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SAHAND MINA ENGINEERING CO LTD.

UNIDO

Conversion and Development of Prototype from R12 to R134a Ozone Friendly Refrigerant System at

Khporsandi, Sarma Gostar, Moradi, Isun, Jahan Nama, and Alborz Neishabour Companies

PROJECT NUMBERS

MP/IRA/01/202, 203, 204, 205, 206, 207

Contract Number

02/087

Final Report

December 2002

Sahandmina Engineering Company Ltd.

Final Report

PROJECTS NO.
MP/IRA/01/202, 203, 204, 205, 206, 207

Contract Number 02/087

Khorsandi, Sarma Gostar, Moradi, Isun/ Jahan Nama, and Alborz Neishabour Companies

Introduction

We are delighted to submit to you herewith, our Final Report, concerning calculation and redesign of the prototypes that have been made the counterparts and they have been tested at counterparts' hot chamber. These prototypes have been manufactured under our close engineering supervision and have been tested in accordance with appropriate ISO standard test procedure and relevant performance test characteristics for functionality and performance of the new Ozone friendly R134a refrigerant. Our preliminarily review of test results revealed that majorities of prototypes responded to the new R134a refrigerant functional behavior. The final assessment and evaluation of prototypes test results together with original copies of prototypes

performance sheets will be submitted to you together with our final reports after UNIDO's approval of our this report and we hope that this report could have satisfied the UNIDO in order to comply with our contract.

Synopsis

This report has been prepared based on the Contract between UNIDO and Sahandmina Engineering company.
This project will phase out the use of CFC-11 and CFC-12 in the production of Domestic/commercial refrigeration equipment at *Novin Khorsandi, Sarma Gostar, Moradi, Isun/ Jahan Nama, and Alborz Neishabour*. CFC-11, which is used, as a foam-blowing agent in the production of polyurethane foam will be replaced by **HCFC-141b** and CFC-12, which is used as the refrigerant in the cooling circuit of appliances, will be replaced by **HFC-134a**. The project includes the modification of all cooling equipment produced and the conversion of the production facilities. The model redesign element of the project includes testing, trial manufacture and reliability tests. The cost of converting foaming machines to use HCFC-141b will be covered by the counterpart organizations.

General Background

The objective of this project is to eliminate the use of CFC-11 and CFC-12 in the production of commercial and domestic refrigeration equipment at the *Khorsandi, Sarma Gostar, Moradi, Isun/ Jahan Nama, and Alborz Neishabour*, through conversion to the use of HFC-134a refrigerant for the cooling system and HCFC-141b as blowing agent for the polyurethane insulation foam.

The same operating parameters and the same quality level is guaranteed on completion of the conversion process, but no increase in production capacity will be brought about by the project. The company involved is

aware of the financial limitations of the funding process and is prepared to use its own funds to share some of the cost of the conversion process.

SECTOR BACKGROUND

The Islamic Republic of Iran ratified the Montreal Protocol in March 1990. Subsequently, Iran's Country Programme has outlined a plan for the reduction of the domestic use of ODS by 75% before 1999, and aims to be ODS free by 2005.

Based on the data provided by the Ozone Layer Protection Center/Department of Environment of Iran, the Refrigeration Sector in Iran is estimated to comprise of about 300 enterprises. The annual ODS consumption in the domestic and commercial refrigeration sectors is reported to be about 2,500 ODP MT as of 1998, representing the bulk of the overall ODS consumption in Iran. The domestic and commercial refrigeration sub-sector each contributes about 50% of the total ODS consumption in this sector. The average growth rate in this sector has been about 6.5% annually.

In the domestic refrigeration sub-sector, there are about 10 large manufacturers and about 15 medium-sized manufacturers, with a combined production of about 2 million units. In the commercial refrigeration sub-sector, there are about 30 relatively large-sized enterprises, and the remaining (estimated to be about 300) are small and medium sized. Due to the relatively unsophisticated technology and practices prevailing in the small and medium enterprises, and being unorganized, they will present a challenge to reach out to for purposes of participation in the Montreal Protocol programme for ODS phase-out.

There are two indigenous manufacturers of hermetic refrigeration compressors in Iran, which produce compressors suitable for domestic refrigeration appliances using CFC-12 technology. Their combined production is estimated to be about 800,000 units, which meets only a part

of the domestic demand, the balance being imported. The hermetic and semi-hermetic compressors required by the commercial refrigeration sub-sector are predominantly imported.

The Ozone Layer Protection Center/Department of Environment is leading the efforts for ODS phase-out under the Montreal Protocol, in co-operation with the consuming and supplying industry and with the assistance of the implementing agencies. Complete ODS phase-out is targeted for 2005 except essential uses. The Refrigeration Sector has been identified as a priority sector for ODS phase-out.

In terms of technology and equipment employed the commercial refrigeration sector is very similar to the domestic appliance sector. The primary differences are in the scale of equipment is used, which is bigger in commercial applications, and the variety of products which are manufactured. Most companies manufacture several types of equipment from a wide ranges of applications, including the following:

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

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

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

Counterpart Data

The baseline data for the company covered by this project contains:

- baseline production data
- baseline ODS consumption data
- baseline production equipment data

The *Khorsandi, Sarma Gostar, Moradi, Isun Jahan Sarma, and Ahar Neishabour,* are manufacturers of commercial and domestic refrigerators and freezers. These enterprises are 100% indigenously owned by the same group people and report no exports and being financially sound.

PROJECT SUMMARY

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

through the introduction of new equipment, components and processes, as below:

Refrigeration operation

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

- Compressors suitable for HFC-134a will be required. These will be available from existing suppliers.
- The chemical stability of HFC-134a and of the synthetic lubricants compatible with HFC-134a are highly sensitive to moisture and impurities in the system, as compared to CFC-12 system. The evacuation/charging process for HFC-134a and polyol-ester lubricant will need to ensure the required level of cleanliness and dryness in the system. To ensure this the following is proposed:
- The vacuum pumps will need to be suitable for use with HFC134a of the existing vacuum pumps, are replaced.
- The existing refrigerant charging units are not suitable for use with HFC - 134a and cannot be retrofitted, and will therefore be replaced with two charging units suitable for HFC-134a duty.

The design/sizing of the refrigeration system will need to be suitably changed, to ensure the viability of the process and to maintain the product standards for performance, such as:

1. Up sizing the condensers and re engineering evaporators and condensers, so as to ensure the levels of cleanliness and contamination that can be tolerated with HFC-134a

2. Lengthening of the capillary tubes.
3. Use of filter-dryers with finer pores, suitable for use with HFC-134a
4. The existing leak detectors are suitable for detecting CFC-12 only and will therefore need to be replaced with leak detectors suitable for detecting HFC-134a.
5. Provision for technical assistance from external international refrigeration experts and also from compressor suppliers will be required to be made to ensure smooth transition to the new technology and the successful implementation of the project.
6. In-house and field trials on prototypes of each model will be needed to be carried out, to establish performance and reliability with the HFC-134a based refrigeration systems.
7. The system dryness/cleanliness with the use of HFC-134a being of crucial nature, careful re-assessment of the production program, re-training/orientation of the staff for the new technology would be required.

Aim of the Project

The aim of the immediate project is to;

- Design, calculation for model redefinition.
- Testing 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 6 models of commercial refrigerators made by *Khorsandi, Sarma Gostar, Moradi, Isan/ Jahan Nama, and Alborz Neishabour*..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 have been used to make prototypes .

- R134a Compressors
- R134a Refrigerant
- Refrigerant Accumulators
- Specially designed filter drier
- Specially designed evaporator and condenser

Activities

The activities for implementation of this contract could be summarized as below.

- Site survey of the counterpart premises in order to be familiar with the counterpart facility and production line and also define the prototypes for conversion.
- Site survey of the counterpart premises in order to collect necessary data for calculation of prototype.
- Preparation of Technical data sheet in order to define detail technical specification
- Review the existing technical drawing for the purpose of assessment of possible changes in the design criteria.
- Review each prototype refrigeration circuit for determination of cooling circuit components
- Review and assessment of design criteria following cooling circuit component in order to minimize possible changes and design improvement.

    - Compressor technical specification
    - Condenser type, material and design criteria
    - Evaporator type, material and design criteria
    - Capillary tube design, dimensions and material
    - Filter drier, size and material
    - Determination of R12 refrigerant charge for each prototype in order to adjust R134a charge weight

- Coordination with the counterparts for performing, performance test after completion of making prototypes
- Calculation of prototypes in order to determine the size of R134a compressor and implement necessary changes to the cooling circuits
- Preparation of Performance Test Results Sheet, in order to record all data obtained during functional test.
- Testing Prototypes at Hot Chamber.
- Evaluation of Performance test results.
- Corrective action on defective parts and components.
- Replacement of defected parts.
- Adjustment of refrigerant charge for each prototype.
- Assembly line preparation of trial test and production to fulfill R134a cleanliness requirement.

- On the job training to counterpart technical staff to operate new R134a equipment such as new refrigerant charger machine, new vacuum pump, and new leak detector.
- Coordination with equipment supplier to conduct suitable training program to the counterpart technical staff.
- Final visit of the counterpart to assure trial production of R134a products as foreseen in the project investment documents in case of new equipment availability.

Preparation of prototypes for performance test as

The prototypes shall be 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
Continues 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.

The material as sample for making prototypes are 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,

Training

Before making prototypes we conducted a training course to train the technical staffs 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 phases 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
- Selecting Prototype Model
- Refrigeration System components Familiarization
- Refrigeration Load Calculation
- Thermostat Selection and Adjustment
- Refrigerant Charging Methods
- Testing Prototypes
- Analyzing Prototype Test Results

Making Prototypes

- Prototype Model Selection
- Refrigeration System Components Selection

1- Defrost Type
2- No-Frost Type

- Familiarization with Refrigeration System Components
  1- Condenser
     a. Wire on Tube
     b. Tube welded on Plate
     c. Tune on Plate
     d. Tube in the Body
     e. Tube on the fins
  2- Capillary Tube
     a. Tube Length
     b. Tube Diameter
     c. Tube Material
  3- Expansion Valve
     a. Size
     b. Capacity
     c. Material
  4- Filter Direr
     a. Weight
     b. Material
     c. Model
  5- Evaporator
     a. Roll Bond
     b. Wire on Tube
     c. Tube welded on Plate
     d. Tune on Plate
     e. Tube in the Body
     f. Tube on the fins
- Refrigeration Load Calculation
  1- Aim of Calculation
     a. Model Re-Definition
     b. Model Improvement
     c. Model Modification
     d. Conversion of Prototype
     e. Model New Design
  2- Methods of Refrigeration Load Calculation
     a. ASHREA
     b. Manufacturer
     c. Institutes and Universities

3- Different Elements Required for Calculation
   a. Heat Transfer
      Dimension, Insulation, Ambient, Working Condition
      Gasket, etc.
   b. Product Load
      Food, Material, Ice, Etc.
   c. Infiltration
      Door Opening, Air Replacement
   d. Miscellaneous devices and apparatus
      Light, Fan, Etc.

