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Explanatory notes to the data form for the certification of reefer containers for flower bulb carriage

Issued to: Genstar Corporation, San Francisco USA

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1. Introduction:

The certification of containers for the carriage of flowerbulbs has been introduced in the late 1970 's in order to keep the quality of the produkt optimal during transit. A second argument was the reduction of risk for insurance companies, involved in the transportation of flowerbulbs, for loss of an expensive agricultural product caused by inferior equipped containers. As a result there is quite a difference in fee to insure a load of flower bulbs during a carriage over sea by means of a certified or a not certified container.
The requirements for the certification were agreed upon by the Laboratory for Flower Bulb Culture (LBO) at Lisse, the former Sprenger Institute now the Agrotechnological Research Institute (ATO -DLO) at Wageningen and the Transport Advisory Bureau of the Flower Bulb Shippers Association at Rotterdam, the Netherlands. The latter bureau keeps record of the certified reefer containers in the world and is equipped to inform shippers and insurance companies directly on request. ATO - DLO has been charged with the inspection of the containers and the issue of the certificates of approval.

As can be seen from the requirements in Annex 1 the approval of containers for the transportation of flower bulbs is mainly based on conditions influencing the climate inside the container box. This is additional to other certificates which cover issue's like mechanical strength of containers, hasards at sea, biological and toxilogical dangers connected with the transportation of foodstuffs.
The system of approval has been set up in a way that it can be operated in the field. This means that the required measurements to determine the air circulation rate and the ventilation rate in container boxes can be performed on empty containers at container terminals or workshops for the maintenance of container equipment. Testing of containers under laboratory conditions for this purpose would have made the system complicated and expensive. Therefore the requirements for flowerbulbs during real transports have been translated to requirements for empty containers and also for the 50 Hz frequency of the electrical supply in the Netherlands. As an example the ventilation requirement for flower bulbs of about 4 m^3 / $h.m^3$ has been translated to the requirement for an empty container and 50 Hz mains as 2.6 m^3 / $h.m^3$.

The requirements (Annex 1) mention optimal conditions and acceptable conditions. With these requirements for ideal and acceptable equipped reefers, the containers can be labeled as very good, good, just acceptable and not acceptable.

In order to facilitate the certification of containers for companies which own large series of similar containers and have building programmes running at factories for the construction of those containers a change of procedure has been introduced in the year 1992. In stead of approval afterwards the testprocedure and certification can be performed at the moment the container leaves the factory. For that case ATO accepts data according to the data form of Annex 2, gathered by inspectors of licensing organisations like the American Bureau of Shipping or Veritas as a base for the approval of containers for the carriage of flower bulbs.

2. Remarks on the items indicated in the data form:

General Information:

It is the intention to test one container out of 100 during the production of a series of more than 100 containers or at least one container of a series per month. For series less than 100 containers one container will be regarded as representative for the series. The container to inspect can be chosen at random. The fleet-number or the owners-number of the inspected container has to be filled in on the form together with the range of (maximal 100) owners-numbers the container is chosen from. For recognition of the certified containers later, it is important that the manufacturer, the model-number and the range of serial-numbers of the boxes given by the factory, are known.

Information about the conditioning unit:

If the description of the refrigeration-heating units and the controllers to be used is handed over to ATO before the production and the inspection of the containers starts, the global information about the units, to be filled in on the data form, will be sufficient to valuate the refrigeration- and heating-power installed in the containers of the series

Especially for identification of the containers later, we like to have the factory serial-numbers of the conditioning units that correspond with the serial-numbers of the boxes.

A question, asked together with those related to the conditioning units, is aimed at the presence of extra facilities in the containers like CA, MA and humidity control.

CA = controlled atmosphere. This means that auxiliary apparatus is present to control the CO2-level and the O2-level of the air inside the container. The container box has to be almost airtight and a nitrogen generator and a CO2-source like a bottle with compressed CO2 is present or a CO2-scrubber. The oxygen in both cases is controlled by ventilation.

MA = modified atmosphere. This means that the container is provided with connections so that a gasmixture can be injected into the box before the start of a voyage. In transit the composition of the gasmixture inside the box is not controlled any more.

