



TOGETHER
for a sustainable future

OCCASION

This publication has been made available to the public on the occasion of the 50th anniversary of the United Nations Industrial Development Organisation.



TOGETHER
for a sustainable future

DISCLAIMER

This document has been produced without formal United Nations editing. The designations employed and the presentation of the material in this document do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations Industrial Development Organization (UNIDO) concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries, or its economic system or degree of development. Designations such as “developed”, “industrialized” and “developing” are intended for statistical convenience and do not necessarily express a judgment about the stage reached by a particular country or area in the development process. Mention of firm names or commercial products does not constitute an endorsement by UNIDO.

FAIR USE POLICY

Any part of this publication may be quoted and referenced for educational and research purposes without additional permission from UNIDO. However, those who make use of quoting and referencing this publication are requested to follow the Fair Use Policy of giving due credit to UNIDO.

CONTACT

Please contact publications@unido.org for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at www.unido.org

22819



Bosmak (nig.) Limited

**84, YAYA ABATAN STREET,
OGBA-IKEJA
P.O. BOX 2464 MUSHIN,
LAGOS STATE
TEL: 49252332, 08023041074
E-mail: masalaobosmak@yahoo.com.**

OUR REF: BNL/UNIDO/02/051/03

YOUR REF: ML/SB

DATE: 11TH NOVEMBER, 2002

THE CONTRACTS OFFICER (Gen. Services)
UNITED NATIONS IND. DEV. ORG.
P.O. BOX 300
A - 1400 VIENNA.
AUSTRIA
TEL: 431 26026-0

ATTN: MOUNIRA LATRECH

Dear Miss Latrech,

**MP/NIR/01/022 REDESIGN CONVERSION OF REFRIG. CYCLES
OF ICE-MAKER, COLD-ROOM CONTRACT NO. 02/051
DRAFT FINAL REPORT**

I have the pleasure in forwarding herewith our Draft Final Report three copies on the Redesign of our REFRIGERATION CYCLE Appliances. Also enclosed Two Invoices original and copy.

We use this opportunity to thank you immensely for your support towards our project.

We look forward to hearing from you.

Best Regards.


**MURITALA S. ALAO
MANAGING DIRECTOR
BOSMAK NIGERIA LTD**



Bosmak (nig.) Limited

84, YAYA ABATAN STREET,
OGBA-IKEJA
P.O. BOX 2464 MUSHIN,
LAGOS STATE
TEL: 49252332, 08023041074
E-mail: masalaobosmak@yahoo.com.

DRAFT FINAL REPORT

**FOR REDESIGN AND CONVERSION OF REFRIGERATION CYCLE
OF APPLIANCES FOR ICE BLOCK MACHINE MODEL B03K ICE
MAKER BS 280L FREEZER MODEL BF 10T AND BF 15T COLD –
ROOM**

PRODUCED BY:

BOSMAK NIGERIA LIMITED

PREPARED BY:

**M.S ALAO
BOSMAK NIGERIA LIMITED
84, YAYA – ABATAN STREET,
OGBA, LAGOS STATE.**

11TH NOVEMBER, 2002.

INTRODUCTION

THIS draft Final Report refers to the activities included between steps 1 and 3 of the UNIDO TERMS OF REFERENCE.

The objective of the whole project is to eliminate the use of CFC – 11 and CFC – 12 in the production and service of **ICE BLOCK MAKING MACHINE FREEZER AND COLD- ROOM** at **BOSMAK** Nigeria Limited through conversion to the use of **HFC 134a** as refrigerant and **HCFC 141b** as Blowing Agent in the polyurethane insulation foam.

It mainly Consists in a Summary of the logistic activities, technical services for the Re-design and conversion of Refrigeration cycles of appliances produced by **BOSMAK NIGERIA LIMITED**.

BOSMAK NIGERIA LIMITED
UNIDO PROJECT NO MP / NIR / 01 / 022
DRAFT FINAL REPORT

FOR REDESIGN AND CONVERSION OF REFRIGERANT CYCLES OF APPLIANCES FOR ICE-BLOCK MAKING MACHINES MODEL NO B03K FREEZER BS 280L, AND COLD – ROOM BF10T AND BF 15T.

AIMS AND OBJECTIVE

We have achieved our main aim of using R-134a and R404a as a cooling medium and the production of prototype and testing of the whole system. Our objective of making production involving optimized costs is also achieved.

REDESIGN

We have carefully considered and successfully utilized locally available components

FACTORY PROCESSES:

Careful consideration was given to **CLEANLINESS** of soldering joints, brazing and lockrings because of R-134A materials compatibility related to non soluble substances to imparities in the system. As the capillary has a cross flow section for below Imm^2 and a temperature drop, these substances resulted in blockage there when exceeding a few milligrams. A milligram is around a mm^3 . This able to block more than a mm of capillary. R-134A behaviour is very mush different in area of solubility than R-12, because of its polarity. There is only one way of avoiding these serious problem:

KEEP CLEAN!.