- Compressor

Cooling System (Static, Oil, Air)

1- Pressure
   a. LBP (Low Back Pressure)
   b. HBP (High Back Pressure)
   c. MBP (Medium Back Pressure)
2- Model
   a. Hermetic
   b. Semi-Hermetic
   c. Open
3- Type of Refrigerant
   a. R12
   b. R134a
   c. Isobutene
   d. Blend
4- Accessories
   a. Capacitor Type
   b. Starting Relay
   c. Voltage, Frequency and Current
   d. Electrical Circuit
5- Mounting Compressor
   a. Refrigerant Fellow Direction
   b. Top on the Roof
   c. Bottom on Base
   d. Double Compressor Mounted
6- Compressor Capacity

a. Watt
b. Horse Power
c. B.T.U/Hr
d. Kcal/Hr

7- Compressor Test Condition

CECOMAF

Evaporating Temp.	-25° C
Condensing Temp.	55° C
Ambiant Temp.	32° C
Suction Gas Temp.	32° C
Liquid Temp.	55° C
Volatage/Hertz	220V/50 Hz

Heat out Put= Capacity + Watt Consumption

ASHRAE

Evaporating Temp.	-23.3° C
Condensing Temp.	55° C
Ambiant Temp.	32° C
Suction Gas Temp.	32° C
Liquid Temp.	32° C
Volatage/Hertz	220V/50 Hz

Heat out Put= Capacity + Watt Consumption

ASHRAE to CECOMAF

Conversion of Capacity From CECOMAF into ASHRAE

R134a Multiply by 1.231
R22 Multiply by 1.097
R404 Multiply by 1.183
1 Watt = 0.86 Kcal/h
1 Watt = 3.41 BTU/h
1 Kcal/h = 1.0162 Watt
1 BTU/h = 0.293 Watt

8- Evaporating Temp. and Selection of Compressor

9- Thermostat

Thermostat Adjustment

a. Cut-in Time - 5 to -15 Compressor Connected

b. Cut-out time -15 to -25 Compressor Dis-Connected
c. Thermostat Setting, Max. Med, Min
d. Thermostat Temperature Difference

- Refrigerant Type

1- CFC- 12
2- HFC-134a
3- Isobutene, R-600
4- Blend, (Isobutene+ Propane)

- Methods of Refrigerant Charging
  1- Bottle, 13.5 Kg. Cylinder
  2- Portable Charger
  3- Production, Evacuation and Charging Equipment
- Refrigerant Charge Weight
  1- Experimental, trial and error
  2- Calculation
  3- Comparison with other Refrigerants
- Refrigeration Leak Detection Procedure
  1- Conventional Method, (water and Soap)
  2- Portable Electronic Leak Detector
  3- Production Electronic Leak Detector
  4- Nitrogen, and Helium Leak Detection Procedure

- Accuracy and Precision of Leak Detection Procedure
  5- Conventional Method, (water and Soap)
  6- Portable Electronic Leak Detector
  7- Production Electronic Leak Detector
  8- Nitrogen, and Helium Leak Detection Procedure
- Recovery
- Recycling
- Reclaiming

Testing Prototypes

- Test Prototypes with R12 Refrigerant to get desired test results.
- Hot Chamber Specification
- Placing Prototypes at Hot Chamber
- Mounting Sensors and their Place and Location
- Testing Condition

1- Tropical "T" 43 °C
2- Sub-Tropical 38 °C
3- Normal 32 °C
4- Sub-Normal 28 °C
5- Cold 18 °C
6- Relative Humidity

- Test Package
- « M » Package
- Meat
- Ice
- Different Tests
    1- Operational
    2- Performance
    3- Energy Consumption
    4- Ice Making
    5- Humidity
- Testing Procedure
    1- Pull Down
    2- Continuous Run
    3- Cyclic Run
- Duration of Test
- Reading Test Result
- Test Results Analysis

Conclusion

All prototypes were tested successfully at the counterparts premises. The test results are being evaluated for proper functioning of refrigeration system components specially R134a compressor. The main difficulties and problems during implementation of the contract were hot chamber design and performance. The hot chambers are being constructed locally and improper insulation and air distribution inside the hot room, ineffective testing system and software affected the test performance quality.

Recommendation

An up to dated, effective, and user-friendly Testing system for the enterprises is recommended to be supplied to the counterparts, to improve quality of model redesign and performance test.

Kindest Regards

Sahand Mina Engineering Co. Ltd.

Refrigeration Load Calculation
Heat Leaks Through Walls
Khorsandi
$Q = U \cdot A \cdot \Delta T$

Description	Dimension	Surface Area Sq. Mt.	Ambient Temp. °C	Reference Inside Temp.	ΔT Temp. Diff.	X Insulation Thickness	K Thermal Conductivity	U Coeff. Heat Resistance	Q U . A . ΔT *Watt*
Side Walls	2x420x220	18.48	43	-18	61	70	0.0184	0.26	293.09
Back Panel	230x220	5.06	50	-18	68	70	0.0184	0.26	89.46
Top surface	420x230	9.66	43	-18	61	70	0.0184	0.26	153.21
Bottom surface	420x230	9.66	43	-18	61	70	0.0184	0.26	153.21
Door Panel	230x220	5.06	43	-18	61	70	0.0184	0.26	80.25
Total									769.22

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Product Load Calculation
Khorsandi

Product to be loaded	Product Mass Load Kg.	Product Specific heat Above Freezing Point J/Kg. K	Product Specific heat Below Freezing Point J/Kg K	Latent Heat of Fusion J/Kg.	Product Initial Temp C	Product Final Temp. C	Temp. Diff.	Q_1 $m C_1 \Delta T$	Q_2 $m . C_2 . \Delta T$	Q_3 $M . h$
ICE	35	4180	1950	333000	25	-18	43	60.47	20.31	192.71

$Q_1=(50x25x4180)/86400 =60.47$, $Q_2 = (50x18x1950)/86400 =20.31$, $Q_3= (50x333000)/86400=192.71$

$Total = Q_1 + Q_2 + Q_3 = 273.49 Watts$

Miscellanies Heat Load

Air Change = V . N . H V = Refrigerator Internal Volume N = Number of Air Change per Day H = Heat removed from cubic meter of air = 75000 jul/sec.	Gasket U . A. ΔT $U=0.07$ $L=8$ Mt. ΔT mean=65	Electrometer	Florescent Lamp	Total
(16.8x30x75000)/86400 = 437.5	36.4	N/A	N/A	473.9

Total refrigeration Load

Heal Leaks Through Walls	Product Load	Miscellanies Load	Safety Factors	Grand Total
769.22	273.49	437.5	20	1776.25

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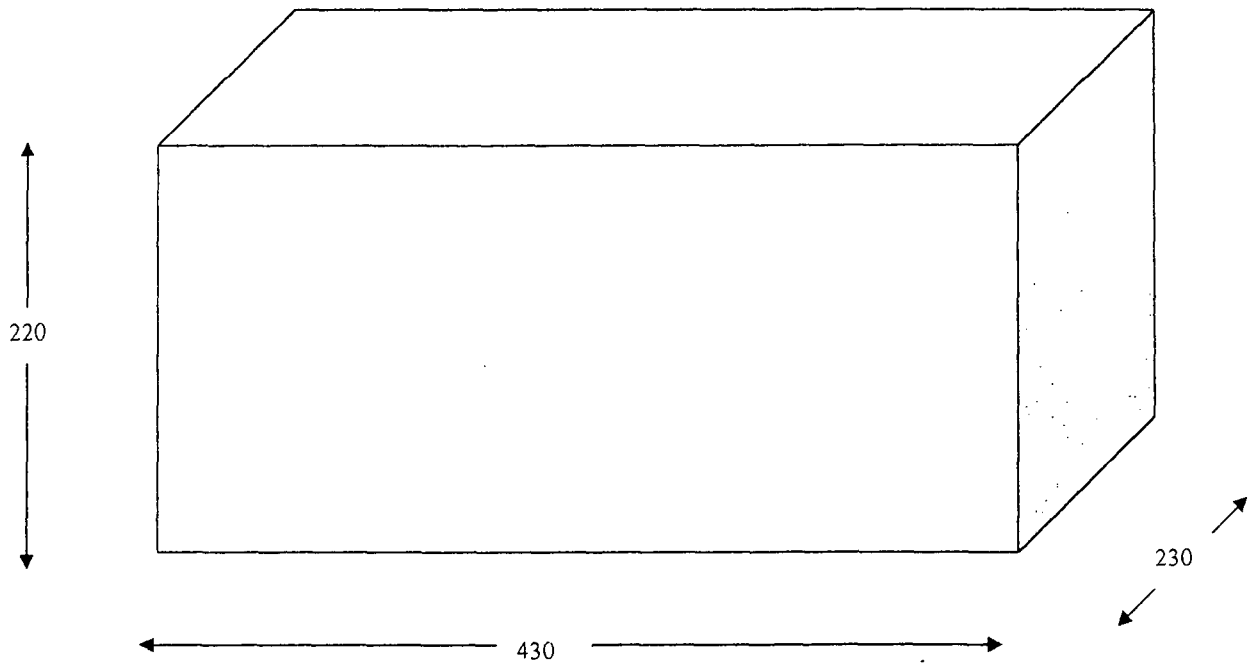

Khorsandi

Product Technical Specification ***Korsandi***	
Description	**Specification**
Company Name	Khorsandi
Product Name	Khorsandi
Product Model	Connex
Product Application	Trunk cooling Connex
Operating Temperature	32 c
Climatic Condition	Normal
Product Overall Dimension WxLxH mm	4200*2300*2200
Freezer Compartment Overall Dimension and Wall Thickness	100 mm
Product Shape, Double Doors, Upright, Chest, etc	Connex
Product Net Volume	16800 liter
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 Side Walls, Top, Bottom, Door, Back Panel	50 mm
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%
Refrigerant Type	R12
Refrigerant Charge Weight Gr.	2000Gr.
Type of Compressor, Hermetic, Semi Hermetic, Open	Hermetic
Compressor Cooling Capacity Watt	1850
Compressor Model Number	¾ G
Compressor Manufacturer	Danfoss
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 37*34 cm
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.	Wire and Tube
Evaporator Material, Aluminum, Copper, Copper Coated, etc,	Copper
Dryer Type,	Cylindrical
Dryer Material, Weight and Size	Silicon jell 100 Gr.
Capillary Tube Diameter and Length	0.32 mm dim. 3000 mm length

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Refrigeration Load Calculation
Heat Leaks Through Walls
Sarma Gostar Shiraz
$Q = U \cdot A \cdot \Delta T$

Description	Dimension	Surface Area Sq. Mt.	Ambient Temp. °C	Reference Inside Temp.	ΔT Temp. Diff.	X Insulation Thickness	K Thermal Conductivity	U Coeff. Heat Resistance	Q $U \cdot A \cdot \Delta T$ *Watt*
Side Walls	2x240x160	7.68	43	-25	68	80	0.0184	0.23	120.11
Back Panel	160x170	2.72	50	-25	75	80	0.0184	0.23	46.92
Top surface	240x170	4.08	43	-25	68	80	0.0184	0.23	63.81
Bottom surface	240x170	4.08	43	-25	68	80	0.0184	0.23	63.81
Door Panel	160x170	2.72	43	-25	68	80	0.0184	0.23	42.54
Total									337.19

