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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

22542

FINAL REPORT

for

Al- Mokhtar Workshop, Al- Shahba Workshop,Batriq Workshop, Awadi Workshop, Afaneh Workshop, Quds Workshop companies

In this final report we describe our activities as well as providing all documents prepared from our previous reports, additional photos and test sheets are provided to this report as requested. The test sheets are means for evaluating and analyzing the performance of refrigeration component under specific environmental condition as specified by ISO standards and manufacturer technical requirements. This report could be used as a guideline for counterparts for future use, especially on selection of new components. Special consideration must be taken to select proper R134a compressor to replace with conventional R12 compressor. It is also important to adjust refrigerant charge balance to the existing refrigeration cycle with any major changes to the evaporator and condenser. In high backpressure type compressor it might needed to adjust capillary tube to balance pressure increase into the refrigeration system. All necessary advises were given to the counterparts during our several visit to their premises and conduction of technical course.

Since these companies are the same in nature and usually do not have any testing facility to test their new and existing models during changing compressor models. It is seriously recommended to use one of existing hot chamber in the city, to assure safe and economical operation of refrigeration system.

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Tel Showroom : 4653262 - Factory : 4161372 - Fax : 962 -6- 4160786 - Fax : 962 -6- 4613340 - P.O.Box : 921940 Amman - Jordan
E-mail: maurice@joinnet.com.jo

We are proud to have the opportunity to be UNIDO's team member to phase out OSD from many companies. We will attempt to use our experience and capabilities to continue assisting UNIDO and small commercial refrigerator sector to improve their technical awareness, and count us as a focal point to access to up to date information and technical assistance.

Activities

1- Visiting counterparts premises several times to assure precise technical data for providing necessary information for calculating refrigeration load calculation.
2- Assisting counterparts to select most common and well selling prototype models to be made and test under new circumstances.
3- Supervising related activities concerning making prototypes.
4- Conducting several briefing meeting and training session at our classroom located beside our hot chamber at our factory and counterparts premises to familiarize the counterparts' technical staff with new refrigerant physical, chemical and operation properties and behavior.
5- Contacting UNDP and Ozone office in several occasions to plan for implementation of the project in time.
6- Coordinating with UNIDO staff and Ozone office staff in Beirut for execution of different activities foreseen in the contract.
7- Storing and preserving charging equipment at our warehouse to assure safe and trustful stocking as requested by UNIDO's project manager and Ozone Office.
8- Deliver all charging equipment to counterparts as they were received in accordance with packing list and project documents.

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9- Assuring safe handling and equipment free of any defects by visual inspection due to possible mechanical damages, before delivery to the counterparts.

10- Explaining to the counterparts' operation purposes and application of each machine as purchased and supplied by UNIDO and manufacturer.

11- Conducting an orientation course for technical staff of counterparts to be familiarized with application of equipments and use of them.

12- Testing Performance test on all prototypes to assure accomplishment of contract to fulfill new R134a refrigerant.

13- Evaluation on performance test results of prototypes to adjust and do necessary changes to refrigeration cycle in retrofit program foreseen in the contract.

14- Advise the counterpart to do necessary changes to all models produced. These changes could be defined as proper amount of refrigerant weight and proper compressor selection, using cooling capacity calculated in this program.

15- This to notice that amount of cooling capacity could be used as guidance, obviously it is almost impossible to find a compressor model to fit excite cooling capacity. There are a lot of factors that should be into consideration while selecting compressor.

16- The counterparts were advised to do performance test on all new compressor models selected to replace the old model, regardless

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E-mail: maurice@joinnet.com.jo

of performance and technical characteristics defined by the manufactures.

17- A comprehensive explanation given to the counterparts to use different compressor manufacturers brochure and technical data.

In this report we explain our activities and technical data gathered for component selection and also determine proper configuration for new design criteria.

We spent a lot of time in market to suggest to the counterparts the new component replacement to fit R134a ozone friendly refrigerant system circuit.

Compressor selection was the main concern in this regard due to certain limitation of compressor capacity availability in Jordan market.

Our main concern in implementation of project is testing prototypes, which are the most important part of project.

Counterparts showed good role and cooperat5ion to make prototypes and testing them are on process, the test results will be submitted to you whenever they are completed and pass performance test requirement.

The new criteria is defined as new operating condition under usage of R134a Ozone friendly refrigerant. As we learnt through our experience, following components have significant role to be adapted for new environmental and technical circumference.

- Compressor
- Drier
- Capillary tube
- Refrigerant Charge

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E-mail: maurice@joinnet.com.jo

El Mogktar Workshop

Prototype # 1

Product Technical Specification

Description	Specification
Company Name	El Mogktar Workshop
Product Name	Upright Refrigerator
Product Model	MRU1
Product Application	Vegetables
Operating Temperature	32 C
Climatic Condition	Normal
Product Overall Dimension WxLxH mm	70*70*200 cm
Freezer Compartment Overall Dimension and Wall Thickness	N/A
Refrigerator Compartment Overall Dimension and Wall Thickness	50 mm.
Product Shape, Double Doors, Upright, Chest, etc	Upright case with one door
Freezer Internal Net Volume	N/A
Refrigerator Net Volume	980 Lit.
Product Net Volume	500 Lit.
Product Inside Temperature C	+ 5 C
Water Storage Tank Capacity, Water Cooler	N/A
Type of Water Storage Tank Cylinder, Cubic, etc.	N/A
Water Fellow per hour for water cooler	N/A
Water Storage Tank Dimension	N/A
Water Outlet Temperature	N/A
Water Inlet Temperature	N/A
Freezer Inside Temperature	N/A
Refrigerator Inside Temperature	+ 5 C
Evaporating Temperature	-10 C
Foam Insulation Thickness mm Side Walls, Top, Bottom, Door, Back Panel	50 mm.

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Type of PU Foam	R11 Pu Foam
Foam Density, Kg/Cu. Mt.	35-40 Kg/Cu. Mt.
Foam Mixture, Percentage Pol% + R11% + Isocyanate%	37% + 13% + 50%
Total amount of Foam Injection, Kg	10 Kg
Refrigerant Type	R12
Refrigerant Charge Weight Gr.	300 Gr.
Type of Compressor, Hermetic, Semi Hermetic, Open	Hermetic
Compressor Cooling System Static, Oil Cooled, Fan Cooled	Fan Cooled
Compressor Cooling Capacity Watt	390 Watt
Compressor input Power, Watt	¼ Hp.
Compressor Model Number	
Compressor Manufacturer	
Compressor Mounting Place Top, Bottom, Front, Back	Top
Condenser Type, Static, Fan Cooled	Fan Cooled
Condenser Dimension, Length, Inside Tube Diameter,	Three Rows Tube Coil and Fins
Condenser Material, Aluminum, Copper, Copper Coated, etc,	Copper and Aluminum
Condenser mounting Place, Back Wall, Top, Bottom	Top
Evaporator Type, Fin and Tube, Roll Bond, Wire and Tube, etc.	Tube Coils and Fins
Evaporator Dimension, Length, Surface Area, Inside Tube Diameter	
Evaporator Material, Aluminum, Copper, Copper Coated, etc,	Copper and Aluminum
Dryer Type,	Cylindrical
Dryer Material, Weight and Size	300 Gr.
Capillary Tube Diameter and Length	0.8 mm dim, 3000 mm Length

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El Mogktar Workshop

Prototype # 2

Product Technical Specification	
Description	**Specification**
Company Name	El Mogktar Workshop
Product Name	Water Cooler
Product Model	MWT1
Product Application	Water Cooler
Operating Temperature	32 C
Climatic Condition	Normal
Product Overall Dimension WxLxH mm	40 * 40 * 105
Freezer Compartment Overall Dimension and Wall Thickness	N/A
Refrigerator Compartment Overall Dimension and Wall Thickness	50 mm
Product Shape, Double Doors, Upright, Chest, etc	
Freezer Internal Net Volume	N/A
Refrigerator Net Volume	N/A
Product Net Volume	N/A
Product Inside Temperature C	+ 5 C
Water Storage Tank Capacity, Water Cooler	30 Lit.
Type of Water Storage Tank Cylinder, Cubic, etc.	Cubic
Water Fellow per hour for water cooler	20 Lit.
Water Storage Tank Dimension	30*30*30
Water Outlet Temperature	+ 6 C
Water Inlet Temperature	+ 25 C
Freezer Inside Temperature	N/A
Refrigerator Inside Temperature	N/A
Evaporating Temperature	0 C
Foam Insulation Thickness mm Side Walls, Top, Bottom, Door, Back Panel	50 mm

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Type of PU Foam	R-11 Pu Foam
Foam Density, Kg/Cu. Mt.	35-40 Kg/Cu. Mt.
Foam Mixture, Percentage Pol% + R11% + Isocyanate%	37% + 13% + 50%
Total amount of Foam Injection, Kg	2 Kg
Refrigerant Type	R 12
Refrigerant Charge Weight Gr.	200 Gr.
Type of Compressor, Hermetic, Semi Hermetic, Open	Hermetic
Compressor Cooling System Static, Oil Cooled, Fan Cooled	Fan Cooled
Compressor Cooling Capacity Watt	280 Watt
Compressor input Power, Watt	¼ Hp
Compressor Model Number	
Compressor Manufacturer	
Compressor Mounting Place Top, Bottom, Front, Back	Bottom
Condenser Type, Static, Fan Cooled	Fan Cooled
Condenser Dimension, Length, Inside Tube Diameter,	Two Rows Tube Coil and Fins
Condenser Material, Aluminum, Copper, Copper Coated, etc,	Copper and Aluminum
Condenser mounting Place, Back Wall, Top, Bottom	Bottom
Evaporator Type, Fin and Tube, Roll Bond, Wire and Tube, etc.	Fin and Tube
Evaporator Dimension, Length, Surface Area, Inside Tube Diameter	Tube Coil and Fins
Evaporator Material, Aluminum, Copper, Copper Coated, etc,	Copper
Dryer Type,	Cylindrical
Dryer Material, Weight and Size	20 Gr.
Capillary Tube Diameter and Length	0.8 mm dim. 3000 mm length

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Al-Shahba'a Workshop

Prototype # 1

Product Technical Specification	
Description	**Specification**
Company Name	Al-Shahba'a Workshop
Product Name	Water Cooler
Product Model	HL-2000
Product Application	Water Cooler
Operating Temperature	32 C
Climatic Condition	Normal
Product Overall Dimension WxLxH mm	50*40*140 cm
Freezer Compartment Overall Dimension and Wall Thickness	N/A
Refrigerator Compartment Overall Dimension and Wall Thickness	N/A
Product Shape, Double Doors, Upright, Chest, etc	Stand
Freezer Internal Net Volume	N/A
Refrigerator Net Volume	N/A
Product Net Volume	N/A
Product Inside Temperature C	N/A
Water Storage Tank Capacity, Water Cooler	30 Lit.
Type of Water Storage Tank Cylinder, Cubic, etc.	Cylinder
Water Fellow per hour for water cooler	50 Lit/H
Water Storage Tank Dimension	30*40*45
Water Outlet Temperature	+ 6 C
Water Inlet Temperature	35 C
Freezer Inside Temperature	N/A
Refrigerator Inside Temperature	N/A
Evaporating Temperature	-5 C
Foam Insulation Thickness mm Side Walls, Top, Bottom, Door, Back Panel	40 mm

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Type of PU Foam	R 11 PU Foam
Foam Density, Kg/Cu. Mt.	40 Kg/Cu. Mt.
Foam Mixture, Percentage Pol% + R11% + Isocyanate%	37% + 13% + 50%
Total amount of Foam Injection, Kg	5 Kg
Refrigerant Type	R 12
Refrigerant Charge Weight Gr.	350 Gr.
Type of Compressor, Hermetic, Semi Hermetic, Open	Hermetic
Compressor Cooling System Static, Oil Cooled, Fan Cooled	Fan Cooled
Compressor Cooling Capacity Watt	280 Watt
Compressor input Power, Watt	250 Watt
Compressor Model Number	S10 Danfus 8500
Compressor Manufacturer	Danfus
Compressor Mounting Place Top, Bottom, Front, Back	Bottom
Condenser Type, Static, Fan Cooled	Fan Cooled
Condenser Dimension, Length, Inside Tube Diameter,	Three Rows, Tube Coil and Fins
Condenser Material, Aluminum, Copper, Copper Coated, etc,	Aluminum + Copper
Condenser mounting Place, Back Wall, Top, Bottom	Bottom
Evaporator Type, Fin and Tube, Roll Bond, Wire and Tube, etc.	Tubes 5/16
Evaporator Dimension, Length, Surface Area, Inside Tube Diameter	14 M. Length , Coil Shape, 5/16 Dim.
Evaporator Material, Aluminum, Copper, Copper Coated, etc,	Cooper
Dryer Type,	
Dryer Material, Weight and Size	30 Gr.
Capillary Tube Diameter and Length	0.6 mm, 3 meters length

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Al Shaba'a Workshop

Prototype # 2

Product Technical Specification	
Description	**Specification**
Company Name	Al-Shaba'a Workshop
Product Name	Meat Refrigerator, Upright
Product Model	Al-1300
Product Application	Meat Shaw Case
Operating Temperature	32 C
Climatic Condition	Normal
Product Overall Dimension WxLxH mm	120*70*200 Cm
Freezer Compartment Overall Dimension and Wall Thickness	N/A
Refrigerator Compartment Overall Dimension and Wall Thickness	60 mm
Product Shape, Double Doors, Upright, Chest, etc	Upright show case with double glass doors
Freezer Internal Net Volume	N/A
Refrigerator Net Volume	1050 Liters
Product Net Volume	800 liters
Product Inside Temperature C	+ 5 C
Water Storage Tank Capacity, Water Cooler	N/A
Type of Water Storage Tank Cylinder, Cubic, etc.	N/A
Water Fellow per hour for water cooler	N/A
Water Storage Tank Dimension	N/A
Water Outlet Temperature	N/A
Water Inlet Temperature	N/A
Freezer Inside Temperature	N/A
Refrigerator Inside Temperature	+ 5 C
Evaporating Temperature	-10 C
Foam Insulation Thickness mm Side Walls, Top, Bottom, Door, Back Panel	60 mm

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Type of PU Foam	R11 Pu Foam
Foam Density, Kg/Cu. Mt.	40 Kg/Cu. Mt.
Foam Mixture, Percentage Pol% + R11% + Isocyanate%	37% + 13% + 50 %
Total amount of Foam Injection, Kg	20 Kg
Refrigerant Type	R 12
Refrigerant Charge Weight Gr.	400 Gr.
Type of Compressor, Hermetic, Semi Hermetic, Open	Hermetic
Compressor Cooling System Static, Oil Cooled, Fan Cooled	Fan Cooled
Compressor Cooling Capacity Watt	600 Watts
Compressor input Power, Watt	550 Watts
Compressor Model Number	S18 8820
Compressor Manufacturer	Danfus
Compressor Mounting Place Top, Bottom, Front, Back	Bottom
Condenser Type, Static, Fan Cooled	Fan Cooled
Condenser Dimension, Length, Inside Tube Diameter,	Four rows, Tube Coil and Fins, 5/16
Condenser Material, Aluminum, Copper, Copper Coated, etc,	Copper Coated
Condenser mounting Place, Back Wall, Top, Bottom	Bottom
Evaporator Type, Fin and Tube, Roll Bond, Wire and Tube, etc.	Tube Coil and Find
Evaporator Dimension, Length, Surface Area, Inside Tube Diameter	95 * 50 cm, ½ inch
Evaporator Material, Aluminum, Copper, Copper Coated, etc,	Copper Coil Coated by Aluminum
Dryer Type,	Cylindrical
Dryer Material, Weight and Size	Ranco, 20 Gr.
Capillary Tube Diameter and Length	0.8 mm , 3000 mm length

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Al-Batriq Workshop

Prototype # 1

Product Technical Specification	
Description	**Specification**
Company Name	Al-Batriq Workshop
Product Name	Meat Refrigerator
Product Model	7
Product Application	Meat Show Case
Operating Temperature	32 C
Climatic Condition	Normal
Product Overall Dimension WxLxH mm	150*235*75 Cm
Freezer Compartment Overall Dimension and Wall Thickness	N/A
Refrigerator Compartment Overall Dimension and Wall Thickness	50 mm
Product Shape, Double Doors, Upright, Chest, etc	Upright Refrigerator with Double Glass Door
Freezer Internal Net Volume	N/A
Refrigerator Net Volume	1500 Lit.
Product Net Volume	
Product Inside Temperature C	+3 C
Water Storage Tank Capacity, Water Cooler	N/A
Type of Water Storage Tank Cylinder, Cubic, etc.	N/A
Water Fellow per hour for water cooler	N/A
Water Storage Tank Dimension	N/A
Water Outlet Temperature	N/A
Water Inlet Temperature	N/A
Freezer Inside Temperature	N/A
Refrigerator Inside Temperature	+3 C
Evaporating Temperature	
Foam Insulation Thickness mm Side Walls, Top, Bottom, Door, Back Panel	50 mm

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Type of PU Foam	R11 Pu Foam
Foam Density, Kg/Cu. Mt.	40 Kg/Cu. Mt.
Foam Mixture, Percentage Pol% + R11% + Isocyanate%	37% + 13% + 50 %
Total amount of Foam Injection, Kg	20 Kg
Refrigerant Type	R 12
Refrigerant Charge Weight Gr.	600 Gr.
Type of Compressor, Hermetic, Semi Hermetic, Open	Hermetic
Compressor Cooling System Static, Oil Cooled, Fan Cooled	Fan Cooled
Compressor Cooling Capacity Watt	800 Watt
Compressor input Power, Watt	1 Hp
Compressor Model Number	Nick Model
Compressor Manufacturer	Italy
Compressor Mounting Place Top, Bottom, Front, Back	Top Roof
Condenser Type, Static, Fan Cooled	Static
Condenser Dimension, Length, Inside Tube Diameter,	3/8 Inch Diameter
Condenser Material, Aluminum, Copper, Copper Coated, etc,	Coated Copper
Condenser mounting Place, Back Wall, Top, Bottom	Top Roof
Evaporator Type, Fin and Tube, Roll Bond, Wire and Tube, etc.	Fin and Tube
Evaporator Dimension, Length, Surface Area, Inside Tube Diameter	
Evaporator Material, Aluminum, Copper, Copper Coated, etc,	Cooper and Aluminum
Dryer Type,	Cylindrical
Dryer Material, Weight and Size	Ranco, 40 Gr.
Capillary Tube Diameter and Length	0.55 mm , 370 cm length

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Al-Batriq Workshop

Prototype # 2

Product Technical Specification	
Description	**Specification**
Company Name	Al-Batriq Workshop
Product Name	Water Cooler
Product Model	3
Product Application	Water Cooler
Operating Temperature	32 C
Climatic Condition	Normal
Product Overall Dimension WxLxH mm	55*150*45 cm
Freezer Compartment Overall Dimension and Wall Thickness	N/A
Refrigerator Compartment Overall Dimension and Wall Thickness	N/A
Product Shape, Double Doors, Upright, Chest, etc	Stand
Freezer Internal Net Volume	N/A
Refrigerator Net Volume	N/A
Product Net Volume	N/A
Product Inside Temperature C	N/A
Water Storage Tank Capacity, Water Cooler	40 Liters
Type of Water Storage Tank Cylinder, Cubic, etc.	Cubic
Water Fellow per hour for water cooler	60 Lit/H
Water Storage Tank Dimension	40 Liters
Water Outlet Temperature	+8 C
Water Inlet Temperature	+28 C
Freezer Inside Temperature	N/A
Refrigerator Inside Temperature	N/A
Evaporating Temperature	-10 C
Foam Insulation Thickness mm Side Walls, Top, Bottom, Door, Back Panel	50 mm

هاتف المعرض : ٤٦٥٣٢٦٢ ـ المصنع : ٤١٦١٣٧٢ ـ فاكس : ٤١٦٠٧٨٦ ـ٦ـ ٩٦٢ ـ فاكس : ٤٦١٣٣٤٠ ـ٦ـ ٩٦٢ ـ ص.ب : ٩٢١٩٤٠ عمان ـ الاردن
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Type of PU Foam	R11 Pu Foam
Foam Density, Kg/Cu. Mt.	40 Kg/Cu. Mt.
Foam Mixture, Percentage Pol% + R11% + Isocyanate%	37% + 13% + 50%
Total amount of Foam Injection, Kg	3 Kg
Refrigerant Type	R 12
Refrigerant Charge Weight Gr.	200 Gr.
Type of Compressor, Hermetic, Semi Hermetic, Open	Hermetic
Compressor Cooling System Static, Oil Cooled, Fan Cooled	Fan Cooled
Compressor Cooling Capacity Watt	450 Watt
Compressor input Power, Watt	½ Hp
Compressor Model Number	Nick Model
Compressor Manufacturer	Italy
Compressor Mounting Place Top, Bottom, Front, Back	Bottom
Condenser Type, Static, Fan Cooled	Fan Cooled
Condenser Dimension, Length, Inside Tube Diameter,	
Condenser Material, Aluminum, Copper, Copper Coated, etc,	Coated Copper
Condenser mounting Place, Back Wall, Top, Bottom	Bottom
Evaporator Type, Fin and Tube, Roll Bond, Wire and Tube, etc.	
Evaporator Dimension, Length, Surface Area, Inside Tube Diameter	
Evaporator Material, Aluminum, Copper, Copper Coated, etc,	Copper
Dryer Type,	Cylindrical
Dryer Material, Weight and Size	20 Gr.
Capillary Tube Diameter and Length	

هاتف المعرض : ٤٦٥٣٢٦٢ - المصنع : ٤١٦١٣٧٢ - فاكس : ٤١٦٠٧٨٦ -٦- ٩٦٢ - فاكس : ٤٦١٣٣٤٠ -٦- ٩٦٢ - ص.ب : ٩٢١٩٤٠ عمان - الاردن
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E-mail: maurice@joinnet.com.jo

Al-Awadi Workshop

Prototype # 1

Product Technical Specification

Description	Specification
Company Name	Al-Awadi Workshop
Product Name	Water Cooler
Product Model	GM 1000
Product Application	Water Cooler
Operating Temperature	32 C
Climatic Condition	Normal
Product Overall Dimension WxLxH mm	41*67*127 cm
Freezer Compartment Overall Dimension and Wall Thickness	N/A
Refrigerator Compartment Overall Dimension and Wall Thickness	N/A
Product Shape, Double Doors, Upright, Chest, etc	Stand
Freezer Internal Net Volume	N/A
Refrigerator Net Volume	N/A
Product Net Volume	N/A
Product Inside Temperature C	+ 7 C
Water Storage Tank Capacity, Water Cooler	30 Litters
Type of Water Storage Tank Cylinder, Cubic, etc.	Cylindrical
Water Fellow per hour for water cooler	80 Liters/H
Water Storage Tank Dimension	45*30 cm
Water Outlet Temperature	+7 C
Water Inlet Temperature	+28 C
Freezer Inside Temperature	N/A
Refrigerator Inside Temperature	N/A
Evaporating Temperature	-23 C
Foam Insulation Thickness mm	40 mm

هاتف المعرض : ٤٦٥٣٢٦٢ - المصنع : ٤١٦١٣٧٢ - فاكس : ٤١٦٠٧٨٦ -٦- ٩٦٢ - فاكس : ٤٦١٣٣٤٠ -٦- ٩٦٢ - ص.ب : ٩٢١٩٤٠ عمان - الاردن
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E-mail: maurice@joinnet.com.jo

Side Walls, Top, Bottom, Door, Back Panel	
Type of PU Foam	R11 Pu Foam
Foam Density, Kg/Cu. Mt.	40 Kg/Cu. Mt.
Foam Mixture, Percentage Pol% + R11% + Isocyanate%	37% + 13% + 50%
Total amount of Foam Injection, Kg	6 Kg
Refrigerant Type	R 12
Refrigerant Charge Weight Gr.	240 Gr.
Type of Compressor, Hermetic, Semi Hermetic, Open	Hermetic
Compressor Cooling System Static, Oil Cooled, Fan Cooled	Fan Cooled
Compressor Cooling Capacity Watt	250 Watts
Compressor input Power, Watt	¼ Hp, 184 Watts
Compressor Model Number	AEZ1380A
Compressor Manufacturer	
Compressor Mounting Place Top, Bottom, Front, Back	Bottom
Condenser Type, Static, Fan Cooled	Fan Cooled
Condenser Dimension, Length, Inside Tube Diameter,	Two Rows , 5/16 inch
Condenser Material, Aluminum, Copper, Copper Coated, etc,	Copper and Aluminum
Condenser mounting Place, Back Wall, Top, Bottom	Bottom
Evaporator Type, Fin and Tube, Roll Bond, Wire and Tube, etc.	Copper Tubes Surrounding the Tank
Evaporator Dimension, Length, Surface Area, Inside Tube Diameter	15 m. Length
Evaporator Material, Aluminum, Copper, Copper Coated, etc,	Copper
Dryer Type,	Ranco
Dryer Material, Weight and Size	Silica, Cylindrical, 15 Gr.
Capillary Tube Diameter and Length	1 mm , 1800 mm length

هاتف المعرض : ٤٦٥٣٢٦٢ ـ المصنع : ٤١٦١٣٧٢ ـ فاكس : ٤١٦٠٧٨٦ ـ٦ـ ٩٦٢ ـ فاكس : ٤٦١٣٣٤٠ ـ٦ـ ٩٦٢ ـ ص.ب : ٩٢١٩٤٠ عمان ـ الاردن
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E-mail: maurice@joinnet.com.jo

Al-Awadi Workshop

Prototype # 2

Product Technical Specification

Description	Specification
Company Name	Al-Awadi Workshop
Product Name	Chest Freezer
Product Model	1200
Product Application	Freezer
Operating Temperature	32 C
Climatic Condition	Normal
Product Overall Dimension WxLxH mm	65*125*88
Freezer Compartment Overall Dimension and Wall Thickness	45 mm
Refrigerator Compartment Overall Dimension and Wall Thickness	N/A
Product Shape, Double Doors, Upright, Chest, etc	Chest
Freezer Internal Net Volume	500 Liters
Refrigerator Net Volume	N/A
Product Net Volume	400 Liters
Product Inside Temperature C	-18 C
Water Storage Tank Capacity, Water Cooler	N/A
Type of Water Storage Tank Cylinder, Cubic, etc.	N/A
Water Fellow per hour for water cooler	N/A
Water Storage Tank Dimension	N/A
Water Outlet Temperature	N/A
Water Inlet Temperature	N/A
Freezer Inside Temperature	-23 C
Refrigerator Inside Temperature	N/A
Evaporating Temperature	-29
Foam Insulation Thickness mm	40 mm

هاتف المعرض : ٤٦٥٣٢٦٢ - المصنع : ٤١٦١٣٧٢ - فاكس : ٤١٦٠٧٨٦ -٦- ٩٦٢ - فاكس : ٤٦١٣٣٤٠ -٦- ٩٦٢ - ص.ب : ٩٢١٩٤٠ عمان - الاردن
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E-mail: maurice@joinnet.com.jo

Side Walls, Top, Bottom, Door, Back Panel	
Type of PU Foam	R11 Pu Foam
Foam Density, Kg/Cu. Mt.	40 Kg/Cu. Mt.
Foam Mixture, Percentage Pol% + R11% + Isocyanate%	37% + 13% + 50%
Total amount of Foam Injection, Kg	15 Kg
Refrigerant Type	R12
Refrigerant Charge Weight Gr.	
Type of Compressor, Hermetic, Semi Hermetic, Open	Hermetic
Compressor Cooling System Static, Oil Cooled, Fan Cooled	Fan Cooled
Compressor Cooling Capacity Watt	250 Watts
Compressor input Power, Watt	¼ Hp 184 Watts
Compressor Model Number	AEZ1380 A
Compressor Manufacturer	
Compressor Mounting Place Top, Bottom, Front, Back	Bottom
Condenser Type, Static, Fan Cooled	Static
Condenser Dimension, Length, Inside Tube Diameter,	100*70 cm , ¼ inch Tubes
Condenser Material, Aluminum, Copper, Copper Coated, etc,	Iron Bars
Condenser mounting Place, Back Wall, Top, Bottom	Back
Evaporator Type, Fin and Tube, Roll Bond, Wire and Tube, etc.	Copper Tubes surrounding the inside body, 5/16 inch
Evaporator Dimension, Length, Surface Area, Inside Tube Diameter	22 m Length
Evaporator Material, Aluminum, Copper, Copper Coated, etc,	Copper
Dryer Type,	Ranco
Dryer Material, Weight and Size	Silica gel, 15 Gr., Cylindrical
Capillary Tube Diameter and Length	1 mm, length 220 cm

هاتف المعرض : ٤٦٥٣٢٦٢ - المصنع : ٤١٦١٣٧٢ - فاكس : ٤١٦٠٧٨٦ -٦- ٩٦٢ - فاكس : ٤٦١٣٣٤٠ -٦- ٩٦٢ - ص.ب : ٩٢١٩٤٠ عمان - الاردن
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E-mail: maurice@joinnet.com.jo

Afaneh Workshop

Prototype # 1

Product Technical Specification	
Description	**Specification**
Company Name	Afaneh Workshop
Product Name	Water Cooler
Product Model	222-F
Product Application	Water Cooler
Operating Temperature	32 C
Climatic Condition	Normal
Product Overall Dimension WxLxH mm	34*34*95 cm
Freezer Compartment Overall Dimension and Wall Thickness	N/A
Refrigerator Compartment Overall Dimension and Wall Thickness	N/A
Product Shape, Double Doors, Upright, Chest, etc	Stand
Freezer Internal Net Volume	N/A
Refrigerator Net Volume	N/A
Product Net Volume	N/A
Product Inside Temperature C	+ 5 C
Water Storage Tank Capacity, Water Cooler	40 Liters
Type of Water Storage Tank Cylinder, Cubic, etc.	Cubic
Water Fellow per hour for water cooler	60 Liters/H
Water Storage Tank Dimension	35*35*35 cm
Water Outlet Temperature	+6 C
Water Inlet Temperature	+26 C
Freezer Inside Temperature	N/A
Refrigerator Inside Temperature	N/A
Evaporating Temperature	N/A
Foam Insulation Thickness mm	40 mm

هاتف المعرض : ٤٦٥٣٢٦٢ - المصنع : ٤١٦١٣٧٢ - فاكس : ٤١٦٠٧٨٦ -٦- ٩٦٢ - فاكس : ٤٦١٣٣٤٠ -٦- ٩٦٢ - ص.ب : ٩٢١٩٤٠ عمان - الاردن
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Side Walls, Top, Bottom, Door, Back Panel	
Type of PU Foam	R11 PU Foam
Foam Density, Kg/Cu. Mt.	40 Kg/Cu. Mt.
Foam Mixture, Percentage Pol% + R11% + Isocyanate%	37% + 13% +50%
Total amount of Foam Injection, Kg	3 Kg
Refrigerant Type	R12
Refrigerant Charge Weight Gr.	350Gr.
Type of Compressor, Hermetic, Semi Hermetic, Open	Hermetic
Compressor Cooling System Static, Oil Cooled, Fan Cooled	Fan Cooled
Compressor Cooling Capacity Watt	600 Watts
Compressor input Power, Watt	350 Watts
Compressor Model Number	
Compressor Manufacturer	Danfoss, Germany
Compressor Mounting Place Top, Bottom, Front, Back	Bottom
Condenser Type, Static, Fan Cooled	Fan Cooled
Condenser Dimension, Length, Inside Tube Diameter,	Four Rows Tube Coil and Fins
Condenser Material, Aluminum, Copper, Copper Coated, etc,	Copper
Condenser mounting Place, Back Wall, Top, Bottom	Bottom
Evaporator Type, Fin and Tube, Roll Bond, Wire and Tube, etc.	Copper Tubes
Evaporator Dimension, Length, Surface Area, Inside Tube Diameter	10 M. Length
Evaporator Material, Aluminum, Copper, Copper Coated, etc,	Copper
Dryer Type,	Cylindrical
Dryer Material, Weight and Size	Ranco, 20 Gr.
Capillary Tube Diameter and Length	0.7mm 3000 mm Length

هاتف المعرض : ٤٦٥٣٢٦٢ - المصنع : ٤١٦١٣٧٢ - فاكس : ٤١٦٠٧٨٦ -٦- ٩٦٢ - فاكس : ٤٦١٣٣٤٠ -٦- ٩٦٢ - ص.ب : ٩٢١٩٤٠ عمان - الاردن
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E-mail: maurice@joinnet.com.jo

Afaneh Workshop

Prototype # 2

Product Technical Specification

Description	Specification
Company Name	Afaneh Workshop
Product Name	Chest Freezer
Product Model	100-M
Product Application	Ice Cream Show Case
Operating Temperature	32 C
Climatic Condition	Normal
Product Overall Dimension WxLxH mm	65*125*88
Freezer Compartment Overall Dimension and Wall Thickness	45 mm
Refrigerator Compartment Overall Dimension and Wall Thickness	N/A
Product Shape, Double Doors, Upright, Chest, etc	Chest Freezer
Freezer Internal Net Volume	400 Liters
Refrigerator Net Volume	N/A
Product Net Volume	300 Liters
Product Inside Temperature C	-25 C
Water Storage Tank Capacity, Water Cooler	N/A
Type of Water Storage Tank Cylinder, Cubic, etc.	N/A
Water Fellow per hour for water cooler	N/A
Water Storage Tank Dimension	N/A
Water Outlet Temperature	N/A
Water Inlet Temperature	N/A
Freezer Inside Temperature	-25 C
Refrigerator Inside Temperature	N/A
Evaporating Temperature	-32 C
Foam Insulation Thickness mm	40 mm

هاتف المعرض : ٤٦٥٣٢٦٢ - المصنع : ٤١٦١٣٧٢ - فاكس : ٤١٦٠٧٨٦ -٦- ٩٦٢ - فاكس : ٤٦١٣٣٤٠ -٦- ٩٦٢ - ص.ب : ٩٢١٩٤٠ عمان - الاردن
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E-mail: maurice@joinnet.com.jo

Side Walls, Top, Bottom, Door, Back Panel	
Type of PU Foam	R11 Pu Foam
Foam Density, Kg/Cu. Mt.	40 Kg/Cu. Mt.
Foam Mixture, Percentage Pol% + R11% + Isocyanate%	37% + 13% + 50%
Total amount of Foam Injection, Kg	12 Kg
Refrigerant Type	R12
Refrigerant Charge Weight Gr.	350Gr.
Type of Compressor, Hermetic, Semi Hermetic, Open	Hermetic
Compressor Cooling System Static, Oil Cooled, Fan Cooled	Fan Cooled
Compressor Cooling Capacity Watt	600 Watts
Compressor input Power, Watt	550 Watts
Compressor Model Number	
Compressor Manufacturer	Danfoss Germany
Compressor Mounting Place Top, Bottom, Front, Back	Bottom
Condenser Type, Static, Fan Cooled	Fan Cooled
Condenser Dimension, Length, Inside Tube Diameter,	Four Rows Tube Coil and Fins
Condenser Material, Aluminum, Copper, Copper Coated, etc,	Copper
Condenser mounting Place, Back Wall, Top, Bottom	Bottom
Evaporator Type, Fin and Tube, Roll Bond, Wire and Tube, etc.	Tubes
Evaporator Dimension, Length, Surface Area, Inside Tube Diameter	
Evaporator Material, Aluminum, Copper, Copper Coated, etc,	Copper
Dryer Type,	Cylindrical
Dryer Material, Weight and Size	Ranco 20 Gr.
Capillary Tube Diameter and Length	0.7 mm dim. 3000 mm length

هاتف المعرض : ٤٦٥٣٢٦٢ - المصنع : ٤١٦١٣٧٢ - فاكس : ٤١٦٠٧٨٦ -٦- ٩٦٢ - فاكس : ٤٦١٣٣٤٠ -٦- ٩٦٢ - ص.ب : ٩٢١٩٤٠ عمان - الاردن
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E-mail: maurice@joinnet.com.jo

Al-Quds Workshop

Prototype # 1

Product Technical Specification	
Description	**Specification**
Company Name	Al-Quds Workshop
Product Name	Water Cooler
Product Model	Quds 10
Product Application	Water Cooler
Operating Temperature	32 C
Climatic Condition	Normal
Product Overall Dimension WxLxH mm	41*67*127 cm
Freezer Compartment Overall Dimension and Wall Thickness	N/A
Refrigerator Compartment Overall Dimension and Wall Thickness	N/A
Product Shape, Double Doors, Upright, Chest, etc	Stand
Freezer Internal Net Volume	N/A
Refrigerator Net Volume	N/A
Product Net Volume	N/A
Product Inside Temperature C	+ 7 C
Water Storage Tank Capacity, Water Cooler	30 Litters
Type of Water Storage Tank Cylinder, Cubic, etc.	Cylindrical
Water Fellow per hour for water cooler	80 Liters/H
Water Storage Tank Dimension	45*30 cm
Water Outlet Temperature	+7 C
Water Inlet Temperature	+28 C
Freezer Inside Temperature	N/A
Refrigerator Inside Temperature	N/A
Evaporating Temperature	-23 C
Foam Insulation Thickness mm Side Walls, Top, Bottom, Door, Back Panel	40 mm

هاتف المعرض : ٤٦٥٣٢٦٢ - المصنع : ٤١٦١٣٧٢ - فاكس : ٤١٦٠٧٨٦ -٦- ٩٦٢ - فاكس : ٤٦١٣٣٤٠ -٦- ٩٦٢ - ص.ب : ٩٢١٩٤٠ عمان - الاردن
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E-mail: maurice@joinnet.com.jo

Type of PU Foam	R11 Pu Foam
Foam Density, Kg/Cu. Mt.	40 Kg/Cu. Mt.
Foam Mixture, Percentage Pol% + R11% + Isocyanate%	37% + 13% + 50%
Total amount of Foam Injection, Kg	6 Kg
Refrigerant Type	R 12
Refrigerant Charge Weight Gr.	240 Gr.
Type of Compressor, Hermetic, Semi Hermetic, Open	Hermetic
Compressor Cooling System Static, Oil Cooled, Fan Cooled	Fan Cooled
Compressor Cooling Capacity Watt	250 Watts
Compressor input Power, Watt	¼ Hp, 184 Watts
Compressor Model Number	AEZ1380A
Compressor Manufacturer	
Compressor Mounting Place Top, Bottom, Front, Back	Bottom
Condenser Type, Static, Fan Cooled	Fan Cooled
Condenser Dimension, Length, Inside Tube Diameter,	Two Rows , 5/16 inch
Condenser Material, Aluminum, Copper, Copper Coated, etc,	Copper and Aluminum
Condenser mounting Place, Back Wall, Top, Bottom	Bottom
Evaporator Type, Fin and Tube, Roll Bond, Wire and Tube, etc.	Copper Tubes Surrounding the Tank
Evaporator Dimension, Length, Surface Area, Inside Tube Diameter	15 m. Length
Evaporator Material, Aluminum, Copper, Copper Coated, etc,	Copper
Dryer Type,	Ranco
Dryer Material, Weight and Size	Silica, Cylindrical, 15 Gr.
Capillary Tube Diameter and Length	1 mm , 1800 mm length

هاتف المعرض : ٤٦٥٣٢٦٢ - المصنع : ٤١٦١٣٧٢ - فاكس : ٤١٦٠٧٨٦ -٦- ٩٦٢ - فاكس : ٤٦١٣٣٤٠ -٦- ٩٦٢ - ص.ب : ٩٢١٩٤٠ عمان - الاردن
Tel Showroom : 4653262 - Factory : 4161372 - Fax : 962 -6- 4160786 - Fax : 962 -6- 4613340 - P.O.Box : 921940 Amman - Jordan
E-mail: maurice@joinnet.com.jo

Al-Ouds Workshop

Prototype # 2

Product Technical Specification	
Description	**Specification**
Company Name	Al-Quds Workshop
Product Name	Water Cooler
Product Model	Quds 11
Product Application	Water Cooler
Operating Temperature	32 C
Climatic Condition	Normal
Product Overall Dimension WxLxH mm	39*39*102 cm
Freezer Compartment Overall Dimension and Wall Thickness	N/A
Refrigerator Compartment Overall Dimension and Wall Thickness	N/A
Product Shape, Double Doors, Upright, Chest, etc	Stand
Freezer Internal Net Volume	N/A
Refrigerator Net Volume	N/A
Product Net Volume	N/A
Product Inside Temperature C	+7 C
Water Storage Tank Capacity, Water Cooler	8 Liters
Type of Water Storage Tank Cylinder, Cubic, etc.	Cylindrical
Water Fellow per hour for water cooler	50 Liters
Water Storage Tank Dimension	30*25 cm
Water Outlet Temperature	+7 C
Water Inlet Temperature	+28 C
Freezer Inside Temperature	N/A
Refrigerator Inside Temperature	N/A
Evaporating Temperature	-23 C
Foam Insulation Thickness mm	40 mm

هاتف المعرض : ٤٦٥٣٢٦٢ ـ المصنع : ٤١٦١٣٧٢ ـ فاكس : ٤١٦٠٧٨٦ ـ٦ـ ٩٦٢ ـ فاكس : ٤٦١٣٣٤٠ ـ٦ـ ٩٦٢ ـ ص.ب : ٩٢١٩٤٠ عمان ـ الاردن
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E-mail: maurice@joinnet.com.jo

Side Walls, Top, Bottom, Door, Back Panel	
Type of PU Foam	R11 Pu Foam
Foam Density, Kg/Cu. Mt.	40 Kg/Cu. Mt.
Foam Mixture, Percentage Pol% + R11% + Isocyanate%	37% + 13% + 50%
Total amount of Foam Injection, Kg	4 Kg
Refrigerant Type	R12
Refrigerant Charge Weight Gr.	180 Gr.
Type of Compressor, Hermetic, Semi Hermetic, Open	Hermetic
Compressor Cooling System Static, Oil Cooled, Fan Cooled	Fan Cooled
Compressor Cooling Capacity Watt	250 Watts
Compressor input Power, Watt	¼ Hp, 184 Watts
Compressor Model Number	AEZ1380A
Compressor Manufacturer	
Compressor Mounting Place Top, Bottom, Front, Back	Bottom
Condenser Type, Static, Fan Cooled	Fan Cooled
Condenser Dimension, Length, Inside Tube Diameter,	Two Rows, 5/16 Inch
Condenser Material, Aluminum, Copper, Copper Coated, etc,	Copper and Aluminum Fins
Condenser mounting Place, Back Wall, Top, Bottom	Bottom
Evaporator Type, Fin and Tube, Roll Bond, Wire and Tube, etc.	Tubes Surrounding the Tank
Evaporator Dimension, Length, Surface Area, Inside Tube Diameter	15 M. Copper Tubes
Evaporator Material, Aluminum, Copper, Copper Coated, etc,	Copper
Dryer Type,	Ranco
Dryer Material, Weight and Size	Silica, 15 Gr. Cylindrical
Capillary Tube Diameter and Length	1 mm dim, 1800 length

هاتف المعرض : ٤٦٥٣٢٦٢ - المصنع : ٤١٦١٣٧٢ - فاكس : ٤١٦٠٧٨٦ -٦- ٩٦٢ - فاكس : ٤٦١٣٣٤٠ -٦- ٩٦٢ - ص.ب : ٩٢١٩٤٠ عمان - الاردن
Tel Showroom : 4653262 - Factory : 4161372 - Fax : 962 -6- 4160786 - Fax : 962 -6- 4613340 - P.O.Box : 921940 Amman - Jordan
E-mail: maurice@joinnet.com.jo

Refrigeration Load Calculation for
Water Cooler and Chest Freezer and Display cases

Refrigeration load consist of three individual components:

1- Transmission load;
Heat transfer through side walls by conduction
2 - Product load;
Heat Removed from and produced by the products which are stored.
3 - Internal load;
Heat produced by internal sources such as lights, fan or heaters;
4 - Infiltration load
Heat gains associated with air entering the refrigerated space and door opening and etc.;

In this section , the above mentioned components will be discussed separately to analyze and extract the most useful and practical equipment's.

