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Frozen Food Legislation

by
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INTRODUCTION

When the production of frozen foods began to rise in Europe in the 1950s and 1960s, authorities (and consumers) in several countries were somewhat uncertain and anxious about this relatively new type of food. There seemed to be a need for detailed requirements on production, handling and distribution of such products, but the anxiety is unjustified, as there is no microbial growth in foods with a temperature of about -8°C or colder. For thawed foods, the risk is the same as for the equivalent unfrozen foods.

This paper will concentrate on EU legislation on the temperature of frozen foods, but the existing guidelines in the US and Australia will be mentioned. Legislation on hygiene, environmental issues, working conditions, labelling, HACCP, packaging, etc. of frozen foods is the same for food production in general.

I. DEFINITIONS: FROZEN FOODS – QUICK-FROZEN FOODS

When the term 'frozen foods' is used, it very often means or includes quick-frozen foods: see for example the title of this paper.

In legislation and according to the ATP Agreement,[1] frozen foods and quick-frozen foods are two different types of products.

EU Directive 89/108[2] *applies to* quick-frozen foodstuffs that are intended for supply to the ultimate consumer and to restaurants, canteens, etc. (Article 8). *For the purposes of this Directive*, ice cream and other edible ices are not regarded as quick-frozen foods (Article 1).

The temperature of quick-frozen foods must be stable and maintained at -18°C or colder at all points (Article 5). Quick-frozen foods must be labelled with one or more of the following: 'quick-frozen' (English), 'dybfrossen' (Danish), 'surgelé' (French), 'tiefgefroren' or 'Tiefkühlkost' or 'tiefgekühlt' or 'gefrostet' (German), 'surgelato (Italian), etc. (Article 8).

Thus, the Quick-Frozen Food (QFF) Directive only applies to foodstuffs labelled 'quick-frozen' (or similar in other languages), and the definition of a quick-frozen food is that its temperature is -18°C or colder and has 'quick-frozen' printed on it.

It seems that the designation 'deep frozen' would have been more appropriate than 'quick-frozen'.

Frozen foods

The temperature of frozen foods must be -12°C or colder, and this temperature must be maintained. In several countries, e.g. Denmark, frozen foods must not be sold in supermarkets etc. *In other countries,* frozen foods can be sold to the ultimate consumer, provided they are labelled 'frozen' (English), 'congelé' (French), 'gefroren' (German), etc.

As a matter of fact, the definition of frozen foods is not quite clear. The temperature of some meat products is sometimes reduced to about -5°C in order to facilitate or improve the slicing process. The sliced product is sold as a chilled product, and it has been discussed whether such meat has been frozen and should be labelled as such.

In Australia the terms quick-frozen foods and frozen foods are used synonymously.

II. RAW MATERIALS AND PREPARATION BEFORE FREEZING

The QFF Directive (Directive 89/108): raw materials used in the manufacture of quick-frozen foodstuffs must be of sound, genuine and merchantable quality and be of the required degree of freshness (Article 3). This sentence is of little practical importance, except that it does stress that products close to being of unacceptable quality, i.e. close to the end of their shelf life, should not be frozen.

On the other hand, with the number of different food products that are frozen, it is understandable that the legislation in this area is limited.

Article 3, paragraph 2 of the QFF Directive requires preparation and quick-freezing to be carried out promptly, using appropriate technical equipment. This should limit chemical, biochemical and microbiological changes to a minimum.

This paragraph contains little information for producers of frozen foods. In most cases, the freezing process should be initiated immediately after preparation (without undue delay). However, for some foods (beef, turkey, etc.) the quality, e.g. texture, could be improved by ageing before freezing.

III. THE FREEZING PROCESS

The QFF Directive includes a vague statement: during 'quick-freezing', the zone of maximum crystallization should be passed as quickly as possible (Article 1). This implies that liquid nitrogen freezing must always be used, as this is the fastest freezing method.

