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22239

Maurice Al-Deek Company

UNIDO, Project Number
MP/JOR/98/89
Contract Number 99/023

Final Report

July 1999

Maurice Ind. ICEBERG موريس الصناعية

To: *Mr. V. Koloskov*
Contracts Officer
General Service Section
Financial Performance Control Branch
Field Operation and Administration Division
UINDO, Vienna, Austria
Fax: 00 431 26026 6815

Date: 28 July 1999

Subject: Final Report

Reference: Contract Number 99/023, Project Number MP/JOR/98/089

Dear Mr. Koloskov

We are Pleased to submit to you here with our Final Report of Contract number 99/023, regarding conversion of Prototypes. In our report you will find the main activities, calculation of prototypes for redesign and redefinition of models and also test result sheets of prototypes that have been tested at our Hot Chamber at our Factory in Amman. It is highly appreciated if you advise us for any further action. We also enclose invoice number 13473 for further action.

With Regards
Faithfully Yours

Maurice Al-Deek
Managing Director

cc. Dr. Malayeri, UNIDO Austria

مؤسسة موريس الديك
للثلاجات والمصنوعات المعدنية

هاتف معرض : ٦٥٣٢٦٢ - المصنع : ٧٣١٣٧٢ - فاكس : ٦١٣٣٤٠-٦-٩٦٢ - ص.ب : ٩٢١٩٤٠ عمان - الاردن
Tel Showroom : 653262 - Factory : 731372 - Fax : 962 -6- 613340 - P.O.Box : 921940 Amman - Jordan

To: Mr. V. Koloskov
Contracts Officer
General Service Section
Financial Performance Control Branch
Field Operation and Administration Division
UINDO, Vienna, Austria
Fax: 00 431 26026 6815

Date: 28 July 1999

Subject: *Invoice 13743, Final Payment*

Reference: *Contract Number 99/023, Project Number MP/JOR/98/089*

The amount of 4,000 four thousand USD, as the final payment of contract 99/023 referring to page 8 paragraph 3.05d) upon approval of final report , payable to :

Maurice Al-Deek Co.
Account Number 41396/8/515
Arab Bank Plc.
Abu-Alanda Branch
P.O. Box 351 Abu Alanda
Amman - Jordan

Tel: 00 962 6 4161451
Fax 00 962 6 4162161

Maurice Al-Deek
Managing Director

مؤسسة موريس الديك
للثلاجات والمصنوعات المعدنية

July 1999

UNIDO, Project MP/JOR/98/89 Contract 99/023

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Tel Showroom : 653262 - Factory : 731372 - Fax : 962 -6- 613340 - P.O.Box : 921940 Amman - Jordan

Printing In Labaratory Of
Maurice Ind. [Jordan]

Maurice Ind. [Jordan]

TestDate:	99/07/15 15:36	*Report No.:*	Spec & Remark
TestName:	Energy Consumtion	*ReportDate:*	99/07/16 15:09

Total Result :

1 - Total Test Time	*22 Hours*	
2 - Working Percent	*98 %On*	
3 - Energy	*3.757 kwh*	
4 - Zoom Time	*22:33 Hour*	
5 - Compr Current	*3.02 Amp*	
6 - Evaprator Mean Temp	*3.6 C*	
7 - Cabin Mean Temp	*6.9 C*	
8 - Crisp Temp	*8 C*	
9 - Compr Temp	*64 C*	
10- Condensor In Temp	*67.6 C*	
11- Condensor Out Temp	*21.2 C*	
12- Condition	*31.1 C*	*38 %H*
13- Volt	*Max=246 Mean=238 Min=218*	
14-		
15-		
16-		
17-		

Product Spec :

1 - File Name		*99071515.k36*
2 - Test Kind	G	*Perform.*
3 - Product Serial		*Prt.mdsw*
4 - Product Name		*Show case*
5 - Product Model		*MDM-200*
6 - Product Capacity		*3 Stage*
7 - Compressor Name		*Elc. lux*
8 - Compressor Model		*R134a*
9 - Compressor Power		*1/3 Hp*
10 - Compressor Amper		*3 Amp*
11 - Thermostat No.		*3*
12 - Thermostat Type		*Ranco*
13 -		
14 -		

Technical Manager: *ICRC*

Lab Chief : *MARIO AL-DEEK*

Lab Specialist: *ZIAD*

Remark :

Remark1
Remark2
Remark3

Remark :

sign :

Industrial Control Research Center HotRoom Ver 5

Printing In Labaratory Of
Maurice Ind. [Jordan]

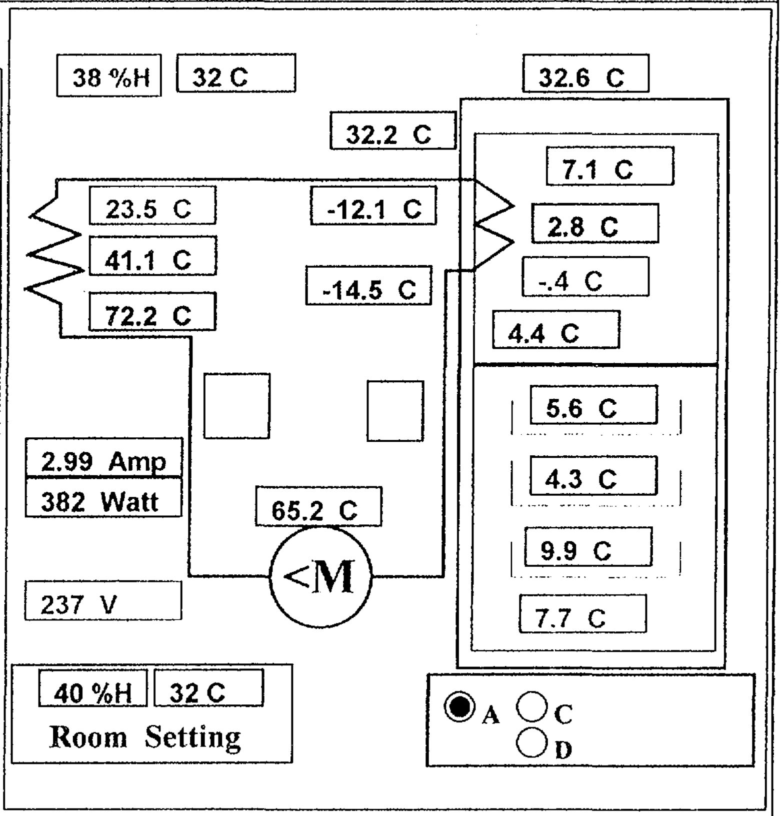
Maurice Ind. [Jordan]

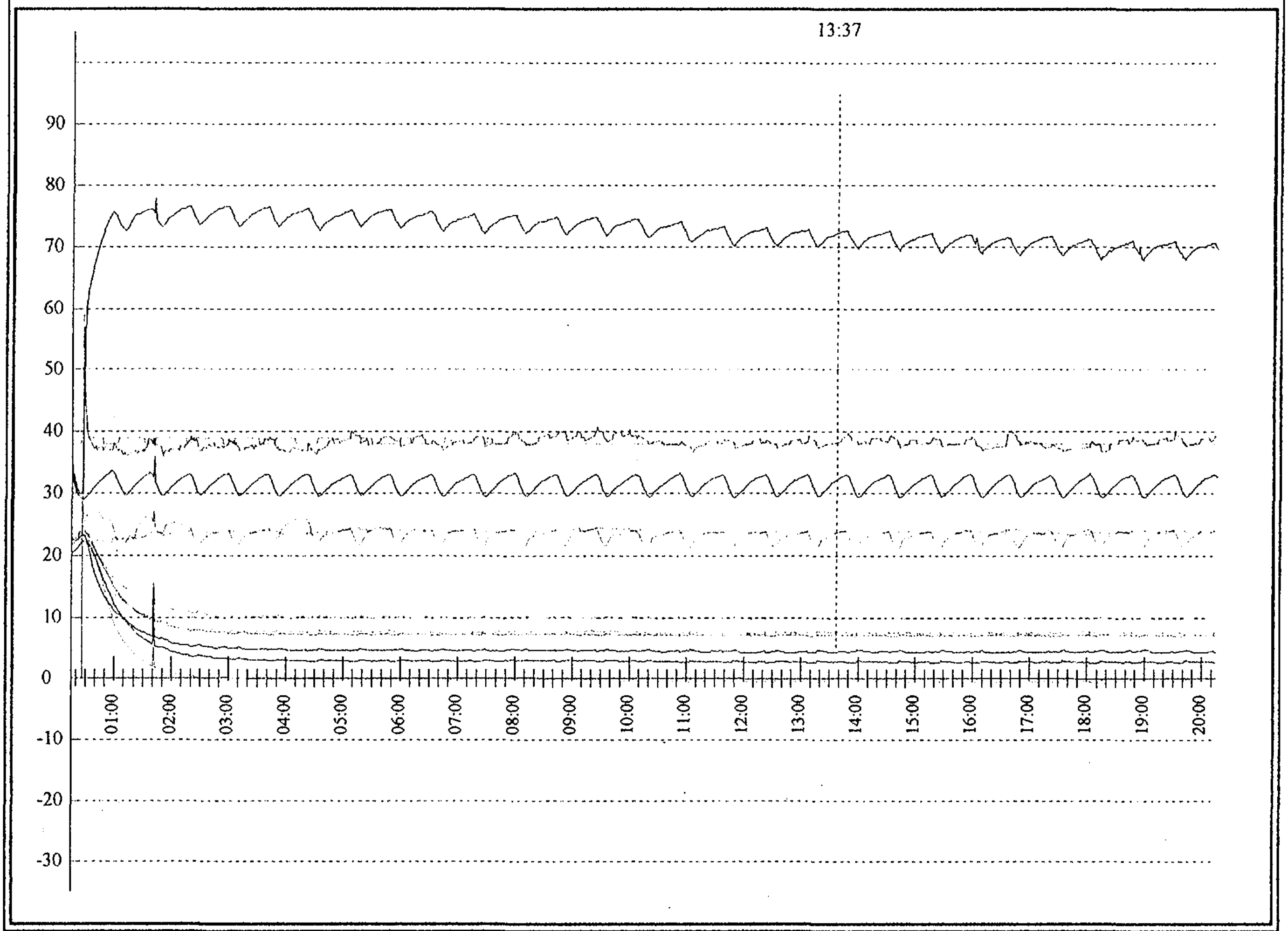
TestDate: 99/07/15 15:36 *Report No.:* ( ) - Page 1

PageTestName: Energy Consumtion *ReportDate:* 99/07/16 15:52

Page Result :

1 - Page Test Time	*20*	*Hours*
2 - Working Percent	*99*	*%On*
3 - Energy (Accord to page)	*3.803*	*kwh*
4 - Zoom Time	*13:37*	*Hour*
5 - Compr Current	*2.99*	*Amp*
6 - Evaprator Mean Temp	*3.4*	*C*
7 - Cabin Mean Temp	*6.6*	*C*
8 - Crisp Temp	*7.7*	*C*
9 - Compr Temp	*65.2*	*C*
10- Condensor In Temp	*72.2*	*C*
11- Condensor Out Temp	*23.5*	*C*
12- Condition	*32 C*	*38 %H*
13- Volt	*Max=245 Mean=237 Min=218*	
14-		
15-		
16-		
17-		





Industrial Control Research Center HotRoom Ver 5

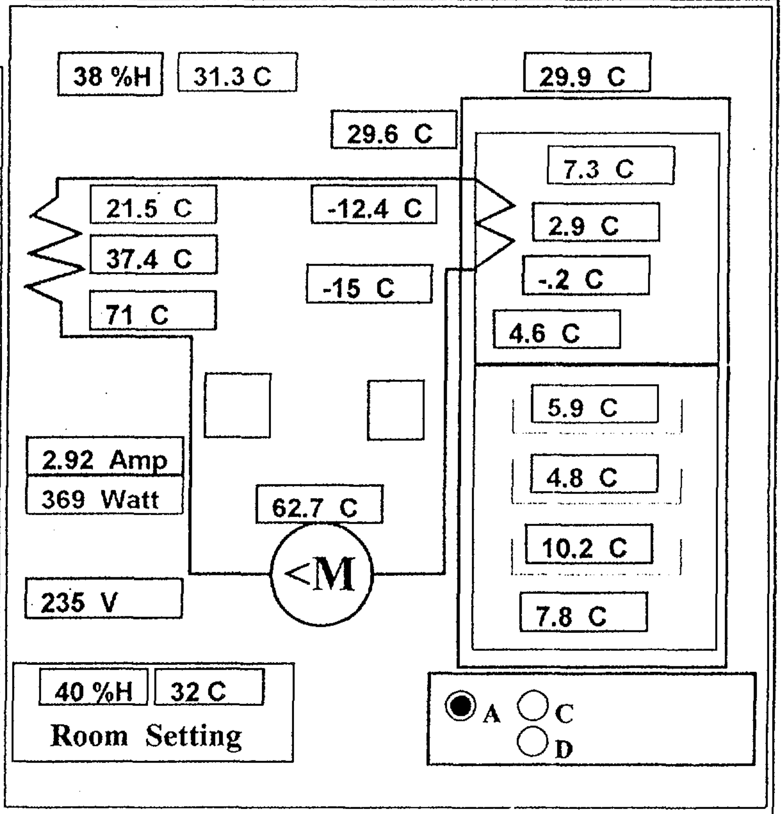
Printing In Labaratory Of
Maurice Ind. [Jordan]

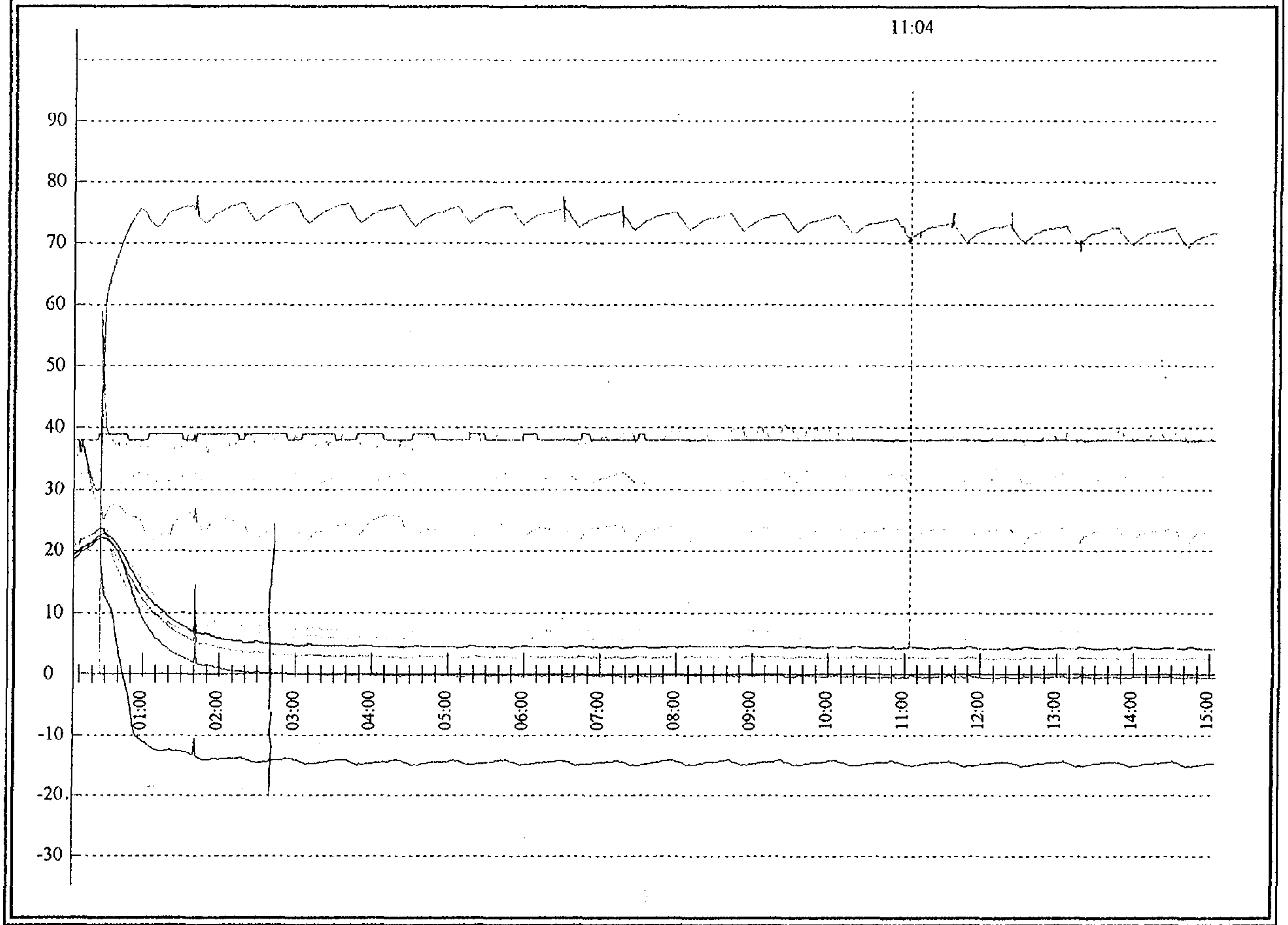
Maurice Ind. [Jordan]

TestDate: 99/07/15 15:36 *Report No.:* ( ) - Page 1
PageTestName: Energy Consumtion *ReportDate:* 99/07/16 15:42

Page Result :

1 - Page Test Time	*15 Hours*	
2 - Working Percent	*97 %On*	
3 - Energy (Accord to page)	*3.745 kwh*	
4 - Zoom Time	*11:04 Hour*	
5 - Compr Current	*2.92 Amp*	
6 - Evaprator Mean Temp	*3.6 C*	
7 - Cabin Mean Temp	*6.9 C*	
8 - Crisp Temp	*7.8 C*	
9 - Compr Temp	*62.7 C*	
10- Condensor In Temp	*71 C*	
11- Condensor Out Temp	*21.5 C*	
12- Condition	*31.3 C*	*38 %H*
13- Volt	*Max=245 Mean=237 Min=218*	
14-		
15-		
16-		
17-		





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Printing in Labaratory Of
Maurice Ind. [Jordan]

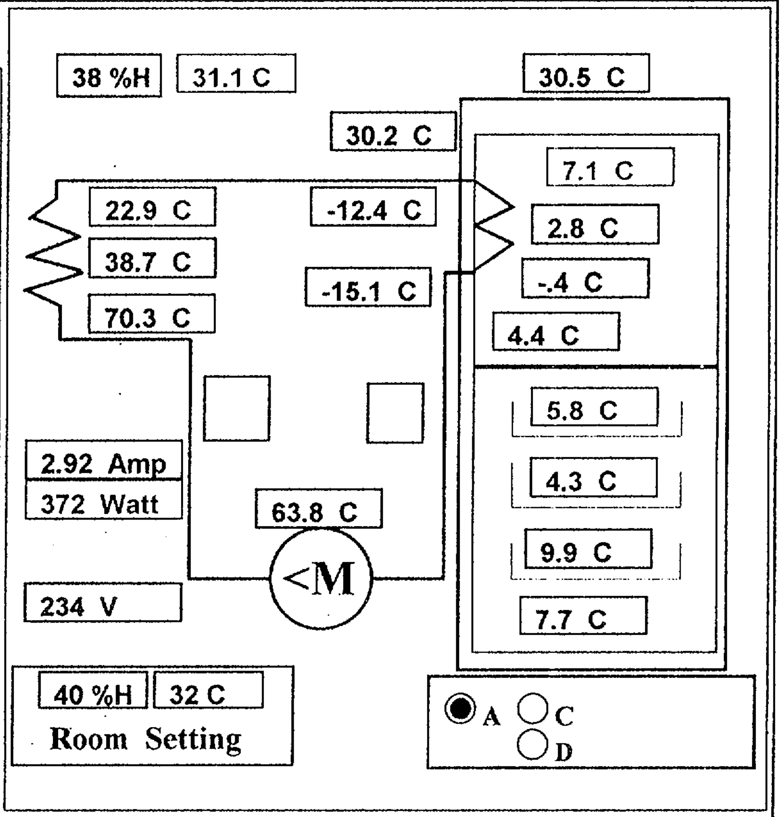
Maurice Ind. [Jordan]

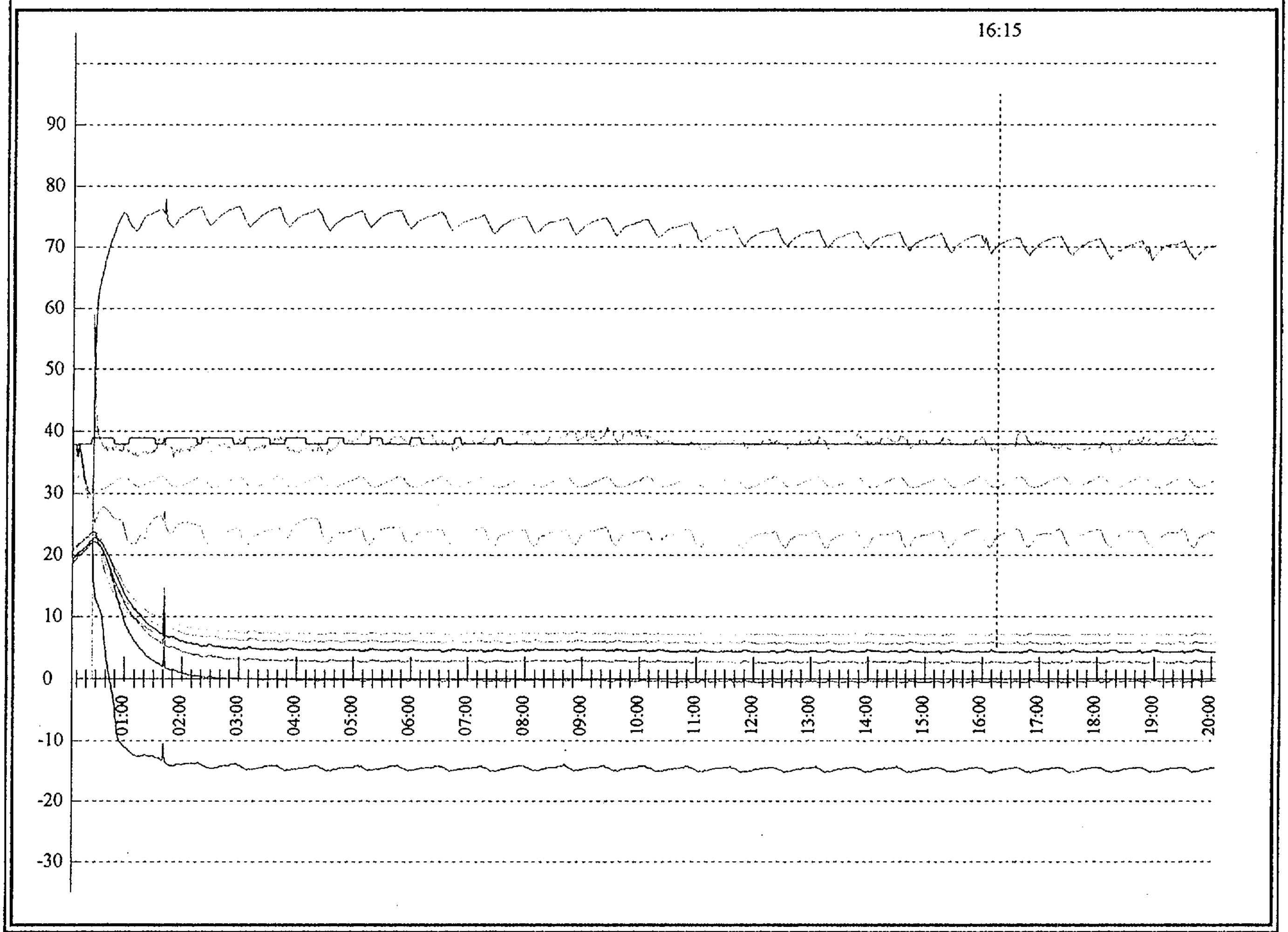
TestDate: 99/07/15 15:36 *Report No.:* ( ) - Page 1