Transmission Load

Heat gain through walls of a refrigerated space depends on cabin Temperature, liner, insulation and cabin conductivity and also the surrounded ambient air. In other word, there are four different resistance opposing heat flows between cabin space and ambient air as given in resistance circuit.

$$T_{refrigerator} \longleftarrow R_{liner} + R_{insulation} + R_{cabin} + R_{ambient} \longleftarrow T_{ambient}$$

Considering the above mentioned resistance, Rl, Rc and Ra are not comparable in magnitude with Ri (Insulation resistance) and so can be neglected in our calculations. Therefore, the resultant circuit and related equations is.

$$U = \frac{1}{1/h_i + x1/k1 + x2/k2 \ldots\ldots 1/h_o}$$

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$R = \frac{x}{KA}$ Heat Resistance

$Q_{TL} = \frac{\Delta T}{R}$ Heat Transfer

Where:

x = Insulation Thickness, mm

K = Insulation Conductivity, $Wmm/m^2 \cdot C$

A = Outside Area, m^2

ΔT = Temperature difference (T_a - T_c), C

If the insulation thickness of side walls, back panels, top, bottom and door are different. Heat transfer for each part can be calculated separately and then summed for freezer and refrigerator compartments as necessary, heat transfer for each compartment should be calculated separately and then added together.

Product Load

Heat removed from products (meat, fruits, vegetables, water and etc.) to reduce temperature from receiving to storage temperature is known as product load. Following steps can be taken to calculated of product loads.

1 - Heat removed from initial temperature (T_i) to storing temperature (T_{rs}) in refrigerator compartment is;

$Q_{rs} = \dot{M} C (T_i - T_{rs})$

Where:

$\dot{M}$ = Mass of product, Kg / h

C = Specific heat of product, Kcal / Kg

2 - Heat removed from initial temperature (Ti) to freezing temperature (Tf) is ;

$Q_{af} = \dot{M} C (T_i - T_f)$

Where:

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$\dot{M}$ = Mass of product, Kg / h

C = Specific heat of product above freezing point, Kcal / Kg

3 - Latent heat of fusion for products is equal to;

$$Q_L = \dot{M}\ h$$

Where h = Latent heat of product, Kcal / Kg

4 - Heat removed from freezing temperature (Tf) to final storage temperature (Tfs) is;

$$Q_{bf} = \dot{M}\ C_{bf}\ (Tf - Tfs)$$

Where:

C_{bf} = Specific heat of products below freezing temperature.

For upright freezers or chest freezer, total product load is

$$Q_{pl} = Q_{af} + Q_l + Q_{bf}$$

For storage products to some lower temperatures above freezing temperature in refrigerator display cases compartment is;

$$Qpl = Qrs$$

Internal Load

Electrical energy dissipated in the refrigerated space such as lights, fan motors, heaters, should be calculated as appropriate depending on type of display cases and other products.

Infiltration Load

Infiltration air load is the heat transfer due to exchanging of refrigerated air with ambient caused by opening of the door or leakage through the gasket area and /or open top freezer of show cases. Infiltration load is one of the most important load components.

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Total Refrigeration load

As it was mentioned before, transmission load (Q_{tl}), product load (Q_{pl}) and internal load (Q_{IL}) can be calculated separately. For infiltration load (air exchange through doorways or gasket leakage), we have to take into account that depending on the type of models we have to consider different amount of heat gain, or a percentage of amount of the above mentioned components. (Transmission load, product load and internal load). For example;

$$Q_{TL} = 1.10 (Q_{TL} + Q_{PL} + Q_{IL})$$

Refrigeration Load Calculation for different type of Water Coolers

Water cooler cabinet usually consist of a sheet metal housing built around a steel framework, inside this sheet housing there is usually a condensing unit, located near the floor, and above this is the water-cooling mechanism. The latter is the only part insulated (foamed plastic) from the room. The insulation is usually specially formed and between one and one half inches and two inches thick. These cabinets are made in such a way that one or more sides may be easily removed to gain access to the interior. The basin of the water cooler is generally made of porcelain-coated cast iron, porcelai coated - steel, or stainless steel. Heat exchangers are frequently used on water coolers. These make use of the low temperature of waste water and the suction line to pre-cool the fresh water line to the evaporator coil.

Self-cooler are of two types,

1- Bottle Type.
2- Tap water type

The bottle cooler usually uses a 20 to 25 liter bottle of water inverted on the top of the cabinet. Overflow and drain water are stored in a container built the

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cabinet. These coolers use air-cooled condensing units exclusively. They are used where water and drains are not available or where available the plumbing insulation may be expensive.

Water cooler using a plumbing supply and drain connection, must be installed according the relevant approved standards. The plumbing should be concealed, a hand shutoff valve should be installed in the fresh water line. Drain pipe at least 1 inches in diameter provided, and rubber opening must be above the drain in such a way as to eliminate the chance for accidental siphoning of the drain water back into the fresh water system. The tap water models use variety of evaporator coil wrapped around the water-cooling tank.

Temperatures of the cooling water are variable depending on the persons who are drinking the water. We consider 10 C for the temperature of drinking water, while our inlet temperature is considered 24 C.

In large business establishment, in office buildings, or in factories, multiple water cooler, instead of individual ones, are popular. These

coolers have one large condensing unit supplying many bubbles and these may be of many different types.

Water cooler is a device that usually is used in the public area to supply cold drinking water to the customers and different people. The appliance is mainly used in the Airports, Railways Station, Coach Terminals, Banks, Offices, Parks, and etc. therefore, it is hard to specify an standard for cold water consumption during the day from the water cooler.

We consider three refrigeration load components that should be taken into our consideration.

1- Heat gain by heat transmission from, main water storage tank wall insulation.

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2- Heat removed from water entering to the water tank at the initial refrigeration system operating condition, (water stored in storage tank during the night, with normal ambient temperature) which is divided by 24 hrs.
3- Heat removed from Drinking Water flow that are consumed during designated operating hours "$\dot{M}$ "

The problem of determining the refrigeration load of a water-cooled installation is basically a specific heat and heat leakage problem combination. The water is cooled to temperature which vary upward from about 4 degree centigrade , and the amount heat removed from the water to cool it to a predetermined temperature is simple specific heat problem. The water, being maintained at these low temperature, results in a heat leakage from room into the water, and this part involves the heat leakage portion of installation.

$Q_1 = m\ C\ \Delta T$, Where:

Q_1 Total heat removed from total drinking water tank volume capacity (lit.) during specific period, related to compressor cooling capacity power in Watts, at initial compressor start up, and early in the morning. When the water temperature is 30 C.

m total weight of water in the water cooler storage tank in Kg. Considering that one litter of water at 24 C is equal to approximately one Kg.

C Specific heat factor of water in Kcal/Kg °C

ΔT Temperature difference (Ti–Tc), where, Ti is inlet water temperature, and Tc is final cooled water.

$$Q2 = \dot{M}\ C\ \Delta T$$

Q2 Total heat removed from total drinking water flow (lit.) during specific period, 16 hours. In Kcal.

$\dot{M}$ total weight of water flow during 16 hours. in Kg.

C Specific heat factor of water in Kcal/Kg °C

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T Temperature difference (Ti–Tc), where, Ti is inlet water temperature, and Tc is final cooled water temperature.

$$Q3 = UA\ \Delta T$$

Where:

Q3 Total Leak, gained through side wall of drinking water storage tank by conduction in Kcal..

U Heat Resistance Coefficient Factor in Kcal/Sq. mt. C

A Total Area which heat is transmitted by. In Sq. Mt.

ΔT Temperature difference (Ta – Tc), where, T is ambient temperature, and Tc is final cooled water temperature.

Load Calculation for Water Cooler
Al- Shabah Workshop 50 liters/Hour

Q1 = m C ΔT, Where:

Q1 Total heat removed from total drinking water tank volume capacity (lit.) during specific period, related to compressor cooling capacity power in Watts, at initial compressor start up, and early in the morning. When the water temperature is 24 C.

m total weight of original water in the water cooler storage tank in Kg. Considering that one litter of water at 25 C is equal to approximately one Kg.

Tank Valume = 30x40x45= 54000 Cubic Cm. = Approx54 lit

M = 54 liter = 54 Kg.

C Specific heat factor of water in Kcal/Kg °C = 1

ΔT Temperature difference (Ti–Tc), where, Ti is inlet water temperature, and Tc is final cooled water.

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Ti = 25 °C and Tc = 5 °C

Ti – Tc = 25-5 = 20 °C

Q1 = m C ΔT = 54 x 1 x 20 = 1080 Kcal = 1080 x 1.163 = 1256 Watts/24 hrs

Q1 = 1256 /24 water cooler operating time per day = 52 Watts

Q1 = 52 Watts

$Q2 = \dot{M}$ C ΔT

Q2 Total heat removed from total drinking water flow (lit.) during specific period, 16 hours. In Kcal.

$\dot{M}$ total weight of water flow during 16 hours. in Kg. = H x N x M where:
H = Total Water Cooler Usage Time (Hours) = 16
N = Number of Glass of Drinking Water per Hour = 20
M = Kg weight of water in one Glass of Water = 0.2 Kg

$\dot{M}$ = 2(16 x 20 x 0.2) = lit. + 20% Waste Water = 154
C Specific heat factor of water in Kcal/Kg °C = 1
ΔT Temperature d(Ti – Tc), where, Ti is inlet water temperature, and Tc is final cooled water temperature.

Ti = 25 °C and T= 5 °C
Ti – Tc = 25-5 = 20 °C

Q2 = m C ΔT = 154 x 1 x 20 = 3080 Kcal = 3080 x 1.163 = 3582 Watts/16 hrs
Q2 = 3582/12 compressor operating time per day = 298 Watts

Q2 = 298 Watts

Q3 = UA ΔT, Where:

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Q3 Total Leak, gained through side wall of drinking water storage tank by conduction in Kcal..

U Heat Resistance Coefficient Factor in Kcal/Sq. mt. C

$$U = \frac{1}{1/hi + x1/K1 + x2/k2 \ldots\ldots 1/ho} = 0.59$$

hi = ho = 9.37 W/m^2. K

A Total Area which heat is transmitted by. In Sq. Mt.

$A_1 = 0.628$

$A_2 = 0.135$

$A_1 + A_2 = 0.808$ Sq. Mt.

ΔT Temperature difference (Ta – Tc), where, T is ambient temperature, and Tc is final cooled water temperature.

Ta = 32 °C and Tc = 6 °C

Ta – Tc = 32-6 = 26 °C

$Q3 = (UA_1 \Delta T) + (UA_2 \Delta T = (0.59 \times 0.628 \times 26) + (0.59 \times 0.18 \times 36) = 15.2$ Watts

Q3 = 15.2 Watts

Qt = Q1 + Q2 + Q3 = 52 + 298 + 15 = 395 + 10% safety factor = 401 Watts

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Refrigeration Load Calculation
Al Shabah Upright Refrigerator Model AI-1300

a) Transmission load calculation

Refrigerator Compartment	Dimension Cm.	Area (sq.mt.)	Insulation Thickness	Temp. Difference
Side Walls	2 x (80x200)	2.8	60mm	27 c
Back Panel	160x200	2.4	60mm	27 c
Bottom	80x160	0.84	60mm	27 C
Top	80x160	0.84	60mm	37 c
Doors	160x200	2.4	60mm	27 c

Insulation Type: Pu Foam with R141b blowing agent.
Thermal Conductivity for Foam = 0.027 W/ mt. ° C
Temperature Difference Refrigerator Compartment:
ΔT = 32 - (+5) = 27 ° C
Ambient Temperature = 32 °C
Refrigerator Air Temperature = +5 °C

Calculation :

Heat Leak For Refrigerator Compartment.

$$Q_{TL} = Q_{SW} + Q_{Back\ Panel} + Q_{door} + Q_{Bottom} + Q_{top}$$

$$Q = U\,A\,(T_a - T_r)$$

$$U = \frac{1}{1/h_i + x1/K1 + x2/k2 \cdots\cdots 1/h_o}$$

Where :

U = Heat Resistance Coefficient Factor

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K_I = Foam Thermal Conductivity
$h_i = h_o$ = Air Convection Factor = 9.37 Watt/Mt^ K

Due to the short thickness of cabinet out side panel and Metal inner liner heat resistance of these materials have been considered negligible.
Therefore:

1- $Q_{SideWalls} = [U A (T_a - T_r)]$
T_a = Ambient Temperature 32
T_r = refrigerator air Temperature 5
U = 0.41 W/ sq.m °C
A = 2.8 Sq. Mt., T_a = 32 °C, T_f = + 5 °C
therefore
$Q_{SideWalls} = 0.41 \times 2.8 \times 27 = 30.1$ Watts
$Q_{SideWalls} = 30.1$ Watts

2- $Q_{doors} = [U A (T_a - T_r)]$
U = 1.2 W/ sq.m °C, $T_a - T_r = 27$, A = 3.2,
$Q_{doors} = 1.2 \times 2.4 \times 27 =$ Watts $Q_{doors} = 78$ Watts

3- $Q_{top} = [U A (T_a - T_r)]$
U = 0.41 w/sq. Mt. °C,
Ta - Tr = 37 ,
A = 084
$Q_{top} = 0.41 \times 0.84 \times 37 = 12.74$ Watts
$Q_{top} = 12.74$ Watts

4 -$Q_{back\ panel} = [U A (T_a - T_r)]$
U = 0.41 w/sq. Mt. °C,
Ta - Tr = 27 , A = 2.4
$Q_{back\ panel} = 0.41 \times 2.4 \times 27 = 26.6$ Watts

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$Q_{\text{back panel}} = 26.6$ Watts

5 -$Q_{\text{Bottom}} = [U A (T_a - T_r)]$
U = 0.41 w/sq. Mt. °C,
Ta - Tr= 27, A = 0.84
$Q_{\text{Bottom Surface}} = 0.41x\ 0.84 \times 27 = 9.3$ Watt
$Q_{\text{Bottom Surface}} = 9.3$ Watts

Total Refrigerator Heat Leak =30.1+26.6+12.7+9.3+78 = 156.7 W

Product Load

A product placed in a refrigerator at a temperature higher than the storage temperature will lose heat until it reaches the storage temperature. The quantity of heat to be removed may be calculated from knowledge of the product, including its state upon entering the refrigerator, its final state, its weight, specific heat above and below freezing point, its freezing temperature and latent heat.

When a definite weight of product is cooled from one state and temperature to another state and temperature, some or all of the following calculations must be made:

Heat removal from initial temperature to some lower temperature above freezing.

$$Q = mc(T_1-T_2)$$

Heat removal from initial temperature to freezing point of product.

$$Q = mc(T_i-T_f)$$

Heat removal to freeze product.

$$Q = mh_{if}$$

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Heat removal from freezing point to final temperature below freezing.

$$Q = mc(T_f - T_3)$$

Where

Q = heat removed, Kj
M = weight of product, kg
C = specific heat of product above freezing point, Kj/Kg. K
T_1 = initial temp. C
T_2 = lower temperature above freezing, C
T_f = freezing temperature of product, C
H_{if} = latent heat of fusion, kj per kg

Since this product is mainly used for storing fresh Lamb meet and beef above

freezing point at +5 C, we consider 600 Kg of meet to be stored in this refrigerator therefore we calculate as follow,

$$Q = mc(T_1 - T_2)$$

M = 600 kg
C = 0.67 Btu/(lb)F deg = 0.67 x 4.184 = 2.8 j/g K
T_1 = 25 C
T_2 = 5 C
Q = 600000x2.8x (25-5) =33600000 jul/86400 = 389 Watt

Internal Load
N/A

Door Opening
Refrigerator Internal Volume 1050 lit.
Number of air change as per ASHREA standard = 70 per day
Heat removed per cubic meter of air 75000 j

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Air Change load = 1.05x70x75000/86400 = 63.8 Watt

$Q_{Total} = Q_{heat\ leak} + Q_{product\ load} + Q_{internal\ load} + Q_{air\ change}$

$Q_{Total} = 157 + 389 + 64 = 610$

Considering 20 % of Q total for safety factor

Cooling Capacity Required = $Q_{Grand\ Total} = 610 + 10\%(61) = 671$ watts

Load Calculation for Water Cooler
Al- Batriq Workshop 40 liters/Hour

Q1 = m C ΔT, Where:

Q1 Total heat removed from total drinking water tank volume capacity (lit.) during specific period, related to compressor cooling capacity power in Watts, at initial compressor start up, and early in the morning. When the water temperature is 24 C.

m total weight of original water in the water cooler storage tank in Kg. Considering that one litter of water at 25 C is equal to approximately one Kg.

Tank Valume = 25x35x45= 39 Cubic Cm. = Approx 39 lit

M = 39 liter = 39 Kg.

C Specific heat factor of water in Kcal/Kg °C = 1

ΔT Temperature difference (Ti–Tc), where, Ti is inlet water temperature, and Tc is final cooled water.

Ti = 28 °C and Tc = 8 °C

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Ti – Tc = 28-8 = 20 °C

Q1 = m C ΔT = 39 x 1 x 20 = 780 Kcal = 780 x 1.163 = 907 Watts/24 hrs

Q1 = 907 /24 water cooler operating time per day = 38 Watts

Q_1 = 38 Watts

$Q2 = \dot{M}$ C ΔT

Q2 Total heat removed from total drinking water flow (lit.) during specific period, 16 hours. In Kcal.

$\dot{M}$ total weight of water flow during 16 hours. in Kg. = H x N x M where:
H = Total Water Cooler Usage Time (Hours) = 16
N = Number of Glass of Drinking Water per Hour = 20
M = Kg weight of water in one Glass of Water = 0.2 Kg
$\dot{M}$ = 2(16 x 20 x 0.2) = lit. + 20% Waste Water = 154
C Specific heat factor of water in Kcal/Kg °C = 1
ΔT Temperature d(Ti – Tc), where, Ti is inlet water temperature, and Tc is final cooled water temperature.

Ti = 28 °C and T= 8 °C
Ti – Tc = 28-8 = 20 °C

Q2 = m C ΔT = 154 x 1 x 20 = 3080 Kcal = 3080 x 1.163 = 3582 Watts/16 hrs
Q2 = 3582/12 compressor operating time per day = 298 Watts

Q2 = 298 Watts

Q3 = UA ΔT, Where:

Q3 Total Leak, gained through side wall of drinking water storage tank by conduction in Kcal..
U Heat Resistance Coefficient Factor in Kcal/Sq. mt. C

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$$U = \frac{1}{1/hi + x1/K1 + x2/k2 \ldots\ldots 1/ho} = 0.59$$

hi = ho = 9.37 W/m^2. K

A Total Area which heat is transmitted by. In Sq. Mt.

$A_1 = 0.559$

$A_2 = 0.158$

$A_1 + A_2 = 0.717$ Sq. Mt.

ΔT Temperature difference (Ta – Tc), where, T is ambient temperature, and Tc is final cooled water temperature.

Ta = 32 °C and Tc = 6 °C

Ta – Tc = 32-8 = 24 °C

$Q3 = (UA_1 \Delta T) + (UA_2 \Delta T = (0.59 \times 0.559 \times 24) + (0.59 \times 0.158 \times 34) = 9.5$ Watts

Q3 = 9.5 Watts

Qt = Q1 + Q2 + Q3 = 39 + 298 + 9.5 = 395 + 10% safety factor = 381 Watts

Refrigeration Load Calculation
Batriq Upright Refrigerator Model 7

a) Transmission load calculation

Refrigerator Compartment	Dimension Cm.	Area (sq.mt.)	Insulation Thickness	Temp. Difference
Side Walls	2 x (75x235)	3.525	50mm	29 c
Back Panel	150x235	3.525	50mm	29 c
Bottom	150x75	1.125	50mm	29 C
Top	150x75	1.125	50mm	39 c
Doors	150x235	3.525	50mm	29 c

هاتف المعرض : ٤٦٥٣٢٦٢ - المصنع : ٤١٦١٣٧٢ - فاكس : ٤١٦٠٧٨٦ -٦- ٩٦٢ - فاكس : ٤٦١٣٣٤٠ -٦- ٩٦٢ - ص.ب : ٩٢١٩٤٠ عمان - الاردن
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Insulation Type: Pu Foam with R141b blowing agent.
Thermal Conductivity for Foam = 0.027 W/ mt. ° C
Temperature Difference Refrigerator Compartment:
$\Delta T = 32 - (+5) = 27$ ° C
Ambient Temperature = 32 °C
Refrigerator Air Temperature = +5 °C

Calculation :

Heat Leak For Refrigerator Compartment.

$$Q_{TL} = Q_{SW} + Q_{Back\ Panel} + Q_{door} + Q_{Bottom} + Q_{top}$$

$$Q = U\ A\ (T_a - T_r)$$

$$U = \frac{1}{1/h_i + x1/K1 + x2/k2 \ldots\ldots 1/h_o}$$

Where :

U = Heat Resistance Coefficient Factor
K_1 = Foam Thermal Conductivity
$h_i = h_o$ = Air Convection Factor = 9.37 Watt/Mt^ K

Due to the short thickness of cabinet out side panel and Metal inner liner heat resistance of these materials have been considered negligible.
Therefore:

1- $Q_{SideWalls} = [\ U\ A\ (T_a - T_r)\ ]$
T_a = Ambient Temperature 32
T_r = refrigerator air Temperature 5
U = 0.48 W/ sq.m °C
A = 3.525 Sq. Mt., T_a = 32 °C, T_f = + 3 °C

هاتف المعرض : ٤٦٥٣٢٦٢ - المصنع : ٤١٦١٣٧٢ - فاكس : ٤١٦٠٧٨٦ -٦- ٩٦٢ - فاكس : ٤٦١٣٣٤٠ -٦- ٩٦٢ - ص.ب : ٩٢١٩٤٠ عمان - الاردن
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therefore
$Q_{SideWalls} = 0.48 \times 3.525 \times 29 = 49.1$ Watts
$Q_{SideWalls} = 49.1$ Watts

2- $Q_{doors} = [U A (T_a - T_r)]$
$U = 1.2$ W/ sq.m °C , $T_a - T_r = 29$, $A = 3.525$,
$Q_{doors} = 1.2 \times 3.525 \times 29 =$ Watts $Q_{doors} = 192.3$ Watts

3- $Q_{top} = [U A (T_a - T_r)]$
$U = 0.48$ w/sq. Mt. °C,
$Ta - Tr = 39$,
A = 1.125
$Q_{top} = 0.48 \times 1.125 \times 39 = 21.06$ Watts
$Q_{top} = 21.6$ Watts

4 -$Q_{back\ panel} = [U A (T_a - T_r)]$
$U = 0.48$ w/sq. Mt. °C,
$Ta - Tr = 29$, $A = 3.525$
$Q_{back\ panel} = 0.81 \times 3.525 \times 29 = 49.1$ Watts
$Q_{back\ panel} = 49.1$ Watts

5 -$Q_{Bottom} = [U A (T_a - T_r)]$
$U = 0.49$ w/sq. Mt. °C,
$Ta - Tr = 29$, $A = 1.125$
$Q_{Bottom\ Surface} = 0.48 \times 1.125 \times 28 = 15.7$ Watt
$Q_{Bottom\ Surface} = 15.7$ Watts

Total Refrigerator Heat Leak =49.1+49.1+21.1+15.7+192.3 = 327.3 W

هاتف المعرض : ٤٦٥٣٢٦٢ - المصنع : ٤١٦١٣٧٢ - فاكس : ٤١٦٠٧٨٦ -٦- ٩٦٢ - فاكس : ٤٦١٣٣٤٠ -٦- ٩٦٢ - ص.ب : ٩٢١٩٤٠ عمان - الاردن
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Product Load

A product placed in a refrigerator at a temperature higher than the storage temperature will lose heat until it reaches the storage temperature. The quantity of heat to be removed may be calculated from knowledge of the product, including its state upon entering the refrigerator, its final state, its weight, specific heat above and below freezing point, its freezing temperature and latent heat.

When a definite weight of product is cooled from one state and temperature to another state and temperature, some or all of the following calculations must be made:

Heat removal from initial temperature to some lower temperature above freezing.

$$Q = mc(T_1-T_2)$$

Heat removal from initial temperature to freezing point of product.

$$Q = mc(T_i-T_f)$$

Heat removal to freeze product.

$$Q = mh_{if}$$

Heat removal from freezing point to final temperature below freezing.

$$Q = mc(T_f-T_3)$$

Where

Q = heat removed, Kj
M = weight of product, kg
C = specific heat of product above freezing point, Kj/Kg. K
T_1 = initial temp. C
T_2 = lower temperature above freezing, C
T_f = freezing temperature of product, C
H_{if} = latent heat of fusion, kj per kg

هاتف المعرض : ٤٦٥٣٢٦٢ - المصنع : ٤١٦١٣٧٢ - فاكس : ٤١٦٠٧٨٦ -٦- ٩٦٢ - فاكس : ٤٦١٣٣٤٠ -٦- ٩٦٢ - ص.ب : ٩٢١٩٤٠ عمان - الاردن
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Since this product is mainly used for storing fresh Lamb meet and beef above

freezing point at +5 C, we consider 600 Kg of meet to be stored in this refrigerator therefore we calculate as follow,

$$Q = mc(T_1-T_2)$$

M = 600 kg
C = 0.67 Btu/(lb)F deg = 0.67 x 4.184 = 2.8 j/g K
T_1 = 25 C
T_2 = 5 C
Q = 600000x2.8x (25-5) =33600000 jul/86400 = 389 Watt

Internal Load
N/A

Door Opening
Refrigerator Internal Volume 1500 lit.
Number of air change as per ASHREA standard = 70 per day
Heat removed per cubic meter of air 75000 j

Air Change load = 1.5x70x75000/86400 = 91.1 Watt

$Q_{Total} = Q_{heat\ leak} + Q_{product\ load} + Q_{internal\ load} + Q_{air\ change}$

$Q_{Total} = 327.3 + 389 + 91.1 = 807.1$

Considering 20 % of Q total for safety factor

Cooling Capacity Required = $Q_{Grand\ Total}$ = 807 + 10%(81) = 888 watts

هاتف المعرض : ٤٦٥٣٢٦٢ - المصنع : ٤١٦١٣٧٢ - فاكس : ٤١٦٠٧٨٦ -٦- ٩٦٢ - فاكس : ٤٦١٣٣٤٠ -٦- ٩٦٢ - ص.ب : ٩٢١٩٤٠ عمان - الاردن
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Load Calculation for Water Cooler
Al- Awadi Workshop Model 1300

Q1 = m C ΔT, Where:

Q1 Total heat removed from total drinking water tank volume capacity (lit.) during specific period, related to compressor cooling capacity power in Watts, at initial compressor start up, and early in the morning. When the water temperature is 24 C.

m total weight of original water in the water cooler storage tank in Kg. Considering that one litter of water at 25 C is equal to approximately one Kg.

Tank Valume = 30x30x45= 40.5 Cubic Cm. = Approx 40.5 lit
M = 40.5 liter = 40.5 Kg.

C Specific heat factor of water in Kcal/Kg °C = 1

ΔT Temperature difference (Ti–Tc), where, Ti is inlet water temperature, and Tc is final cooled water.

Ti = 28 °C and Tc = 7 °C

Ti – Tc = 28-7 = 21 °C

Q1 = m C ΔT = 40.5 x 1 x 21 = 850 Kcal = 850 x 1.163 = 989 Watts/24 hrs

Q1 = 989 /24 water cooler operating time per day = 41.2 Watts

Q_1 = 41.2 Watts

$Q2 = \dot{M}$ C ΔT

هاتف المعرض : ٤٦٥٣٢٦٢ - المصنع : ٤١٦١٣٧٢ - فاكس : ٤١٦٠٧٨٦ -٦- ٩٦٢ - فاكس : ٤٦١٣٣٤٠ -٦- ٩٦٢ - ص.ب : ٩٢١٩٤٠ عمان - الأردن
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Q2 Total heat removed from total drinking water flow (lit.) during specific period, 16 hours. In Kcal.

$\dot{M}$ total weight of water flow during 16 hours. in Kg. = H x N x M where:
H = Total Water Cooler Usage Time (Hours) = 16
N = Number of Glass of Drinking Water per Hour = 20
M = Kg weight of water in one Glass of Water = 0.2 Kg

$\dot{M}$ = 2(16 x 20 x 0.2) = lit. + 20% Waste Water = 154
C Specific heat factor of water in Kcal/Kg °C = 1
ΔT Temperature d(Ti – Tc), where, Ti is inlet water temperature, and Tc is final cooled water temperature.

Ti = 28 °C and T= 7 °C
Ti – Tc = 28-7 = 21 °C

Q2 = m C ΔT = 154 x 1 x 21 = 3234 Kcal = 3234 x 1.163 = 3761 Watts/16 hrs
Q2 = 3761/12 compressor operating time per day = 313 Watts

Q2 = 313 Watts

Q3 = UA ΔT, Where:

Q3 Total Leak, gained through side wall of drinking water storage tank by conduction in Kcal..
U Heat Resistance Coefficient Factor in Kcal/Sq. mt. C

$$U = \frac{1}{1/hi + x1/K1 + x2/k2 \ldots\ldots 1/ho} = 0.59$$

hi = ho = 9.37 W/m^2. K
A Total Area which heat is transmitted by. In Sq. Mt.
$A_1 = 0.550$
$A_2 = 0.140$
$A_1 + A_2 = 0.690$ Sq. Mt.

هاتف المعرض : ٤٦٥٣٢٦٢ - المصنع : ٤١٦١٣٧٢ - فاكس : ٤١٦٠٧٨٦ -٦- ٩٦٢ - فاكس : ٤٦١٣٣٤٠ -٦- ٩٦٢ - ص.ب : ٩٢١٩٤٠ عمان - الاردن
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ΔT Temperature difference (Ta – Tc), where, T is ambient temperature, and Tc is final cooled water temperature.

Ta = 32 °C and Tc = 7 °C

Ta – Tc = 32-7 = 25 °C

$Q3 = (UA_1 \Delta T) + (UA_2 \Delta T = (0.59 \times 0.550 \times 25) + (0.59 \times 0.140 \times 35) = 11.8$ Watts

Q3 = 11.8 Watts

Qt = Q1 + Q2 + Q3 = 41.2 + 313 + 12.8 = 367 + 10% safety factor = 404 Watts

Refrigeration Load Calculation
Al Awadi Chest Freezer Model 1200

a) Transmission load calculation

Freezer Compartment	Dimension Cm.	Area (sq.mt.)	Insulation Thickness	Temp. Difference
Side Walls	2 x (65x88)	1.444	40mm	55 c
Back Panel	125x88	1.1	40mm	55 c
Bottom	65x88	0.572	40mm	65 C
Top	65x88	0.572	40mm	55 c
Doors	125x88	1.1	40mm	55 c

Insulation Type: Pu Foam with R141b blowing agent.
Thermal Conductivity for Foam = 0.027 W/ mt. ° C
Temperature Difference Refrigerator Compartment:
ΔT = 32 - (-23) = 55 ° C
Ambient Temperature = 32 °C
Freezer Air Temperature = -23 °C

هاتف المعرض : ٤٦٥٣٢٦٢ - المصنع : ٤١٦١٣٧٢ - فاكس : ٤١٦٠٧٨٦ -٦- ٩٦٢ - فاكس : ٤٦١٣٣٤٠ -٦- ٩٦٢ - ص.ب : ٩٢١٩٤٠ عمان - الاردن
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Calculation :

Heat Leak For Freezer Compartment.

$Q_{TL} = Q_{SW} + Q_{Back\ Panel} + Q_{door} + Q_{Bottom} + Q_{top}$

$$Q = U\ A\ (T_a - T_r)$$

$$U = \frac{1}{1/h_i + x1/K1 + x2/k2 \cdots\cdots 1/h_o}$$

Where :

U = Heat Resistance Coefficient Factor
K_1 = Foam Thermal Conductivity
$h_i = h_o$ = Air Convection Factor = 9.37 Watt/Mt^ K

Due to the short thickness of cabinet out side panel and Metal inner liner heat resistance of these materials have been considered negligible.
Therefore:

1- $Q_{SideWalls}$ = [U A (T_a - T_r)]
T_a = Ambient Temperature 32
T_r = refrigerator air Temperature -23
U = 0.59 W/ sq.m °C
A = 1.444 Sq. Mt., T_a = 32 °C, T_f = -23 °C
therefore
$Q_{SideWalls}$ = 0.59 x 1.444 x 55 = 48.9 Watts
$Q_{SideWalls}$ = 48.9 Watts

2- $Q_{Top\ door}$ = [U A (T_a - T_r)]
U = 0.59W/ sq.m °C ,T_a - T_r=55, A = 0.572,
Q_{doors} = 0.59 x 0.572 x 55 = Watts Q_{doors} = 18.6 Watts

هاتف المعرض : ٤٦٥٣٢٦٢ - المصنع : ٤١٦١٣٧٢ - فاكس : ٤١٦٠٧٨٦ -٦- ٩٦٢ - فاكس : ٤٦١٣٣٤٠ -٦- ٩٦٢ - ص.ب : ٩٢١٩٤٠ عمان - الاردن
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3- $Q_{\text{Front Panel}} = [U A (T_a - T_r)]$
U = 0.59 w/sq. Mt. °C,
Ta - Tr= 55 ,
A = 1.1
$Q_{\text{Front Panel}} = 0.59 \times 1.1 \times 55 = 35.7$ Watts
$Q_{\text{Front Panel}} = 35.7$ Watts

4 -$Q_{\text{back panel}} = [U A (T_a - T_r)]$
U = 0.59 w/sq. Mt. °C,
$T_a - T_r =$, A = 1.1
$Q_{\text{back panel}} = 0.59 \times 1.1 \times 55 = 35.7$ Watts
$Q_{\text{back panel}} = 35.7$ Watts

5 -$Q_{\text{Bottom}} = [U A (T_a - T_r)]$
U = 0.59 w/sq. Mt. °C,
Ta - Tr= 65, A = 0.572
$Q_{\text{Bottom Surface}} = 0.59 \times 0.572 \times 65 = 22$ Watt
$Q_{\text{Bottom Surface}} = 22$ Watts

Total Refrigerator Heat Leak =46.9+35.7+18.6+35.7+22 = 158.8 W

Product Load

A product placed in a refrigerator at a temperature higher than the storage temperature will lose heat until it reaches the storage temperature. The quantity of heat to be removed may be calculated from knowledge of the product, including its state upon entering the refrigerator, its final state, its weight, specific heat above and below freezing point, its freezing temperature and latent heat.