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Product Load Calculation
Sarma Gostar Shiraz

Product to be loaded	Product Mass Load Kg.	Product Specific heat Above Freezing Point J/Kg. K	Product Specific heat Below Freezing Point J/Kg K	Latent Heat of Fusion J/Kg.	Product Initial Temp C	Product Final Temp. C	Temp. Diff.	Q_1 $m\,C_1\,\Delta T$	Q_2 $m\,.\,C_2\,.\,\Delta T$	Q_3 $M\,.\,h$
ICE	35	4180	1950	333000	25	-18	43	42.33	14.22	134.9

$Q_1=(35x25x4180)/86400 =42.33$, $Q_2 = (35x18x1950)/86400 =14.22$, $Q_3= (35x333000)/86400=134.9$

$Total = Q_1 + Q_2 + Q_3 = 191.45 Watts$

Miscellanies Heat Load

Air Change = V . N . H V = Refrigerator Internal Volume N = Number of Air Change per Day H = Heat removed from cubic meter of air = 75000 jul/sec.	Gasket U . A. ΔT $U=0.07$ $L=5.6$ *Mt.* ΔT *mean=70*	Electrometer	Florescent Lamp	Total
(4.9x30x75000)/86400 = 127.6	27.44	N/A	N/A	155.04

Total refrigeration Load

Heal Leaks Through Walls	Product Load	Miscellanies Load	Safety Factors	Grand Total
337.19	191.45	155.04	20	820.42

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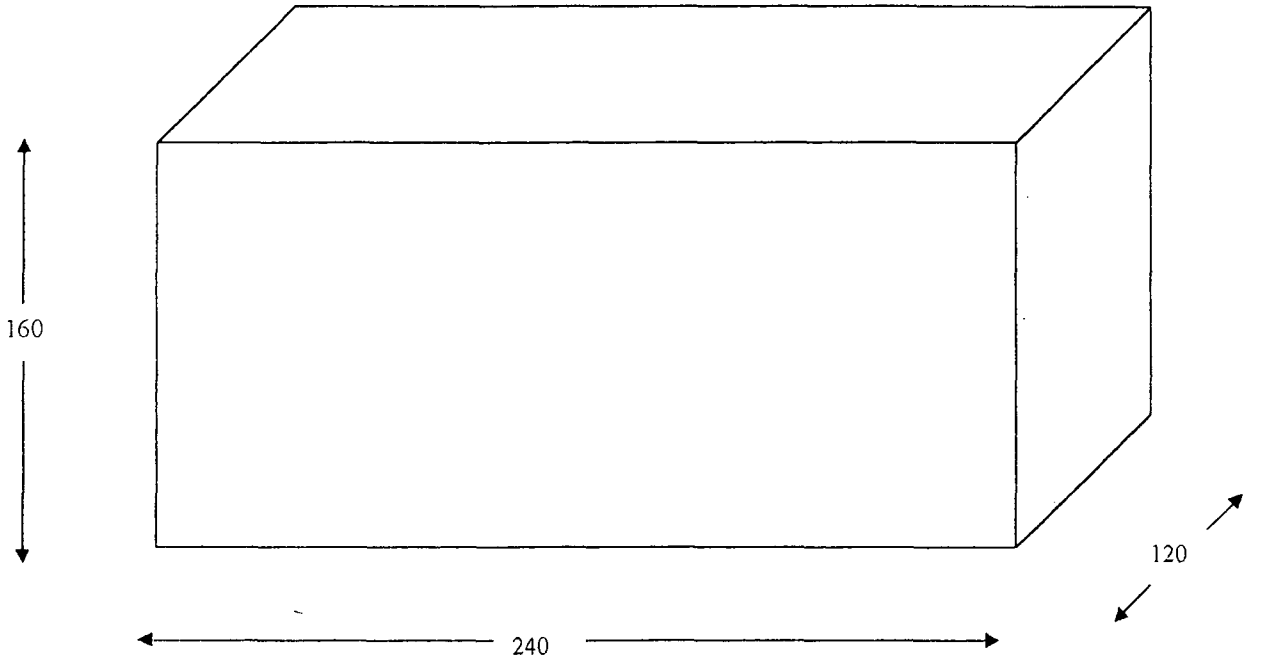

Sarma Gostar Shiraz

Product Technical Specification *Sarma Gostar Shiraz*	
Description	**Specification**
Company Name	Sarma Gostar Shiraz
Product Name	Freezer Connex
Product Model	Connex
Product Application	Connex for Trunk
Operating Temperature	43
Climatic Condition	Tropical
Product Overall Dimension WxLxH mm	240x170x160
Freezer Compartment Overall Dimension and Wall Thickness	8 cm
Refrigerator Compartment Overall Dimension and Wall Thickness	N/A
Product Shape, Double Doors, Upright, Chest, etc	Connex
Freezer Internal Net Volume	4950 Liters
Refrigerator Net Volume	N/A
Product Net overall Volume	6530 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 Side Walls, Top, Bottom, Door, Back Panel	80 mm
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%
Refrigerant Type	R12
Refrigerant Charge Weight Gr.	2200 Gr.
Type of Compressor, Hermetic, Semi Hermetic, Open	Hermetic
Compressor Cooling System Static, Oil Cooled, Fan Cooled	Oil Cooled
Compressor Cooling Capacity	900 Watt

Watt	
Compressor Manufacturer	Danfoss
Compressor Mounting Place Top, Bottom, Front, Back	Front
Condenser Type, Static, Fan Cooled	Fan Cooled
Condenser Dimension, Length, Inside Tube Diameter,	60x50 cm;
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	D:7 cm; 140x75cm
Evaporator Material, Aluminum, Copper, Copper Coated, etc,	Copper
Dryer Type,	ALCO 163
Dryer Material, Weight and Size	Silicon Jell 500gr
Capillary Tube Diameter and Length	Expansion valve ;GES 2; Danfoss

Sahand Mina Engineering Co. Ltd.

Refrigeration Load Calculation
Heat Leaks Through Walls
Moradi Rf 20
$Q = U \cdot A \cdot \Delta T$

Description	Dimension	Surface Area Sq. Mt.	Ambient Temp. °C	Reference Inside Temp.	ΔT Temp. Diff.	X Insulation Thickness	K Thermal Conductivity	U Coeff. Heat Resistance	Q U . A . ΔT *Watt*
Upper Side Walls	2x 101x48	0.97	32	+5	27	45	0.0184	0.41	10.74
Upper Back Panel	101x56	0.57	45	+5	40	45	0.0184	0.41	9.35
Top surface	56x48	0.27	32	+5	27	45	0.0184	0.41	3
Bottom surface	54x47	0.25	50	-18	68	70	0.0184	0.26	4.42
Upper Door Panel	101x56	0.57	32	+5	27	40	0.0184	0.41	6.31
Lower Door Panel	64x48	0.31	32	-18	50	70	0.0184	0.26	4.03
Lower Side Walls	2x64x43	0.55	32	-18	50	70	0.0184	0.26	7.15
Lower Back Panel	64x48	0.31	45	-18	63	70	0.0184	0.26	5.08
Total									49.81

Sahand Mina Engineering Co. Ltd.

Product Load Calculation
Moradi Rf20

Product to be loaded	Product Mass Load Kg.	Product Specific heat Above Freezing Point J/Kg. K	Product Specific heat Below Freezing Point J/Kg K	Latent Heat of Fusion J/Kg.	Product Initial Temp C	Product Final Temp. C	Temp. Diff.	Q_1 $m C_1 \Delta T$	Q_2 $m . C_2 . \Delta T$	Q_3 $M . h$
ICE	10	4180	1950	333000	25	-18	43	12.1	4.06	38.54

Q_1=(10x25x4180)/86400 =12.1, Q_2 = (10x18x1950)/86400 =4.06, Q_3= (10x333000)/86400=38.54

Total = $Q_1 + Q_2 + Q_3$ = 54.7Watts

Miscellanies Heat Load

Air Change = V . N . H V = Refrigerator Internal Volume N = Number of Air Change per Day H = Heat removed from cubic meter of air = 75000 jul/sec.	Gasket U . A. ΔT *U=0.07* *L =5.38* *Mt.* ΔT *mean=45*	Electrometer	Florescent Lamp	Total
(0.4)x30x75000)/86400 = 10.42	16.95	N/A	N/A	27.37

Total refrigeration Load

Heal Leaks Through Walls	Product Load	Miscellanies Load	Safety Factors	Grand Total
49.81	54.7	27.37	25	164.85

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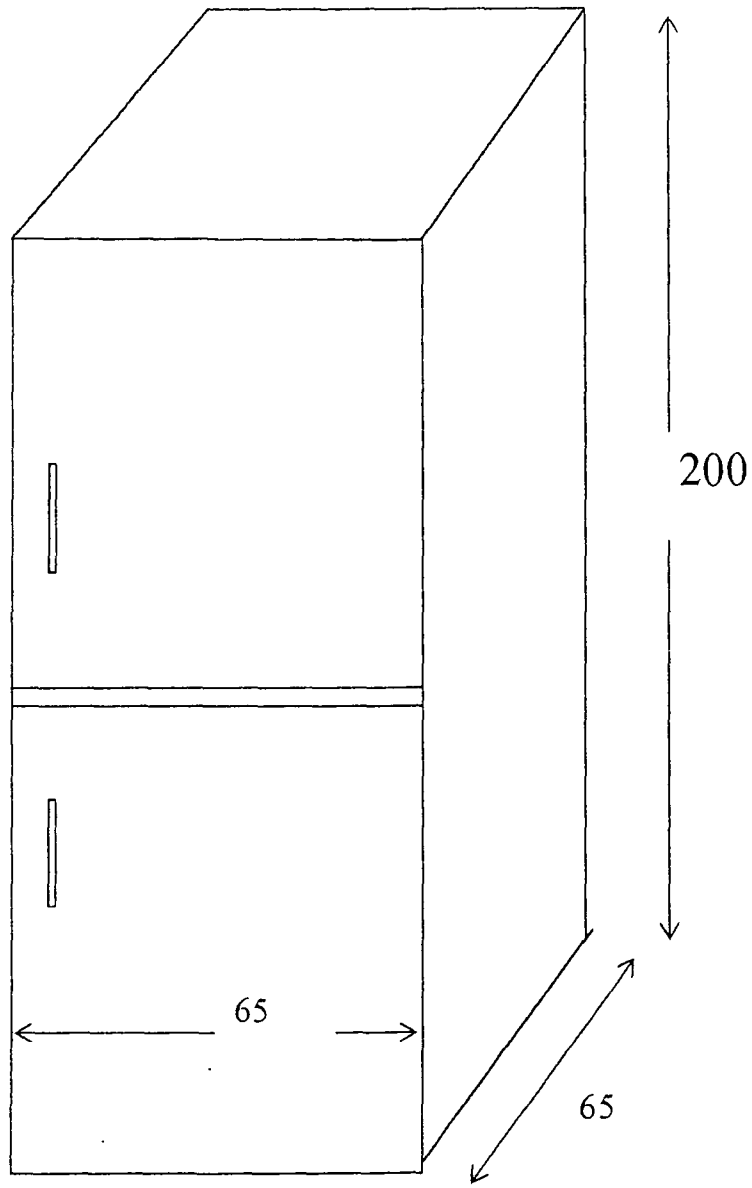