PageTestName: Energy Consumtion *ReportDate:* 99/07/16 15:39

Page Result :

1 - Page Test Time *20 Hours*
2 - Working Percent *98 %On*
3 - Energy (Accord to page) *3.771 kwh*
4 - Zoom Time *16:15 Hour*
5 - Compr Current *2.92 Amp*
6 - Evaprator Mean Temp *3.4 C*
7 - Cabin Mean Temp *6.6 C*
8 - Crisp Temp *7.7 C*
9 - Compr Temp *63.8 C*
10- Condensor In Temp *70.3 C*
11- Condensor Out Temp *22.9 C*
12- Condition *31.1 C 38 %H*
13- Volt *Max=245 Mean=237 Min=218*
14-
15-
16-
17-





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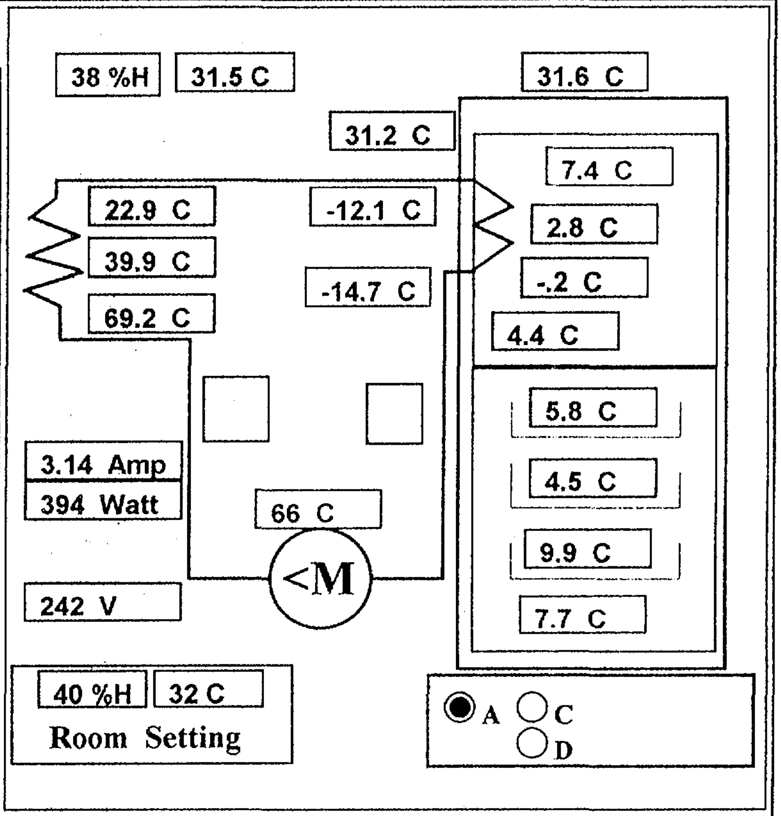
Printing In Labaratory Of
Maurice Ind. [Jordan]

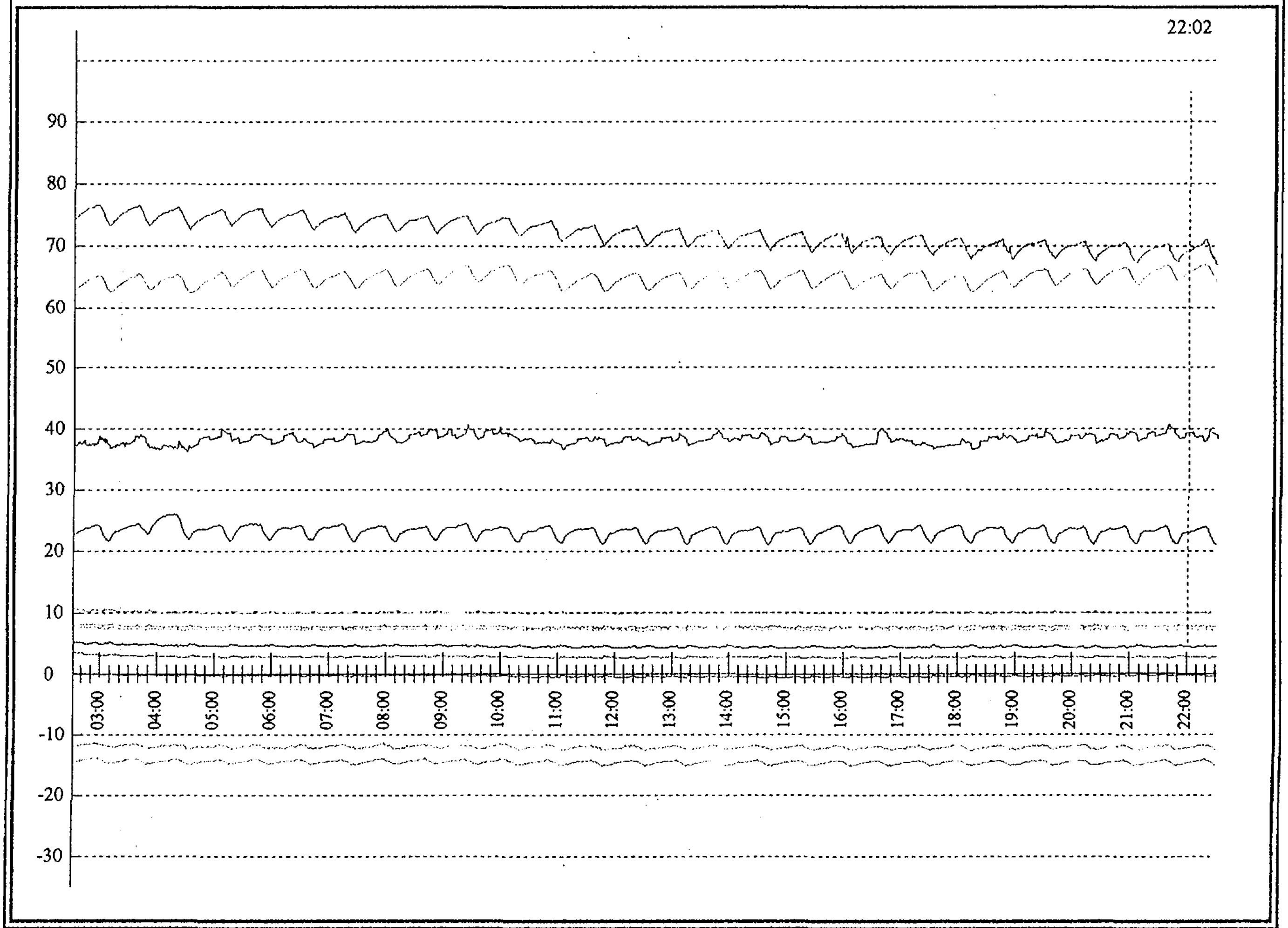
Maurice Ind. [Jordan]

TestDate: 99/07/15 15:36 *Report No.:* ( ) - Page 1
PageTestName: Energy Consumtion *ReportDate:* 99/07/16 15:30

Page Result :

1 - Page Test Time	*20 Hours*
2 - Working Percent	*100 %On*
3 - Energy (Accord to page)	*3.846 kwh*
4 - Zoom Time	*22:02 Hour*
5 - Compr Current	*3.14 Amp*
6 - Evaprator Mean Temp	*3.6 C*
7 - Cabin Mean Temp	*6.7 C*
8 - Crisp Temp	*7.7 C*
9 - Compr Temp	*66 C*
10- Condensor In Temp	*69.2 C*
11- Condensor Out Temp	*22.9 C*
12- Condition	*31.5 C 38 %H*
13- Volt	*Max=246 Mean=239 Min=230*
14-	
15-	
16-	
17-	





Industrial Control Research Center HotRoom Ver 5

Printing In Labaratory Of
Maurice Ind. [Jordan]

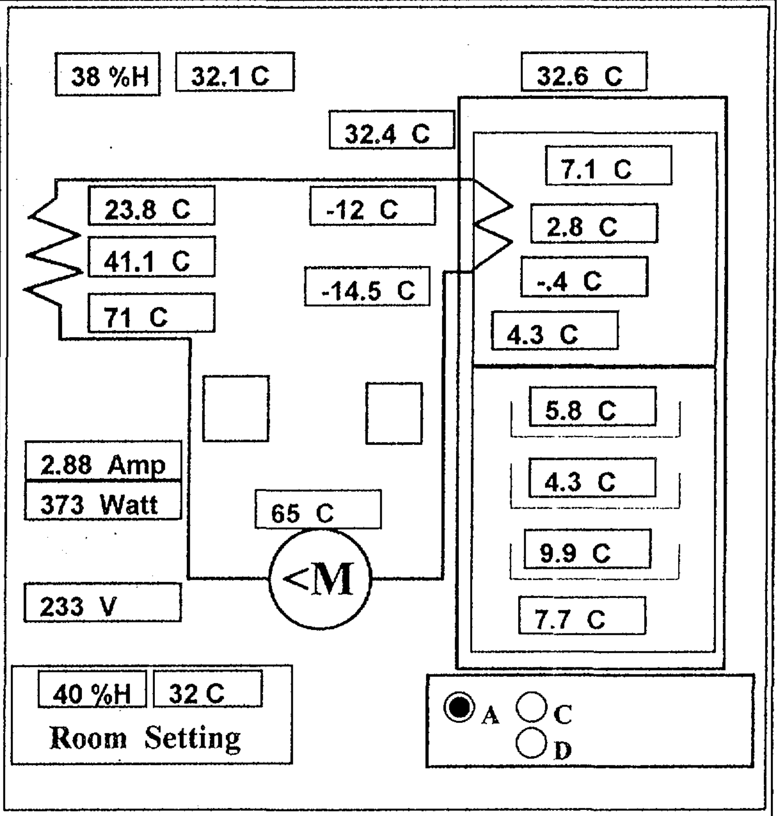
Maurice Ind. [Jordan]

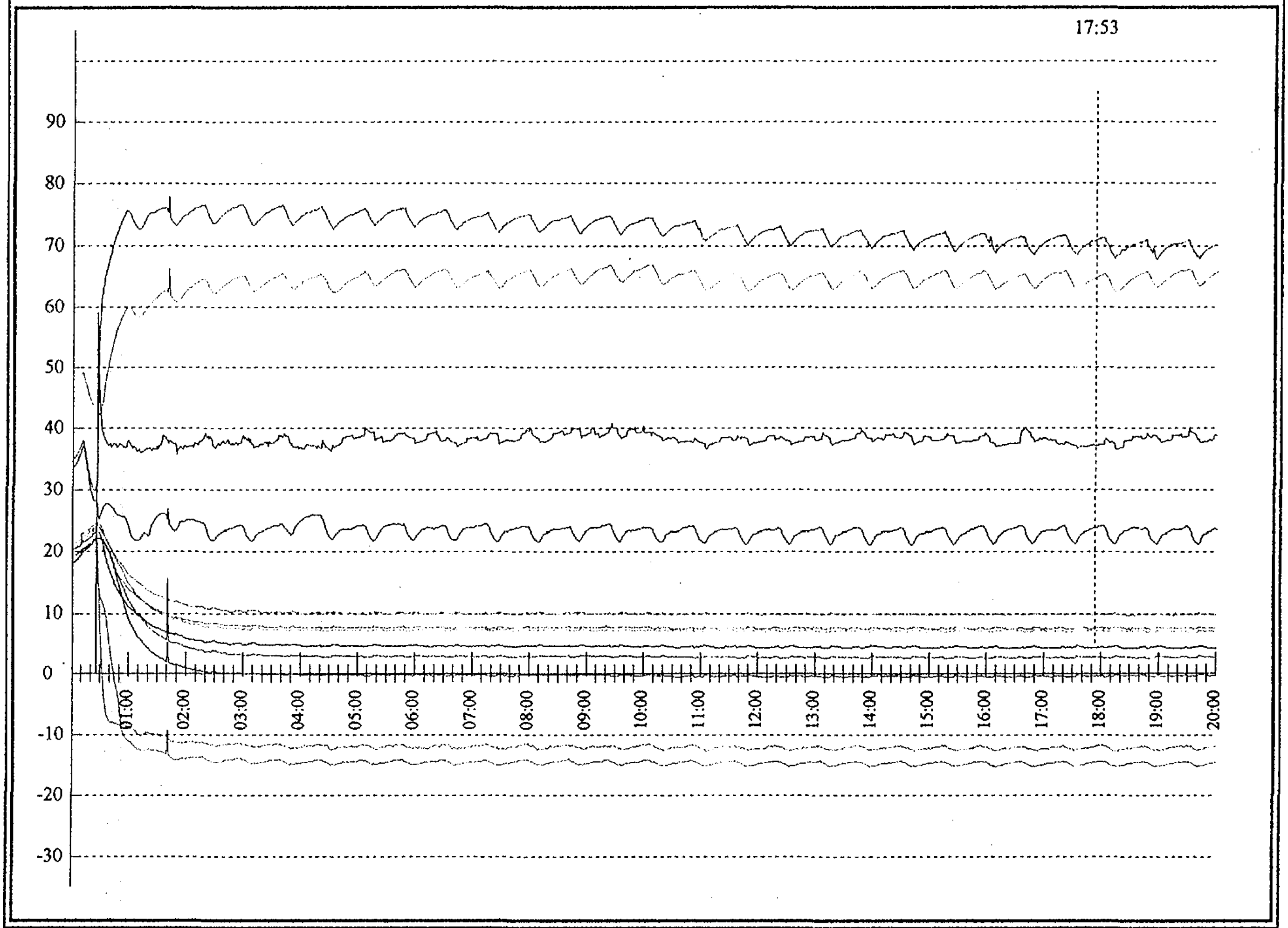
TestDate: 99/07/15 15:36 ***Report No.:*** ( ) - Page 1

PageTestName: Energy Consumtion ***ReportDate:*** 99/07/16 15:27

Page Result :

1 - Page Test Time	*20 Hours*	
2 - Working Percent	*97 %On*	
3 - Energy (Accord to page)	*3.754 kwh*	
4 - Zoom Time	*17:54 Hour*	
5 - Compr Current	*2.88 Amp*	
6 - Evaprator Mean Temp	*3.4 C*	
7 - Cabin Mean Temp	*6.6 C*	
8 - Crisp Temp	*7.7 C*	
9 - Compr Temp	*65 C*	
10- Condensor In Temp	*71 C*	
11- Condensor Out Temp	*23.8 C*	
12- Condition	*32.1 C*	*38 %H*
13- Volt	*Max=245 Mean=237 Min=218*	
14-		
15-		
16-		
17-		





Printing In Labaratory Of
Maurice Ind. [Jordan]

Maurice Ind. [Jordan]

TestDate: 99/07/15 15:36 ***Report No.:*** ( ) - Page 1
PageTestName: Energy Consumtion ***ReportDate:*** 99/07/16 15:19

Page Result :

1 - Page Test Time	*10 Hours*
2 - Working Percent	*100 %On*
3 - Energy (Accord to page)	*3.877 kwh*
4 - Zoom Time	*17:43 Hour*
5 - Compr Current	*2.89 Amp*
6 - Evaprator Mean Temp	*3.4 C*
7 - Cabin Mean Temp	*6.6 C*
8 - Crisp Temp	*7.7 C*
9 - Compr Temp	*64.1 C*
10- Condensor In Temp	*70.3 C*
11- Condensor Out Temp	*23.1 C*
12- Condition	*31.3 C 38 %H*
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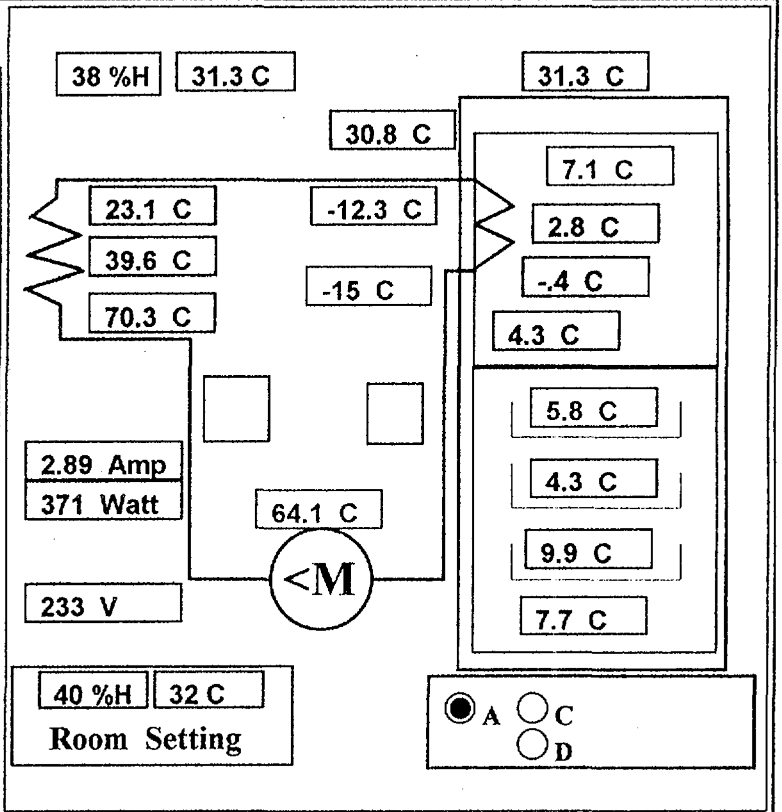
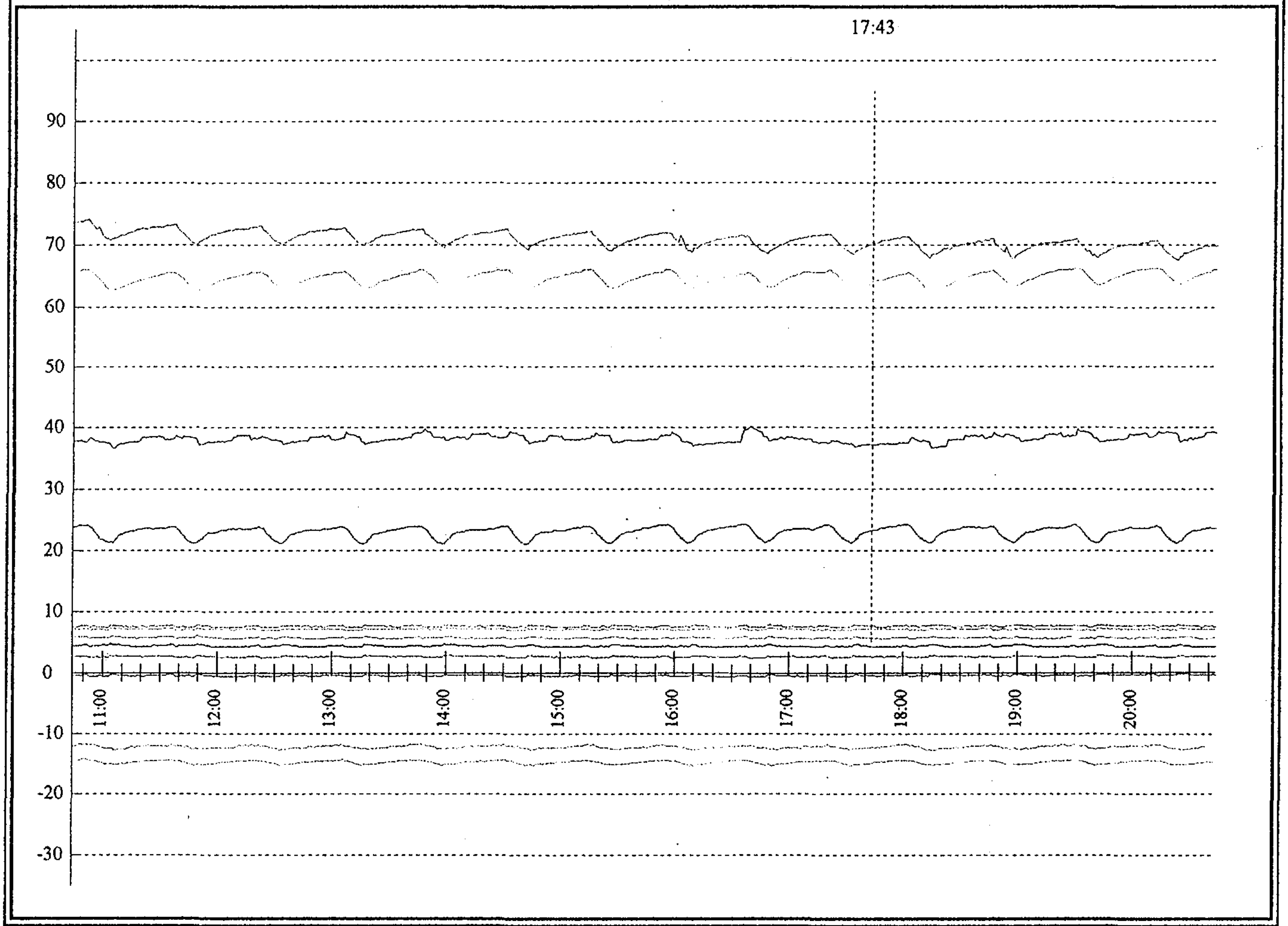
15-	
16-	
17-	