هاتف المعرض : ٤٦٥٣٢٦٢ - المصنع : ٤١٦١٣٧٢ - فاكس : ٤١٦٠٧٨٦ -٦- ٩٦٢ - فاكس : ٤٦١٣٣٤٠ -٦- ٩٦٢ - ص.ب : ٩٢١٩٤٠ عمان - الاردن
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When a definite weight of product is cooled from one state and temperature to another state and temperature, some or all of the following calculations must be made:

Heat removal from initial temperature to some lower temperature above freezing.

$$Q = mc(T_1-T_2)$$

Heat removal from initial temperature to freezing point of product.

$$Q = mc(T_i-T_f)$$

Heat removal to freeze product.

$$Q = mh_{if}$$

Heat removal from freezing point to final temperature below freezing.

$$Q = mc(T_f-T_3)$$

Where

Q = heat removed, Kj
M = weight of product, kg
C = specific heat of product above freezing point, Kj/Kg. K
T_1 = initial temp. C
T_2 = lower temperature above freezing, C
T_f = freezing temperature of product, C
H_{if} = latent heat of fusion, kj per kg

Since this product is mainly used for storing fresh Lamb meet and beef above

freezing point at -23 C, we consider 30 Kg of meet to be stored in this Freezer therefore we calculate as follow,

$$Q_1 = mc(T_1-T_2)$$

M = 30 kg

$C_{\text{Above Freezing}}$ = 3.2 Kj/kg K

هاتف المعرض : ٤٦٥٣٢٦٢ ـ المصنع : ٤١٦١٣٧٢ ـ فاكس : ٤١٦٠٧٨٦ ـ٦ـ ٩٦٢ ـ فاكس : ٤٦١٣٣٤٠ ـ٦ـ ٩٦٢ ـ ص.ب : ٩٢١٩٤٠ عمان ـ الاردن
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$T_1 = 25$ C
$T_2 = 0$ C
Q = 30000x3.2x [25-0] =2400000 jul/86400 = 28 Watt

$Q_2 = mc(T_1-T_2)$
M = 40 kg
C Below Freezing = 1.61 Kj/(kg. K)
$T_1 = 0$ C
$T_2 = -23$ C
Q = 30000x1.61x [(0-(-23)] =1110900 jul/86400 = 12.8 Watt

$Q_3 = mh$

$Q_3 = 30000 \times 204/86400 = 71$

Q total for product loaded = 28 + 13 + 71 = 112

Internal Load
N/A

Door Opening
Refrigerator Internal Volume 400 lit.
Number of air change as per ASHREA standard = 70 per day
Heat removed per cubic meter of air 75000 j

Air Change load = 0.4x20x75000/86400 = 6.9
Watt

Q_{Total} = Q heat leak +Q product load + Q internal load + Q air change

هاتف المعرض : ٤٦٥٣٢٦٢ - المصنع : ٤١٦١٣٧٢ - فاكس : ٤١٦٠٧٨٦ -٦- ٩٦٢ - فاكس : ٤٦١٣٣٤٠ -٦- ٩٦٢ - ص.ب : ٩٢١٩٤٠ عمان - الاردن
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$Q_{Total} = 159 + 112 + 7 = 278$ Watts

Considering 10 % of Q total for safety factor

Cooling Capacity Required = $Q_{Grand\ Total}$ = 278 + 10%(81) = 306 watts

Load Calculation for Water Cooler
Al- Quds Workshop Model Quds-1

Q1 = m C ΔT, Where:

Q1 Total heat removed from total drinking water tank volume capacity (lit.) during specific period, related to compressor cooling capacity power in Watts, at initial compressor start up, and early in the morning. When the water temperature is 24 C.

m total weight of original water in the water cooler storage tank in Kg. Considering that one litter of water at 25 C is equal to approximately one Kg.

Tank Volume = 40x30x45=54 Cubic Cm. = Approx 54 lit
M = 54 liter = 54 Kg.

C Specific heat factor of water in Kcal/Kg °C = 1

ΔT Temperature difference (Ti–Tc), where, Ti is inlet water temperature, and Tc is final cooled water.

Ti = 28 °C and Tc = 7 °C

Ti – Tc = 28-7 = 21 °C

Q1 = m C ΔT = 54 x 1 x 21 = 1136 Kcal = 1136 x 1.163 = 1319 Watts/24 hrs

هاتف المعرض : ٤٦٥٣٢٦٢ - المصنع : ٤١٦١٣٧٢ - فاكس : ٤١٦٠٧٨٦ -٦- ٩٦٢ - فاكس : ٤٦١٣٣٤٠ -٦- ٩٦٢ - ص.ب : ٩٢١٩٤٠ عمان - الاردن
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Q1 = 1319/24 water cooler operating time per day = 55 Watts

$$Q_1 = 55 \text{ Watts}$$

$Q2 = \dot{M}\ C\ \Delta T$

Q2 Total heat removed from total drinking water flow (lit.) during specific period, 16 hours. In Kcal.

$\dot{M}$ total weight of water flow during 16 hours. in Kg. = H x N x M where:
H = Total Water Cooler Usage Time (Hours) = 16
N = Number of Glass of Drinking Water per Hour = 20
M = Kg weight of water in one Glass of Water = 0.2 Kg

$\dot{M}$ = 2(16 x 20 x 0.2) = lit. + 20% Waste Water = 154
C Specific heat factor of water in Kcal/Kg °C = 1
ΔT Temperature d(Ti – Tc), where, Ti is inlet water temperature, and Tc is final cooled water temperature.

Ti = 28 °C and T= 7 °C
Ti – Tc = 28-7 = 21 °C

Q2 = m C ΔT = 154 x 1 x 21 = 3234 Kcal = 3234 x 1.163 = 3761 Watts/16 hrs
Q2 = 3761/12 compressor operating time per day = 313 Watts

Q2 = 313 Watts

Q3 = UA ΔT, Where:

Q3 Total Leak, gained through side wall of drinking water storage tank by conduction in Kcal..
U Heat Resistance Coefficient Factor in Kcal/Sq. mt. C

$$U = \frac{1}{1/hi + x1/K1 + x2/k2 \cdots\cdots 1/ho} = 0.59$$

هاتف المعرض : ٤٦٥٣٢٦٢ - المصنع : ٤١٦١٣٧٢ - فاكس : ٤١٦٠٧٨٦ -٦- ٩٦٢ - فاكس : ٤٦١٣٣٤٠ -٦- ٩٦٢ - ص.ب : ٩٢١٩٤٠ عمان - الاردن
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hi = ho = 9.37 W/m^2. K

A Total Area which heat is transmitted by. In Sq. Mt.

$A_1 = 0.790$

$A_2 = 0.180$

$A_1 + A_2 = 0.970$ Sq. Mt.

ΔT Temperature difference (Ta – Tc), where, T is ambient temperature, and Tc is final cooled water temperature.

Ta = 32 °C and Tc = 7 °C

Ta – Tc = 32-7 = 25 °C

$Q3 = (UA_1 \Delta T) + (UA_2 \Delta T = (0.59 \times 0.790 \times 25) + (0.59x0.180x35) = 15.4$ Watts

Q3 = 15.4 Watts

Qt = Q1 + Q2 + Q3 = 54 + 313 + 15.4 = 382 + 10% safety factor = 420 Watts

Load Calculation for Water Cooler
Al- Quds Workshop Model Quds-II

Q1 = m C ΔT, Where:

Q1 Total heat removed from total drinking water tank volume capacity (lit.) during specific period, related to compressor cooling capacity power in Watts, at initial compressor start up, and early in the morning. When the water temperature is 24 C.

m total weight of original water in the water cooler storage tank in Kg. Considering that one litter of water at 25 C is equal to approximately one Kg.

Tank Volume = 30x30x25=22.5 Cubic Cm. = Approx 22.5 lit

M = 22.5 liter = 22.5 Kg.

C Specific heat factor of water in Kcal/Kg °C = 1

هاتف المعرض : ٤٦٥٣٢٦٢ - المصنع : ٤١٦١٣٧٢ - فاكس : ٤١٦٠٧٨٦ -٦- ٩٦٢ - فاكس : ٤٦١٣٣٤٠ -٦- ٩٦٢ - ص.ب : ٩٢١٩٤٠ عمان - الاردن
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ΔT Temperature difference (Ti–Tc), where, Ti is inlet water temperature, and Tc is final cooled water.

Ti = 28 °C and Tc = 7 °C

Ti – Tc = 28-7 = 21 °C

Q1 = m C ΔT = 22.5 x 1 x 21 = 472.5 Kcal = 472.5 x 1.163 = 550 Watts/24 hrs

Q1 = 550/24 water cooler operating time per day = 23 Watts

Q_1 = 23 Watts

Q2 = $\dot{M}$ C ΔT

Q2 Total heat removed from total drinking water flow (lit.) during specific period, 16 hours. In Kcal.

$\dot{M}$ total weight of water flow during 16 hours. in Kg. = H x N x M where:
H = Total Water Cooler Usage Time (Hours) = 16
N = Number of Glass of Drinking Water per Hour = 20
M = Kg weight of water in one Glass of Water = 0.2 Kg

$\dot{M}$ = 2(16 x 20 x 0.2) = lit. + 20% Waste Water = 154
C Specific heat factor of water in Kcal/Kg °C = 1
ΔT Temperature d(Ti – Tc), where, Ti is inlet water temperature, and Tc is final cooled water temperature.

Ti = 28 °C and T= 7 °C
Ti – Tc = 28-7 = 21 °C

Q2 = m C ΔT = 154 x 1 x 21 = 3234 Kcal = 3234 x 1.163 = 3761 Watts/16 hrs
Q2 = 3761/12 compressor operating time per day = 313 Watts

هاتف المعرض : ٤٦٥٣٢٦٢ - المصنع : ٤١٦١٣٧٢ - فاكس : ٤١٦٠٧٨٦ -٦- ٩٦٢ - فاكس : ٤٦١٣٣٤٠ -٦- ٩٦٢ - ص.ب : ٩٢١٩٤٠ عمان - الاردن
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Q2 = 313 Watts

Q3 = UA ΔT, Where:

Q3 Total Leak, gained through side wall of drinking water storage tank by conduction in Kcal..

U Heat Resistance Coefficient Factor in Kcal/Sq. mt. C

$$U = \frac{1}{1/hi + x1/K1 + x2/k2 \cdots\cdots 1/ho} = 0.59$$

hi = ho = 9.37 W/m^2. K

A Total Area which heat is transmitted by. In Sq. Mt.

$A_1 = 0.228$

$A_2 = 0.09$

$A_1 + A_2 = 0.318$ Sq. Mt.

ΔT Temperature difference (Ta – Tc), where, T is ambient temperature, and Tc is final cooled water temperature.

Ta = 32 °C and Tc = 7 °C

Ta – Tc = 32-7 = 25 °C

$Q3 = (UA_1\ \Delta T) + (UA_2\ \Delta T = (0.59 \times 0.228 \times 25) + (0.59x0.09x35) =$ 8 Watts

Q3 = 8 Watts

Qt = Q1 + Q2 + Q3 = 23 + 313 + 8 = 344 + 10% safety factor = 378 Watts

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Load Calculation for Water Cooler
Al- Afaneh Workshop Model 222 F

Q1 = m C ΔT, Where:

Q1 Total heat removed from total drinking water tank volume capacity (lit.) during specific period, related to compressor cooling capacity power in Watts, at initial compressor start up, and early in the morning. When the water temperature is 24 C.

m total weight of original water in the water cooler storage tank in Kg. Considering that one litter of water at 25 C is equal to approximately one Kg.

Tank Volume = 35x35x35=43 Cubic Cm. = Approx 43 lit

M = 43 liter = 43 Kg.

C Specific heat factor of water in Kcal/Kg °C = 1

ΔT Temperature difference (Ti–Tc), where, Ti is inlet water temperature, and Tc is final cooled water.

Ti = 26 °C and Tc = 6 °C

Ti – Tc = 26-6 = 20 °C

Q1 = m C ΔT = 43 x 1 x 20 = 860 Kcal = 860 x 1.163 = 1000 Watts/24 hrs

Q1 = 1000/24 water cooler operating time per day = 42 Watts

Q_1 = 42 Watts

$Q2 = \dot{M}$ C ΔT

هاتف المعرض : ٤٦٥٣٢٦٢ - المصنع : ٤١٦١٣٧٢ - فاكس : ٤١٦٠٧٨٦ -٦- ٩٦٢ - فاكس : ٤٦١٣٣٤٠ -٦- ٩٦٢ - ص.ب : ٩٢١٩٤٠ عمان - الاردن
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Q2 Total heat removed from total drinking water flow (lit.) during specific period, 16 hours. In Kcal.

$\dot{M}$ total weight of water flow during 16 hours. in Kg. = H x N x M where:
H = Total Water Cooler Usage Time (Hours) = 16
N = Number of Glass of Drinking Water per Hour = 20
M = Kg weight of water in one Glass of Water = 0.2 Kg

$\dot{M}$ = 2(16 x 20 x 0.2) = lit. + 20% Waste Water = 154
C Specific heat factor of water in Kcal/Kg °C = 1
ΔT Temperature d(Ti – Tc), where, Ti is inlet water temperature, and Tc is final cooled water temperature.

Ti = 26°C and T= 6 °C
Ti – Tc = 26-6= 20C

Q2 = m C ΔT = 154 x 1 x 19=2926l = 2925x1.163 = 3403 Watts/16 hrs
Q2 = 3403/12 compressor operating time per day = 283 Watts

Q2 = 283 Watts

Q3 = UA ΔT, Where:

Q3 Total Leak, gained through side wall of drinking water storage tank by conduction in Kcal..
U Heat Resistance Coefficient Factor in Kcal/Sq. mt. C

$$U = \frac{1}{1/hi + x1/K1 + x2/k2 \ldots\ldots 1/ho} = 0.59$$

hi = ho = 9.37 W/m^2. K
A Total Area which heat is transmitted by. In Sq. Mt.
$A_1 = 0.612$
$A_2 = 0.123$
$A_1 + A_2 = 0.738$ Sq. Mt.

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ΔT Temperature difference (Ta – Tc), where, T is ambient temperature, and Tc is final cooled water temperature.

Ta = 32 °C and Tc = 6 °C

Ta – Tc = 32-6 = 26 °C

$Q3 = (UA_1\ \Delta T) + (UA_2\ \Delta T = (0.59 \times 0.612 \times 26) + (0.59x0.123x26) = 12.8$ Watts

Q3 = 13 Watts

Qt = Q1 + Q2 + Q3 = 42 + 298 + 13 = 353 + 10% safety factor = 388 Watts

Refrigeration Load Calculation
Al Afaneh Chest Freezer Model 100-M

a) Transmission load calculation

Freezer Compartment	Dimension Cm.	Area (sq.mt.)	Insulation Thickness	Temp. Difference
Side Walls	2 x (65x88)	1.444	40mm	55 c
Back Panel	125x88	1.1	40mm	55 c
Bottom	65x88	0.572	40mm	65 C
Top	65x88	0.572	40mm	55 c
Doors	125x88	1.1	40mm	55 c

Insulation Type: Pu Foam with R141b blowing agent.
Thermal Conductivity for Foam = 0.027 W/ mt. ° C
Temperature Difference Refrigerator Compartment:
ΔT = 32 - (-23) = 55 ° C
Ambient Temperature = 32 °C
Freezer Air Temperature = -23 °C

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Calculation :

Heat Leak For Freezer Compartment.

$Q_{TL} = Q_{SW} + Q_{Back\ Panel} + Q_{door} + Q_{Bottom} + Q_{top}$

$$Q = U\ A\ (T_a - T_r)$$

$$U = \frac{1}{1/h_i + x1/K1 + x2/k2 \cdots\cdots 1/h_o}$$

Where :

U = Heat Resistance Coefficient Factor
K_1 = Foam Thermal Conductivity
$h_i = h_o$ = Air Convection Factor = 9.37 Watt/Mt^ K

Due to the short thickness of cabinet out side panel and Metal inner liner heat resistance of these materials have been considered negligible.
Therefore:

1- $Q_{SideWalls} = [\ U\ A\ (T_a - T_r)\ ]$
T_a = Ambient Temperature 32
T_r = refrigerator air Temperature -23
U = 0.59 W/ sq.m °C
A = 1.444 Sq. Mt., T_a = 32 °C, T_r = -23 °C
therefore
$Q_{SideWalls}$ = 0.59 x 1.444 x 55 = 48.9 Watts
$Q_{SideWalls}$ = 48.9 Watts

2- $Q_{Top\ door} = [\ U\ A\ (T_a - T_r)\ ]$
U = 0.59W/ sq.m °C ,$T_a - T_r$=55, A = 0.572,
Q_{doors} = 0.59 x 0.572 x 55 = Watts Q_{doors} = 18.6 Watts

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3- $Q_{\text{Front Panel}} = [U A (T_a - T_r)]$
U = 0.59 w/sq. Mt. °C,
Ta - Tr= 55 ,
A = 1.1
$Q_{\text{Front Panel}} = 0.59 \times 1.1 \times 55 = 35.7$ Watts
$Q_{\text{Front Panel}} = 35.7$ Watts

4 -$Q_{\text{back panel}} = [U A (T_a - T_r)]$
U = 0.59 w/sq. Mt. °C,
$T_a - T_r =$, A = 1.1
$Q_{\text{back panel}} = 0.59 \times 1.1 \times 55 = 35.7$ Watts
$Q_{\text{back panel}} = 35.7$ Watts

5 -$Q_{\text{Bottom}} = [U A (T_a - T_r)]$
U = 0.59 w/sq. Mt. °C,
Ta - Tr= 65, A = 0.572
$Q_{\text{Bottom Surface}} = 0.59 \times 0.572 \times 65 = 22$ Watt
$Q_{\text{Bottom Surface}} = 22$ Watts

Total Refrigerator Heat Leak =46.9+35.7+18.6+35.7+22 = 158.8 W

Product Load

A product placed in a refrigerator at a temperature higher than the storage temperature will lose heat until it reaches the storage temperature. The quantity of heat to be removed may be calculated from knowledge of the product, including its state upon entering the refrigerator, its final state, its

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weight, specific heat above and below freezing point, its freezing temperature and latent heat.

When a definite weight of product is cooled from one state and temperature to another state and temperature, some or all of the following calculations must be made:

Heat removal from initial temperature to some lower temperature above freezing.

$$Q = mc(T_1-T_2)$$

Heat removal from initial temperature to freezing point of product.

$$Q = mc(T_i-T_f)$$

Heat removal to freeze product.

$$Q = mh_{if}$$

Heat removal from freezing point to final temperature below freezing.

$$Q = mc(T_f-T_3)$$

Where

Q = heat removed, Kj
M = weight of product, kg
C = specific heat of product above freezing point, Kj/Kg. K
T_1 = initial temp. C
T_2 = lower temperature above freezing, C
T_f = freezing temperature of product, C
H_{if} = latent heat of fusion, kj per kg

Since this product is mainly used for storing fresh Lamb meet and beef above

freezing point at -23 C, we consider 30 Kg of meet to be stored in this Freezer therefore we calculate as follow,

$$Q_1 = mc(T_1-T_2)$$

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M = 30 kg
C Above Freezing = 3.2 Kj/kg K
T_1 = 25 C
T_2 = 0 C
Q = 30000x3.2x [25-0] =2400000 jul/86400 = 28 Watt

Q_2 = mc(T_1-T_2)
M = 40 kg
C Below Freezing = 1.61 Kj/(kg. K)
T_1 = 0 C
T_2 = -23 C
Q = 30000x1.61x [(0-(-23)] =1110900 jul/86400 = 12.8 Watt

Q_3 = mh

Q_3 = 30000 x 204/86400 = 71

Q total for product loaded = 28 + 13 + 71 = 112

Internal Load
N/A

Door Opening
Refrigerator Internal Volume 400 lit.
Number of air change as per ASHREA standard = 70 per day
Heat removed per cubic meter of air 75000 j

Air Change load = 0.4x20x75000/86400 = 6.9
Watt

هاتف المعرض : ٤٦٥٣٢٦٢ - المصنع : ٤١٦١٣٧٢ - فاكس : ٤١٦٠٧٨٦ -٦- ٩٦٢ - فاكس : ٤٦١٣٣٤٠ -٦- ٩٦٢ - ص.ب : ٩٢١٩٤٠ عمان - الاردن
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$Q_{Total} = Q_{heat\ leak} + Q_{product\ load} + Q_{internal\ load} + Q_{air\ change}$

$Q_{Total} = 159 + 112 + 7 = 278$ Watts

Considering 10 % of Q total for safety factor

Cooling Capacity Required = $Q_{Grand\ Total}$ = 278 + 10%(81) = 306 watts

Load Calculation for Water Cooler
Al- Mokhtar Workshop Model MWT1

Q1 = m C ΔT, Where:

Q1 Total heat removed from total drinking water tank volume capacity (lit.) during specific period, related to compressor cooling capacity power in Watts, at initial compressor start up, and early in the morning. When the water temperature is 24 C.

m total weight of original water in the water cooler storage tank in Kg. Considering that one litter of water at 25 C is equal to approximately one Kg.

Tank Volume = 30x30x30=27 Cubic Cm. = Approx 27 lit
M = 27 liter = 27 Kg.

C Specific heat factor of water in Kcal/Kg °C = 1

ΔT Temperature difference (Ti–Tc), where, Ti is inlet water temperature, and Tc is final cooled water.

Ti = 25 °C and Tc = 6 °C

Ti – Tc = 25-6 = 19 °C

هاتف المعرض : ٤٦٥٣٢٦٢ - المصنع : ٤١٦١٣٧٢ - فاكس : ٤١٦٠٧٨٦ -٦- ٩٦٢ - فاكس : ٤٦١٣٣٤٠ -٦- ٩٦٢ - ص.ب : ٩٢١٩٤٠ عمان - الاردن
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Q1 = m C ΔT = 27 x 1 x 19 = 513 Kcal = 513 x 1.163 = 597 Watts/24 hrs

Q1 = 597/24 water cooler operating time per day = 25 Watts

Q_1 = 25 Watts

$Q2 = \dot{M}$ C ΔT

Q2 Total heat removed from total drinking water flow (lit.) during specific period, 16 hours. In Kcal.

$\dot{M}$ total weight of water flow during 16 hours. in Kg. = H x N x M where:
H = Total Water Cooler Usage Time (Hours) = 16
N = Number of Glass of Drinking Water per Hour = 20
M = Kg weight of water in one Glass of Water = 0.2 Kg

$\dot{M}$ = 2(16 x 20 x 0.2) = lit. + 20% Waste Water = 154
C Specific heat factor of water in Kcal/Kg °C = 1
ΔT Temperature d(Ti – Tc), where, Ti is inlet water temperature, and Tc is final cooled water temperature.

Ti = 25°C and T= 6 °C
Ti – Tc = 25-6= 19C

Q2 = m C ΔT = 154 x 1 x 19=2926l = 2925x1.163 = 3403 Watts/16 hrs
Q2 = 3403/12 compressor operating time per day = 283 Watts

Q2 = 283 Watts

Q3 = UA ΔT, Where:

Q3 Total Leak, gained through side wall of drinking water storage tank by conduction in Kcal..
U Heat Resistance Coefficient Factor in Kcal/Sq. mt. C

هاتف المعرض : ٤٦٥٣٢٦٢ ـ المصنع : ٤١٦١٣٧٢ ـ فاكس : ٤١٦٠٧٨٦ ـ٦ـ ٩٦٢ ـ فاكس : ٤٦١٣٣٤٠ ـ٦ـ ٩٦٢ ـ ص.ب : ٩٢١٩٤٠ عمان ـ الاردن
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$$U = \frac{1}{1/hi + x1/K1 + x2/k2 \ldots\ldots 1/ho} = 0.48$$

hi = ho = 9.37 W/m^2. K

A Total Area which heat is transmitted by. In Sq. Mt.

$A_1 = 0.450$

$A_2 = 0.09$

$A_1 + A_2 = 0.540$ Sq. Mt.

ΔT Temperature difference (Ta – Tc), where, T is ambient temperature, and Tc is final cooled water temperature.

Ta = 32 °C and Tc = 5 °C

Ta – Tc = 32-5 = 27 °C

$Q3 = (UA_1\ \Delta T) + (UA_2\ \Delta T = (0.48 \times 0.450 \times 27) + (0.48x0.09x35) =$ 6.9 Watts

Q3 = 8 Watts

Qt = Q1 + Q2 + Q3 = 25 + 283 + 7 = 315 + 10% safety factor = 347 Watts

Refrigeration Load Calculation
Al Mokhtar Upright Refrigerator Model MRU1

a) Transmission load calculation

Refrigerator Compartment	Dimension Cm.	Area (sq.mt.)	Insulation Thickness	Temp. Difference
Side Walls	2 x (70x200)	2.8	50mm	27 c
Back Panel	70x200	1.4	50mm	27 c
Bottom	70x70	0.49	50mm	27 C
Top	70x70	0.49	50mm	37 c
Doors	160x200	1.4	50mm	27 c

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Insulation Type: Pu Foam with R141b blowing agent.
Thermal Conductivity for Foam = 0.027 W/ mt. ° C
Temperature Difference Refrigerator Compartment:
ΔT = 32 - (+5) = 27 ° C
Ambient Temperature = 32 °C
Refrigerator Air Temperature = +5 °C

Calculation :

Heat Leak For Refrigerator Compartment.

$$Q_{TL} = Q_{SW} + Q_{Back\ Panel} + Q_{door} + Q_{Bottom} + Q_{top}$$

$$Q = U\ A\ (T_a - T_r)$$

$$U = \frac{1}{1/h_i + x1/K1 + x2/k2 \cdots\cdots 1/h_o}$$

Where :

U = Heat Resistance Coefficient Factor
K_1 = Foam Thermal Conductivity
$h_i = h_o$ = Air Convection Factor = 9.37 Watt/Mt^ K

Due to the short thickness of cabinet out side panel and Metal inner liner heat resistance of these materials have been considered negligible.
Therefore:

1- $Q_{SideWalls}$ = [U A (T_a - T_r)]
T_a = Ambient Temperature 32
T_r = refrigerator air Temperature 5
U = 0.48 W/ sq.m °C
A = 2.8 Sq. Mt., T_a = 32 °C, T_f = + 5 °C

هاتف المعرض : ٤٦٥٣٢٦٢ ـ المصنع : ٤١٦١٣٧٢ ـ فاكس : ٤١٦٠٧٨٦ ـ٦ـ ٩٦٢ ـ فاكس : ٤٦١٣٣٤٠ ـ٦ـ ٩٦٢ ـ ص.ب : ٩٢١٩٤٠ عمان ـ الاردن
Tel Showroom : 4653262 - Factory : 4161372 - Fax : 962 -6- 4160786 - Fax : 962 -6- 4613340 - P.O.Box : 921940 Amman - Jordan
E-mail: maurice@joinnet.com.jo

therefore
$Q_{SideWalls} = 0.48x\ 2.8\ x\ 27 = 36.3$ Watts
$Q_{SideWalls} = 36.3$ Watts

2- $Q_{doors} = [\ U\ A\ (T_a - T_r)\ ]$
$U = 0.48$ W/ sq.m °C , $T_a - T_r = 27$, $A = 3.2$,
$Q_{doors} = 0.48\ x\ 1.4\ x\ 27 =$ Watts $Q_{doors} = 18$ Watts

3- $Q_{top} = [\ U\ A\ (T_a - T_r)\ ]$
$U = 0.48$ w/sq. Mt. °C,
$Ta - Tr = 37$,
A = 0.49
$Q_{top} = 0.48\ x\ 0.49\ x\ 37 = 8.7$ Watts
$Q_{top} = 8.7$ Watts

4 -$Q_{back\ panel} = [\ U\ A\ (T_a - T_r)\ ]$
$U = 0.48$ w/sq. Mt. °C,
$Ta - Tr = 27$, $A = 1.4$
$Q_{back\ panel} = 0.48x\ 1.4\ x\ 27 = 18.1$ Watts
$Q_{back\ panel} = 18.1$ Watts

5 -$Q_{Bottom} = [\ U\ A\ (T_a - T_r)\ ]$
$U = 0.48$ w/sq. Mt. °C,
$Ta - Tr = 27$, $A = 0.49$
$Q_{Bottom\ Surface} = 0.48x\ 0.49\ x\ 27 = 6.4$ Watt
$Q_{Bottom\ Surface} = 6.4$ Watts

Total Refrigerator Heat Leak =36.3+18.1+8.7+6.4+18.1 = 87.6

هاتف المعرض : ٤٦٥٣٢٦٢ ـ المصنع : ٤١٦١٣٧٢ ـ فاكس : ٤١٦٠٧٨٦ ـ٦ـ ٩٦٢ ـ فاكس : ٤٦١٣٣٤٠ ـ٦ـ ٩٦٢ ـ ص.ب : ٩٢١٩٤٠ عمان ـ الاردن
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Product Load

A product placed in a refrigerator at a temperature higher than the storage temperature will lose heat until it reaches the storage temperature. The quantity of heat to be removed may be calculated from knowledge of the product, including its state upon entering the refrigerator, its final state, its weight, specific heat above and below freezing point, its freezing temperature and latent heat.

When a definite weight of product is cooled from one state and temperature to another state and temperature, some or all of the following calculations must be made:

Heat removal from initial temperature to some lower temperature above freezing.

$$Q = mc(T_1-T_2)$$

Heat removal from initial temperature to freezing point of product.

$$Q = mc(T_i-T_f)$$

Heat removal to freeze product.

$$Q = mh_{if}$$

Heat removal from freezing point to final temperature below freezing.

$$Q = mc(T_f-T_3)$$

Where

Q = heat removed, Kj
M = weight of product, kg
C = specific heat of product above freezing point, Kj/Kg. K
T_1 = initial temp. C
T_2 = lower temperature above freezing, C
T_f = freezing temperature of product, C
H_{if} = latent heat of fusion, kj per kg

هاتف المعرض : ٤٦٥٣٢٦٢ ـ المصنع : ٤١٦١٣٧٢ ـ فاكس : ٤١٦٠٧٨٦ ـ٦ـ ٩٦٢ ـ فاكس : ٤٦١٣٣٤٠ ـ٦ـ ٩٦٢ ـ ص.ب : ٩٢١٩٤٠ عمان ـ الاردن
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Since this product is mainly used for storing fresh vegetable meet above

freezing point at + 5 C, we consider 600 Kg of meet to be stored in this refrigerator therefore we calculate as follow,

$$Q = mc(T_1-T_2)$$

M = 100 kg
C = Average 3.9 j/g K
T_1 = 25 C
T_2 = 5 C
Q = 100000x 3.9 x (25-5) =7800000 jul/86400 = 90 Watt

Internal Load
N/A

Door Opening
Refrigerator Internal Volume 980 lit.
Number of air change as per ASHREA standard = 70 per day
Heat removed per cubic meter of air 75000 j

Air Change load = 0.98 x 70 x 75000/86400 = 59 Watt

$Q_{Total} = Q_{heat\ leak} + Q_{product\ load} + Q_{internal\ load} + Q_{air\ change}$

$Q_{Total} = 87 + 90 + 59 = 236$

Considering 10 % of Q total for safety factor

Cooling Capacity Required = $Q_{Grand\ Total} = 236 + 10\%(24) = 260$ watts

هاتف المعرض : ٤٦٥٣٢٦٢ - المصنع : ٤١٦١٣٧٢ - فاكس : ٤١٦٠٧٨٦ -٦- ٩٦٢ - فاكس : ٤٦١٣٣٤٠ -٦- ٩٦٢ - ص.ب : ٩٢١٩٤٠ عمان - الاردن
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Printing in Labaratory Of
Maurice Ind. [Jordan]

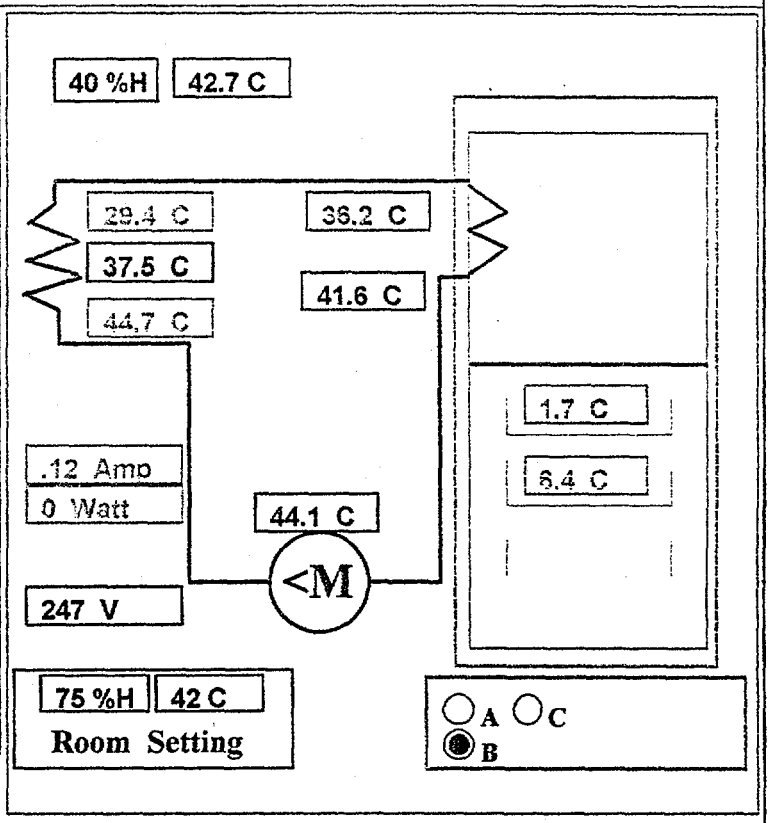
Maurice Ind. [Jordan]

TestDate: 01/01/15 15:31 *Report No.:* ( ) - Page 1

PageTestName: Energy Consumtion *ReportDate:* 2001/02/24 11:24

Page Result :

1 - Page Test Time	*10 Hours*
2 - Working Percent	*13 %On*
3 - Energy (Accord to page)	*0.291 kwh*
4 - Zoom Time	*7:37 Hour*
5 - Compr Current	*0.12 Amp*
6 - Evaprator Mean Temp	*-24.7 C*
7 - Cabin Mean Temp	*12.5 C*
8 - Crisp Temp	*30.6 C*
9 - Compr Temp	*44.1 C*
10- Condensor In Temp	*44.7 C*
11- Condensor Out Temp	*29.4 C*
12- Condition	*42.7 C 40 %H*
13- Volt	*Max=248 Mean=242 Min=230*
14-	
15-	
16-	
17-	



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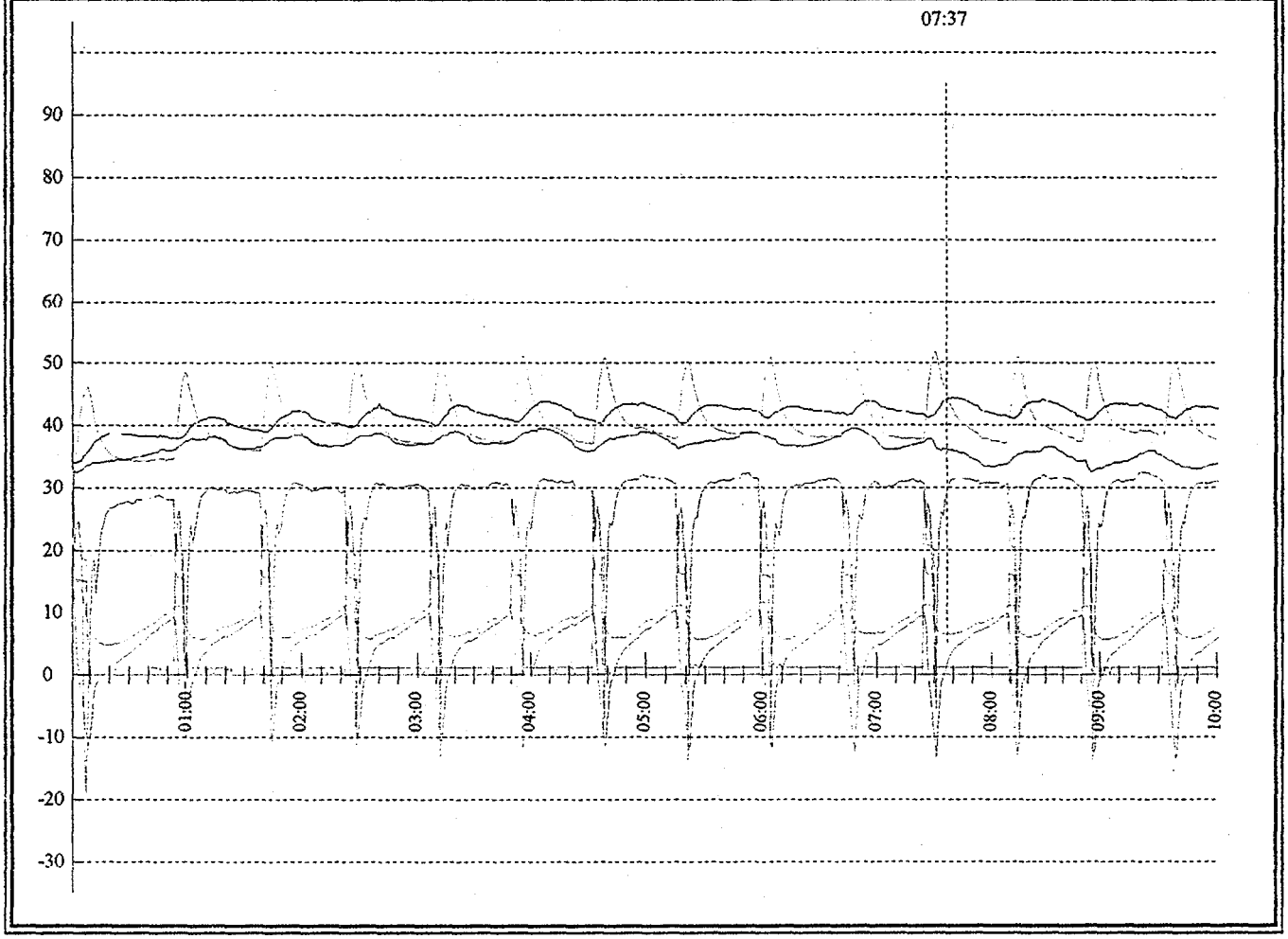

