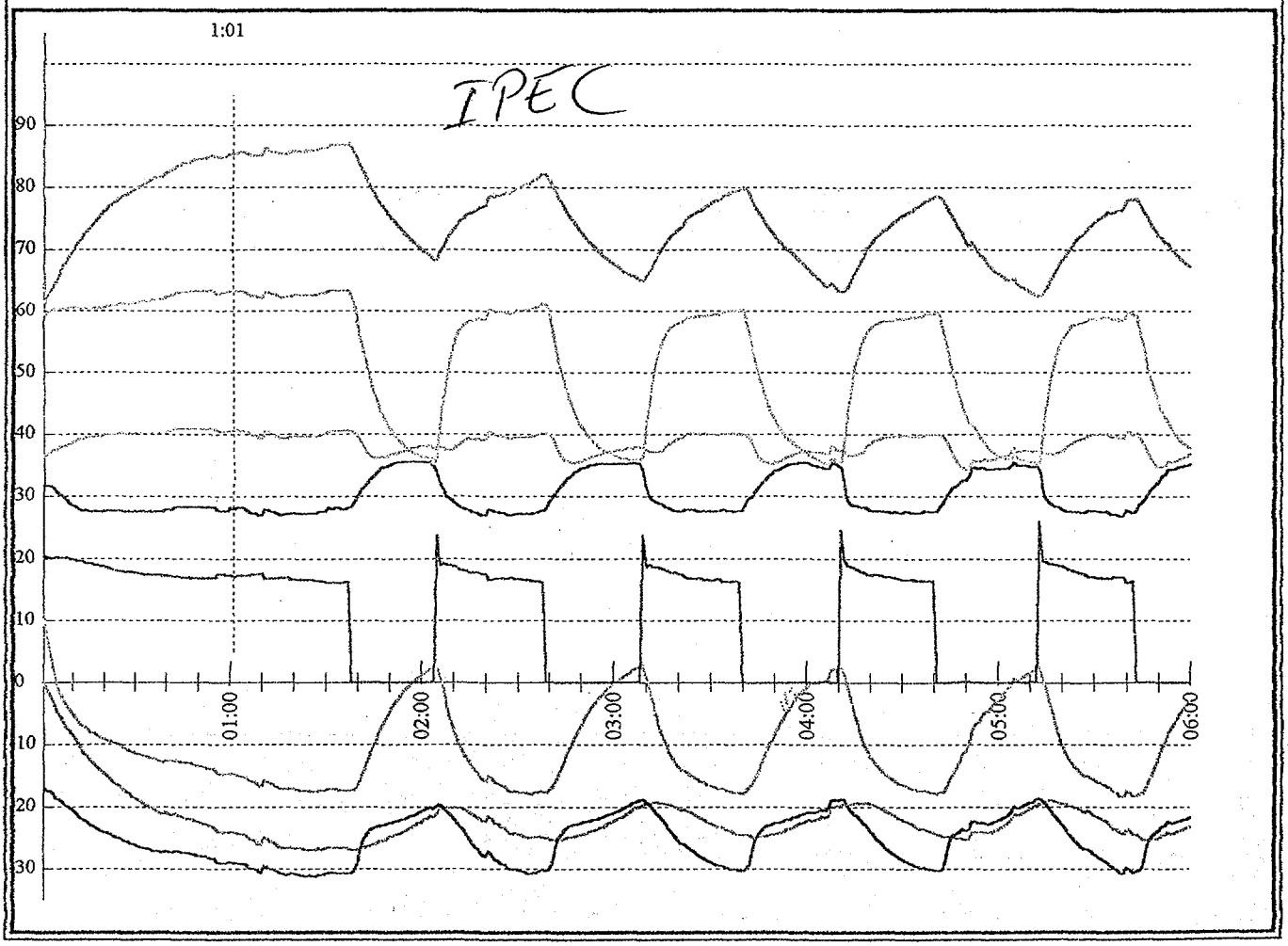
TestDate: **2000/06/24 08:12** *Report No.:* ( ) - Page 1

PageTestName: *Cycling Performance* *ReportDate:* 2000/06/26 09:02

Page Result :

1 - Page Test Time	*6 Hours*
2 - Working Percent	*61 %On*
3 - Energy (Accord to page)	*2.243 kwh*
4 - Zoom Time	*1:01 Hour*
5 - Compr Current	*1.37 Amp*
6 - Evaprator Mean Temp	*-25.3 C*
7 - Cabin Mean Temp	*2.5 C*
8 - Crisp Temp	*18.9 C*
9 - Compr Temp	*85.4 C*
10- Condensor In Temp	*63.3 C*
11- Condensor Out Temp	*40.5 C*
12- Condition	*33.7 C 20 %H*
13- Volt	*Max=225 Mean=222 Min=217*
14-	
15-	
16-	
17-	





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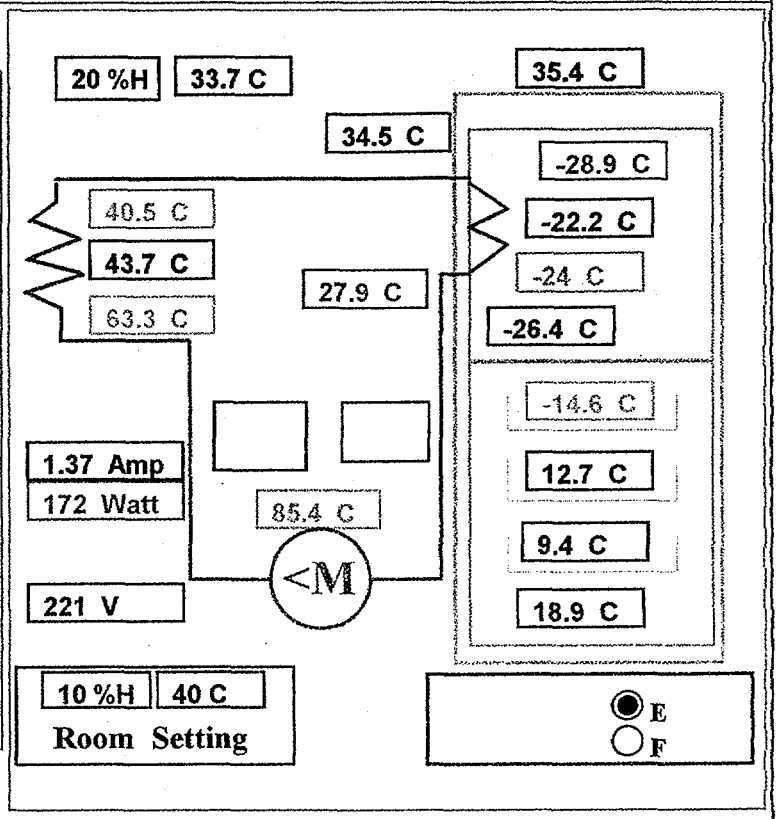
IPEC Company HotRoom

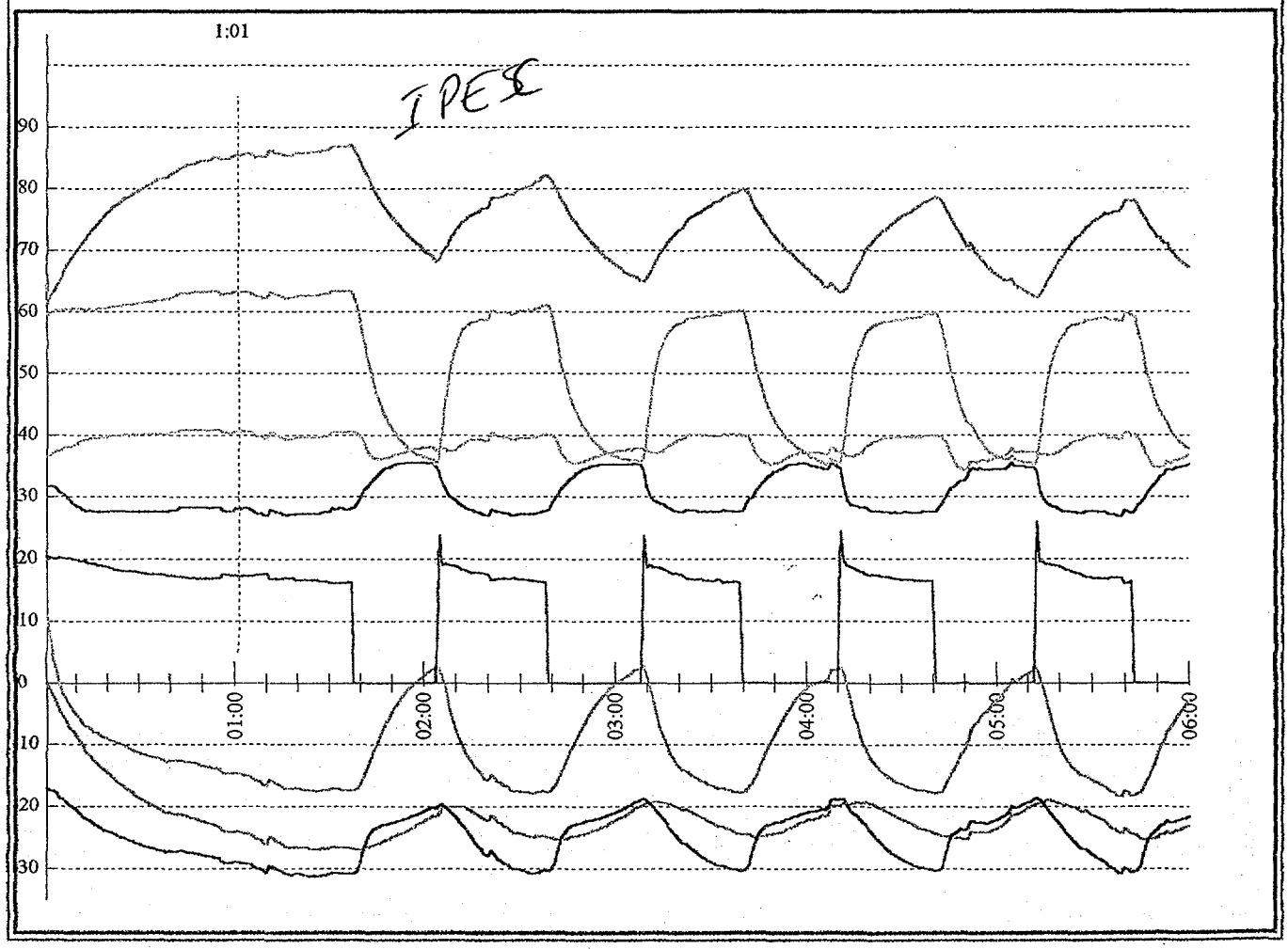
TestDate: **2000/06/24 08:12** *Report No.:* ( ) - Page 1

PageTestName: *Cycling Performance* *ReportDate:* 2000/06/26 09:02

Page Result :

1 - Page Test Time	*6 Hours*
2 - Working Percent	*61 %On*
3 - Energy (Accord to page)	*2.243 kwh*
4 - Zoom Time	*1:01 Hour*
5 - Compr Current	*1.37 Amp*
6 - Evaprator Mean Temp	*-25.3 C*
7 - Cabin Mean Temp	*2.5 C*
8 - Crisp Temp	*18.9 C*
9 - Compr Temp	*85.4 C*
10- Condensor In Temp	*63.3 C*
11- Condensor Out Temp	*40.5 C*
12- Condition	*33.7 C 20 %H*
13- Volt	*Max=225 Mean=222 Min=217*
14-	
15-	
16-	
17-	





Industrial Control Research Center HotRoom Ver 5

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IPEC Company HotRoom

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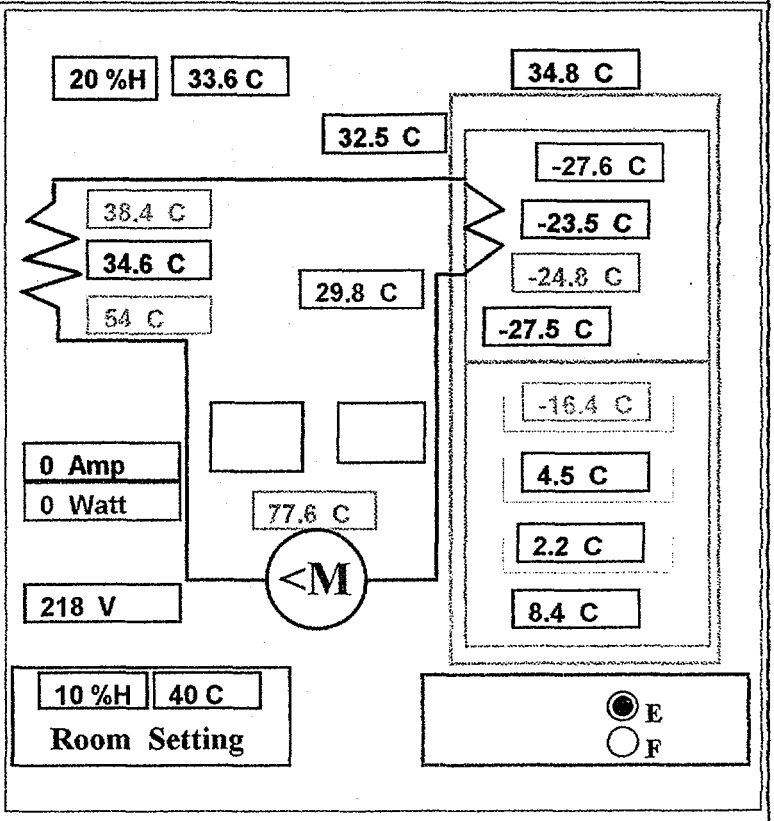
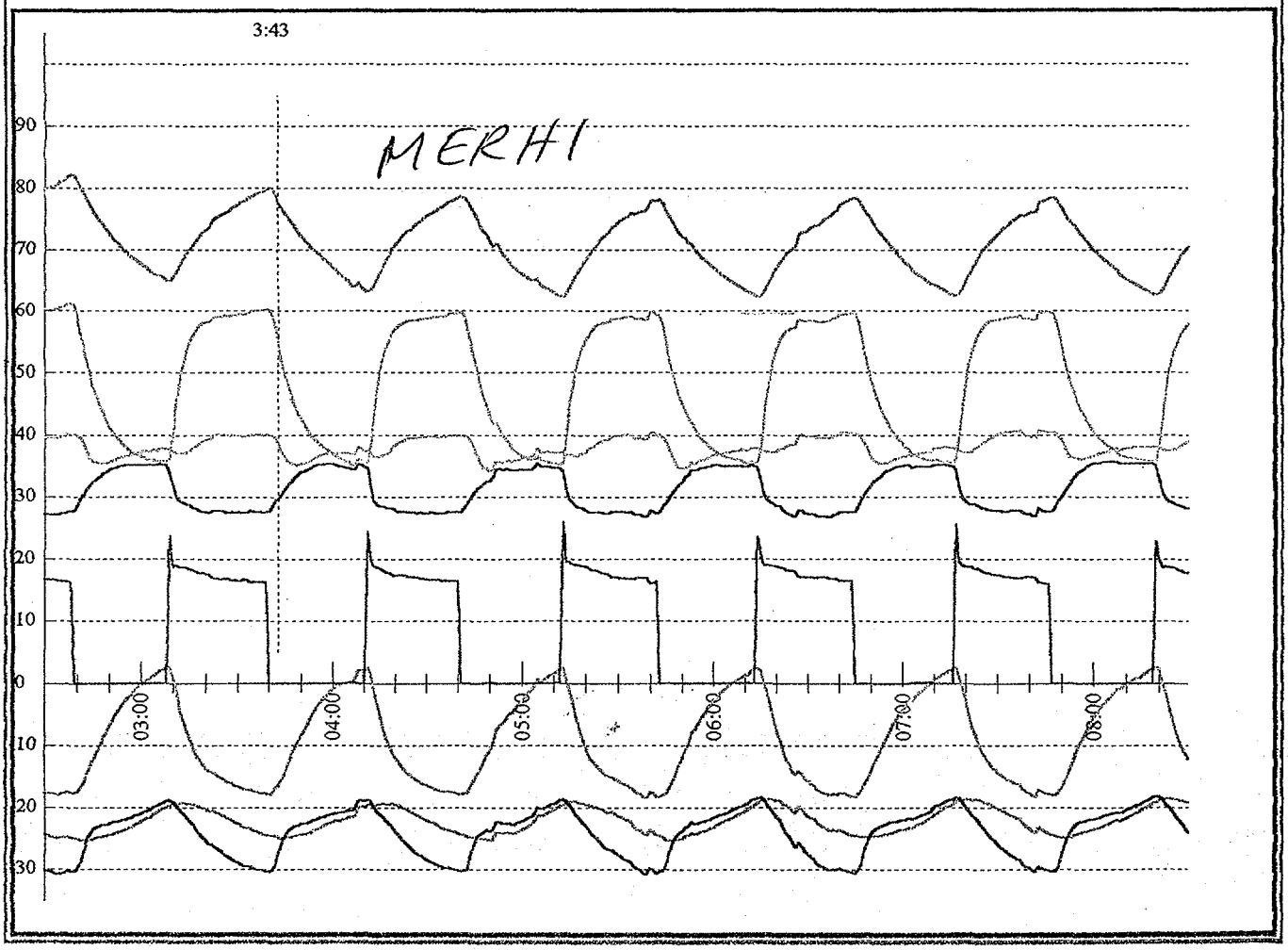
TestDate: **2000/06/24 08:12** Report No.: ( ) - Page 1

