OCCASION

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

DISCLAIMER

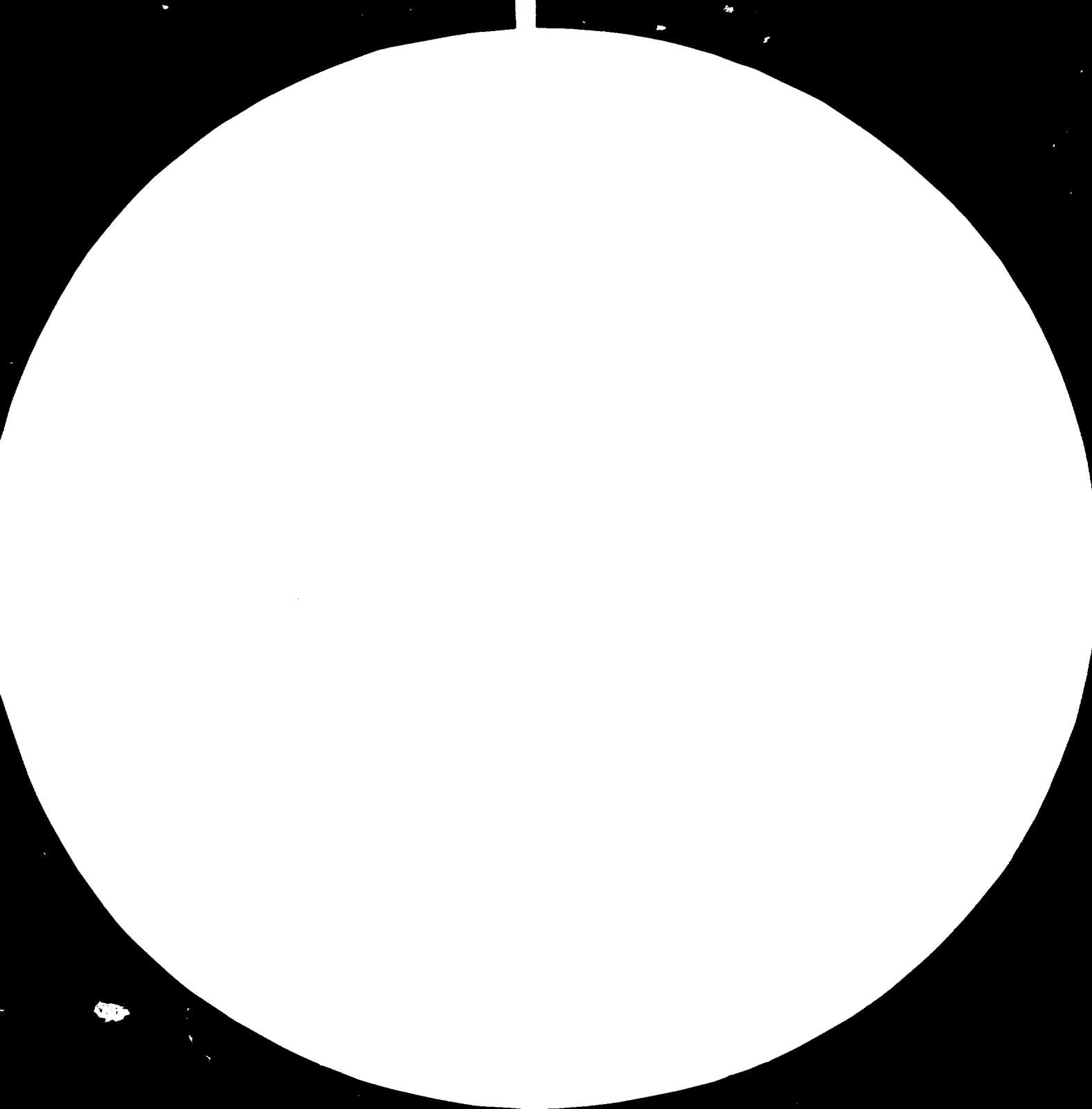
FAIR USE POLICY

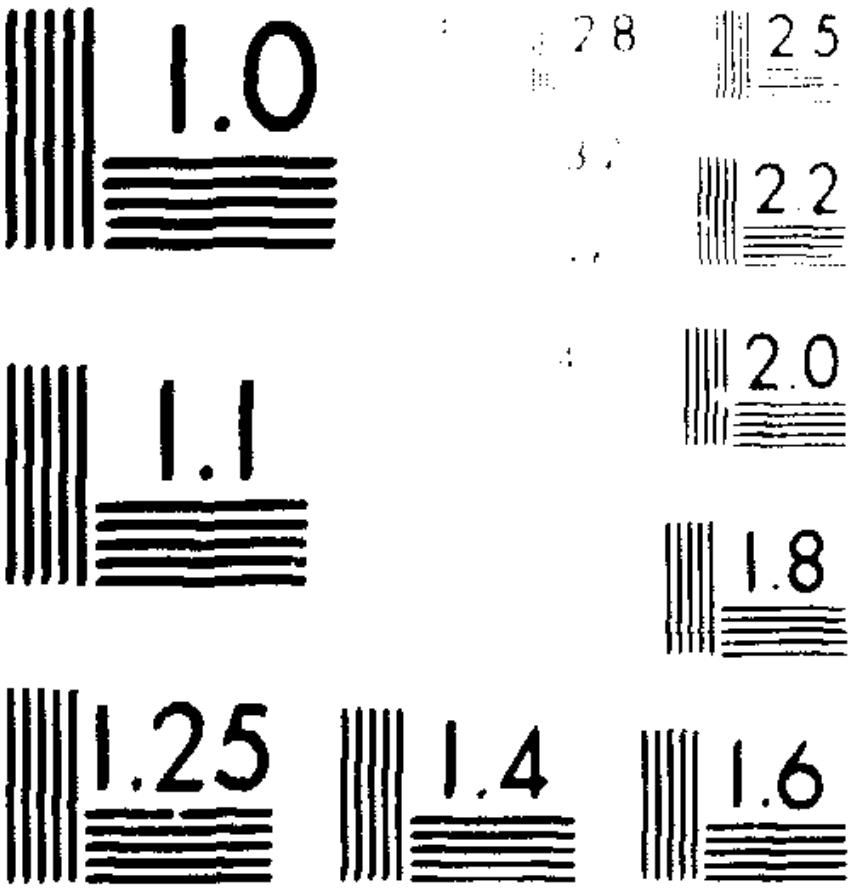
CONTACT

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

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

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





RESTRICTED

11577

DP/ID/SER.A/358
29 April 1982
English

ESTABLISHMENT OF A PACKAGING RESEARCH, TESTING, DEVELOPMENT AND INFORMATION DEPARTMENT AT JAMAICA BUREAU OF STANDARDS, KINGSTON

DP/JAM/77/008

JAMAICA.

Technical report: Tinplate containers *

Prepared for the Government of Jamaica
by the United Nations Industrial Development Organization,
executing agency for the United Nations Development Programme

003365

Based on the work of E. F. Meyer, expert in tinplate containers

United Nations Industrial Development Organization
Vienna

* This document has been reproduced without formal editing.

V.82-22941

C O N T E N T S

SUMMARY

A consultant in tinplate containers has been assigned to the Jamaican Bureau of Standards within the frame of a project aimed at establishing a packaging research and testing department.

The consultant paid visits to can manufacturers, users and distribution centres in order to detect, discuss and advice on canning problems, imparted classes in canning technology, participated in a round table conference, checked the existing equipment in the laboratory and advised on future research activities which might be undertaken by the packaging department of the Bureau of Standards in co-operation with the industry.

INTRODUCTION

The Government of Jamaica is establishing a Packaging Department in the Bureau of Standards, Kingston. A UNIDO project was implemented in March 1979 to assist in this activity. The project is described in the project document "Establishment of a Packaging Research, Testing, Development and Information Department at the Jamaican Bureau of Standards, Kingston" DP/JAM/77/008/A/01/37 of April 1978.