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Printing in Labaratory Of
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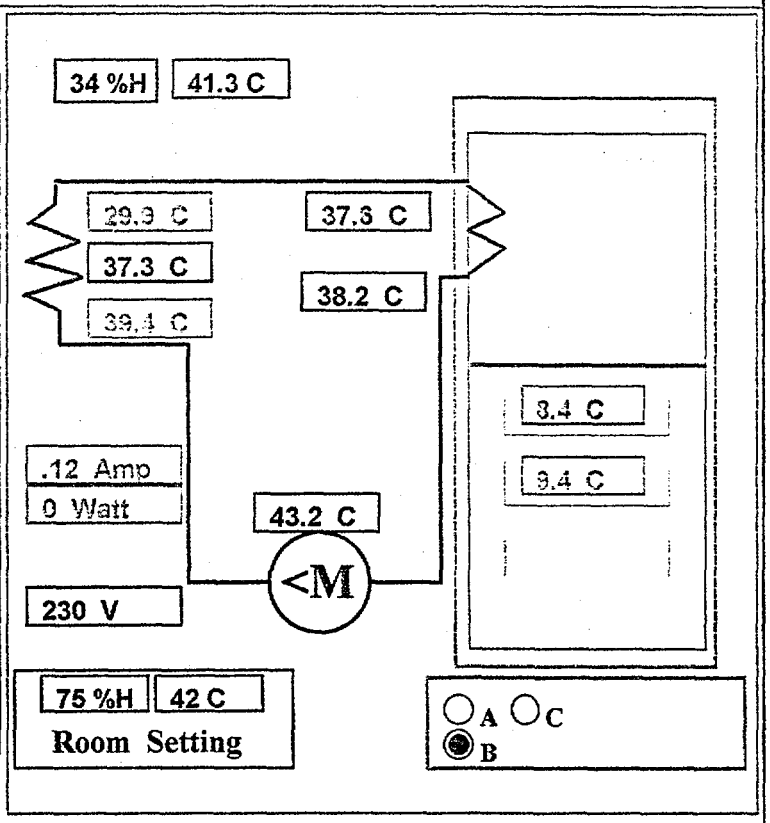
TestDate: **01/01/15 15:31** *Report No.:* ( ) - Page 1

PageTestName: Energy Consumtion *ReportDate:* 2001/02/24 11:25

Page Result :

1 - Page Test Time	*9 Hours*
2 - Working Percent	*13 %On*
3 - Energy (Accord to page)	*0.256 kwh*
4 - Zoom Time	*18:11 Hour*
5 - Compr Current	*0.12 Amp*
6 - Evaprator Mean Temp	*17.9 C*
7 - Cabin Mean Temp	*16.1 C*
8 - Crisp Temp	*31.9 C*
9 - Compr Temp	*43.2 C*
10- Condensor In Temp	*39.4 C*
11- Condensor Out Temp	*29.9 C*
12- Condition	*41.3 C 34 %H*
13- Volt	*Max=245 Mean=236 Min=222*
14-	
15-	
16-	
17-	



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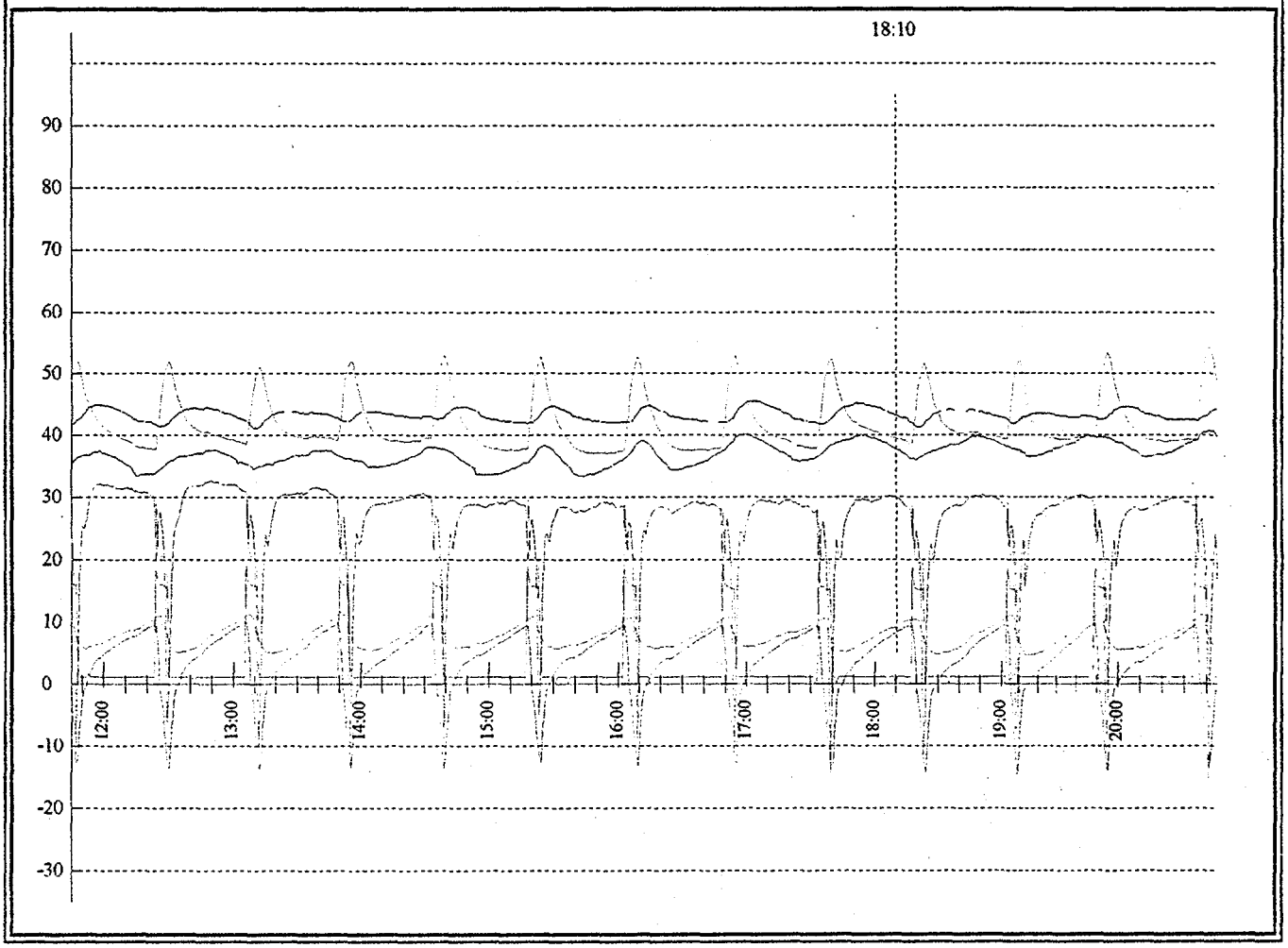

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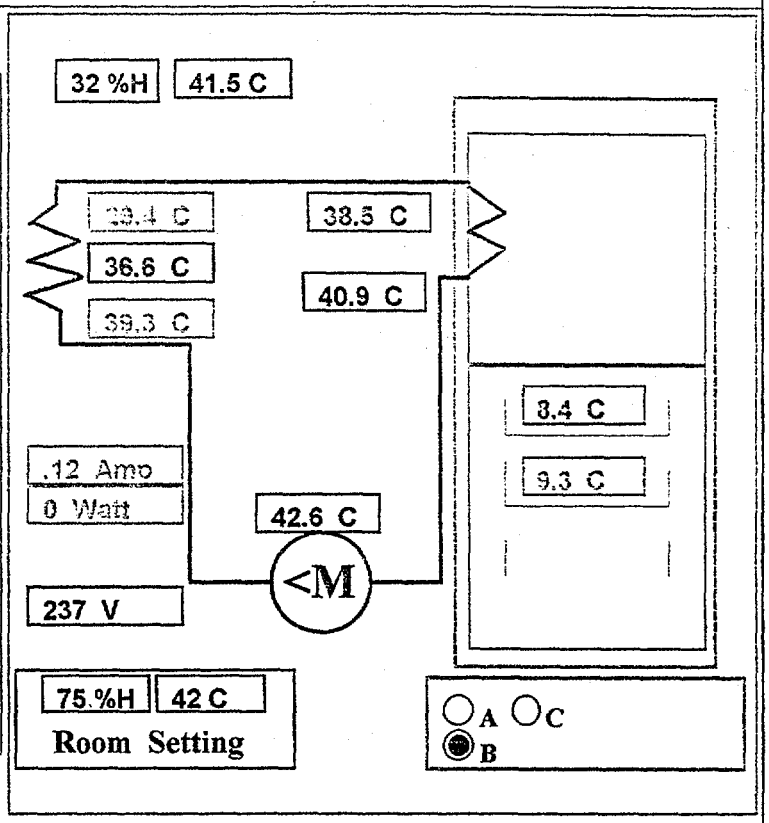
TestDate: **01/01/15 15:31** *Report No.:* ( ) - Page 1

PageTestName: Energy Consumtion *ReportDate:* 2001/02/24 11:27

Page Result :

1 - Page Test Time	*20 Hours*
2 - Working Percent	*12 %On*
3 - Energy (Accord to page)	*0.223 kwh*
4 - Zoom Time	*21:17 Hour*
5 - Compr Current	*0.12 Amp*
6 - Evaprator Mean Temp	*23.4 C*
7 - Cabin Mean Temp	*16 C*
8 - Crisp Temp	*31.3 C*
9 - Compr Temp	*42.6 C*
10- Condensor In Temp	*39.3 C*
11- Condensor Out Temp	*29.4 C*
12- Condition	*41.5 C 32 %H*
13- Volt	*Max=249 Mean=238 Min=222*
14-	
15-	
16-	
17-,	



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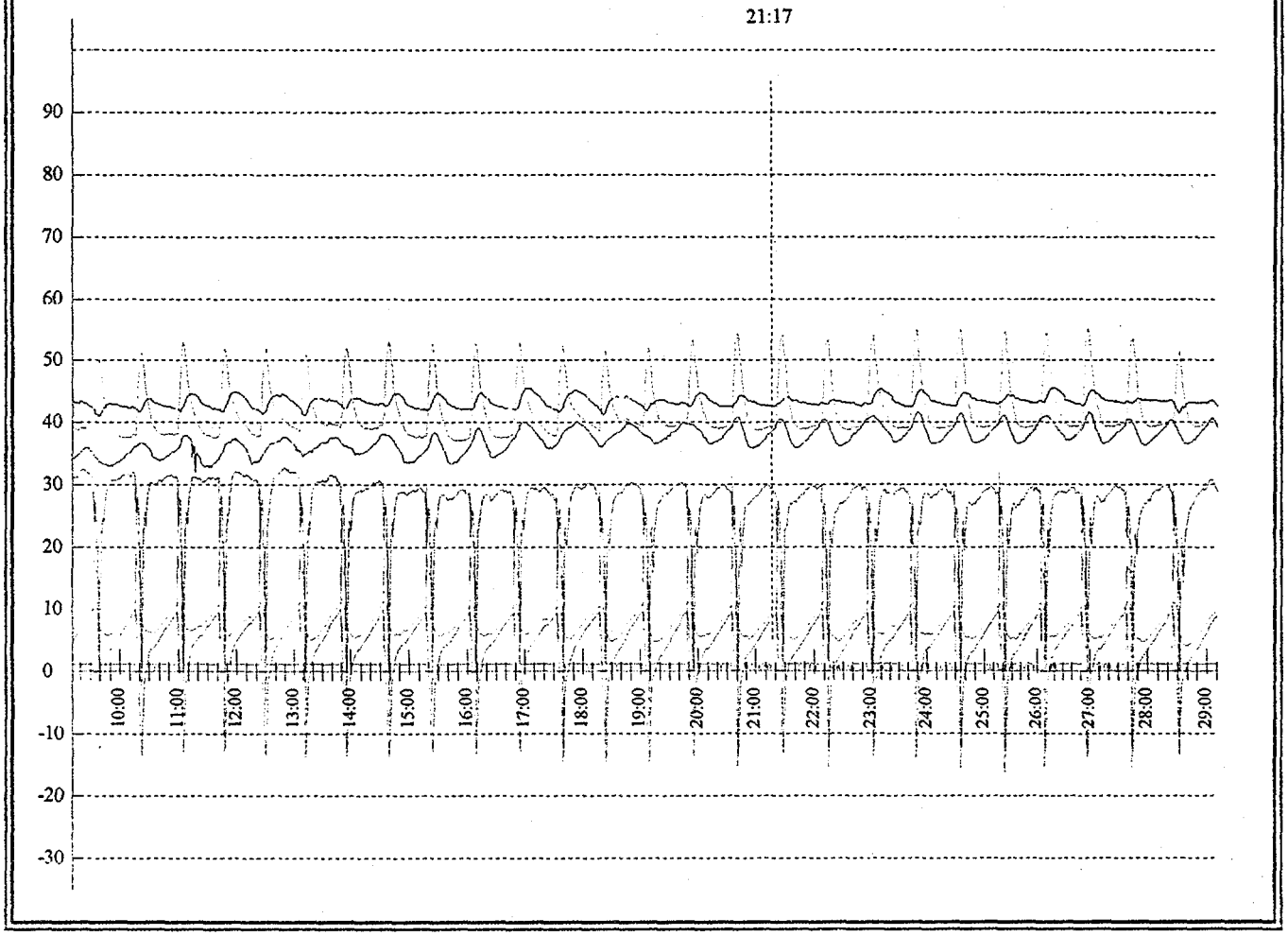

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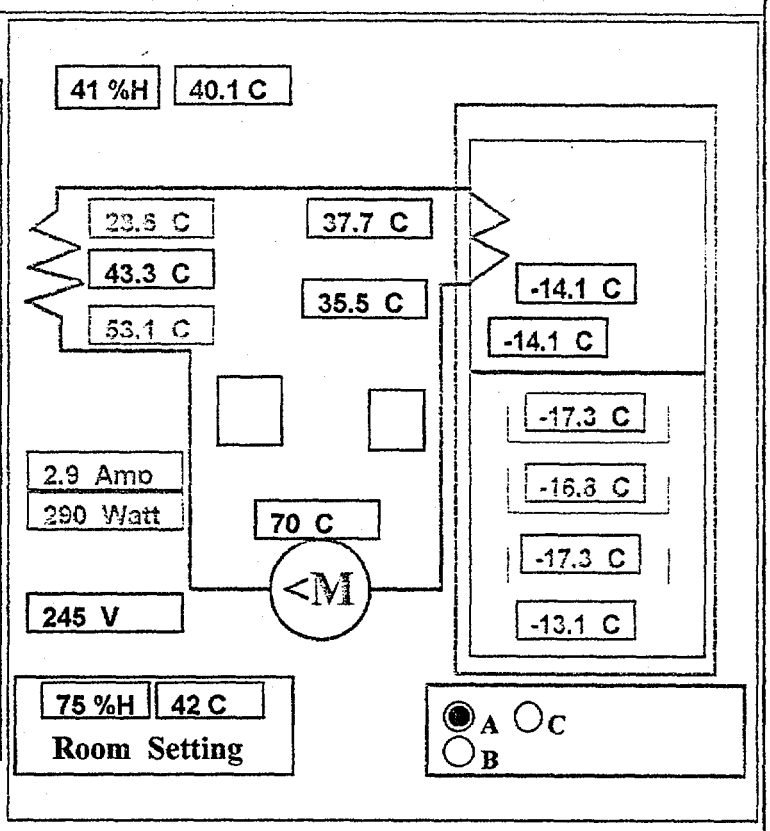
TestDate: **01/01/15 15:31** *Report No.:* ( ) - Page 1

PageTestName: Energy Consumtion *ReportDate:* 2001/02/24 11:20

Page Result :

1 - Page Test Time	*10 Hours*
2 - Working Percent	*74 %On*
3 - Energy (Accord to page)	*1.475 kwh*
4 - Zoom Time	*4:38 Hour*
5 - Compr Current	*2.9 Amp*
6 - Evaprator Mean Temp	*-13.5 C*
7 - Cabin Mean Temp	*-17.1 C*
8 - Crisp Temp	*-13.1 C*
9 - Compr Temp	*70 C*
10- Condensor In Temp	*53.1 C*
11- Condensor Out Temp	*28.6 C*
12- Condition	*40.1 C 41 %H*
13- Volt	*Max=248 Mean=242 Min=230*
14-	
15-	
16-	
17-	



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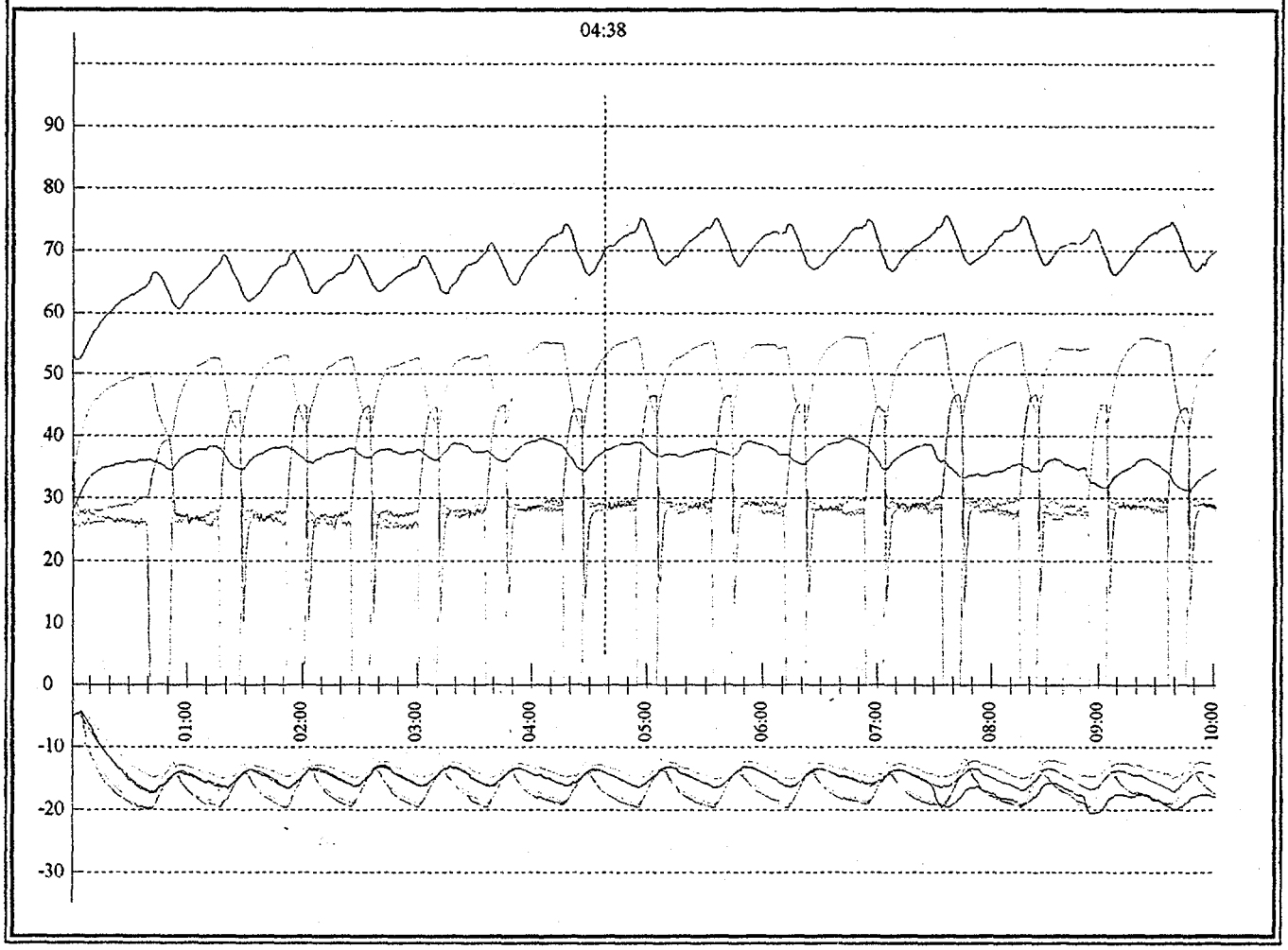

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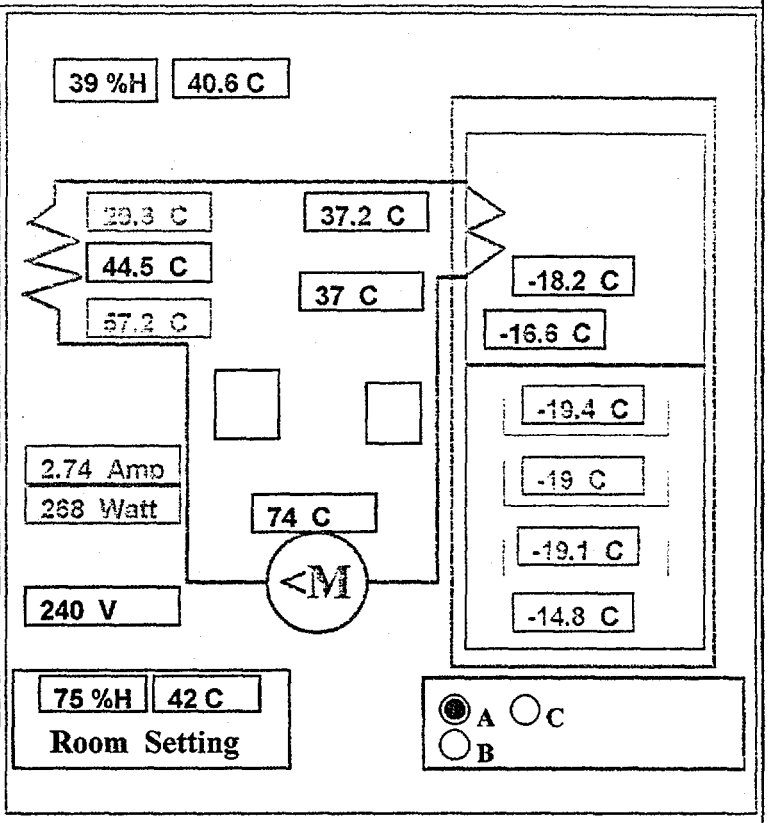
TestDate: **01/01/15 15:31** *Report No.:* ( ) - Page 1

PageTestName: Energy Consumtion *ReportDate:* 2001/02/24 11:20

Page Result :

1 - Page Test Time	*9 Hours*
2 - Working Percent	*79 %On*
3 - Energy (Accord to page)	*1.506 kwh*
4 - Zoom Time	*13:25 Hour*
5 - Compr Current	*2.74 Amp*
6 - Evaprator Mean Temp	*-30.6 C*
7 - Cabin Mean Temp	*-19.1 C*
8 - Crisp Temp	*-14.3 C*
9 - Compr Temp	*74 C*
10- Condensor In Temp	*57.2 C*
11- Condensor Out Temp	*29.8 C*
12- Condition	*40.6 C 39 %H*
13- Volt	*Max=249 Mean=240 Min=222*
14-	
15-	
16-	
17-	



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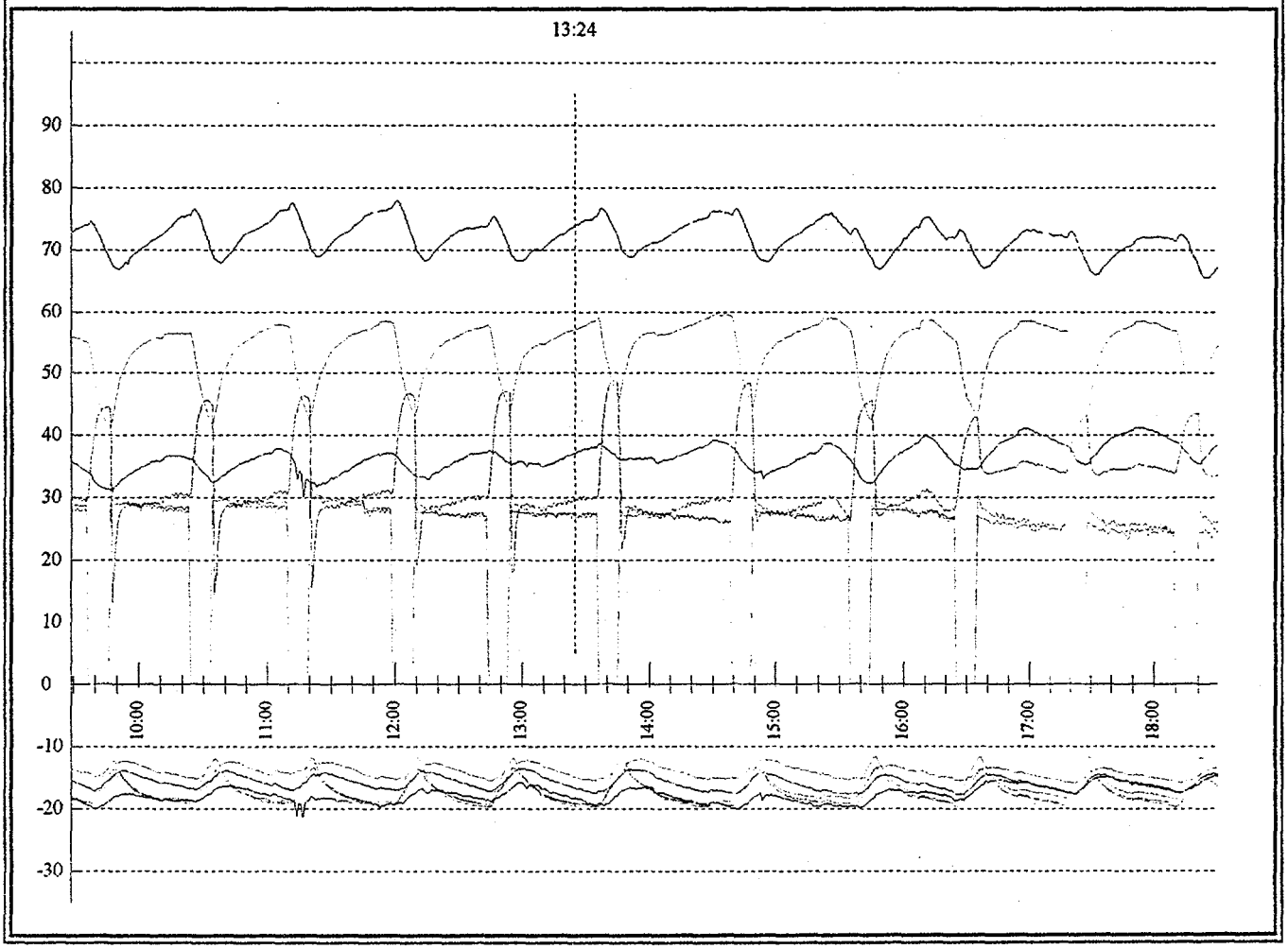

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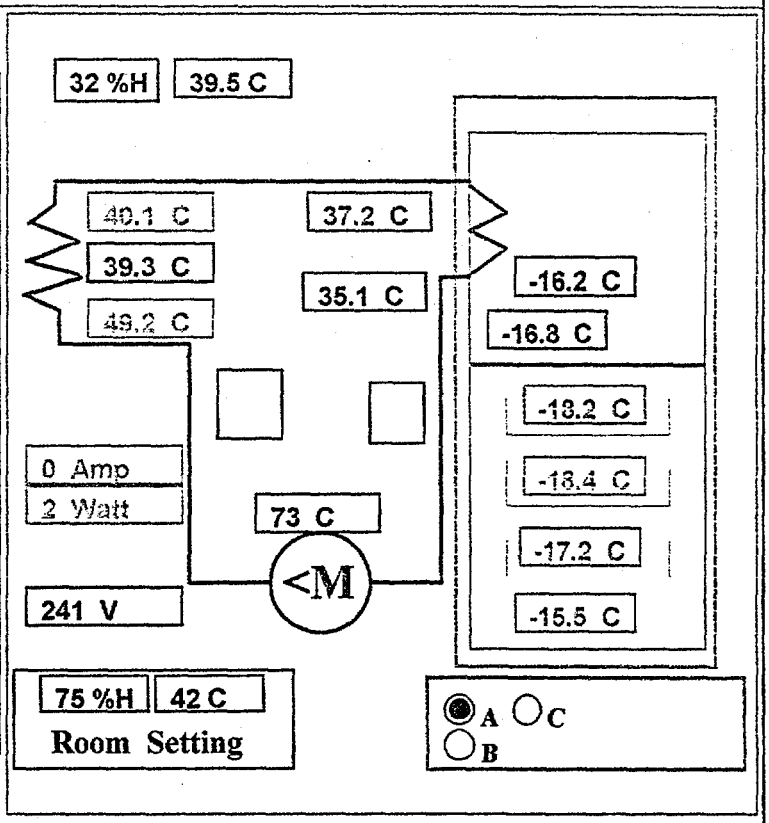
TestDate: **01/01/15 15:31** *Report No.:* ( ) - Page 1

PageTestName: Energy Consumtion *ReportDate:* 2001/02/24 11:22

Page Result :

1 - Page Test Time	*20 Hours*
2 - Working Percent	*81 %On*
3 - Energy (Accord to page)	*1.473 kwh*
4 - Zoom Time	*30:06 Hour*
5 - Compr Current	*00 Amp*
6 - Evaprator Mean Temp	*-15.7 C*
7 - Cabin Mean Temp	*-17.9 C*
8 - Crisp Temp	*-15.5 C*
9 - Compr Temp	*73 C*
10- Condensor In Temp	*49.2 C*
11- Condensor Out Temp	*40.1 C*
12- Condition	*39.5 C 32 %H*
13- Volt	*Max=250 Mean=238 Min=222*
14-	
15-	
16-	
17-	



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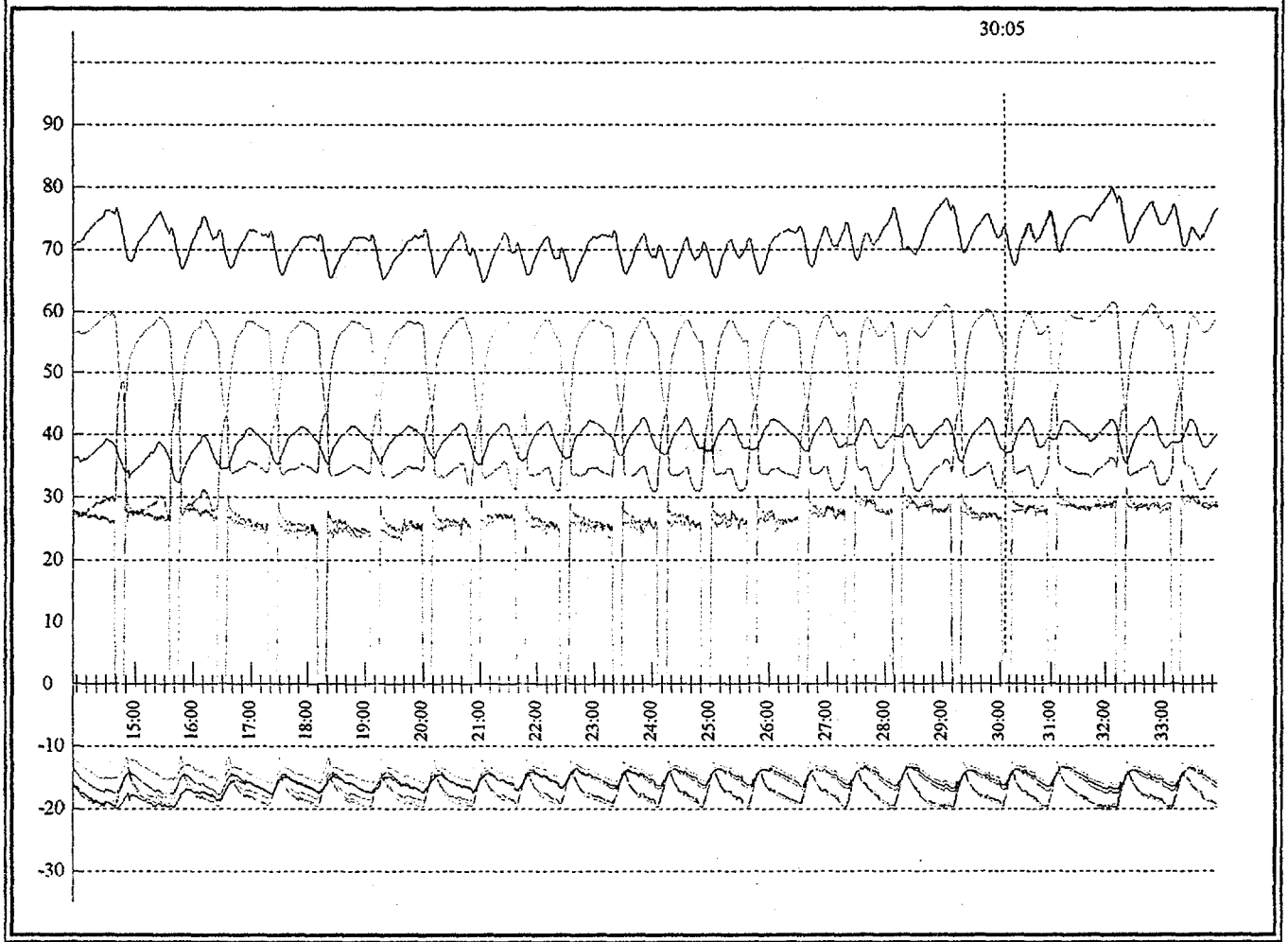

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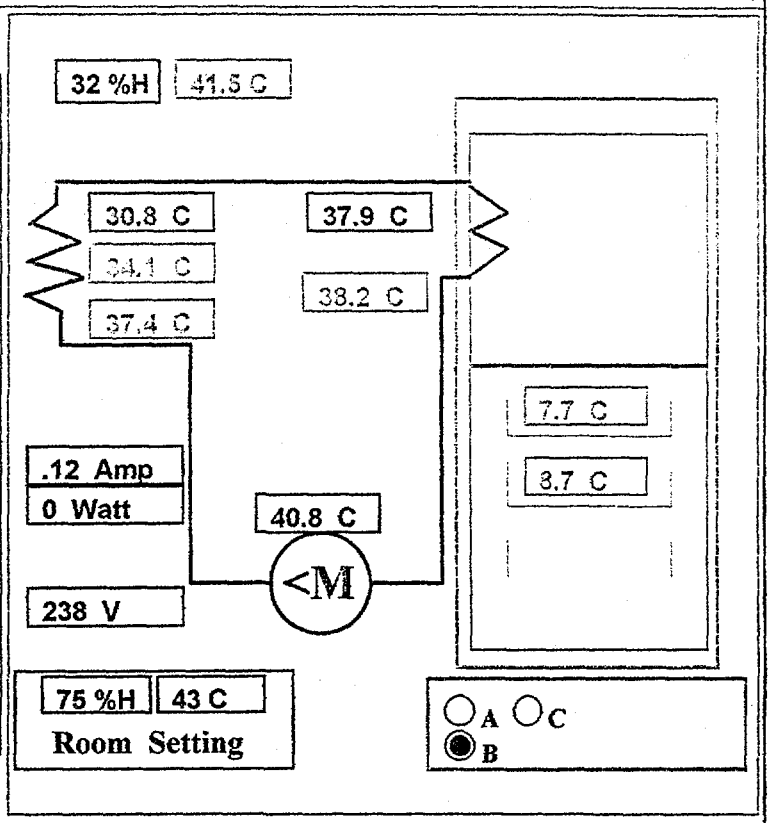
TestDate: **01/01/18 08:58** *Report No.:* ( ) - Page 1

PageTestName: Energy Consumtion *ReportDate:* 2001/02/24 09:33

Page Result :

1 - Page Test Time	*10 Hours*
2 - Working Percent	*12 %On*
3 - Energy (Accord to page)	*0.349 kwh*
4 - Zoom Time	*5:42 Hour*
5 - Compr Current	*0.12 Amp*
6 - Evaprator Mean Temp	*30 C*
7 - Cabin Mean Temp	*14.7 C*
8 - Crisp Temp	*28.6 C*
9 - Compr Temp	*40.8 C*
10- Condensor in Temp	*37.4 C*
11- Condensor Out Temp	*30.3 C*
12- Condition	*41.5 C 32 %H*
13- Volt	*Max=244 Mean=235 Min=222*
14-	
15-	
16-	
17-	



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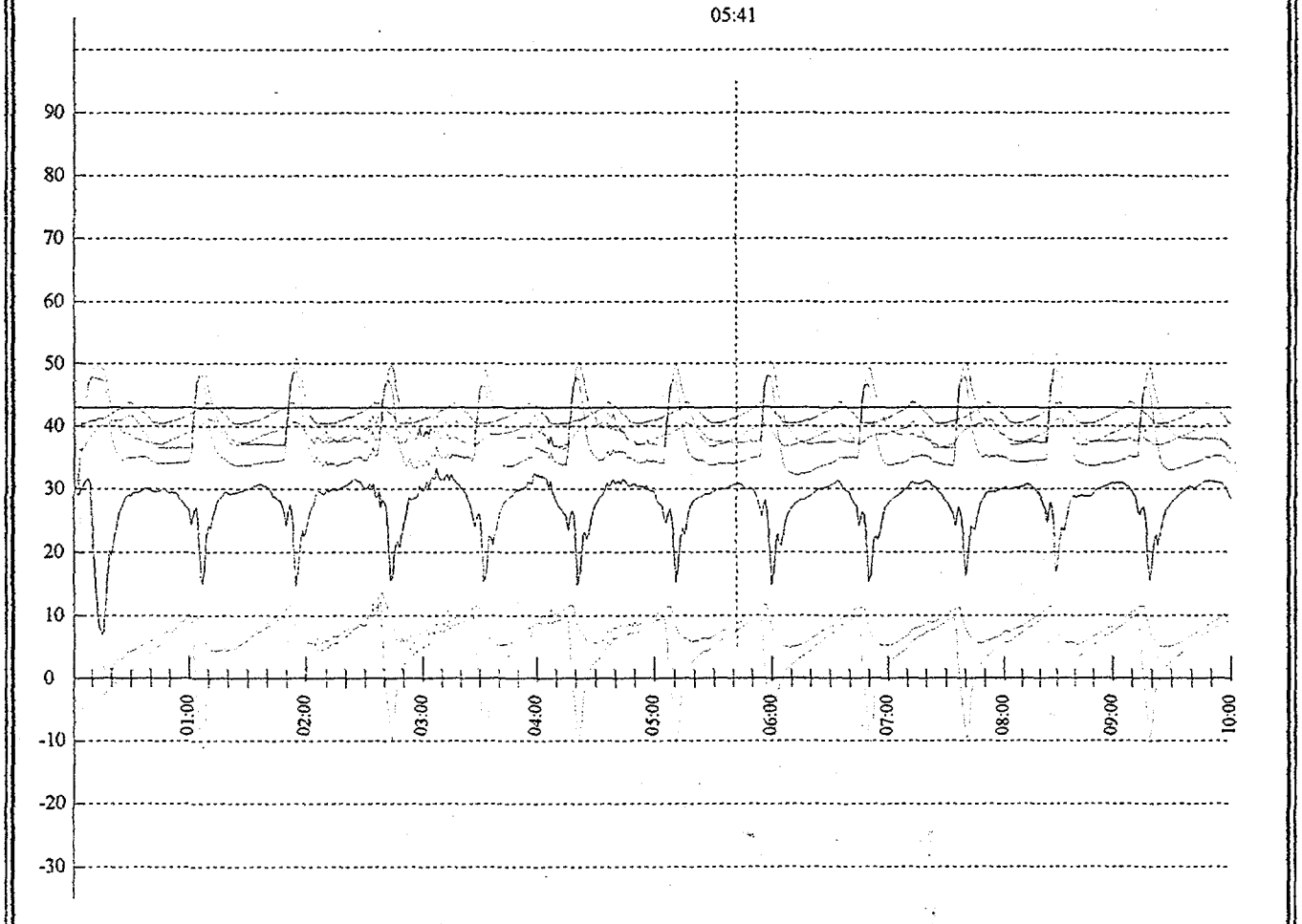