A humidifier for the circulating air can be present with a watersupply or one that uses the condensed water from the evaporator.

A dehumidifier can be present of the type evaporator-heater combination or one based on a chemical reaction.

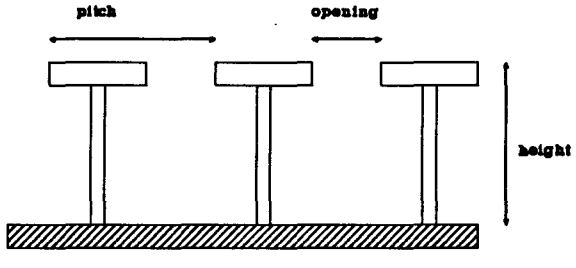
Information about the boxes:

From experience it is known that containers, even from the same series, can differ in nett interior dimensions. The result is that incidentally a container offered to a shipper is just too small for the planned loading pattern . Differences in nett interior dimensions can result from the use of different batches of metal sheets with distinct profiles for the lining

of the innerwalls of the containers during the production of one series.

The **nett internal length** in our case is the length of the container from the flat bulkhead till the end of the footing of the floor T-bars near the door.
The **nett internal width** is the smallest distance between the protruding parts of the profiles of the linings of the long side innerwalls of the containers.
The **nett internal height** is the distance from the top of the floor T-bars till the maximum load mark on the wall of the container box.

For the **height, pitch and opening of the T-bars** see drawing 1. Together with the number of floor T-bars these data define the area for the delivery of the conditioned air into the container box. Furthermore they are of significance for the performance of the container when loaded, in distributing the circulating air over the floor surface.



Drawing 1. T-bars floor

Number and placing of drainholes concerns a requirement, that is added to the original requirements in 1984. This took place after the occurence of several cases, where excess water was found inside container boxes, wetting the load. This phenomenon occured mainly when containers passed through hot humid regions. The required high ventilation rate in the case of flower bulbs can easily cause this type of problem while excess watervapour is sucked in under those conditions. As long as a facility to lower the ventilation rate temporary under those circumstances is lacking, the problem is not solved definitive. Over the drain openings in front of the containers a high airspeed is maintained while the circulating air passes there through narrow channels. This phenomenon hampers the discharge of water at that point and facilitates the penetration of excess water from the unit compartment into the box. Therefore 4 drains are required for a world wide certificate; a second pair at the back of the container.

The **type of aircirculation** can be the usual bottom to top or like in mechanical refrigerated trucks top to bottom or different.

With **the dimensions of the opening in the bulkhead** for the return air (usual air circulation system) is meant the dimensions of the opening in the vertical plane.
Sometimes there are more open area's than one.

The openings in the front of the container for **inlet and outlet of ventilation air** can be round shaped (write diameter on the form), square shaped (write length and width on the form) or oval shaped (write length and width on the form and the word "oval").

The **questions about wall's, ceiling, bulkhead, door,** refer to the material (stainless steel or synthetic material etc.) of the inner linings and the presence of a profiled or a flat surface.

Information on air circulation and ventilation:

Frequency: To establish the circulation and ventilation rates it is necessary to know the frequency of the electrical supply during the measurements.

The circulation rate of the container has to be measured with the highest fan speed and with an open door and open drainholes in the front of the container box (zero back pressure). To derive a figure for the delivered air it is the intention to measure the maximum air speed that can be found in the openings between the floor T-bars. Measuring point about 50 cm's from the bulkhead and outside the kickplate which covers the T-bars in front of the box. The rate of the delivered air is derived from the number of openings, the vertical area of the openings and an assumed parabolic airspeed profile defined by the measured maximum airspeed and the two dimensions of the opening. For ATO to have the raw measured data is adequate; the calculation for the air rate is carried out by means of a small computerprogramme. The raw data give also an indication of the speed profile of the delivered air over the width of the container. This profile has to show a symmetric picture for both sides of the container centered around the middle of the bulkhead. If this is not the case the air circulation fans of the unit do not perform satisfactory.
If the resulting air rate is lower than 50 m^3 / $h.m^3$, ATO will ask the manufacturer for the the fan performance data. These data are consulted to be sure that with an additional load resistance or pressure drop of 70 Pa the air circulation stays above the threshold of
40 m^3 / $h.m^3$.