Refrigerator and Freezer
Moradi Rf 20

Product Technical Specification ***Moradi***	
Description	**Specification**
Company Name	Moradi
Product Name	Refrigerator & Freezer
Product Model	RF20
Product Application	Domestic
Operating Temperature	32 C
Climatic Condition	Normal
Product Overall Dimension WxLxH mm	200*65*65
Freezer Compartment Overall Dimension and Wall Thickness	64x48x43 85 mm
Refrigerator Compartment Overall Dimension and Wall Thickness	101x56x48 48mm
Product Shape, Double Doors, Upright, Chest, etc	Double Door
Freezer Internal Net Volume	130 Liter
Refrigerator Internal Net Volume	270 Liter
Product Overall 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	-18 C
Refrigerator Inside Temperature	5 C
Evaporating Temperature	-23 C
Foam Insulation Thickness mm Side Walls, Top, Bottom, Door, Back Panel	Ref 45mm; Fre 70mm
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%
Refrigerant Type	R12
Refrigerant Charge Weight Gr.	220Gr.
Type of Compressor, Hermetic, Semi Hermetic, Open	Hermetic
Compressor Cooling System Static, Oil Cooled, Fan Cooled	Oil Cooled
Compressor Cooling Capacity	220 Watts

Watt	
Compressor Model Number	20 G
Compressor Manufacturer	Danfoss Germany
Compressor Mounting Place Top, Bottom, Front, Back	Bottom
Condenser Type, Static, Fan Cooled	Static Cooled
Condenser Dimension, Length, Inside Tube Diameter,	Length 19.735; 25 Tube
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.	Wire & Tubes
Evaporator Dimension, Length, Surface Area, Inside Tube Diameter	Length 25.37m; Internal Diameter6.6mm; 57 Tubes
Evaporator Material, Aluminum, Copper, Copper Coated, etc,	Copper
Dryer Type,	XH5
Dryer Material, Weight and Size	15 Gr
Capillary Tube Diameter and Length	0.29 mm dim. 3225 mm length

Sahand Mina Engineering Co. Ltd.

Refrigeration Load Calculation
Heat Leaks Through Walls
Isun IRF 700
$Q = U \cdot A \cdot \Delta T$

Description	Dimension	Surface Area Sq. Mt.	Ambient Temp. °C	Reference Inside Temp.	ΔT Temp. Diff.	X Insulation Thickness	K Thermal Conductivity	U Coeff. Heat Resistance	Q U . A . ΔT *Watt*
Upper Side Walls	2x 88x51	0.9	32	+5	27	40	0.0184	0.46	11.18
Upper Back Panel	88x62	0.55	45	+5	40	40	0.0184	0.46	10.12
Top surface	62x51	0.32	32	+5	27	40	0.0184	0.46	3.97
Bottom surface	54x47	0.25	50	-18	68	60	0.0184	0.31	5.27
Upper Door Panel	88x62	0.55	32	+5	27	40	0.0184	0.46	6.83
Lower Door Panel	70x54	0.38	32	-18	50	60	0.0184	0.31	5.89
Lower Side Walls	2x70x47	0.66	32	-18	50	60	0.0184	0.31	10.23
Lower Back Panel	70x54	0.38	45	-18	63	60	0.0184	0.31	7.42
Total									60.91

Sahand Mina Engineering Co. Ltd.

Product Load Calculation
Isun IRF 700

Product to be loaded	Product Mass Load Kg.	Product Specific heat Above Freezing Point J/Kg. K	Product Specific heat Below Freezing Point J/Kg K	Latent Heat of Fusion J/Kg.	Product Initial Temp C	Product Final Temp. C	Temp. Diff.	Q_1 $m\,C_1\,\Delta T$	Q_2 $m.\,C_2.\,\Delta T$	Q_3 $M.\,h$
ICE	10	4180	1950	333000	25	-18	43	12.1	4.06	38.54

Q_1=(10x25x4180)/86400 =12.1, Q_2 = (10x18x1950)/86400 =4.06, Q_3= (10x333000)/86400=38.54

Total = $Q_1 + Q_2 + Q_3$ = 54.7Watts

Miscellanies Heat Load

Air Change = V . N . H V = Refrigerator Internal Volume N = Number of Air Change per Day H = Heat removed from cubic meter of air = 75000 jul/sec.	Gasket U . A. ΔT *U=0.07* *L =5.48 Mt.* ΔT *mean=32*	Electrometer	Florescent Lamp	Total
(0.33)x30x75000)/86400 = 8.59	12.27	N/A	N/A	24.48

Total refrigeration Load

Heal Leaks Through Walls	Product Load	Miscellanies Load	Safety Factors	Grand Total
60.91	54.7	20.87	25	170.6

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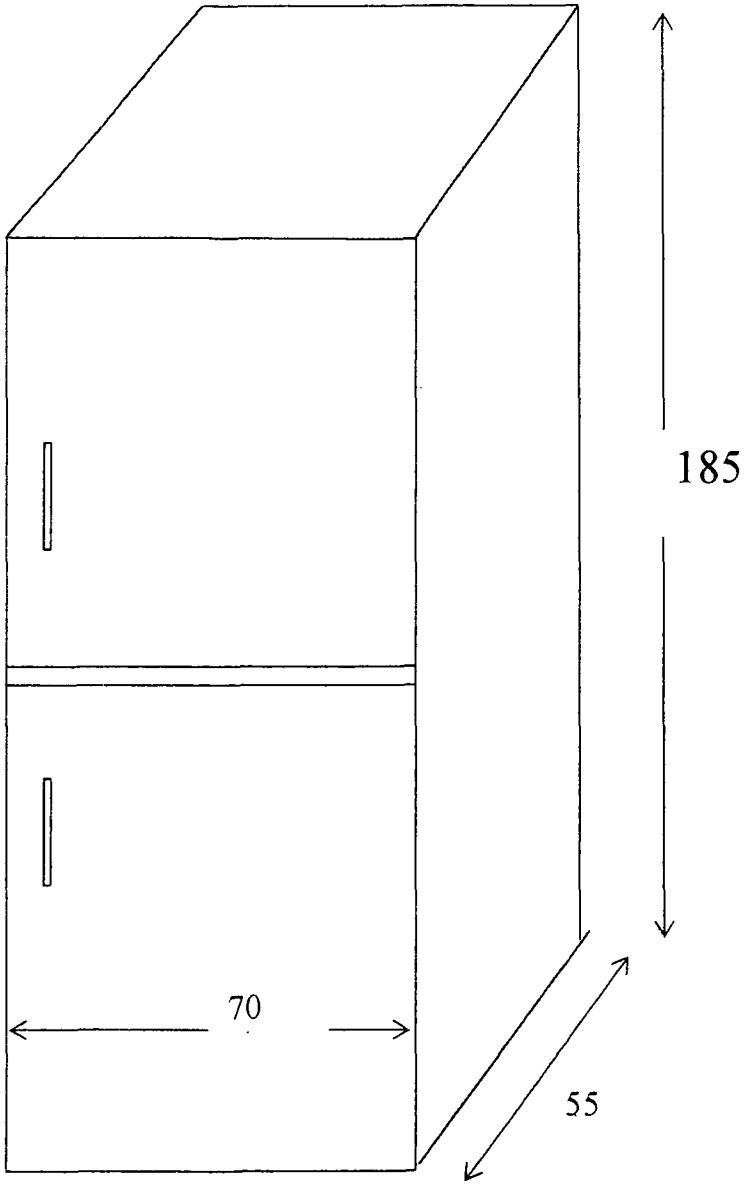

Refrigerator and Freezer

Isun IRF 700

Product Technical Specification ***Isun Workshop***	
Description	**Specification**
Company Name	Isun Workshop
Product Name	Refrigerator & Freezer
Product Model	IRF 700
Product Application	Domestic
Operating Temperature	32 C
Climatic Condition	Normal
Product Overall Dimension WxLxH mm	70*55*185
Freezer Compartment Overall Dimension and Wall Thickness	54x70x47 40 mm
Refrigerator Compartment Overall Dimension and Wall Thickness	62x88x51 60mm
Product Shape, Double Doors, Upright, Chest, etc	Double Door
Freezer Internal Net Volume	125 Liter
Refrigerator Internal Net Volume	205 Liter
Product Overall Volume	710 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	-18 C
Refrigerator Inside Temperature	5 C
Evaporating Temperature	-23 C
Foam Insulation Thickness mm Side Walls, Top, Bottom, Door, Back Panel	Ref 40mm; Fre 60mm
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%
Refrigerant Type	R12
Refrigerant Charge Weight Gr.	360Gr.
Type of Compressor, Hermetic, Semi Hermetic, Open	Hermetic
Compressor Cooling System Static, Oil Cooled, Fan Cooled	Oil Cooled
Compressor Cooling Capacity	220 Watts

Watt	
Compressor Model Number	20 G
Compressor Manufacturer	Danfoss Germany
Compressor Mounting Place Top, Bottom, Front, Back	Bottom
Condenser Type, Static, Fan Cooled	Static Cooled
Condenser Dimension, Length, Inside Tube Diameter,	Length 19.735; 25 Tube
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.	Wire & Tubes
Evaporator Dimension, Length, Surface Area, Inside Tube Diameter	Length 25.37m; Internal Diameter6.6mm; 57 Tubes
Evaporator Material, Aluminum, Copper, Copper Coated, etc,	Copper
Dryer Type,	XH5
Dryer Material, Weight and Size	15 Gr
Capillary Tube Diameter and Length	0.29 mm dim. 3225 mm length

Sahand Mina Engineering Co. Ltd.

Refrigeration Load Calculation
Heat Leaks Through Walls
Sanaye Boroudati Jahan Nama
$Q = U \cdot A \cdot \Delta T$

Description	Dimension	Surface Area Sq. Mt.	Ambient Temp. °C	Reference Inside Temp.	ΔT Temp. Diff.	X Insulation Thickness	K Thermal Conductivity	U Coeff. Heat Resistance	Q $U \cdot A \cdot \Delta T$ *Watt*
Side Wall	2{(90x110) -(50x50)}	1.48	32	-28	60	60	0.0184	0.31	27.53
Top surface	(60x110)-2x(50x50)	0.41	32	-28	60	60	0.0184	0.31	7.63
Bottom surface	(60x110)-(50x60)	0.36	32	-28	60	60	0.0184	0.31	6.7
Left Side Panel	60x90	0.54	32	-28	60	60	0.0184	0.31	10.04
Right Side Panel	(40x60)	0.24	32	-28	60	60	0.0184	0.31	4.46
Comp& Cond. Mounting Place	2x(50x60)	0.6	50	-28	78	60	0.0184	0.31	14.51
Total									70.87

Sahand Mina Engineering Co. Ltd.

Product Load Calculation
Sanaye Boroudati Jahan Nama

Product to be loaded	Product Mass Load Kg.	Product Specific heat Above Freezing Point J/Kg. K	Product Specific heat Below Freezing Point J/Kg K	Latent Heat of Fusion J/Kg.	Product Initial Temp C	Product Final Temp. C	Temp. Diff.	Q_1 $m\,C_1\,\Delta T$	Q_2 $m.\,C_2.\,\Delta T$	Q_3 $M.\,h$
ICE	15	4180	1950	333000	25	-28	43	18.14	9.53	57.81

Q_1*=(15x25x4180)/86400 =18.14,* Q_2 *= (15x28x1950)/86400 =9.53,* Q_3*= (15x333000)/86400=57.81*

$$Total = Q_1 + Q_2 + Q_3 = 85.48\,Watts$$

Miscellanies Heat Load

Air Change = V . N . H V = Refrigerator Internal Volume N = Number of Air Change per Day H = Heat removed from cubic meter of air = 75000 jul/sec.	Gasket U . A. ΔT *U=0.07* *L =5 Mt.* ΔT *mean=60*	Electrometer	Florescent Lamp	Total
(0.3x30x75000)/86400 = 7.8	21	16	N/A	44.8

Total refrigeration Load

Heal Leaks Through Walls	Product Load	Miscellanies Load	Safety Factors	Grand Total
70.87	85.48	44.8	20	241.38

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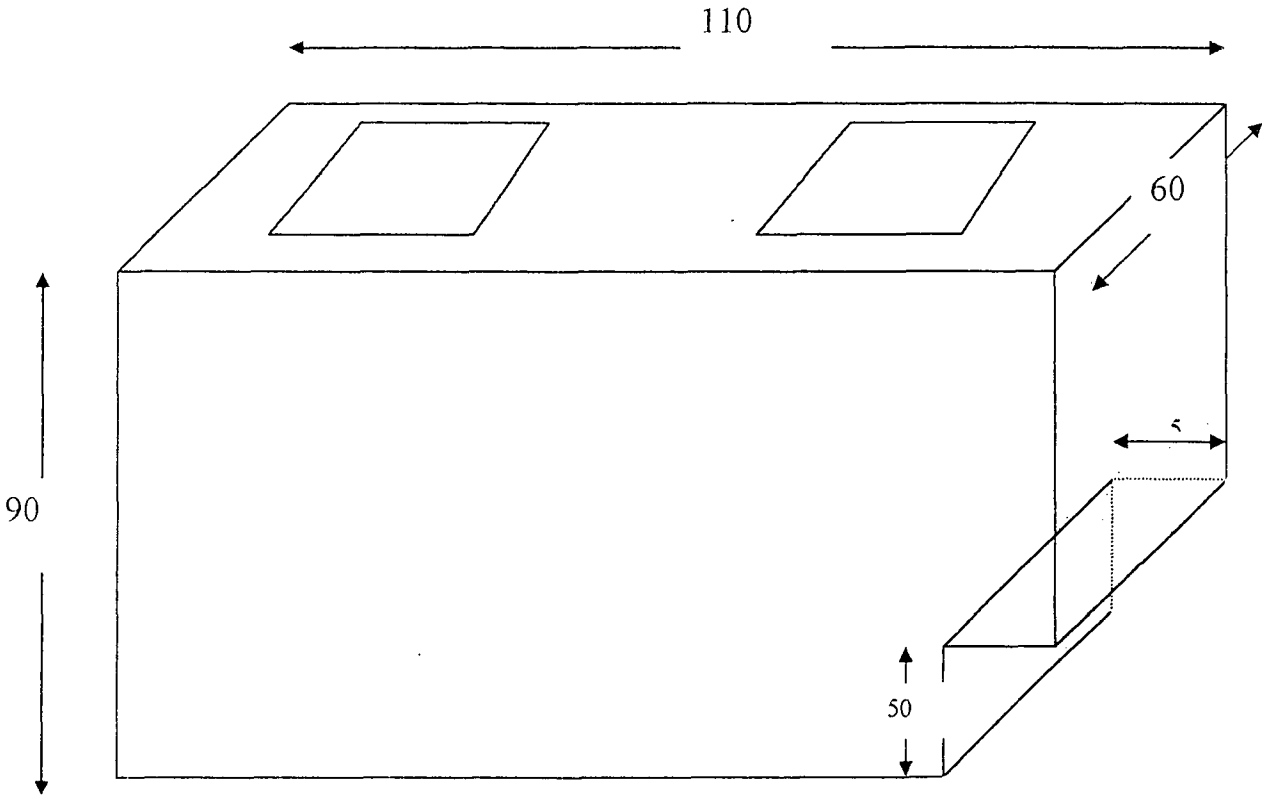

Refrigerator and Freezer
Sanaye Boroudati Jahan Nama

Product Technical Specification *Sanaye Boroudati Jahan Nama*	
Description	**Specification**
Company Name	Sanaye Boroudati Jahan Nama
Product Name	Chest Freezer
Product Model	2 Doors
Product Application	Commercial & Domestic
Operating Temperature	32 C
Climatic Condition	Normal
Product Overall Dimension WxLxH mm	110*90*70
Freezer Compartment Overall Dimension and Wall Thickness	60 mm
Refrigerator Compartment Overall Dimension and Wall Thickness	N/A
Product Shape, Double Doors, Upright, Chest, etc	Chest Freezer
Freezer Internal Net Volume	300 Liters
Refrigerator Net Volume	N/A
Product Net Volume	300 Liters
Product Inside Temperature C	-28 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	-28 C
Refrigerator Inside Temperature	N/A
Evaporating Temperature	-32 C
Foam Insulation Thickness mm Side Walls, Top, Bottom, Door, Back Panel	60 mm
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%
Refrigerant Type	R12
Refrigerant Charge Weight Gr.	450Gr.
Type of Compressor, Hermetic, Semi Hermetic, Open	Hermetic
Compressor Cooling System Static, Oil Cooled, Fan Cooled	Fan Cooled
Compressor Cooling Capacity	250 Watts

Watt	
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,	30 Rows Tube Coil and Fins Length 35 cm; Diameter 11cm
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	20 Gr.
Capillary Tube Diameter and Length	0.36 mm dim. 28000 mm length

Sahand Mina Engineering Co. Ltd.

Refrigeration Load Calculation
Heat Leaks Through Walls
Alborz Neishabour
$Q = U \cdot A \cdot \Delta T$

Description	Dimension	Surface Area Sq. Mt.	Ambient Temp. °C	Reference Inside Temp.	ΔT Temp. Diff.	X Insulation Thickness	K Thermal Conductivity	U Coeff. Heat Resistance	Q U . A . ΔT *Watt*
Upper Side Walls	2x 110x51	1.12	32	+5	27	40	0.0184	0.46	13.91
Upper Back Panel	110x58	0.64	45	+5	40	40	0.0184	0.46	11.77
Top surface	58x51	0.3	32	+5	27	40	0.0184	0.46	3.73
Bottom surface	54x49	0.26	50	-18	68	60	0.0184	0.31	5.48
Upper Door Panel	110x58	0.64	32	+5	27	40	0.0184	0.46	7.95
Lower Door Panel	41x54	0.22	32	-18	50	60	0.0184	0.31	3.41
Lower Side Walls	2x41x49	0.4	32	-18	50	60	0.0184	0.31	6.2
Lower Back Panel	41x54	0.22	45	-18	63	60	0.0184	0.31	4.3
Total									56.75

Sahand Mina Engineering Co. Ltd.

Product Load Calculation
Alborz Neishabour

Product to be loaded	Product Mass Load Kg.	Product Specific heat Above Freezing Point J/Kg. K	Product Specific heat Below Freezing Point J/Kg K	Latent Heat of Fusion J/Kg.	Product Initial Temp C	Product Final Temp. C	Temp. Diff.	Q_1 $m C_1 \Delta T$	Q_2 $m . C_2 . \Delta T$	Q_3 $M . h$
ICE	10	4180	1950	333000	25	-18	43	12.1	4.06	38.54

$Q_1=(10x25x4180)/86400 =12.1$, $Q_2 = (10x18x1950)/86400 =4.06$, $Q_3= (10x333000)/86400=38.54$

$Total = Q_1 + Q_2 + Q_3 = 54.7 Watts$

Miscellanies Heat Load

Air Change = V . N . H V = Refrigerator Internal Volume N = Number of Air Change per Day H = Heat removed from cubic meter of air = 75000 jul/sec.	Gasket U . A. ΔT $U=0.07$ $L=5.26$ *Mt.* ΔT *mean=45*	Electrometer	Florescent Lamp	Total
(0.3x30x75000)/86400 = 7.81	16.57	N/A	N/A	24.38

Total refrigeration Load

Heal Leaks Through Walls	Product Load	Miscellanies Load	Safety Factors	Grand Total
56.78	54.7	24.38	25	169.83

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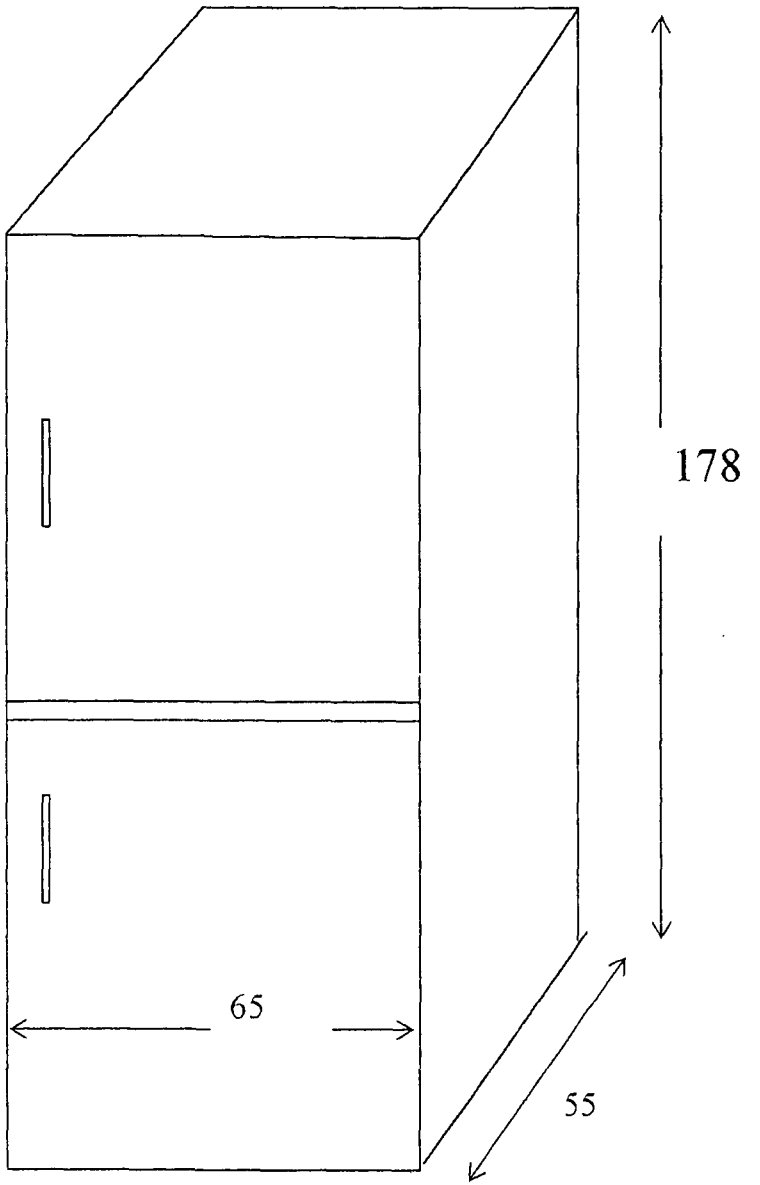


Refrigerator and Freezer
Alborz Neishabour

Product Technical Specification ***Alborz Neishabour***	
Description	**Specification**
Company Name	Alborz Neishabour
Product Name	Refrigerator & Freezer
Product Model	F 16 Al
Product Application	Domestic
Operating Temperature	32 C
Climatic Condition	Normal
Product Overall Dimension WxLxH mm	178x65x55
Freezer Compartment Overall Dimension and Wall Thickness	41x5x49 40mm
Refrigerator Compartment Overall Dimension and Wall Thickness	110x58x51 60mm
Product Shape, Double Doors, Upright, Chest, etc	Double Door
Freezer Internal Net Volume	75 Liter
Refrigerator Internal Net Volume	225 Liter
Product Overall Volume	635 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	-18 C
Refrigerator Inside Temperature	5 C
Evaporating Temperature	-23 C
Foam Insulation Thickness mm Side Walls, Top, Bottom, Door, Back Panel	Ref 40mm; Fre 60mm
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%
Refrigerant Type	R12
Refrigerant Charge Weight Gr.	250gr
Type of Compressor, Hermetic, Semi Hermetic, Open	Hermetic
Compressor Cooling System Static, Oil Cooled, Fan Cooled	Oil Cooled
Compressor Cooling Capacity	200 Watts

Watt	
Compressor Model Number	20 G
Compressor Manufacturer	National Germany
Compressor Mounting Place Top, Bottom, Front, Back	Bottom
Condenser Type, Static, Fan Cooled	Static Cooled
Condenser Dimension, Length, Inside Tube Diameter,	Length 15m; 24Tube; 6mm
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.	Wire & Tubes
Evaporator Dimension, Length, Surface Area, Inside Tube Diameter	Length 12m; Internal Diameter 8mm; 32 Tubes
Evaporator Material, Aluminum, Copper, Copper Coated, etc,	Copper
Dryer Type,	XH5
Dryer Material, Weight and Size	15 Gr
Capillary Tube Diameter and Length	0.31 mm dim. 2700 mm length

Sarma Gostar Shiraz

Setting

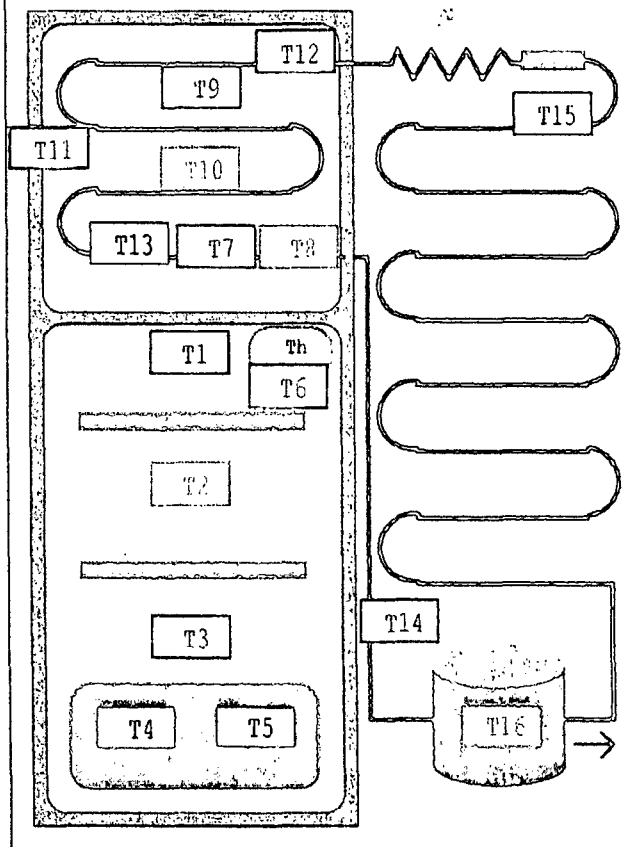
Test Date	Nov 21-02
Test Type	Run
Hot Room Temp.	32
Hot Room Hum.	50
File Name	OM\FR-16\16-29

Product Specification

Product Type	Connex
Compressor Type	Danfoss
Refrigerant	R134 -250 gr
Cappil. Length	0.036 in - 340 Cm
Evap. Volume	110 CC - 11.5 m
Condensor Length	12 PASS-4 TUBE-12 m
Thermostat Type	DANFOSS-Short

Test Result

Total Test Time(h:m)	15:17
Working Time(h:m)	15:17
Working Percentage	100.0%
Energy Cons.(KWh)	2.231
Av. En. Cons.(KWh/Day)	3.503
No. of Thermostat	0
No. of Over Load	0



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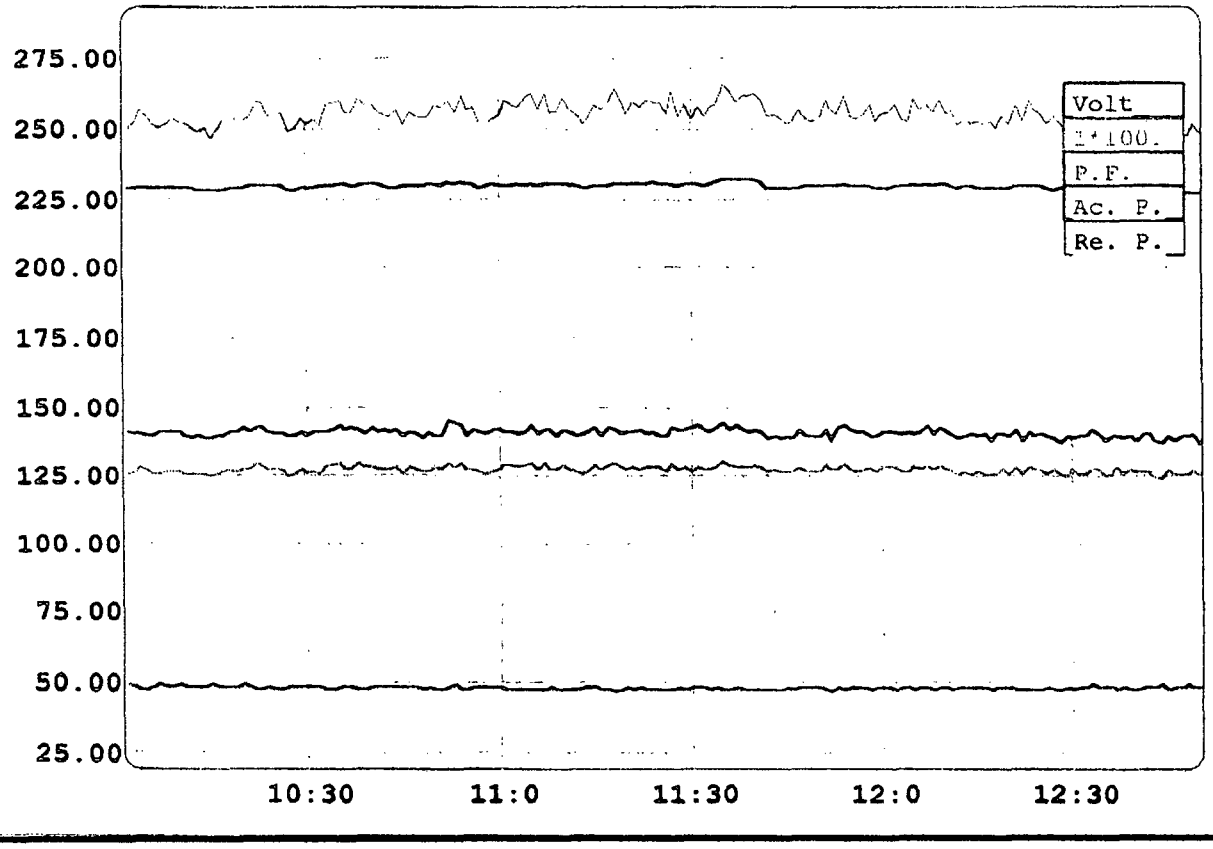


Alborz Neishabour

Setting

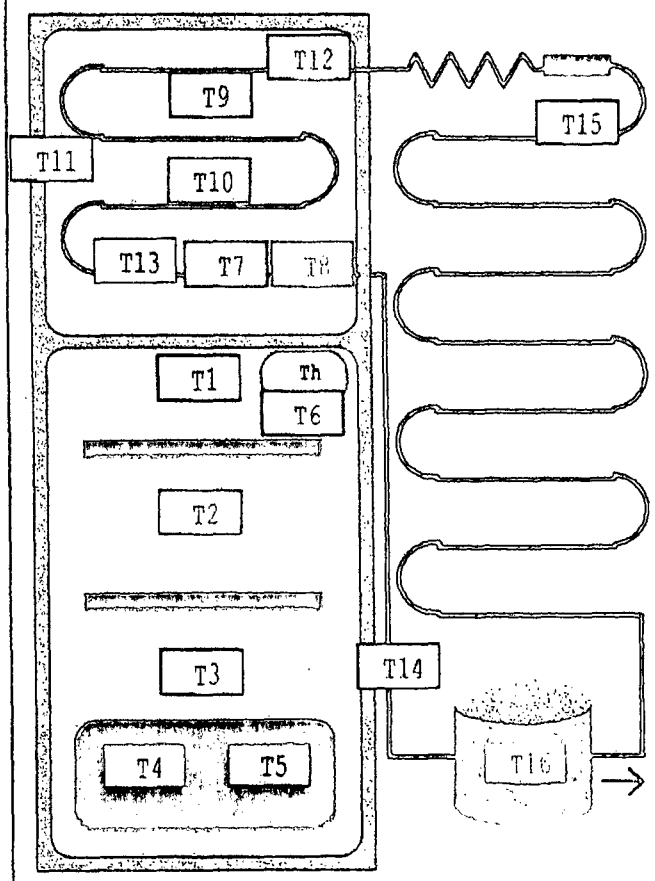
Test Date	Nov 6-02
Test Type	Cycling
Hot Room Temp.	12
Hot Room Hum.	50
File Name	OM\FR-16\16-30

Product Specification

Product Type	F 16 AL
Compressor Type	NATIONAL-20G
Refrigerant	R134-250 gr
Cappil. Length	0.036 in - 340 Cm
Evap. Volume	110 CC - 11.5 m
Condensor Length	12 PASS-4 TUBE-12 m
Thermostat Type	DANFOSS-3.7