In practice, any moving air system is deemed to produce the required freezing rate.[3] The QFF Directive contains no information about freezing time or freezing rate, and it would also be very difficult to prescribe a maximum freezing time and/or a minimum freezing rate for different

foodstuffs. One of the difficulties is that there is no generally approved definition of freezing time or of freezing rate.

More details may be found in national legislation. *According to a Danish Government notice,*[4] freezing of fish and fishery products must be started as soon as possible after preparation or arrival to the plant. Until freezing starts, the products must be kept properly chilled. The freezing process must be done in air-blast freezers, or in other freezers approved by the competent authorities. Air-blast freezers must be easy to clean and the air circulation rate around and between the products must be at least 5 m/s. The products must be stacked so that an even distribution of the circulating air is achieved. It is required that the temperature of the circulating air must be -18°C or colder when the freezing process is stopped.

Requirements on maximum freezing time or minimum freezing rate have been laid down in some countries (see Section IV).

In Denmark, it was required that retail packages of meat must be frozen before being placed in transport packages. However, retail packages of meat could be placed in a transport carton before freezing, if the total weight of the carton did not exceed 20 kg, and the freezing was completed within 12 hours. This rule no longer exists.

The US Code of Practice[5] *states that* with most products the temperature range for maximum crystallization should be passed quickly.

IV. FREEZING – END TEMPERATURE

Directive 89/108 requires that after quick-freezing the product temperature must be -18°C or colder after thermal stabilization. This is useful wording,[6] as it means that the freezing process can be stopped before the core temperature is -18°C. It is sometimes recommended that for practical purposes the freezing process can be stopped when the core temperature is -10°C or colder. For most products, this would mean that the average temperature is the same or colder than the stipulated storage temperature.

The freezing process can be considered ended when all points in the food are -18°C or colder. The length of this stabilization period depends on the type of food (thermal conductivity), how it is packaged, and how the temperature distribution in the food is at the beginning of stabilization. Therefore, the IIR[7] recommends that batches undergoing temperature stabilization should be marked to keep them from being dispatched too early.

In some countries, there has been legislation requiring that a core temperature of -18°C must be reached in less than 1 hour for small pieces (steaks), 2 to 6 hours for medium sized pieces, e.g. poultry and roasts, and 24 hours for large packs, e.g. cartons with boned meat.

V. STORAGE TEMPERATURE AND STORAGE ROOMS

As mentioned above, frozen foods must be stored at -12°C or colder, quick-frozen foods at -18°C or colder. Some frozen foods, e.g. beef, broilers, butter, have a fairly long storage life even at -12°C, while foods such as lean fish require storage temperatures around -28°C in order to reduce the quality loss and have a long storage life.

In the US, *-18°C or colder is recommended, adding that some products, e.g. ice cream and frozen snacks require -23°C or colder.*

The EU Directive 92/1[8] requires that *storage facilities must have installed a temperature recording device. Such devices must with suitable intervals record the air temperature around the foodstuffs. The temperature recordings must be dated and stored for at least a year.*

A Danish Government notice[4] requires that walls, floor, and roof of storage rooms for frozen fishery products must be insulated, with a K-value of 0.16 W/m^2 or less, and with a water vapour barrier. The refrigerating capacity must be sufficient to obtain a maximum difference between evaporator temperature and room temperature of 7°C.

VI. TRANSPORT

International transport

The Agreement on International Carriage of Perishable Foodstuffs (ATP) has been ratified by about 30 countries, mainly in Europe, but also by Russia, the US, etc. In refrigerated transport between countries having ratified the ATP (Contracting Parties) special equipment must be used (Articles 3 and 4). This equipment must be inspected and tested for compliance with the standards in annex 1, Appendices 1, 2, 3 and 4. Each Contracting Party shall recognize the validity of certificates of compliance issued in conformity with Annex 1 by the competent authority of another Contracting Party (Article 2).

In ATP, Annex 2, it is stated: for the carriage of frozen and quick-frozen foodstuffs, the transport equipment has to be selected and used in such a way that during carriage the highest temperature of the foodstuff in any point of the load does not exceed:

- Ice cream: -20°C
- Quick-frozen foods, frozen fish, etc.: -18°C
- All frozen foodstuffs (except butter): -12°C
- Butter: -10°C.

