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DEVELOPMENT OF THE PRODUCTION OF PACKAGING FOR EXPORT GOODS
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REPUBLIC OF CHILE

Technical report: Transport packaging of fruits for export purposes*

Prepared for the Government of Chile
by the United Nations Industrial Development Organization,
acting as executing agency for the United Nations Development Programme

Based on the work of A.E. Garcia,
consultant in transport packaging

Backstopping officer: J. Belo, Engineering Industries Branch

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United Nations Industrial Development Organization
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* This document has not been edited.

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A. INTRODUCTION AND JOB DESCRIPTION

"In June 1977, once the survey on "Packaging for Chilean processed food" was finished, the Production Promotion Corporation (CORFO) realized the need for a specialized body in packaging, and due to this fact supported the creation of a Center of this nature which started its operations in 1978, under the direction of INTEC-CHILE.

At the initial stage, a great impulse was given to training in this field of Chilean technicians and professionals, in order to be able to have from the very beginning a highly qualified group of people, and to be able to count at a later stage on the adequate means and physical infrastructure to develop, at a high level, a technical activity.

The initial phase of organization and equipping was finished. Currently the Center is carrying out, on a permanent basis, applied research work under the patronage of national and international bodies, and provides upon the request of private and public sector enterprises.

With regard to its structure, besides CORFO representatives from the private sector involved in packaging and who actively participate in financing, orientation and activities are associated with the institute.

The aims of the Center are to keep informed, to carry out research and development and to provide consultant services in packaging to its associates as well as to third parties, leaving open the possibility for new members to join."

Job description

The consultant will be assigned to the packaging center of the institute for technological research (INTEC - CHILE) reporting to and acting in consultation with the local office of UNDP during his mission in Santiago. He will carry out the mission work in close co-operation with the national counterparts assigned to the project and will be specifically expected to:

1. Get acquainted with the structure, operation conditions and services of the Packaging Center, as with the objectives of the project as a whole and the general purpose of his mission.
2. Get acquainted with the equipment, technical personnel and testing methodologies already existent at the laboratory of the Packaging Center for simulation of transport stresses and applied research and quality control on transport packages and respective materials.
3. Participate in working meetings with technical managers of Chilean transport packages manufacturer and user industries, for appraisal of the concerned problems which exist in the country and discussion about the measures which should be adopted for appropriate solution within an adequate period of time.
4. Elaborate an integrated programme, as extensive as possible, of the tests on transport packages and their materials which can be carried out with the equipment which is available at the laboratory and/or should be acquired at low or reasonable cost.

5. Teach and train the technical personnel of the national counterpart on the theoretical basis, methodology and practical execution of the tests on transport packages and their materials which are compatible with the available equipment and related capabilities.
6. Elaborate a summary plan, by stages, for development of the laboratory section devoted to transport packages and concerned materials testing, including future needs in terms of equipment and physical conditions for its operation.
7. Co-operate with the technical personnel of the national counterpart in the discussion of the quantitative values which could be required as mandatory limits for the different tests, in the light of the requirements in the export target markets and the national prevailing conditions.
8. Participate in technical events and advise on subjects within the field of this specialization as proposed by the national project co-ordinator in consultation with the local office of the United Nations Development Programme.

B. ACTIVITIES - CONDUCTION OF THE MISSION

The mission was conducted based on three basic activities: internal group discussion, visits to industries, and meetings for mission re-analysis. Apart from this an external seminar was prepared, a meeting to discuss the associative model of INTEC and meetings with PNUD and ODEPLAN (Chilean Planning Office) were set to discuss the mission and the packaging center as a whole.

Internal group discussion

During the mission a series of group discussions were conducted to clarify all the aspects related to the area of distribution packaging. All aspects presented in the findings and recommendations of this report were discussed and some others related to how to get better results from testing equipment in terms of accuracy and function.

Mrs. Tania Cvitanic and Mrs. Loreto Sotomayor were the most present counterparts in these discussions. Mrs. Cvitanic is from corrugated board testing and Mrs. Sotomayor from distribution aspects of laboratory testing.

The pre-conditioning and conditioning for test paper based packages were discussed. The ways to check the temperature and relative humidity in the laboratory as well as the standard conditions prescribed by the standards concerned were also presented.

Software that helps planning of primary and distribution packages was presented and an explanation was given on how to use it and improve it according to the interest that the institution has in this area.