ELECTRICAL:

here below for reference purposes Our Electrical panels have been redesigned. The Cabinets for our Ice Makers and Cold-Room were produced with the HCF 414b Blown Polyurethane Foam using the GUSMER MACHINE. We produced and installed these models nos Bo3k Ice-Maker as well as model BF 15T Cold-Room for the following customers whose addresses are given

1. MODEL NO BO3K
2. MAKE 60 MOULDS ICE – BLOCK M/C
3. NAME OF OWNER ALHAJA SIBIAT GBADAMOSI
4. ADDRESS WHERE THE UNITS IS INSTALLED

PLOT 1, ABOLOBODE CLOSE, AJAH, LAGOS.

1. MODEL NO BF 15T
2. MAKECOLD-ROOM (BLAST FREEZER)
3. MAKER OF OWNER: ELITE FARMS NISERIA LIMITED
4. ADDRESS WHERE THE UNIT IS INSTALLED
NO 2 AKOREDE CRESCENT, IJU ISHAGA, LAGOS.

COMPRESSOR

The Compressor used for R-134A application requires different solvency than mineral oil. New lubricant polyol Ester were Hygroscopic.

CONDENSER

The same size of Condenser as used in the R-12 system was used for all MODELS. However the freezer condenser was fitted with Fan to make it (Forced draft) Maximum condensing Temperature during stable condition was 55⁰ at 43 ambient temperature

DRYER

A 44 pores filter formally used in the R-12 system was discarded. It was replaced with X117 a more compatible molecular sieve.

EVAPORATOR

The primary system of the Ice Maker was redesigned with 5/8 copper pipe and the lenth of the pipe was also increased. A suction Line / Liquid Line Heat Exchanger was introduced to prevent Liquid Flood Back to compressor and facilitate smooth oil Return.

We have used Suction Line/Liquid Line Heat exchanger to improve and increase the system efficiency. This means, a good suction line heat Exchanger is part of proper application. Without this, efficiency will be loss than R-12 in several cases, because efficiency at 25^oc to 35^oc suction gas temperature is almost the same for all refrigerants. It also is necessary to get the suction line temperature above humidity condensation of surrounding air. With no changes many R-12 appliances refilled with R-134a will show cold suction lines.

ICE-MAKER BO 3K

DIMENSION = 5 X 25 X 25

NET CAPACITY = 360 ICE PER DAY

LID FOAM THICKNESS 100MM

TEMPERATURE - 25^oc

POWER CONSUMPTION 84 VOLTAGE 380 – 420V KW/H

POWER RATING HP 4

CONDENSER AIR COOLED FORCED DRAFT

EVAPORATOR 16MM (5/8)
DIAMETER

Our Ice Makers noticeable change is in the copper piping design. We used 5/8 to run the Evaporator and Expansion valve as the control. A 60 CANS (Mould of ice block of 60kg) is been harvested at every 4 hours which is powered by a 4 Horse power condensing unit at low temperature of minus – 25^oc.

FREEZER (280 LITRES) BS 280L

Compressor Capacity 1/5 Horse power, the freezer capacity was 280 Litres and the temperature achieved was minus – 20oc. The compressor Running Load Amperage was 2.5 Ampere. The capillary tube was increased. The condenser used was forced draft. We changed from the Natural Air-cooled convention to reduce high condenser temperature and high condenser pressure.

Prototype made have been tested under the following conditions.

Ambient temperature 32oc
Relative Humidity 70%
Type of test performance
Type of compressor Hermetic (TECUMSEH)
DRIER 117 (15 grams)
Size of capillary 1.8mm Diameter and length 2m
Condenser (Forced Draft Air-Cooled)
Energy 4.4KW/24HRS
TEMPERATURE -18oc – 20oc
Compressor Cooling Capacity 165 watts.

THERMOSTAT:- The increase resistance of the **Capillary Tube** increased the pressure Equalising time during standstill period. The thermostat differential was modified. 20^{oc} temperature was attained within 40 minutes without LOAD. Energy consumption was 1.16 kw / 24Hes the termostal Cut-in time – 5 to 15 Compressor Connected. Cut-out time – 15 to 25 compressor Dis-connected.

Compressor Test Condition

| | | |
|---|-------------------------|-------------------------|
| 1 | Evaporating Temperature | 25 ^{oc} |
| 2 | Condensing Temperature | 55 ^{oc} |
| 3 | Ambient Temperature | 32 ^{oc} |
| 4 | Suction Gas Temperature | 32 ^{oc} |
| 5 | Liquid Temperature | 55 ^{oc} |
| 6 | Voltage / Hert3 | 220v / 50 ^{H3} |

COLD ROOM

The Cold Room BODY CABINETS WAS PRODUCED WITH BLOWN POLYURETHANE FOAM HCF 141b with GUSMER SPRAY. Manuerop Compressor was used for the Cold-Room. Compressor was Noiseless a low temperature of – 40 was recorded achieved within 9 hours. This cold room is been used for Blast Freezing. (Chicken) a suction line liquid line heat exchanger was however installed to avoid liquid fool back to the compressor. This particular Cold Room / Blast Freezer was installed for ELITE FARMS NIG. LTD. NO2 AKOREDE CRESCENT, IJU ISHGA LAGOS, for Blast FREEZING CHICKEN.