Industrial Control Research Center HotRoom Ver 5

Printing In Labaratory Of
Maurice Ind. [Jordan]

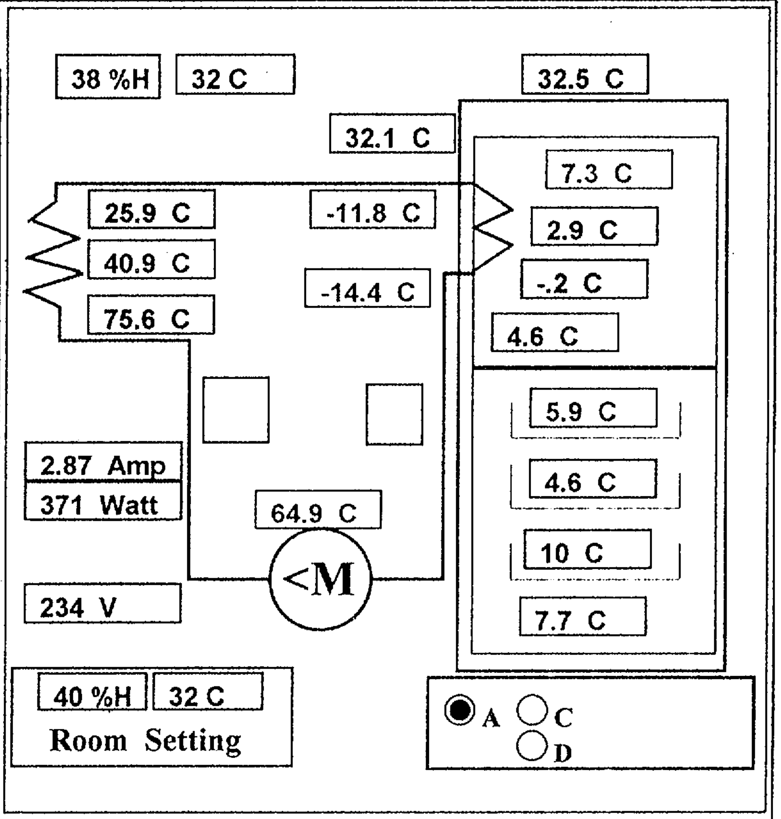
Maurice Ind. [Jordan]

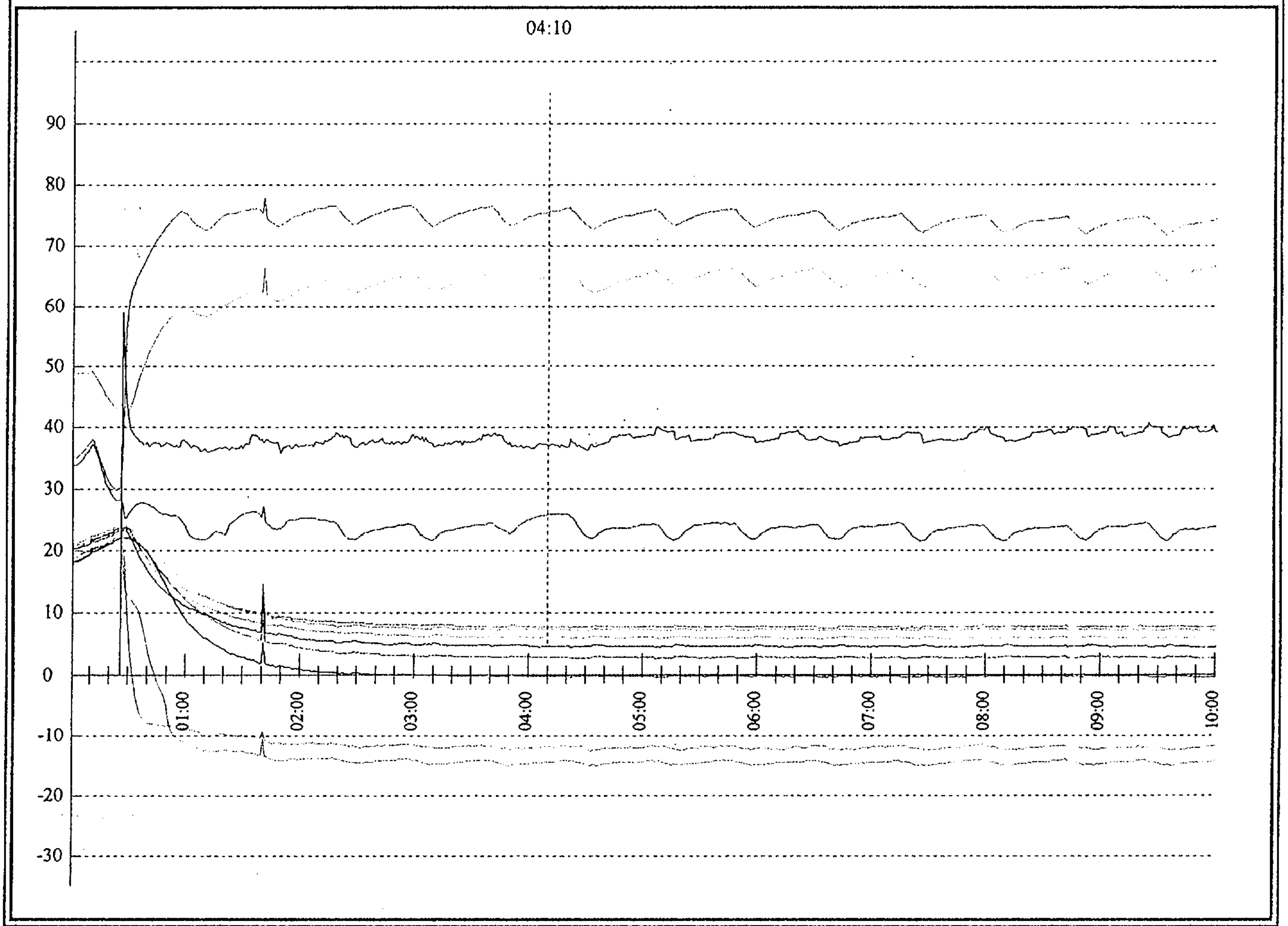
TestDate: 99/07/15 15:36 ***Report No.:*** ( ) - Page 1

PageTestName: Energy Consumtion ***ReportDate:*** 99/07/16 15:16

Page Result :

1 - Page Test Time	*10 Hours*
2 - Working Percent	*95 %On*
3 - Energy (Accord to page)	*3.639 kwh*
4 - Zoom Time	*4:10 Hour*
5 - Compr Current	*2.87 Amp*
6 - Evaprator Mean Temp	*3.6 C*
7 - Cabin Mean Temp	*6.8 C*
8 - Crisp Temp	*7.7 C*
9 - Compr Temp	*64.9 C*
10- Condensor In Temp	*75.6 C*
11- Condensor Out Temp	*25.9 C*
12- Condition	*32 C 38 %H*
13- Volt	*Max=245 Mean=237 Min=218*
14-	
15-	
16-	
17-	





Industrial Control Research Center HotRoom Ver 5

Printing In Labaratory Of
Maurice Ind. [Jordan]

Maurice Ind. [Jordan]

TestDate: 99/07/15 15:36 *Report No.:* Spec & Remark
TestName: Energy Consumtion *ReportDate:* 99/07/16 15:02

Total Result :

1 - Total Test Time	*22*	*Hours*
2 - Working Percent	*68*	*%On*
3 - Energy	*2.468*	*kwh*
4 - Zoom Time	*22:33*	*Hour*
5 - Compr Current	*3.51*	*Amp*
6 - Evaprator Mean Temp	*-5.7*	*C*
7 - Cabin Mean Temp	*-2.8*	*C*
8 - Crisp Temp	*-5.5*	*C*
9 - Compr Temp	*51*	*C*
10- Condensor In Temp	*59.8*	*C*
11- Condensor Out Temp	*32.4*	*C*
12- Condition	*31.1 C*	*38 %H*
13- Volt	*Max=246 Mean=238 Min=218*	
14-		
15-		
16-		
17-		

Product Spec :

1 - File Name		*99071515.k36*
2 - Test Kind	G	*Perform.*
3 - Product Serial		*Prt-mdcf2*
4 - Product Name		*Chest Free*
5 - Product Model		*MDCF-125*
6 - Product Capacity		*1250 lit*
7 - Compressor Name		*Elec.lux*
8 - Compressor Model		*R134a*
9 - Compressor Power		*1/4 Hp*
10 - Compressor Amper		
11 - Thermostat No.		*3*
12 - Thermostat Type		*Ranco*
13 -		
14 -		

Technical Manager: *ICRC*

Lab Chief : *MARIO AL-DEEK*

Lab Specialist: *ZIAD*

Remark :

Remark1
Remark2
Remark3

Remark :

sign :

Industrial Control Research Center HotRoom Ver 5

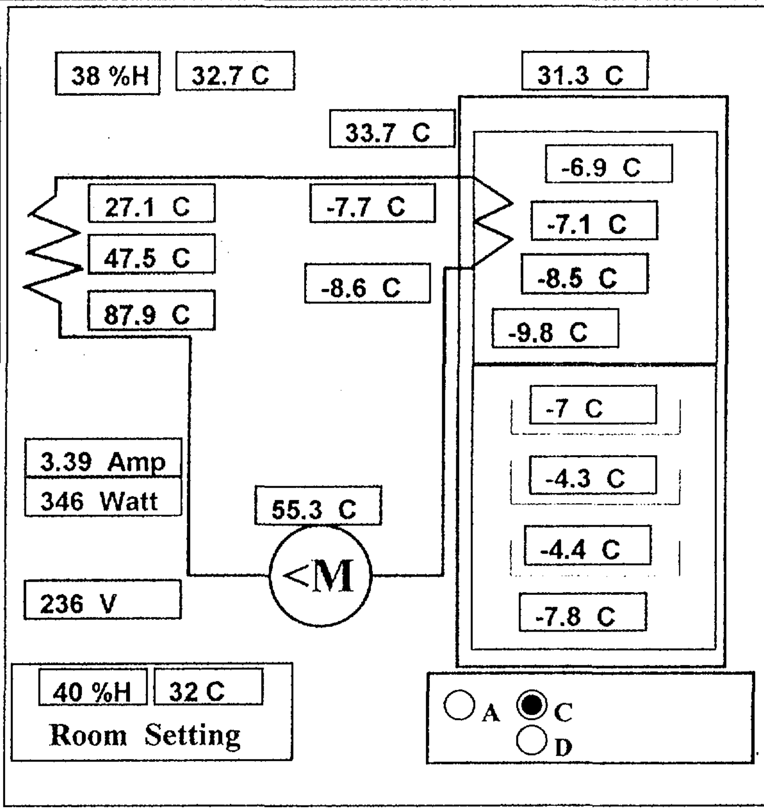
Printing In Labaratory Of
Maurice Ind. [Jordan]

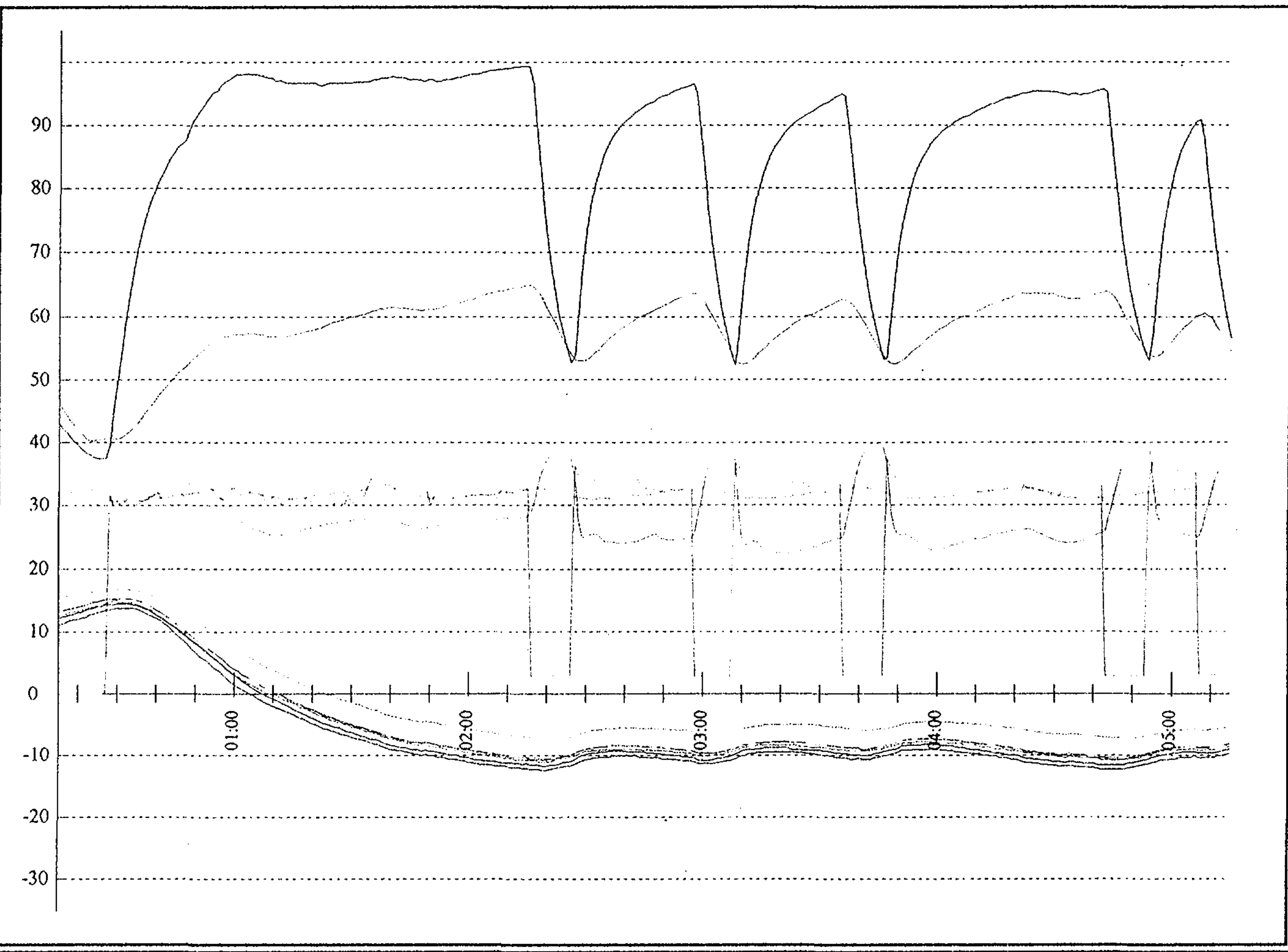
Maurice Ind. [Jordan]

TestDate: 99/07/15 15:36 *Report No.:* ( ) - Page 1
PageTestName: Energy Consumtion *ReportDate:* 99/07/16 14:30

Page Result :

1 - Page Test Time	*5 Hours*
2 - Working Percent	*78 %On*
3 - Energy (Accord to page)	*2.337 kwh*
4 - Zoom Time	*13:05 Hour*
5 - Compr Current	*3.39 Amp*
6 - Evaprator Mean Temp	*-8 C*
7 - Cabin Mean Temp	*-5.2 C*
8 - Crisp Temp	*-7.8 C*
9 - Compr Temp	*55.3 C*
10- Condensor In Temp	*87.9 C*
11- Condensor Out Temp	*27.1 C*
12- Condition	*32.7 C 38 %H*
13- Volt	*Max=245 Mean=234 Min=218*
14-	
15-	
16-	
17-	





Industrial Control Research Center HotRoom Ver 5

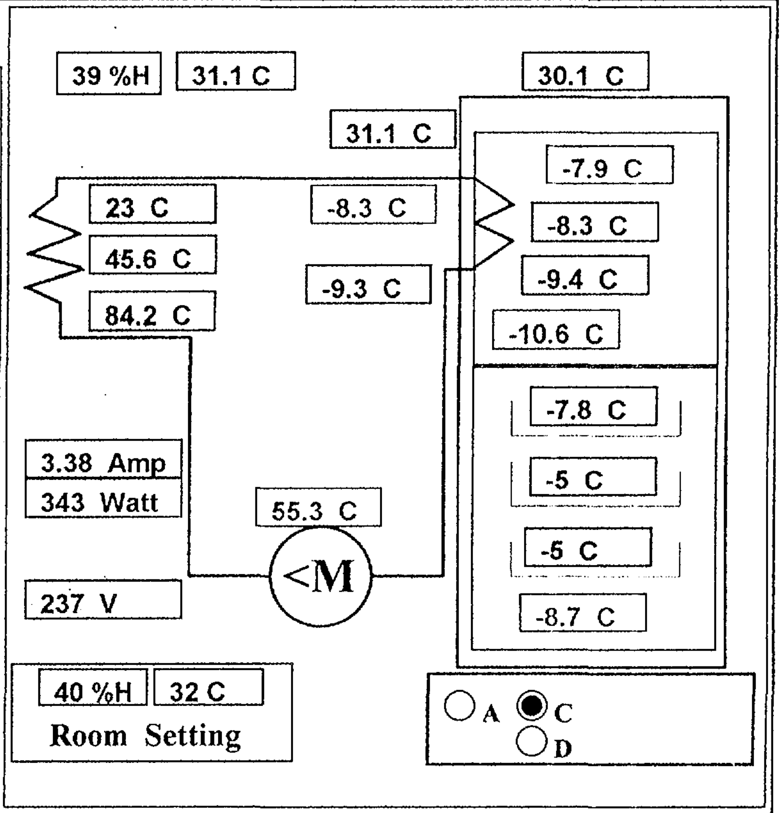
Printing In Labaratory Of
Maurice Ind. [Jordan]

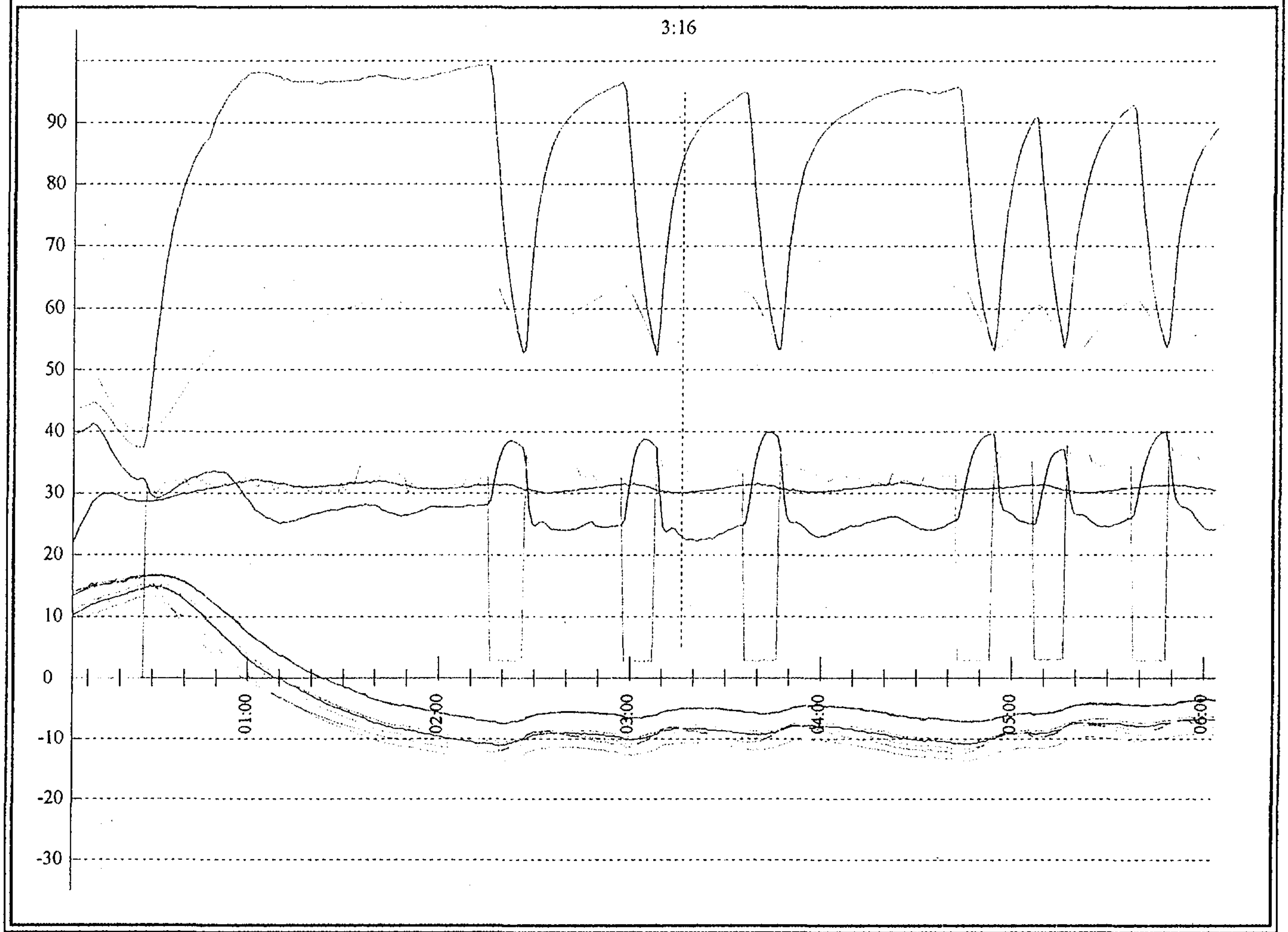
Maurice Ind. [Jordan]

TestDate: 99/07/15 15:36 *Report No.:* ( ) - Page 1
PageTestName: Energy Consumtion *ReportDate:* 99/07/16 14:55

Page Result :