Changes in the equipment found in the laboratory and accessories to improve the equipment's performance were suggested as well as some changes that would delay the need to purchase additional equipments were presented to the staff.

Visit to industries

During the mission three visits were made to help the expert get an idea of Chile's productive sector and suggest some others projects to direct the job made at INTEC to their needs; these visits were:

- CORESA:

CORESA is a company that produces plastic and metal containers, woven sacks, bags and plastics for agricultural use.

- FRUTEC:

FRUTEC is a trade company for fruits and vegetables that selects and packs fruits by its size and quality.

- VERA Y GIANINI:

VERA Y GIANINI is a paper, board and corrugated board producer which prints and manufactures paper sacks, cartons and box board packaging with the appropriate technology.

From the visits it was understood that INTEC can perform an important job for the Chilean packaging industry and helps the country get better results for its exports. Some examples of projects that would direct the institution to that end were discussed during the mission.

C. FINDINGS AND RECOMMENDATIONS

To facilitate understanding, this outline was divided in parts describing the distribution packaging knowledge and testing. The latter include: compression test; vibration test; shock and free fall tests. Additional parts deal with staff; the associative model and further acquisitions.

Compression test

INTEC has two compression testers. An old one, which has been partially developed in-house; the other one was bought from A. Mack Low - Smith Ltd., England, model GUI5 3AH with circular register Bristol & Babcock model 29500 - 14 - Z120, purchased through the UNIDO project.

The old one has the nominal load capacity of 2000 lbs (1000 kg), a testing area of 100 x 80 cm, and is 1.0 meter high. It incorporates a load cell (Schaevitz 2000) with digital reading and analog output (Metroc - 452A). This compression tester was found by the expert to be of no use because of doubts in its functioning. Some changes were made during the mission in the sense of making it better and operative.

One of the difficulties was that the load cell was not in full contact with the platens and there was an off load of approximately 40 kg. This was rightly accounted for in the tests carried out by INTEC but made it impossible to know when the friction in the bearings were within the desirable range because it was not read by the load cell. The suggestion here was to make a pre-load of approximately 10 kg and adjust electronically to zero. This was done and the results were as expected.

The second problem with the compression tester was the height sensor that seemed to have a very long warm up time and it was very difficult to correlate the output voltage to the exact position. It was advisable to get a new sensor or to use the HP plotter, using XT in place of XY plotter, by just changing the configuration of the plotter furnished, doing this the displacement was calculated by correlating the speed of the crosshead in the machine and the speed in the plotter.

The second and bigger compression machine owned by INTEC has a load capacity of 5000 kg set in two ranges 0 - 1000 and 0 - 5000 kg.

The one-ton dial was not working, probably because of damage sustained in its transportation from the factory to Chile. Attempts to contact the company have failed and it is the opinion of the expert that UNIDO should contact the manufacturer of the machine and ask them to help INTEC in solving the problem.

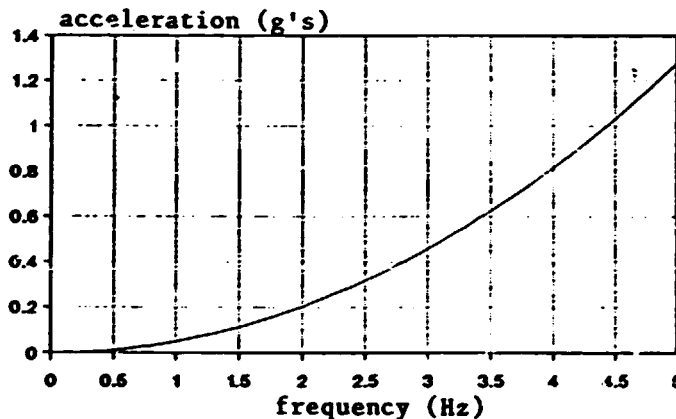
The system uses a hydraulic piston to convert the force applied to the packaging into pressure and to convert it once more into force by the gauges (1000 and 5000 kg). There are two that work simultaneously up to 1000 kg and beyond that one protective valve seems to interrupt the pressure to the 1000 kg gauge keeping the 5000 kg one working.

In transport it is very common to find high levels of shocks and it could have damaged the protective valve and interrupted straightly the oil line to the low pressure gauge. It seems that this valve has to be exchanged and the system has to be vacuum refilled. Since the new compression tester was not working for the 1000 kg gauge it made very important to have the old tester operative.