Instrumentation: For air speed measurements in the small openings between the floor profiles a calibrated anemometer with digital output can be used. Modern instruments can give mean results and maximum and minimum values over a chosen time interval. The range of velocities measured in containers runs from 0 m/s - to 15 m/s.
Manufacturers of suitable anemometers are:

Testotherm GmbH & Co., Postfach 1140, D - 7825 Lenzkirch/ Schwarzwald, Germany,
tel. 49 - 7653 - 681 - 0; fax 49 - 7653 - 681 - 100;
type 452 with probe 0635 - 1549/202, range 0 - 10 m/s or probe 0635 - 1045,
range 0 - 20 m/s (3 functions probe)

Alnor Oy, Ruissalontie 11, Postbox 506, SF 20101 Turku 10, Finland,
tel. 358 - 21 - 308700, fax 358 - 21 - 309302
type GGA 65 with range 0.1 - 30 m/s; in the range 5 to 15 m/s with 0.1 m/s accuracy.

The return air: To have a check on the magnitude of the air circulation rate the mean air speed of the return air has to be known. It was agreed to take 5 air speed measurements along the longest middel line of the rectangular shaped opening for the return air in the bulkhead of the container. One in the middle, the others with equal distances to the neighbouring points and the vertical edges of the opening. The surface for the return air is sometimes divided over more than one opening. In that case and for openings with a relative small surface take 3 air speed measurements. The surface referred to is the surface of the opening(s) in the vertical plane of the bulkhead. Even if the return opening of the unit itself (grill) is not in that vertical plane.

Ventilation: The ventilation rate of the container is difficult to measure very precise in the field. On the other hand it is a crucial requirement with regard to the carriage of flower bulbs. One problem is that the accessibility of the inlet and outlet openings is hampered by the slide cover. This slide cover also often prevents the use of a tube. Therefore it is advised to perform ventilation measurements before the slide cover is mounted.
The ventilation till now is measured by measuring the airspeed at 5, minimal 3 spots, of the inlet and outlet opening and multiplying the mean of these figures by the measured area of the opening. Formally the **ventilation rate** found for the **inlet** is the decisive figure. The ventilation rate at the outlet serves as a check on the magnitude of the first derived ventilation. ATO is checking on an instrument that can measure the ventilation volume flow directly in stead of indirectly by means of air speed measurements. As soon as the usability of this instrument is established ATO will provide the necessary information.
For the time being the accepted way to measure ventilation with an anemometer is as follows:

1. measure ventilation before the slide covers are mounted.
2. measure ventilation with the circulation fans at their highest speed; empty container.
3. measure ventilation with the doors of the container closed, drainholes open and take some time after closing the doors for the development of the system of pressure differences inside the container box.
4. Use a tube with a smooth inner wall and a length of 70 cm or more but not too long, with a diameter that covers the opening; usually 12 cm diameter will do. For the inlet side take measurements inside the tube; anemometer sensor through a small hole in the tube wall about 10 cm from the inlet opening. For the outlet take the same tube but turn it around, the hole for the anemometer far from the outlet opening. It is assumed that a flat air speed profile develops in the tube, while the distance is too short for the development of a full parabolic profile. The ventilation is then calculated with a mean speed multiplied with an area slightly smaller than the real area of the crossection of the tube (correction 4 %).
5. Take 3 measurements inside the tube, one in the middle of the cross section, two at both sides of the centre at a distance of half a radius. These figures are sufficient to determine on a flat or a parabolic flow pattern.

As on the subject of circulation ATO prefers to have the raw data. This means **three air speed data** and **the tube diameter** if a tube is used.

ATO will introduce an instrument for direct volume measurement of the ventilation flow [m^3/h] as soon as possible. The instrument under consideration is developed to measure the performance of central air heating systems in buildings and works with the principle of zero pressure compensation. The instrument needs adaptors and tubing to match the openings of the ventilation channels and the opening of the instrument.