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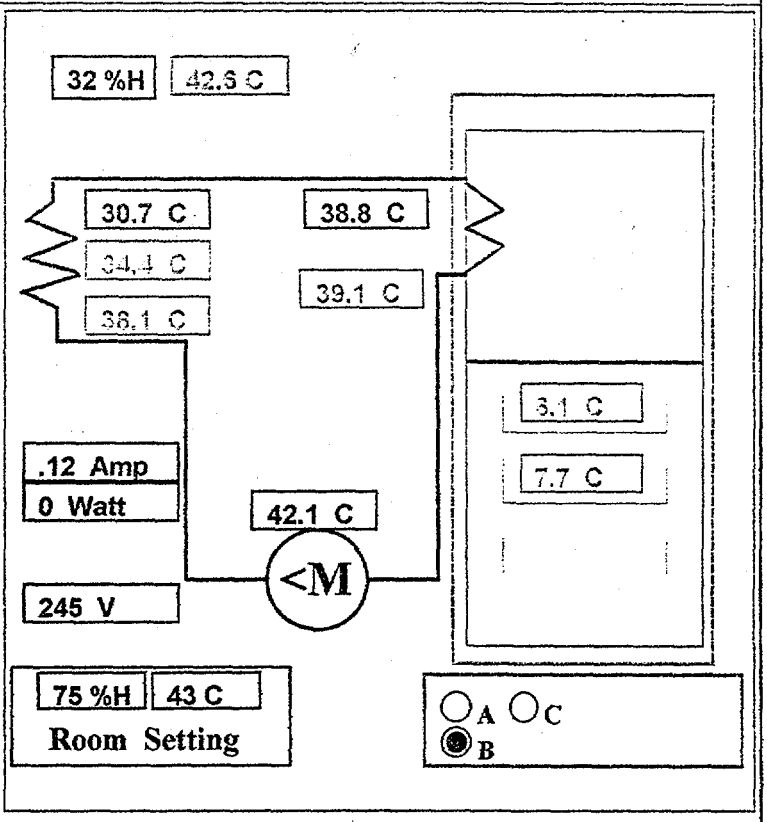
TestDate: **01/01/18 08:58** *Report No.:* ( ) - Page 1

PageTestName: Energy Consumtion *ReportDate:* 2001/02/24 09:35

Page Result :

1 - Page Test Time	*10 Hours*
2 - Working Percent	*11 %On*
3 - Energy (Accord to page)	*0.201 kwh*
4 - Zoom Time	*20:29 Hour*
5 - Compr Current	*0.12 Amp*
6 - Evaprator Mean Temp	*30.1 C*
7 - Cabin Mean Temp	*14 C*
8 - Crisp Temp	*28.9 C*
9 - Compr Temp	*42.1 C*
10- Condensor In Temp	*38.1 C*
11- Condensor Out Temp	*30.7 C*
12- Condition	*42.6 C 32 %H*
13- Volt	*Max=249 Mean=245 Min=237*
14-	
15-	
16-	
17-	



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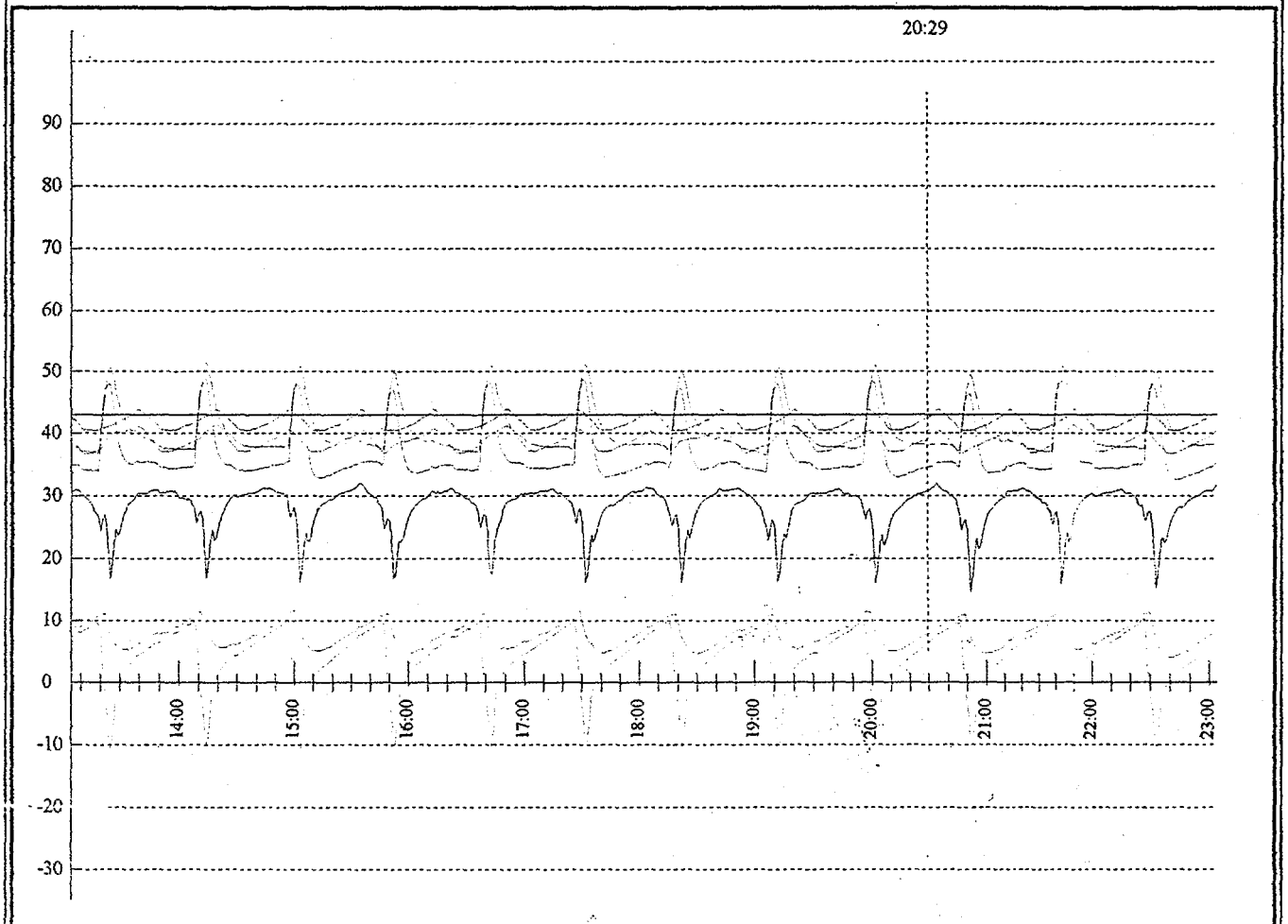

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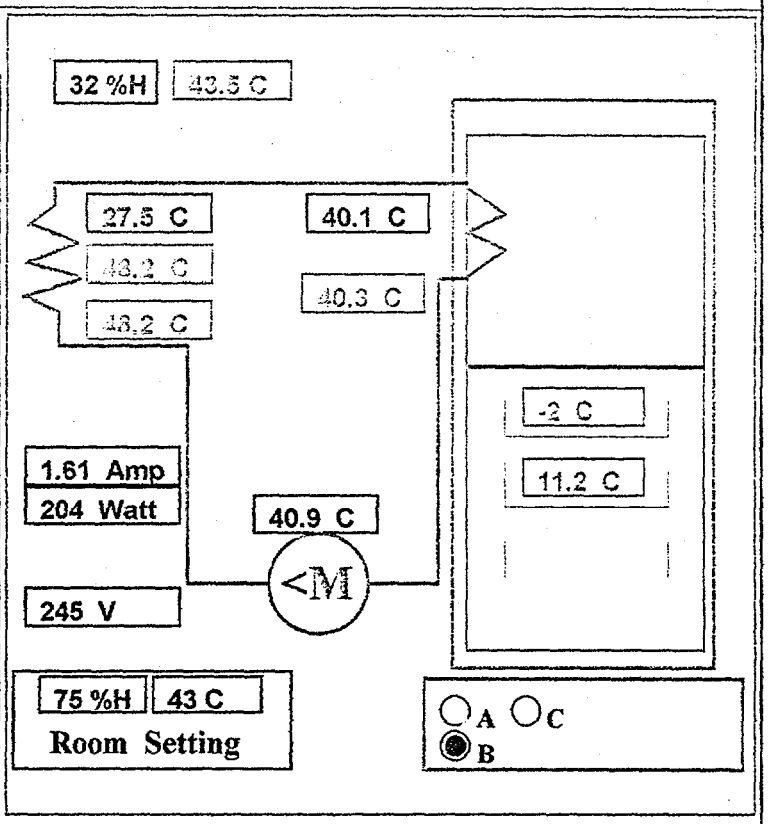
TestDate: **01/01/18 08:58** *Report No.:* ( ) - Page 1

PageTestName: Energy Consumtion *ReportDate:* 2001/02/24 09:37

Page Result :

1 - Page Test Time	*20 Hours*
2 - Working Percent	*11 %On*
3 - Energy (Accord to page)	*0.223 kwh*
4 - Zoom Time	*27:37 Hour*
5 - Compr Current	*1.61 Amp*
6 - Evaprator Mean Temp	*31.1 C*
7 - Cabin Mean Temp	*12.9 C*
8 - Crisp Temp	*30 C*
9 - Compr Temp	*40.9 C*
10- Condensor In Temp	*48.2 C*
11- Condensor Out Temp	*27.5 C*
12- Condition	*43.5 C 32 %H*
13- Volt	*Max=249 Mean=243 Min=234*
14-	
15-	
16-	
17-	



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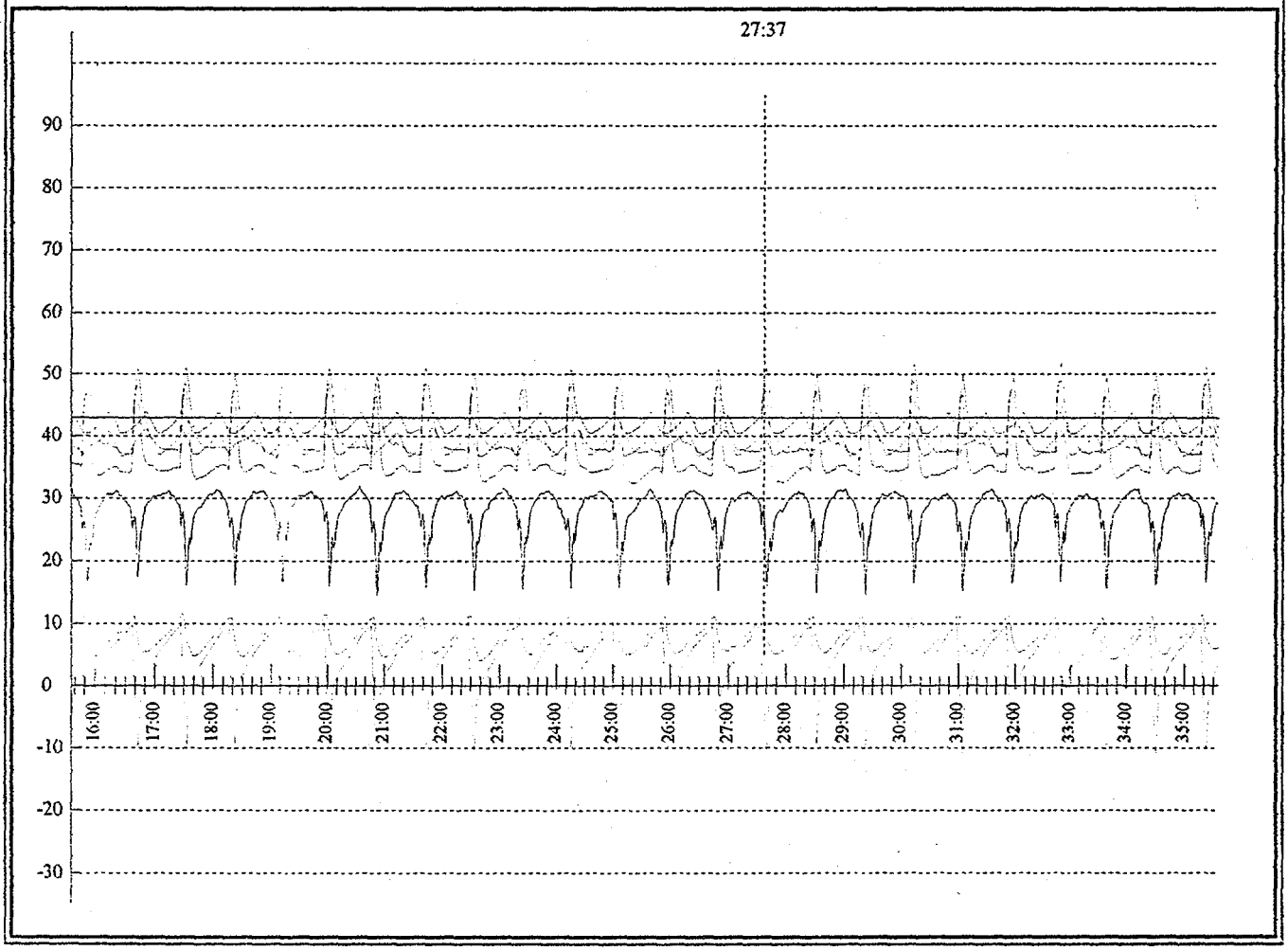

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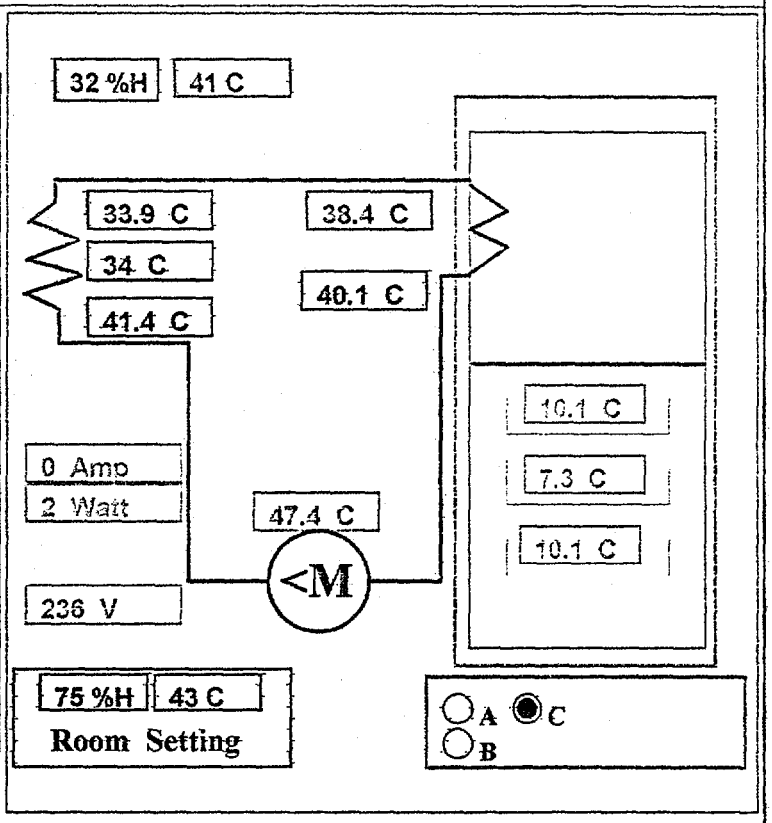
TestDate: **01/01/18 08:58** *Report No.:* ( ) - Page 1

PageTestName: Energy Consumtion *ReportDate:* 2001/02/24 09:44

Page Result :

1 - Page Test Time	*10 Hours*
2 - Working Percent	*21 %On*
3 - Energy (Accord to page)	*0.474 kwh*
4 - Zoom Time	*5:38 Hour*
5 - Compr Current	*00 Amp*
6 - Evaprator Mean Temp	*31.7 C*
7 - Cabin Mean Temp	*9.1 C*
8 - Crisp Temp	*31.3 C*
9 - Compr Temp	*47.4 C*
10- Condensor In Temp	*41.4 C*
11- Condensor Out Temp	*33.9 C*
12- Condition	*41 C 32 %H*
13- Volt	*Max=244 Mean=235 Min=222*
14-	
15-	
16-	
17-	



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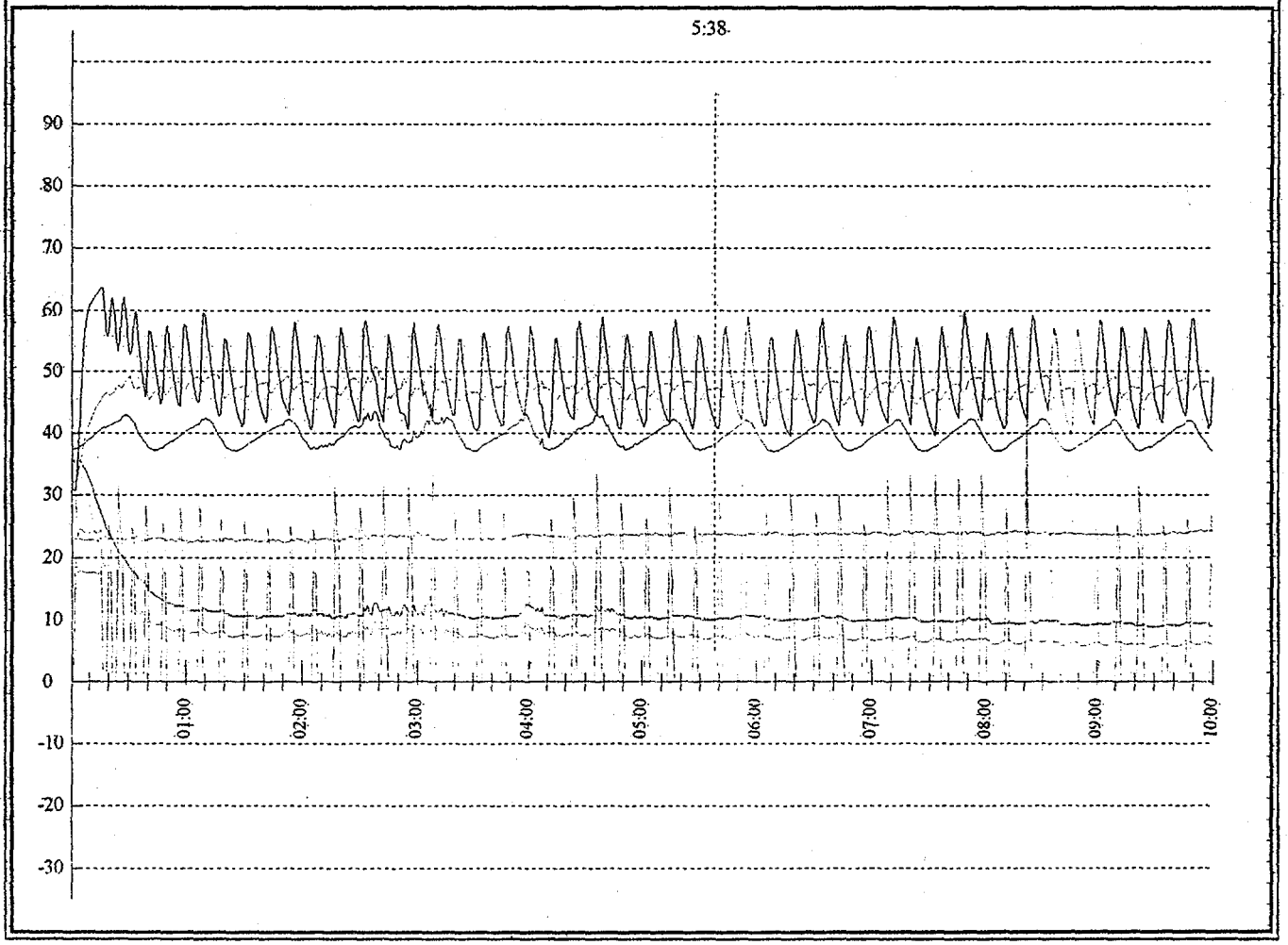

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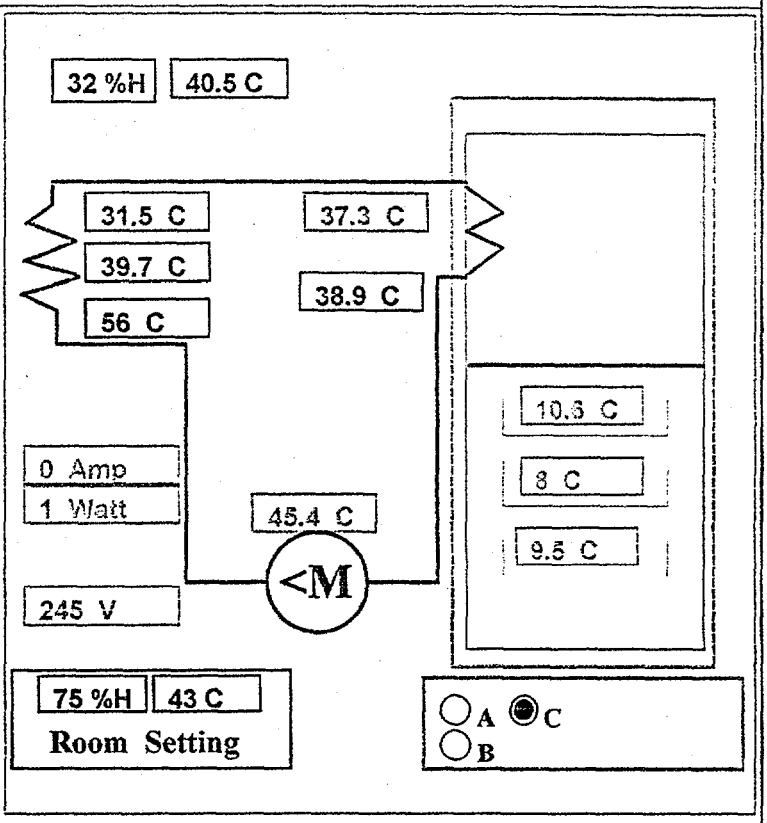
TestDate: **01/01/18 08:58** *Report No.:* ( ) - Page 1

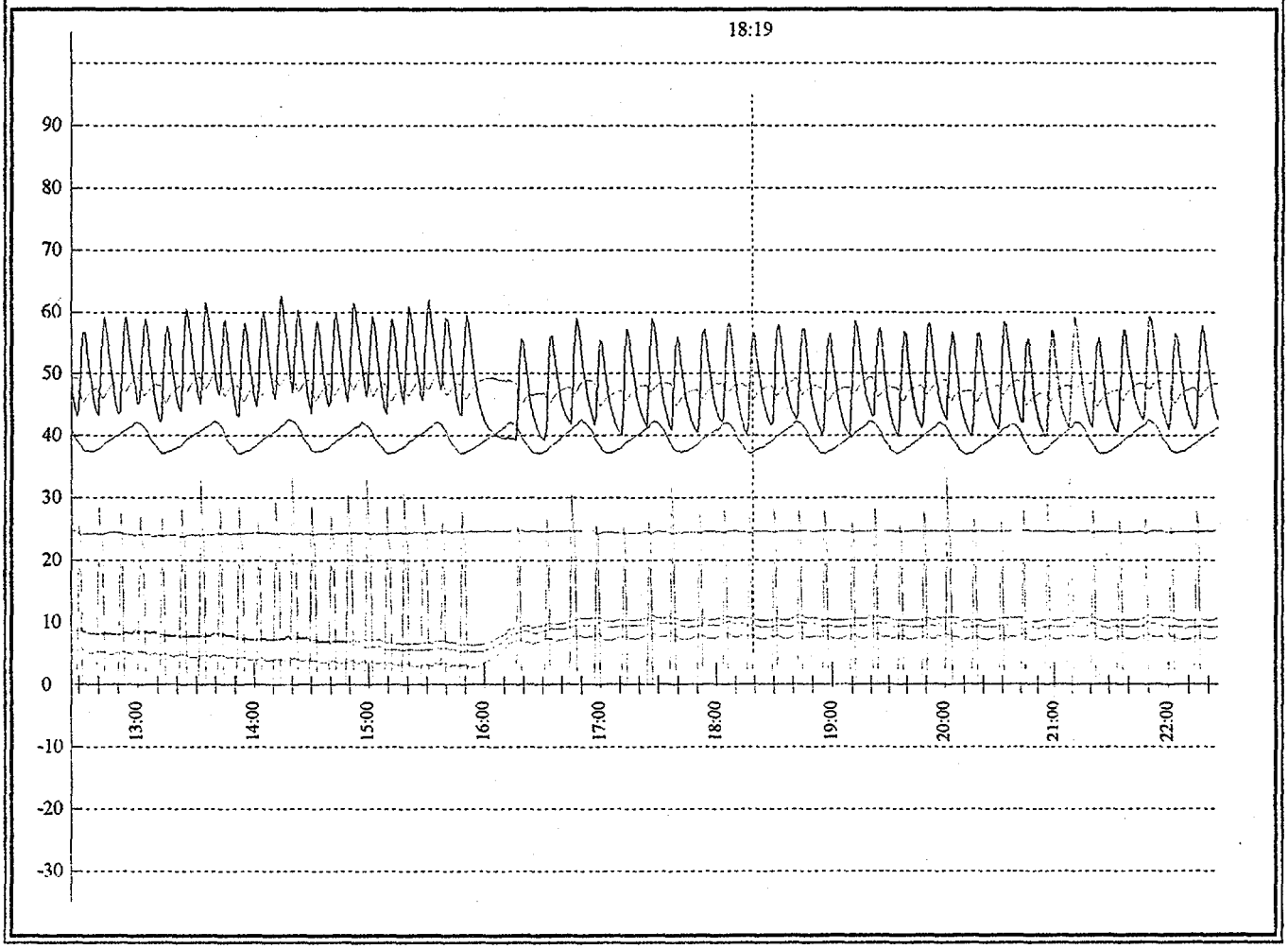
PageTestName: Energy Consumtion *ReportDate:* 2001/02/24 09:50

Page Result :

1 - Page Test Time	*10 Hours*
2 - Working Percent	*19 %On*
3 - Energy (Accord to page)	*0.513 kwh*
4 - Zoom Time	*18:19 Hour*
5 - Compr Current	*00 Amp*
6 - Evaprator Mean Temp	*32.1 C*
7 - Cabin Mean Temp	*9.3 C*
8 - Crisp Temp	*31.3 C*
9 - Compr Temp	*45.4 C*
10- Condensor In Temp	*56 C*
11- Condensor Out Temp	*31.5 C*
12- Condition	*40.5 C 32 %H*
13- Volt	*Max=249 Mean=245 Min=237*
14-	
15-	
16-	
17-.	



Awadi Workshop



Industrial Control Research Center HotRoom Ver 5

Printing in Labaratory Of
Maurice Ind. [Jordan]

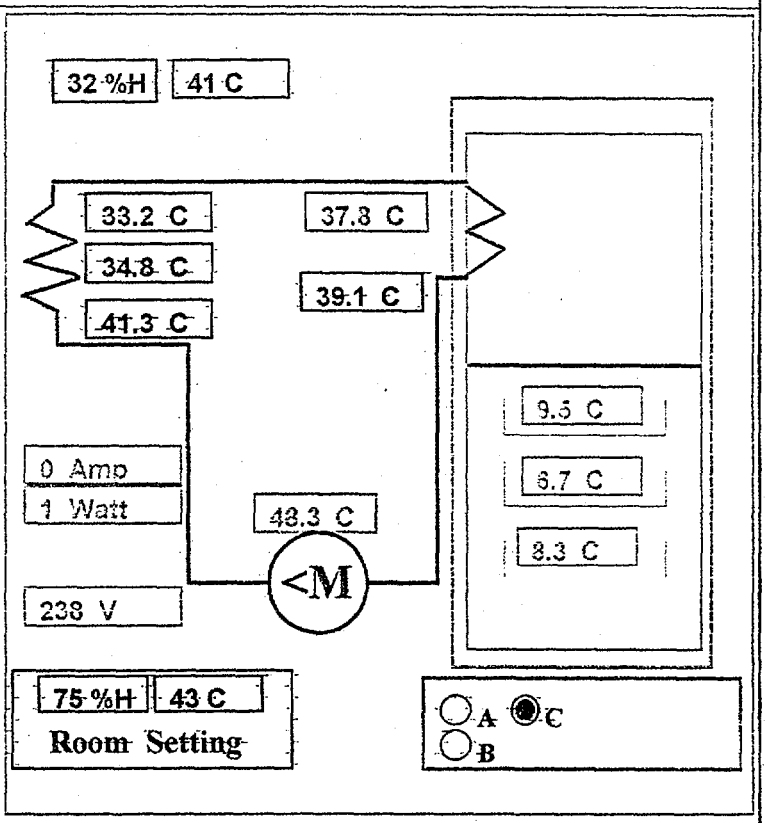
Maurice Ind. [Jordan]

TestDate: **01/01/18 08:58** *Report No.:* ( ) - Page 1

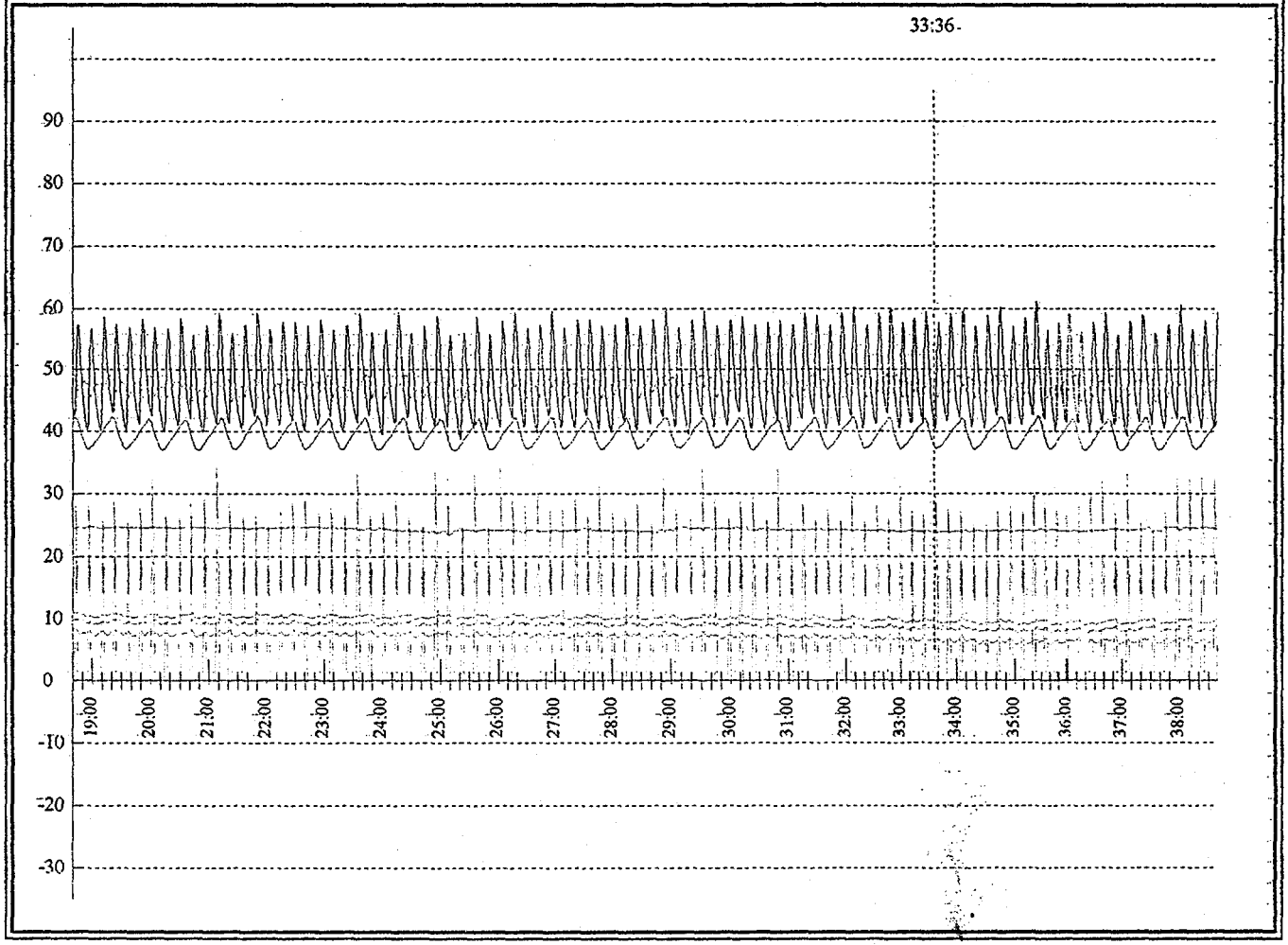
PageTestName: Energy Consumtion *ReportDate:* 2001/02/24 09:46

Page Result :

1 - Page Test Time	*20 Hours*
2 - Working Percent	*17 %On*
3 - Energy (Accord to page)	*0.452 kwh*
4 - Zoom Time	*33:36 Hour*
5 - Compr Current	*00 Amp*
6 - Evaprator Mean Temp	*32.1 C*
7 - Cabin Mean Temp	*8.1 C*
8 - Crisp Temp	*31.3 C*
9 - Compr Temp	*48.3 C*
10- Condensor In Temp	*41.3 C*
11- Condensor Out Temp	*33.2 C*
12- Condition	*41 C 32 %H*
13- Volt	*Max=249 Mean=243 Min=234*
14-	
15-	
16-	
17-	



Awadi Workshop



Industrial Control Research Center Hotkoom Ver 5

Printing in Labaratory Of
Maurice Ind. [Jordan]

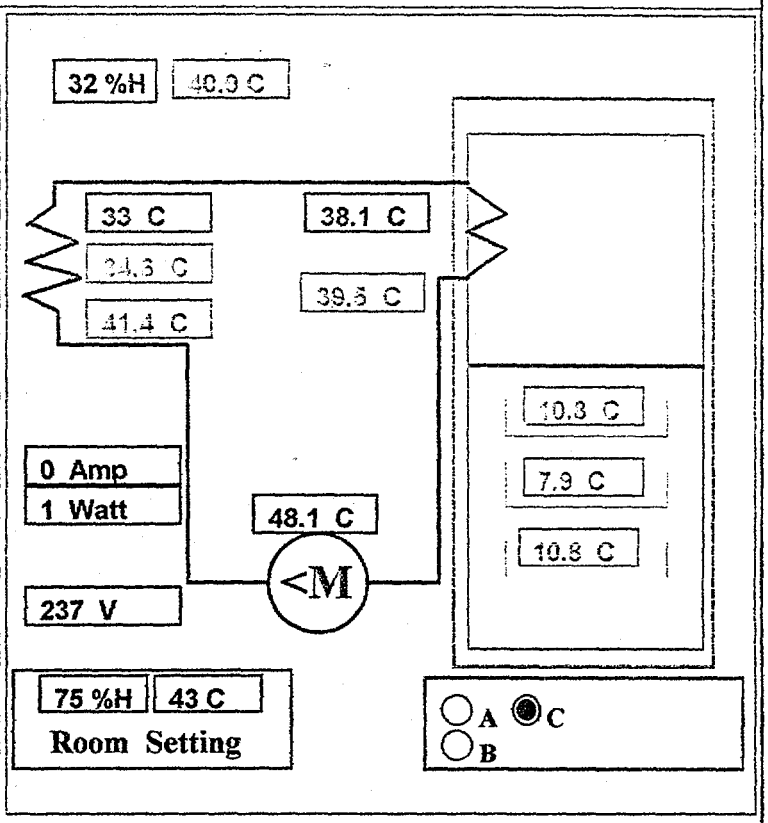
Maurice Ind. [Jordan]

TestDate: **01/01/18 08:58** *Report No.:* ( ) - Page 1

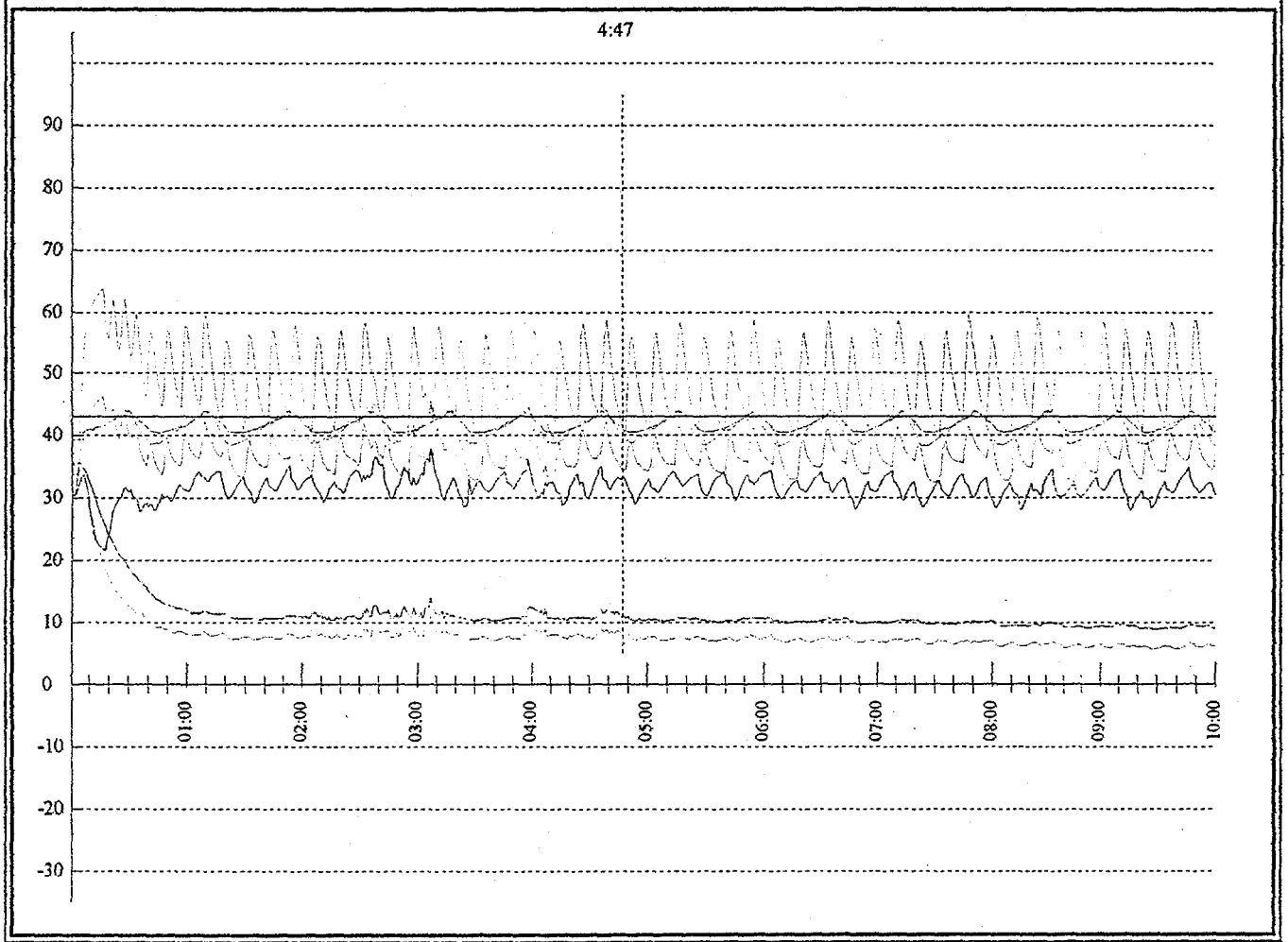
PageTestName: Energy Consumtion *ReportDate:* 2001/02/24 09:39