PageTestName: Cycling Performance ReportDate: 2000/06/26 09:12

Page Result :

1 - Page Test Time	6 Hours
2 - Working Percent	47 %On
3 - Energy (Accord to page)	1.777 kwh
4 - Zoom Time	3:43 Hour
5 - Compr Current	00 Amp
6 - Evaprator Mean Temp	-25.8 C
7 - Cabin Mean Temp	-3.2 C
8 - Crisp Temp	8.4 C
9 - Compr Temp	77.6 C
10- Condensor In Temp	54 C
11- Condensor Out Temp	38.4 C
12- Condition	33.6 C 20 %H
13- Volt	Max=225 Mean=222 Min=217
14-	
15-	
16-	
17-	





Industrial Control Research Center HotRoom Ver 5

Printing in Labaratory Of
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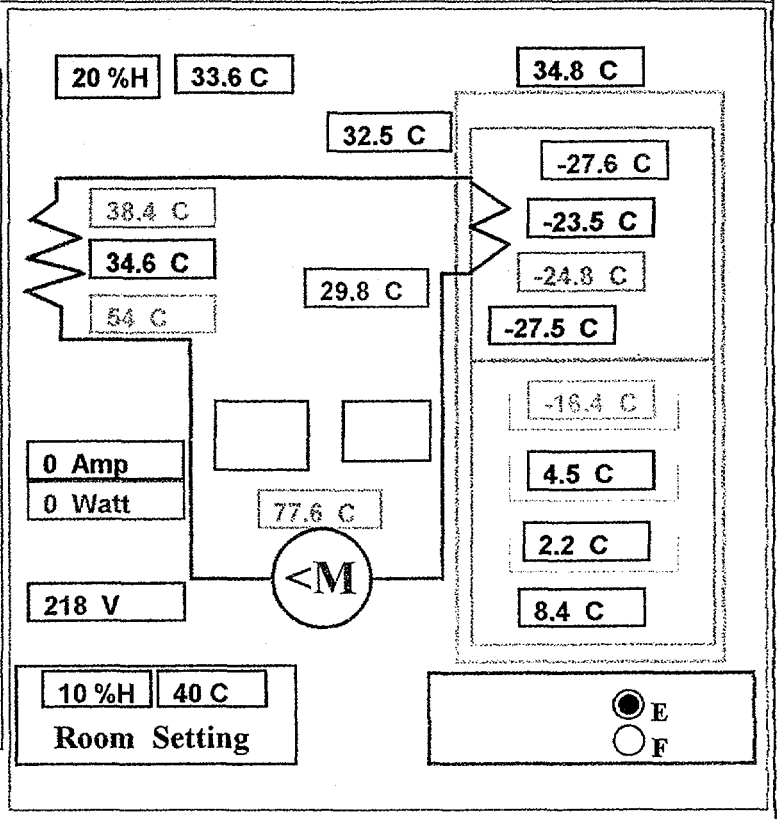
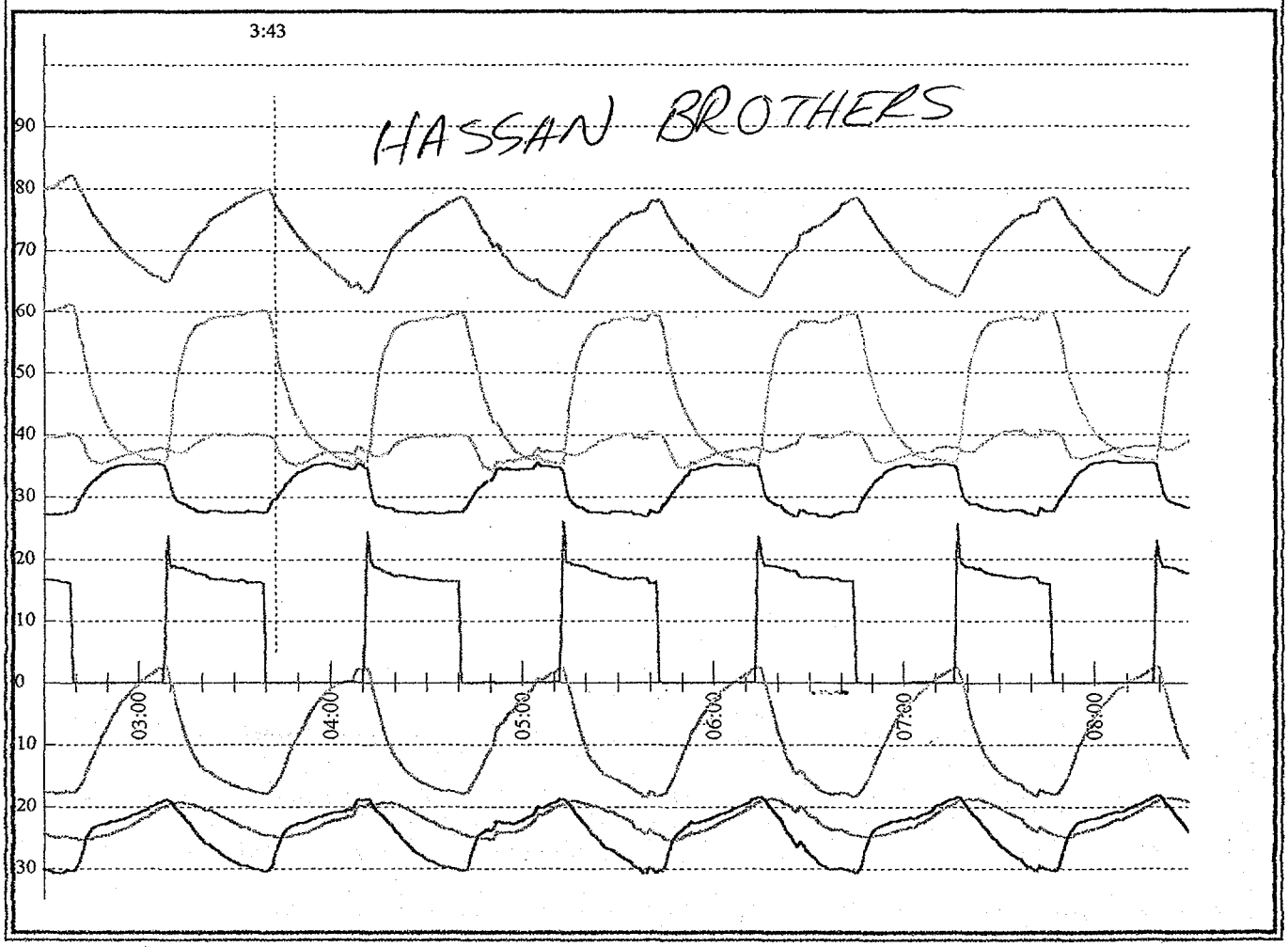
TestDate: **2000/06/24 08:12** *Report No.:* ( ) - Page 1

PageTestName: *Cycling Performance* *ReportDate:* 2000/06/26 09:12

Page Result :

1 - Page Test Time	*6 Hours*
2 - Working Percent	*47 %On*
3 - Energy (Accord to page)	*1.777 kwh*
4 - Zoom Time	*3:43 Hour*
5 - Compr Current	*00 Amp*
6 - Evaprator Mean Temp	*-25.8 C*
7 - Cabin Mean Temp	*-3.2 C*
8 - Crisp Temp	*8.4 C*
9 - Compr Temp	*77.6 C*
10- Condensor In Temp	*54 C*
11- Condensor Out Temp	*38.4 C*
12- Condition	*33.6 C 20 %H*
13- Volt	*Max=225 Mean=222 Min=217*
14-	
15-	
16-	
17-	





Industrial Control Research Center HotRoom Ver 5

Printing In Labaratory Of
IPEC Company HotRoom

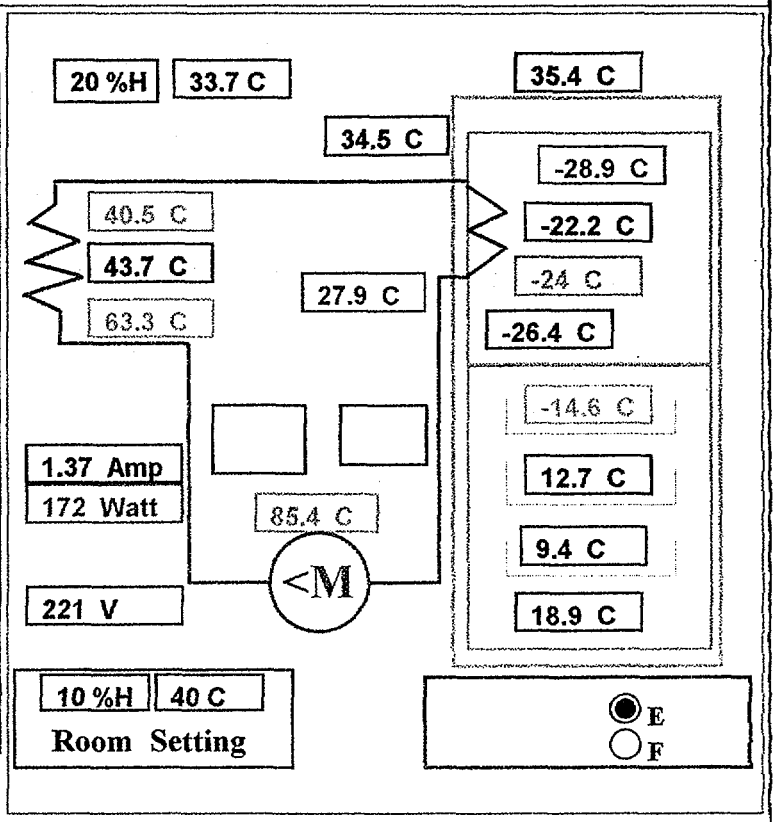
IPEC Company HotRoom

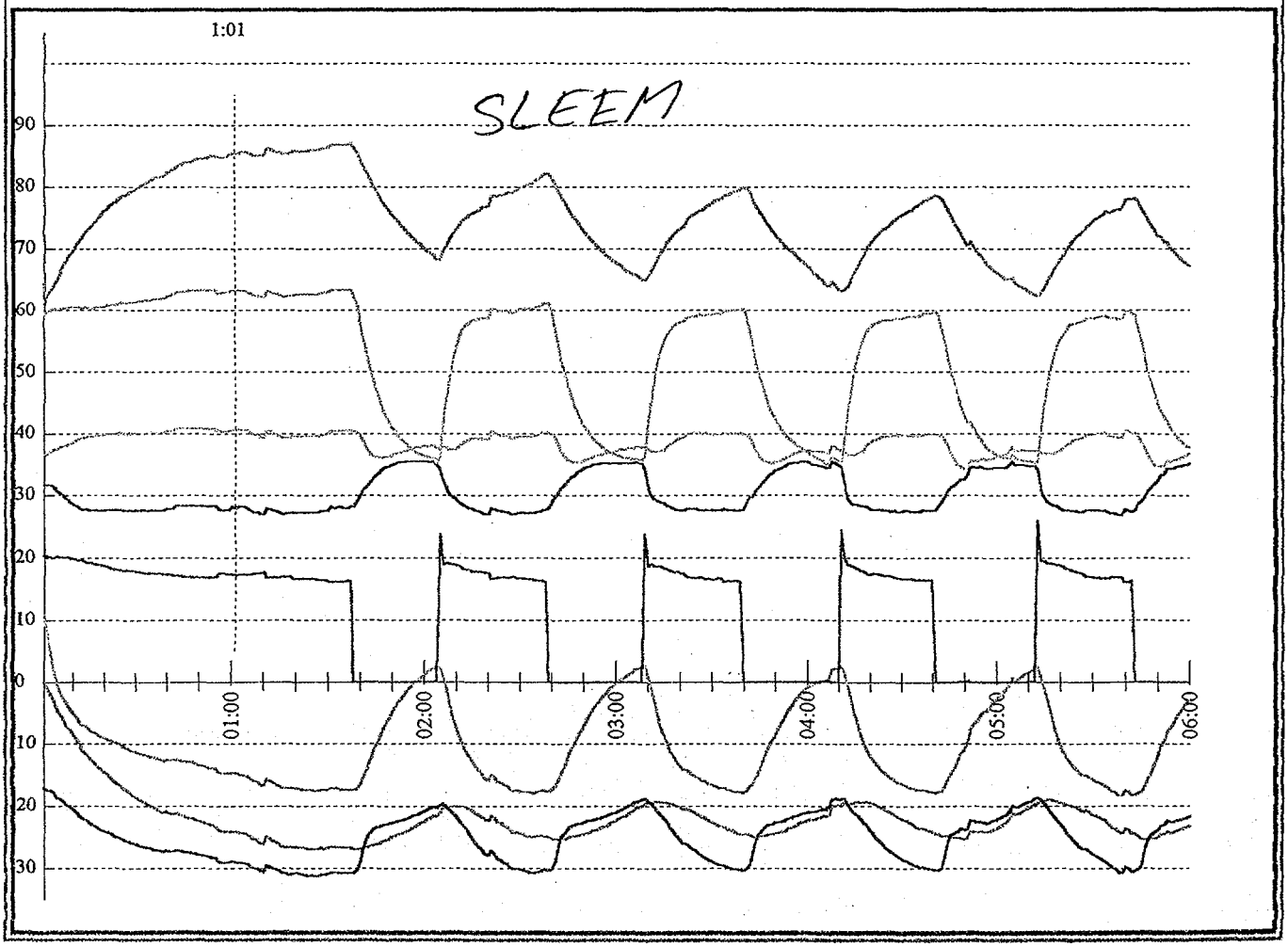
TestDate: **2000/06/24 08:12** *Report No.:* ( ) - Page 1