1 - Page Test Time	*6 Hours*
2 - Working Percent	*76 %On*
3 - Energy (Accord to page)	*2.348 kwh*
4 - Zoom Time	*3:16 Hour*
5 - Compr Current	*3.38 Amp*
6 - Evaprator Mean Temp	*-9 C*
7 - Cabin Mean Temp	*-5.9 C*
8 - Crisp Temp	*-8.7 C*
9 - Compr Temp	*55.3 C*
10- Condensor In Temp	*84.2 C*
11- Condensor Out Temp	*23 C*
12- Condition	*31.1 C 39 %H*
13- Volt	*Max=245 Mean=235 Min=218*
14-	
15-	
16-	
17-	





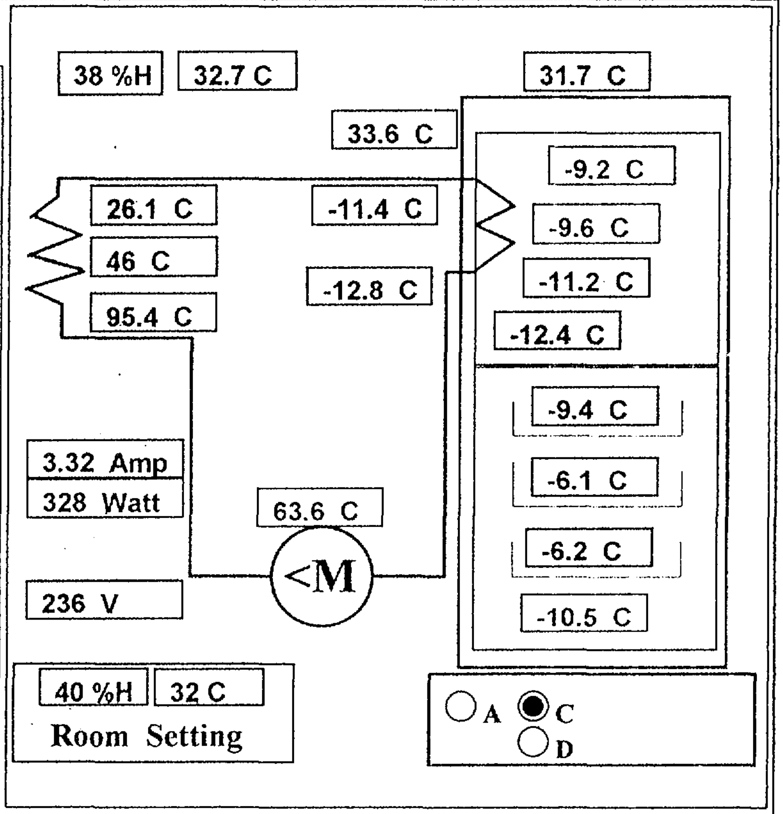
Printing In Labaratory Of
Maurice Ind. [Jordan]

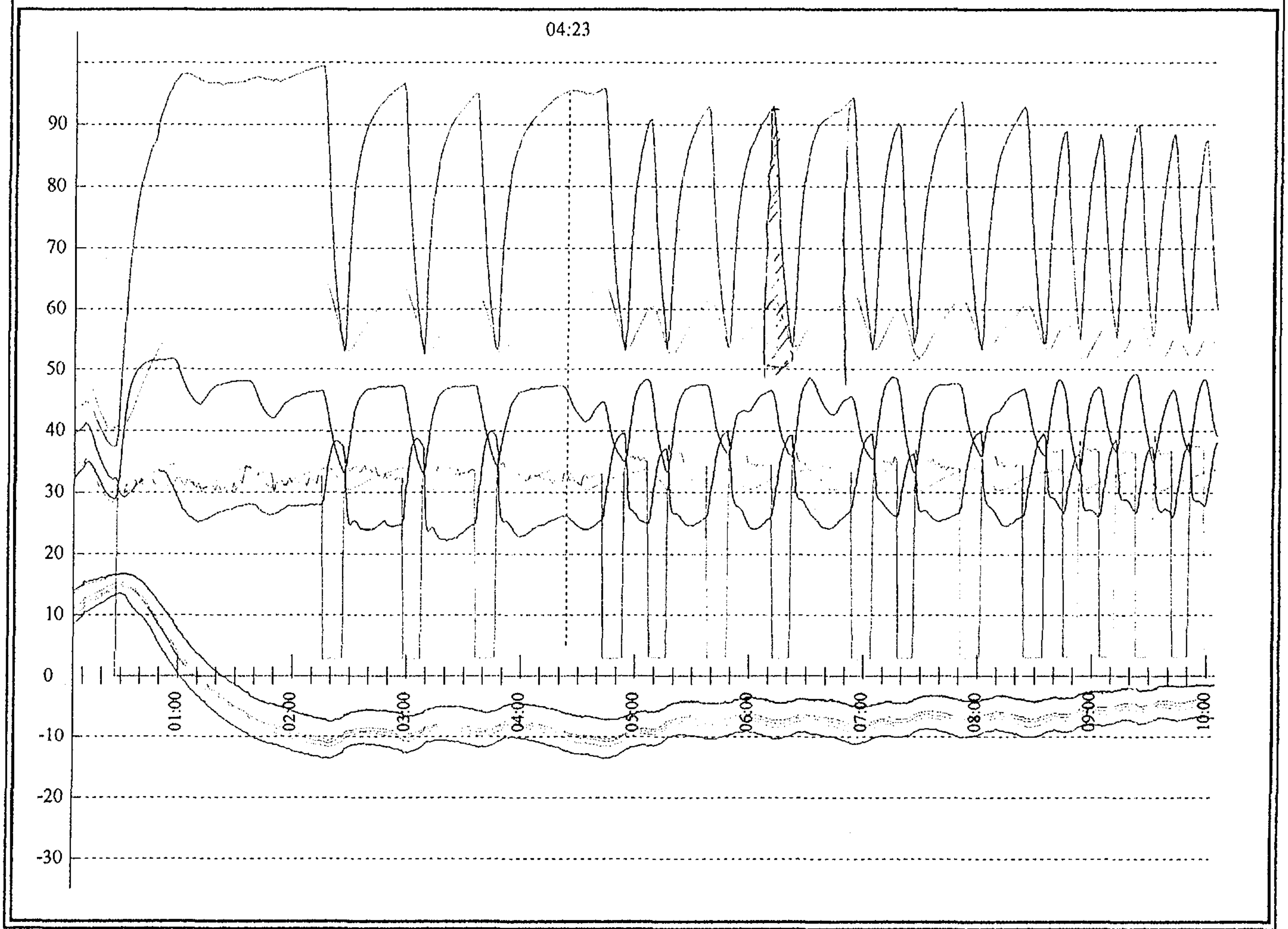
Maurice Ind. [Jordan]

TestDate: 99/07/15 15:36 *Report No.:* ( ) - Page 1
PageTestName: Energy Consumtion *ReportDate:* 99/07/16 14:46

Page Result :

1 - Page Test Time	*10 Hours*	
2 - Working Percent	*70 %On*	
3 - Energy (Accord to page)	*2.413 kwh*	
4 - Zoom Time	*4:24 Hour*	
5 - Compr Current	*3.32 Amp*	
6 - Evaprator Mean Temp	*-10.6 C*	
7 - Cabin Mean Temp	*-7.2 C*	
8 - Crisp Temp	*-10.5 C*	
9 - Compr Temp	*63.6 C*	
10- Condensor In Temp	*95.4 C*	
11- Condensor Out Temp	*26.1 C*	
12- Condition	*32.7 C*	*38 %H*
13- Volt	*Max=245 Mean=237 Min=218*	
14-		
15-		
16-		
17-		





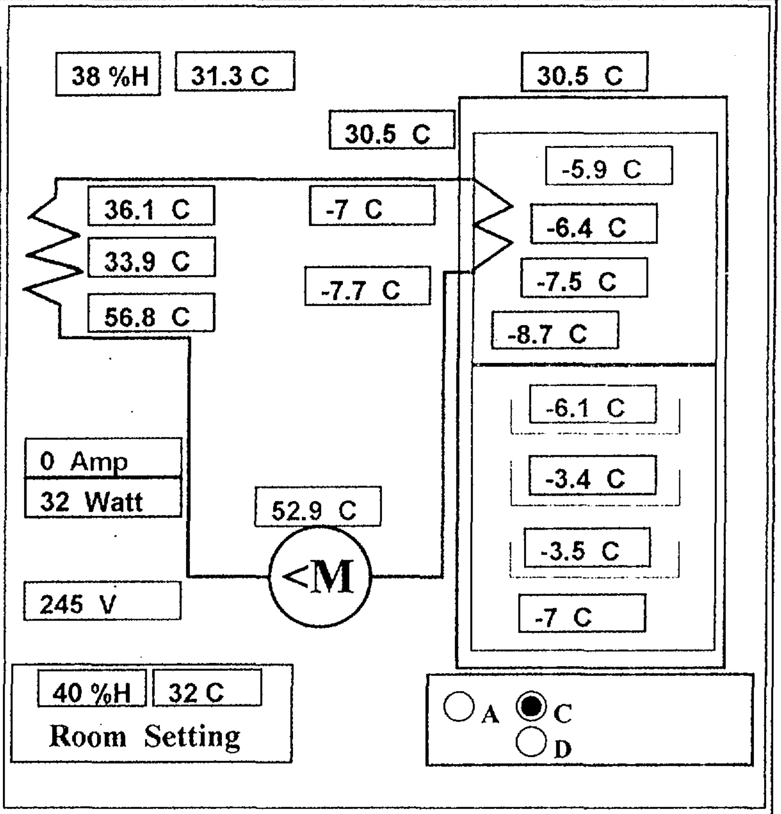
Industrial Control Research Center HotRoom Ver 5

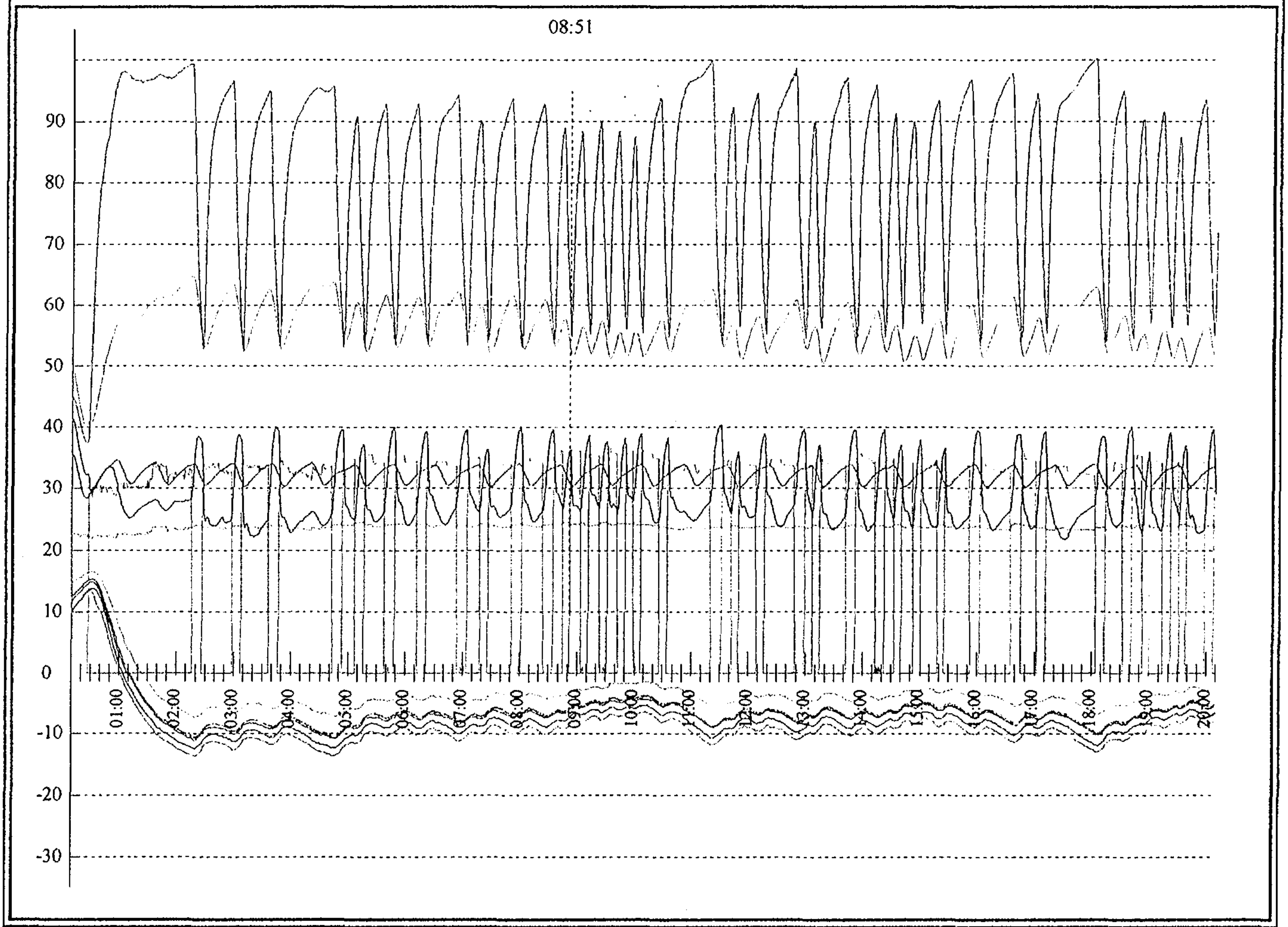
Maurice Ind. [Jordan]

TestDate: 99/07/15 15:36 **Report No.:** ( ) - Page 1
PageTestName: Energy Consumtion **ReportDate:** 99/07/16 14:38

Page Result :

1 - Page Test Time	*20 Hours*
2 - Working Percent	*69 %On*
3 - Energy (Accord to page)	*2.492 kwh*
4 - Zoom Time	*8:52 Hour*
5 - Compr Current	*00 Amp*
6 - Evaprator Mean Temp	*-7.1 C*
7 - Cabin Mean Temp	*-4.3 C*
8 - Crisp Temp	*-7 C*
9 - Compr Temp	*52.9 C*
10- Condensor In Temp	*56.8 C*
11- Condensor Out Temp	*36.1 C*
12- Condition	*31.3 C 38 %H*
13- Volt	*Max=245 Mean=237 Min=218*
14-	
15-	
16-	
17-	





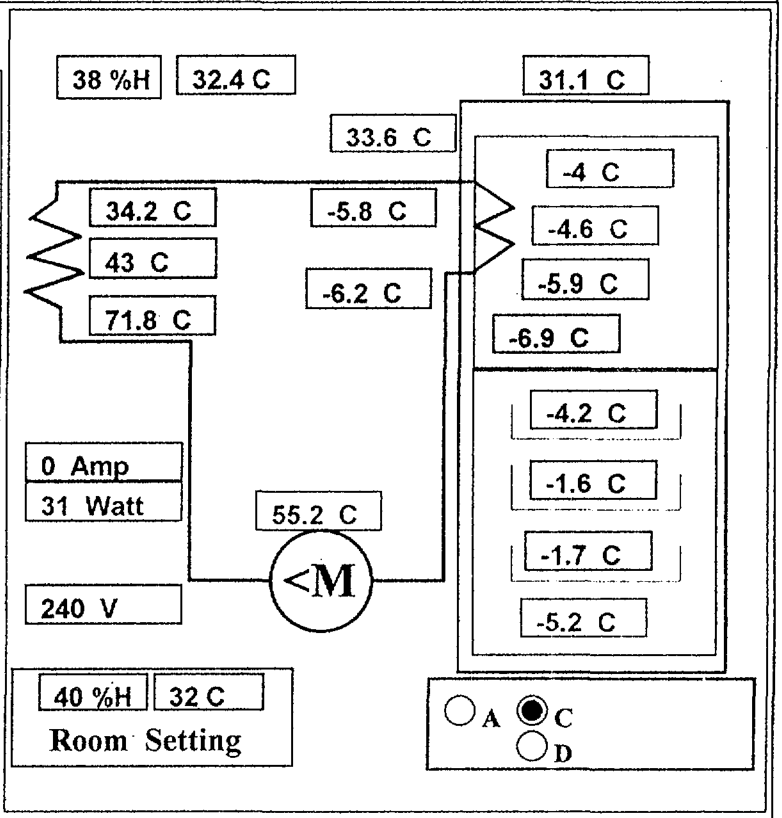
Printing In Labaratory Of
Maurice Ind. [Jordan]

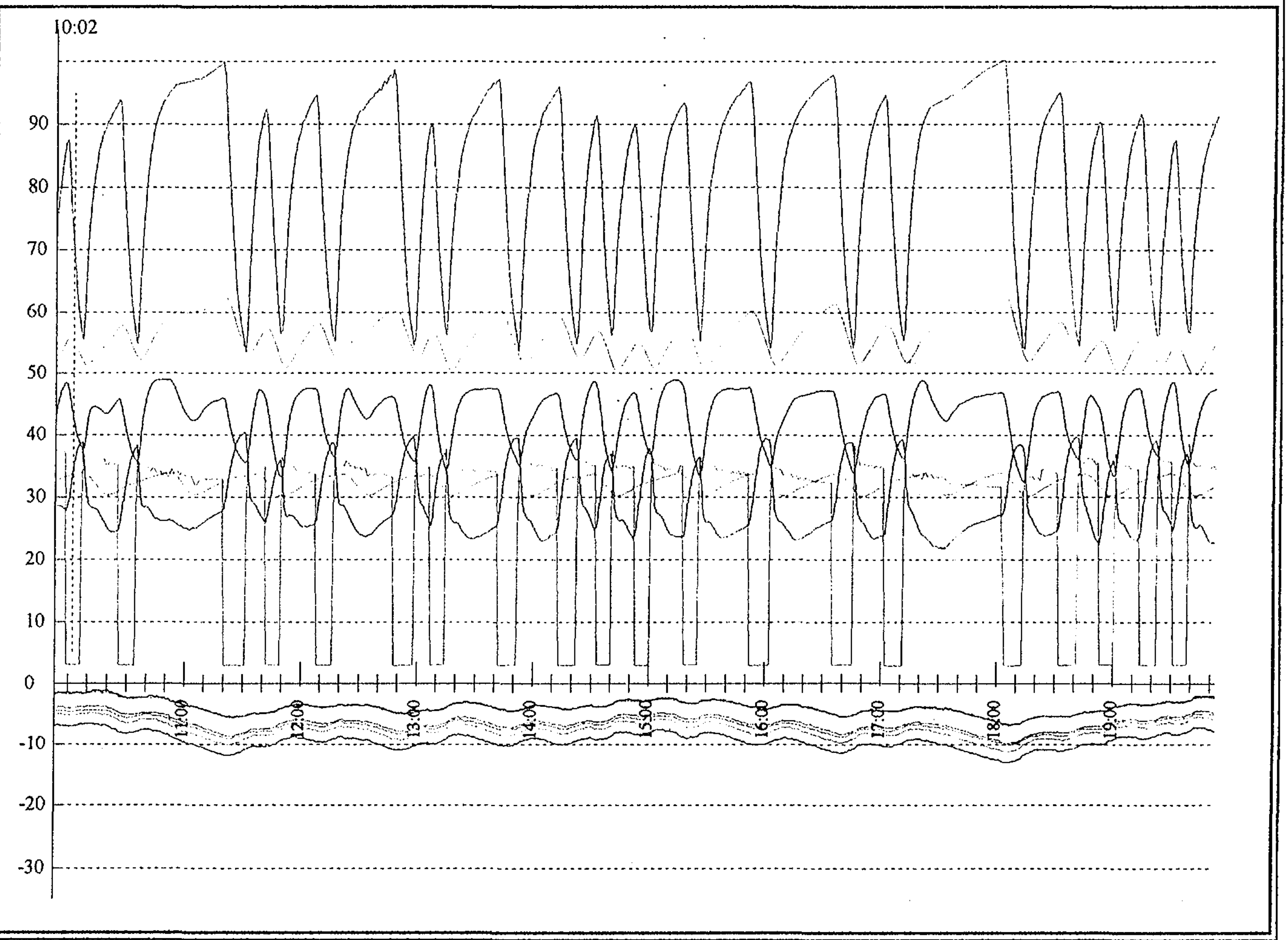
Maurice Ind. [Jordan]

TestDate: 99/07/15 15:36 *Report No.:* ( ) - Page 1
PageTestName: Energy Consumtion *ReportDate:* 99/07/16 14:49

Page Result :

1 - Page Test Time	*10*	*Hours*
2 - Working Percent	*69*	*%On*
3 - Energy (Accord to page)	*2.563*	*kwh*
4 - Zoom Time	*10:02*	*Hour*
5 - Compr Current	*00*	*Amp*
6 - Evaprator Mean Temp	*-5.3*	*C*
7 - Cabin Mean Temp	*-2.5*	*C*
8 - Crisp Temp	*-5.2*	*C*
9 - Compr Temp	*55.2*	*C*
10- Condensor In Temp	*71.8*	*C*
11- Condensor Out Temp	*34.2*	*C*
12- Condition	*32.4 C*	*38 %H*
13- Volt	*Max=244 Mean=238 Min=232*	
14-		
15-		
16-		
17-		





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Printing In Labaratory Of
Maurice Ind. [Jordan]

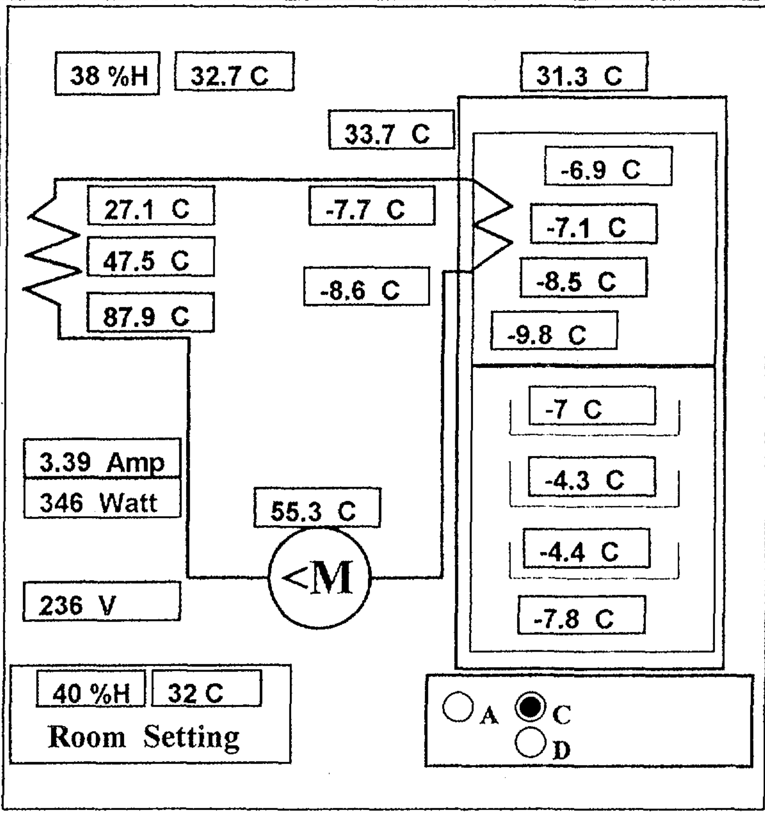
Maurice Ind. [Jordan]