Page Result :

1 - Page Test Time	*10 Hours*
2 - Working Percent	*21 %On*
3 - Energy (Accord to page)	*0.474 kwh*
4 - Zoom Time	*4:47 Hour*
5 - Compr Current	*00 Amp*
6 - Evaprator Mean Temp	*32.4 C*
7 - Cabin Mean Temp	*9.3 C*
8 - Crisp Temp	*31.3 C*
9 - Compr Temp	*48.1 C*
10- Condensor In Temp	*41.4 C*
11- Condensor Out Temp	*33 C*
12- Condition	*40.9 C 32 %H*
13- Volt	*Max=244 Mean=235 Min=222*
14-	
15-	
16-	
17-	



Batriq Workshop



Industrial Control Research Center HotRoom Ver 5

Printing in Labaratory Of
Maurice Ind. [Jordan]

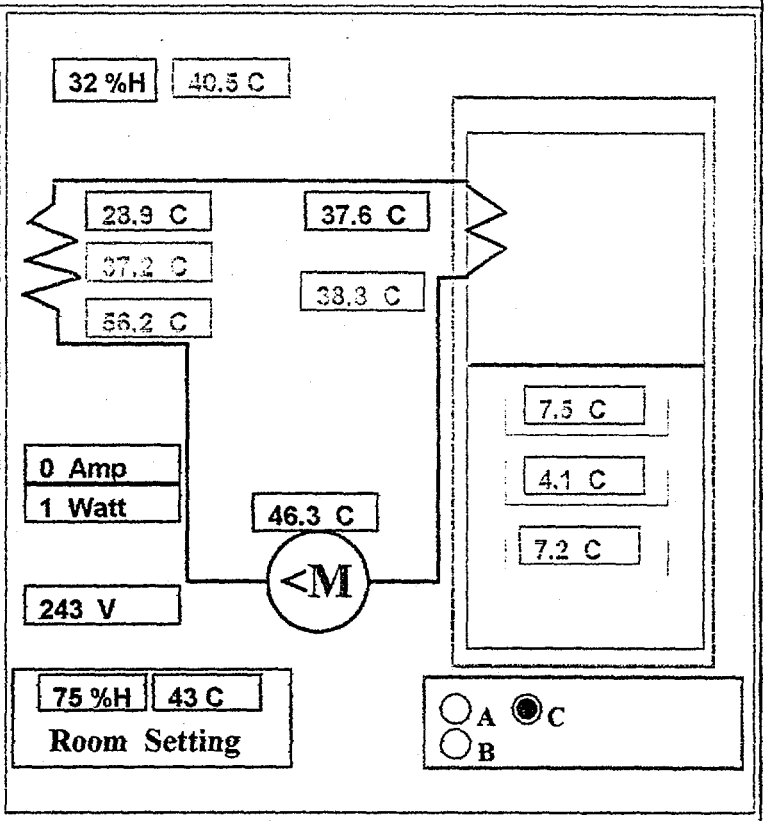
Maurice Ind. [Jordan]

TestDate: **01/01/18 08:58** *Report No.:* ( ) - Page 1

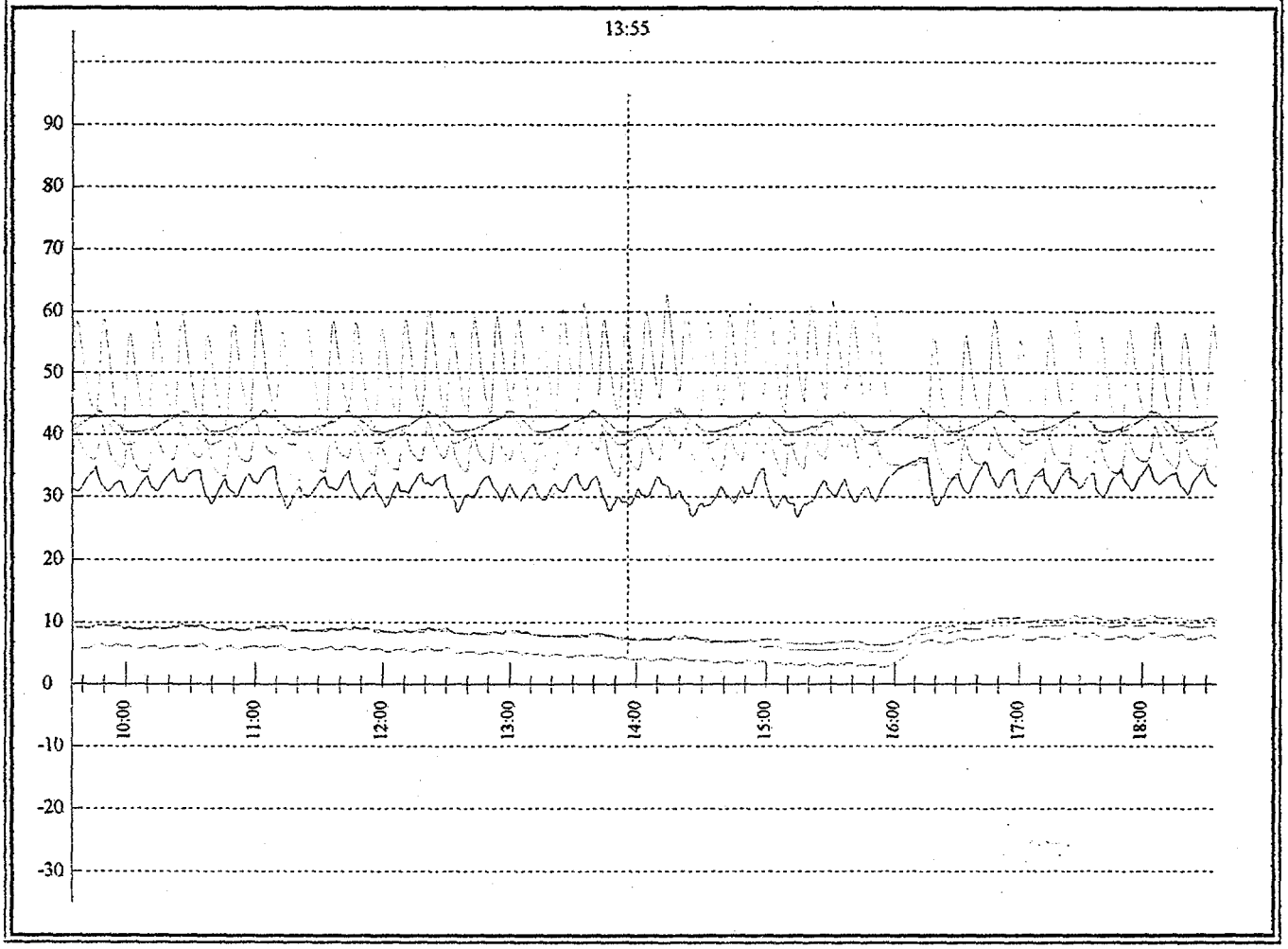
PageTestName: Energy Consumtion *ReportDate:* 2001/02/24 09:40

Page Result :

1 - Page Test Time	*9 Hours*
2 - Working Percent	*20 %On*
3 - Energy (Accord to page)	*0.534 kwh*
4 - Zoom Time	*13:56 Hour*
5 - Compr Current	*00 Amp*
6 - Evaprator Mean Temp	*32.1 C*
7 - Cabin Mean Temp	*6.2 C*
8 - Crisp Temp	*31.3 C*
9 - Compr Temp	*46.3 C*
10- Condensor in Temp	*56.2 C*
11- Condensor Out Temp	*28.9 C*
12- Condition	*40.5 C 32 %H*
13- Volt	*Max=249 Mean=244 Min=236*
14-	
15-	
16-	
17-	



Batriq Workshop



Industrial Control Research Center HotKoom Ver 5

Printing in Labaratory Of
Maurice Ind. [Jordan]

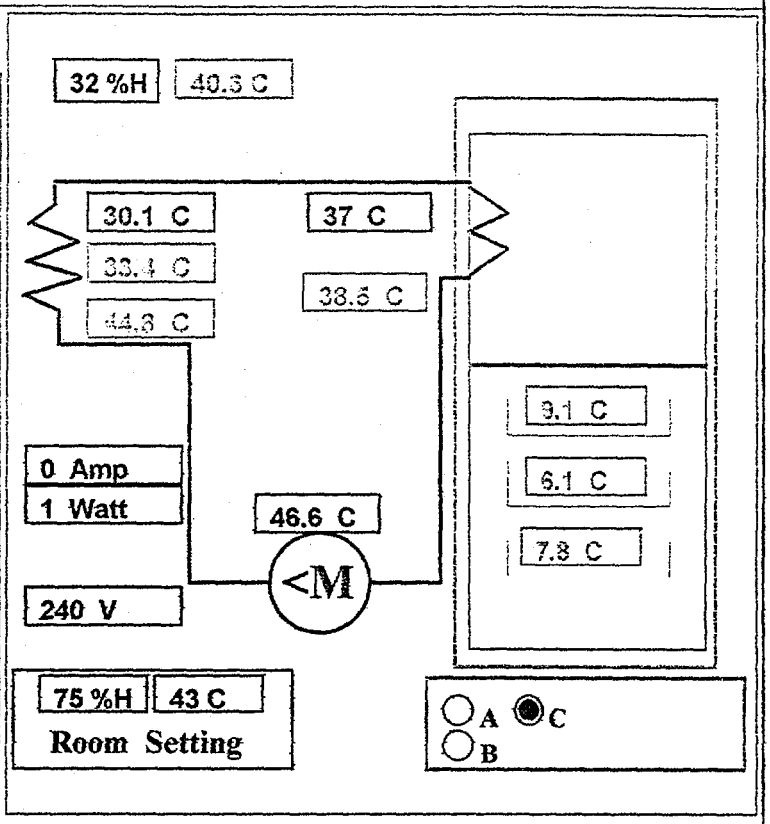
Maurice Ind. [Jordan]

TestDate: **01/01/18 08:58** *Report No.:* ( ) - Page 1

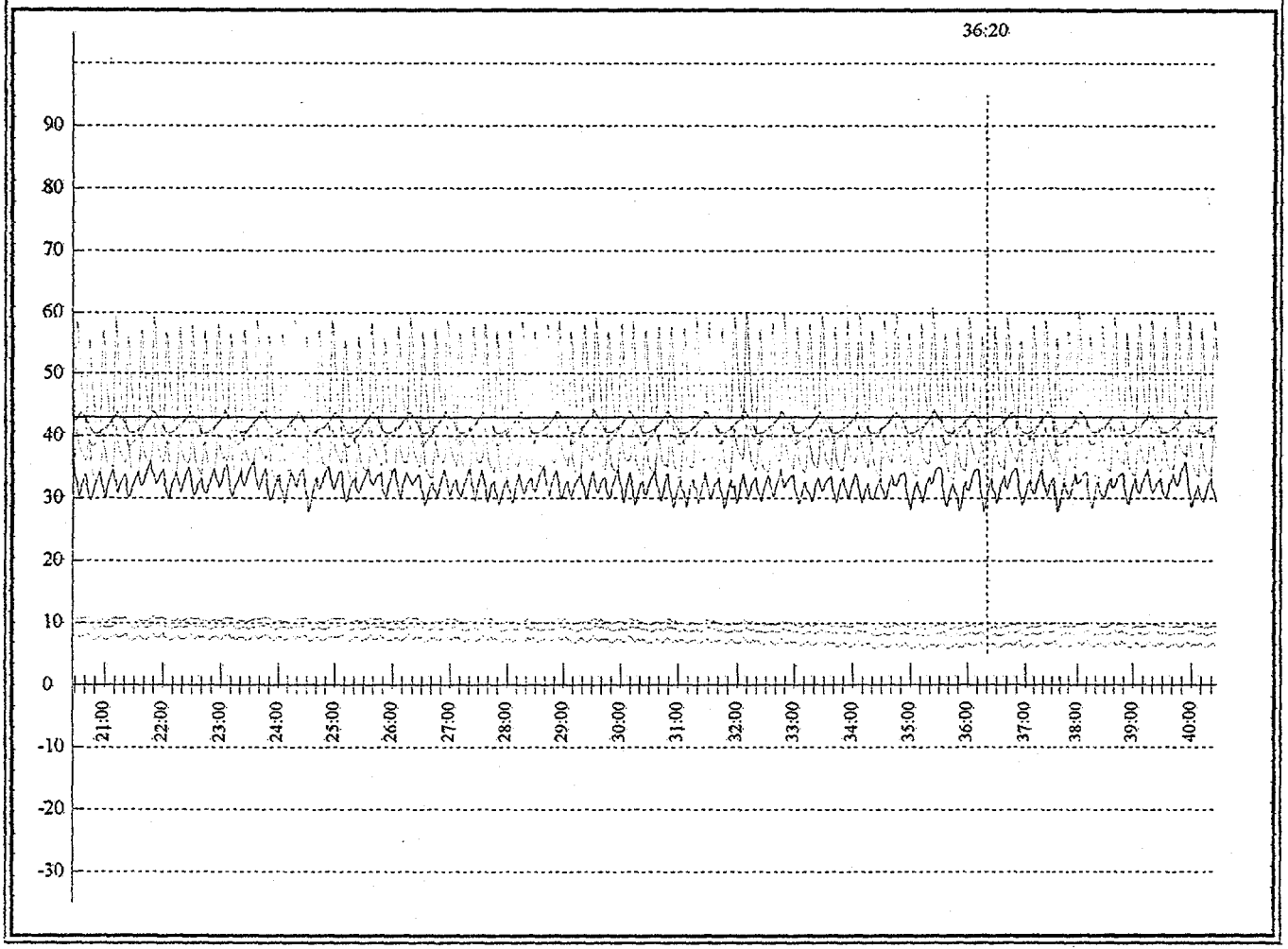
PageTestName: Energy Consumtion *ReportDate:* 2001/02/24 09:42

Page Result :

1 - Page Test Time	*20 Hours*
2 - Working Percent	*13 %On*
3 - Energy (Accord to page)	*0.446 kwh*
4 - Zoom Time	*36:20 Hour*
5 - Compr Current	*00 Amp*
6 - Evaprator Mean Temp	*31.8 C*
7 - Cabin Mean Temp	*7.6 C*
8 - Crisp Temp	*31.3 C*
9 - Compr Temp	*46.6 C*
10- Condensor In Temp	*44.8 C*
11- Condensor Out Temp	*30.1 C*
12- Condition	*40.6 C 32 %H*
13- Volt	*Max=249 Mean=243 Min=234*
14-	
15-	
16-	
17-	



Batriq Workshop



Printing in Labaratory Of
Maurice Ind. [Jordan]

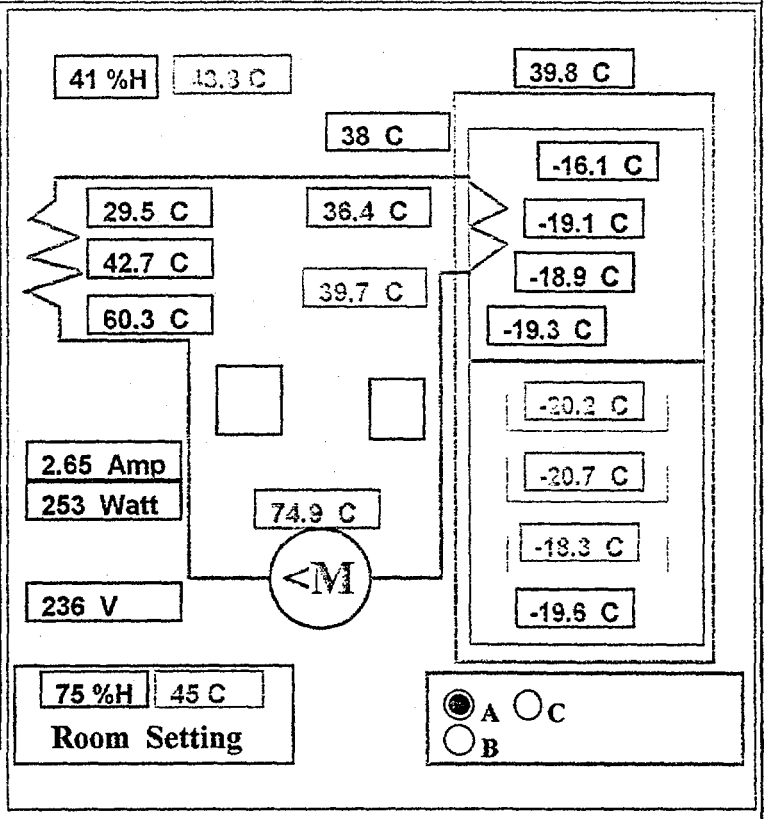
Maurice Ind. [Jordan]

TestDate: **01/01/03 13:35** *Report No.:* ( ) - Page 1

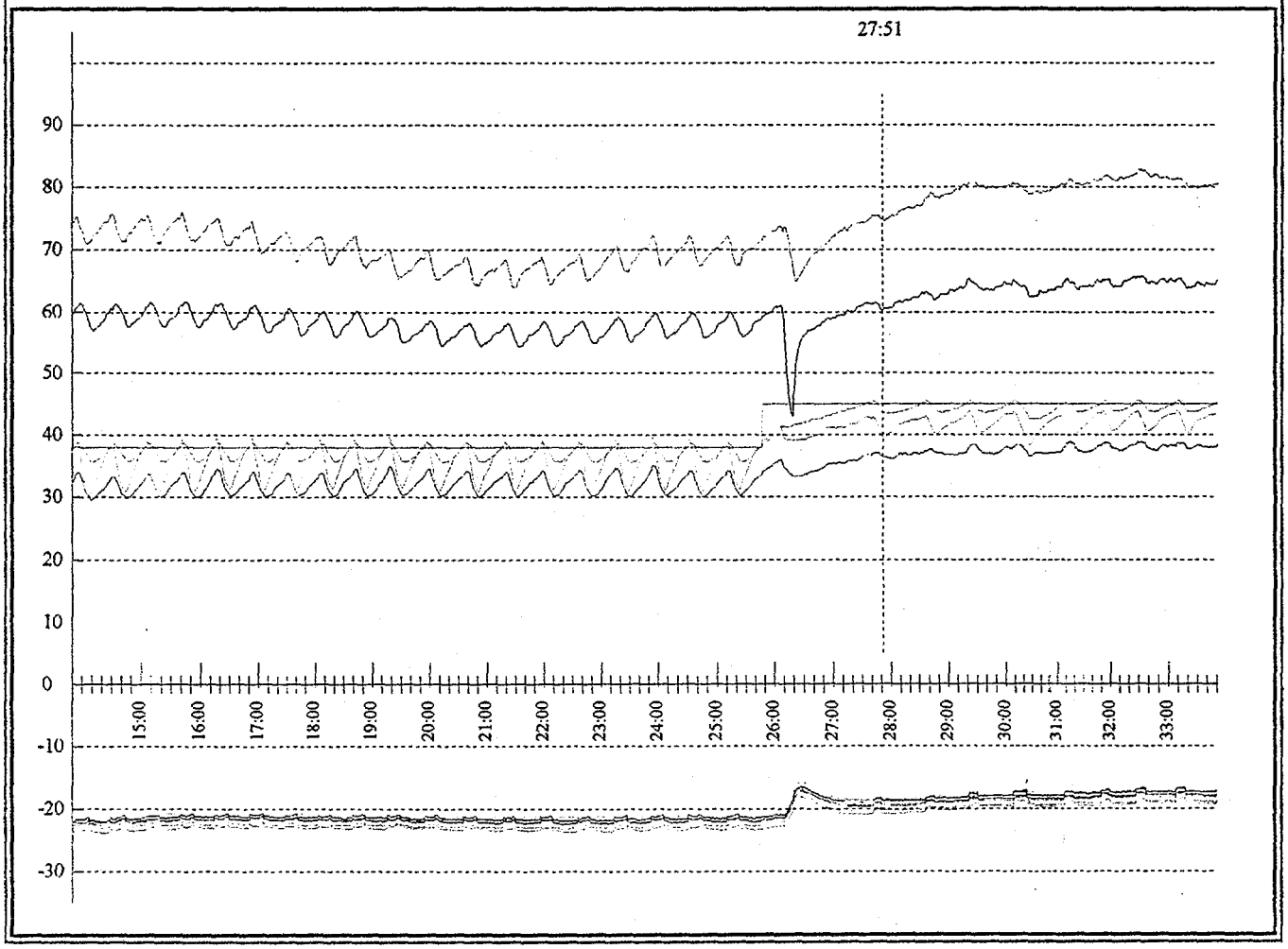
PageTestName: Energy Consumtion *ReportDate:* 2001/02/24 09:59

Page Result :

1 - Page Test Time	*20 Hours*
2 - Working Percent	*99 %On*
3 - Energy (Accord to page)	*1.406 kwh*
4 - Zoom Time	*27:52 Hour*
5 - Compr Current	*2.65 Amp*
6 - Evaprator Mean Temp	*-18.3 C*
7 - Cabin Mean Temp	*-19.7 C*
8 - Crisp Temp	*-19.6 C*
9 - Compr Temp	*74.9 C*
10- Condensor In Temp	*60.3 C*
11- Condensor Out Temp	*29.5 C*
12- Condition	*43.3 C 41 %H*
13- Volt	*Max=247 Mean=237 Min=219*
14-	
15-	
16-	
17-	



Batriq Workshop



Industrial Control Research Center Hotkoom Ver 5

Printing in Labaratory Of
Maurice Ind. [Jordan]

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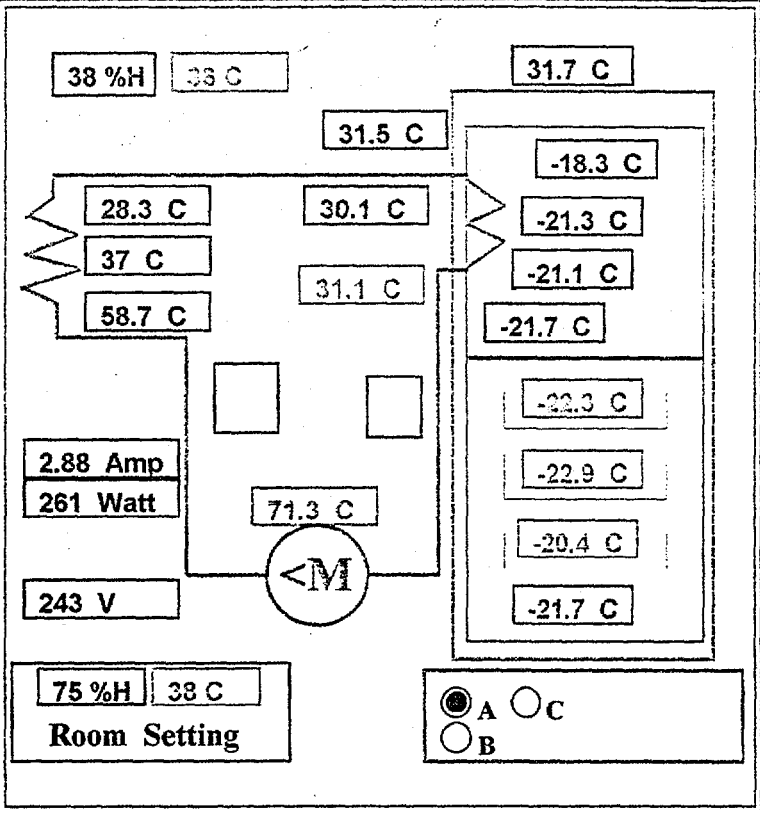
TestDate: **01/01/03 13:35** *Report No.:* ( ) - Page 1

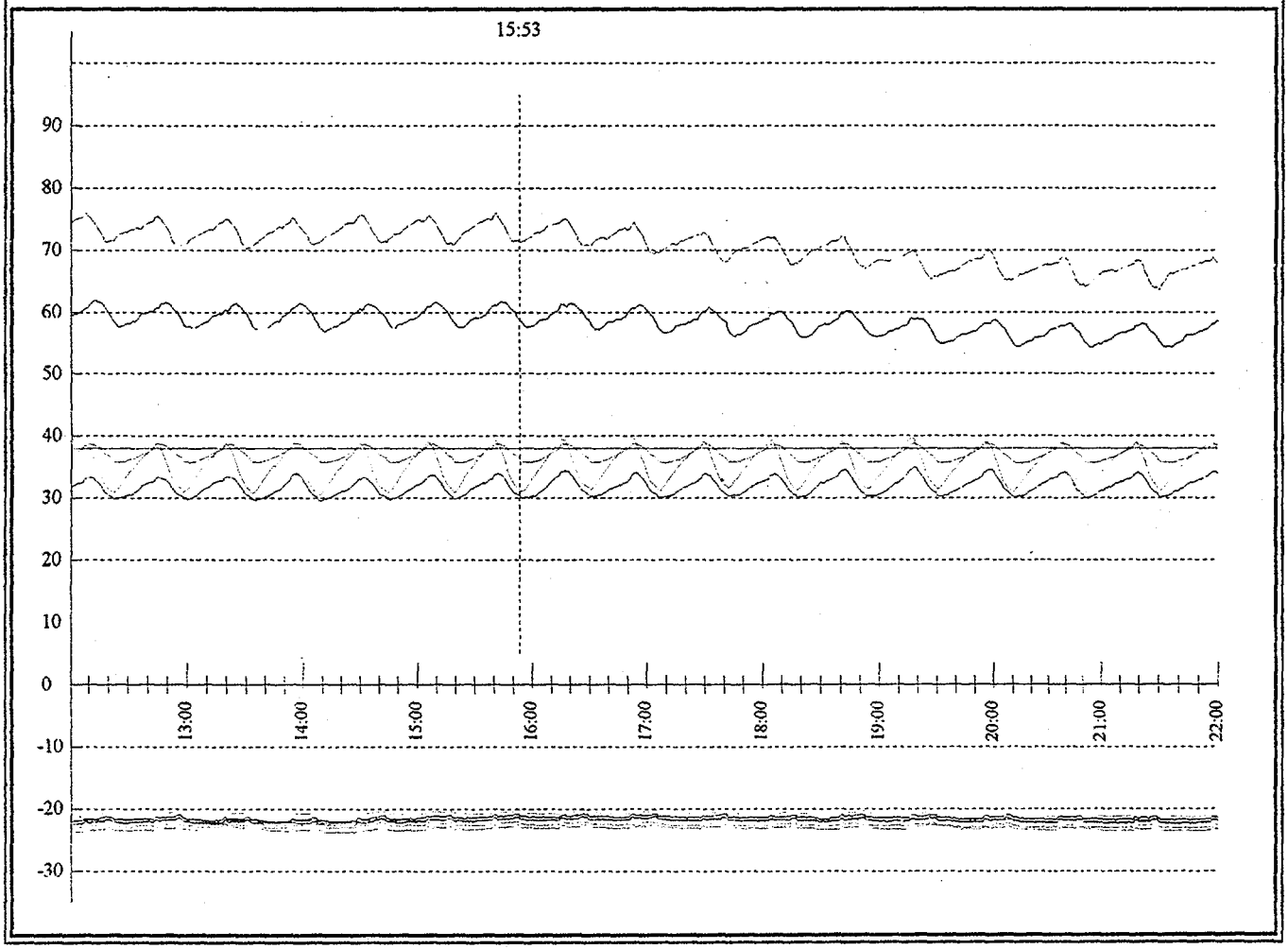
PageTestName: Energy Consumtion *ReportDate:* 2001/02/24 09:58

Page Result :

1 - Page Test Time	*10 Hours*
2 - Working Percent	*100 %On*
3 - Energy (Accord to page)	*1.386 kwh*
4 - Zoom Time	*15:54 Hour*
5 - Compr Current	*2.33 Amp*
6 - Evaprator Mean Temp	*-20.6 C*
7 - Cabin Mean Temp	*-21.8 C*
8 - Crisp Temp	*-21.7 C*
9 - Compr Temp	*71.3 C*
10- Condensor In Temp	*58.7 C*
11- Condensor Out Temp	*28.3 C*
12- Condition	*36 C 38 %H*
13- Volt	*Max=247 Mean=237 Min=219*
14-	
15-	
16-	
17-	



Batriq Workshop



Printing in Labaratory Of
Maurice Ind. [Jordan]

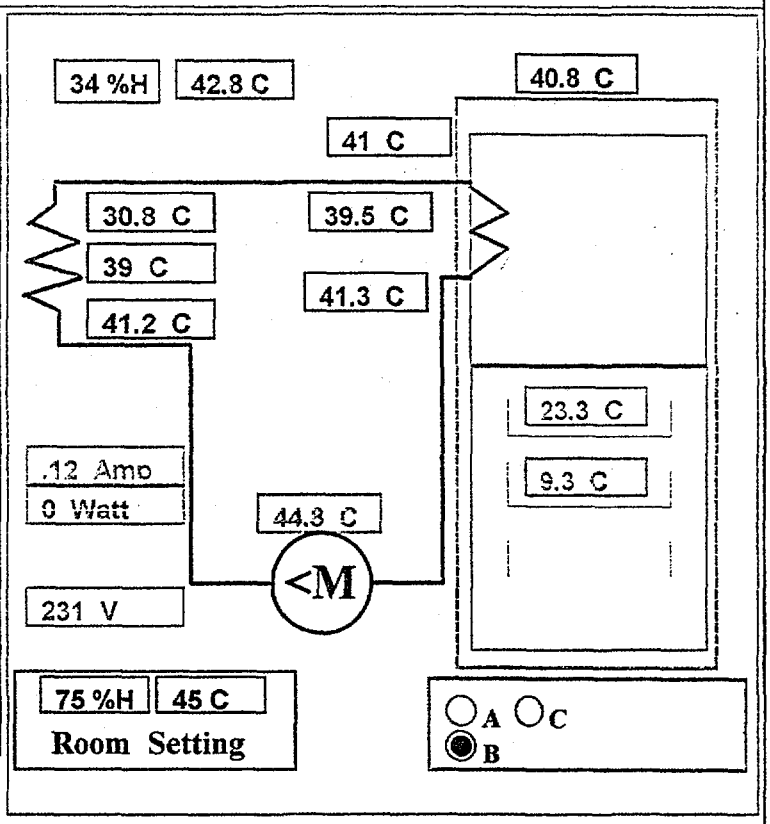
Maurice Ind. [Jordan]

TestDate: **01/01/06 15:26** *Report No.:* ( ) - Page 1

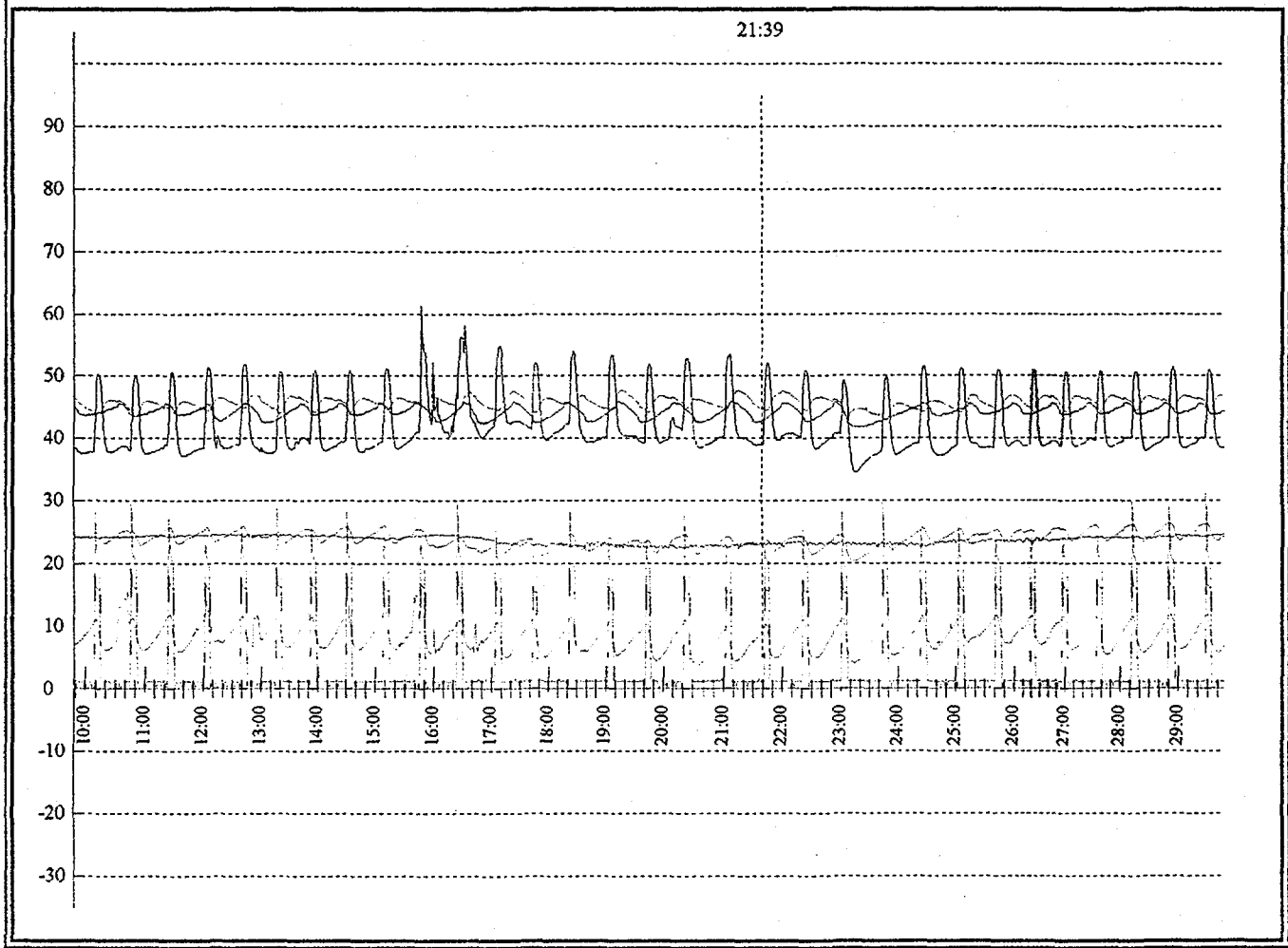
PageTestName: Energy Consumtion *ReportDate:* 2001/02/24 10:40

Page Result :

1 - Page Test Time	*20 Hours*
2 - Working Percent	*15 %On*
3 - Energy (Accord to page)	*0.233 kwh*
4 - Zoom Time	*21:39 Hour*
5 - Compr Current	*0.12 Amp*
6 - Evaprator Mean Temp	*31.6 C*
7 - Cabin Mean Temp	*22.6 C*
8 - Crisp Temp	*37.1 C*
9 - Compr Temp	*44.3 C*
10- Condensor In Temp	*41.2 C*
11- Condensor Out Temp	*30.8 C*
12- Condition	*42.8 C 34 %H*
13- Volt	*Max=247 Mean=237 Min=222*
14-	
15-	
16-	
17-	



Batriq Workshop



Industrial Control Research Center HotRoom Ver 5

Printing in Labaratory Of
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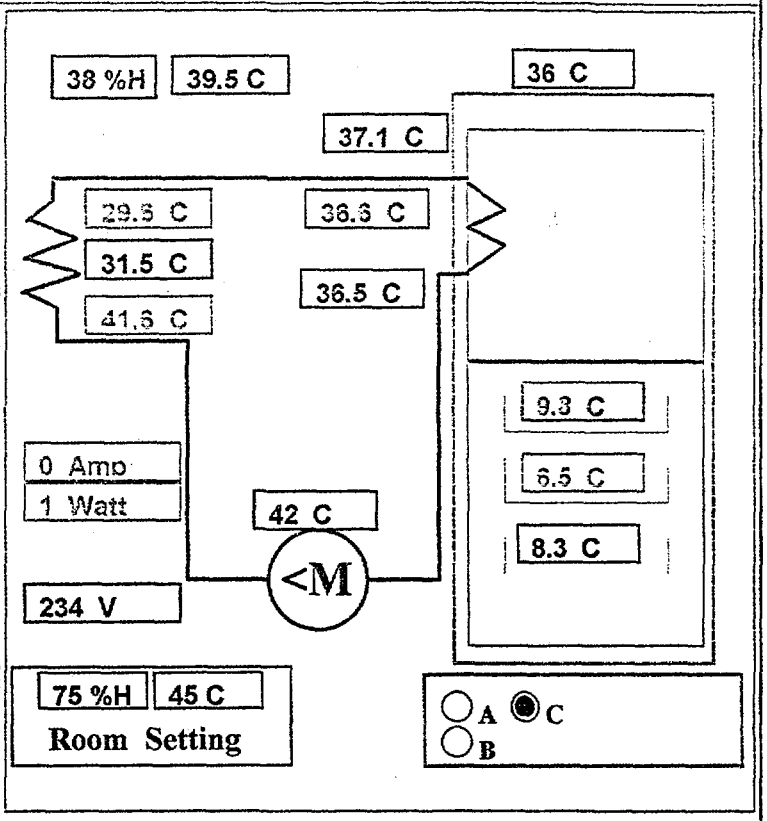
Maurice Ind. [Jordan]