PageTestName: *Cycling Performance* *ReportDate:* 2000/06/26 09:02

Page Result :

1 - Page Test Time	*6 Hours*
2 - Working Percent	*61 %On*
3 - Energy (Accord to page)	*2.243 kwh*
4 - Zoom Time	*1:01 Hour*
5 - Compr Current	*1.37 Amp*
6 - Evaprator Mean Temp	*-25.3 C*
7 - Cabin Mean Temp	*2.5 C*
8 - Crisp Temp	*18.9 C*
9 - Compr Temp	*85.4 C*
10- Condensor In Temp	*63.3 C*
11- Condensor Out Temp	*40.5 C*
12- Condition	*33.7 C 20 %H*
13- Volt	*Max=225 Mean=222 Min=217*
14-	
15-	
16-	
17-	





Industrial Control Research Center HotRoom Ver 5

Printing in Labaratory Of
IPEC Company HotRoom

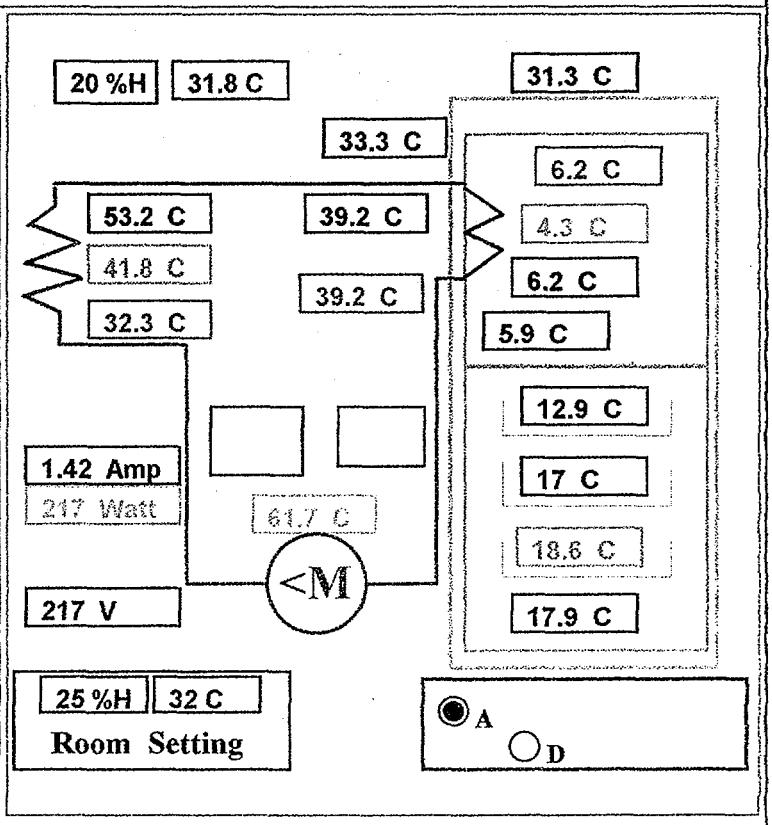
IPEC Company HotRoom

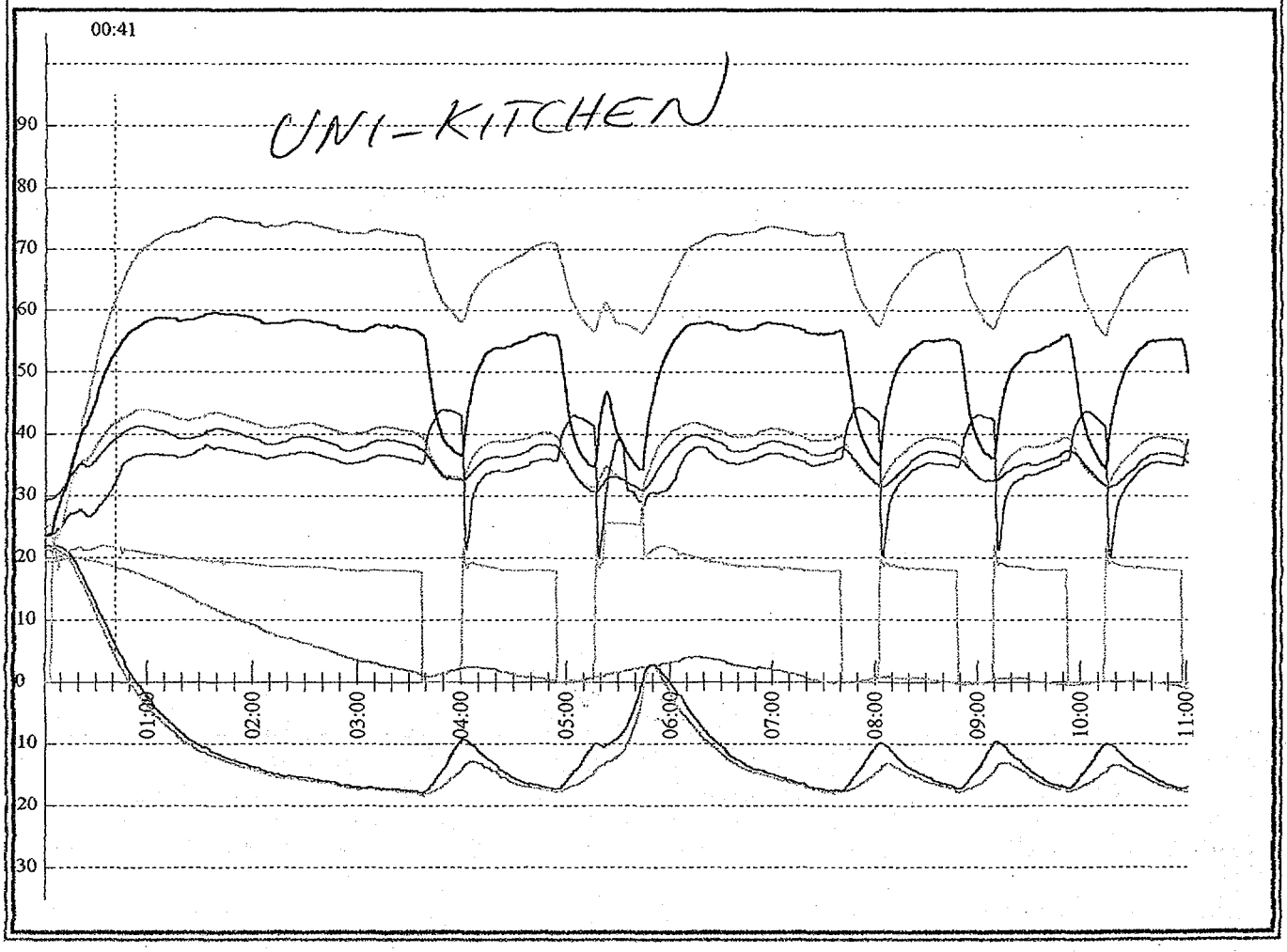
TestDate: **2000/06/24 08:12** *Report No.:* ( ) - Page 1

PageTestName: *Cycling Performance* *ReportDate:* 2000/06/26 09:29

Page Result :

1 - Page Test Time	*11 Hours*
2 - Working Percent	*82 %On*
3 - Energy (Accord to page)	*2.542 kwh*
4 - Zoom Time	*0:41 Hour*
5 - Compr Current	*1.42 Amp*
6 - Evaprator Mean Temp	*5.6 C*
7 - Cabin Mean Temp	*16.1 C*
8 - Crisp Temp	*17.9 C*
9 - Compr Temp	*61.7 C*
10- Condensor In Temp	*32.3 C*
11- Condensor Out Temp	*53.2 C*
12- Condition	*31.8 C 20 %H*
13- Volt	*Max=225 Mean=221 Min=216*
14-	
15-	
16-	
17-	





Industrial Control Research Center HotRoom Ver 5

Printing in Labaratory Of
IPEC Company HotRoom

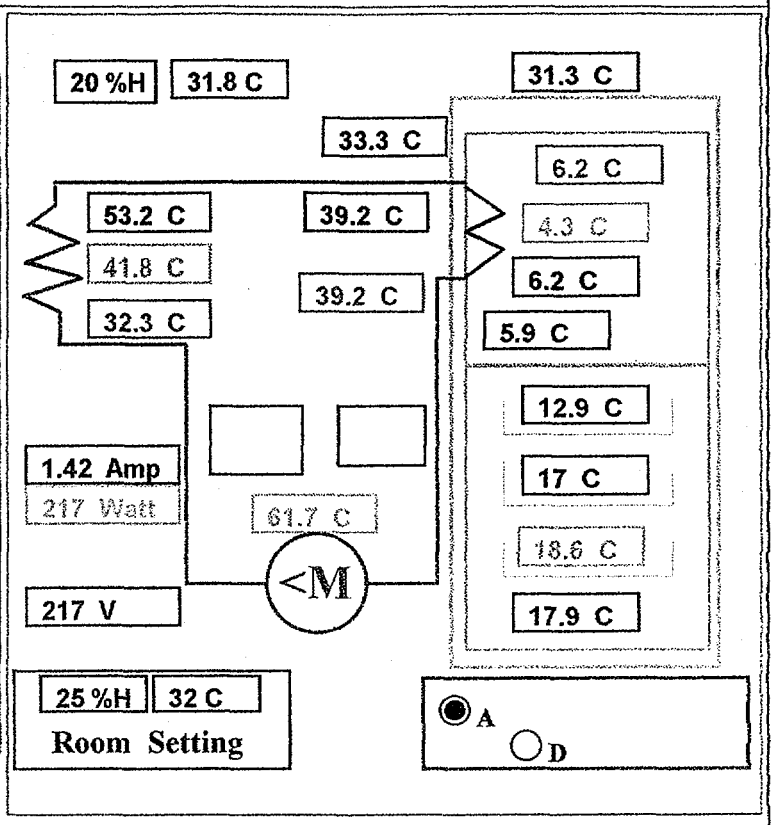
IPEC Company HotRoom

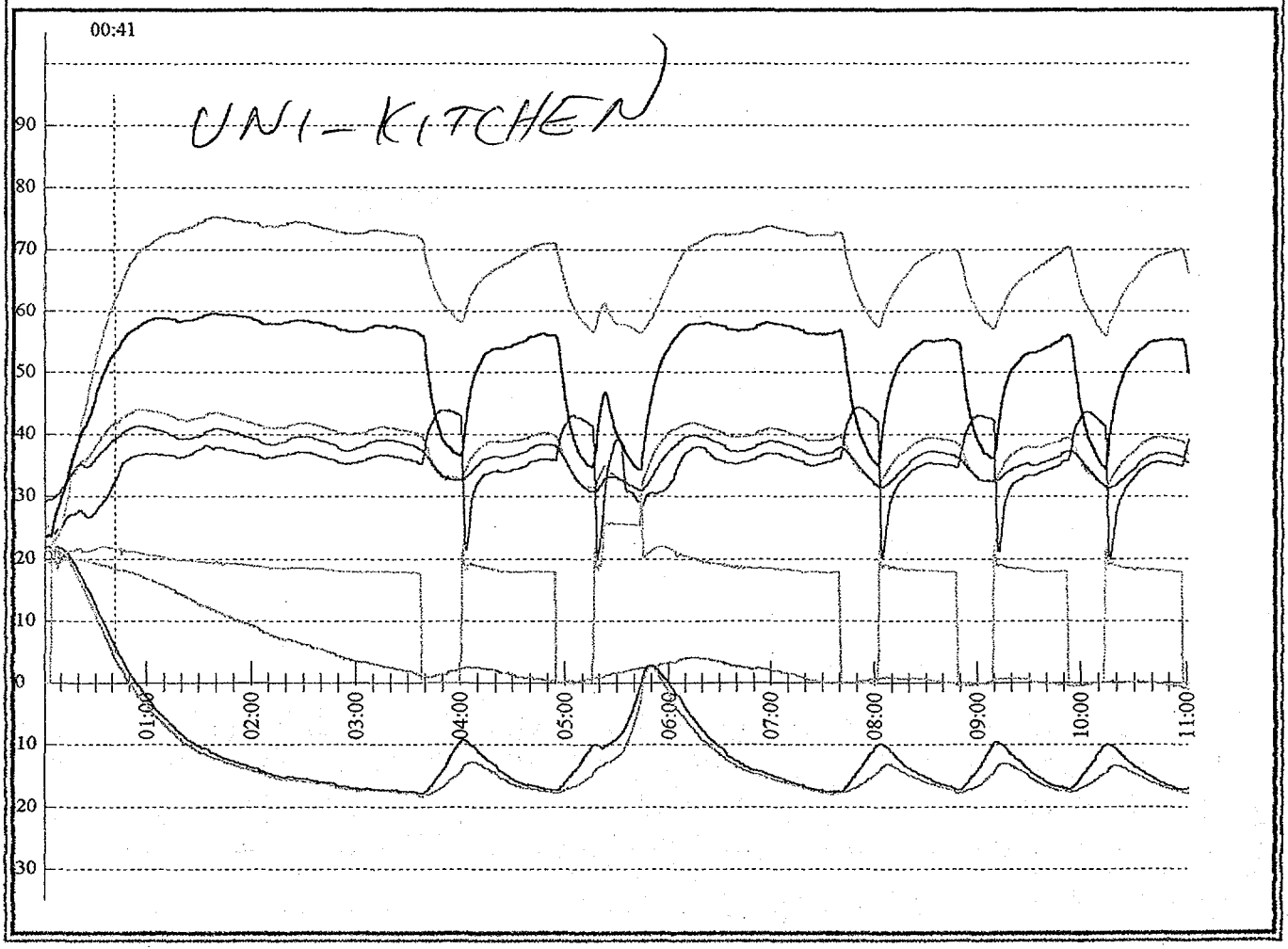
TestDate: **2000/06/24 08:12** *Report No.:* ( ) - Page 1

PageTestName: *Cycling Performance* *ReportDate:* 2000/06/26 09:29

Page Result :

1 - Page Test Time	*11 Hours*
2 - Working Percent	*82 %On*
3 - Energy (Accord to page)	*2.542 kwh*
4 - Zoom Time	*0:41 Hour*
5 - Compr Current	*1.42 Amp*
6 - Evaprator Mean Temp	*5.6 C*
7 - Cabin Mean Temp	*16.1 C*
8 - Crisp Temp	*17.9 C*
9 - Compr Temp	*61.7 C*
10- Condensor In Temp	*32.3 C*
11- Condensor Out Temp	*53.2 C*
12- Condition	*31.8 C 20 %H*
13- Volt	*Max=225 Mean=221 Min=216*
14-	
15-	
16-	
17-	