TestDate: 99/07/15 15:36 *Report No.:* (   ) - Page 1

PageTestName: Energy Consumtion *ReportDate:* 99/07/16 14:32

Page Result :

1 - Page Test Time	*20*	*Hours*
2 - Working Percent	*70*	*%On*
3 - Energy (Accord to page)	*2.507*	*kwh*
4 - Zoom Time	*13:05*	*Hour*
5 - Compr Current	*3.39*	*Amp*
6 - Evaprator Mean Temp	*-8*	*C*
7 - Cabin Mean Temp	*-5.2*	*C*
8 - Crisp Temp	*-7.8*	*C*
9 - Compr Temp	*55.3*	*C*
10- Condensor In Temp	*87.9*	*C*
11- Condensor Out Temp	*27.1*	*C*
12- Condition	*32.7 C*	*38 %H*
13- Volt	*Max=245 Mean=237 Min=218*	
14-		
15-		
16-		
17-		



Industrial Control Research Center HotRoom Ver 5

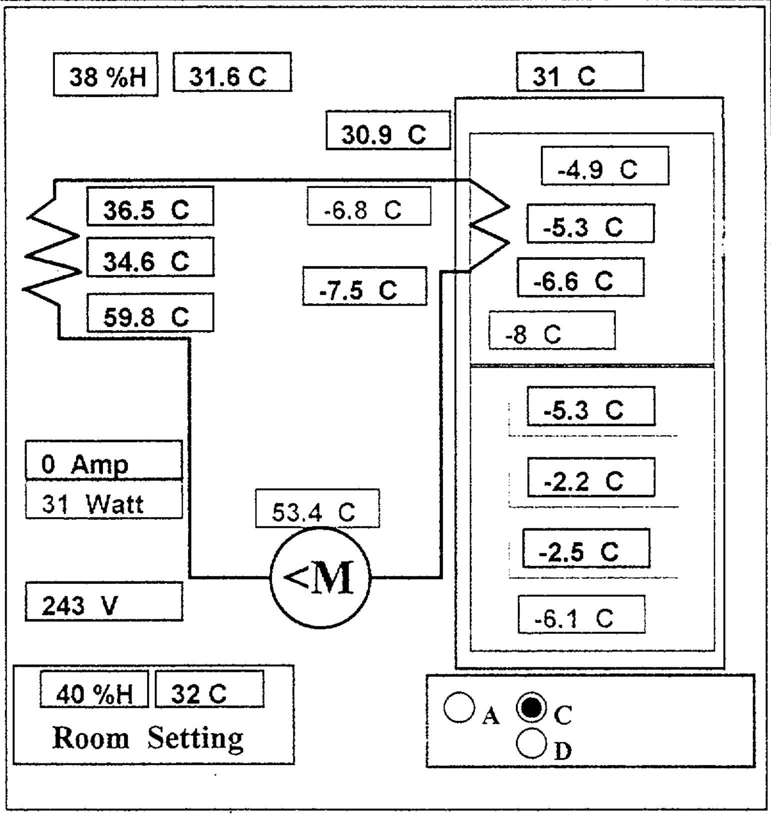
Printing In Labaratory Of
Maurice Ind. [Jordan]

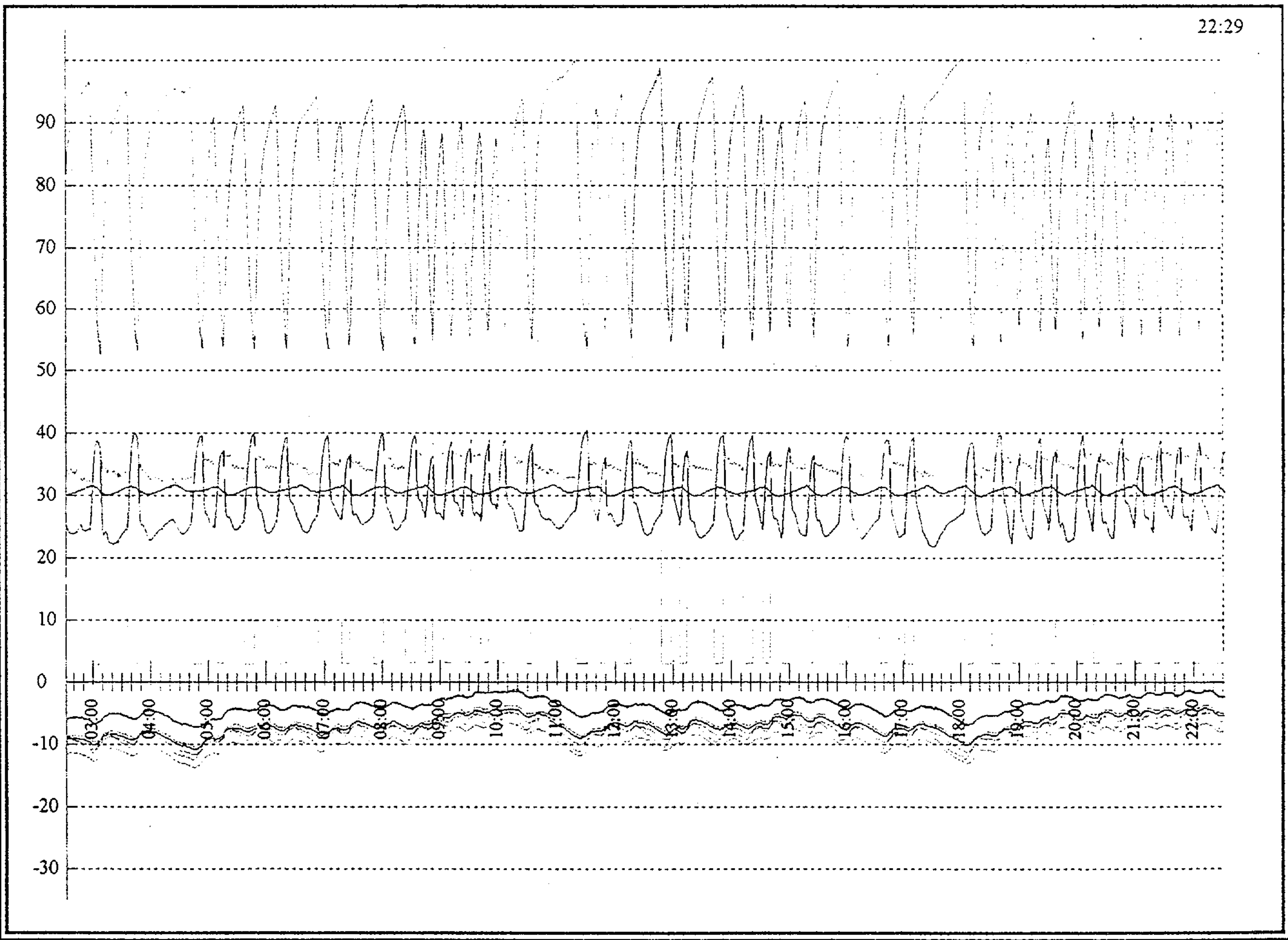
Maurice Ind. [Jordan]

TestDate: 99/07/15 15:36 *Report No.:* ( ) - Page 1
PageTestName: Energy Consumtion *ReportDate:* 99/07/16 14:58

Page Result :

1 - Page Test Time	*20 Hours*
2 - Working Percent	*67 %On*
3 - Energy (Accord to page)	*2.527 kwh*
4 - Zoom Time	*22:30 Hour*
5 - Compr Current	*00 Amp*
6 - Evaprator Mean Temp	*-6.2 C*
7 - Cabin Mean Temp	*-3.3 C*
8 - Crisp Temp	*-6.1 C*
9 - Compr Temp	*53.4 C*
10- Condensor In Temp	*59.8 C*
11- Condensor Out Temp	*36.5 C*
12- Condition	*31.6 C 38 %H*
13- Volt	*Max=246 Mean=239 Min=230*
14-	
15-	
16-	
17-	





Industrial Control Research Center HotRoom Ver 5

Printing In Labaratory Of
Maurice Ind. [Jordan]

Maurice Ind. [Jordan]

TestDate: 99/07/15 15:36
TestName: Energy Consumtion

Report No.: Spec & Remark
ReportDate: 99/07/16 15:35

Total Result :

1 - Total Test Time	*22 Hours*
2 - Working Percent	*33 %On*
3 - Energy	*0.277 kwh*
4 - Zoom Time	*22:33 Hour*
5 - Compr Current	*00 Amp*
6 - Evaprator Mean Temp	*11.5 C*
7 - Cabin Mean Temp	*29.2 C*
8 - Crisp Temp	*29.4 C*
9 - Compr Temp	*28.1 C*
10- Condensor In Temp	*28.4 C*
11- Condensor Out Temp	*27.8 C*
12- Condition	*31.1 C 38 %H*
13- Volt	*Max=246 Mean=238 Min=218*
14-	
15-	
16-	
17-	

Product Spec :

1 - File Name		*99071515.k36*
2 - Test Kind	G	*Perform.*
3 - Product Serial		*Prt.mdwc/4*
4 - Product Name		*Water Cool*
5 - Product Model		*MDWC-100*
6 - Product Capacity		*100 L/H*
7 - Compressor Name		*Elect.lux*
8 - Compressor Model		*134 a*
9 - Compressor Power		*1/5 Hp*
10 - Compressor Amper		
11 - Thermostat No.		*3*
12 - Thermostat Type		*Ranco*
13 -		
14 -		

Technical Manager: *ICRC*

Lab Chief : *MARIO AL-DEEK*

Lab Specialist: *ZIAD*

Remark :

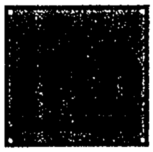
Remark1
Remark2
Remark3

Remark :

sign :

Printing In Labaratory Of
Maurice Ind. [Jordan]

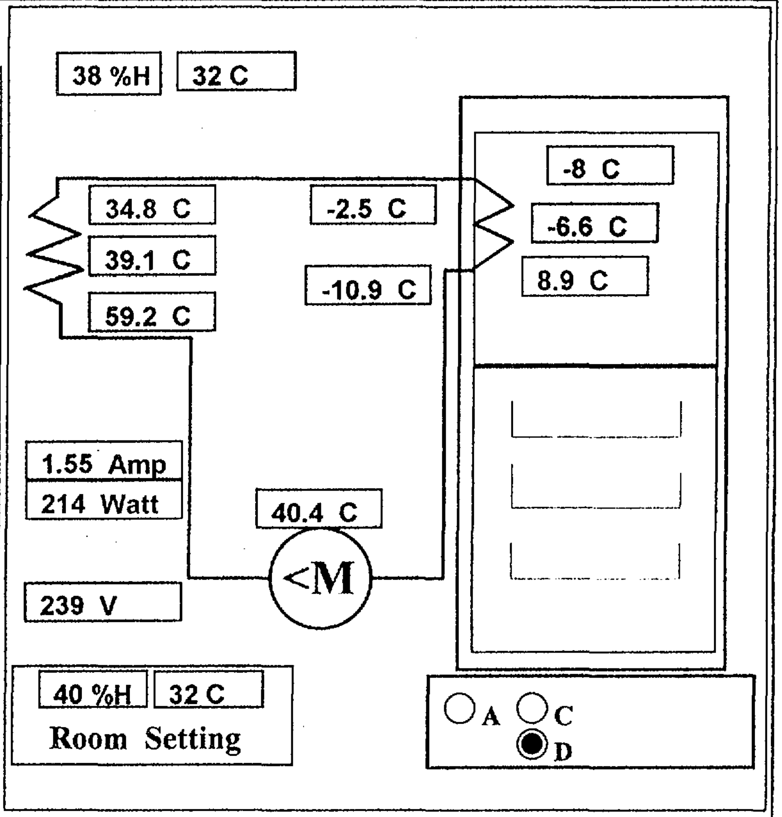
Maurice Ind. [Jordan]

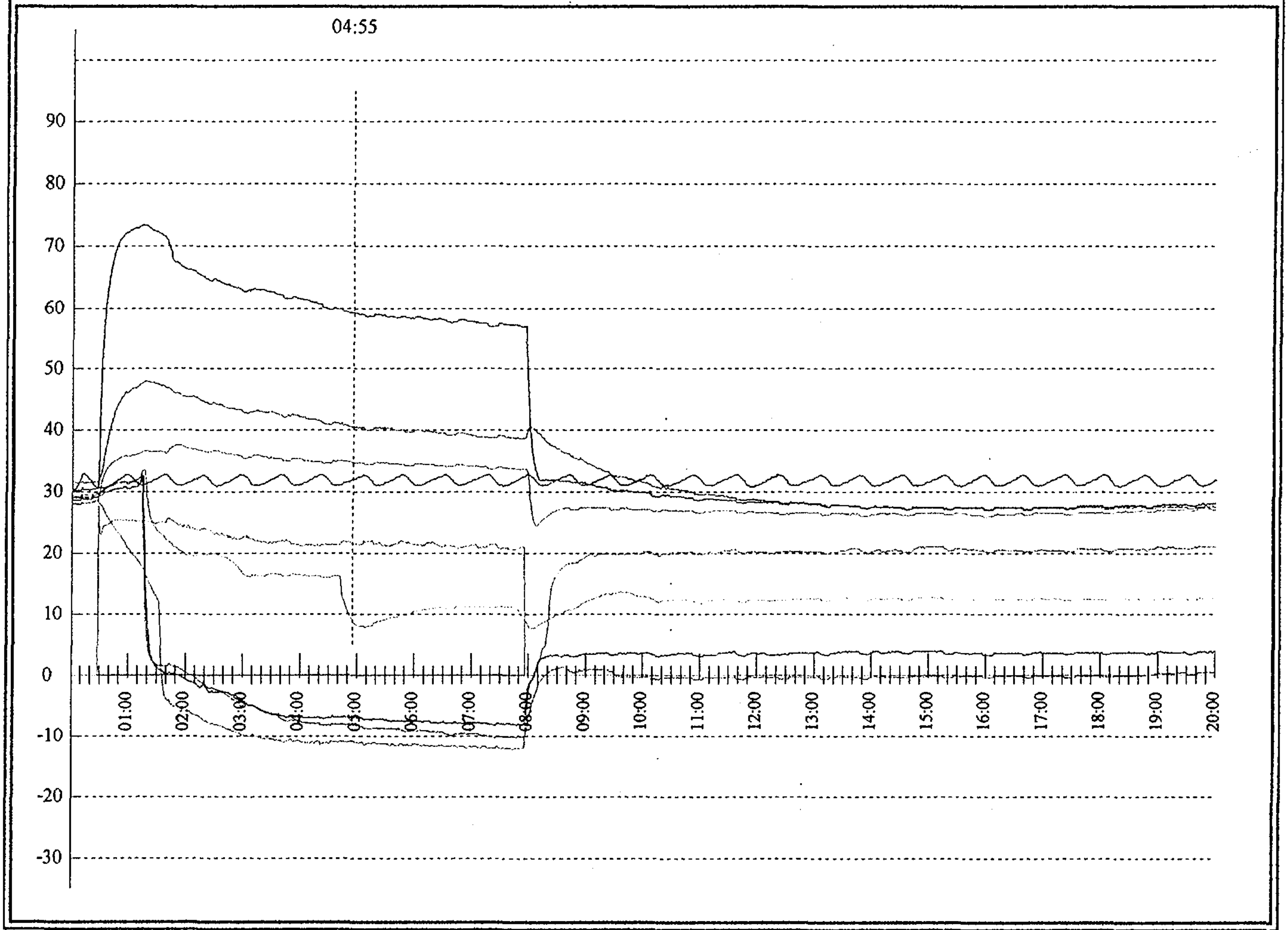


TestDate: 99/07/15 15:36 *Report No.:* ( ) - Page 1
PageTestName: Energy Consumtion *ReportDate:* 99/07/16 15:49

Page Result :

1 - Page Test Time	*20 Hours*
2 - Working Percent	*37 %On*
3 - Energy (Accord to page)	*0.312 kwh*
4 - Zoom Time	*4:55 Hour*
5 - Compr Current	*1.55 Amp*
6 - Evaprator Mean Temp	*6.3 C*
7 - Cabin Mean Temp	*30.4 C*
8 - Crisp Temp	*30 C*
9 - Compr Temp	*40.4 C*
10- Condensor In Temp	*59.2 C*
11- Condensor Out Temp	*34.8 C*
12- Condition	*32 C 38 %H*
13- Volt	*Max=245 Mean=237 Min=218*
14-	
15-	
16-	
17-	





Industrial Control Research Center HotRoom Ver 5

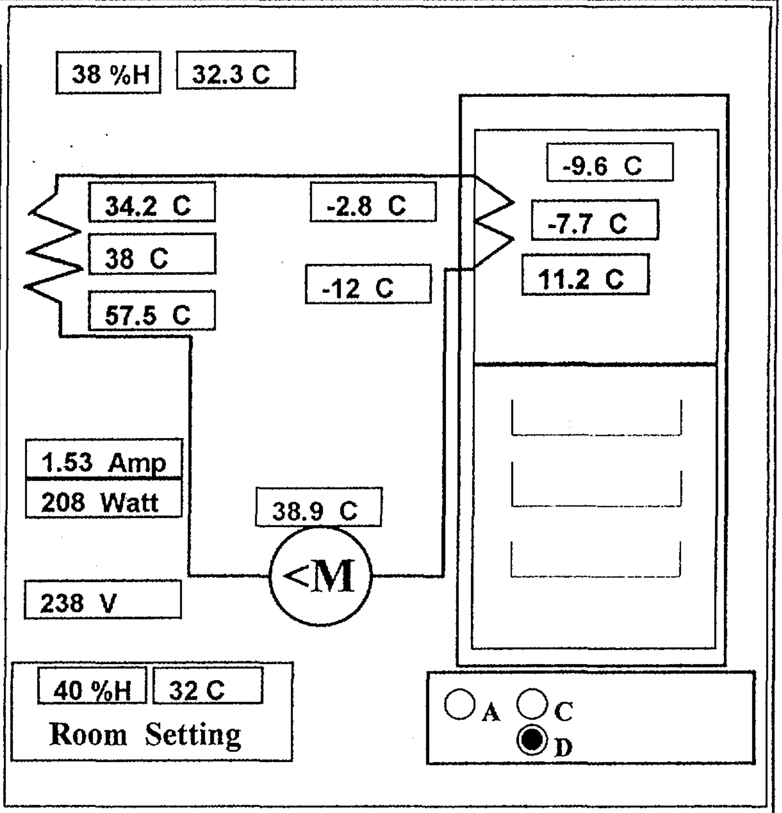
Printing In Labaratory Of
Maurice Ind. [Jordan]

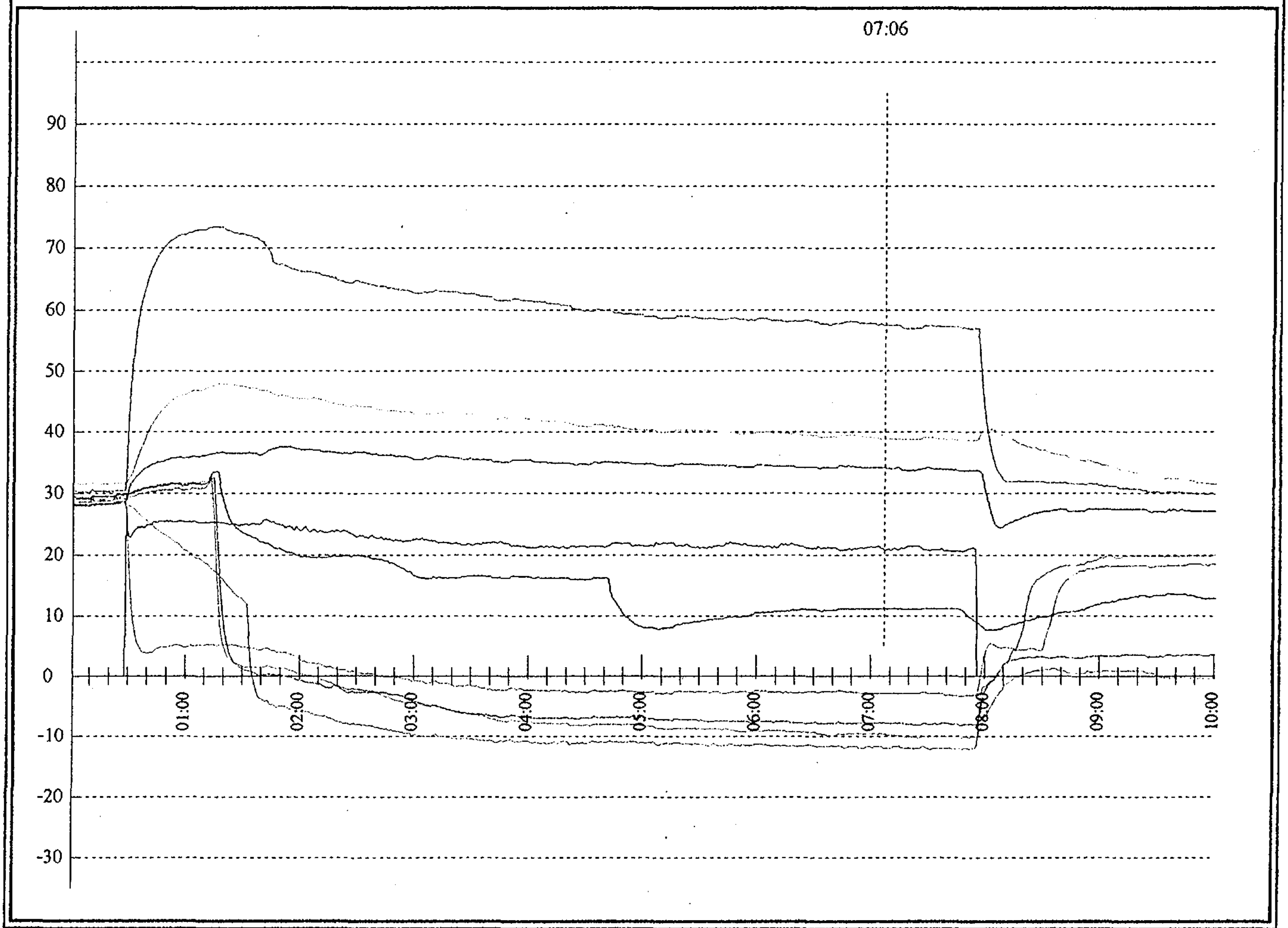
Maurice Ind. [Jordan]