TestDate: **01/01/15 10:34** *Report No.:* ( ) - Page 1

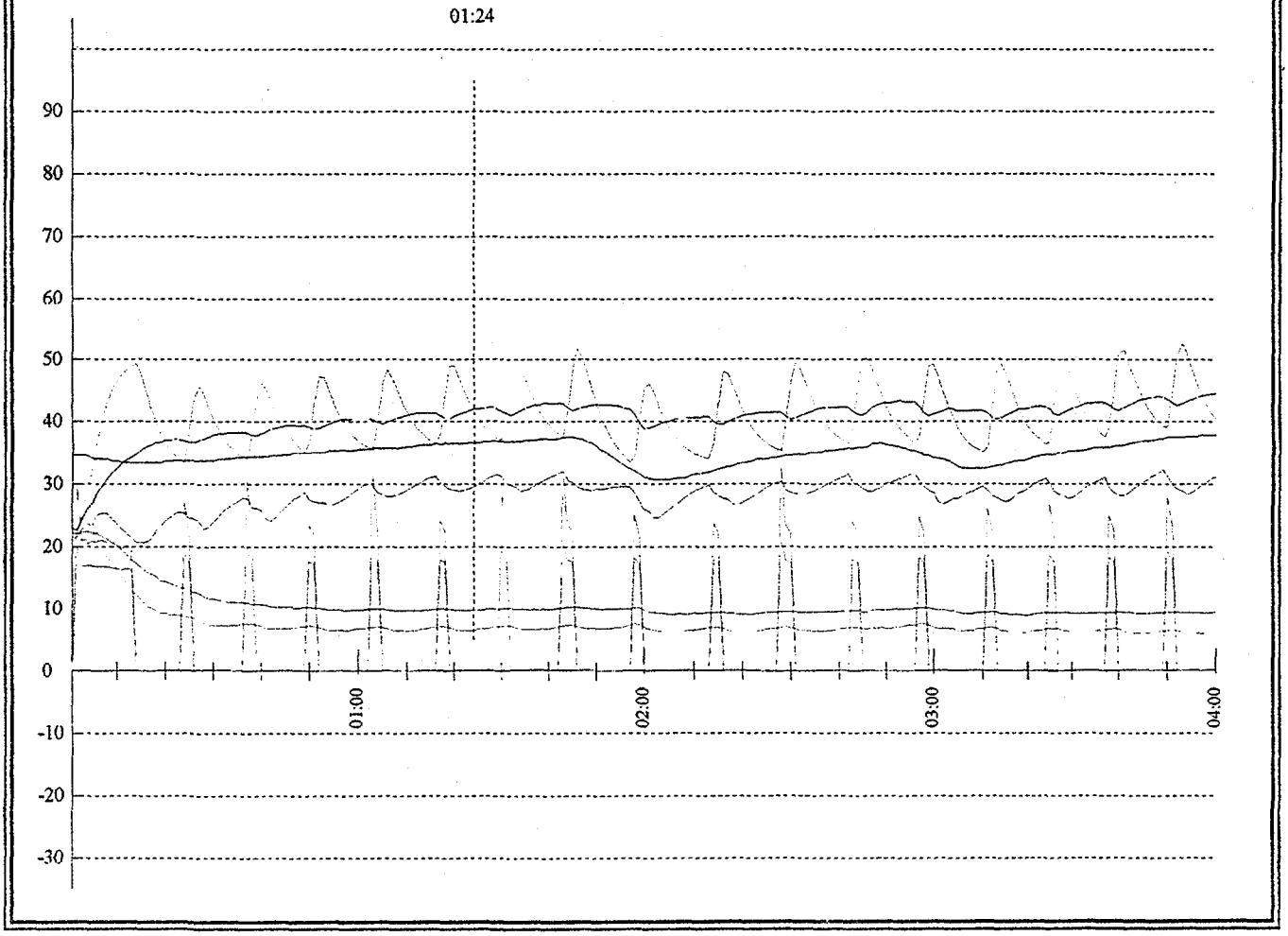
PageTestName: Energy Consumtion *ReportDate:* 2001/02/24 11:09

Page Result :

1 - Page Test Time	*4 Hours*
2 - Working Percent	*19 %On*
3 - Energy (Accord to page)	*0.464 kwh*
4 - Zoom Time	*1:24 Hour*
5 - Compr Current	*00 Amp*
6 - Evaprator Mean Temp	*26.6 C*
7 - Cabin Mean Temp	*8.2 C*
8 - Crisp Temp	*25.9 C*
9 - Compr Temp	*42 C*
10- Condensor In Temp	*41.6 C*
11- Condensor Out Temp	*29.6 C*
12- Condition	*39.5 C 38 %H*
13- Volt	*Max=241 Mean=235 Min=224*
14-	
15-	
16-	
17-	



Al-Shaba Workshop



Industrial Control Research Center HotRoom Ver 5

Printing in Labaratory Of
Maurice Ind. [Jordan]

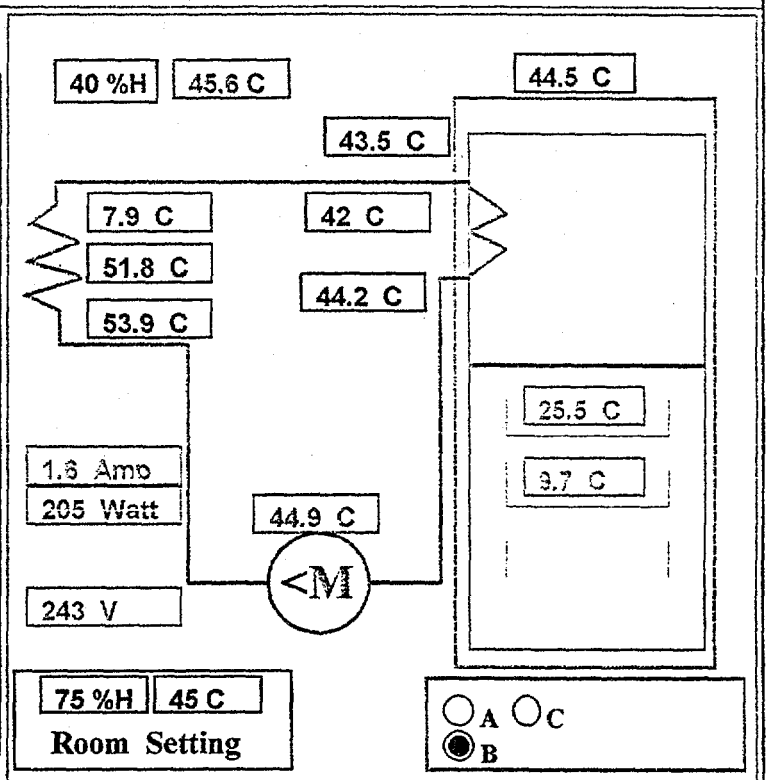
Maurice Ind. [Jordan]

TestDate: **01/01/06 15:26** *Report No.:* ( ) - Page 1

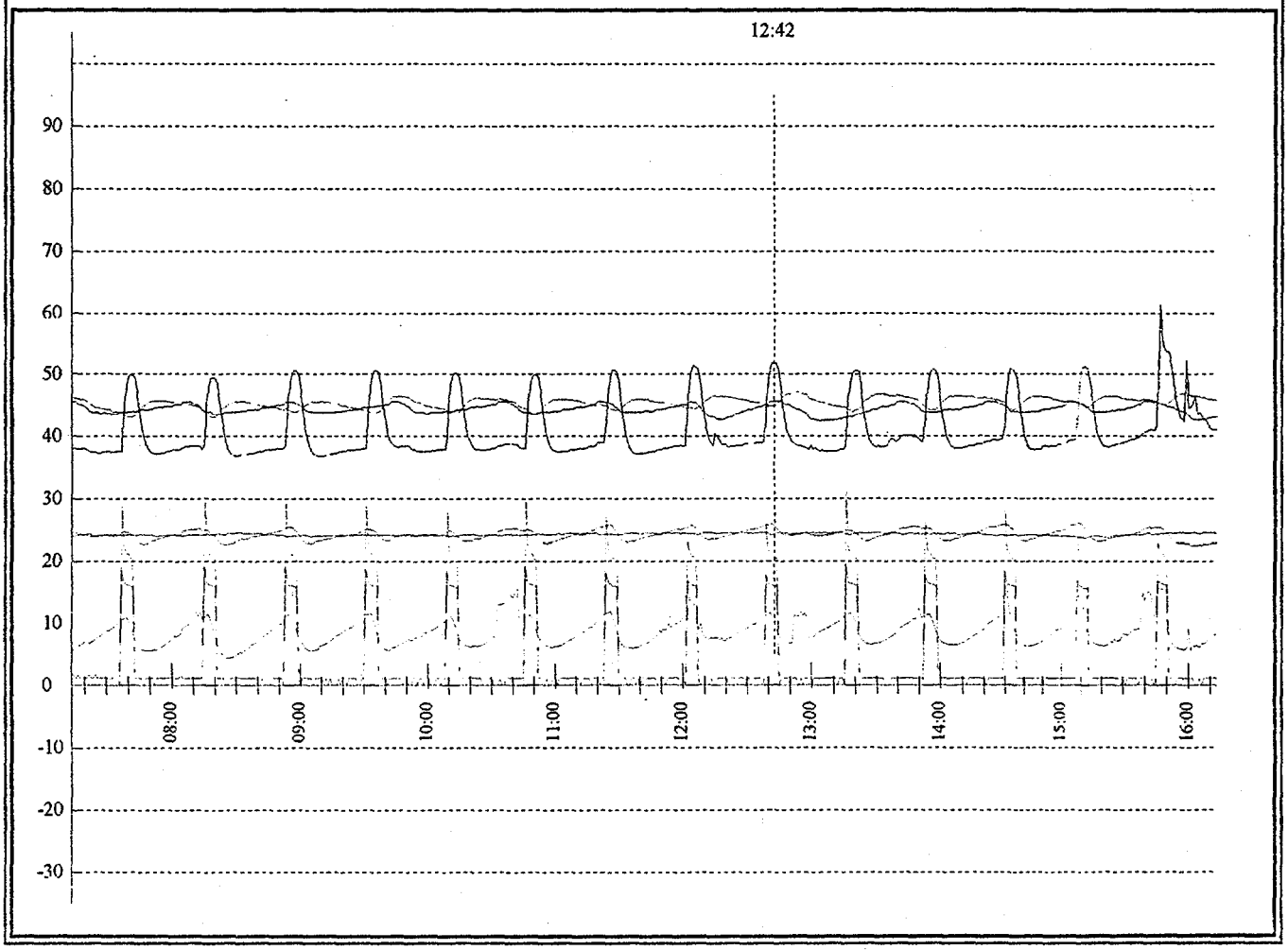
PageTestName: Energy Consumtion *ReportDate:* 2001/02/24 10:39

Page Result :

1 - Page Test Time	*9 Hours*
2 - Working Percent	*15 %On*
3 - Energy (Accord to page)	*0.203 kwh*
4 - Zoom Time	*12:43 Hour*
5 - Compr Current	*1.6 Amp*
6 - Evaprator Mean Temp	*31.7 C*
7 - Cabin Mean Temp	*23.4 C*
8 - Crisp Temp	*37.2 C*
9 - Compr Temp	*44.9 C*
10- Condensor In Temp	*53.9 C*
11- Condensor Out Temp	*7.9 C*
12- Condition	*45.6 C 40 %H*
13- Volt	*Max=247 Mean=243 Min=237*
14-	
15-	
16-	
17-	



Al-Shaba Workshop



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*Printing in Labaratory Of
Maurice Ind. [Jordan]

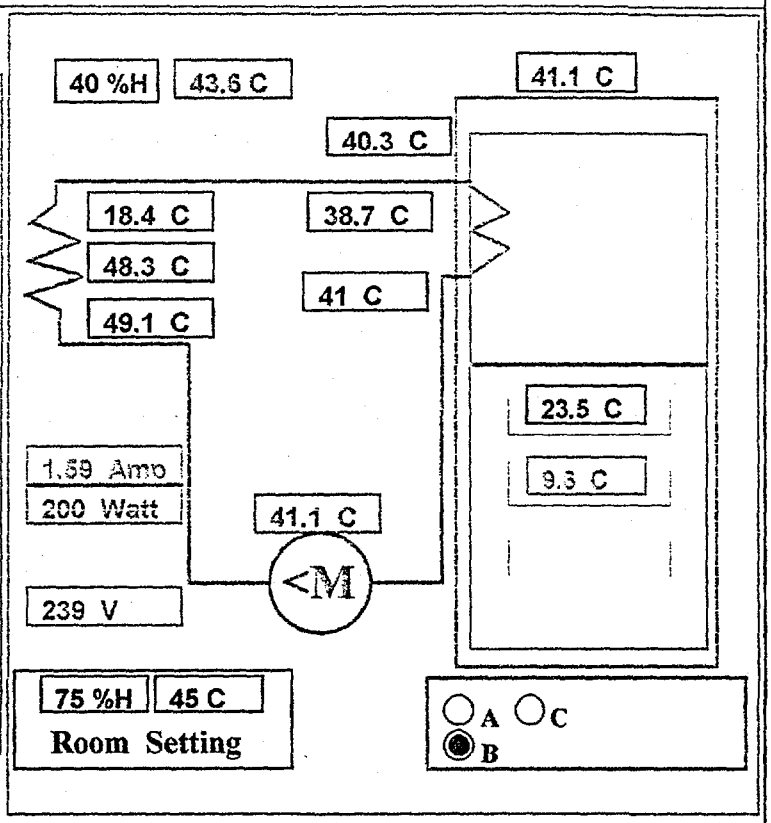
Maurice Ind. [Jordan]

TestDate: **01/01/06 15:26** *Report No.:* ( ) - Page 1

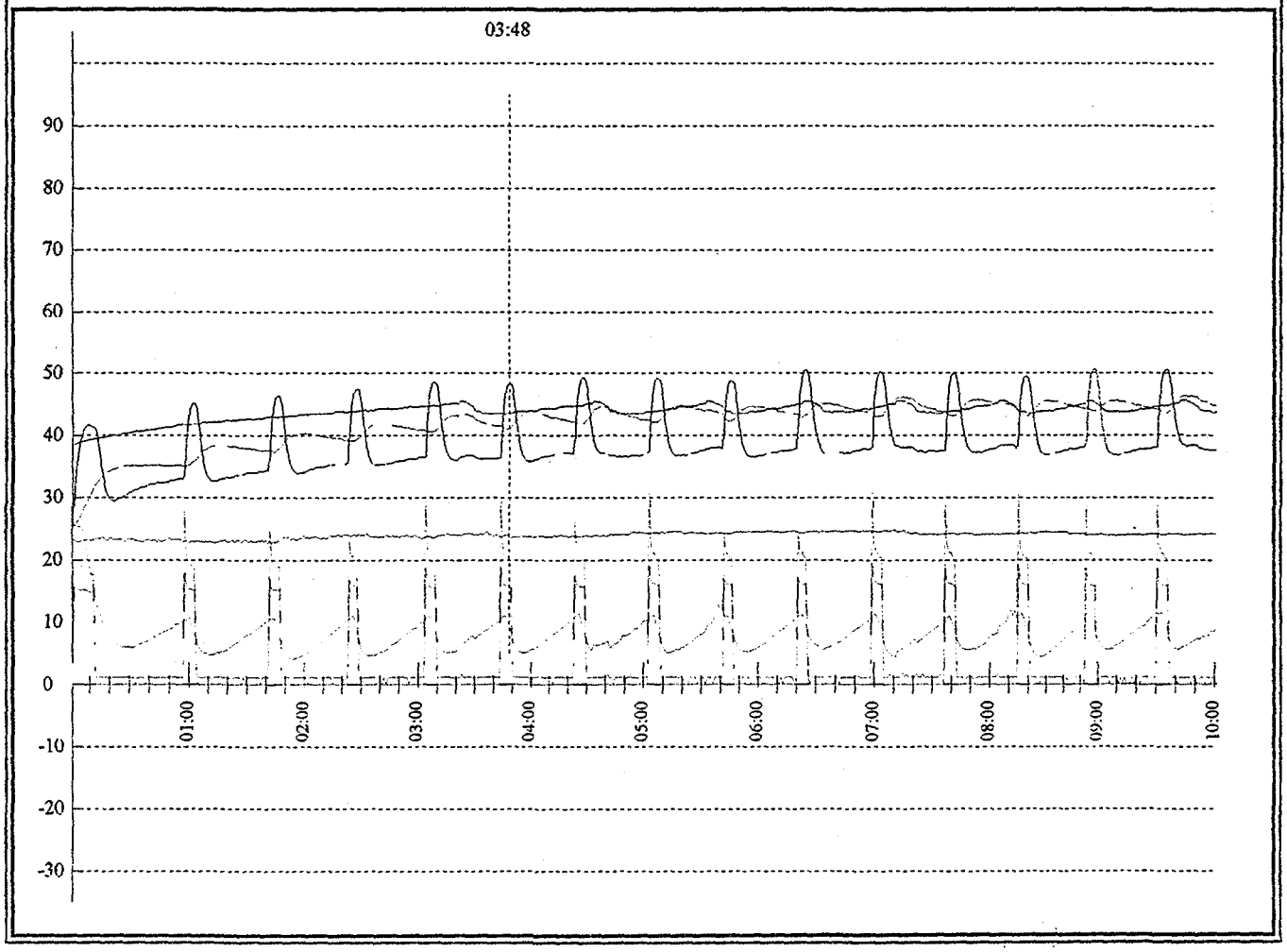
PageTestName: Energy Consumtion *ReportDate:* 2001/02/24 10:37

Page Result :

1 - Page Test Time	*10 Hours*
2 - Working Percent	*15 %On*
3 - Energy (Accord to page)	*0.311 kwh*
4 - Zoom Time	*3:48 Hour*
5 - Compr Current	*1.59 Amp*
6 - Evaprator Mean Temp	*28.2 C*
7 - Cabin Mean Temp	*21.6 C*
8 - Crisp Temp	*33.4 C*
9 - Compr Temp	*41.1 C*
10- Condensor In Temp	*49.1 C*
11- Condensor Out Temp	*18.4 C*
12- Condition	*43.6 C 40 %H*
13- Volt	*Max=248 Mean=240 Min=226*
14-	
15-	
16-	
17-	



Al-Shaba Workshop



Printing In Labaratory Of
Maurice Ind. [Jordan]

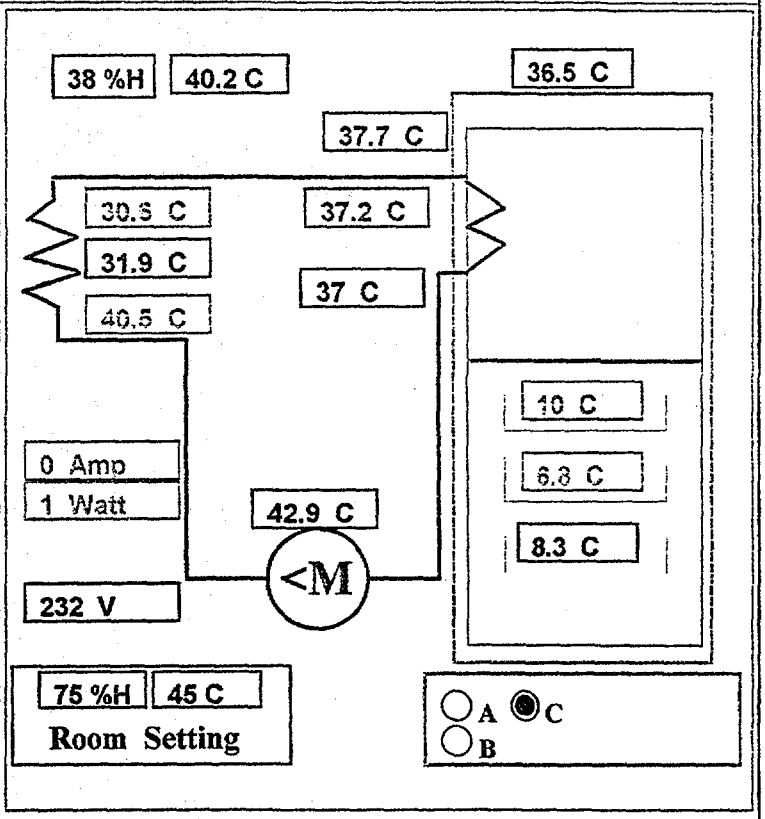
Maurice Ind. [Jordan]

TestDate: 01/01/15 10:34 *Report No.:* ( ) - Page 1

PageTestName: Energy Consumtion *ReportDate:* 2001/02/24 11:09

Page Result :

1 - Page Test Time	*3 Hours*
2 - Working Percent	*21 %On*
3 - Energy (Accord to page)	*0.471 kwh*
4 - Zoom Time	*1:39 Hour*
5 - Compr Current	*00 Amp*
6 - Evaprator Mean Temp	*27.2 C*
7 - Cabin Mean Temp	*8.3 C*
8 - Crisp Temp	*26.4 C*
9 - Compr Temp	*42.9 C*
10- Condensor In Temp	*40.5 C*
11- Condensor Out Temp	*30.6 C*
12- Condition	*40.2 C 38 %H*
13- Volt	*Max=239 Mean=235 Min=224*
14-	
15-	
16-	
17-	



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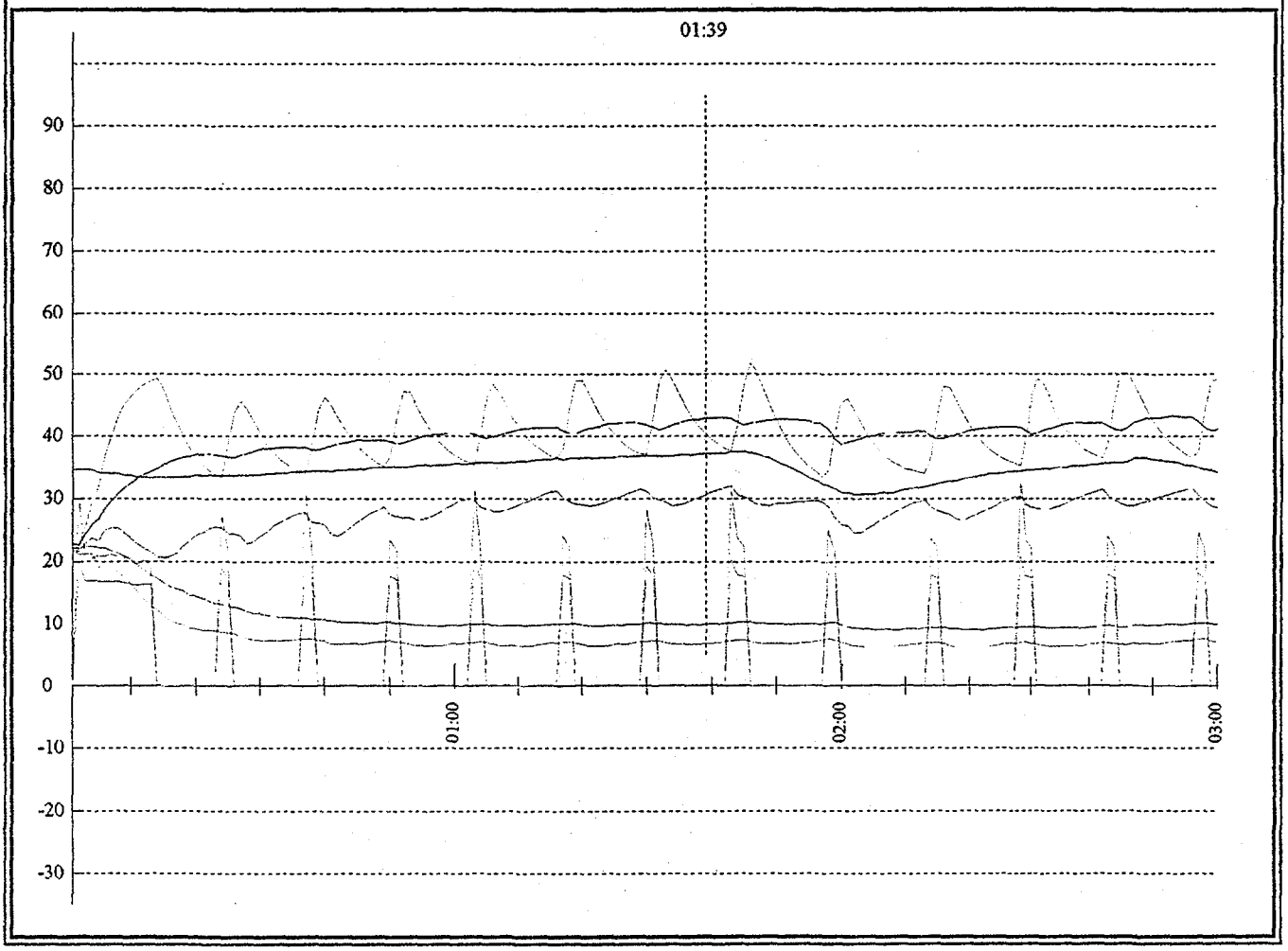


Industrial Control Research Center HotRoom Ver 5

Printing in Labaratory Of
Maurice Ind. [Jordan]

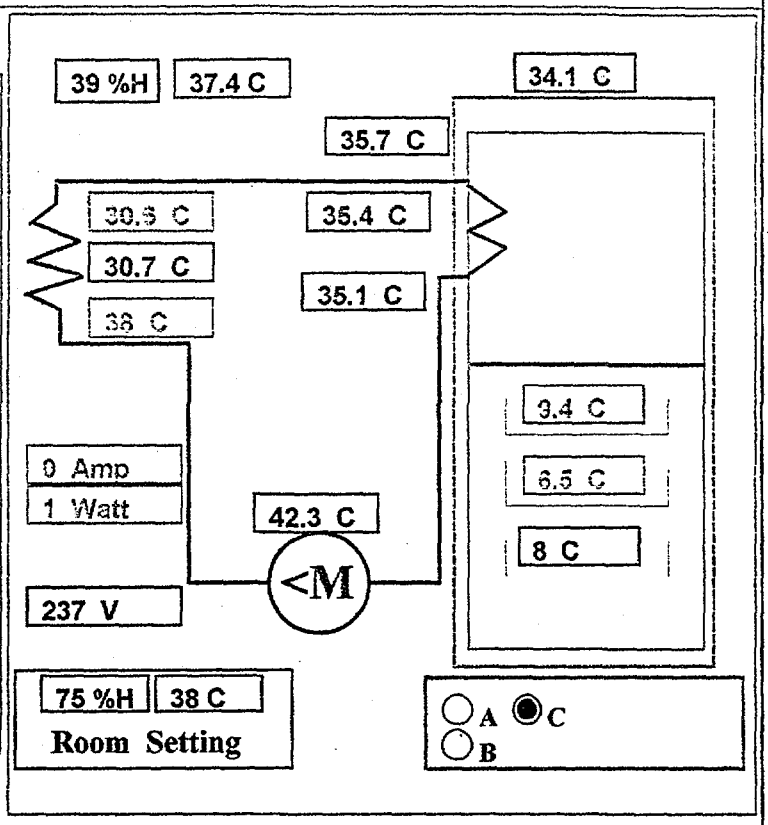
Maurice Ind. [Jordan]

TestDate: **01/01/15 10:34** *Report No.:* ( ) - Page 1

PageTestName: Energy Consumtion *ReportDate:* 2001/02/24 11:09

Page Result :

1 - Page Test Time	*2 Hours*
2 - Working Percent	*15 %On*
3 - Energy (Accord to page)	*0.304 kwh*
4 - Zoom Time	*2:39 Hour*
5 - Compr Current	*00 Amp*
6 - Evaprator Mean Temp	*27.1 C*
7 - Cabin Mean Temp	*7.9 C*
8 - Crisp Temp	*26.5 C*
9 - Compr Temp	*42.3 C*
10- Condensor In Temp	*38 C*
11- Condensor Out Temp	*30.6 C*
12- Condition	*37.4 C 39 %H*
13- Volt	*Max=239 Mean=237 Min=229*
14-	
15-	
16-	
17-	



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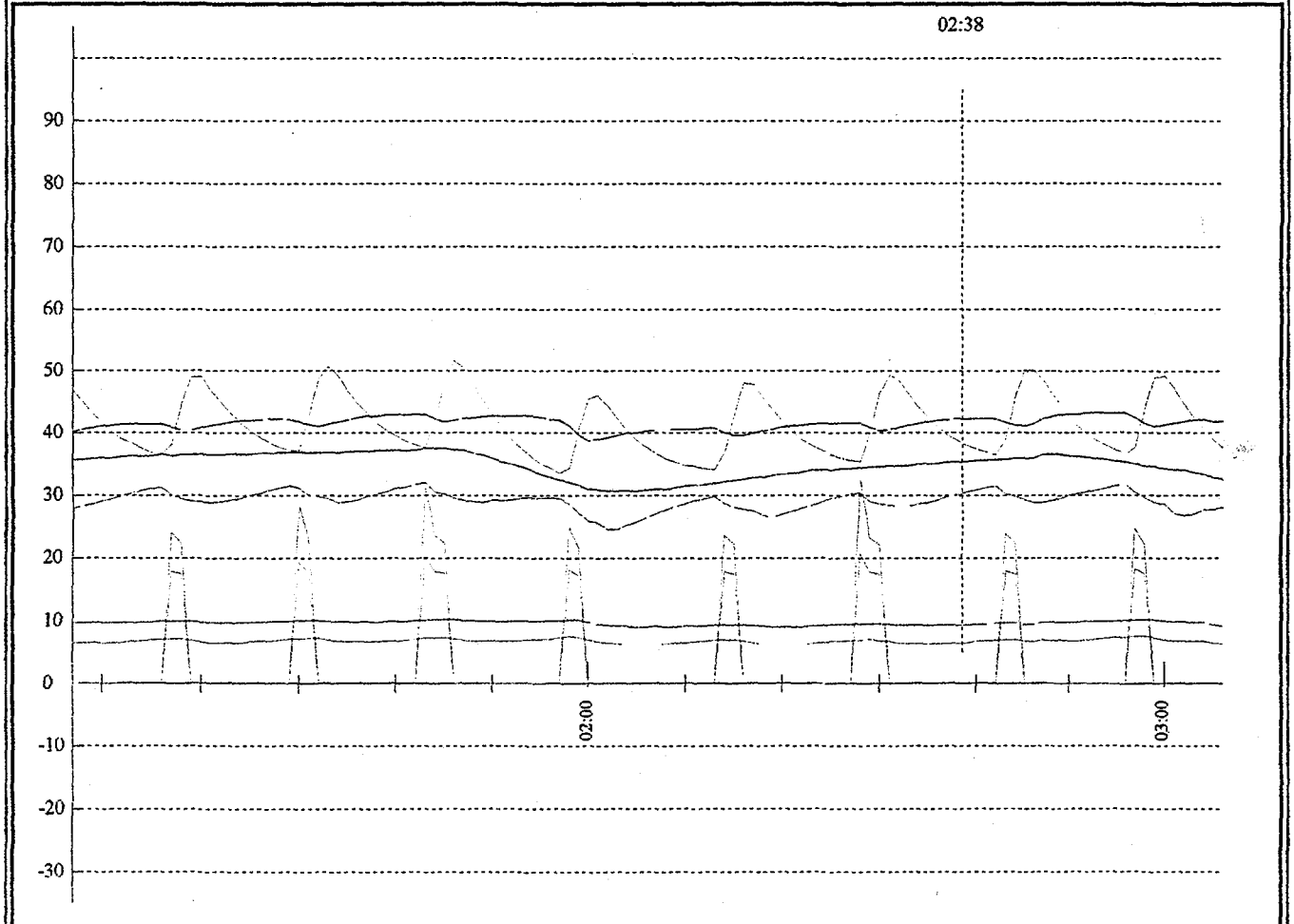


Industrial Control Research Center HotRoom Ver 5

Printing in Labaratory Of
Maurice Ind. [Jordan]

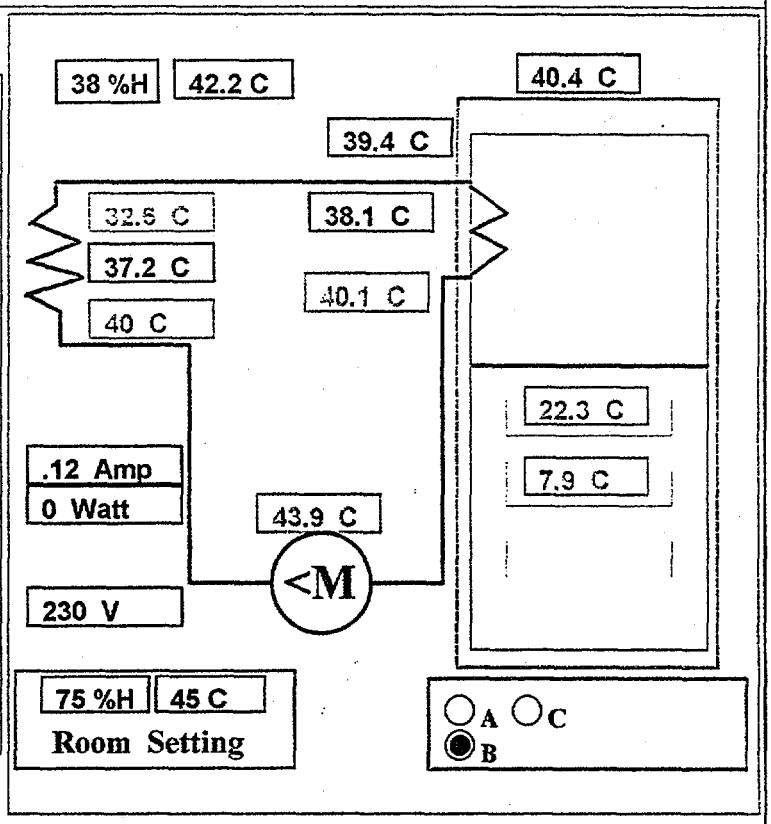
Maurice Ind. [Jordan]

TestDate: **01/01/06 15:26** *Report No.:* ( ) - Page 1

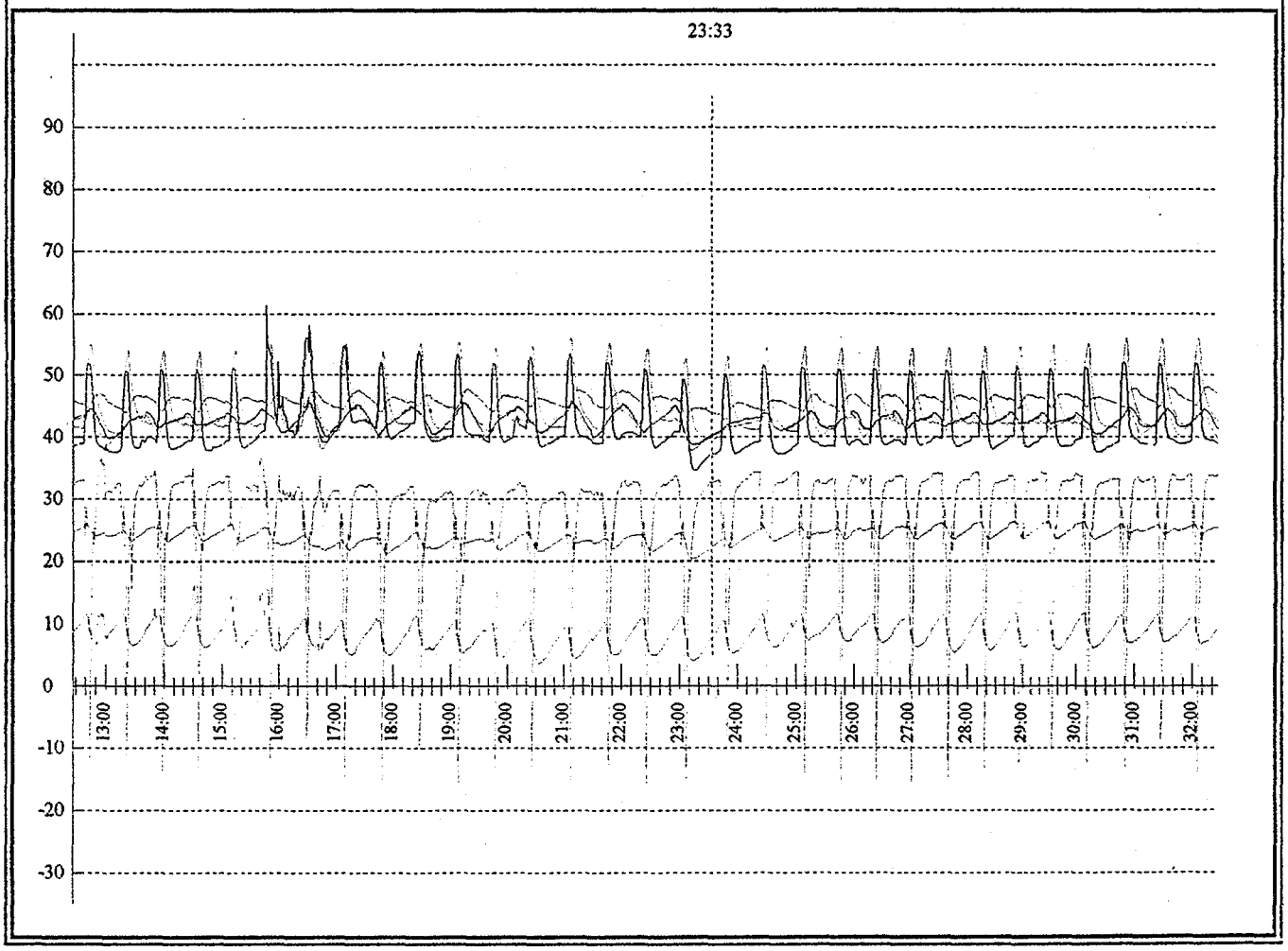
PageTestName: Energy Consumtion *ReportDate:* 2001/02/24 10:45

Page Result :

1 - Page Test Time	*20*	*Hours*
2 - Working Percent	*15*	*%On*
3 - Energy (Accord to page)	*0.23*	*kwh*
4 - Zoom Time	*23:34*	*Hour*
5 - Compr Current	*0.12*	*Amp*
6 - Evaprator Mean Temp	*31.5*	*C*
7 - Cabin Mean Temp	*21.3*	*C*
8 - Crisp Temp	*35.8*	*C*
9 - Compr Temp	*43.9*	*C*
10- Condensor In Temp	*40*	*C*
11- Condensor Out Temp	*32.6*	*C*
12- Condition	*42.2 C*	*38 %H*
13- Volt	*Max=248 Mean=237 Min=222*	
14-		
15-		
16-		
17-		



Al-Shaba Workshop



Industrial Control Research Center HotRoom Ver 5

Printing in Labaratory Of
Maurice Ind. [Jordan]

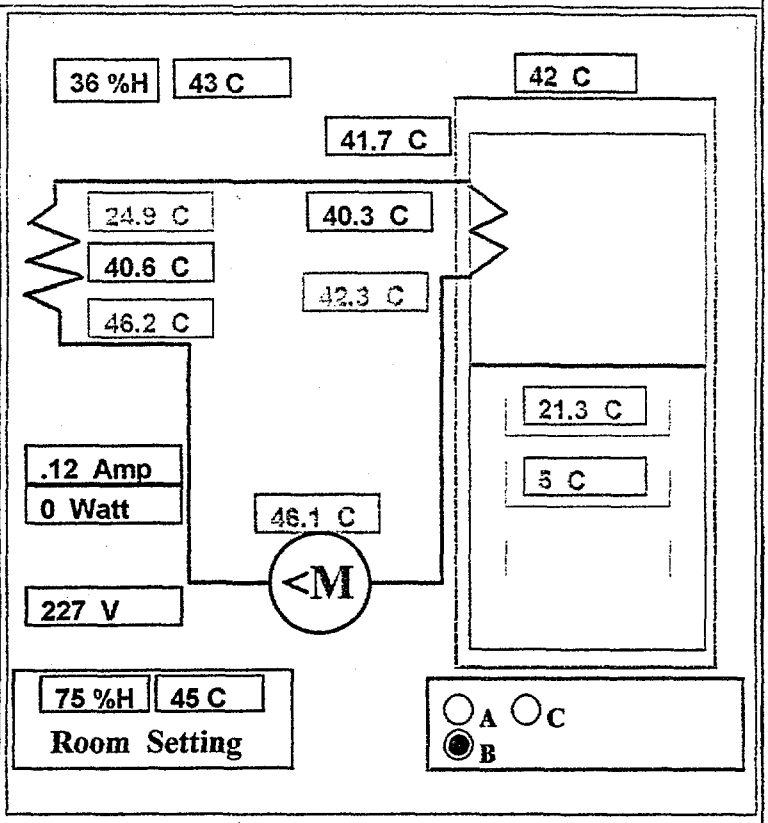
Maurice Ind. [Jordan]