Transport within the EU

The QFF Directive requires that *the temperature of quick-frozen foods must be maintained at -18°C or colder at all points in the product, with possibly brief upward fluctuations of no more than 3°C during transport (Article 5).*

Directive 92/1 requires that transport equipment must have installed an appropriate temperature recording device. Such devices must with suitable intervals record the air temperature surrounding the foodstuffs. The device must be approved by the authorities in the Member State where the vehicle is registered. The temperature recordings must be dated and stored for at least a year by the responsible person. It is not obvious who this responsible person should be.

In the ATP Agreement context, the temperature recordings must be stored by the operator.

The ATP Agreement includes requirements on the technical properties of transport equipment.

No such rules exist in most EU countries, where transport/distribution of perishable foods can (and do) take place in unsuitable equipment, e.g. too little insulation, refrigeration machinery with insufficient cooling capacity, etc.

In France,[9] however, *ATP-certified equipment must be used for the transport of chilled, frozen*

and quick-frozen foodstuffs. For different groups of foods it is prescribed which of the ATP categories (ATP, Annex 1, Appendix 4) must be used.

In some countries, frozen and chilled foods are distributed in the same insulated vehicle with the frozen food helping to maintain cool temperatures in the chilled foods during hot summer weather.

VII. LOCAL DISTRIBUTION

The QFF Directive, Article 5,2: *Tolerances in the product temperature in accordance with good distribution practice shall be permitted. These tolerances shall not exceed 3°C (i.e. -15°C is permitted).*

Directive 92/1, Article 2: Temperature recording is not mandatory, but a clearly visible thermometer measuring air temperature must be installed.

Definition of local distribution
The difference between transport and local distribution has sometimes been discussed. Local distribution was defined in the UK as 'that part of the distribution chain in which the product is delivered to the point of retail sale (including sale to a catering establishment)'.

In France, the duration of local distribution (a delivery round) is limited to 8 hours.[9]

The US Code of Practice recommends that frozen foods with a temperature warmer than -12°C should be rejected or, if accepted, examined for acceptable quality prior to being offered for sale.

VIII. DISPLAY CABINETS

The QFF Directive, Article 5,2 (b): *tolerances in the product temperature in accordance with good practice are permitted. These tolerances may reach 3°C (i.e. to a product temperature of -15°C) if and to the extent that the Member States so decide. The Member State shall select the temperature in the light of stock or product rotation in the retail trade. The Commission shall be informed of the measures taken.*

In Denmark, a government notice[10] reads: In display cabinets, quick-frozen foods must be maintained at -18°C or colder, except during brief defrosting periods etc. (paragraph 5,2 [3]).

Directive 92/1, Article 2: Temperature recording is not mandatory. The temperature is measured by at least one clearly visible thermometer, which in open (gondola type) cabinets must measure the temperature of the return air at the load-line level. The maximum load line must be clearly marked.

For retail back-up storage rooms less than 10 m^3 temperature recording is not mandatory, and it is allowed to measure the air temperature by means of a clearly visible thermometer.

In the US: Display cases should be capable of maintaining a product temperature of -18°C or colder except during defrost cycles and brief periods of loading. It is recommended that new

refrigeration equipment installation include an audible or visual alarm that will activate when refrigeration failure occurs. The alarm enhances a rapid response to adverse temperatures.

In Australia: The temperature requirements of frozen foods in retail cabinets was removed in about 1980 and replaced with a requirement that *stores selling frozen food at retail level must do so from cabinets that met the then relevant Australian Standard AS1731-1983. In the existing Food Standards, a food business displaying frozen (and potentially hazardous) foods must ensure that the food remains frozen when displayed.*

IX. TEMPERATURE CONTROL

EU Directive 92/2[11] establishes the sampling procedure to be used in the official control of the temperature of quick-frozen foods.

Annex 1 details the sampling procedure. The packages selected for temperature measurement shall be such that their temperature is representative of the warmest point of the load. *In storage rooms:* samples should be selected from critical points, e.g. near the doors, in the centre of the room, in the air returning to the refrigeration unit. *In transport and local distribution:* at unloading, four samples must be selected from the following critical points: top and bottom of the load near the doors, top rear points of the load (farthest away from the refrigeration unit), centre of the load, centre of the front surface of the load (closest to the refrigeration unit), top and bottom corners of the front surface (closest to the return air intake of the refrigeration unit). This procedure should have been worded in another way. It is well-known that in most (all) cases the warmest packs are situated near the doors. Of the points mentioned only the first two should be denominated as “critical”.

ATP, Annex 2, Appendix 2, is on procedure for the sampling and measurements of temperature for carriage of chilled, frozen and quick-frozen perishable foodstuffs. The text is similar to the EU Directive 92/2, but the word “critical” is not used.

Figure 1 shows the 9 “critical” points referred to in EU Directive 92/2. Also shown are additional locations recommended by experts.[6]

In display cabinets: Directive 92/2 states that *packs are selected from each of the three warmest locations in the cabinet* (Annex 1, 1,3). *For persons with knowledge of display cabinets this should not present problems.*

Temperature control

Directive 92/2 indicates that inspection should take account of information provided by temperature monitoring (recording) devices. Progression to temperature measurements of the quick-frozen food should only be undertaken when there is reasonable doubt concerning the product temperature.

ATP, Annex 2, states that when a load has been selected for temperature control, a non-destructive measurement (between-case or between-pack) should at first be used. Only when the results of non-destructive measurements do not conform with the prescribed temperatures (taking into account allowable tolerances), are destructive measurements to be carried out.

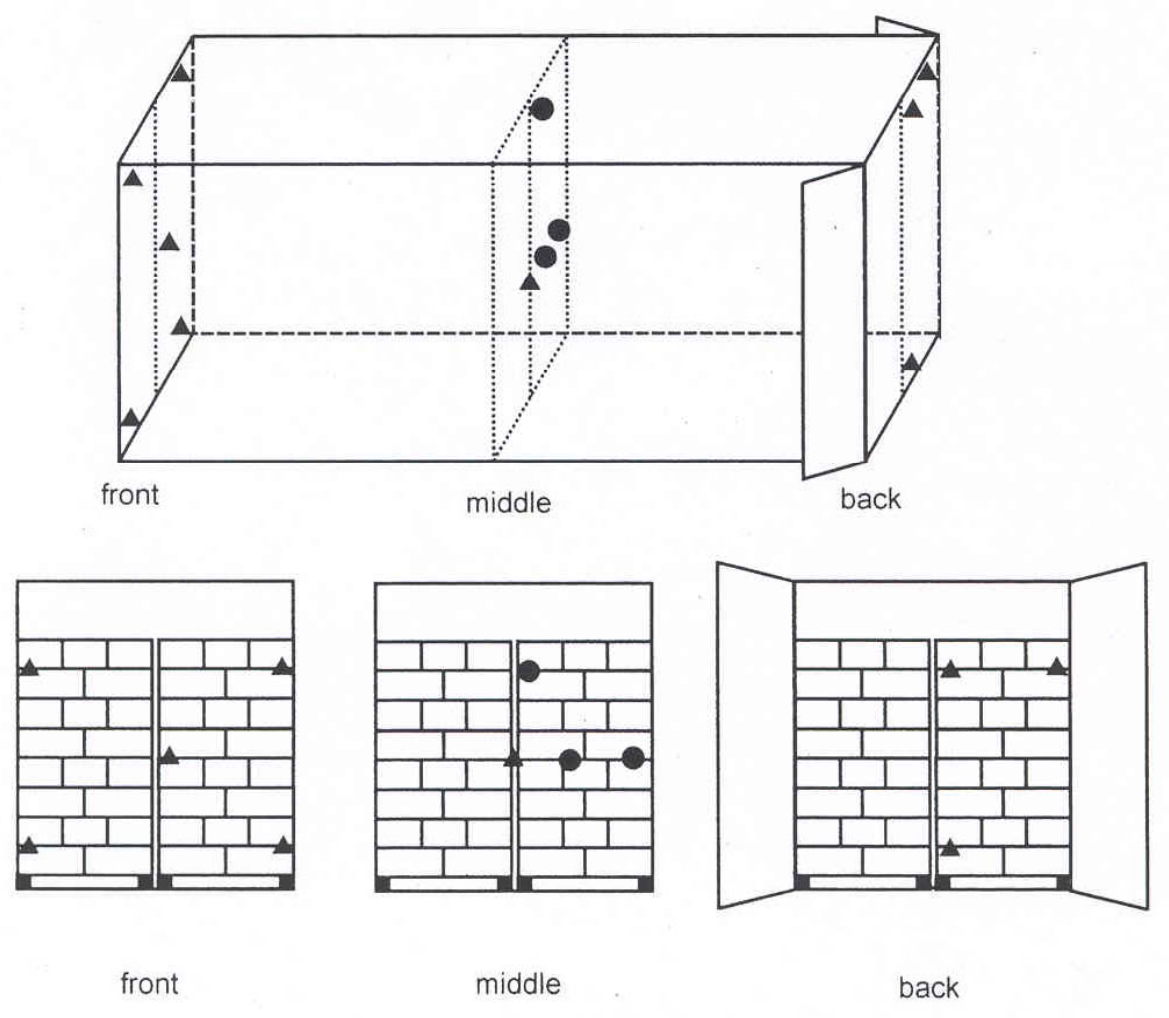

Figure 1. Official control of temperatures of quick-frozen foods — sampling locations for a single-compartment vehicle

Directive 92/2, Annex 2 describes the reference method (a destructive method) to be used in the official control. Specifications for the temperature measuring instruments are also given (Annex 2, 5.) It is approximately the same information as given in ATP, Annex 2, C.13 and D.

It is very relevant to describe temperature control of chilled, frozen and quick-frozen foodstuffs in the same document, as is the case in ATP, Annex 2. In the EU, no rules on temperature measurement of frozen or chilled foods exist. No good explanation has been found.

X. THAWING

It is often recommended, e.g. given in the cooking instructions on the label, that if frozen foods must be thawed before cooking, this should be done in a refrigerator.

This may be good advice for consumers, as it ensures that the temperature of the food does not become so high as to result in excessive microbial growth, especially of pathogenic bacteria.

One implication of EU legislation is that the surface temperature of meat should not rise above 7°C and offal above 3°C during thawing.

Specific legislation on thawing is limited.

The Danish Government notice[4] requires that *thawing of fish must be done hygienically, preferably in special containers. During thawing the product temperature must not rise so much that the quality is reduced. Thawing equipment must be approved by the competent authorities*.

In France, thawing should be carried out at a temperature between 0°C and 4°C, unless the company has an official approval to using another thawing method.

The US Code of Practice. Frozen foods should be thawed only:
- according to manufacturers' instructions;
- in a refrigerator not warmer than 5°C;
- under potable quality running water not warmer than 21°C;
- in a microwave oven or in conventional cooking equipment; the thawing and cooking process should be continuous;
- thawed products should be promptly prepared for service or placed at 5°C or colder.

XI. REFREEZING

EU Directive 89/108 specifies that: *the label of any quick-frozen food must bear a clear message of the type: do not refreeze after defrosting (Article 8, d.).*

In some countries, this sentence reads something like: must not be refrozen after defrosting.

As some consumers may use inappropriate thawing methods, store the thawed foods too long at a temperature that is too high, and have no access to fast freezing, the sentence seems to contain a reasonable warning to the consumer in order to minimize the risk of unacceptable microbial growth.

Refreezing has been used for many years in the fish industry and in other sectors of the food industry.

XII. THAWED FOODS

In many countries, thawed foods must be labelled to inform the consumer that the food is thawed. For example: 'previously frozen' or 'thawed'.

Generally, the storage life of thawed foods is the same as that of the unfrozen equivalent.

In any case, the consumer has the right to know that freezing has taken place.