Industrial Control Research Center HotRoom Ver 5

Printing In Labaratory Of
IPEC Company HotRoom

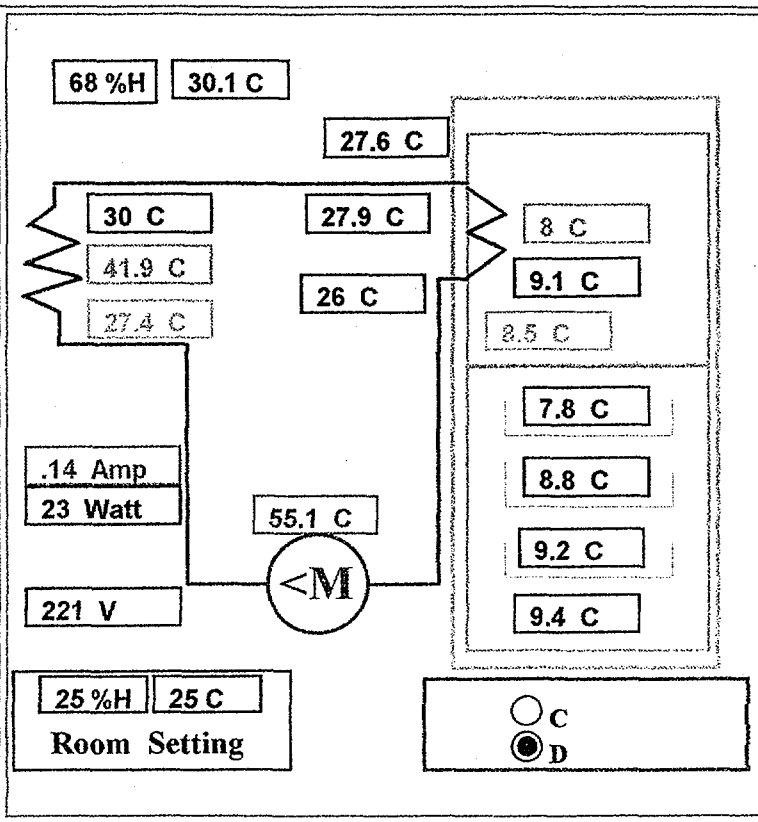
IPEC Company HotRoom

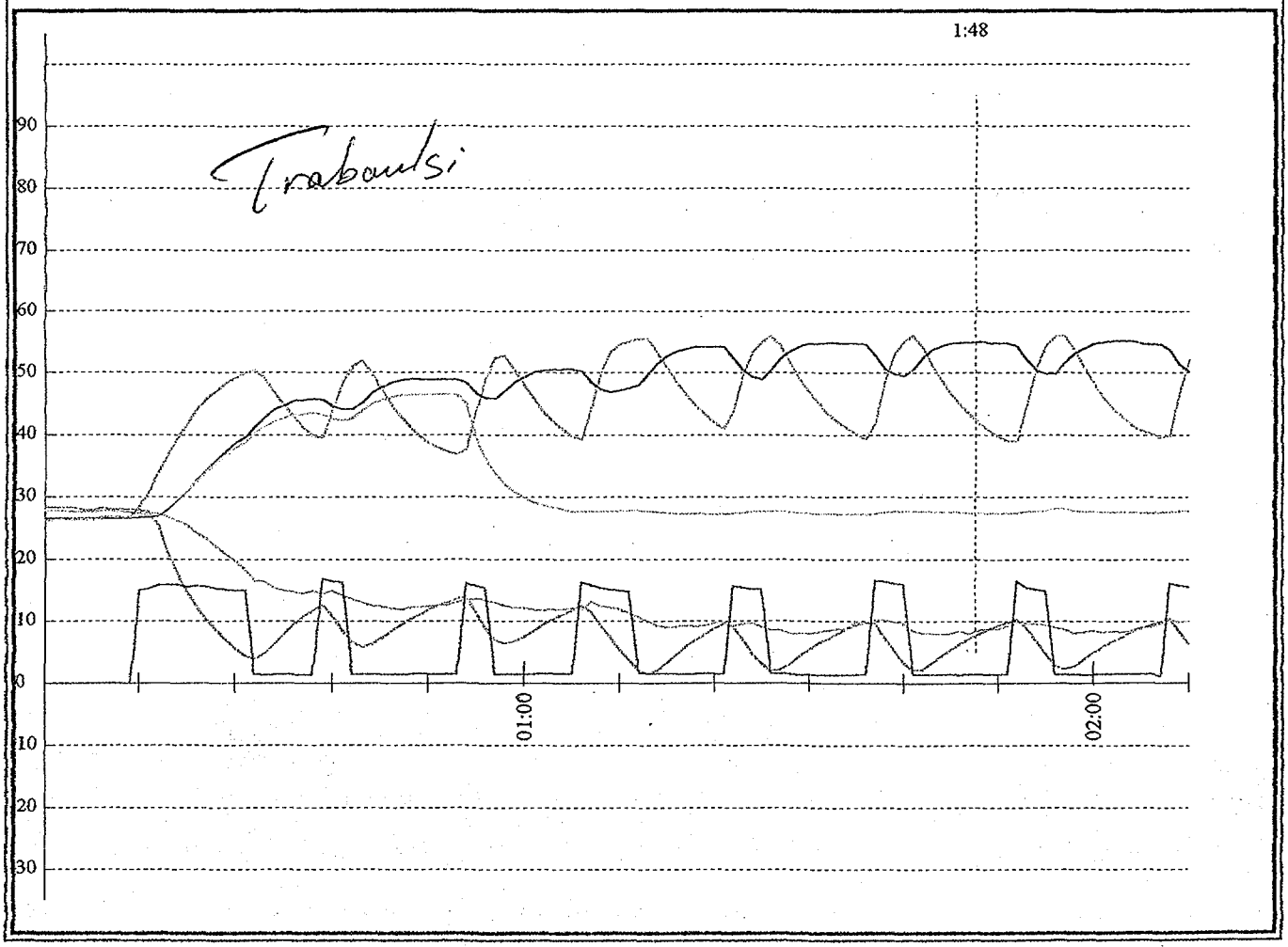
TestDate: **2000/06/24 08:12** *Report No.:* ( ) - Page 1

PageTestName: *Cycling Performance* *ReportDate:* 2000/06/26 13:28

Page Result :

1 - Page Test Time	*2 Hours*
2 - Working Percent	*32 %On*
3 - Energy (Accord to page)	*0.779 kwh*
4 - Zoom Time	*1:48 Hour*
5 - Compr Current	*0.14 Amp*
6 - Evaprator Mean Temp	*8.8 C*
7 - Cabin Mean Temp	*8.6 C*
8 - Crisp Temp	*9.4 C*
9 - Compr Temp	*55.1 C*
10- Condensor In Temp	*27.4 C*
11- Condensor Out Temp	*30 C*
12- Condition	*30.1 C 68 %H*
13- Volt	*Max=229 Mean=224 Min=215*
14-	
15-	
16-	
17-	





Industrial Control Research Center HotRoom Ver 5

Printing in Labaratory Of
IPEC Company HotRoom

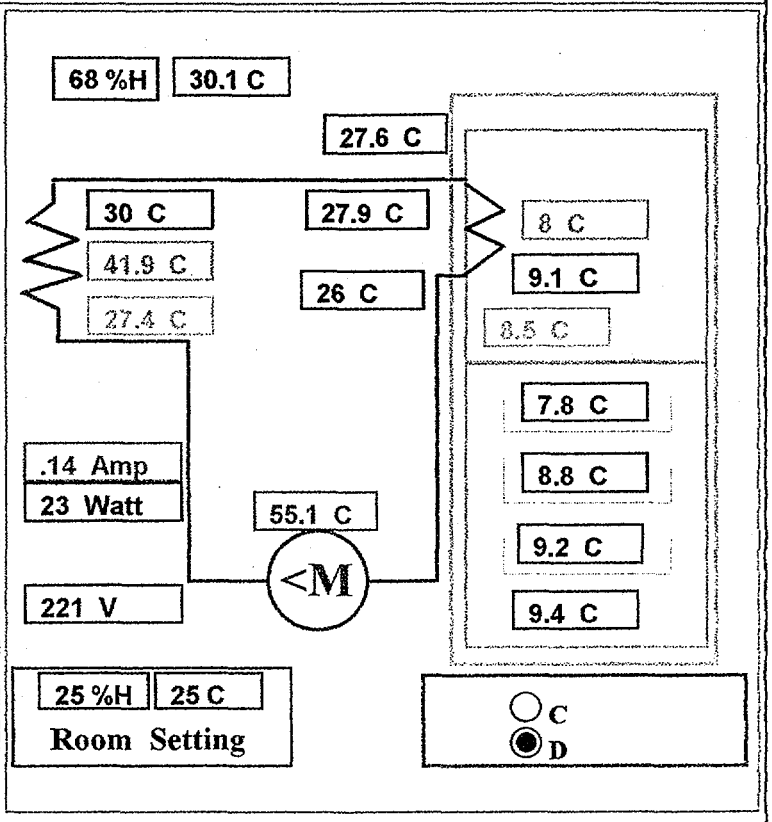
IPEC Company HotRoom

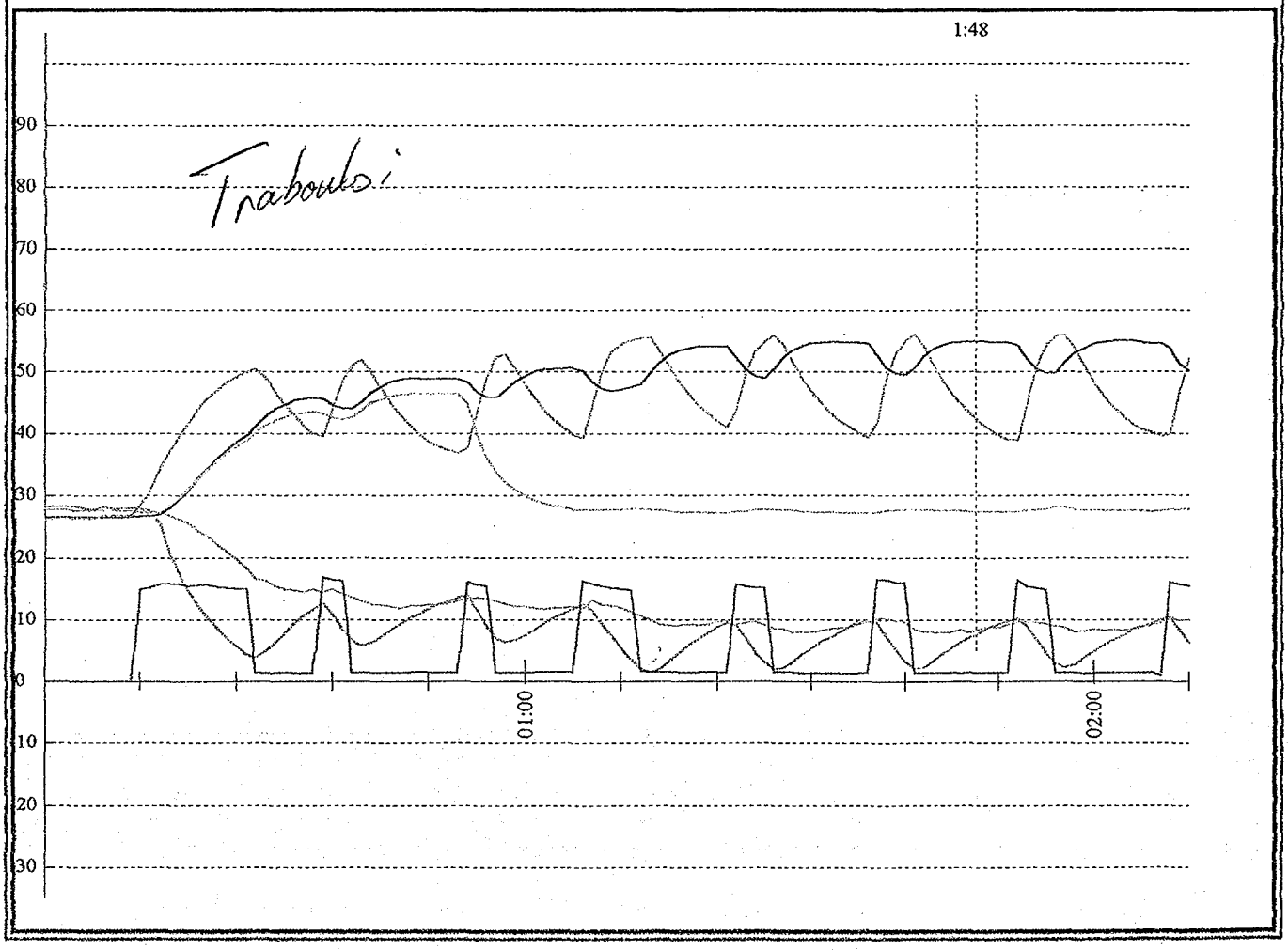
TestDate: 2000/06/24 08:12 Report No.: ( ) - Page 1

PageTestName: Cycling Performance ReportDate: 2000/06/26 13:28

Page Result :

1 - Page Test Time	2 Hours
2 - Working Percent	32 %On
3 - Energy (Accord to page)	0.779 kwh
4 - Zoom Time	1:48 Hour
5 - Compr Current	0.14 Amp
6 - Evaprator Mean Temp	8.8 C
7 - Cabin Mean Temp	8.6 C
8 - Crisp Temp	9.4 C
9 - Compr Temp	55.1 C
10- Condensor In Temp	27.4 C
11- Condensor Out Temp	30 C
12- Condition	30.1 C 68 %H
13- Volt	Max=229 Mean=224 Min=215
14-	
15-	
16-	
17-	





Industrial Control Research Center HotRoom Ver 5

Printing in Labaratory Of
IPEC Company HotRoom

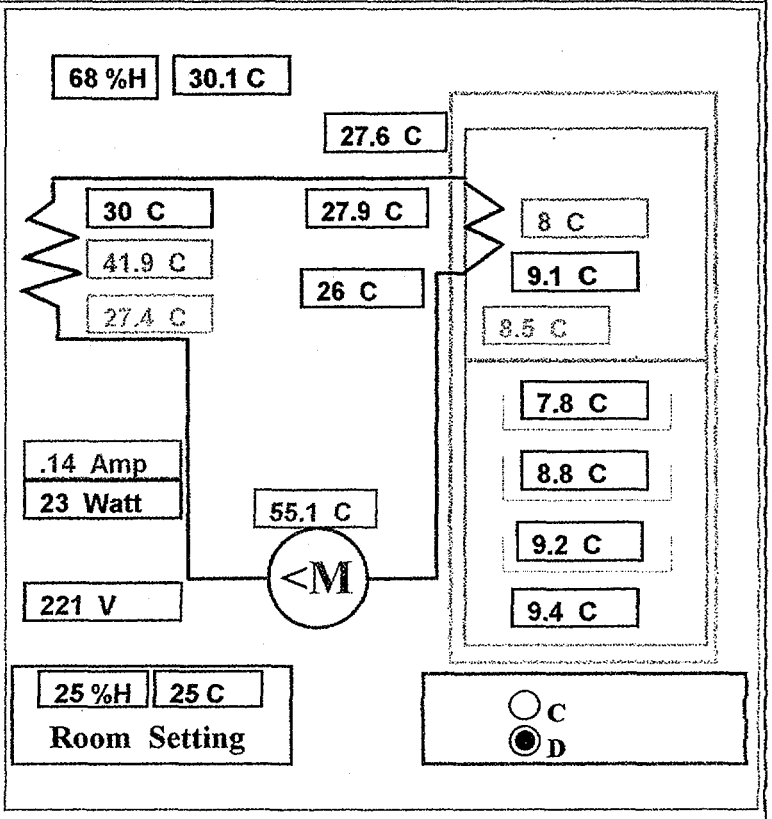
IPEC Company HotRoom

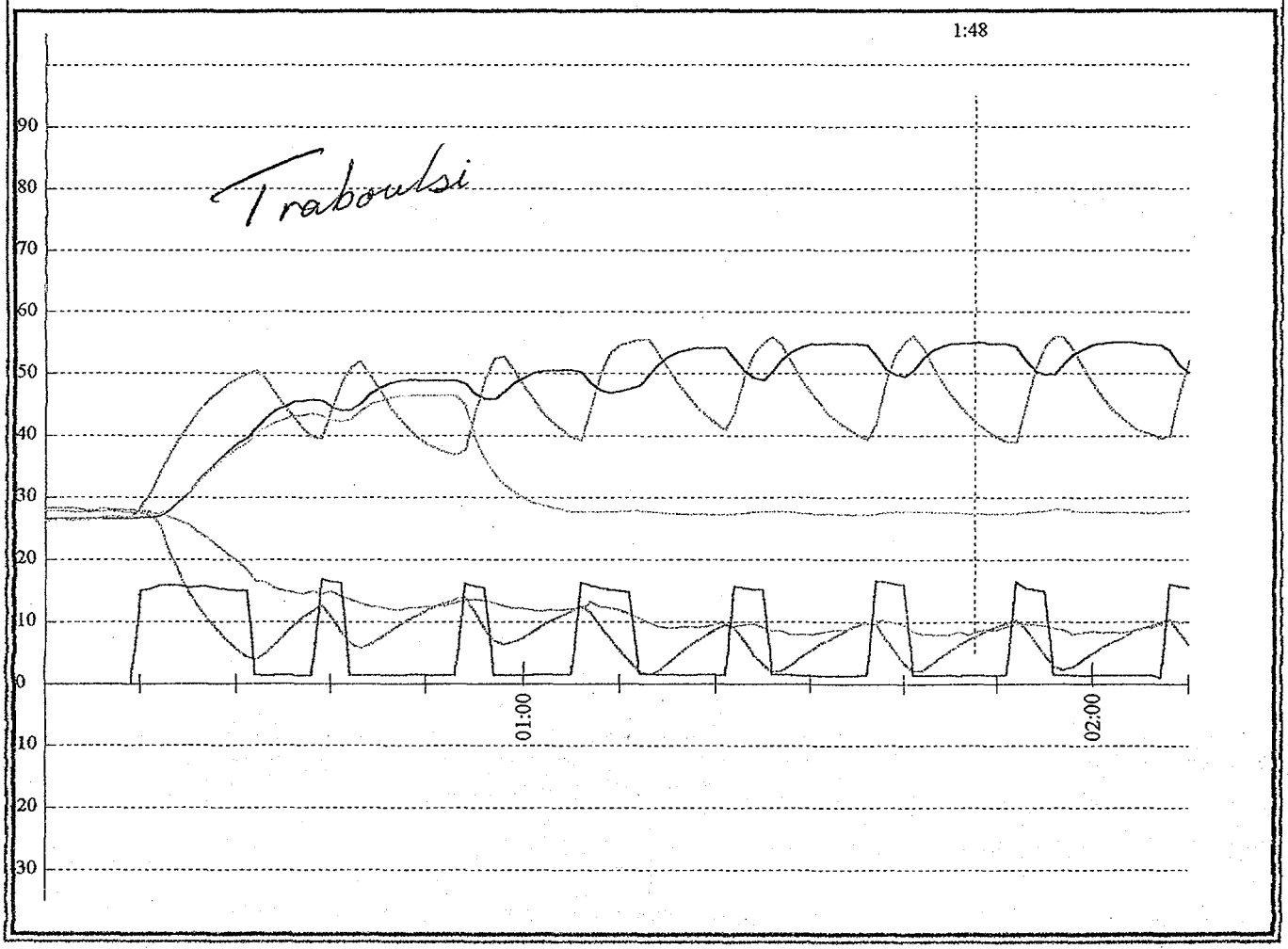
TestDate: **2000/06/24 08:12** *Report No.:* ( ) - Page 1

PageTestName: *Cycling Performance* *ReportDate:* 2000/06/26 13:28

Page Result :

1 - Page Test Time	*2 Hours*
2 - Working Percent	*32 %On*
3 - Energy (Accord to page)	*0.779 kwh*
4 - Zoom Time	*1:48 Hour*
5 - Compr Current	*0.14 Amp*
6 - Evaprator Mean Temp	*8.8 C*
7 - Cabin Mean Temp	*8.6 C*
8 - Crisp Temp	*9.4 C*
9 - Compr Temp	*55.1 C*
10- Condensor In Temp	*27.4 C*
11- Condensor Out Temp	*30 C*
12- Condition	*30.1 C 68 %H*
13- Volt	*Max=229 Mean=224 Min=215*
14-	
15-	
16-	
17-	





Industrial Control Research Center HotRoom Ver 5

Printing in Labaratory Of
IPEC Company HotRoom

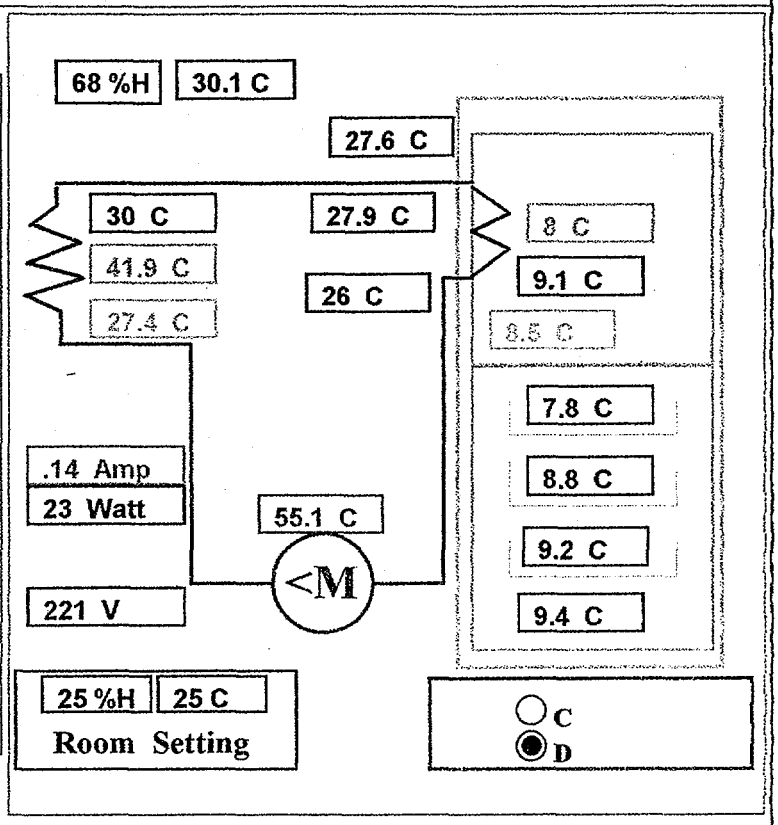
IPEC Company HotRoom

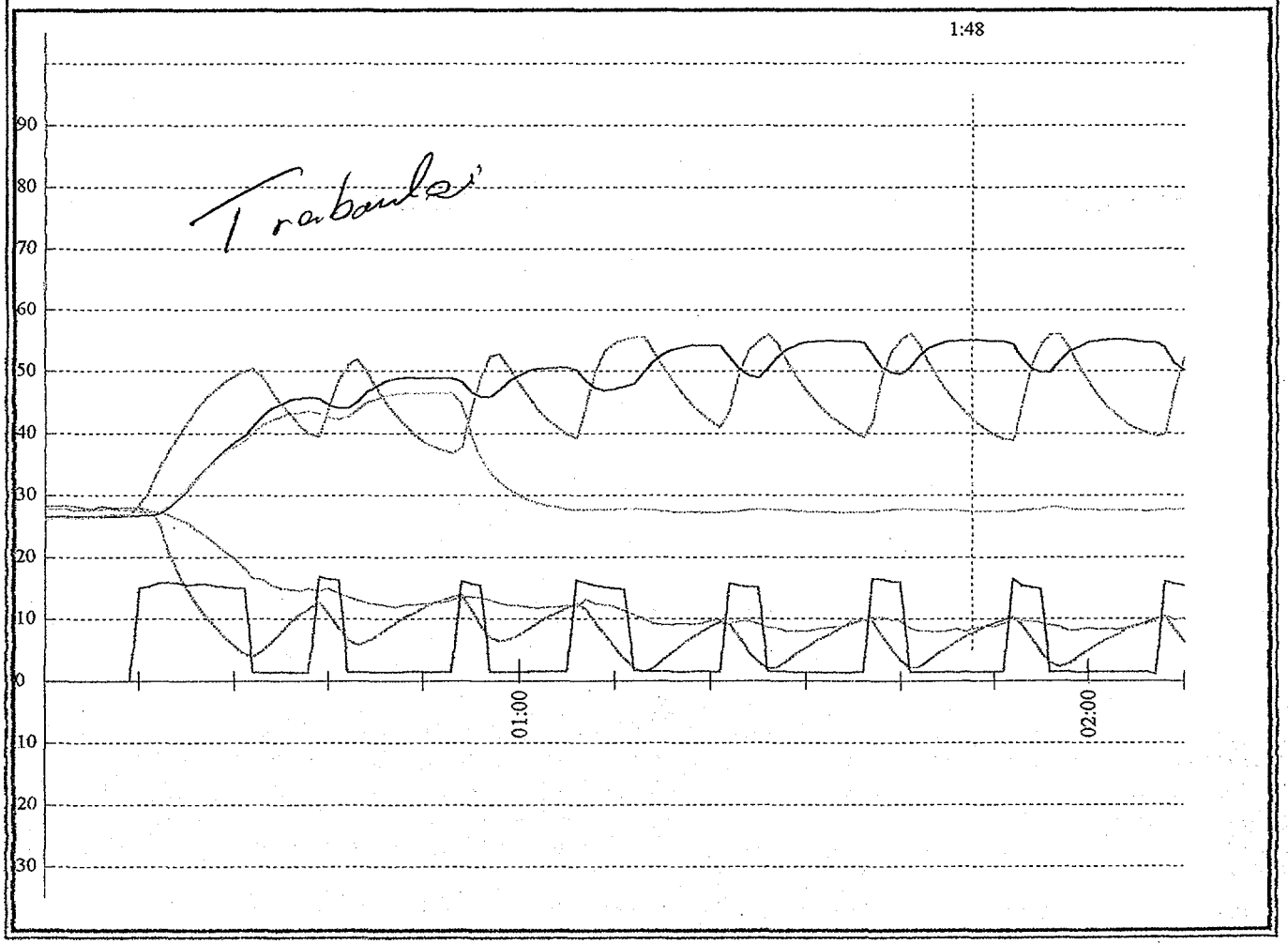
TestDate: **2000/06/24 08:12** Report No.: ( ) - Page 1

PageTestName: Cycling Performance ReportDate: 2000/06/26 13:28

Page Result :

1 - Page Test Time	2 Hours
2 - Working Percent	32 %On
3 - Energy (Accord to page)	0.779 kwh
4 - Zoom Time	1:48 Hour
5 - Compr Current	0.14 Amp
6 - Evaprator Mean Temp	8.8 C
7 - Cabin Mean Temp	8.6 C
8 - Crisp Temp	9.4 C
9 - Compr Temp	55.1 C
10- Condensor In Temp	27.4 C
11- Condensor Out Temp	30 C
12- Condition	30.1 C 68 %H
13- Volt	Max=229 Mean=224 Min=215
14-	
15-	
16-	
17-	





