INTERNATIONAL STANDARD

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Tomatoes — Guide to cold storage and refrigerated transport

Tomates — Guide pour l'entreposage et le transport réfrigérés

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 5524 was prepared by Technical Committee ISO/TC 34, *Agricultural food products.*

This second edition cancels and replaces the first edition (ISO 5524:1977) together with ISO 6821:1981, of which it constitutes a minor revision.

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Introduction

This International Standard gives general recommendations for the cold storage and refrigerated transport of tomatoes. These recommendations may need to be modified to suit particular cultivars of tomato, local climatic conditions, cultivation practices, market requirements and distances of transportation, etc. Experts will be able to establish those recommendations most appropriate for particular market requirements and ecological and agrotechnical factors. In addition, the quality of the harvest and the storage conditions attainable in particular transport vehicles and cold stores may necessitate modifications to these recommendations.

Subject to local conditions and the fact that tomatoes are living matter, the application of the recommendations made in this International Standard should enable much wastage during refrigerated transport and cold storage to be avoided.

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Tomatoes — Guide to cold storage and refrigerated transport

1 Scope

This International Standard gives guidance on the operations to be carried out before and the conditions to be met during the cold storage and refrigerated transport of tomatoes [*Lycopersicon lycopersicum* (L.) Karsten ex Farw., syn. *Lycopersicon esculentum* Miller nom. cons., syn. *Solanum lycopersicum* L.], for maintaining quality and avoiding deterioration.

These recommendations are not applicable to tomatoes intended for industrial processing.

2 Preparation of tomatoes intended for refrigerated transport and cold storage

2.1 Harvesting

Tomatoes should be harvested in dry weather. Their ripeness at harvest, which is identified by the colour of the tomatoes (see table 1), should be appropriate for the intended duration and conditions of transport, the intended use of the tomatoes and the required duration of storage.

The colour of tomatoes is thus the most important criterion for establishing the harvesting time. The destination and the time at which the fruits will be presented on the market should also be taken into consideration.

Tomatoes should be conditioned, packed and dispatched or stored as soon as possible after harvesting, with a delay not exceeding 12 h.

2.2 Quality

Tomatoes intended for transport or a short period of storage should comply with technical quality standards and specifications established for inland markets or food exportation in the country concerned.

Tomatoes should be conditioned carefully and size graded. They should be sound and clean, have a firmness characteristic of their degree of maturity and be free from excessive surface moisture.

The presence of the peduncle is optional; it depends on the destination of the fruits and does not constitute a condition necessary for successful transport or cold storage. It is important to ensure that the degree of ripeness of a lot of tomatoes is as uniform as possible and therefore the range in colour should not exceed two adjacent degrees on the colour chart (see table 1).

2.3 Packing

Tomatoes intended for cold storage and refrigerated transport may be packed in various types of packages (for example, wooden, fibreboard or plastic materials), provided that the pressure exerted on the fruits does not lead to a reduction in quality during transport or storage. It is considered that for both transport and storage, the total depth of tomatoes packed in layers should not exceed 20 cm.

Good air circulation around and through the packages should also be provided.

2.4 Pre-cooling

If the tomatoes are to be kept under refrigeration until they are marketed, they should be pre-cooled.

After the tomatoes have been harvested, conditioned and packed, they should be pre-cooled to a temperature that differs by no more than 2 °C from the optimum transport or storage temperature.

To avoid water vapour condensation on the product, pre-cooling of the transport vehicle is also recommended.

3 Loading into refrigerated vehicles or cold stores

Tomatoes should be loaded into the transport vehicle or into the cold store as soon as possible, but not later than 24 h, after harvesting.

The quality of the tomatoes is markedly impaired if the temperature of the fruit rises to above 25 °C for even a few hours.

If the optimum temperature range shown in table 1 and in table 2 cannot be maintained, the temperature should be between 6 °C and 25 °C, but the tomatoes should not be held at a temperature outside the optimum range for more than 12 h.

It is recommended that any one transport vehicle or cell is filled with tomatoes of the same degree of ripeness and the same grade and size.

Packs containing tomatoes shall be handled carefully.

If mechanized loading/unloading operations are used in the store, it is recommended that the packs are palletized and secured. When the packs are put into store, it is important to allow for good air circulation.

4 Optimum conditions during refrigerated transport and cold storage[1)]

4.1 Temperature

The optimum temperature to be used during the refrigerated transport and cold storage of tomatoes depends on the degree of ripeness of the tomatoes, the intended duration of transport and storage, and the conditions of distribution. In general, the riper the tomato, the lower the storage temperature it can withstand.

Table 1 specifies recommended storage temperatures as a function of the degree of ripeness of the tomatoes.

Table 1 — Optimum storage temperature in terms of ripeness

Degree of ripeness[1)]	Temperature °C
1	12 to 13
2	10 to 12
3	9 to 10
4	8 to 10
5	6 to 8

1) 1, turning; 2, light pink; 3, pink to light orange; 4, orange to light red; 5, red.

Table 2 specifies recommended temperatures in transport vehicles as a function of the degree of ripeness of the tomatoes and the duration of transport.

If it is necessary to complete the ripening of the tomatoes before distribution, it is recommended that they be kept at a temperature of at least 18 °C but not more than 25 °C for at least 12 h.[1)]

Table 2 — Optimum temperature in transport vehicles in terms of ripeness and duration of transport

Degree of ripeness[1)] at loading	Duration of transport: 2 days to 3 days		4 days to 6 days	
	Temperature during transportation °C	Degree of ripeness[1)] after transportation	Temperature during transportation °C	Degree of ripeness[1)] after transportation
1	12 to 14	4	12 to 14	5
2	12 to 14	4	12 to 14	5
3	10 to 12	5	10 to 12	5
4	8 to 10	5	6 to 8 8 to 10	5 5
5	8 to 10	5	6 to 8 8 to 10	5 5

1) See table 1.

1) See also ISO 3659:1977, *Fruits and vegetables — Ripening after cold storage.*

4.2 Relative humidity of air

The relative humidity of the air should be maintained constant at (90 ± 3) %.

4.3 Circulation of air

The air circulation in transport vehicles and in cold stores should be such that the appropriate temperature and relative humidity are maintained constant and uniform.

4.4 Duration of storage in cold stores

The maintenance of the quality of tomatoes stored under the conditions of temperature and relative humidity specified varies as a function of the ripeness of the fruits, the storage temperature, the vehicle used for transportation and the cultivar.

Tomatoes are able to maintain their quality under the conditions specified for a period of 7 days to 21 days.

5 Operations to be carried out during storage, at the end of storage and in transport vehicles

During storage, regular quality control of the stored tomatoes is recommended. At the end of a period of storage or transport, the tomatoes should be pre-warmed to avoid condensation of water vapour on the surface of the fruits.

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