Test Result

Total Test Time(h:m)	23:59
Working Time(h:m)	13:15
Working Percentage	55.38
Energy Cons.(KWh)	2.681
Av. En. Cons.(KWh/Day)	2.683
No. of Thermostat	0
No. of Over Load	72



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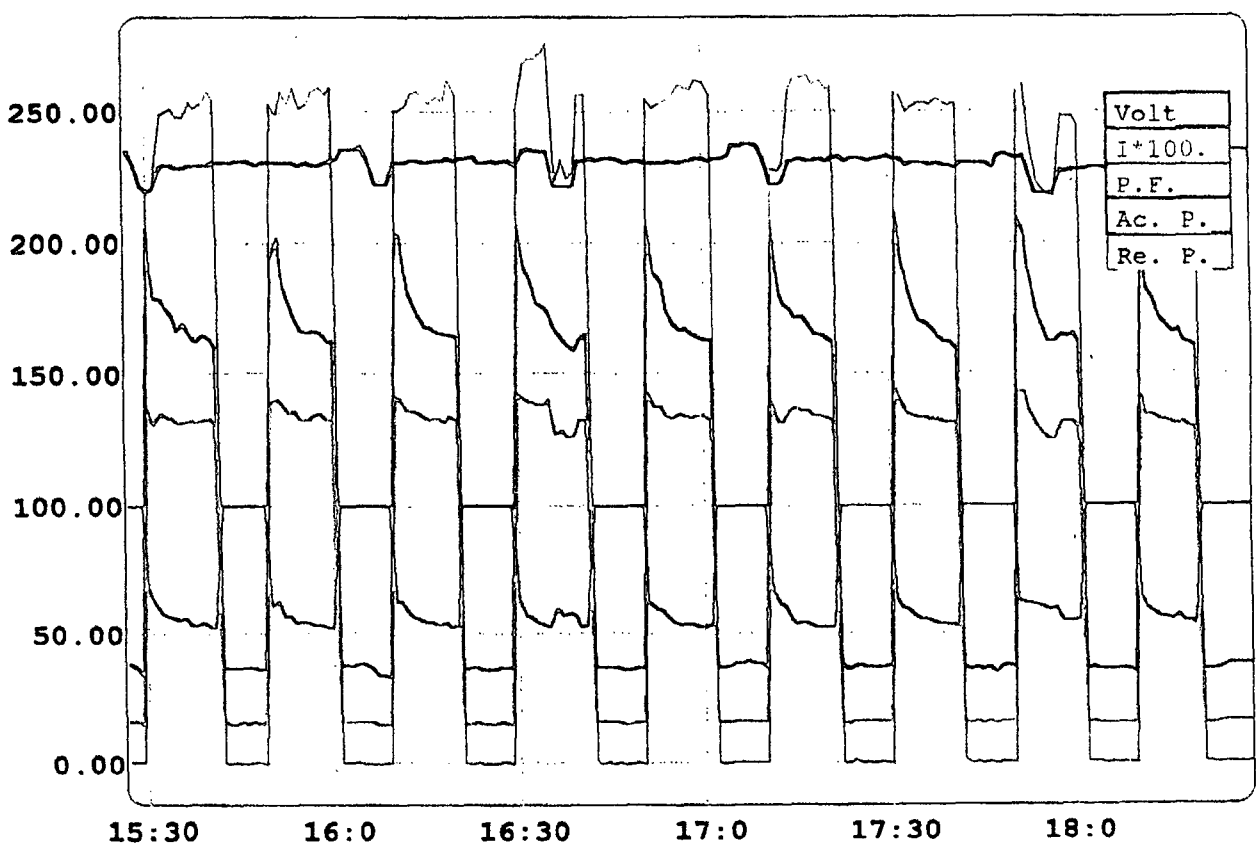


Moradi

Setting

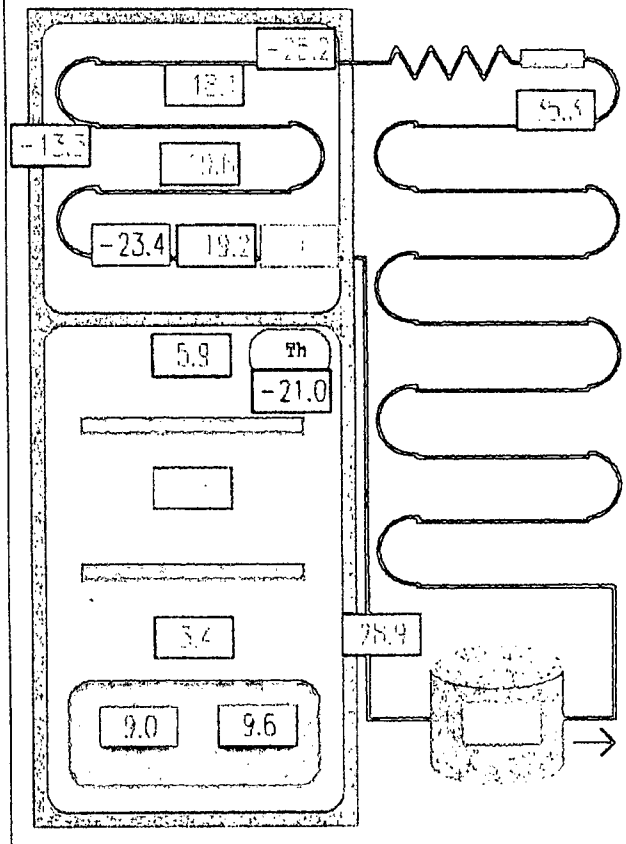
Test Date	Oct 20-02
Test Type	Cycling
Hot Room Temp.	32
Hot Room Hum.	50
File Name	OM\FR-16\16-30

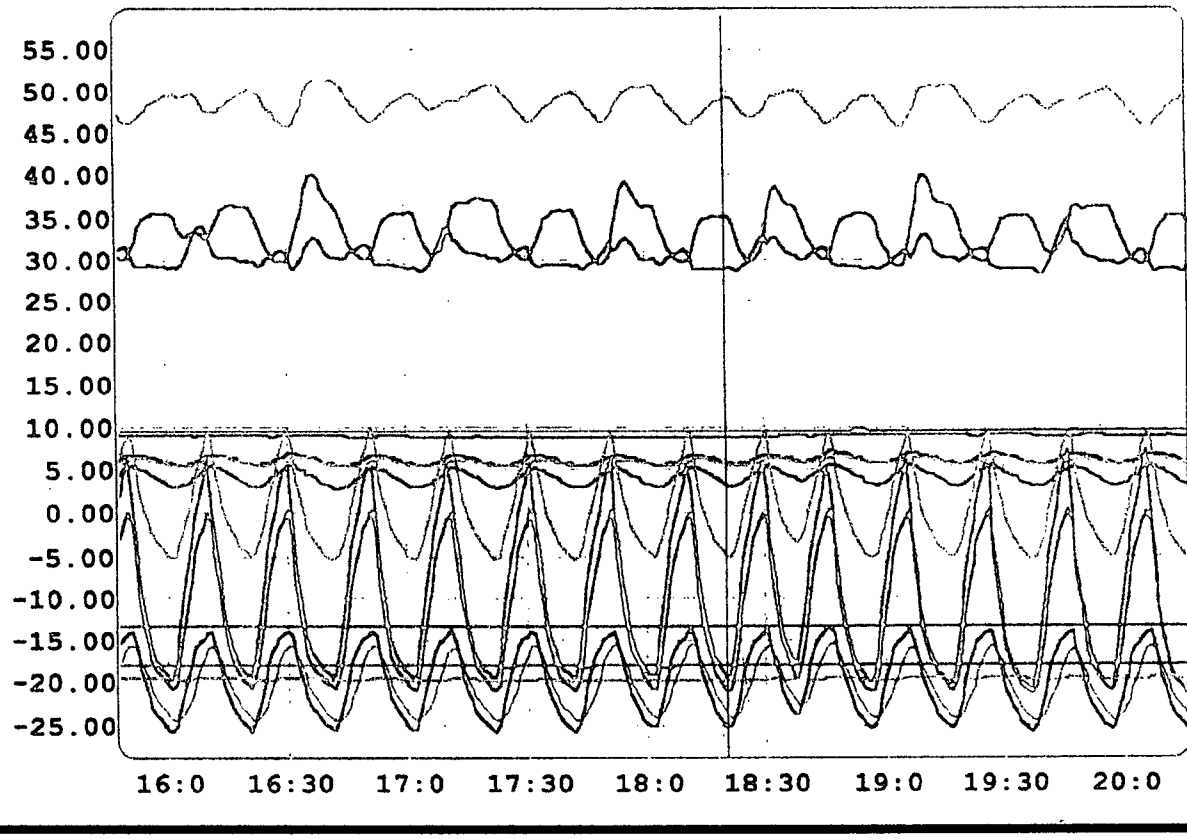
Product Specification

Product Type	RF20
Compressor Type	NATIONAL-20G
Refrigerant	R134-250 gr
Cappil. Length	0.036 in - 340 Cm
Evap. Volume	110 CC - 11.5 m
Condenser Length	12 PASS-4 TUBE-12 m
Thermostat Type	DANFOSS-3.7

Test Result

Total Test Time(h:m)	23:59
Working Time(h:m)	13:15
Working Percentage	55.30
Energy Cons.(KWh)	2.681
Av. En. Cons.(KWh/Day)	2.683
No. of Thermostat	0
No. of Over Load	72





KHORSANDI

Setting

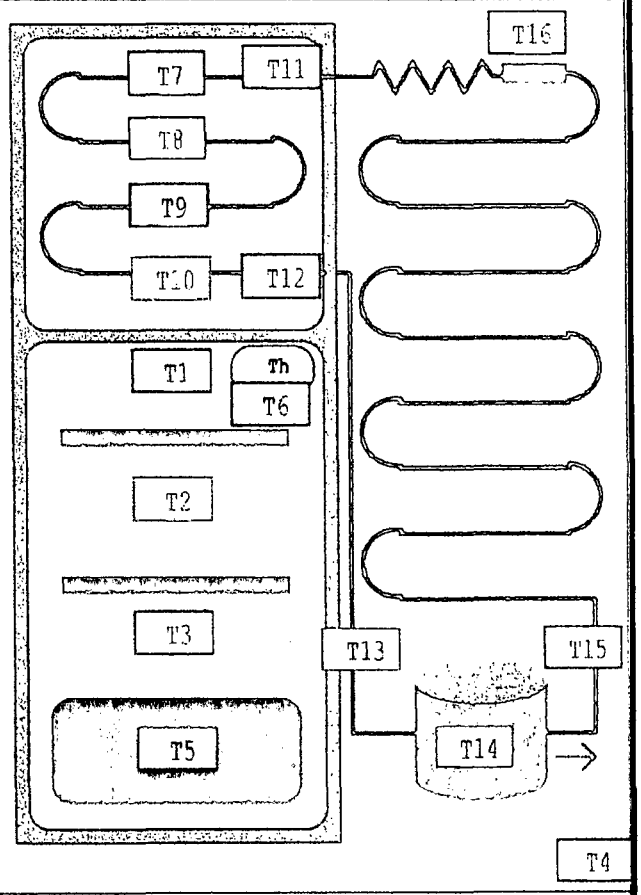
Test Date	Oct 6-02
Test Type	Cycling
Hot Room Temp.	32
Hot Room Hum.	50
File Name	M\FR-18\18-006