TestDate: 99/07/15 15:36 **Report No.:** ( ) - Page 1
PageTestName: Energy Consumtion **ReportDate:** 99/07/16 15:23

Page Result :

1 - Page Test Time		*10 Hours*
2 - Working Percent		*74 %On*
3 - Energy (Accord to page)		*0.626 kwh*
4 - Zoom Time		*7:07 Hour*
5 - Compr Current		*1.53 Amp*
6 - Evaprator Mean Temp		*6 C*
7 - Cabin Mean Temp		*30 C*
8 - Crisp Temp		*29.7 C*
9 - Compr Temp		*38.9 C*
10- Condensor In Temp		*57.5 C*
11- Condensor Out Temp		*34.2 C*
12- Condition	*32.3 C*	*38 %H*
13- Volt	*Max=245 Mean=237 Min=218*	
14-		
15-		
16-		
17-		





Industrial Control Research Center HotRoom Ver 5

Printing In Labaratory Of
Maurice Ind. [Jordan]

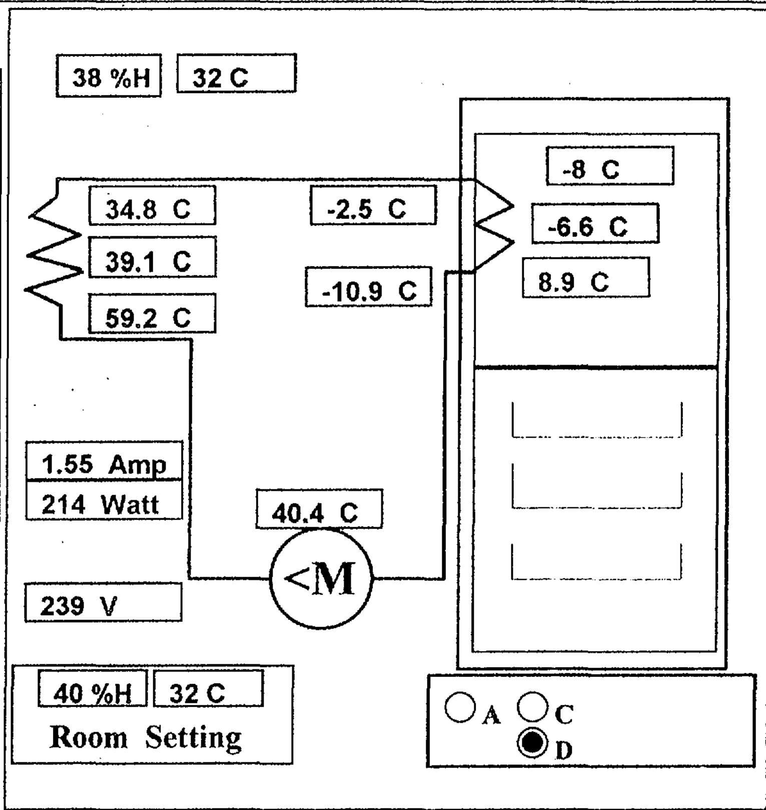
Maurice Ind. [Jordan]

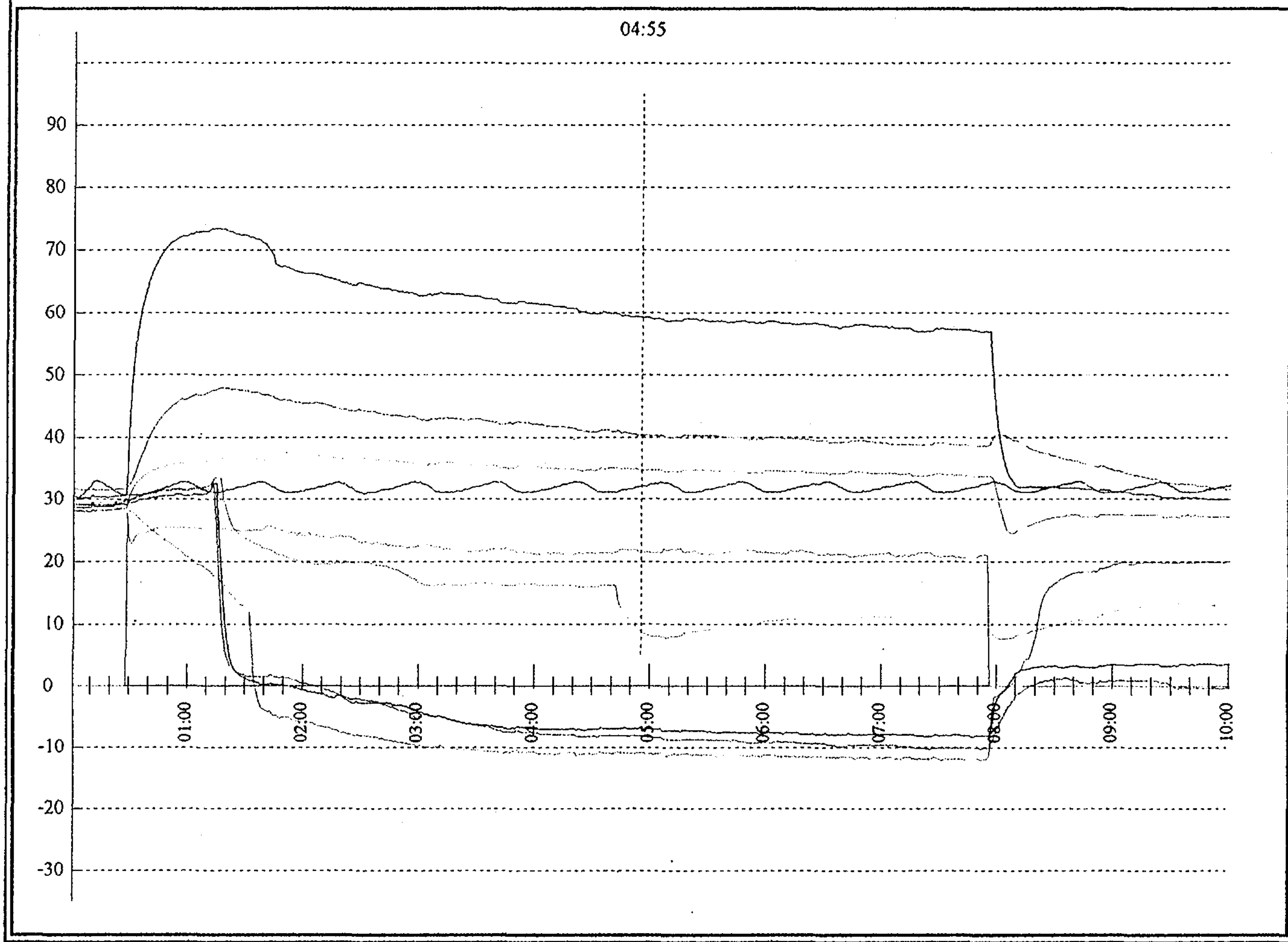
TestDate: 99/07/15 15:36 ***Report No.:*** ( ) - Page 1

PageTestName: Energy Consumtion ***ReportDate:*** 99/07/16 15:47

Page Result :

1 - Page Test Time *10 Hours*
2 - Working Percent *74 %On*
3 - Energy (Accord to page) *0.626 kwh*
4 - Zoom Time *4:55 Hour*
5 - Compr Current *1.55 Amp*
6 - Evaprator Mean Temp *6.3 C*
7 - Cabin Mean Temp *30.4 C*
8 - Crisp Temp *30 C*
9 - Compr Temp *40.4 C*
10- Condensor In Temp *59.2 C*
11- Condensor Out Temp *34.8 C*
12- Condition *32 C 38 %H*
13- Volt *Max=245 Mean=237 Min=218*
14-
15-
16-
17-





Industrial Control Research Center HotRoom Ver 5

Printing In Labaratory Of
Maurice Ind. [Jordan]

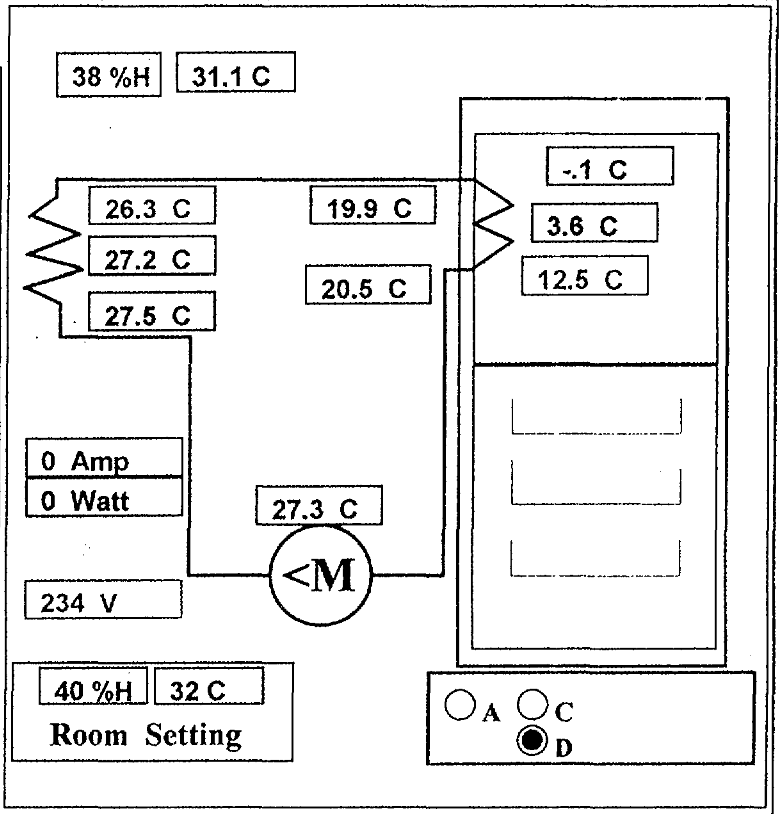
Maurice Ind. [Jordan]

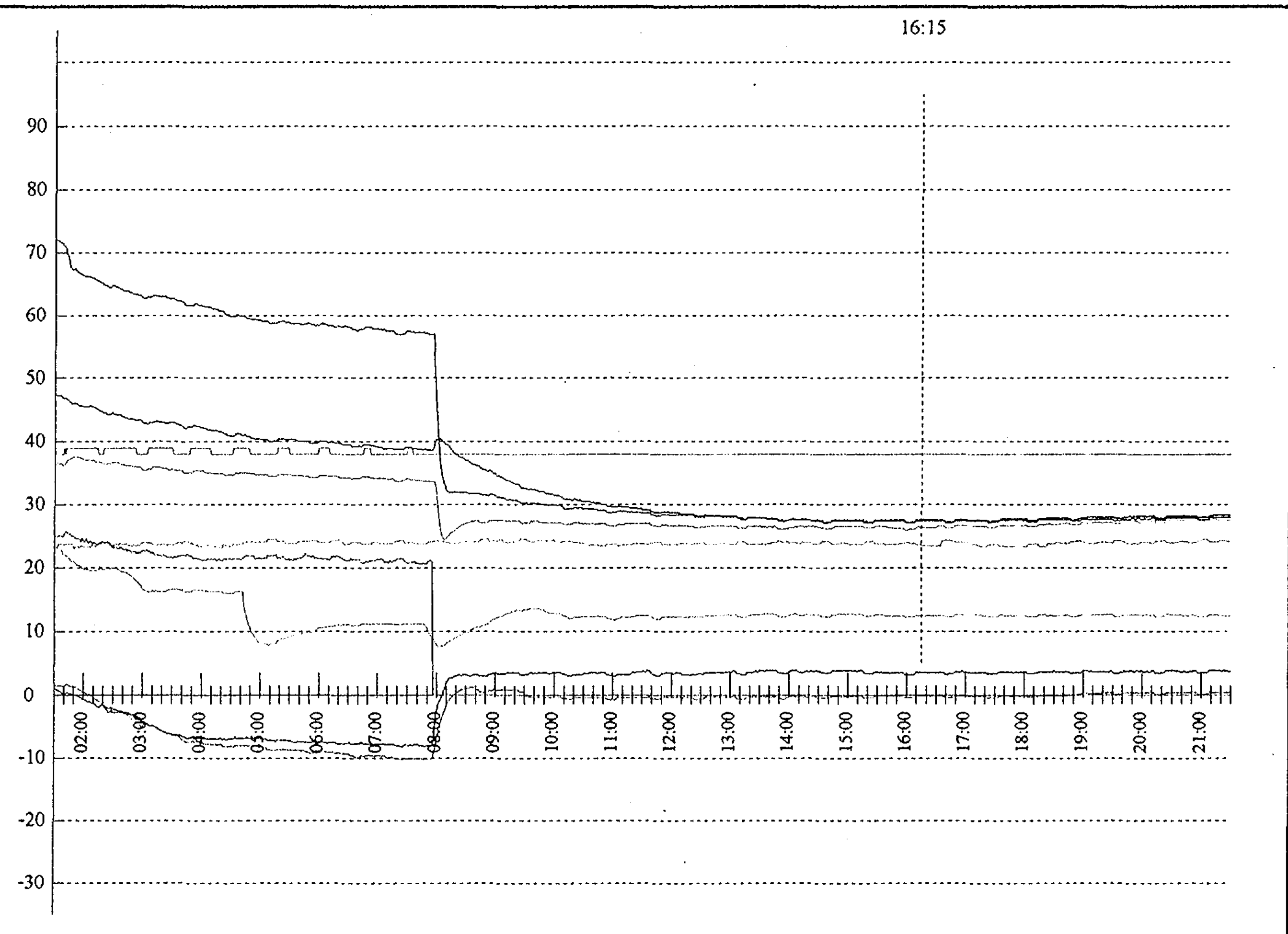
TestDate: 99/07/15 15:36 ***Report No.:*** ( ) - Page 1

PageTestName: Energy Consumtion ***ReportDate:*** 99/07/16 15:55

Page Result :

1 - Page Test Time	*20 Hours*
2 - Working Percent	*32 %On*
3 - Energy (Accord to page)	*0.239 kwh*
4 - Zoom Time	*16:15 Hour*
5 - Compr Current	*00 Amp*
6 - Evaprator Mean Temp	*11 C*
7 - Cabin Mean Temp	*28.7 C*
8 - Crisp Temp	*28.8 C*
9 - Compr Temp	*27.3 C*
10- Condensor In Temp	*27.5 C*
11- Condensor Out Temp	*26.3 C*
12- Condition	*31.1 C 38 %H*
13- Volt	*Max=245 Mean=238 Min=229*
14-	
15-	
16-	
17-	





Industrial Control Research Center HotRoom Ver 5

Printing In Labaratory Of
Maurice Ind. [Jordan]

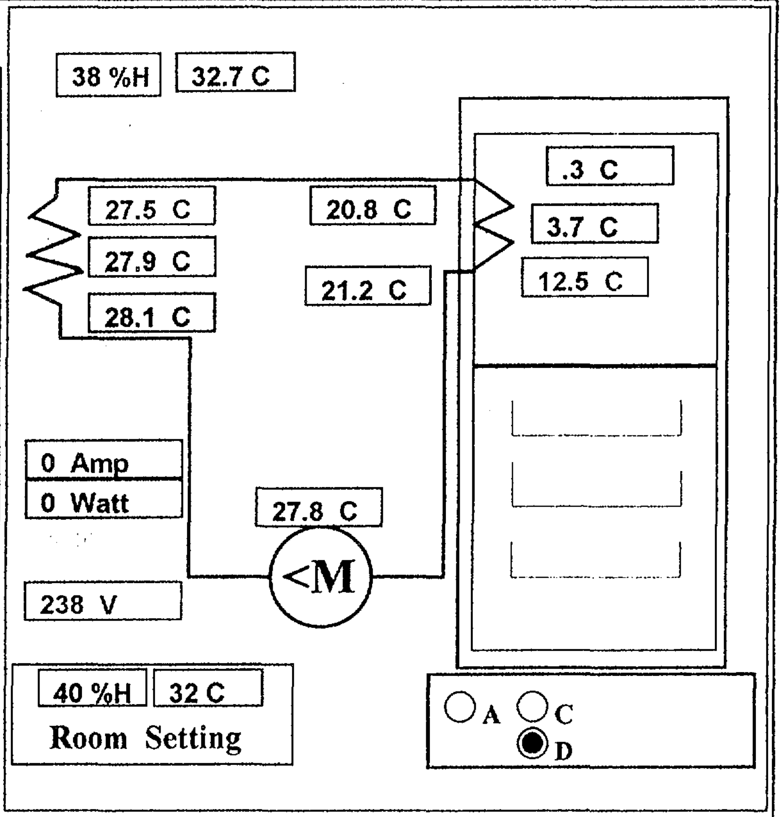
Maurice Ind. [Jordan]

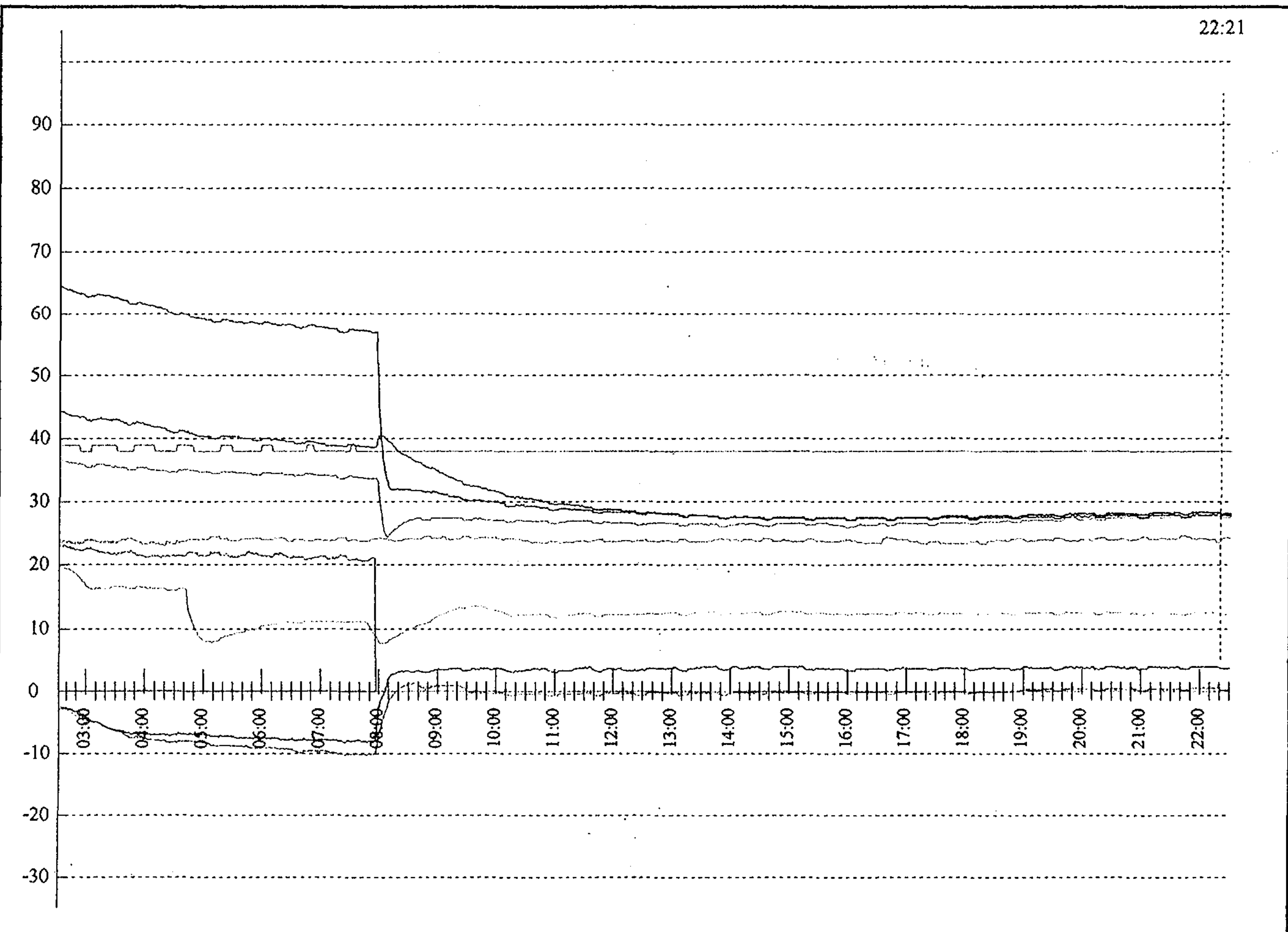
TestDate: 99/07/15 15:36 ***Report No.:*** ( ) - Page 1

PageTestName: Energy Consumtion ***ReportDate:*** 99/07/16 15:57

Page Result :

1 - Page Test Time	*20*	*Hours*
2 - Working Percent	*26*	*%On*
3 - Energy (Accord to page)	*0.18*	*kwh*
4 - Zoom Time	*22:21*	*Hour*
5 - Compr Current	*00*	*Amp*
6 - Evaprator Mean Temp	*11.2*	*C*
7 - Cabin Mean Temp	*29*	*C*
8 - Crisp Temp	*29.1*	*C*
9 - Compr Temp	*27.8*	*C*
10- Condensor In Temp	*28.1*	*C*
11- Condensor Out Temp	*27.5*	*C*
12- Condition	*32.7 C*	*38 %H*
13- Volt	*Max=246 Mean=239 Min=230*	
14-		
15-		
16-		
17-		