The Tinplate and Can Consultant was one of ten (10) specialists being recruited by UNIDO to help train the staff of the Packaging Department in their specific fields of activities.

The consultant concentrated on training his counterpart, helping local industry and having discussions with Mrs. Domville, Head, Packaging Centre.

CONDUCT OF THE MISSION

The Consultant arrived in Kingston on the 3rd November 1980 and a workplan was drawn up, see Appendix I.
It includes visits to Can Makers, (Metal Box and Nestle), Canneries, a battery manufacturer (who uses tinplate) Supermarkets and a Crown cap manufacturer.

The contacts made in Jamaica are listed in Appendix II.
Throughout the mission effort was made:

(a) to pass maximum knowledge to the counterpart

(b) to help local industry

(c) to communicate future developments

The following specific activities were carried out.

(1) A series of lectures and training for the counterpart and the Packaging Centre was held.

(2) A Round Table Conference was held for the industries concerned with the consultant.

(3) A large number of works visits were undertaken. Discussions took place, which were helpful.

(4) Existing equipment in the Metallurgy Department was checked. It was found adequate (incl. equipment ordered for the Packaging Centre).

(5) A number of development programmes were suggested and detailed.

The consultant left Kingston on 19 December 1980.

OBSERVATIONS

(1) General

All tinplate and T.F.S. (tin free steel) is imported into Jamaica. Metal Box (Jamaica) Limited import their tinplate mostly through Great Britain, where it is inspected by M.B's T.I.D. (tinplate Inspection Department). It is also lacquered and printed, if required, in Great Britain. 95% of the cans manufactured in Jamaica are from M.B.; the remainder is manufactured by Jamaica Milk Products, who run one line and manufacture a 73 x 81 mm 14 oz condensed milk can, which runs straight into the factory's aseptic canning line. This can has dry seams; i.e. no solder on the side seam and no lining compound in the ends.

Printing and lacquering is carried out by West Indies Crown Cap, who are at present using the printed and lacquered tinplate and T.F.S. for the manufacture of crowns for beer - and carbonated beverage bottles, i.e. self manufacture. W.I. Crown Cap intend to put a 2nd lacquering/printing line in for paint and oil cans for M.B.
The use of T.F.S. is only just beginning for crowns. With the price of tin between £6,500 and £8,000, there could be a great saving without deterioration of the quality of the crowns.

Metal Box has two can making lines, on which they try to manufacture 10 (ten) different sizes of cans (6 different diameters and 10 different heights), i.e. they are giving a service to industry. (Diameter and height changes of a can line take one to three days).

Things at present are very difficult for both can makers and canner, because of lack of foreign exchange. M.B. cannot buy all the tinplate it requires, hence the canners are suffering from a shortage of cans and have to let their customers down. A vicious circle, which should be broken soon.

(2) Factory Visits

Details of all visits are recorded in the Centre. The impression created is one of tension and some unsympathetic misunderstanding between can maker and canners. One can only sympathise with both sides.

The volume of cans manufactured in Jamaica is relatively small (35 millions), a drop of over 50% since 1972.

It would pay the industry to get together and discuss standardisation of can sizes. Is it necessary to have so many different diameters and heights? It costs the cannermoney to change to different can, but may it be worthwhile for the sake of efficiency?

(3) Heavy Metals in Food Cans

Manufacturers (can makers and canners) seem to be fully aware of the stringent regulations regarding Lead and Tin in foods and drinks which are being introduced throughout E.E.C. countries and other parts of the world. Metal Box will be taking steps to eliminate Lead and is aware of the tin problem. Elimination of tin should be a joint exercise between can maker, canner and the Packaging Centre. The consultant has started enquiries regarding lacquers containing tin particles, i.e. controlled tin dissolution. It is up to the canners to carry out work .

The answer from Dr. M. Warwick regarding the use of lacquer with tin particles is appended. It is felt, that the canners with the help of Metal Box and the Packaging Centre should take up Dr. Warwick's offer and conduct an experiment with the suggested lacquer system, using unlacquered cans as controls.

(4) Palletising of cans and ends

A study group must be set up to look at better ways than used at present to transport empty cans from the can maker to the cannery. At present empty cans are put into boxes (24 or 48 cans per box), which are close folded. Practice throughout the world is palletising. 5690 cans 73 x 115 can be moved by one man. (a factor of 237 campared with handling 24 cans !)

Advantages:

(1) Saving of manpower

(2) Less damage to cans.

(3) Savings in money

(4) Easier handling.

Investigation will bring out the cost of palletising, i.e. new vehicles, palletiser, fork lift truck etc.

(5) Visits to Supermarkets

A few visits were paid to supermarkets.

(1) All petfood cans had T.F.S. ends.

(2) Some American human food cans had T.F.S. ends. All cans were in good shape.

(3) Some cans were well displayed, showed no rust and very little damage. These were from one large Jamaican food producer.

(4) Cans from other canners in Jamaica were fair. Some cans showed denting.

(5) Some cans were a disgrace, dirty, rusty and badly damaged (mainly impact damage). These appear to be imported from Caribbean sources.

(6) Cost Reductions:

A programme of cost reduction recommendations has been worked out. M.B, the canners and the Packaging Centre welcome the programme. The recommendations should not alter the performance of the cans.

The recommendations include for the 307 x 408 can:

(a) Stonefinish (instead of bright).

(b) Substance reductions, counteracted by beading of the cans.

(c) T.F.S. ends instead of tinplate ends.

(d) Use of U M.M. (unmended menders).

For the 211 ends:

T.F.S. ends.

A very important factor in any cost reduction exercise is education and discipline of all personnel at the can makers, the canners, the storage depot and the supermarket. If the substance of a can is reduced, it must be handled more carefully. The programme has got to succeed, if Jamaica wants to remain competitive.

The Packaging Centre will help in ensuring by metallurgical tests that the correct materials are used and also help in assessing filled can performance (level of damage, taste, colour, texture etc). Control cans will be the standard cans used at present. Abuse testing will be carried out by the Packaging Centre.

(7) An exercise to find the origin of Lead in foods and drinks in Jamaica.

The consultant suggests the following experiment:
Select a number of cans containing solder pellets. Grade the pellets by size and put the cans into groups according to solder pellet contamination size. Controls: Clean cans.

Pack test 5 products: Tomato juice, Orange juice, Grapefruit juice, Fruit Punch, Grapefruit segments.
Analyse contents at regular intervals for 18 months (plus initial raw material).
Is there a gradual increase in lead, or is there an initial dissolution, which then settles down to a steady figure?
We must get documented evidence under local conditions. Can we tolerate any lead contamination, i.e. small solder pellets?

(8) An exercise to overcome Nitrate detinning.

Produce cans with an epoxy phenolic base coat and a tin containing (pigmented) epoxy phenolic top coat.

(a) Fill with pineapples as received
(b) Fill with pineapples plus small addition of Nitrate.
(c) Fill with pineapples plus lacquer addition of Nitrate.
(d, e & f) use plain cans as controls with pineapples as received and with additions as in'b and c'.

Also analyse pineapples before packing.
The canners will have to decide from the experimental results, which way they want to go.

In this investigation efforts should also be made to establish, why detinning occurs:

(a) Water?
(b) tinplate?
(c) fertiliser?
(d) weather?

or a combination of factors?

(9) Response to suggestion:

Cost reductions, Lead and Nitrate will be examined. After the Round Table Conference it was agreed to set up a committee of a canner, the can makers and the Packaging Centre to plan the work, which has to be carried out.

(10) University of the West Indies:

After a visit to Dr. K.E. Magnus, Head, Chemistry Department of the University of the West Indies, it was found, that our suggestion to carry out some of the research proposed by the consultant, was welcomed. The Chemistry Department has just started to include Food Technology (including processing) in its programme and Dr. Magnus promised that post-graduate work could start in October 1981. The consultant outlined a programme of investigation into Nitrate detinning, in which Dr. Magnus was most interested.

(11) ROUND TABLE CONFERENCE

A seminar for can makers, canners, and lacquer manufacturers was held on the 4th December 1980. It was fairly well attended.

After opening remarks by Dr. Henry and Mrs. Domville, the consultant gave a short talk, covering:

(1) The history of the can.
(2) Advances in Can Technology in the last 20 years.

- (a) D.R. plate (double reduced)
- (b) T.F.S. plate (tin free steel)
- (c) D.W.I. can (drawn and wall ironed)
- (d) D.R.D. can (drawn and re-drawn)
- (e) Soundronic Welding.

(3) Problems:
- (a) Nitrate detinning
- (b) Heavy metals (Lead and Tin)

(4) Counter Measures and Development work.

(5) Palletising
(6) Cost Reduction Exercise
(7) Lacquering.

A good debate ensued.
Arising out of the conference, a meeting was convened between a canner, the can maker and the Packaging Centre to plan the development work.

RECOMMENDATIONS:

(1) Developments:

The canners, can makers and the Packaging Centre should set up a development programme to investigate:

(a) Why do failures occur in canning?

(b) Practices of growers?

(c) Safer canning practices.

(d) New can developments, incl. lacquers, lining compounds, new technology in tinplate and can manufacture etc.

(e) Elimination or restriction of heavy metals.

(2) Investigations:

Areas, which need immediate attention and study:

(a) Nitrate detinning (see para 8)

(b) Lead contamination (see para 7)

(c) Canning practices.

(3) Palletising:

Canners and can makers ought to look at palletising of cans and ends. Packaging into (and unpacking from) boxes is very slow and cumbersome. Cans and boxes, which are re-used to send the filled cans out, are damaged.

(4) Monitoring of incoming tinplate:

The can makers (or the canner) should use the Packaging Centre for checks on incoming tinplate, i.e. tin coating, lacquer identification, substance, hardness and Special Property Tests. There is a misconception among can users, that on differentially coated tinplate the heavily coated side is always marked. The marked side is always the first written coating weight on the order: hence a clerical mistake can lead to a canning disaster.

ANNEX I

UNITED NATIONS

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

UNIDO

31 August 1979

PROJECT IN JAMAICA

JOB DESCRIPTION

DP/JAM/77/008/11-02/31.7.E

Post title Expert in tinplate containers

Duration Eight weeks

Date required October 1979

Duty station Kingston, with possibility of travel within the country

Purpose of project

Duties The expert will work with a small team of local specialists on problems associated with tinplate container quality. The expert will be expected to:

1. Carry out a survey of the existing tinplate container quality. Advise counterpart staff on any development work required as a result of this survey, indicating the way this should be carried out.

2. Advise counterpart staff and local industry in the preparation of buying specifications and in the preparation of standards for specific applications.

3. Advise counterpart staff on the preparation of long term storage trials of canned products on evaluation techniques and on typical problems associated with canned food production and marketing.

4. Hold a round table conference or seminar for local industry.

The expert will also be expected to prepare a final report, setting out the findings of his mission and his recommendations to the Government on further action which might be taken.

QUALIFICATIONS — At least five years experience in the canning industry, preferably with a degree in Metallurgy or science subject.

LANGUAGE — English.

BACKGROUND INFORMATION — Growing demands in the country's industry for better and less expensive packaging which should withstand international quality specifications require intensification of the local activities in this field.

Realising the important role of standardization in upgrading the quality of packaging, the Government has established a Packaging Research and Testing Department at the Government Bureau of Standards to provide adequate testing facilities necessary to formulate technical specifications for the standards. This department will also act as an independent packaging laboratory offering its services to the manufacturers and users.

The above consultancy is one of a number being implemented as a means of training the local staff and bringing the various facets of its work into full operation.

ANNEX II

TRAINING PROGRAMME IN TIN PLATE CONTAINERS

ERNEST MEYER - 3 NOVEMBER TO 19 DECEMBER 1980

MONDAY 3 NOVEMBER	TUESDAY 4 NOVEMBER	WEDNESDAY 5 NOVEMBER	THURSDAY 6 NOVEMBER	FRIDAY 7 NOVEMBER
Arrival in Kingston	Introduction and Orientation.	Programme Planning Bureau visit Metalurgical lab.		
Counterpart		Background, Matecials, Lacquers		

MONDAY 10 NOVEMBER	TUESDAY 11 NOVEMBER	WEDNESDAY 12 NOVEMBER	THURSDAY 13 NOVEMBER	FRIDAY 14 NOVEMBER
TALK - 9.00 - 10.00 am Introduction and history of can making	VISIT Grace Kennedy (Canner) morning Discussion - T.Barnes Can Committee Harbour Street	TALK - 2.30 - 4.30 p.m Tin plate. VISIT 10.00 a.m. Grace Canners VISIT 11.00 a.m. DaCosta Bros.	VISIT - 9.30 a.m. West Indies Crown Cap, Kingston. Mr. Akeung	TALK - 9.00 - 10.00 am Can making operations Solder types.

MONDAY 17 NOVEMBER	TUESDAY 18 NOVEMBER	WEDNESDAY 19 NOVEMBER	THURSDAY 20 NOVEMBER	FRIDAY 21 NOVEMBER
TALK - 9.00 - 10.00 am Heavy metals VISIT - 2.30 p.m. Metal Box	DISCUSSION GROUP 2.30 - 4.30 pm JIDC Food Technology Bureau Food Section (inspection)	VISIT Jamaica Milk Products Bog Walk. Contact - Mr. Patrick Henry	TALK - 9.00 - 10.00 am Lacquers	VISIT - 10 a.m. Citrus Co. of Jamaica Mr. J. Bourke
MONDAY 24 NOVEMBER	**TUESDAY 25 NOVEMBER**	**WEDNESDAY 26 NOVEMBER**	**THURSDAY 27 NOVEMBER**	**FRIDAY 28 NOVEMBER**
TALK - 9.00 - 10.00 Can testing Q.C. test methods VISIT - 10.30 Metal Box VISIT - 2.30 p.m. Coates Bros.	VISIT - 2.30 p.m. Foods of Jamaica (Mussons)	TALK - 9.00 -10.00 am The Canning operation and pasteuridation aseptic canning	TALK - 9.00 - 10.00 Specifications, cost reduction pointers	VISIT - 10.15 a.m. Grace Kennedy

MONDAY 1 DECEMBER	TUESDAY 2 DECEMBER	WEDNESDAY 3 DECEMBER	THURSDAY 4 DECEMBER	FRIDAY 5 DECEMBER
TALK - 9.00 - 10.00am New technology Double reduced, tin free steel, 2 piece can, DRD, DWI, AL.		VISIT - 10.a.m. Contact - Mr. Priestland Berec	ROUND TABLE - 9.30-12.00 Observations on the Jamaican situation Consultations - 2.0-4.30	
Counterpart		Developments, forward planning		
MONDAY 8 DECEMBER	TUESDAY 9 DECEMBER	WEDNESDAY 10 DECEMBER	THURSDAY 11 DECEMBER	FRIDAY 12 DECEMBER
Dr. Magnus University of the West Indies.	"The use of metal containers in Industry", A talk by Van Leer and Metal Box.	Discussion with Mrs. Hall, Food Science.	VISIT - 10. a.m. West Indies Crown Cap.	
Counterpart				

MONDAY 15 DECEMBER	TUESDAY 16 DECEMBER	WEDNESDAY 17 DECEMBER	THURSDAY 18 DECEMBER	FRIDAY 19 DECEMBER
Report preparation	Report preparation	Report preparation		
Counterpart		Consolidation and revision		Leave for London BA.264 - 5.25 p.m.

ANNEX III

CONTACTS MADE IN JAMAICA

Bureau of Standards - Packaging Centre

Mrs. M. Domville	-	Head, Packaging Centre
Miss I. Bennett	-	Counterpart, Retail Pack Specialist
Miss P. Douce	-	Packaging Materials Specialist
Mr. E. Williams	-	Transit Packaging Specialist
Mr. J. Salisbury	-	UNIDO, Project Manager
Dr. A. Henry	-	Director
Mrs. J Crawford	-	Deputy Director
Dr. O. Thomas	-	Deputy Director
Mr. K. Garfield	-	Head, Materials Science
Mrs. P. Brown	-	Head, Chemistry, Micro Biology Quality Assurance
Mrs. M. Lettman	-	Librarian
Mrs. M. Galloway	-	Head, Administration

United Nations Development Programme Office

Mr. Y.J. Joury	-	Resident Representative

Grace Kennedy Cannery

Mr. T. O'Brian	-	Works Manager

DaCostas Bros. Cannery (part of Grace Kennedy)

Mr. T. Barnes	-	Technical Director
Dr. D. McNeil	-	Factory Manager
Mr. K. Jones	-	Quality Controller

Grace Kennedy Foods

Miss M. Tenn	-	Director
Miss L. Douglas	-	Chemist
Mr. P. Duncan	-	Quality Control

West Indies Crown Cap (Part of Desnoes and Geddes).

Mr. K. Akeung	-	General Manager

Metal Box (Jamaica) Ltd.

Mr. J. Minott	-	Managing Director
Mr. Palmer	-	Technical Manager
Mr. Perkins	-	Production Controller

Jamaica Milk Products Ltd. (Nestle)

Mr. P. Henry	-	Chemist and Quality Controller
Mr.G.M. Francis	-	Engineer
Miss J. Duncan	-	Assistant Chemist

Citrus Company of Jamaica

Mr. J. Bourke	-	General Manager
Miss B. Bisnett	-	Chief Chemist

Coates Brothers (Jamaica) Ltd.

Mr. A. Roche	-	General Manager
Mr. P. Hammersley	-	Technical Manager

Foods of Jamaica (Mussons)

Mr. J. Jackson	-	Chemist
Mr. W. Phillips	-	Consultant Engineer

BEREC Caribbean Ltd.

Mr. C.R.D. Priestland	-	Managing Director
Mr. Tavares	-	Production Manager

University of the West Indies -

Dr. K.E. Magnus	-	Head, Chemistry.

ANNEX IV

INTERNATIONAL CONTACTS ESTABLISHED FOR THE PACKAGING CENTRE

(1) Dr..J.C. Sherlock, Ministry of Agriculture, Food and Fisheries, London.

(2) Dr.D. Henshall, Camden Food Research Association, Chipping Campden.

(3) L. Warner, Research Laboratory, British Steel Corporation, Swansea.

(4) R. Davies, Librarian, Research Laboratory, British Steel Corporation, Swansea.

(5) Dennis Hayes, Product Manager- R.C.S., Alcoa Manufacturing (G.B.) Ltd. Swansea.

(6) S. Canning, Chief Chemist and Director, Arthur Holden & Sons Ltd. Birmingham.

(7) Dr. M. Warwick, International Tin Research Institute, Peri ale, Middlesex

(8) D.K. Lougher, Chief Chemist, American Can (U.K) Ltd., Liverpool.

(9) Keith Jewell, Campden Food Research Association, Chipping, Campden.

(10) Allan Martin, Microbiologist, Pedigree Petfoods, Melton, Mowbray.

(11) David Owen, Sales Manager,
W.R. Grace Ltd., London.

(12) M. Roger, Chief Quality Controller
Mardon Illingworth Ltd., Sutton-in-Ashfield.

(14) J. Kasler, Associate Director,
Technica Assistance-Metal
American Can Internationa;
Americal Can Company
75 Holly Hill Lane
Greenwich, Connecticut, 06830, U.S.A.

(15) Mr. E. Pachebat, Technical Manager, International Paint, London.

ANNEX V

TOPICS DISCUSSED AT METAL BOX FACTORY

(1) Ordering procedures
(2) Can sizes
(3) Can types
(4) Origin of tinplate (N.S.C., U.S. Steel, National Steel, Rasselstein?)
(5) Seperation of different tinplate
(6) Tinplate specification (bodies and ends)
    (a) Type (L, N, M.R.)
    (b) Temper
    (c) Annealing
    (d) Passivation
    (e) Oil
    (f) Sheet size
    (g) Grain direction
    (h) Gauge (tolerance?)
    (i) Ccating (K type?)
    (j) Finish (stone finish - cost reduction)
(7) Q.C. tests
(8) Lacquer
    (a) Origin (Holden, Coates, Int. Paints)
        (self lacquering in Jamaica?)
    (b) Type
    (c) Q.C. tests
        M.E.K. rub
        Adhesion (selotape)
        Blush test
        CU SO_4 test

(9) Ends

- (a) Peaking resistance
- (b) Pull back
- (c) Compound
  - (1) Placement
  - (2) Weight
  - (3) Type

(10) Defects

- (a) Investigation
- (b) Action

(11) Heavy Metals

- (a) Pb
- (b) Su

(12) Development Program.

(13) Palletising

(14) D.R.

(15) T.F.S.

ANNEX VI

TALKS GIVEN TO STAFF OF THE PACKAGING CENTRE

(1) The History of the can

(2) Iron production

(3) Steel Production

(4) Tinplate Production including Batch and continuous annealing

(5) Double Reduced Tinplate

(6) Tinfree Steel

(7) Continuous casting

(8) D.R.D. (drawn and re-drawn) cans

(9) D.W.I. (drawn and wall ironed) cans

(10) Three-piece can making

(11) Can faults

(12) End faults

(13) Heavy metals (Pb and Sn)

(14) Specification for tinplate cans and ends.

(15) Cost Reductions

(16) Lacquers and lacquering

(17) Processing, incl. static retorts, continuous cookers and aseptic canning.

(18) Tinplate Testing.

ANNEX VII

REPORTS, STANDARDS AND BOOKS LEFT AT THE PACKAGING CENTRE

(a) Evaluating a double seam (W.R. Grace).

(b) Evaluating a double seam (Metal Box).

(c) Tinplate (British Steel Corporation).

(d) Lacquers, Varnishes and Coatings (Arthur Holden and Sons Ltd).

(e) Standards Quality Specifications (Pedigree Petfoods).

(f) Recommended Industry Specifications for Open Top Processed Food Cans. (Great Britain).

(g) The manufacture and Quality Control of Coated Steel for the canning Industry. (G. Jefford, B.S.C.).

(h) Role of tin powder incorporated into lacquers for tinplate containers (Dr. M. Warwick, International Tin Research Inst.).

(i) Rate of Dissolution of tin from Tinplate in oxygen-free citrate solutions (Sherlock, Hancox and Britton, Tin Research).

(j) Promotion by Nitrates of the Dissolution of Tin by Acids and its inhibition (Sherlock and Britton, Tin Research Inst.)

(k) Effect of Nitrates in Fruit Products and Beverages on Can corrosion (Dennis Herbert, Metal Box).

(l) The role of sulphur dioxide and nitrate on detinning of canned grapefruit juice. (Saguy, Maunheim and Passy, Israel).

(m) Detinning in Canned Tomatoes caused by Accumulations of Nitrate in the Fruit (University of Florida and the Ohio State University).

(n) The nitrate Detinning Reaction in Model Systems (Farrow, Lao and Kim, Washington).

(o) Research Program on internal Can Corrosion (Farrow and Somers, Washington).

(p) The Nitrate Corrosion of Canned Orange Juice Soft Drink in Japan (Horio, Iwamoto and Shiga, Japan).

(q) Trouble shooting some Detinning Problems Encountered by the Canning Industry (Dr.D. Henshall, Chipping, Campden).

(r) ASTM Methods for Determination of Pickle Lag, Iron solution value, Alloy-Tin Couple and Tin Crystal size.

(s) The Lead in Food Regulations 1979.