INTERNATIONAL STANDARD

ISO 1134

Second edition
1993-10-15

Pears — Cold storage

Poires — Entreposage réfrigéré

Reference number
ISO 1134:1993(E)

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 1134 was prepared by Technical Committee ISO/TC 34, *Agricultural food products*, Sub-Committee SC 14, *Fresh fruits and vegetables*.

This second edition cancels and replaces the first edition (ISO 1134:1980), which has been technically revised.

Annexes A and B of this International Standard are for information only.

International Organization for Standardization
Case Postale 56 • CH-1211 Genève 20 • Switzerland
Printed in Switzerland

Introduction

This International Standard provides guidance of a very general nature only. Because of the variability of the fruit according to the time and place of cultivation, local circumstances may make it necessary to specify other conditions of harvesting or other physical conditions in the store.

This International Standard does not apply unreservedly, therefore, to all varieties in all climates, and each specialist will decide on any modifications to be made.

Moreover, it does not take into account the role played by horticultural factors, and wastage during storage is not dealt with. The importance of these two subjects has not been forgotten, but the influential factors (i.e. ecological or agrotechnical factors) are not very well known; moreover, the origin of many of the most frequent physiological disorders of pears is still uncertain, as are often the appropriate means of combating them. It was therefore considered difficult to prepare recommendations on these two points.

Nevertheless, it was considered useful to give, in annex B, a few recommendations which appear sufficiently well founded in the present state of knowledge.

Subject to all possible restrictions arising from the fact that fruits are living material and may vary considerably, the application of the guidance contained in this International Standard should enable much wastage in cold storage to be avoided and long-term storage to be achieved in most cases.

This page intentionally left blank

Pears — Cold storage

1 Scope

This International Standard gives guidance on conditions for the successful cold storage of varieties of pears (*Pyrus communis* Linnaeus) up to their use in the fresh state.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 2169:1981, *Fruits and vegetables — Physical conditions in cold stores — Definitions and measurement.*

AGRI/WP.1/EUR.STAN.1, *Apples and pears.*[1)]

3 Conditions for harvesting and storage

3.1 Harvesting

The practical criteria of ripeness most frequently used for defining the best time for harvesting[2)] are the following.

a) Basic colour of the outer skin:[3)] judged with the aid of a standard table.

b) Firmness of the flesh: estimated by means of a spring penetrometer.

c) The total soluble solids content of the fruit, which should be at least 10 % at harvest: determined by a refractometer.

d) Ease of separation.

e) Presence of starch in the flesh of the fruits: checked by treating a cross-section of the fruit with an iodine/potassium iodide solution.

The values obtained from these criteria are not universally valid; for a given variety they vary from one region to another and it is for the grower to decide on his own criteria for picking, on the basis of experience.

Determination of the optimum harvest time is more important for early varieties (for example, Coscia) than for late varieties.

The fixing of the time of harvesting has greater importance for controlled-atmosphere storage than for storage in air.

3.2 Characteristics for storage

Fruit put into store should be of quality "extra" and "I", the characteristics of which are defined in AGRI/WP.1/EUR.STAN.1.

Fruit put into cold store should be sound, free from bruises or physiological disorders, and free from any visible sign of fungal or bacterial attack. It should be clean and free from any trace of water in the liquid state.

1) Revised European Standard, recommended by the Working Party on Standardization of Perishable Produce and Quality Development of the Economic Commission for Europe.

2) The number of days after flowering is also used sometimes as a criterion for harvesting.

3) The basic colour should be distinguished from the red anthocyanin pigmentation, the intensity and extent of which vary according to the variety and, to some extent, with exposure to sunlight.

3.3 Putting into store

The fruit should be put into the cold store as soon as possible after harvesting, the temperature being lowered to a value suitable for the variety.

Rapid removal of field heat and precooling of harvested pears are essential for long storage.

3.4 Method of storage

The fruit should be handled with care. The packages should allow free circulation of air. Storage densities of about 250 kg per cubic metre of usable space are recommended for a stack of pallets.

The use of box pallets provides an increase of 10 % to 20 % in storage density.

4 Optimum storage conditions

4.1 Temperature

The pears should be kept at as low a temperature as possible, subject only to avoiding the risk of freezing. In general, the best results are obtained at – 1 °C to + 0,5 °C.