Instrumentation:

If an anemometer is used the range must be 0 - 10 m/s. This means that one of the types mentioned under circulation will do.

The firm manufacturing the volume flow meter under consideration is:
ACIN Instruments BV, Postbox 19191, 2500 CD Den Haag, the Netherlands.
tel. 31 - 70 - 3888990, fax 31 - 70 - 3800031.

Wageningen, oktober 1992, JWR.

ANNEX 1

Requirements for the approval of refrigerated containers for flower bulb transports.

Optimal specifications:

- Temperature control of delivery air in a band of .25 K accuracy, required range of temperature settings -2 oC up to +25 oC.
- Continuous air circulation between 4000 and 5000 m^3/h for a standard 40 ft container or 80-100 $m^3/h.m^3$ internal volume for any other containers at an additional pressure head of 150 Pa for cargo resistance.
- Provisions for a proper air distribution e.g. 75 mm floor profiles in a 40 ft container and 35 mm floor profiles in a 20 ft container.
- An air ventilation rate of minimum 150 m^3/h in a standard 40 ft container or 2.6 $m^3/h.m^3$ internal container volume for other containers. The ventilation measured at the inlet of an empty closed container without additional pressure difference at 50 cs electrical supply. Fresh air in- and outlet have to be located in the same plane.
- A possibility for dehumidification of the delivery air is favourable for flower bulbs; the optimal relative humidity for bulbs such as tulip, hyacinth, daffodil bulbs is ca. 75 %.
- Drain holes in the floor are recommended; in (sub)tropical areas 4 drain holes in the floor are mandatory in 20 ft as well as in 40ft containers.

Acceptable specifications:

- Temperature control of the return air with capacity reduction in steps so that the temperature difference between in- and outlet is less then 4 to 6K; required range of temperature settings is -2 oC up to +25 oC.
- Continuous air circulation of 2000-2500 m^3/h in a standard 40 feet container or 40-50 $m^3/h.m^3$ internal container volume for other containers at an additional pressure head of 70 Pa.
- Provisions for proper air distribution, minimal 60 mm T profile in a 40 ft container and 30 mm in a 20 ft container.
- An air ventilation rate at the inlet of minimum 150 m^3/h in a standard 40 ft container or 2.6 $m^3/h.m^3$ for any other container without additional pressure difference at 50 cs electrical supply. Fresh air has to be conditioned before flowing over the products and the fresh air intake must be far enough from the exhaust.
- Danger of damage by condensation water dripping from cold spots on the cargo has to be avoided.
- Drain holes in the floor are recommended; in (sub)tropical areas 4 drain holes in the floor are mandatory, in 20ft containers as well as in 40ft containers.

JWR 1992 september 18.

ANNEX 2

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DATA FORM for approval flower bulb carriage

General information:

type container (20 ft; 40 ft; h.cube; different)	
number test container	
container series numbers	
name manufacturer box	
model nr. box	
serial numbers of the boxes	

Information about the unit:

name manufacturer	
model nr. unit	
name manufacturer controller	
model nr. controller	
serial number of the units	
extra facilities (CA; MA; humidifier; dehumidifier)	

Information about the box:

gross weight		kg
tare weight		kg
nett interior dimensions (L,W,H)		m
height, pitch, opening T-bars		mm
number T-bars		

number and place drainholes		
air circulation	bottom to top top to bottom horizontal/different	
dimensions air opening bulkhead (L,W)		m
dimensions air opening ventilation (L,W) inlet outlet		m m
wall:	material; profile present/not present	
ceiling:	material; profile present/not present	
bulkhead:	material; profile present/not present	
door:	material; profile present/not present	

Information on air circulation and ventilation:

frequency mains supply: 50 60 Hz

delivery air : (number of T-bars + 1) * max. airspeed between T-bars in [m/s]

return air: minimal 5 air speed measurements evenly distributed over the opening in [m/s]

ventilation: minimal 3 air speed measurements evenly distributed over the opening in [m/s]

inlet	
outlet	

Place inspection; date inspection: