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Potatoes — Storage in the open (in clamps)

Pommes de terre — Entreposage en plein air (en prismes)

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FOREWORD

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Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 5525 was developed by Technical Committee ISO/TC 34, *Agricultural food products*, and was circulated to the member bodies in May 1977.

It has been approved by the member bodies of the following countries :

| | | |
|---------------------|-------------|-----------------------|
| Austria | Israel | Romania |
| Czechoslovakia | Mexico | South Africa, Rep. of |
| Egypt, Arab Rep. of | Netherlands | Spain |
| Ethiopia | New Zealand | Turkey |
| Hungary | Philippines | U.S.S.R. |
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The member body of the following country expressed disapproval of the document on technical grounds :

U.S.A.

Potatoes – Storage in the open (in clamps)

0 INTRODUCTION

Storage of potatoes with or without artificial cooling is dealt with in ISO 2165, *Ware potatoes – Guide to storage*. However, in some countries, most potatoes are commonly stored in clamps (temporary silos) constructed outdoors. In these countries, the technology of storage depends largely on local conditions, but simple methods are in widespread use. It has therefore been found necessary to make these methods the subject of an International Standard.

1 SCOPE AND FIELD OF APPLICATION

This International Standard lays down guidelines relating to the technique of storing potatoes outdoors in clamps, to allow a quality suitable for consumption to be maintained.

These guidelines apply only in regions with temperate climates.

2 CONDITIONS OF HARVESTING AND PUTTING INTO STORE

2.1 Varieties

The methods of storage outlined refer equally to all varieties of potatoes the keeping of which is of economic interest. Differences due to the weather, soil conditions and other environmental factors in various countries and growing areas are considerably greater than differences in varieties.

2.2 Harvesting

Potatoes intended for storage shall be harvested when fully mature, which is generally shown by the fact that the skin cannot be rubbed off by hand, even near the ends.

In the course of digging up and gathering, especially if the latter is carried out by mechanical means, great care shall be taken to prevent damage. This is particularly important to avoid storage losses.

2.3 Quality of potatoes for storage

The potatoes to be stored shall be in perfect condition, free from tubers damaged by disease. They shall be relatively free from adhering soil. If notable quantities of soil are

present, the potatoes shall be subjected to pre-cleaning or shall be stored apart from cleaner ones. Potatoes which have been exposed to rain shall be dried and marketed as quickly as possible, as they are likely to suffer rapid deterioration if stored.

Tubers of smaller size than that specified in standards shall be separated from the potatoes to be stored, even if they are healthy.

2.4 Various treatments

Chemicals may be applied in order to prevent sprouting, in compliance with the directions in force in certain countries.

2.5 Putting into store

Mature potatoes of suitable quality shall be put into store as soon as possible after harvesting and then disturbed as little as possible.

The potatoes should be placed in the clamp with the utmost care in order to avoid damage to the tubers.

Hydraulic tipping trailers should be used for the clamp face, the wheels being blocked in order to prevent their running into the clamp face. The trailers should be tipped slowly to allow the tubers to roll as gently as possible into the clamp. The potatoes should be arranged using a blunt-edged fork equipped either with buttons on the ends of the prongs or with a bar welded across the prongs in order to prevent spearing of the tubers. The use of mechanical lifts should be avoided whenever possible, but, if necessary, a bucket elevator using buckets with blunt edges instead of tines may be used.

Potatoes put into store immediately after harvesting respire at an advanced rate and, in consequence, show a rise in temperature. This process should not be prevented since it accelerates the healing of wounds, etc.

2.6 Siting and shape of clamps

The clamps shall be situated on a water-free site, preferably in a position sheltered on the side from which the most severe weather is to be expected, and also near to a road. The clamps shall extend, preferably, in a north-south direction so that the sun may prevent frost from persisting too long in the walls and possibly reaching the potatoes. The clamp site should be reasonably level and clean.

The width of the clamp shall be maximum 200 cm, and the height 100 cm. Water removal shall be ensured by suitable drainage.