A difference of 1 °C in storage temperature has a profound effect on the time for which the pears can be kept. It has been shown that, during cold storage, the freezing-point of the fruit falls slightly; it is on this account that, for Williams' Bon Chrétien pears, it has been possible to recommend a method of storage based on progressive lowering of the temperature (0 °C; – 0,3 °C; – 0,8 °C; – 1,5 °C). This procedure has enabled the storage life to be appreciably prolonged, but it is difficult to carry out since it is not possible to maintain a large bulk of fruit at a sufficiently uniform temperature in a cold store.

The course of development of the fruit during storage depends on the choice of storage temperature. When the temperature of the cold store is low (0 °C to – 1 °C) the change in ripening characteristics of the pears is very slow during cold storage and it is necessary to submit them to a complementary ripening process at a higher temperature when they are removed from the cold store. On the other hand, from a certain temperature (+ 3 °C for Doyenné du Comice pears, + 4 °C for Passe Crassane), ripening is slow but can be completed in storage.

Some varieties ripen completely at higher temperatures only if the storage period at low temperature has not been too long (for example, Comtesse de Paris, Doyenné du Comice, Kaiser, Abbé Fetel, Louise Bonne d'Avranches and Williams' Bon Chrétien).

An accidental rise in storage temperature can initiate ripening, which continues when the fruit is again exposed to the cold.

Table 1 gives the storage temperature and duration recommended for a number of varieties.

4.2 Relative humidity

Pears may generally be stored at a relative humidity of between 90 % and 95 %.

4.3 Air circulation

An air circulation ratio of 20 to 30 (see ISO 2169) or ventilation of 80 m^3/h to 100 m^3/h per tonne of fruit is recommended.

4.4 Storage life

Table 1 gives the expected storage life under the conditions mentioned above, for a number of varieties. Storage should not be prolonged beyond limits compatible with the maintenance of good quality.

Samples of fruit should be taken in such a way as to detect the appearance of any wastage.

4.5 Operations at the end of storage

The recommended ripening temperature for pears after storage is 15 °C to 18 °C.

The ripening may be accelerated by ethylene treatment. The gas is generally used at concentrations of 1 % to 2 %, the treatment being carried out at a temperature of + 18 °C and at approximately 90 % relative humidity.

Table 1 gives the varieties which should undergo a complementary ripening after cold storage.

5 Adjuncts and other keeping processes

5.1 Controlled-atmosphere storage

The following gas mixtures are most frequently recommended:

carbon dioxide	1,0 % to 3,0 %
oxygen	2,0 % to 5,0 %

These compositions are given only as a guide, and it is for the experts in each country to give any necessary advice on other kinds of compositions according to the particular requirements of each variety, as regards the content of carbon dioxide or of oxygen in the atmosphere or on account of particular local conditions. Annex A gives an example of this.

It should be noted that the storage disorders called "brown heart" and "hard heart" result from the presence of an excess of carbon dioxide (above 5 %) in the atmosphere. It is necessary to avoid the use of mixtures with a high carbon dioxide content for storing varieties known to be susceptible to these disorders (for example, Doyenné du Comice, Beurré Bosc, Williams' Bon Chrétien).

Table 2 summarizes, for certain varieties, the gas mixtures which have given the best results, and also the recommended temperature and the expected storage life.

5.2 Storage in plastic packages

The use of certain types of plastic film which are known to be suitable for contact with food products permits losses in mass during storage to be reduced considerably and, in certain cases, the storage life in the cold is prolonged. Plastic films should be perforated with small holes to prevent a build-up of CO_2. The level of CO_2 should not be above 3 % within the liners, or core and flesh browning may develop. Film liners will extend the storage life of several cultivars of pears by 4 to 8 weeks.