However, in several cases chilled (and other) foods are (and have been for many years) produced using frozen raw materials. This is the case for a number of meat products, and this fact is not stated on the label.

XIII. QUALITY REQUIREMENTS

Generally, there is little legislation on the quality of frozen foods. This is easy to understand as this would be very difficult (impossible) to lay down in legislation. The situation is the same for most foods, although there are compositional requirements for some foods, e.g. some dairy products.

Over the past few years, a lot of emphasis has been placed on food safety. Frozen foods are very safe foods, but, in general, pathogens (or toxins) present in the food before freezing will also be present after thawing.

Thus, HACCP (Hazard Analysis Critical Control Points), GMP (Good Manufacturing Practices) and GHP (Good Hygienic Practices), etc. are as important in the production of frozen foods as in the production of chilled foods.

In many countries, in the EU, and in the Codex Alimentarius, etc. microbiological criteria and sampling plans have been prepared. They apply to chilled foods, and also to frozen foods. In many cases there are limits for salmonellae, *Listeria monocytogenes*, etc.

XIV. TEMPERATURE FLUCTUATIONS

The QFF Directive requires that the temperature of quick-frozen foodstuffs must be stable (and maintained at -18°C or colder (Article 5).

The US Code of Practice recommends reasonably stable air (and product) temperatures.

Several experiments have shown that exposure to fluctuating temperatures had the same effect on quality and remaining storage life as storage at a constant ‘effective mean’ temperature. Temperature fluctuations will cause damage to unpacked or poorly packed foods.

Temperature fluctuations will increase recrystallization. However, it is not clear what direct influence the increased size of the ice crystal has on the sensory quality of the product.

XV. TEMPERATURE ABUSE

In practice, temperature abuse does occur. However, the influence of temperature abuse on the quality of quick-frozen foods is unclear.

A collaborative study included 14 products, all exposed to the same temperature-abuse model, simulating a poor freezer chain (including simulating home transport: two simulating a bad freezer chain (including simulating home transport: 2 hours at room temperature). In most cases, the taste panel (using a preference test) found no difference between samples subjected to temperature abuse and control samples (kept at a constant temperature around -20°C). However, differences in the appearances of the frozen samples were often recorded. The results of this trial indicate that temperature abuse may have a minor influence on many frozen foods, but also, that temperature abuse does have a negative influence and will contribute to quality deterioration, sometimes significantly.

XVI. DISCUSSION

Is the QFF Directive (EU Directive 89/108) necessary?
The QFF Directive has much more to do with perceived food quality and marketing than consumer safety. Also, there is no quantifiable definition of a quick-freezing process in terms of time and temperature. James[3] concluded that the QFF Directive does little to help the consumer, the food industry or the refrigeration industry.

Is more legislation required in the EU?
Many persons are of the opinion that it would be more appropriate to have more harmonization on chilled foods, e.g. on temperatures in the chill chain, and on chilling of heat processed ready meals.

Legislation in the US
There is no federal legislation requiring any particular temperature for quick-frozen foods. The FDA Food Code (not legislation) is only concerned with food safety, not quality, and contains very little guidance on food freezing except 'frozen foods shall be kept frozen'.

The Frozen Food Roundtable[5] is endorsed by 15 trade associations, and the recommended practices are gauged to maintain the quality of frozen foods. Information about the use of HACCP and other food safety systems may be obtained by contacting any of the endorsing organizations.

Australia
The Australian New Zealand Food Standards Code is based upon the opinion that food legislation should be primarily concerned with food safety and that matters of quality should be taken up by trade practice legislation and enforcement authorities. This means that there are no references to the temperature of frozen foods, except that frozen foods should remain frozen. No definition of frozen food is given. Of course, frozen foods must comply with the general requirement that food be safe and suitable.

The Australian Cold Chain Guidelines (latest edition, 1999) give advice for both frozen and chilled foods. The temperature requirements for frozen foods are that they must be stored or handled never warmer than -18°C.

Regulations governing foods for export are issued and enforced by the Australian Quarantine and Inspection Service.

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