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Printing In Labaratory Of
Maurice Ind. [Jordan]

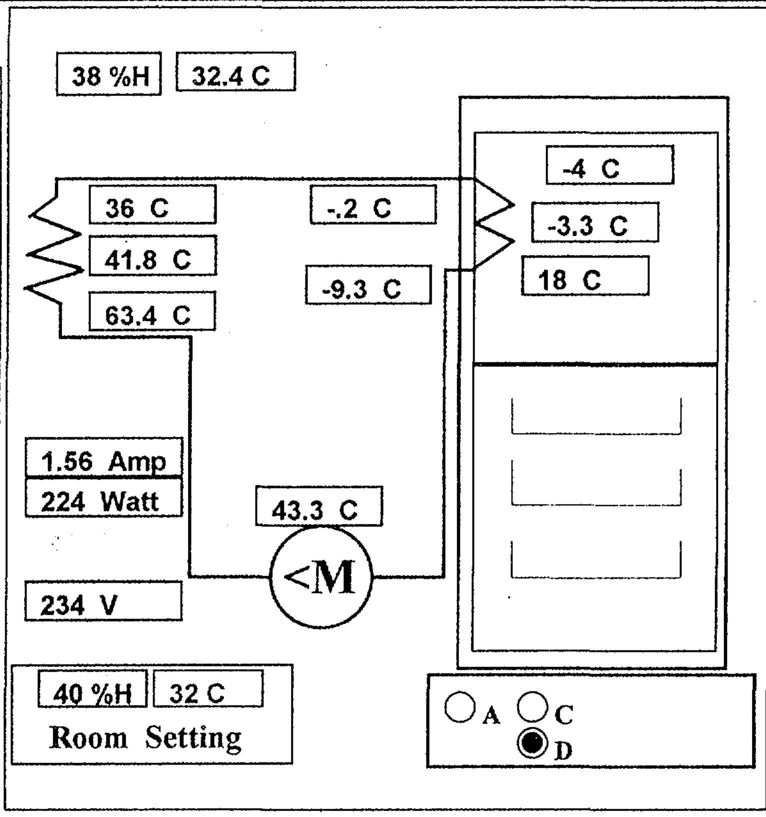
Maurice Ind. [Jordan]

TestDate: 99/07/15 15:36 ***Report No.:*** ( ) - Page 1

PageTestName: Energy Consumtion ***ReportDate:*** 99/07/16 16:00

Page Result :

1 - Page Test Time	*10 Hours*
2 - Working Percent	*64 %On*
3 - Energy (Accord to page)	*0.479 kwh*
4 - Zoom Time	*2:53 Hour*
5 - Compr Current	*1.56 Amp*
6 - Evaprator Mean Temp	*10.6 C*
7 - Cabin Mean Temp	*31 C*
8 - Crisp Temp	*30.5 C*
9 - Compr Temp	*43.3 C*
10- Condensor In Temp	*63.4 C*
11- Condensor Out Temp	*36 C*
12- Condition	*32.4 C 38 %H*
13- Volt	*Max=245 Mean=239 Min=229*
14-	
15-	
16-	
17-	



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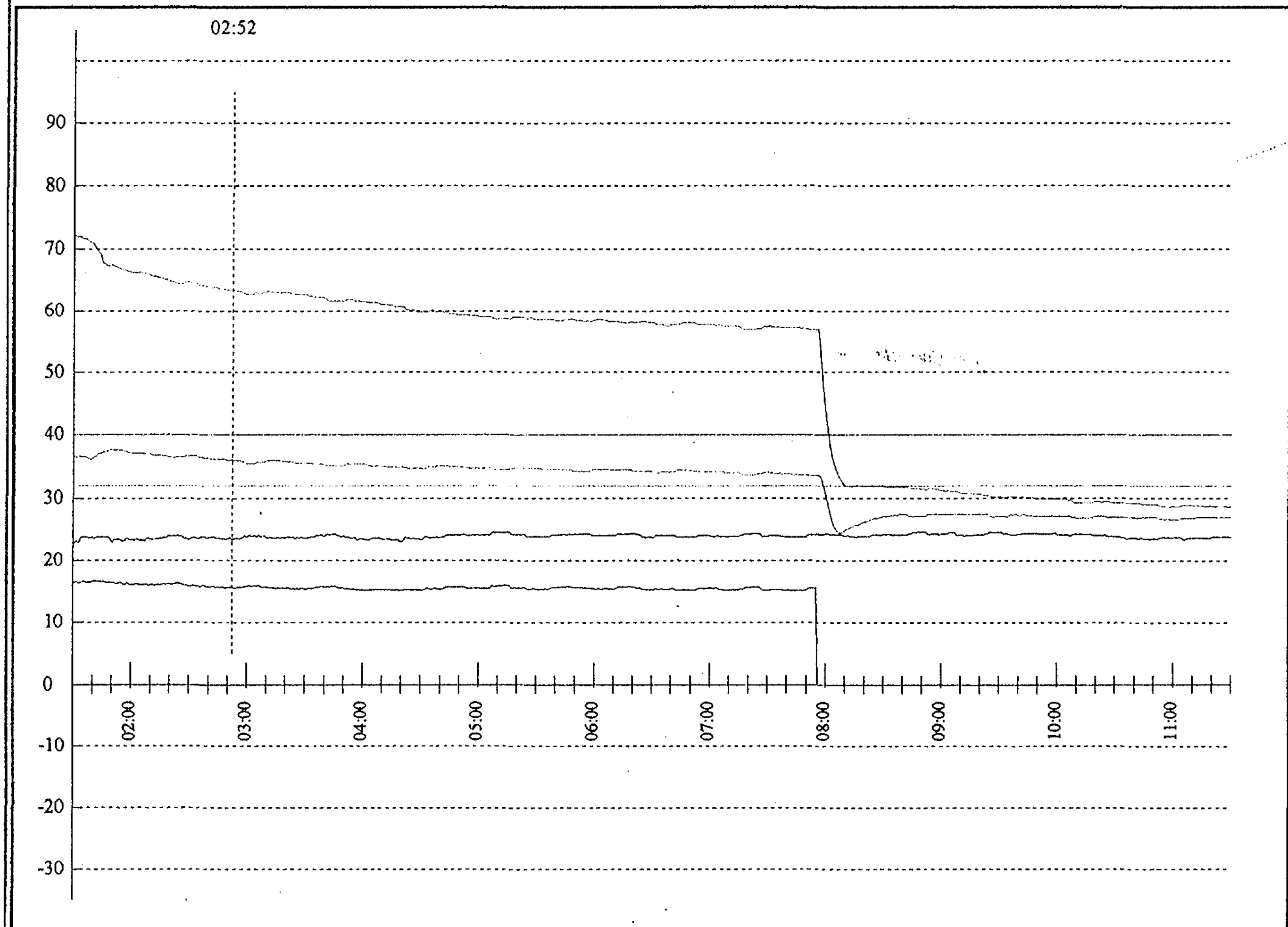


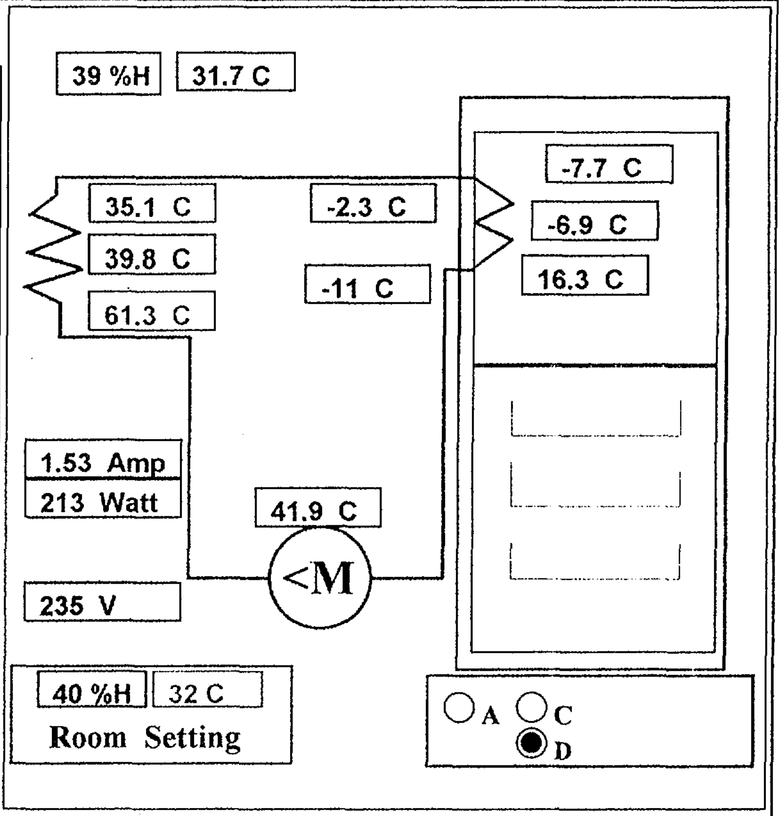
Printing In Labaratory Of
Maurice Ind. [Jordan]

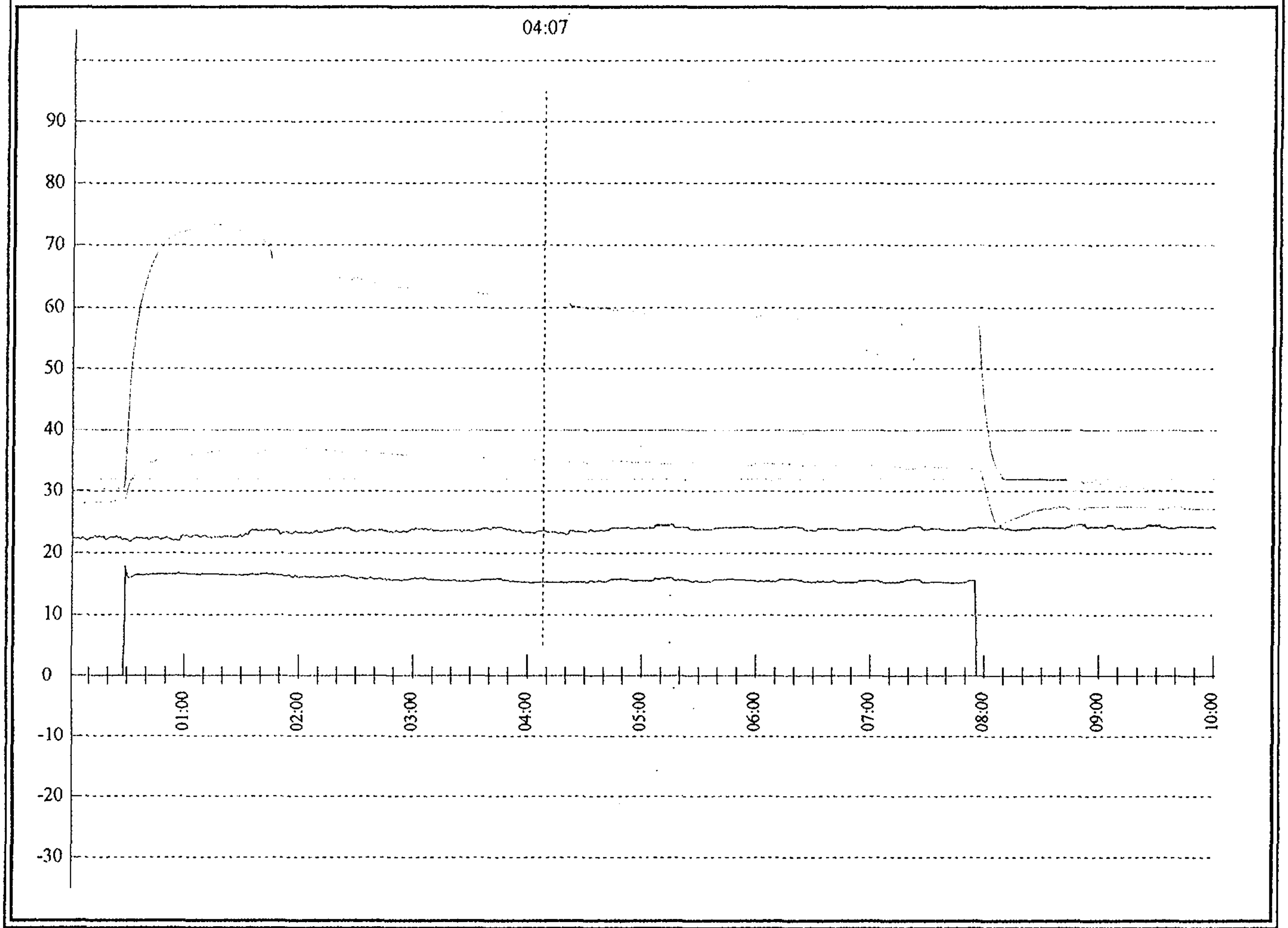
Maurice Ind. [Jordan]

TestDate:	99/07/15 15:36	*Report No.:*	( ) - Page 1
PageTestName:	Energy Consumtion	*ReportDate:*	99/07/16 16:02

Page Result :

1 - Page Test Time	*10 Hours*
2 - Working Percent	*74 %On*
3 - Energy (Accord to page)	*0.626 kwh*
4 - Zoom Time	*4:08 Hour*
5 - Compr Current	*1.53 Amp*
6 - Evaprator Mean Temp	*8.2 C*
7 - Cabin Mean Temp	*30.6 C*
8 - Crisp Temp	*30.2 C*
9 - Compr Temp	*41.9 C*
10- Condensor In Temp	*61.3 C*
11- Condensor Out Temp	*35.1 C*
12- Condition	*31.7 C 39 %H*
13- Volt	*Max=245 Mean=237 Min=218*
14-	
15-	
16-	
17-	





Industrial Control Research Center HotRoom Ver 5

July 1999

UNIDO, Project MP/JOR/98/89 Contract 99/023

General

This Report has been prepared. Based on the UNIDO TOR and relevant contrat between UNIDO and Maurice Al-Deek Co. to convert five prototype models into R134a refrigerant circuit system.

Considering all elements and technical services in the UNIDO,s TOR. And fulfill the entire project requirement in Maurice Al-Deek Co to phase out CFC-12.

The project will phase out the use of CFC-12 for the production of commercial refrigerator at Maurice Al-Deek Co.
The implementation of this project will enable Maurice Al-Deek Co. to convert R12 commercial refrigerator system of its products into Ozone friendly R134a refrigerant System.

Based on Montreal and Jordan agreement, R134a refrigerant was selected as suitable Ozone friendly Refrigerant replacement and an alternative for R12 refrigerant and also Cyclopentane as a substitute for R11.

This change to the cooling system requires significant modification and improvement of cooling system. Due to the enhanced physical and chemical properties of the new refrigerant the main components of the cooling circuits must be replaced or adjusted as a consequence of substitution of R12 into R134a.

This report contencts, calculation of prototypes for determination of cooling capacity of each prototypes and also selecting compatible compressor for substituting R12 compressor with R134a compressor, because this is the first step for making prototype. It is indeed a difficult job to find precise compressor capacity to much the installed R12 compressor in the Jordanian market.

هاتف معرض : ٦٥٣٢٦٢ - المصنع : ٧٣١٣٧٢ - فاكس : ٦١٣٣٤٠-٦-٩٦٢ - ص.ب : ٩٢١٩٤٠ عمان - الاردن
Tel Showroom : 653262 - Factory : 731372 - Fax : 962 -6- 613340 - P.O.Box : 921940 Amman - Jordan

The technical data will help us to calculate required refrigeration load that should be produced by the compressor and evaporators. For making prototypes our policy is to
keep the existing size of condenser and evaporator and perform minor changes as required in cooing circuit, we think that minor adjustment will be required in refrigerant weight charge and probably in length of capillary tube.

In this report we will give some detailed technical data in different tables for each prototype model and then we calculate the refrigeration load calculation for each prototype.

Company Background

Maurice Al-Deek Establishment for Refrigeration & Metal Industries was founded in March 1980, the factory started with 500 sq. meters of premises and four workers to manufacture commercial refrigerators. The company proceeded to expand its activities and increase to production rate and models to cover also Chest Freezers and Water Coolers.

In 1983 the company extended the existing facility from 500-sq. meters to 2500 sq. meters, the total staff also increased to 25 persons. The production of different commercial refrigerators also increased to furnishing restaurants, bakeries and supermarkets with all their needs of commercial refrigerators, freezers, stands, shelves, tables And show cases.

In 1985 the company opened its first show room in the center of Amman and in 1986 the OMS Low Pressure Foam Dispensing machine was installed at the factory, and at the same time the company's staff was

increased to 40 persons. Production of sandwich panels for making cold rooms and building hangers and making pharmaceutical factories with insulated tanks and doors were started at this time.

At present, the factory produces various models of Commercial

هاتف معرض : ٦٥٣٢٦٢ - المصنع : ٧٣١٣٧٢ - فاكس : ٩٦٢-٦-٦١٣٣٤٠ - ص.ب : ٩٢١٩٤٠ عمان - الاردن
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refrigerators, water coolers, freezers, cold rooms with different capacities and upon request models. 70 staff are working for the company as engineer, technicians, and workers in different production lines and two equipped service cars.

Aim of the Project

The aim of the immediate project is to;

Design, calculate and drafting for model redefinition.
Testing two prototypes for functionality and performance criteria.
Redesign the cooling units of the all models so that they could run on the new Ozone friendly R134a instead of the ODP active CFC12.

Scope of the Contract

A study will be made for 5 models of commercial refrigerators made by Maurice Al-Deek Co. to specify;

Dimensional specification;
Type and thickness of insulation
Refrigeration unit component details
Working performance
Energy consumption

Selection of HFC 134a compatible components
Redesign of the refrigeration circuit as necessary
Specifying necessary changes in the cooling system if required
Preparation of the trial equipment one prototype per model
Testing of two prototypes for functionality and performance
Evaluation of the test results

Supply of the Material

Following components and material been used to make prototypes as necessary.

R134a CompressorsR134a Refrigerant
Refrigerant Accumulators

هاتف معرض : ٦٥٣٢٦٢ - المصنع : ٧٣١٣٧٢ - فاكس : ٩٦٢-٦-٦١٣٣٤٠ - ص.ب : ٩٢١٩٤٠ عمان - الأردن
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Specially designed filter drier
Specially designed evaporator and condenser

Some necessary modification of the side panels as required with the new design criteria
Consumable material as required

Activities

In this report we will give some detailed technical data in different tables for each prototype model and then we calculate the refrigeration load calculation for each prototype.

The prototypes were tested under designated ambient temperature mostly at
+ 32 C, the test performance revealed that no significant changes is necessary for refrigeration system circuit, because the original size of evaporator and condensers are much bigger than cooling requirements.

The adjustment will be applied to the mainly to the amount of refrigerant charge and length of capillary tube.

Each prototypes should under go for performance test at the following test criteria.

Pull down test at + 32 C

Continuos run Test at = 32 C ambient temperature

Cyclic run test at + 32 C ambient temperature.

The test condition was selected in accordance with appropriate ISO test standards.

All prototypes were tested at existing hot chamber in our facilities in Awajan Amman

هاتف معرض : ٦٥٣٢٦٢ - المصنع : ٧٣١٣٧٢ - فاكس : ٩٦٢-٦-٦١٣٣٤٠ - ص.ب : ٩٢١٩٤٠ عمان - الاردن
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the test results sheet will be provided after necessary performance test evaluation and perform necessary modification.

Before making prototypes we conducted a training course to train the six companies to make their own prototypes and also make them familiar with the new technology.

The following topics were thought during the theatrical training course.

An orientation to UNIDO CFC phase out project.

Montreal Protocol

Ozone Layer and CFC side effect to Ozone layer

Familiarization with new R134a Refrigerant, application, safety precaution, use and maintenance.

Familiarization with the new vacuum and charging equipment, vacuum pump and charging board.

Recovery and recycling of R12 refrigerant, and also R134a.

Alternative for R11 and R12.

Some explanation about R141b blowing agent,

Selection of refrigeration components to be replaced with R12 refrigeration system.

Calculation and redesign of prototypes

Performance test

Test results Evaluation.

Refrigeration system adjustment.

هاتف معرض : ٦٥٣٢٦٢ - المصنع : ٧٣١٣٧٢ - فاكس : ٩٦٢-٦-٦١٣٣٤٠ - ص.ب : ٩٢١٩٤٠ عمان - الاردن
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The material as sample for making prototypes were supplied mainly

from local market, due to the limitation for purchasing R134a compressor from local market we had to contact several

manufacturers to find out the technical specification for appropriate compressor.

The prices for material specially R134a and R141b blended polyol are much higher than R12 and R11, for instance the price for one kg of R11 blended polyol is about 3.21 US$ and the price for R141b blended polyol is 3.92 US $ it means 0,71 US $ more.

We also invested a lot of money to make our hot chamber, we hope that UNIDO will help us to purchase PC computer and relevant heat and cooling system measuring devices. Such as data loggers electronic control panels PC software and temperature sensors. Having our hot chamber operation is an importance for completion of conversion project of the prototypes, therefore we urge to construct and complete the hot chamber as soon as possible.

هاتف معرض : ٦٥٣٢٦٢ - المصنع : ٧٣١٣٧٢ - فاكس : ٩٦٢-٦-٦١٣٣٤٠ - ص.ب : ٩٢١٩٤٠ عمان - الاردن
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July 1999

UNIDO, Project MP/JOR/98/89 Contract 99/023

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, porcelaicoated - 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 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.

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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.

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

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.

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

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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.

$$Q_2 = \dot{M}\ C\ \Delta T$$

Q_2 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

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

$$Q_3 = UA\ \Delta T$$

Where:

Q_3 Total Leak, gained through side wall of drinking water storage tank by conduction in Kcal..

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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.

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Upright Show Case Model MSD-200 Technical Specification	
Show Case Upright Refrigerator	Type of Product
2000 x 800 x 2000 mm	Overall Dimension
40 mm	Wall Thickness
P.U. Foam R11	Type of Foam
35 - 40 Kg/ cu mt.	Foam Density
100 ISO, 100 Polyol, 35 R11	Foam Mixing Ratio %
1800 lit.	Net Internal Volume
Hermetic, Air Cooled	Type of Compressor
1173 Watts at –15 C	Compressor Cooling Capacity
Fin and Tube	Type of Condenser
4, four rows	Size of Condenser
Fin and Tube	Type of Evaporator
R12	Type of Refrigerant
R12, = 650 Gr.	Refrigerant Charge
30 Gr.	Filter Drier Size
220/50	Power Source
- 15 °C	Designated Inside Evaporator Temperature
5 °C	Designated Inside Ref. Temperature
Standard 32 °C	Designated Operating Condition

هاتف معرض : ٦٥٣٢٦٢ - المصنع : ٧٣١٣٧٢ - فاكس : ٩٦٢-٦-٦١٣٣٤٠ - ص.ب : ٩٢١٩٤٠ عمان - الأردن
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Refrigeration Load Calculation
Upright Refrigerator Showcase Model MDS- 200

a) Transmission load calculation

Refrigerator Compartment	Dimension Cm.	Area (sq.mt.)	Insulation Thickness	Temp. Difference
Side Walls	2 x (120x55) + 2x(80x40)	1.96	40mm	27 c
Back Panel	200x160	3.2	40mm	27 c
Top Surface	80x200	1.6	40mm	27 c
Lower Panel	40x200	0.8	40mm	27 c
Bottom Surface	80x200	1.6	40mm	37 c
Door	120x270	3.24	15mm air	27 c

Insulation Type: Pu Foam with R141b blowing agent.

Thermal Conductivity for Foam = 0.0180 W/ mt. ° C

Thermal Conductivity for Air at -12 at 1 atm. =0.02367 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.

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

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

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$$U = \frac{1}{X_1 / K_1}$$

Where :
U = Heat Resistance Coefficient Factor, K_1 = Foam Thermal Conductivity

Due to the short thickness of cabinet out side panel (0.6 mm) and plastic inner liner (1.5 mm) heat resistance of these materials have been considered negligible.

Therefore:

$Q_{SideWalls} = [U A (T_a - T_r)]$

T_a = Ambient Temperature
T_r = refrigerator air Temperature
U = 1 / (0.040/ 0.0180) = 0.45 W/ sq.m °C
A = 1.96 Sq. Mt.,
T_a = 32 °C
T_f = + 5 °C
therefore
$Q_{SideWalls}$ = 0.45 x 1.96 x 27 = 24 Watts

$Q_{SideWalls}$ = 24 Watts

$Q_{Door\ glass} = [U A (T_a - T_r)]$

U = 1 / (0.015/ 0.024) = 1.6 W/ sq.m °C
$T_a - T_r$ = 27
A = 3.24

Q_{door} = 1.6 x 3.24 x 27 = 140 Watts

Q_{door} = 140 Watts

$Q_{Back\ panel} = [U A (T_a - T_r)]$

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U = 0.45 w/sq. Mt. °C,
$T_a - T_r = 27$
A = 3.2

$Q_{\text{Back panel}} = 0.45 \times 3.2 \times 27 = 39$ Watts

$Q_{\text{Back panel}} = 39$ Watts

$Q_{\text{lower panel}} = [\,U A\,(T_a - T_r)\,]$

U = 0.45 w/sq. Mt. °C,
$T_a - T_r = 27$
A = 0.8

$Q_{\text{lower panel}} = 0.45 \times 0.8 \times 27 = 9.7$ Watts

$Q_{\text{lower panel}} = 9.7$ Watts

$Q_{\text{Top}} = [\,U A\,(T_a - T_r)\,]$
U = 0.45 w/sq. Mt. °C,
$T_a - T_r = 27$
A = 1.6
$Q_{\text{Top}} = 0.45 \times 1.6 \times 27 = 19$ Watts

$Q_{\text{Top}} = 19$ Watts

$Q_{\text{Bottom}} = [\,U A\,(T_a - T_r)\,]$
U = 0.45 w/sq. Mt. °C,
$T_a - T_r = 37$
A = 1.6
$Q_{\text{Bottom Surface}} = 0.45 \times 1.6 \times 37 = 27$Watts

$Q_{\text{Bottom Surface}} = 27$ Watts

Total Refrigerator Heat Leak =24+140+19+27+9.7+39 = 258.7 W

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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 intial 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

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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 800 Kg of milk products to be stored in this refrigerator therefore we calculate as follow,

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

M = 800 kg
C = 0.87 Btu/(lb)F deg = 0.67 x 4.184 = 3.7 j/g K
T_1 = 25 C
T_2 = 5 C
Q = 800000x3.7x (25-5) =59200000 jul/86400 = 685 Watt

Internal Load

Electric Fan 2x10 = 20 Watt
Florescent Lamp = 20 watt

Door Opening
Refrigerator Internal Volume 1800 lit.
Number of air change as per ASHREA standard = 70 per day

Heat removed per cubic meter of air 75000 j

Air Change load = 1.8x70x75000/86400 = 109 Watt

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

$$Q_{Total} = 685 + 258.7 + 20 + 20 + 109 = 1092.7 = 1093$$

Considering 10 % of Q total for safety factor

$$Q_{Grand\ Total} = 1093 + 10\%(109) = 1202 \text{ watts}$$

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With respect to the above calculation we have to select a compressor of R134a with cooling capacity of approximately 1202 watt at –15 degree centigrade evaporating temperature. We select a compressor to match with Electrolux model S34TY

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Meat Show Case Model MDR-160 Technical Specification	
Show Case	Type of Product
1600 x 800 x 2000 mm	Overall Dimension
40 mm	Wall Thickness
P.U. Foam R11	Type of Foam
30 - 40 Kg/ cu m	Foam Density
100 ISO, 100 Polyol, 35 R11	Foam Mixing Ratio %
1200 lit.	Net Internal Volume
Electrolux S26TY, Hermetic, Air Cooled	Type of Compressor
772 Watts	Compressor Cooling Capacity
Fin and Tube	Type of Condenser
3, rows	Size of Condenser
Fin and Tube = 15 meter	Type of Evaporator
R12	Type of Refrigerant
R12, = 600 Gr.	Refrigerant Charge
30 Gr.	Filter Drier Size
220/50	Power Source
- 15 °C	Designated Inside Evaporator Temperature
5 °C	Designated Inside Ref. Temperature
Standard 32 °C	Designated Operating Condition

هاتف معرض : ٦٥٣٢٦٢ - المصنع : ٧٣١٣٧٢ - فاكس : ٩٦٢-٦-٦١٣٣٤٠ - ص.ب : ٩٢١٩٤٠ عمان - الاردن
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Refrigeration Load Calculation
Upright Refrigerator Showcase Model MDR-160

a) Transmission load calculation

Refrigerator Compartment	Dimension Cm.	Area (sq.mt.)	Insulation Thickness	Temp. Difference
Side Walls	2 x (80x200)	3.2	40mm	27 c
Back Panel	160x200	3.2	40mm	27 c
Bottom	80x200	1.6	40mm	27 C
Top	80x200	1.6	40mm	37 c
Doors	160x200	3.2	40mm	27 c

Insulation Type: Pu Foam with R141b blowing agent.
Thermal Conductivity for Foam = 0.0180 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.

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

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

$$U = \frac{1}{X_1 / K_1}$$

Where :

U = Heat Resistance Coefficient Factor
K_1 = Foam Thermal Conductivity

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Due to the short thickness of cabinet out side panel (0.6 mm) and plastic inner liner (1.5 mm) heat resistance of these materials have been considered negligible.
Therefore:

$Q_{SideWalls} = [U A (T_a - T_r)]$

T_a = Ambient Temperature 32
T_r = refrigerator air Temperature 5
U = 1 / (0.040/ 0.0180) = 0.45 W/ sq.m °C
A = 3.2 Sq. Mt.,
T_a = 32 °C
T_f = + 5 °C
therefore
$Q_{SideWalls}$ = 0.45 x 3.2 x 27 = 39 Watts

$Q_{SideWalls}$ = 39 Watts

$Q_{doors} = [U A (T_a - T_r)]$

U = 1 / [(0.040/ 0.018)] = 0.45 W/ sq.m °C
$T_a - T_r = 27$
A = 3.2
Q_{doors} = 0.45 x 3.2 x 27 = 39 Watts
Q_{doors} = 39 Watts

$Q_{top} = [U A (T_a - T_r)]$

U = 0.45 w/sq. Mt. °C,
$T_a - T_r = 37$
A = 1.6
Q_{top} = 0.45 x 1.6 x 37 = 26.6 Watts
Q_{top} = 26.6 Watts

4 -$Q_{back\ panel} = [U A (T_a - T_r)]$

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U = 0.45 w/sq. Mt. °C,
$T_a - T_r = 27$
A = 3.2
$Q_{\text{back panel}} = 0.45 \times 3.2 \times 27 = 39$ Watts
$Q_{\text{back panel}} = 39$ Watts

5 -$Q_{\text{Bottom}} = [\,U A\,(T_a - T_r)\,]$

U = 0.45 w/sq. Mt. °C,
$T_a - T_r = 27$
A = 1.6
$Q_{\text{Bottom Surface}} = 0.45 \times 1.6 \times 27 = 19.4$ Watt
$Q_{\text{Bottom Surface}} = 19.4$ Watts

Total Refrigerator Heat Leak =39 +39 + 26.6 + 19.4 + 39= 163 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 intial temperature to some lower temperature above freezing.

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

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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 +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

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Q = 600000x2.8x (25-5) =33600000 jul/86400 = 389 Watt

Internal Load

Motor Fan 16 Watt

Door Opening
Refrigerator Internal Volume 1200 lit.
Number of air change as per ASHREA standard = 70 per day
Heat removed per cubic meter of air 75000 j

Air Change load = 1.2x70x75000/86400 = 72.9 Watt

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

$Q_{Total} = 163 + 389 + 16 + 73 = 641$

Considering 20 % of Q total for safety factor

$Q_{Grand\ Total} = 641 + 20\%(128) =$ **769** watts

With respect to the above calculation we have to select a compressor of R134a with cooling capacity of approximately 769watt at –15 degree centigrade evaporating

temperature. We should select a compressor to be compatible with Electrolux compressor model S26TY.

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Show Case Model MDM-200 Technical Specification	
Show Case Upright Refrigerator	Type of Product
2000 x 800 x 1100 mm	Overall Dimension
40 mm	Wall Thickness
P.U. Foam R11	Type of Foam
30 - 40 Kg/m	Foam Density
100 ISO, 100 Polyol, 35 R11	Foam Mixing Ratio %
600 lit.	Net Internal Volume
Electrolux Model P12TX	Type of Compressor
458 Watts	Compressor Cooling Capacity
Fin and Tube	Type of Condenser
3 rows	Size of Condenser
Fin and Tube 4 lines	Type of Evaporator
R12	Type of Refrigerant
R12, = 750 Gr.	Refrigerant Charge
30 Gr.	Filter Drier Size
220/50	Power Source
- 15 °C	Designated Inside Evaporator Temperature
5 °C	Designated Inside Ref. Temperature
Standard 32 °C	Designated Operating Condition

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Refrigeration Load Calculation
Upright Refrigerator Showcase Model MDM-200

a) Transmission load calculation

Refrigerator Compartment	Dimension Cm.	Area (sq.mt.)	Insulation Thickness	Temp. Difference
Side Walls	2 x (110x80) – [(70x30)/2[	1.55	40mm	27 c
Lower Front panel	40x200	0.8	40mm	27 c
Back Panel	200 x110	2.2	40mm	27 c
Top Surface	50 x 200	1	40mm	27 c
Bottom Surface	80 x 200	1.6	40mm	37 c
Front Glass	200 x 60	1.2	15mm air	27 c

Insulation Type: Pu Foam with R141b blowing agent.
Thermal Conductivity for Foam = 0.0180 W/ mt. ° C
Thermal Conductivity for Air at – 12 C = 0.0237 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.

$$Q_{TL} = Q_{SW} + Q_{Back\ Panel} + Q_{lower\ panel} + Q_{Bottom} + Q_{top} + Q_{front\ glass}$$

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

$$U = \frac{1}{X_1 / K_1}$$

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Where :
U = Heat Resistance Coefficient Factor

K_1 = Foam Thermal Conductivity
Note : Due to the short thickness of cabinet out side panel (0.6 mm) and plastic inner liner (1.5 mm) heat resistance of these materials have been considered negligible.

Therefore:

$Q_{SideWalls} = [U A (T_a - T_r)]$
T_a = Ambient Temperature
T_r = refrigerator air Temperature
U = 1 / (0.040/ 0.0180) = 0.45 W/ sq.m °C

A = 1.55 Sq. Mt.,
T_a = 32 °C
T_f = + 5 °C
therefore
$Q_{SideWalls}$ = 0.45 x 1.55 x 27 = 19 Watts

$Q_{SideWalls}$ = 19 Watts

$Q_{front\ glass} = [U A (T_a - T_r)]$

U = 1 / (0.015/ 0.0237) = 1.6 W/ sq.m °C
$T_a - T_r = 27$
A = 1.2
$Q_{front\ glass}$ = 1.6 x 1.2 x 27 = 52 Watts

$Q_{front\ glass}$= 52 Watts

$Q_{Back\ panel} = [U A (T_a - T_r)]$

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U = 0.45 w/sq. Mt. °C,
$T_a - T_r = 27$
A = 2.2
$Q_{Back\ panel} = 0.45 \times 2.2 \times 27 = 27$ Watts
$Q_{Back\ panel} = 27$ Watts

$Q_{Top} = [U A (T_a - T_r)]$
U = 0.45 w/sq. Mt. °C,
$T_a - T_r = 27$
A = 1
$Q_{Top} = 0.45 \times 1 \times 27 = 12$ Watts
$Q_{Top} = 12$ Watts

$Q_{Bottom} = [U A (T_a - T_r)]$

U = 0.45 w/sq. Mt. °C,
$T_a - T_r = 37$
A = 1.6

$Q_{Bottom\ Surface} = 0.45 \times 1.6 \times 37 = 27$ Watts
$Q_{Bottom\ Surface} = 27$ Watts

$Q_{lower\ panel} = [U A (T_a - T_r)]$

U = 0.45 w/sq. Mt. °C,
$T_a - T_r = 27$

A = 0.8
$Q_{lower\ panel} = 0.45 \times 0.8 \times 27 = 10$ Watts

Total Refrigerator Heat Leak =

19+27+12+27+52+10=147 Watt

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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 intial 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.

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

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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 300 Kg of meet to be stored in this refrigerator therefore we calculate as follow,

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

M = 300 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 = 300000x2.8x (25-5) =11200000 jul/86400 = 194 Watt

Internal Load

Florescent Lamp = 20 watt

Door Opening
Refrigerator Internal Volume 600 lit.
Number of air change as per ASHREA standard = 70 per day
Heat removed per cubic meter of air 75000 j

Air Change load = 6x70x75000/86400 = 36 Watt

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

$$Q_{Total} = 147 + 194 + 20 + 36 = 397$$

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Considering 10 % of Q total for safety factor

$Q_{\text{Grand Total}}$ = 397 + 10%(40) = **437** watts

With respect to the above calculation we have to select a compressor of R134a with cooling capacity of approximately 437 watt at –15 degree centigrade evaporating temperature. The suitable compressor should compatible with compressor Electrolux model P12TX .

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Chest Freezer Model MDCF-125 Technical Specification	
Chest Freezer	Type of Product
1250 x 650 x 860 mm	Overall Dimension
50 mm	Wall Thickness
P.U. Foam R11	Type of Foam
35 - 40 Kg/m	Foam Density
100 ISO, 100 Polyol, 35 R11	Foam Mixing Ratio %
500 lit.	Net Internal Volume
Electrolux model P12FW	Type of Compressor
235 Watts	Compressor Cooling Capacity
Wire on Tube	Type of Condenser
Tube in Body	Type of Evaporator
R12	Type of Refrigerant
R12, = 300 Gr.	Refrigerant Charge
15 Gr.	Filter Drier Size
220/50	Power Source
- 18 °C	Designated Inside Evaporator Temperature
5 °C	Designated Inside Ref. Temperature
Standard 32 °C	Designated Operating Condition

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Chest Freezer Model MDCF-125

a) Transmission Load Calculation

Dimension

	Dimension Cm.	Area (sq. mt.)	Insulation Thickness mm
Side Walls	2 x (65x86)	1.12	50
Front & Back Panel	2 x (125x86)	2.14	50
Chest Door	125 x 65	0.81	50
Bottom Floor	125 x 65	0.81	50

Insulation Type: Pu Foam R141b expanded blowing PU foam
R141b Foam Thermal Conductivity: 0.018 W /mt.C
Temperature Difference: (ΔT) = 32 - (-25) = 57 C
Ambient Temperature = 32 C
Freezer Air Temperature = - 25 C

Calculation :

$$Q_{TL} = Q_{side\ Walls} + Q_{Bottom} + Q_{Top}$$

$$Q = U A (T_a - T_f)$$

$$U = \frac{1}{X_1 / K_1 + X_2 / K_2 + \dots\dots}$$

Where :

U = Heat Resistance Coefficient Factor
K_1 = Foam Thermal Conductivity
X_1 = Foam Thickness

Note : Due to the short thickness of cabinet out side panel (0.6 mm) and plastic inner liner (1.5 mm) heat resistance of these materials have been considered negligible.Therefore:

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$Q_{SideWalls} = [\,U\,A\,(T_a - T_f)\,]$

T_a = Ambient Temperature
T_f = Freezer air Temperature
U = 1 / (0.05/0.018) = 0.36 W/ sq.m C
A = 1.12 Sq. Mt.
T_a = 32 C
T_f = - 25 C
$Q_{SideWalls}$ = 0.36 x 1.12 x 57 = 23 Watts
$Q_{SideWalls}$ = 23 Watts

$Q_{Front\ Wall} = [\,U\,A\,(T_a - T_f)\,]$
T_a = Ambient Temperature
T_f = Freezer air Temperature
U = 1 / (0.050/0.018) = 0.36 W/ sq.m C
A = 1.07 Sq. Mt.
T_a = 32 C
T_f = - 25 C
$Q_{Front\ Wall}$ = 0.36 x 1.07 x 57 = 22 Watts

$Q_{Front\ Wall}$ = 22 Watts

$Q_{Back\ panel} = [\,U\,A\,(T_a - T_f)\,]$
T_a = Ambient Temperature
T_f = Freezer air Temperature
U = 1 / (0.050/0.018) = 0.36 W/ sq.m C

A = 1.07 Sq. Mt.

T_a = 42 C
T_f = - 25 C
$Q_{back\ panel}$ = 0.36 x 1.07 x 57 = 22 Watts

$Q_{Top} = [\,U\,A\,(T_a - T_f)\,]$
T_a = Ambient Temperature

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T_f = Freezer air Temperature
U = 1 / (0.050/0.018) = 0.36 W/ sq.m C
A = 0.81 Sq. Mt.

T_a = 32 C
T_f = - 25 C
Q_{Top} = 0.36 x 0.81 x 57 = 17 Watts
Q_{Top} = 17 Watts

Q_{Bottom} = [U A (T_a - T_f)]
T_a = Ambient Temperature
T_f = Freezer air Temperature
U = 1/(0.050/ 0.018) = 0.36 W/ sq.m C
A = 0.81 Sq. Mt.
T_a = 42 C
T_f = - 25 C
Q_{Bottom} = 0.36 x 0.81 x 67 = 19 Watts

Total Heat Leaks;

Q_{TL} = 23 + 26 + 22 + 19 + 17 = 107 watts

$Q_{Total\ Heat\ Leaks}$ = 107 Watts

Ice Making Capacity = 5_{Kg} x 1 x (15 - 0) x1.163= 87 Watts

c) Heat gain through infiltration;

We consider 10% safety factor for door opening and infiltration

Heat gain by infiltration = 0.1 x (total heat leaks)

Heat gain by infiltration = 0.1 x (87) = 9 Watts

Total Cooling Capacity Required is calculated as follows;

$Q_{Grand\ Total} = Q_{Heat\ Leaks} + Q_{Ice\ Making} + Q_{Infiltration}$

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$$Q_{\text{Grand Total}} = 107 + 87 + 9 = 203 \text{ Watts}$$

$$Q_{\text{Grand Total}} = 203 \text{ Watts}$$

The suitable R134a compressor should be compatible with cooling capacity of 203 watt. A compressor compatible with Electrolux model P12Fw should be selected.

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Model MDWC-100

$Q_1 = m\ C\ \Delta T$, 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 24 C.

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

M = 100 liter = 100 Kg.

C Specific heat factor of water in Kcal/Kg $^{o}C = 1$

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

Ti = 24 ^{o}C and Tc = 10 ^{o}C

Ti – Tc = 24-10 = 14 ^{o}C

Q_1 = m C ΔT = 100 x 1 x 14 = 1400 Kcal = 1400 x 1.163 = 1628 Watts/24 hrs

Q_1 = 1628 /24 water cooler operating time per day = 69 Watts

Q_1 = 69 Watts

$Q_2 = \dot{M}\ C\ \Delta T$

Q_2 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 = 30

M = Kg weight of water in one Glass of Water = 0.2 Kg

$\dot{M}$ = 16 x 25 x 0.2 = 96 lit. + 20% Waste Water = 96

C Specific heat factor of water in Kcal/Kg $^{o}C = 1$

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

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Ti = 24 °C and T= 10 °C and Ti – Tc = 24-10 = 14 °C

$Q_2 = m\ C\ \Delta T$ = 96 x 1 x 14 = 1344 Kcal = 1344 x 1.163 = 1563 Watts/16 hrs

Q_2 = 1563/12.8 compressor operating time per day = 122 Watts

Q_2 = 122 Watts

$Q_3 = UA\ \Delta T$, Where:

Q_3 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

$$U = \frac{1}{x/K} = \frac{1}{0.05/0.018} = 0.36\ Watt/m^2 \cdot ℃$$

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

A = {(30 x 3.14x50) + [(2x30x30x3.13)/4]} = 0.6123 Sq. Mt.

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

Ta = 30 °C and Tc = 10 °C

Ta – Tc = 30-10 = 20 °C

$Q_3 = UA\ \Delta T$ = 0.36 x 0.6123 x 20 = 4.4 Watts

Q_3 = 4.4 Watts

$Q_t = Q_1 + Q_2 + Q_3$ = 69 + 122 + 4.4 = 195 Watts

Suitable compressor to be selected should have at least 195 watt cooling capacity and must be compatible with compressor model Electrolux L76AV.

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