Product Specification

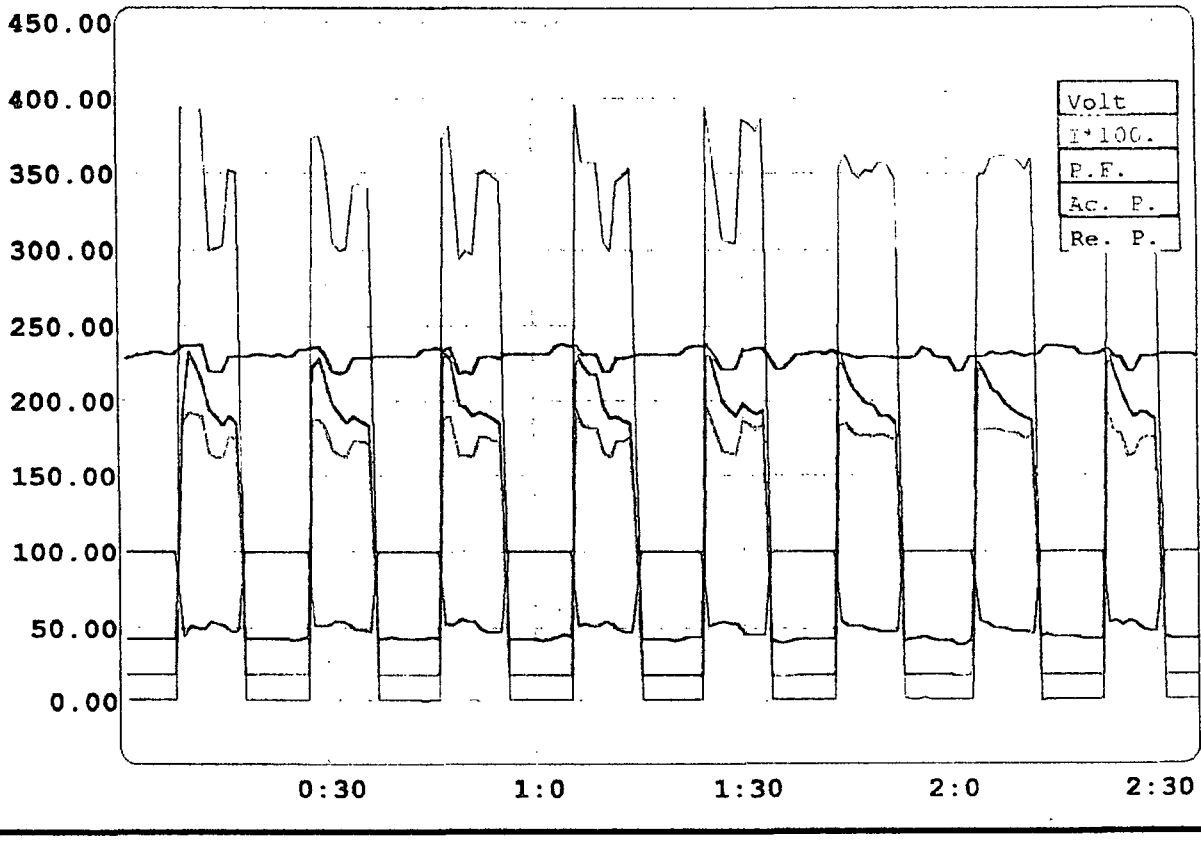
Product Type	Chest Freezer
Compressor Type	Danfoss-1/4 HP
Refrigerant	R134a-225 gr
Cappil. Length	0.036 in - 340 Cm
Evap. Volume	90 CC - 19 m
Condensor Length	12 PASS-4 TUBE-12 m
Thermostat Type	DANFOSS-Short

Test Result

Total Test Time(h:m)	02:37
Working Time(h:m)	01:12
Working Percentage	46.28
Energy Cons.(KWh)	0.3016
Av. En. Cons.(KWh/Day)	2.766
No. of Thermostat	0
No. of Over Load	10



OCT 6-02



Jahan Nama

Setting

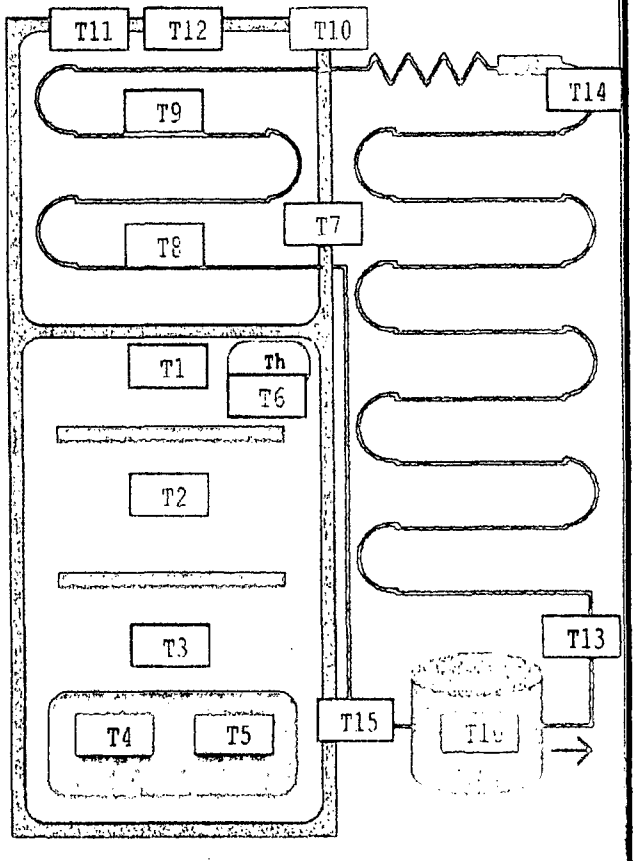
Test Date	Oct 24-02
Test Type	Cycling
Hot Room Temp.	18
Hot Room Hum.	50
File Name	OM\FR-16\16-27

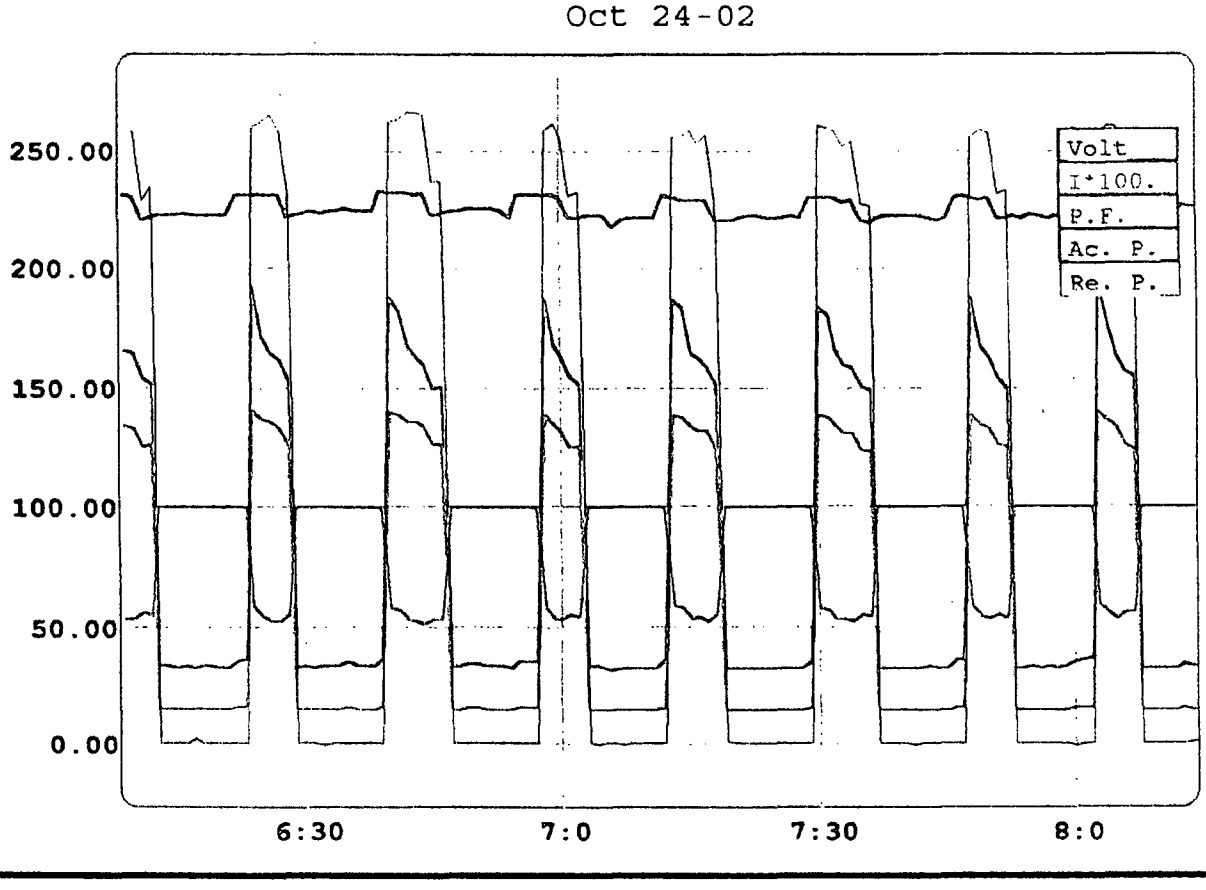
Product Specification

Product Type	Chest freezer
Compressor Type	NATIONAL-20G
Refrigerant	R134-250 gr
Cappil. Length	0.036 in - 340 Cm
Evap. Volume	110 CC - 11.5 m
Condensor Length	12 PASS-4 TUBE-12 m
Thermostat Type	DANFOSS-3.7

Test Result

Total Test Time(h:m)	23:59
Working Time(h:m)	08:08
Working Percentage	33.9%
Energy Cons.(KWh)	1.888
Av. En. Cons.(KWh/Day)	1.889
No. of Thermostat	0
No. of Over Load	91





ISUN

Setting

Test Date	Oct 28-02
Test Type	Pull down - Run
Hot Room Temp.	32
Hot Room Hum.	50
File Name	OM\FR-16\16-39

Product Specification

Product Type	IRF 700
Compressor Type	Danfoss - 1/4 HP
Refrigerant	R134a - 215 gr
Cappil. Length	0.036 in - 360 Cm
Evap. Volume	110 CC-11.5 m-Ac
Condensor Length	12 PASS-4 TUBE-12 m
Thermostat Type	Danfoss-Short

Test Result

Total Test Time(h:m)	21:19
Working Time(h:m)	21:19
Working Percentage	100.0%
Energy Cons.(KWh)	3.380
Av. En. Cons.(KWh/Day)	3.805
No. of Thermostat	0
No. of Over Load	0