LEAK TEST

Since R-134a escapes through the minutest leakage than R-12. This put heavy demands on soldering operation of brazed joints. Soap and water conventional method was used. This process demands time. It is therefore imperative to use a NEW Electronic leak detector.

PURITY: NON CONDENSABLE GASES: EVACUATION: AND CHARGING

R-134a is chlorine free and no chlorinated materials was used for cleaning the internal surfaces of the components used in the R-134a system. A content of a few (%) percentage by volume of Non-Condensable gases can increase the energy consumption of a sensitive appliance like R-134A system. A need for improved, evacuation is required hence the need for a high capacity pump for proper R-134a system evacuation before charging. Advantages are high refrigeration capacity. R-134A requires a much cleaner and dry cooling system than CFC-12 to avoid degradation of the polyester lubricant.

All refrigerants will, if applied properly, lead to same efficiency

Table 1 REFRIGERANT DATA COMPARISON

| Refrigerant | R-12 | R-134A |
|---|---------------------|-----------------------------------|
| Formula | CF ₂ C/2 | CF ₃ CH ₂ F |
| Critical Temperature in °C | 112 | 101 |
| Molecular weight in kg/kmd | 120.9 | 102 |
| Normal boiling point in °C | -29.8 | -26.5 |
| Pressure of -25°C in bar(abs) | 1.24 | 1.07 |
| Liquid density at -25°C in kg/l | 1.47 | 1.37 |
| Vapour density at -25/+32°C | 6.0 | 4.4 |
| Volumetric Capacity at -25/55/32°C in kJ/m ³ | 727 | 658 |
| Enthalpy of vaporization at -25°C in kJ/kg | 163 | 216 |
| Pressure at -20°C in bar (abs) | 5.7 | 5.7 |

GENERAL CONCLUSION

Presently R-134A refrigerant is comparatively more expensive than R-12 refrigerant in the Nigeria market. R-134A of 13.6kg (30lbs) weight sells for ₦11,500 – ₦12,500 (Naira) R-12 13.4kgs (30lbs) weight sells for ₦5,200 – ₦6,000 (Naira). This high differential price in the cost of R-134A refrigerant calls for a more careful approach to brazing of refrigerant pipe joints to avoid refrigerant gas leakage and the use of secovery machine is imperative to avoid or reduce refrigerant waste and cost saving. Also sensitive electronic leak detectors are required to test all brazed joints before charging refrigerants. All refrigerants will if applied properly, lead to **SAME EFFICIENCY**.

DRAFT

| Type | Ice maker | Freezer | Cold Storage | |
|--|-------------------|----------------|--------------|--------------|
| Model | BO3K | BS280L | BF10T | BF15T |
| Dimension | 5 x 2.5 x 25' | 86 x 66 x 87cm | 12 x 10 x 8 | 12 x 12 x 10 |
| Net capacity, L of ice Per day or inner volume | 360kg Of ICE | 280L | 10tons FISH | 15tons FISH |
| Cabinet wall thickness, Mm | 100mm | 60mm | 100mm | 100mm |
| Lid foam thickness, mm | 50mm | 40mm | 100mm | 100mm |
| Temperature, °C | 25 to 30c | -18to20c | -25to30c | -25 to 30c |
| Power consumption, KW / 24h | 84kwh | 4.44kwh | 84kwh | 182kwh |
| Noise level, dB | | | | |
| Voltage: | 380-420v | 220-240v | 380-420v | 380-420v |
| Power rating, HP | 4 HP | 1/5 HP | 4HP | 7.5 HP |
| Inner liner material for The Cabinet | Metal | Metal | Metal | Metal |
| Inner liner material for The lid | Metal | Metal | Metal | Metal |
| Condenser type | Air cooled Forced | Air cooled | Air Forced | Cooled Draft |
| Condenser, diameter, Mm | 10mm | 6.5mm | 10mm | 16mm |
| Condenser, dimension Cm | 70X45 | Plate type | 70X45 | 80X70 |
| Evaporator (coiled eva.): Diameter, length in mm | 13mm | 8mm | 13mm | 16mm |
| Cooling system | Indirect Cooling | Direct Cooling | Direct | Direct |
| Refrigerant charge (R12), | 4.5kg | 960gram | 4.5kg | 7.2kg |

Terms of reference for redesign, Bosmark, Nigeria