Industrial Control Research Center HotRoom Ver 5

Printing in Labaratory Of
IPEC Company HotRoom

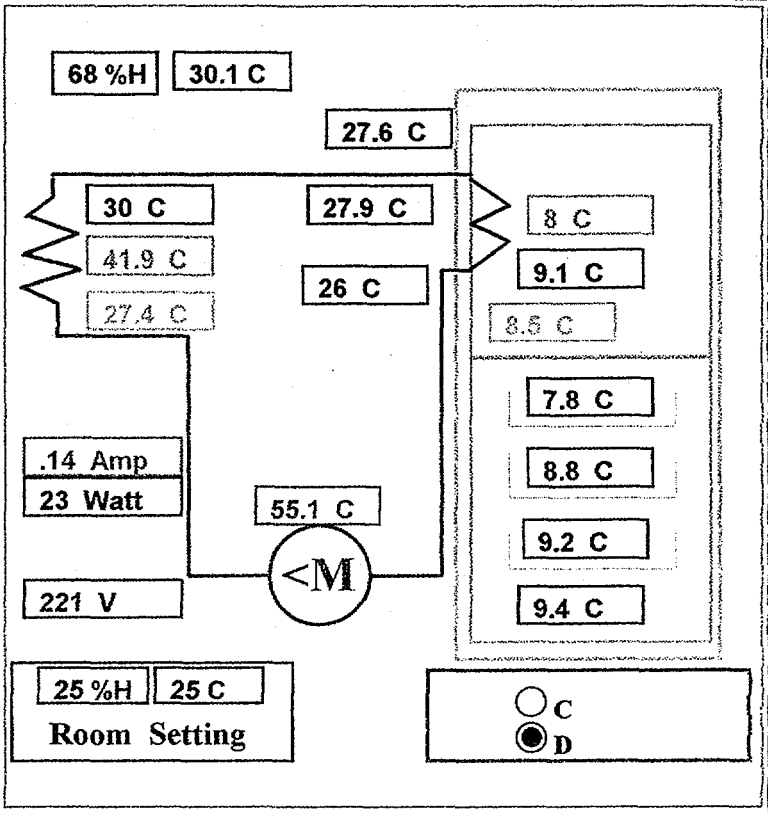
IPEC Company HotRoom

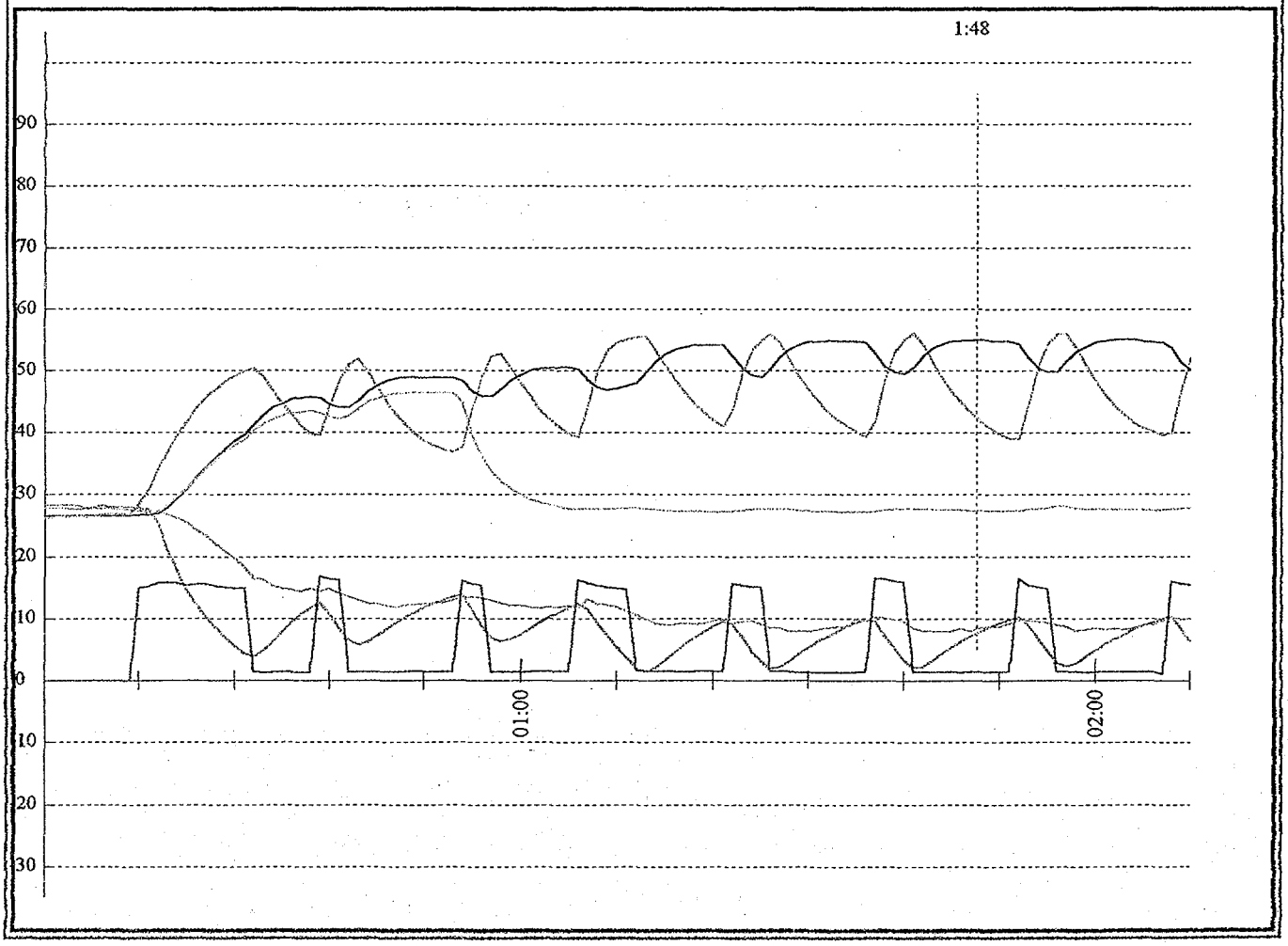
TestDate: **2000/06/24 08:12** *Report No.:* ( ) - Page 1

PageTestName: *Cycling Performance* *ReportDate:* 2000/06/26 13:28

Page Result :

1 - Page Test Time	*2 Hours*
2 - Working Percent	*32 %On*
3 - Energy (Accord to page)	*0.779 kwh*
4 - Zoom Time	*1:48 Hour*
5 - Compr Current	*0.14 Amp*
6 - Evaprator Mean Temp	*8.8 C*
7 - Cabin Mean Temp	*8.6 C*
8 - Crisp Temp	*9.4 C*
9 - Compr Temp	*55.1 C*
10- Condensor In Temp	*27.4 C*
11- Condensor Out Temp	*30 C*
12- Condition	*30.1 C 68 %H*
13- Volt	*Max=229 Mean=224 Min=215*
14-	
15-	
16-	
17-	





Industrial Control Research Center HotRoom Ver 5

Printing in Labaratory Of
IPEC Company HotRoom

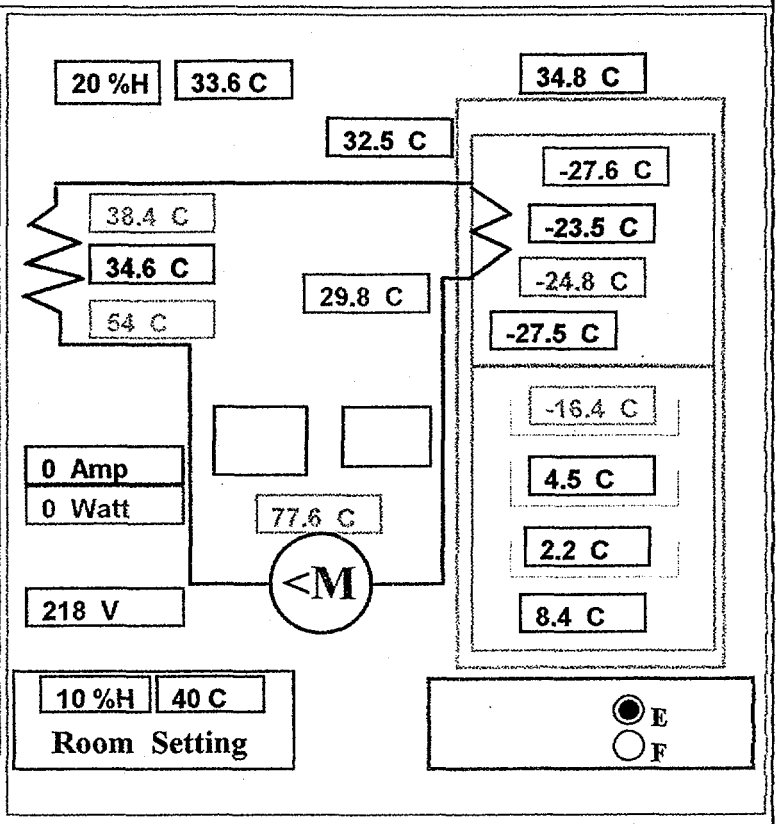
IPEC Company HotRoom

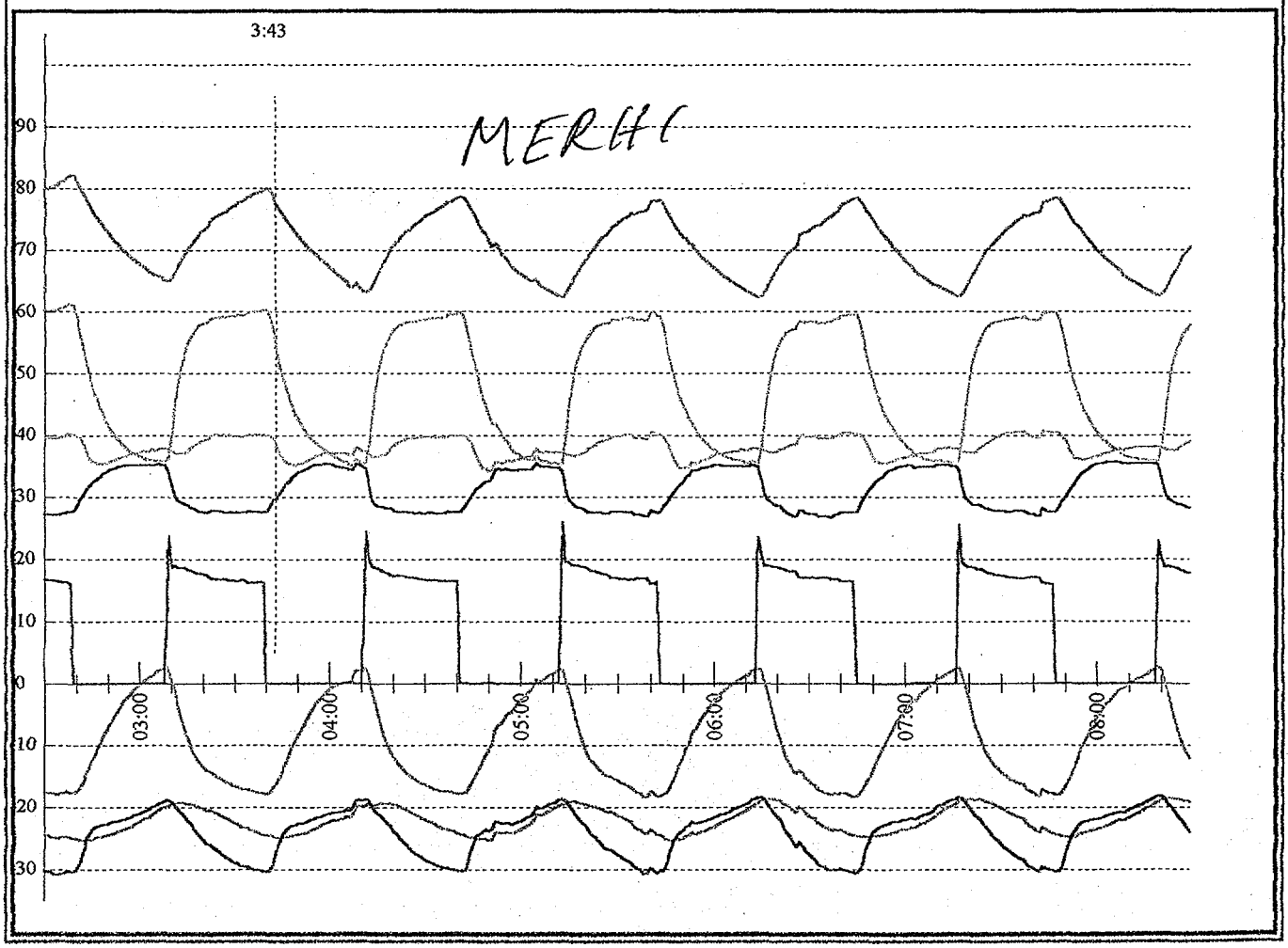
TestDate: **2000/06/24 08:12** *Report No.:* ( ) - Page 1

PageTestName: *Cycling Performance* *ReportDate:* 2000/06/26 09:12

Page Result :

1 - Page Test Time	*6 Hours*
2 - Working Percent	*47 %On*
3 - Energy (Accord to page)	*1.777 kwh*
4 - Zoom Time	*3:43 Hour*
5 - Compr Current	*00 Amp*
6 - Evaprator Mean Temp	*-25.8 C*
7 - Cabin Mean Temp	*-3.2 C*
8 - Crisp Temp	*8.4 C*
9 - Compr Temp	*77.6 C*
10- Condensor In Temp	*54 C*
11- Condensor Out Temp	*38.4 C*
12- Condition	*33.6 C 20 %H*
13- Volt	*Max=225 Mean=222 Min=217*
14-	
15-	
16-	
17-	





Industrial Control Research Center HotRoom Ver 5

Printing in Labaratory Of
IPEC Company HotRoom

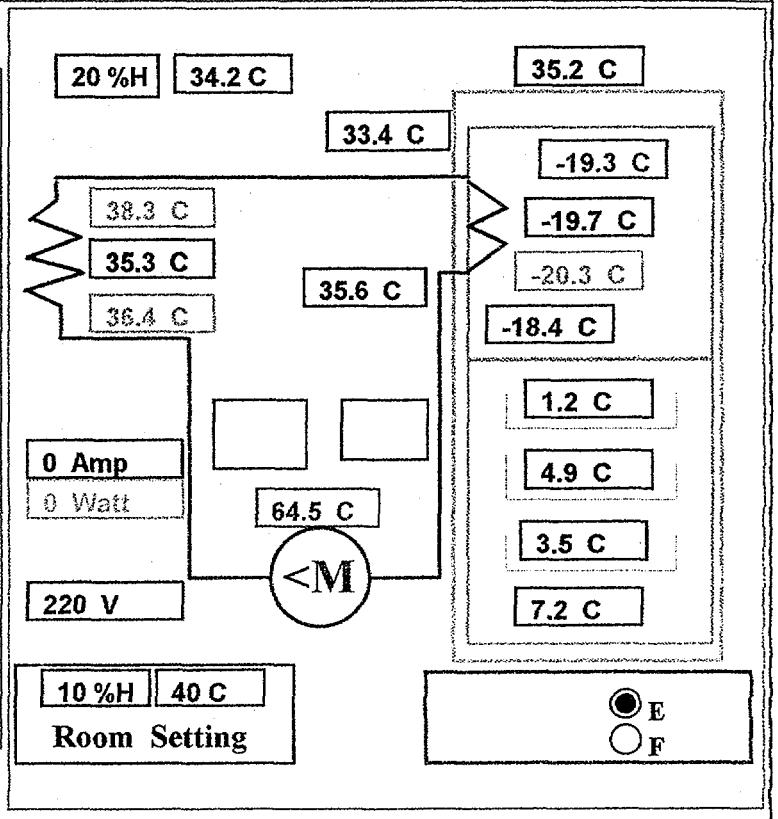
IPEC Company HotRoom

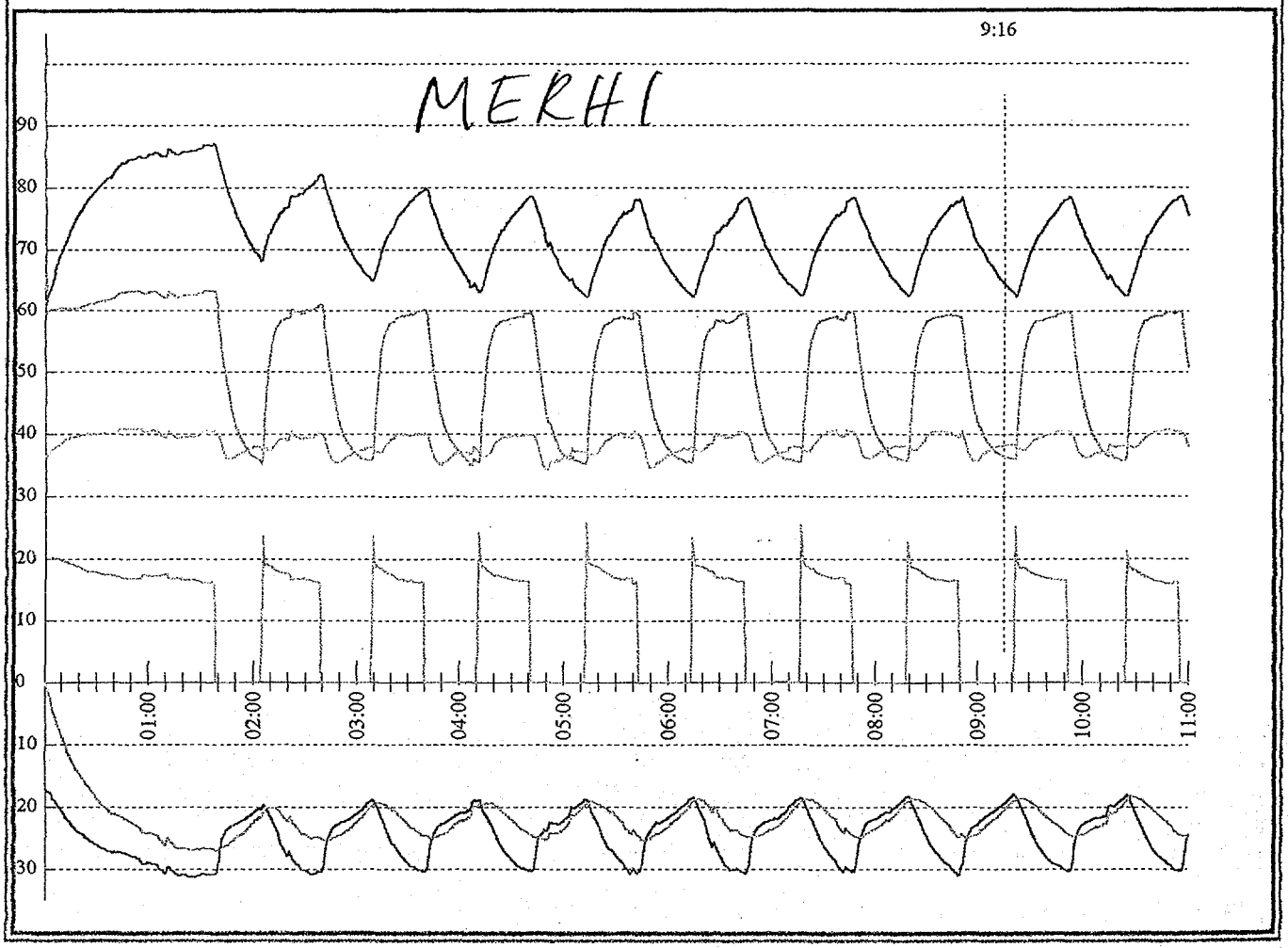
TestDate: **2000/06/24 08:12** *Report No.:* ( ) - Page 1