With the two compression machines INTEC is well equipped for testing transport packaging, pallets, etc. Discussions regarding those tests were carried out and it is the opinion of the expert that the packaging group of INTEC has enough experience to support the Chilean market in this matter.

Vibration test

INTEC is provided with a mechanical vibration table (GAYNES model Y 3000), purchased through the UNIDO project, with fixed one inch double displacement and frequency in the range of 1 to 5 Hz. This provides for different frequencies, dissimilar levels of accelerations. Recognizing this, some studies were carried out in order to prepare for the staff a curve correlating the acceleration X the frequency the vibration table is running, in order to quickly get the condition of test. This was done and the result is presented below:



It can be seen that only one situation at a time can be performed with that vibration equipment.

A second reason for studying the vibration table was to measure the frequency at which it vibrates, because there was no standard system in the equipment that did this job. It was decided that the best would be an electronic rotation meter that worked in RPS (Rotations per Second) with a 3½ digit display. As the price for such a device was considered too high, other possibilities were studied and suggested for the staff. The cheapest method was to use an existent oscilloscope to record the wave and calculate the period of vibration and then the frequency.

Shock and free fall tests

Since there was no shock machine in INTEC, shocks were given to packages and products by means of a free fall drop tester and the resulting pulse recorded in a Tektronix T912 10 MHz screen memory oscilloscope

The free fall drop tester, which was a L.A.B. model 5D - 1005, had a maximum height of 1.7 meters. The sample being tested could be attached to an

accelerometer (DJB 1207) and thus to the oscilloscope in order to capture the shock wave and measure the maximum acceleration as well as the shock duration in ms (milliseconds).

The oscilloscope was checked and worked perfectly but the accelerator and conditioner (DJB RM/04) exhibited a too high level of noise, even then it was possible to work with. The suggestion here was to purchase a new acceleration measurement system in order to avoid the noise and measure the shock parameters more precisely.

Apart from this, INTEC has purchased from GAYNES an electric hook which is suitable for drop tests of high weight and height. In order to install that hook it was advisable that near to the vibration table there was a foundation of approximately 1.2 x 1.2 meter and 1 meter deep considered adequate to run drop tests faced by a normal distribution laboratory.

The necessity here was to build a metallic structure sturdy enough to withstand the normal weight tested, which is approximately 1000 kg and obtain an electric overhead crane to position the product being tested to the right height.

Discussions related to this matter took place during the mission and some trials were carried out to avoid noise disturbances during the test and to advise the kind of work with shock approach expected from INTEC by the industries.

Staff

INTEC was working on physical and mechanical tests based on the experience of two engineers : Tania Cvitanic, who was trained in the USA and Europe in the general area of packaging and has extensive experience in laboratory testing, and Loreto Sotomayor, who does not have as much experience in the packaging field.

According to the expert's opinion the area of distribution packaging can be understood by any engineer but today it is much closer to mechanical design engineering which is very strong in electronic and signal analysis.

According to this, it was suggested that INTEC worked in two ways: training Ms. Sotomayor in the area of distribution packaging as well as hiring a mechanical engineer to augment the potential of INTEC in the area of interest.

Despite this it is very important to mention that at least one more technician has to be hired by INTEC or transferred from another area to the Packaging Center in order to optimize Mrs. Sotomayor's and Mrs. Cvitanic's daily work at the laboratory.

Associative model

INTEC is implementing its associative model in much the same way as of various models existing in the world including CETEA in Brazil. During the mission the expert participated in two meetings concerning the implementation of the model.

It was understood that local industries were very interested in starting the proposed model at INTEC although there were some remaining doubts related

to topics such as the amount of payment that the industries should provide to INTEC and the services they can expect to get from the center.

Based on the CETEA's experience it was advised that the center should charge the industries not more than an engineer's and not less than a technician's salary. These are numbers that vary according to country and industry but at the same time they work exactly as equilibrium numbers. Concerning the services the industries will be able to get from the center it is easy to understand that in one way or another they would influence this and get from their participation in the associative model three main points:

1. priority in the solicitude of trouble shooting projects and analysis;
2. discounts in the regular prices for all kinds of services presented by the center of packaging of INTEC (in the case of CETEA - 20% discount); and
3. representation in a constituted council which would have as its objective the study of packaging in Chile.