TestDate: 01/01/06 15:26 *Report No.:* ( ) - Page 1

PageTestName: Energy Consumtion *ReportDate:* 2001/02/24 10:43

Page Result :

1 - Page Test Time	*10*	*Hours*
2 - Working Percent	*14*	*%On*
3 - Energy (Accord to page)	*0.238*	*kwh*
4 - Zoom Time	*17:54*	*Hour*
5 - Compr Current	*0.12*	*Amp*
6 - Evaprator Mean Temp	*31.3*	*C*
7 - Cabin Mean Temp	*20.9*	*C*
8 - Crisp Temp	*37.1*	*C*
9 - Compr Temp	*46.1*	*C*
10- Condensor In Temp	*46.2*	*C*
11- Condensor Out Temp	*24.9*	*C*
12- Condition	*43 C*	*36 %H*
13- Volt	*Max=246 Mean=236 Min=222*	
14-		
15-		
16-		
17-		



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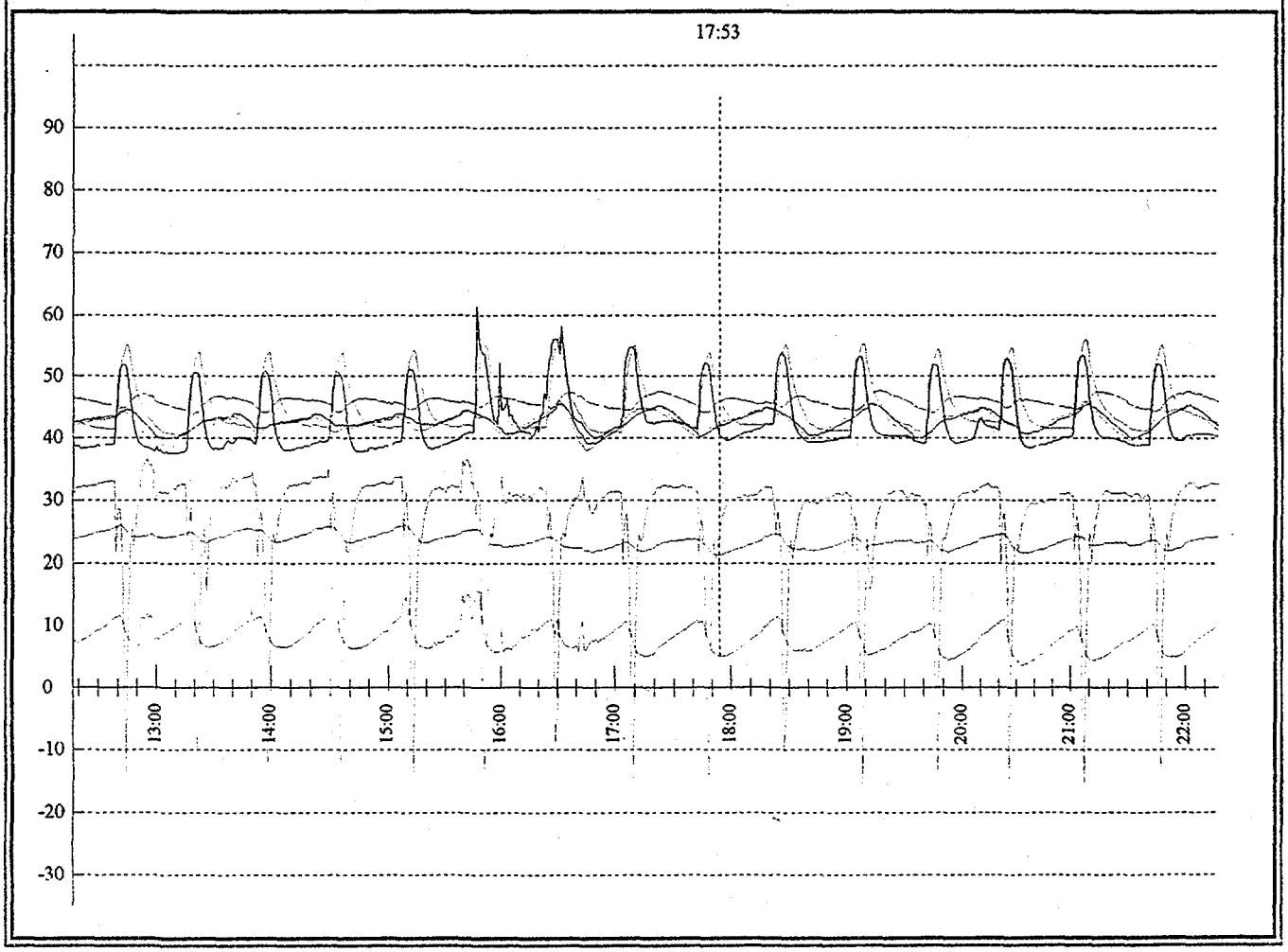

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Printing in Labaratory Of
Maurice Ind. [Jordan]

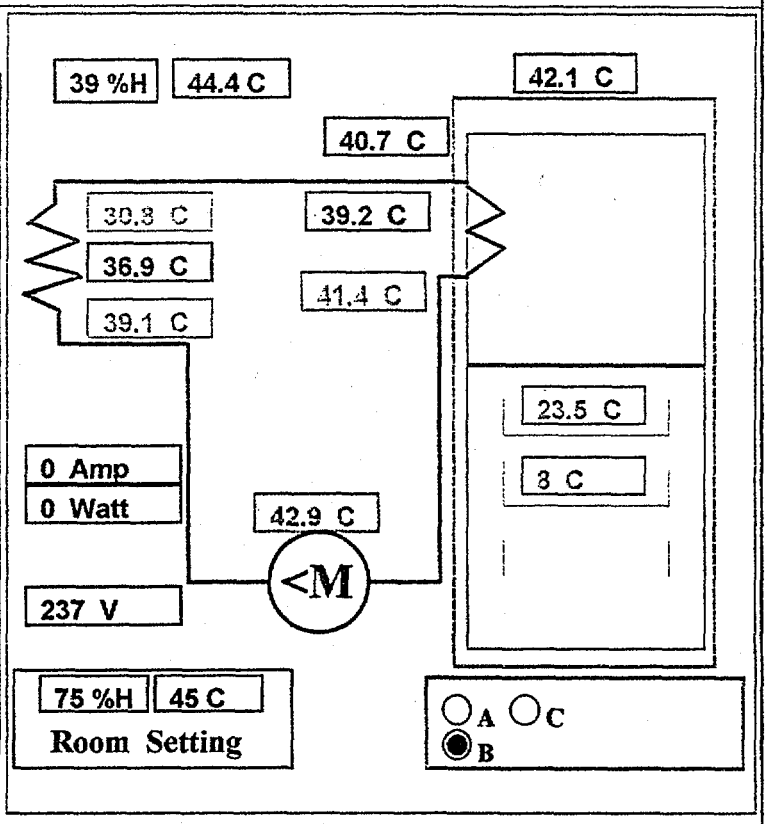
Maurice Ind. [Jordan]

TestDate: **01/01/06 15:26** *Report No.:* ( ) - Page 1

PageTestName: Energy Consumtion *ReportDate:* 2001/02/24 10:41

Page Result :

1 - Page Test Time	*10 Hours*
2 - Working Percent	*15 %On*
3 - Energy (Accord to page)	*0.311 kwh*
4 - Zoom Time	*4:12 Hour*
5 - Compr Current	*00 Amp*
6 - Evaprator Mean Temp	*28.4 C*
7 - Cabin Mean Temp	*21.3 C*
8 - Crisp Temp	*34.1 C*
9 - Compr Temp	*42.9 C*
10- Condensor In Temp	*39.1 C*
11- Condensor Out Temp	*30.8 C*
12- Condition	*44.4 C 39 %H*
13- Volt	*Max=248 Mean=240 Min=226*
14-	
15-	
16-	
17-	



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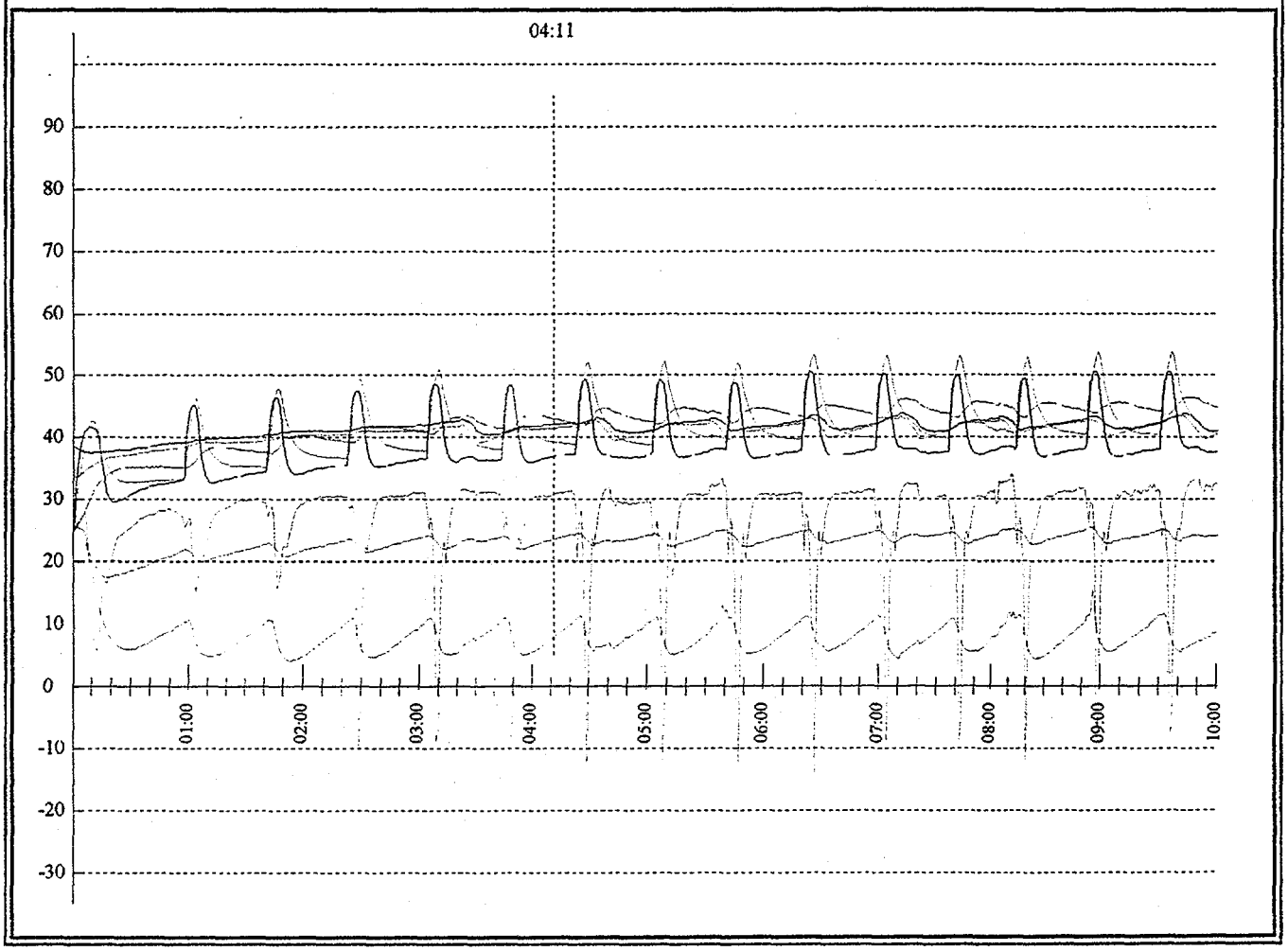


Industrial Control Research Center HotRoom Ver 5

Printing in Labaratory Of
Maurice Ind. [Jordan]

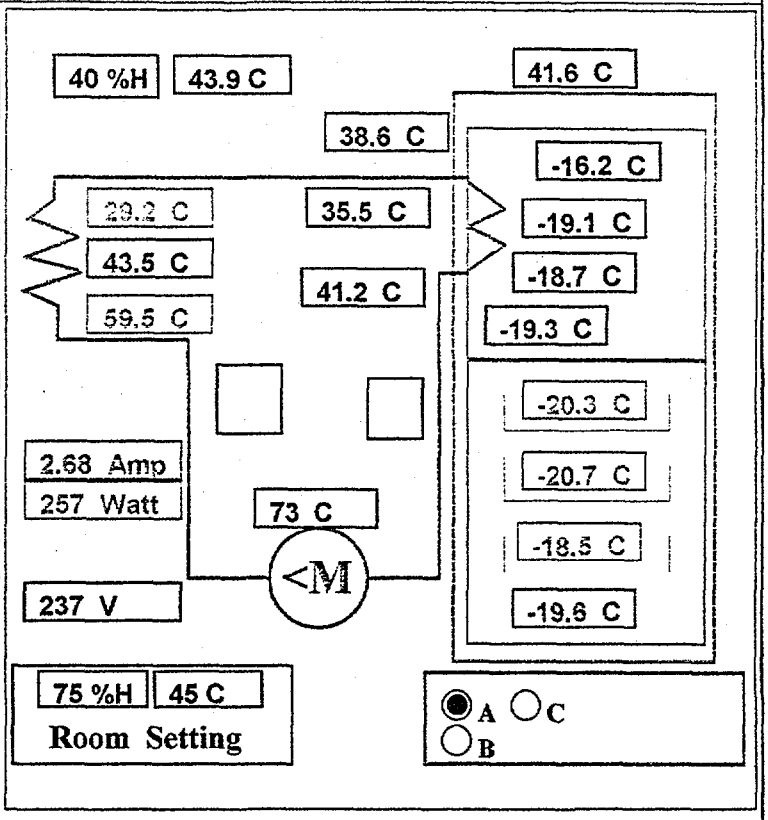
Maurice Ind. [Jordan]

TestDate: **01/01/03 13:35** *Report No.:* ( ) - Page 1

PageTestName: Energy Consumtion *ReportDate:* 2001/02/24 10:06

Page Result :

1 - Page Test Time	*20 Hours*
2 - Working Percent	*99 %On*
3 - Energy (Accord to page)	*1.391 kwh*
4 - Zoom Time	*27:10 Hour*
5 - Compr Current	*2.68 Amp*
6 - Evaprator Mean Temp	*-18.3 C*
7 - Cabin Mean Temp	*-19.8 C*
8 - Crisp Temp	*-19.6 C*
9 - Compr Temp	*73 C*
10- Condensor In Temp	*59.5 C*
11- Condensor Out Temp	*29.2 C*
12- Condition	*43.9 C 40 %H*
13- Volt	*Max=247 Mean=237 Min=219*
14-	
15-	
16-	
17-	



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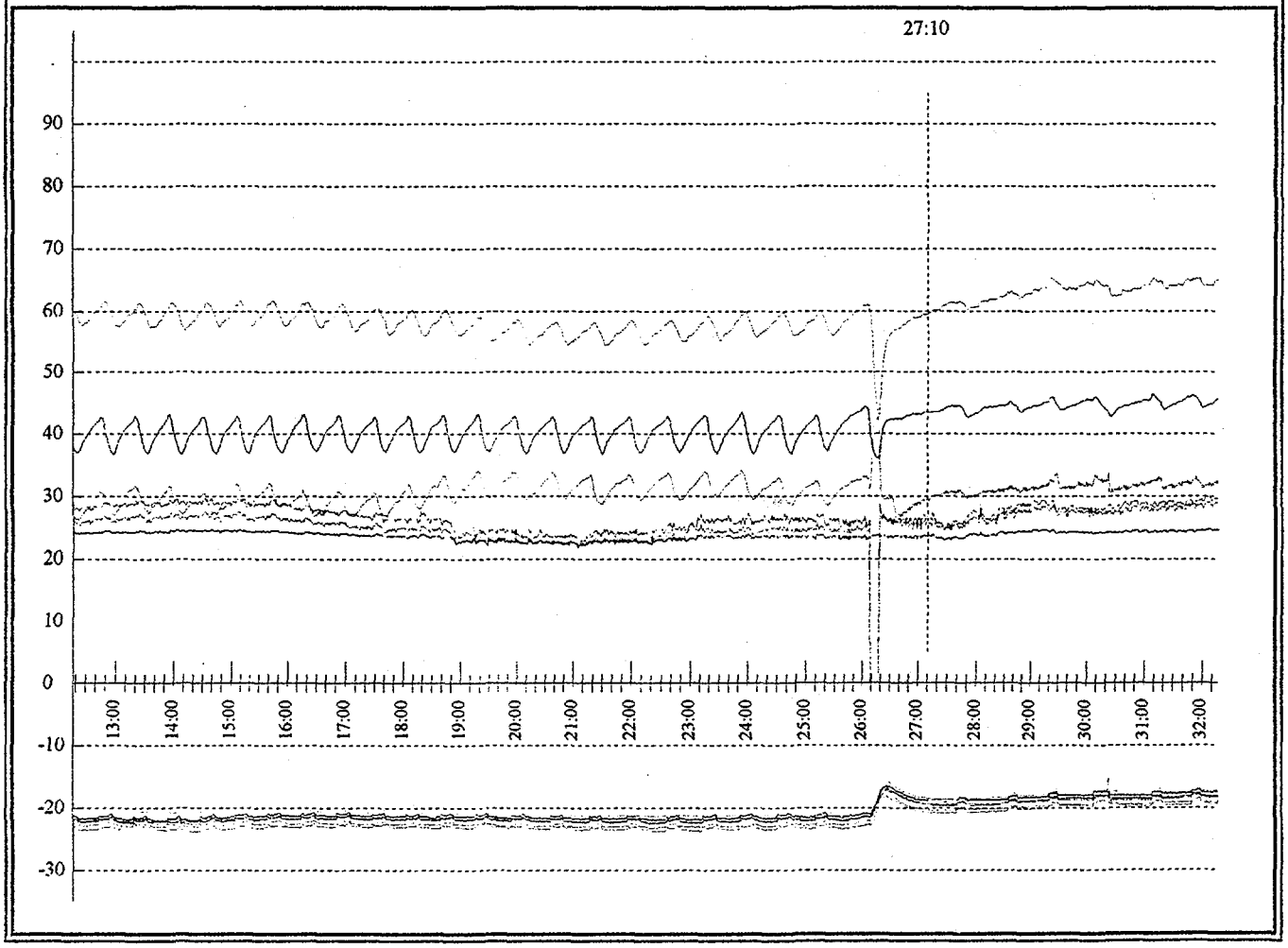

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Printing in Labaratory Of
Maurice Ind. [Jordan]

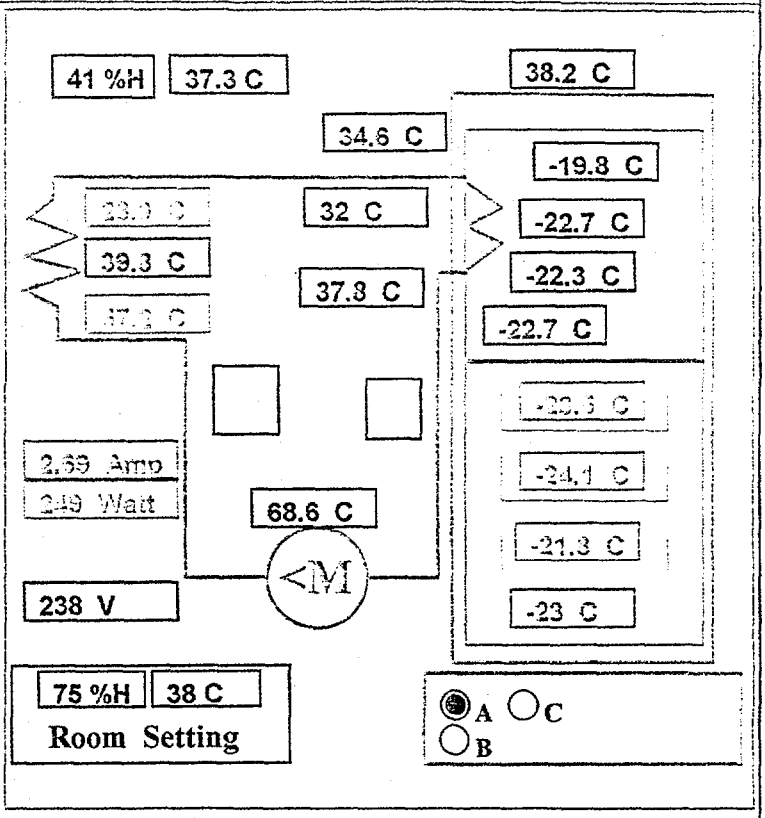
Maurice Ind. [Jordan]

TestDate: 01/01/03 13:35 Report No.: ( ) - Page 1

PageTestName: Energy Consumtion ReportDate: 2001/02/24 10:00

Page Result :

1 - Page Test Time	10	Hours
2 - Working Percent	96	%On
3 - Energy (Accord to page)	1.316	kwh
4 - Zoom Time	4:12	Hour
5 - Compr Current	2.39	Amp
6 - Evaprator Mean Temp	-21.3	C
7 - Cabin Mean Temp	-23.1	C
8 - Crisp Temp	-23	C
9 - Compr Temp	68.6	C
10- Condensor In Temp	57.2	C
11- Condensor Out Temp	23.9	C
12- Condition	37.3 C	41 %H
13- Volt	Max=246 Mean=237 Min=224	
14-		
15-		
16-		
17-		



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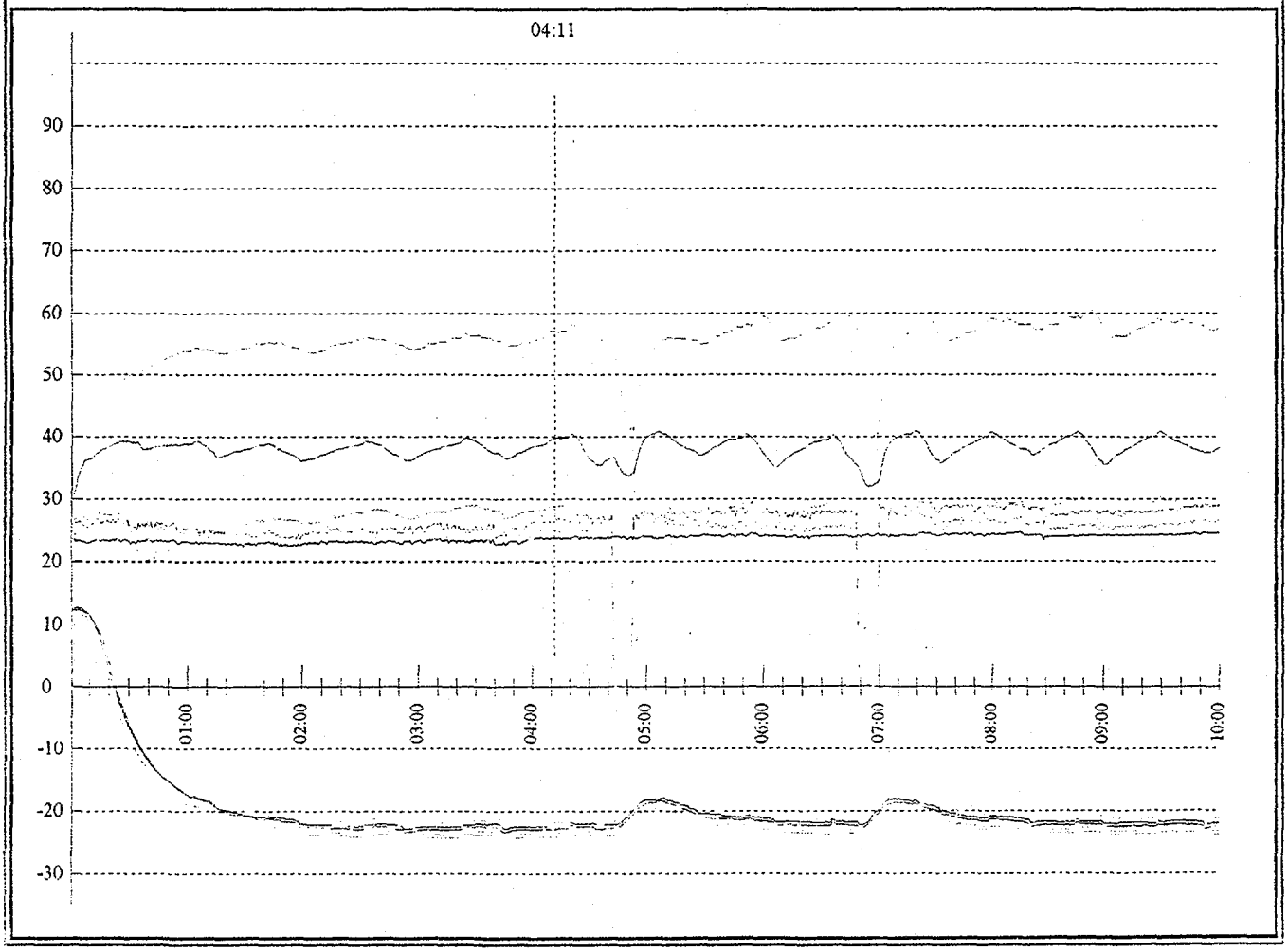

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Printing in Labaratory Of
Maurice Ind. [Jordan]

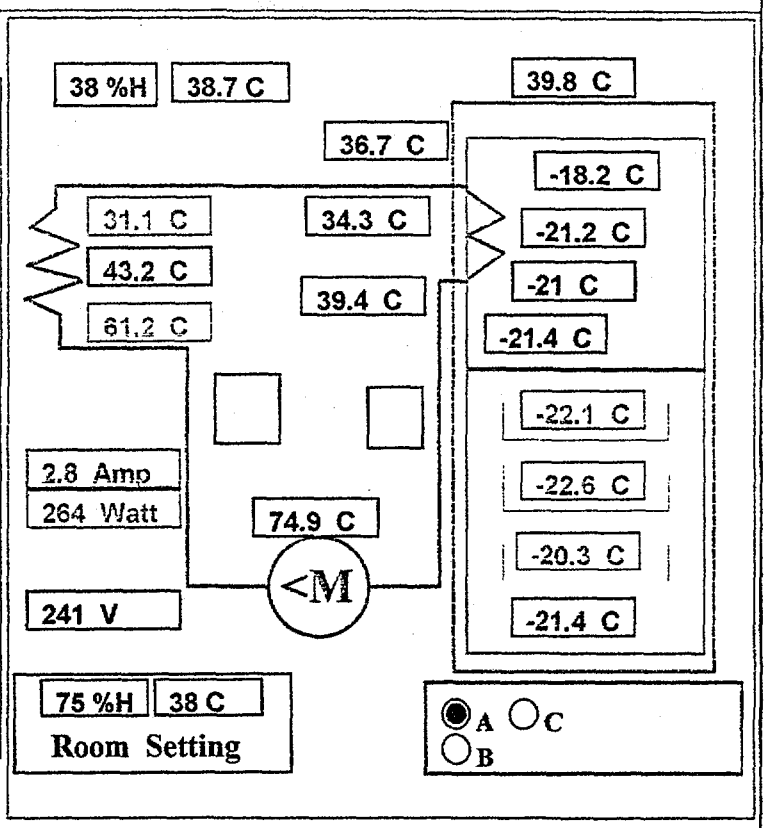
Maurice Ind. [Jordan]

TestDate: 01/01/03 13:35 *Report No.:* ( ) - Page 1

PageTestName: Energy Consumtion *ReportDate:* 2001/02/24 10:05

Page Result :

1 - Page Test Time	*9 Hours*
2 - Working Percent	*100 %On*
3 - Energy (Accord to page)	*1.592 kwh*
4 - Zoom Time	*16:16 Hour*
5 - Compr Current	*2.8 Amp*
6 - Evaprator Mean Temp	*-20.4 C*
7 - Cabin Mean Temp	*-21.6 C*
8 - Crisp Temp	*-21.4 C*
9 - Compr Temp	*74.9 C*
10- Condensor In Temp	*61.2 C*
11- Condensor Out Temp	*31.1 C*
12- Condition	*38.7 C 38 %H*
13- Volt	*Max=248 Mean=243 Min=235*
14-	
15-	
16-	
17-	



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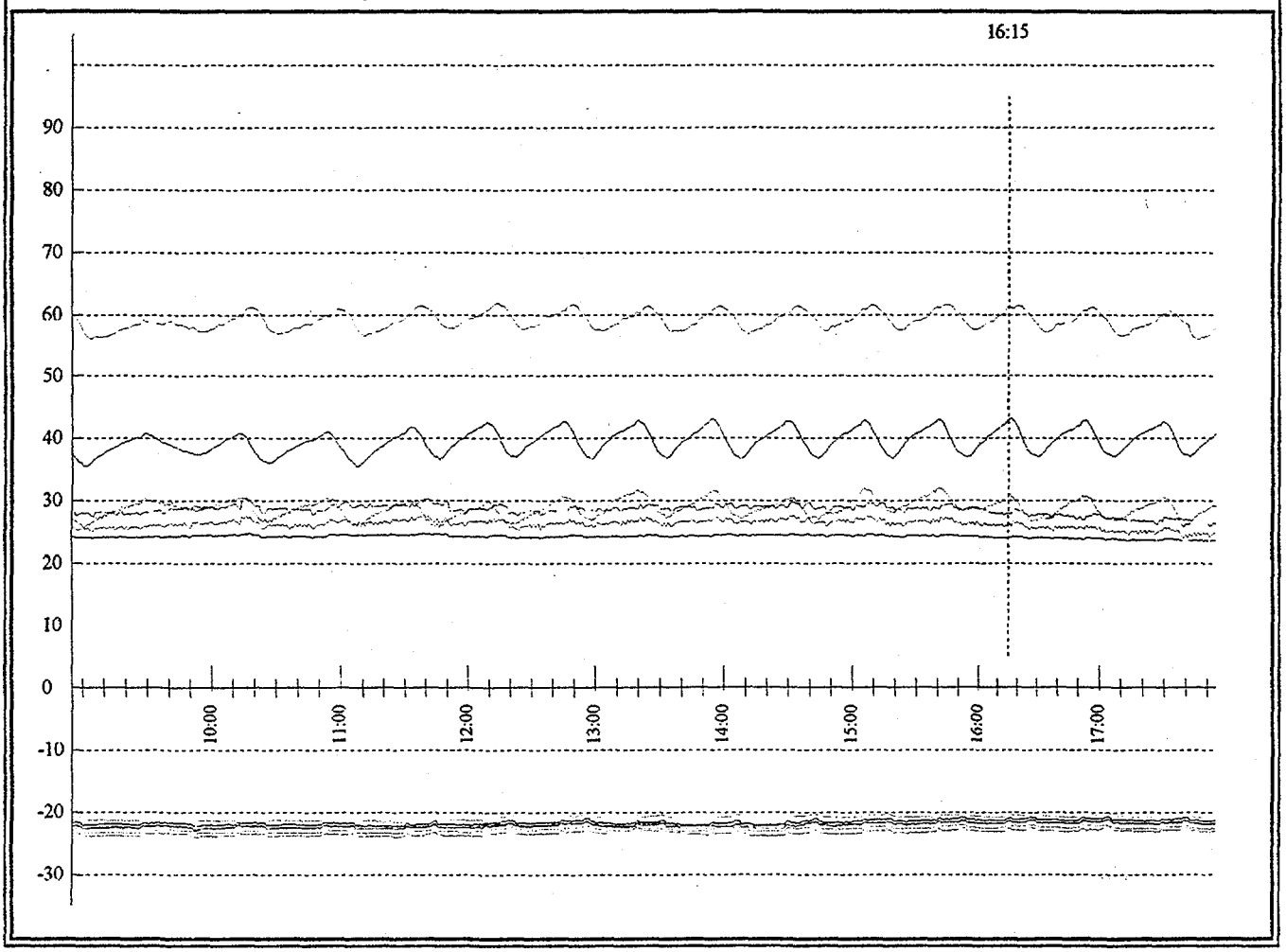

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Printing in Labaratory Of
Maurice Ind. [Jordan]

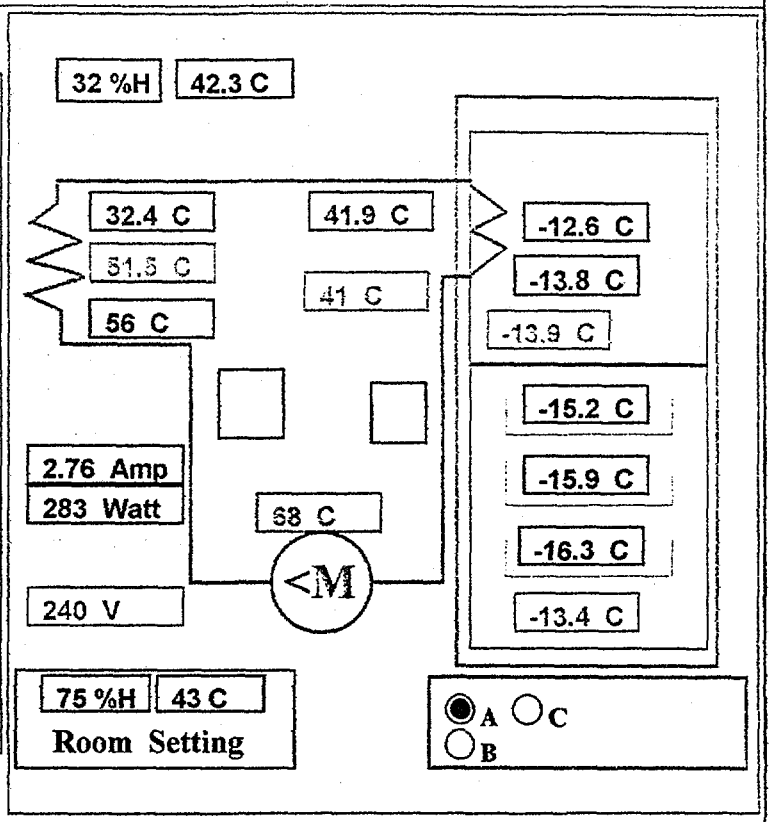
Maurice Ind. [Jordan]

TestDate: **01/01/18 08:58** *Report No.:* ( ) - Page 1

PageTestName: Energy Consumtion *ReportDate:* 2001/02/24 09:27

Page Result :

1 - Page Test Time	*20*	*Hours*
2 - Working Percent	*38*	*%On*
3 - Energy (Accord to page)	*1.86*	*kwh*
4 - Zoom Time	*28:49*	*Hour*
5 - Compr Current	*2.76*	*Amp*
6 - Evaprator Mean Temp	*-13*	*C*
7 - Cabin Mean Temp	*-15.8*	*C*
8 - Crisp Temp	*-13.4*	*C*
9 - Compr Temp	*68*	*C*
10- Condensor in Temp	*56*	*C*
11- Condensor Out Temp	*32.4*	*C*
12- Condition	*42.3 C*	*32 %H*
13- Volt	*Max=249 Mean=243 Min=234*	
14-		
15-		
16-		
17-		



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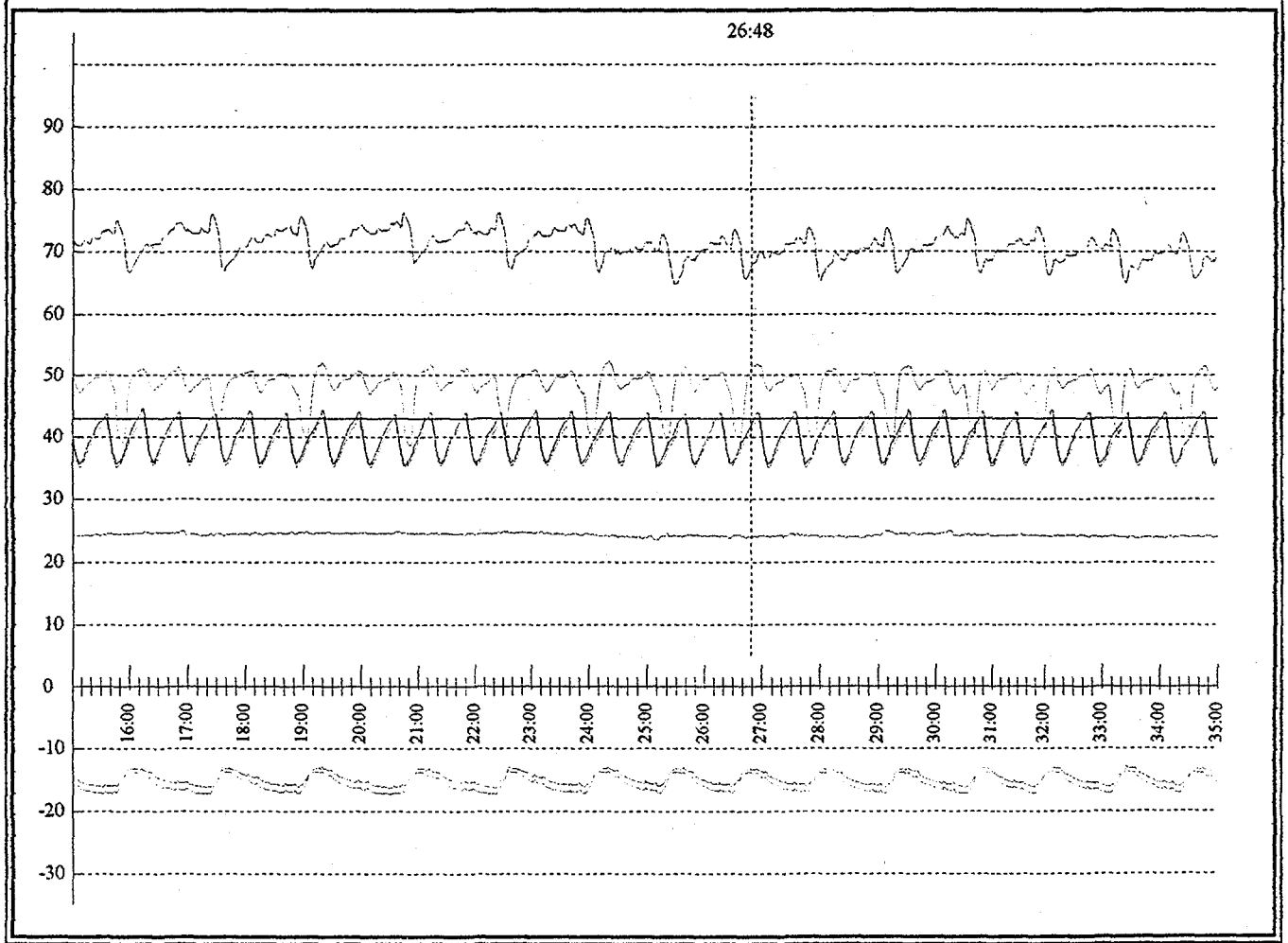

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