PageTestName: *Cycling Performance* *ReportDate:* 2000/06/25 20:06

Page Result :

1 - Page Test Time	*11 Hours*
2 - Working Percent	*56 %On*
3 - Energy (Accord to page)	*2.073 kwh*
4 - Zoom Time	*9:16 Hour*
5 - Compr Current	*00 Amp*
6 - Evaprator Mean Temp	*-19.4 C*
7 - Cabin Mean Temp	*3.2 C*
8 - Crisp Temp	*7.2 C*
9 - Compr Temp	*64.5 C*
10- Condensor In Temp	*36.4 C*
11- Condensor Out Temp	*38.3 C*
12- Condition	*34.2 C 20 %H*
13- Volt	*Max=225 Mean=221 Min=217*
14-	
15-	
16-	
17-	





Industrial Control Research Center HotRoom Ver 5

Printing in Labaratory Of
IPEC Company HotRoom

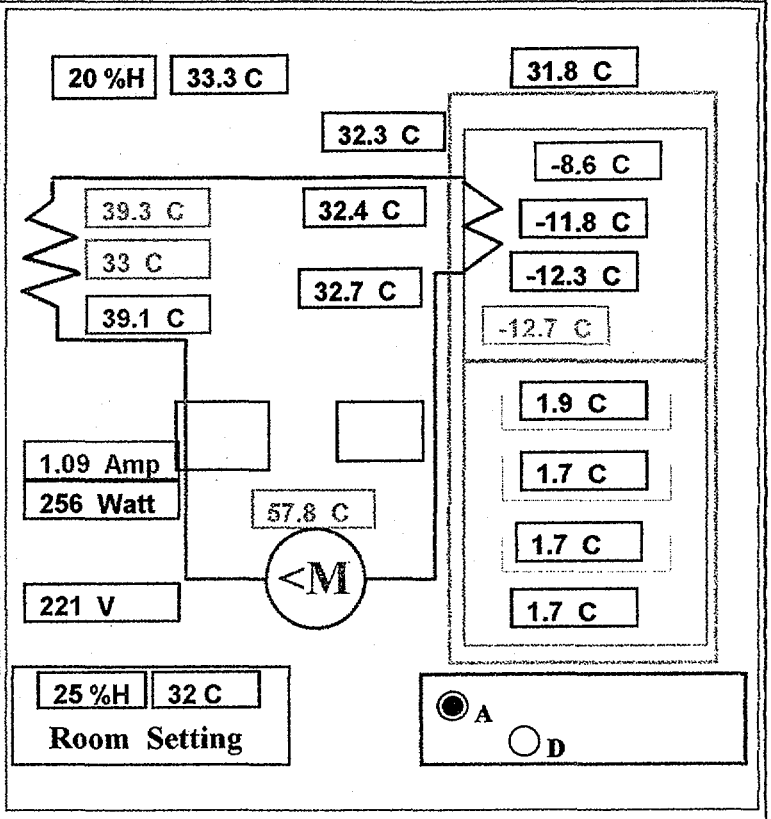
IPEC Company HotRoom

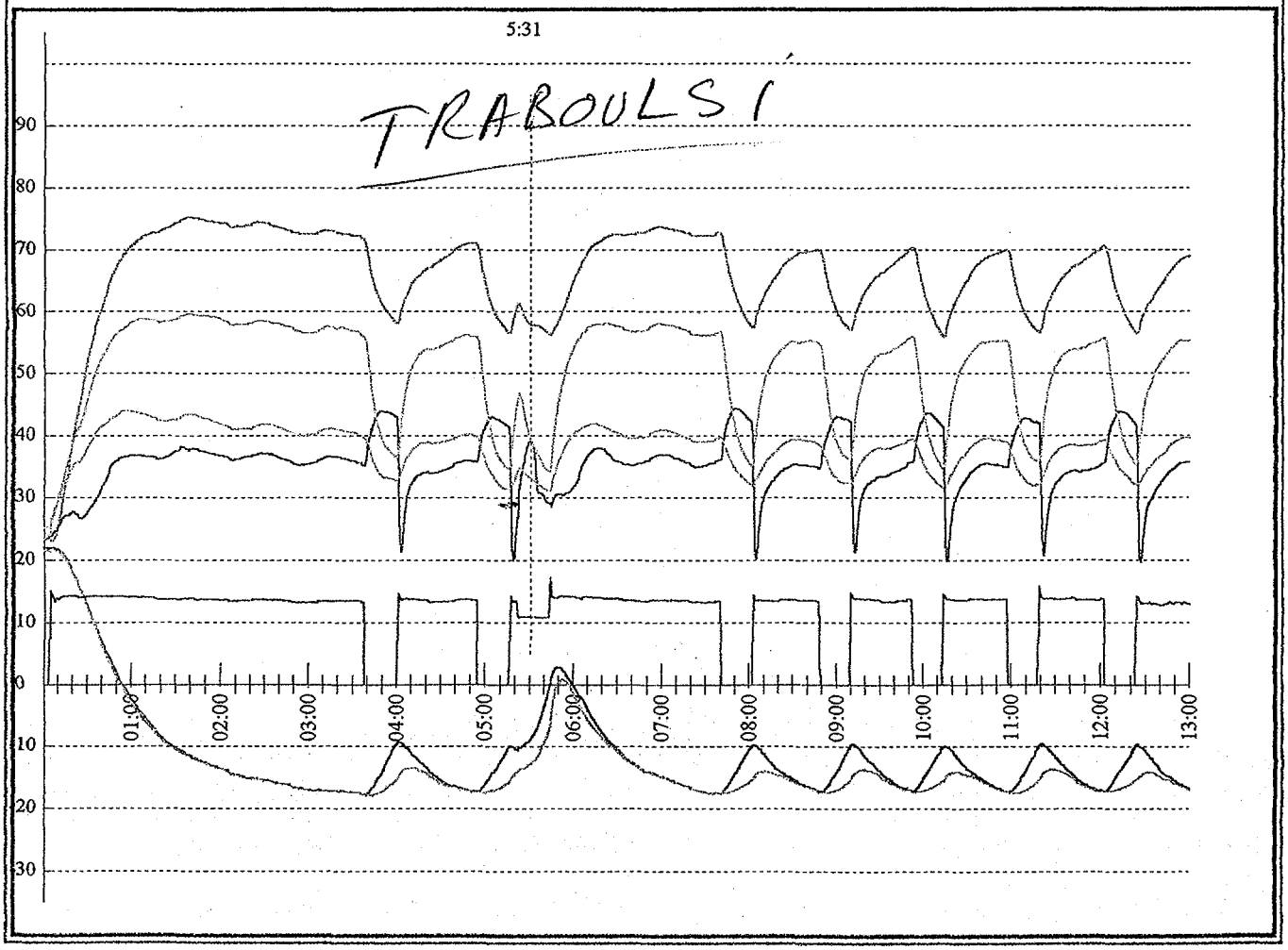
TestDate: **2000/06/24 08:12** *Report No.:* ( ) - Page 1

PageTestName: *Cycling Performance* *ReportDate:* 2000/06/25 20:25

Page Result :

1 - Page Test Time	*13 Hours*
2 - Working Percent	*80 %On*
3 - Energy (Accord to page)	*2.532 kwh*
4 - Zoom Time	*5:31 Hour*
5 - Compr Current	*1.09 Amp*
6 - Evaprator Mean Temp	*-11.3 C*
7 - Cabin Mean Temp	*1.7 C*
8 - Crisp Temp	*1.7 C*
9 - Compr Temp	*57.8 C*
10- Condensor In Temp	*39.1 C*
11- Condensor Out Temp	*39.3 C*
12- Condition	*33.3 C 20 %H*
13- Volt	*Max=226 Mean=221 Min=211*
14-	
15-	
16-	
17-	





Industrial Control Research Center HotRoom Ver 5

Printing in Labaratory Of
IPEC Company HotRoom

IPEC Company HotRoom

TestDate: **2000/06/24 08:12**
TestName: *Cycling Performance*

Report No.: Spec & Remark
ReportDate: 2000/06/26 08:50

Total Result :

1 - Total Test Time	*13 Hours*
2 - Working Percent	*78 %On*
3 - Energy	*2.478 kwh*
4 - Zoom Time	*12:44 Hour*
5 - Compr Current	*1.3 Amp*
6 - Evaprator Mean Temp	*-15.2 C*
7 - Cabin Mean Temp	*-.9 C*
8 - Crisp Temp	*-.5 C*
9 - Compr Temp	*65.8 C*
10- Condensor In Temp	*33.3 C*
11- Condensor Out Temp	*53 C*
12- Condition	*32.1 C 20 %H*
13- Volt	*Max=226 Mean=221 Min=211*
14-	
15-	
16-	
17-	

Product Spec :

1 - File Name	*78081719.k05*
2 - Test Kind G	*UnidoTest*
3 - Product Serial	*11703*
4 - Product Name	*REF. Friz*
5 - Product Model	*ES.652*
6 - Product Capacity	*460 Lit*
7 - Compressor Name	*Mitsushit*
8 - Compressor Model	*FN91F20G*
9 - Compressor Power	*237 W*
10- Compressor Amper	*1.5 A*
11- Thermostat No.	*3*
12- Thermostat Type	*PFN-C171*
13-	
14-	

Technical Manager: ***ICRC***

Lab Chief : ***IMANI***

Lab Specialist: ***IMANI***

Remark :

Remark1
Remark2
Remark3

Remark :

HASSAN BROTHERS

sign :

Industrial Control Research Center HotRoom Ver 5

Printing in Labaratory Of
IPEC Company HotRoom

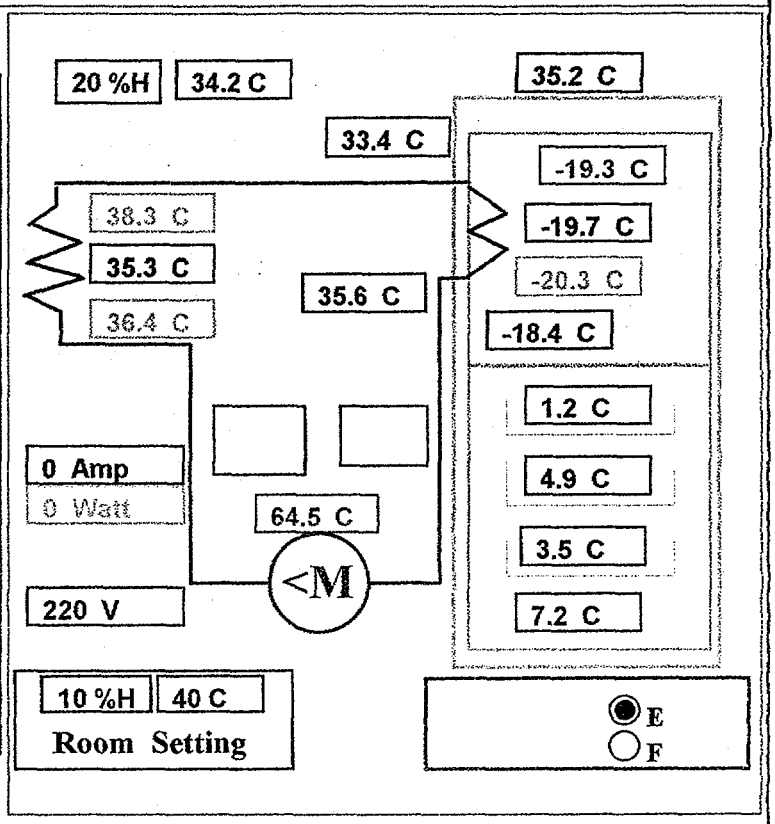
IPEC Company HotRoom

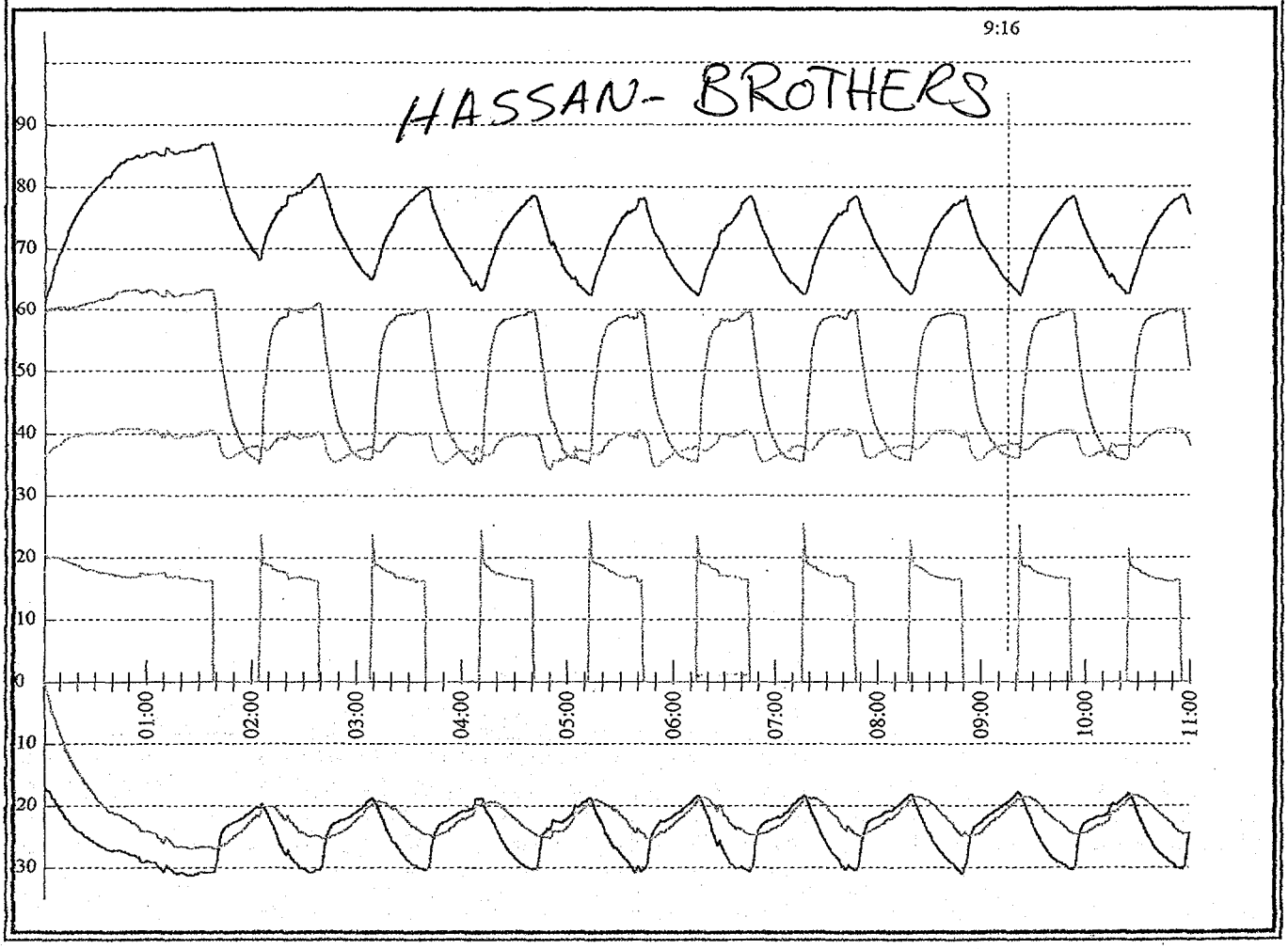
TestDate: **2000/06/24 08:12** *Report No.:* ( ) - Page 1