Internally, when installing the model, it is important to mention some changes that will be very effective in demonstrating the success of the model:

- For the center's staff it important to make clear that the establishment of the model is advantageous and meaningful for the work they are doing and mainly for themselves. This is more easily understood when better payment is involved.

- At INTEC there were some employees who did alternate work with the center and other areas, these personnel have to feel part of the model. An effective way to accomplish this would be to establish a better salary for these employees using the same criteria as used for the Center's staff, as they will probably continue to do the same work.

- Any technological center is only effective when there is a continuous training programme being carried out (once an actualized staff is needed).

Further acquirements

Although INTEC has some very old equipment it is not urgent to buy too much more, it is possible to set a long-term investment programme without compromising the work in the laboratories. In the same sense it is possible to make small changes in the existing equipment in order to facilitate the job done by it.

One point that was advised on this matter was the possibility of buying one or two computers in order to accelerate the work done, such as report, analysis calculus, and provide the possibility of keeping at INTEC a data bank on packaging which could support the staff and industry. It is known that INTEC has a computer center area which supports all departments, but in most cases it is important for each department to have its own.

For a long-term programme it is possible to advise a list of necessary equipment to revitalize the center and attend the Chilean market better. this equipment would include for example gas and liquid chromatograph, infra-red spectrophotometer, universal tester machine, crush tester, mullen tester, shock machine, hydraulic vibration table.

List of bibliographical material given during the mission

1. One exemplar of the book - Fundamentals of Packaging Dynamics by R.K. andenburg & J.J.L.Lee - 3rd Edition
2. Material of the International Seminar - "Packaging Development Seminar"
3. "Informativo CETEA" Vol.I N°1 and 2 ; Vol.II N°1.2 and 3
4. Guia CETEA de Embalagem - 90 - CETEA/ITAL - BRAZIL
5. One exemplar of the book - Testing Methods and Instruments for Corrugated Board by Häkan Märktron
6. Catalogue of Lorentz & Wettre Testing Equipments
7. CORREX - Unit Load Optimiser chart - Pallet Ratio 1:1.5
8. CORREX - Unit Load Optimiser chart - Pallet Ratio 1:1.2
9. CORREX - Unit Load Optimiser chart - Pallet Ratio 1:1
10. Shock and Vibration Calculation Rule

List of bibliographical material sent after the mission

1. Manual - "Manuseio e Utilizaçao do Tambor - Tambores Assepticos" - Van Leer
2. "Befullen und Entleeren" - Big Bag Handling and Filling
3. Complete Information on the Jet Ring System of Muller Ltd - Muller Information
4. The Perfect FD Drum Emptying System - Mueller Catalogue
5. FLUID BAG - information about the system
6. Copy of Hydrodynamics Charts - to help measurement of relative humidity in the laboratory

Description of the software given during the mission

The software given during the mission was PALLET.BAS, written by the expert in basic language. This software redesigns efficiently the primary package in order to optimize the use of pallet space by the distribution package unitizing it in pallet of interest of the user.

It calculates a series of combinations of a primary packaging in the distribution one, determines the percentage of area used by the stacking pattern and keeps in memory the ten most suitable ones to be presented in the end of calculation.

To use the software the user has to first load in a PC computer, the basic, basica, GWbasic or a similar language. After this load the "PALLET" programme and RUN it.

The software will then follow this sequence:

1. Ask for the kind of pallet being used by the user according to the width and length ratio: 1:1 (1100 X 1100 mm for example); 1:1.2 (1000 X 1200 mm for example) or 1:1.5 (800 X 1200 mm for example)
2. Ask for the number of primary packages to be accommodated in the distribution one.
3. Ask for the minimum, maximum width of the primary packaging in millimeters (mm) accepted by the user (and NOT the range of accuracy in the manufacturing). The user must input both numbers separated by comma.
4. The same as 2. for the length of the primary packaging.
5. The same as 2. for the height of the primary packaging.
6. Ask for the minimum, maximum volume accepted by user for the primary packaging in square centimeters (cm²). The reason for this is based on the concept that NOT all the combinations given by W : L : H are acceptable. This stage sets the computer to use only the combinations that will fulfill the needs of a certain volume (product).

REM. If the primary packaging is already defined and has fixed dimensions the user must input these as follows: (100,100 for a dimension of 100 mm) .