Table 1 — Storage in air

Variety	Recommended temperature °C	Expected storage life (weeks)	General remarks
Docteur Guyot	0 to + 1	3 to 4	Complementary ripening necessary
Williams' Bon Chrétien	– 1 to 0	9 to 11	Complementary ripening necessary Susceptible to scald Ripens between + 10 °C and + 24 °C only
Beurré Bosc	– 1	14 to 28	Susceptible to brown heart
Beurré Clairgeau	– 1 to – 0,5	18 to 20	Complementary ripening necessary Susceptible to scald Susceptible to brown heart
Beurré Diel	0 to + 1	8 to 12	
Curé	0 to + 1	16 to 20	5 months maximum
Louise Bonne d'Avranches	0 to + 1	6	Tendency to shrivelling
	– 1 to 0	0 to 12	
Doyenné du Comice	– 1 to 0	8 to 12	Complementary ripening necessary Does not ripen further after 2 1/2 months at + 1 °C In certain areas, does not ripen normally after 2 to 3 months at 0 °C
	+ 2 to + 3	6	Ripens at this temperature Susceptible to scald
Épine du Mas	0 to + 1	12 to 16	
Beurré Hardy	0	12 to 20	Complementary ripening necessary
Passe Crassane	0	20 to 22	Does not ripen normally in some areas unless previously stored in cold conditions (11 weeks at 0 °C)
	– 4	about 17	
Comtesse de Paris	0	20 to 22	Does not ripen normally after too prolonged storage in the cold
Packham	+ 2 to + 3	8	Susceptible to warming
	– 1 to 0	18 to 20	
Conference	0 to + 1	24 to 28	Susceptible to warming
Comtesse de Charnoux	– 0,5	8 to 20	Complementary ripening necessary
Abbé Fetel	0	10 to 12	Does not ripen normally after 3 months of storage
Ankara	0	20	Complementary ripening necessary Bitterness occurs after too prolonged storage in the cold
Rocha	– 0,5 to 0	28 to 32	

Table 2 — Controlled-atmosphere storage

Variety	Temperature °C	Recommended mixtures		Reference	Expected storage life weeks
		Carbon dioxide %	Oxygen %		
Williams' Bon Chrétien[1]	0	4	2	France	24
	– 1 to 0	4,5	3	Italy, Germany	16 to 20
	– 1	2 to 3	2 to 3	Australia	
	– 0,6 to – 1	0,8 to 1,0	2,5 to 3,0	USA	
	0	2	2	Switzerland	
Beurré Bosc	– 1	2 to 3	2 to 3	Australia	22
		0,6 to 1,0	2,5 to 3,0	USA	
Packham	0	5	16	Australia	
Rocha[2]				Portugal	
Doyenné du Comice	0	5	3	Italy	Not very satisfactory
		2	2	Switzerland	
	– 0,6 to – 1	1	2	USA	
	– 0,6 to 0	2	16	Netherlands	
	0	5	2 to 3	United Kingdom	
Passe Crassane	5	5	5	France	28 to 32
	0	5	3	Italy	

NOTE — Data taken from Ryall L.A. and Pentzer W.T. *Handling, Transportation and Storage of Fruits and Vegetables.* Vol. 2, *Fruits and Tree Nuts.* Westport, Connecticut: AVI Co., 2nd edn., 1982.

1) The controlled-atmosphere storage of Williams pears is delicately balanced, as it entails the need to harvest fruit intended for this kind of cold storage at exactly the right time.

In some countries, such as the United Kingdom, controlled-atmosphere storage is no longer recommended for this variety.

2) Transportation is not in a controlled atmosphere.

Annex A
(informative)

Example of storage conditions for varieties of pears

See table A.1.

Table A.1 — Storage conditions in a controlled atmosphere

Cultivar	Temperature °C	Relative humidity %	Mixture		Storage life months
			CO_2 %	O_2 %	
Abbé Fetel	– 1 to 0	90	7 to 8	0 to 1	4 to 5
Asian pear	– 1 to 0	90	1 to 4	3 to 5	3 to 4
Anjou	– 0,5 to 0	92	1 to 2	0,5 to 2	6 to 7
Conference (yellow)[1)]	– 1 to – 0,5	95	6 to 7	1 to 1,5	6 to 7
Conference (green)	– 1,5 to – 0,5	95	2 to 3	1 to 1,5	7 to 8
Doyenné du Comice	– 1 to – 0,5	95	3 to 4	3 to 4	4 to 6
Doyenné d'hiver	– 1 to – 0,5	90	3	3 to 4	6 to 7
Général Leclerc	– 0,5 to 0	92	2 to 3	2 to 3	4 to 5
Hardy	– 1 to 0	95	3 to 4	3 to 5	3 to 5
Kaiser or Bosc	– 1 to – 0,5	95	4 to 5	1 to 1,5	5 to 6
Louise Bonne d'Avranches	– 0,5 to 0	90	2 to 3	2 to 3	4 to 5
Max Red Bartlett	– 1 to – 0,5	90	2 to 3	3 to 4	3 to 4
Packham's Triumph	– 1 to 0	90	2 to 3	3 to 5	5 to 7
Passe Crassane (green)	– 1,5 to – 0,5	95	3 to 4	4 to 5	6 to 7
Passe Crassane (yellow)	5 to 0	92	3 to 5	7 to 8	5 to 6
Pierre Corneille	– 1 to 0	90	2	4	3 to 4
Spodona	– 1 to 0	90	2,5	5	4 to 5
William or Bartlett	– 1 to – 0,5	90	3	4 to 5	4 to 5

1) Remove ethylene.