The triangular section of the clamp may be formed by using a template of boards. Alternatively, a more frequently practised method is to mark the clamp base width with pegs in order to maintain a constant width. By this means the height of the clamp as well as its shape will remain constant.

The distance between clamps (without covering) shall be at least 5 or 6 m along the longitudinal sides, and a free space of 3 m shall be left between the ends of the clamps.

3 OPTIMUM STORAGE CONDITIONS

The values of temperature, relative humidity and ventilation of potato clamps built in the open cannot be determined precisely as these parameters are difficult to control and depend on the prevailing atmospheric conditions. Therefore, this International Standard specifies the operations required for their determination.

3.1 Covering for autumn

The completed potato clamp shall be immediately covered with a loose layer of dry, clean straw 60 to 100 cm thick depending on climatic conditions. This corresponds to a compressed straw layer 12 to 20 cm thick on which, if the tubers are not wet, a layer of earth 5 to 10 cm thick shall be placed; the straw shall be completely covered except for a strip 30 to 40 cm wide along the ridge of the clamp which must be protected against soaking by a separate layer of straw. The earth should be applied from the foot of the clamp. If this is done manually, an effect similar to the tiling of a house should be aimed at. However, if the work is done by mechanical means, special care must be taken to avoid an excessively wide layer of earth at the bottom of the clamp. It is advisable that someone be on hand with a spade to assist when a mechanical shovel is used. If the straw has been exposed to an unusual amount of rain, it should be replaced with a fresh layer of dry straw. This, however, can be avoided by putting the thin layer of earth mentioned above on to the straw immediately after clamping, thus providing sufficient protection from the rain, as well as enabling the temperature of the potatoes to reach the desired level and facilitating healing of wounds.

3.2 Covering for winter

Cooling of the potatoes should be assisted by ventilation. Before covering the clamp with earth, tubers which have begun to rot should, as far as possible, be removed. The earth used for covering may be taken by digging a trench at a distance of at least 160 cm from the edge of the clamp.

To specify temperatures is somewhat misleading, as local conditions and soil types determine definitively how potatoes are protected from the winter climate. The winter coat of earth must be applied to the potatoes as soon as their temperature has fallen to about 6 °C. The earth used for this purpose shall be dry and free from stones and

pebbles. The thickness of this second coat shall be at least 25 cm. Any thickness above this value will depend largely on local conditions and soil types; for example, at this thickness, soils of a peaty nature are able to protect better against frost than can a heavier type of soil with poorer insulating properties. If there is no evidence of advanced decay, it is inexpedient to remove the first coat with a view to extracting decayed tubers as any disturbance of the clamp is likely to reduce its preserving characteristics. The apex of the clamp may be covered either with earth or with a layer of good quality straw compressed by tamping down with a spade. This will be sufficient to keep the potatoes dry, free from the effects of temperature, and still enable them to respire. With the "Dickie Pie" type of clamp, where no earth cover is applied, alternate layers of straw bales and loose straw should be applied, the final outer layer being of loose straw.

In the case of a clamp covered with plastic material, the lower part of the clamp covered only with straw should also be covered with plastic sheet or earth when the temperature drops below freezing point. The winter cover should consist of a layer of straw and then one of earth over the plastic sheet. In a milder climate, a cover of two alternate layers of straw and plastic may be sufficient.

3.3 Optimum temperature and its control

During storage, the temperature of the clamp must be checked at least every 10 days. It is necessary to ensure that the interior temperature of the clamp is maintained within the range +1 to +5 °C. Measurement by means of a thermometer shall be carried out on both sides of the clamp, at intervals of 10 m. The thermometer shall be introduced half-way up the clamp side, perpendicularly to the layer of earth, to a depth such that the end of the thermometer reaches the upper layer of potatoes stored in the clamp. The thermometer should be left in the clamp for 15 to 20 min and the temperature obtained noted.

During storage, the clamps should be regularly checked and all gaps and fissures blocked up. In winter, if the outside temperature falls below -20 °C and the clamp has no snow cover, further protective layers of earth are necessary. Further insulating layers can be applied for this purpose using maize stalks, straw covered by tarpaulin etc., followed by an additional layer of earth.

3.4 Relative humidity

The optimum relative humidity is 85 to 90 % for the outdoor storage of potatoes in clamps. Both control and adjustment are difficult.

3.5 Cooling of the clamp

If the temperature of the clamp rises above +6 °C, cooling and ventilation will be required. For this purpose, the cover of earth should be partly or completely stripped off. Cooling is possible only if there is no danger of frost and when the outside temperature is lower than the temperature inside the clamp. Ventilation and cooling are not always efficient.

If the temperature is constantly rising, it may be that decay has set in. In this case the clamp, or the affected part, should be destroyed in an attempt to save the remaining sound tubers. If the trouble is localized, the remainder of the clamp can be closed again. It is not prudent to reclamp disturbed potatoes, as such tubers are rarely stored with success afterwards. Remedial ventilation should be carried out on clamps where the temperature of the potatoes is above 5 °C. The end of dormancy will naturally cause the temperature to rise a little.

If the temperature is at optimum level, the potatoes are best left undisturbed as the earth-straw cover, being an insulating medium, keeps out heat as well as cold.

For minor ventilation and cooling in dry weather, openings of 60 to 70 cm width should be made on both longitudinal faces of the clamp every 3 to 5 m in alternate directions by removing the earth cover from the ridge to the ground level. If there is absolutely no danger of frost, the layers of straw may also be loosened in these openings. During the day, if there is no risk of frost, the clamp can also be cooled to a temperature below freezing point, but not below -2 °C.

If the temperature is lower than +2 °C, the ventilation openings of the clamp should be covered with a layer of straw, maize stalks etc., of thickness 50 to 70 cm. If the temperature falls to -6 °C, the cover of earth must also be restored.

3.6 Sorting and termination of storage

If the temperature remains above +6 °C for long, damage due to rotting should be carefully checked. In the case of advanced damage, sorting of the potatoes should be carried out in dry frost-free weather. Any tuber showing signs of rotting should be destroyed and the sound potatoes taken out of storage. Potato tubers should not be handled when their temperature is low, to avoid internal browning.

Stronger sprouting due to warming up can be reduced by increasing the extent of the cooling. If rotting of the potatoes assumes serious proportions, this sets a limit to the keeping period in clamps and may necessitate ending storage. The clamp should be demolished in this case. At the end of storage, potatoes must be sorted with care in order to produce the quality corresponding to standards.

3.7 Keeping period

Potatoes can be kept for up to 8 months by suitable storage in clamps.

If the potatoes turn sweet during storage, they shall be stored for 8 days at a higher temperature (+10 °C) before being marketed in order to reduce the sugar content.

4 COMPLEMENTARY METHODS OF PRESERVING

Techniques of simple storage of potatoes in the open can be considerably developed by incorporating ventilation equipment and applying chemical agents to inhibit sprouting and prevent rotting. Storage of potatoes in store houses with a controlled ventilation system allows better control of temperature and consequently of sprouting; this method maintains the good quality of potatoes for a long storage period.

Storage in clamps is the simplest storage technique of various advanced techniques such as silos with or without ventilation and various storage places without artificial cooling but allowing cold storage.

Owing to the great quantities of potatoes that have to be stored, the undemanding nature of the product and the possibilities afforded by the use of chemical inhibitors, up-to-date methods of storage in clamps offer an economic efficiency similar to that of more advanced techniques.

ANNEX

TYPES OF CLAMPS (TEMPORARY SILOS) FOR POTATO STORAGE

Four types of clamping are commonly practised :

- 1) The triangular cross-section type – the traditional clamp.
- 2) The triangular cross-section type sunk into the ground to a depth of 20 cm.
- 3) The clamp with outer walls made of straw bales, to a height of either one or two bales.
- 4) A type of clamp similar to that described in 3), but more complex and far more elaborate. It may have walls three or four bales high and thick. The covering of the potatoes is entirely of straw and, possibly, of polyethylene sheet or kraft paper, with a thickness of up to 2 m. Ventilation shafts are often incorporated along the length of these clamps.

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