PageTestName: *Cycling Performance* *ReportDate:* 2000/06/25 19:59

Page Result :

1 - Page Test Time	*11 Hours*
2 - Working Percent	*56 %On*
3 - Energy (Accord to page)	*2.073 kwh*
4 - Zoom Time	*9:16 Hour*
5 - Compr Current	*00 Amp*
6 - Evaprator Mean Temp	*-19.4 C*
7 - Cabin Mean Temp	*3.2 C*
8 - Crisp Temp	*7.2 C*
9 - Compr Temp	*64.5 C*
10- Condensor In Temp	*36.4 C*
11- Condensor Out Temp	*38.3 C*
12- Condition	*34.2 C 20 %H*
13- Volt	*Max=225 Mean=221 Min=217*
14-	
15-	
16-	
17-	





Industrial Control Research Center HotRoom Ver 5

Printing In Labaratory Of
IPEC Company HotRoom

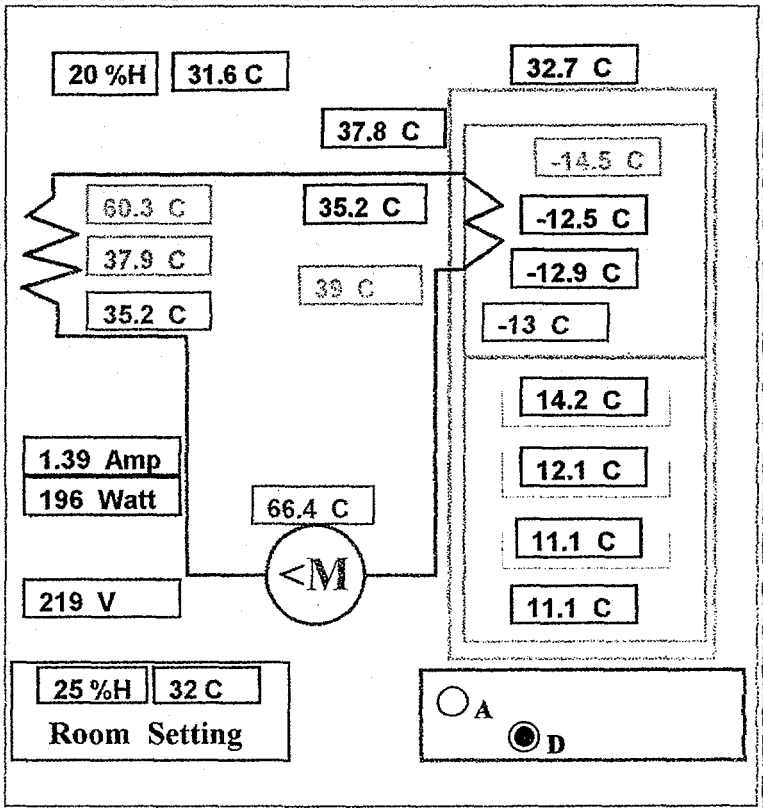
IPEC Company HotRoom

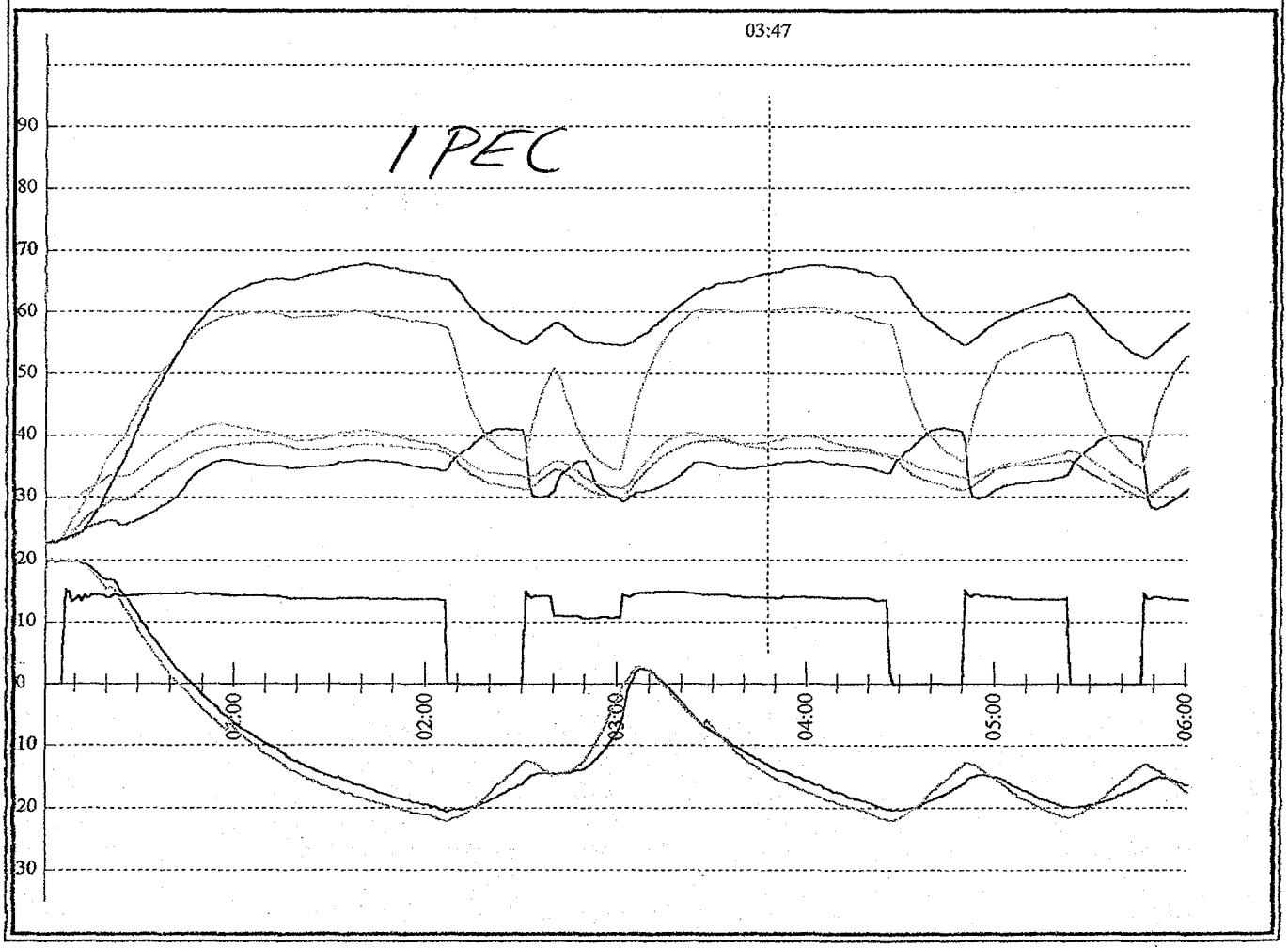
TestDate: 2000/06/24 08:12 Report No.: ( ) - Page 1

PageTestName: Cycling Performance ReportDate: 2000/06/27 09:05

Page Result :

1 - Page Test Time	6 Hours
2 - Working Percent	78 %On
3 - Energy (Accord to page)	1.852 kwh
4 - Zoom Time	3:48 Hour
5 - Compr Current	1.39 Amp
6 - Evaprator Mean Temp	-13.2 C
7 - Cabin Mean Temp	12.4 C
8 - Crisp Temp	11.1 C
9 - Compr Temp	66.4 C
10- Condensor In Temp	35.2 C
11- Condensor Out Temp	60.3 C
12- Condition	31.6 C 20 %H
13- Volt	Max=223 Mean=220 Min=216
14-	
15-	
16-	
17-	





Industrial Control Research Center HotRoom Ver 5

Printing in Labaratory Of
IPEC Company HotRoom

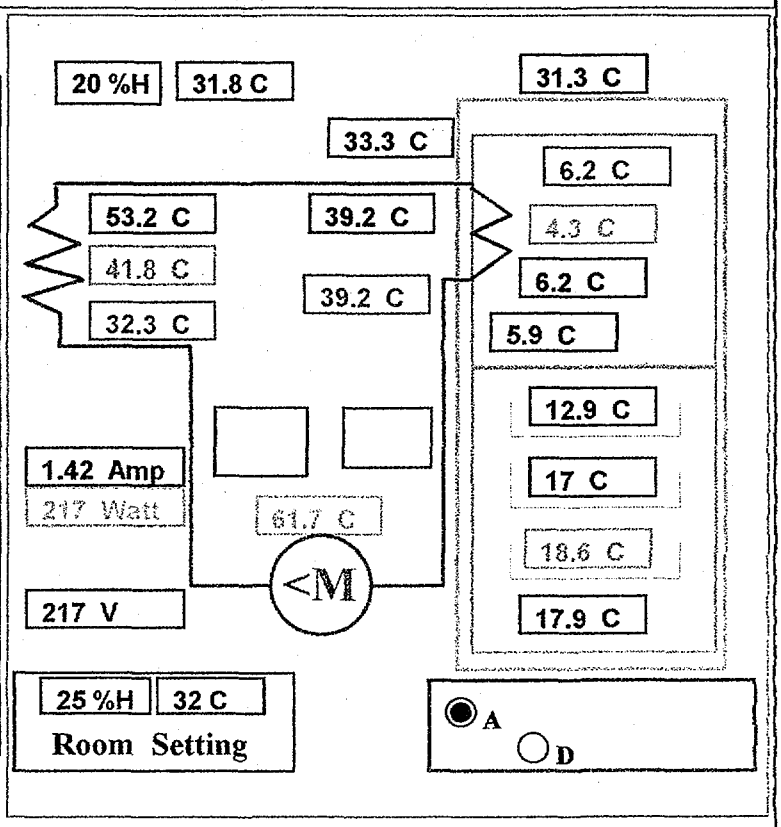
IPEC Company HotRoom

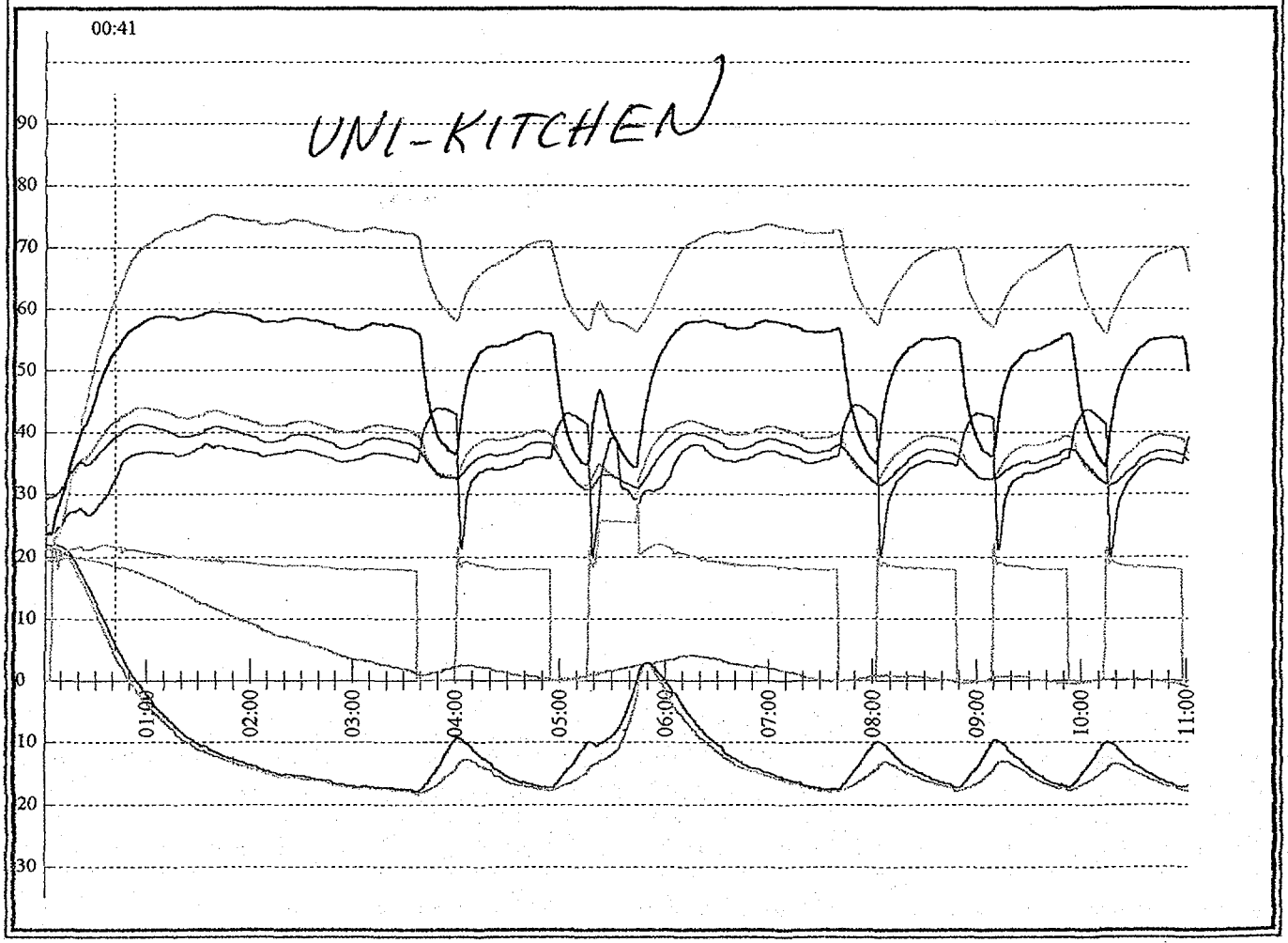
TestDate: **2000/06/24 08:12** *Report No.:* ( ) - Page 1

PageTestName: *Cycling Performance* *ReportDate:* 2000/06/26 09:29

Page Result :

1 - Page Test Time	*11 Hours*
2 - Working Percent	*82 %On*
3 - Energy (Accord to page)	*2.542 kwh*
4 - Zoom Time	*0:41 Hour*
5 - Compr Current	*1.42 Amp*
6 - Evaprator Mean Temp	*5.6 C*
7 - Cabin Mean Temp	*16.1 C*
8 - Crisp Temp	*17.9 C*
9 - Compr Temp	*61.7 C*
10- Condensor In Temp	*32.3 C*
11- Condensor Out Temp	*53.2 C*
12- Condition	*31.8 C 20 %H*
13- Volt	*Max=225 Mean=221 Min=216*
14-	
15-	
16-	
17-	





Industrial Control Research Center HotRoom Ver 5