Annex B
(informative)

Role of the grower and wastage during storage

NOTE 1 The following recommendations on the role of the grower and on wastage during storage are, as in the main text, of a very general nature. It therefore rests with specialists to amplify them, if necessary, in a manner appropriate to their national varieties.

B.1 Role of the grower (Influence of ecology and method of cultivation)

The generally unfavourable influence of certain ecological and agrotechnical factors is now better known.

Under these conditions, and since it is also necessary to supply the market from the first weeks after harvesting, it is desirable not to put into cold storage at all (or to put in storage only for a short period) fruit of which the unfavourable ecological background is liable to make good keeping a matter of delicate balance. This applies especially to

— fruit of large size;

— fruit from young trees;

— fruit from trees which are lightly loaded or closely pruned;

— fruit from trees which have been too heavily manured or treated with unbalanced fertilizer, particularly if the nitrogen content is too high;

— fruit harvested during a rainy period.

It should also be pointed out that after a cold, damp summer, keeping is delicately balanced, and finally that irrigation should be carried out with care and that any excess is detrimental to keeping.

B.2 Wastage in storage

In general, a distinction is made between post-harvest disease and physiological disorders.

B.2.1 Post-harvest disease

Post-harvest diseases originating from different pathogens (fungus, bacteria, etc.) are very numerous. There are hardly any means of combating these, other than protective precautions concerned with:

— care in all handling operations;

— sorting of sound from unsound fruit immediately before putting them into cold storage;

— preliminary disinfection of the cold store and packages;

— frequent disinfection of packing houses;

— systematic removal of sources of contamination in the orchard (cankers, rotten fruit, etc.);

— use of packages impregnated with antiseptics, if not prohibited.

The use of fungicidal aerosols has been recommended. Some countries have, however, prohibited these.

B.2.2 Physiological disorders

Table B.1 classifies the most important data relating to the most frequent disorders.

The data are very general and may not apply to particular local conditions.

Specialists may amplify the table by investigations, in particular, of withering and of brown heart.

Table B.1 — Physiological disorders

Designation and description of the change	**Horticultural factors** (ecology, date of harvesting) **and factors relating to conditions in the cold store provoking or revealing the disorder**	**Remedies and/or preventive measures**	**Susceptible varieties**
Frost Glassy appearance of the flesh and epidermis, general softening	Lowering of temperature below the freezing point	Prevent the lowering of temperature	All varieties
Brown heart (brown core) Dark brown zone around the core. Fissures appear later	Late harvesting Delay in putting into cold storage Excessive concentration of carbon dioxide	Avoid high levels of carbon dioxide	Beurré Bosc Beurré Clairgeau Williams' Bon Chrétien
Senescent breakdown The flesh becomes brown, more or less dark; it is dry and mealy	Late harvesting Delay in putting into cold storage Large fruit and fruit from poor harvest Too long duration of storage Slow cooling High storage temperature	Storage should not be continued when the risks of internal browning are considerable	Passe Crassane Clapp's Favorite Williams' Bon Chrétien
Scald Browning of epidermis, over whole area in bad cases (superficial scald) Browning of epidermis and flesh Located around the peduncle (Anjou scald)	Premature harvesting Large fruit Insufficient ventilation	Thorough and frequent ventilation of the cold store Use of controlled atmosphere The following may also be mentioned: use of chemical products and oiled paper	Williams' Bon Chrétien[1)] Beurré Clairgeau Doyenné du Comice Packham Curé Beurré Hardenport

1) Scald on Williams' Bon Chrétien pears is not of the same kind as that found on apples or on other varieties of pear, and the protective precautions suggested are therefore not suitable for the Williams variety and for certain other varieties of pear.

UDC 634.13:664.8.037(083.13)

Descriptors: agricultural products, plant products, fruits, pears, food storage, cold storage, general conditions.

Price based on 8 pages