7. Ask for the orientation of the primary packaging in the distribution one
C x L; C x H or L x H:

C x L: stands for an orientation where the length and the width of the primary packaging is in a horizontal plane.

C x H: stands for an orientation where the length and the height of the primary packaging is in a horizontal plane.

L x H: stands for an orientation where the width and the height of the primary packaging is in a horizontal plane.

8. Ask for the thickness of the corrugated box board in millimeters (mm), if it is not defined yet because the corrugated box dimensions influence its resistance, it can be assumed and later more accurately calculated.
 9. Ask for the bulging prediction for the corrugated box under the compression strengths and handling in the distribution chain.
 10. Starts the calculation from the most smaller dimensions and for each combination of dimensions it calculates all possible arrangements of the primary packaging in the secondary package, then it calculate all possible dimensions of the secondary package; then all possible arrangements of the secondary package into the pallet, according to the patterns found in the correx unit load optimization charts, keeping in memory the ten most suitable ones.
- REM. (a) As it calculate, the results of the calculation and the patterns being tested with the correspondent area optimization, are shown on the screen.
- (b) Basic language is not a fast one and normally one test can take several minutes to complete. A more faster and more complete software is being developed in CETEA and as soon as it is finished it will be offered to INTEC and other non profitable institutions in the packaging field.
11. When it has finished the job it shows the final result and asks if the printer is ready, answer 'S' only if it is and if the user wants to have a hard copy of the job made. The last question asks if the user wants to continue the work or not.

Description of the Software Sent after the Mission

The software sent after the mission was the UPDOWN.EXE, written by the expert in PASCAL language. Its function is to calculate the mean height and the standard deviation of the DIXON and MOOD up and down methodology described in ASTM Standards Book for drop test of rigid container, but can be used for nearly every package.

To use the software the user first has to load the program in a PC computer.

The software will then observe the following sequence:

1. Ask for the identification of the test; this is just to have it printed later in the hard copy provided by the software.
2. Ask for the increment used in the test in centimeters (cm).
3. Ask for the height of the first drop of the test in centimeters (cm).

Next it asks for the results of each drop (Failure or Non failure) according to the methodology prescription, with the previous result it automatically calculates the next height and asks again for the result obtained. It does this up to the drop of number twenty. Then it immediately furnishes on the screen all the drops and their results with the corresponding calculation made.

If everything is right the user can then use the command PRINT SCREEN on the computer's keyboard and get a hard copy of the results.

Backstopping Officer's Comments

Although the mission has been originally programmed for one month, it was shortened to twenty days duration only.

The implementation time was affected by the condition that the mission had to be awarded to a French expert, in order to take advantage of the travel being paid by the French Government, and later on by inability of the selected French expert to undertake the mission. The Brazilian expert was finally selected.

The mission included a main component of counterparts training of the setting-up and operation of the main testing equipment which is used for the performance evaluation of transport packages, namely compression testers, vibration tester, shock and free fall testers. The use of computer software in planing of transport packages was also introduced to the technical counterpart.

Advice was given with regard to the use of complementary instruments like accelerometer, oscilloscope, etc. in connection with the common tests to be performed, as well as on additional equipment which should be considered for acquisition as soon as the concerned conditions be favourable.

The institutional model of the Packaging Centre of INTEC-CHILE was analyzed during group discussions with the staff concerned, in the light of the Brazilian experience with the associative model of the Food Packaging Technology Centre at the Institute of Food Technology, Campinas, State of Sao Paulo, where the expert performs his regular duties.

Ad hoc advice was also given by the expert during his visits to industries, namely a manufacturer of paper, board and corrugated board packages, another manufacturer of plastic and metal containers, woven sacks and plastic bags, and a trade company which uses transport packages for fruits and vegetables.

The expert also co-operated in the carry-out of a seminar on transport packaging of fruits for export purposes, which was open to participants from outside of INTEC-CHILE.

The short duration of the mission did not allow the practical execution of new models of transport packages, for specific fruits being exported from Chile.

In addition to endorsing the specific recommendations of the expert, the backstopping officer recommends that the Packaging Centre of INTEC-CHILE goes on in assisting exporters of fruits in their designing and specifying of well adapted transport packages, whenever necessary or convenient in consultation with CETEA/ITAL from Brazil.