MINISTRY OF AGRICULTURE
OF THE CZECH REPUBLIC

BOHEMIAN-MORAVIAN UNION OF
ORGANIZATIONS FOR AGRICULTURE
SUPPLY AND PURCHASE

Principles of Good Manufacturing Practice for Storage of Grain Crops and Oilseeds

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Ministry of Agriculture Czech Republic
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These Principles of Good Manufacturing Practice for Storage of Grain Crops and Oilseeds were processed in co-operation with the Ministry of Agriculture of the Czech Republic, the Food Processing Chamber of the Czech Republic and the Agrarian Chamber of the Czech Republic, based on Czech legislation and in accordance with European Union documents.

These Principles are a basic document for every storage operator and feed manufacturer storing grains and oilseeds to elaborate his own document of Good Manufacturing Practice adapted to his specific conditions.
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1. Introduction

The purpose of the Principles of Good Manufacturing Practice for Storage Grain Crops and oilseeds is to provide operators of storage facilities with the basic rules for processing their own Good Manufacturing Practice Principles and their application in practice in their facilities. The principles are based on the conditions and requirements of EC legislative directives and the laws, decrees, ordinances and technical standards of the Czech Republic. They especially comply with the Regulation of the European Parliament and Council (EC) No. 178/2002 laying down general principles and requirements of the food law, establishing EFSA (European Food Safety Authority), and stipulating procedures concerning food safety and Regulation of the European Parliament and Council No. 183/2005 on feed hygiene.
The goal of the Principles of Good Manufacturing Practice for Storage Grain Crops and Oilseeds is to secure complying with food and feed safety requirements and for stock to be stored with minimal weight and quality losses, and thus connect to the principles of Good Manufacturing Practice in the agricultural basic industry.

Overview of related legislative guidelines and standards:

EC Legislation:
Regulations:

Regulation of the European Parliament and Council (EC) No. 178/2002, laying down the general principles and requirements of food law, establishing the European Food Safety Authority and laying down procedures in matters of food safety,
Regulation of the European Parliament and Council (EC) No. 1829/2003 on genetically modified food and feed ,
Regulation of the European Parliament and Council (EC) No. 1830/2003 on traceability of food and feed made from genetically modified organisms and on modification of Directive **2001/18/EC,**
Regulation of the European Parliament and Council (EC) No. 829/2003 on genetically modified food and feed ,
Regulation of the European Parliament and Council (EC) No. 830/2003 on traceability and labelling of genetically modified organisms and traceability of food and feed made from genetically modified organisms ,
Regulation of the European Parliament and Council (EC) No. 183/2005, laying down the requirements on feed hygiene,
Commission Regulation (EC) No. 856/2005, which amends **Regulation (EC) No. 466/2001**, regarding fusarium toxins, as amended.

Directives:
Council Directive No. 96/25/EC on the circulation of certain feed materials (as amended).

Czech legislation and ordinances:
Act No. 505/1990 Coll., on metrology,
Act No. 91/1996 Coll., on feed, as amended,
Act No. 110/1997 Coll., on food and tobacco products and the amendment of related laws, as amended,

Act No. 125/1997 Coll., on wastes, as amended.

Act No. 166/1999 Coll., on veterinary care and the amendment of related laws (Veterinary Law), as amended,
Act No. 256/2000 Coll., on the National Agricultural Intervention Fund and the amendment of related laws (National Agricultural Intervention Fund Law),
Act No. 258/2000 Coll., on the protection of public health and the amendment of related laws, as amended,
Act No. 307/2000 Coll., on agricultural warehouse certificates and public agricultural warehouses and the amendment of related laws,
Act No. 78/2004 Coll., on handling genetically modified organisms and products, as amended,
Act No. 94/2004 Coll., which amends Act No. 477/2001 Coll., on packaging, as amended,
Act No. 326/2004 Coll., on phytopatological care, and the amendment of related laws.

Government Orders:
Government Order No. 180/2004 Coll., on the provision of certain measures of collective organisation of the grain crops market,
Government Order No. 406/2004 Coll., on the specific requirements for securing work safety and health protection in environments with a risk of explosion,
Government Order No. 98/2005 Coll., which stipulates the fast rapid alert in the case of a hazard to people's health by food and feed.

Decrees:
Decree No. 329/1997 Coll., as amended by Decree No. 418/2000 Coll., which stipulates the execution of Act No. 110/1997 Coll., on food and tobacco products and the amendment of related laws, on starch and products from starch, legumes and oilseeds,
Decree No. 147/1998 Coll., as amended by Decree No. 196/2002 Coll. and Decree No. 161/2004 Coll., on the manner of determining critical points in manufacturing technology,
Decree No. 451/2000 Coll., which stipulates the execution of the Feed Law, as amended,
Decree No. 124/2001 Coll., which lays down the requirements for taking samples and the principles of laboratory testing of feed, complementary substances and premixes and the manner of retaining samples, as amended,
Decree No. 345/2002 Coll., which lays down the test gear for mandatory verification and test gear subject to type approval,
Decree No. 356/2002 Coll., which establishes a list of pollutants, general emission limits, manner of transmitting messages and information, determination of the amount of pollutants, darkness of smoke, permissible level of malodours and their intensity, conditions for the authorisation of persons, requirements for keeping operational records of air pollution sources and conditions for their enforcement,
Decree No. 132/2004 Coll., on the microbiological requirements concerning food and the manner of their inspection and evaluation,
Decree No. 158/2004 Coll., as amended by Decree No. 68/2005 Coll., which determines the maximum residue amounts of individual types of pesticides in foods and raw food materials,
Decree No. 209/2004 Coll., on the specific conditions for handling genetically modified organisms and products, as amended by Decree 86/2006 Coll.,
Decree No. 211/2004 Coll., on testing methods and the manner of taking and preparing control samples, as amended,
Decree No. 212/2004 Coll., on determining the amount in stock and the manner of its reporting to the National Agricultural and Food Inspection Authority,

Decree No. 305/2004 Coll., which determines the types of contaminating and toxicologically significant substances and their permitted amounts in food,
Decree No. 328/2004 Coll., on the monitoring of the occurrence and extermination of pests in storage facilities for plant products and regulation of their occurrence in public agricultural storage facilities and the storage facilities of the National Agricultural Intervention Fund.

Czech national standards:
ČSN 46 1100 Grain crops for food processing – Sections 1-7,
ČSN 46 1200 Grain Crops – Sections 1-10,
ČSN 46 1300 Legumes – Sections 1-5,
ČSN 46 2300 Oilseeds – Sections 1-7.

2. Current Situation in the Czech Republic

More than half of all appropriate storage facilities are currently represented by silos. Other storage facilities include hangar types and combined facilities. The total capacity in the Czech Republic amounts to approximately 10 million tons. Temporary storage facilities in the agricultural primary industry, suitable only for short-term storage, amount to approximately one third of this storage capacity. Nowadays new storage facilities are being built in the agricultural primary industry supported by EU financial funds.
Storage is supervised by national institutions (Ministry of Agriculture, National Agricultural Intervention Fund, Central Institute for Supervising and Testing in Agriculture (ÚKZÚZ), internal and external audits (ISO 9001, GTP/GMP) and customers.

3. Definitions and Terms

For the purposes hereof, the following terms shall be construed as follows:

Storage – Storing goods in designated, pre-prepared and treated spaces, which secure that the quality and weight of the goods is maintained. Title to the goods may pass during storage.

Short-Term/Long-Term Storage – This is not determined and defined by time, but by the technical conditions enabling storage without deterioration of quality. As a rule, the dividing line between short-term and long-term storage is considered to be 6 months.

Rules of Storage – Rules determining the general procedures for operation in a storage facility. Rules of Storage are determined by the storage operator.

Sanitation – Treatment of properly cleaned storage areas by a permitted agent, which prevents the presence of storage pests. Sanitation is often carried out by a specialised company or a specially trained worker.

Disinfection and Insect/Rodent Control – Application of permitted agents preventing the occurrence of rodents, mildew etc. These services are often carried out by a specialised company with verified expertise.

Pre-Cleaning – Removal of coarse impurities and organic residue from plant products.

Active Ventilation – Technological equipment of storage areas enabling leading air out from between intergranular spaces of plant products, which dries and cools the stored goods.

Cooled Storage – Storage of goods with a temperature of 10 ºC or lower, achieved either by cooling systems or cool air distributed through active ventilation.

Quality Control Plan – A guideline which specifically determines quality control procedures during reception, storage and release.

Inter-Operation Quality Control – Procedures for quality control in the course of storage.

Sampling Plan – Precise procedures for taking samples of goods to check their quality. This may be included in the Quality Control Plan or form a separate regulation.

Storage Facility Operator – A physical or legal entity which carries out storage in storage areas.

Chemical-Aided Storage – Storage of damp grain products (more than 14%) for feed purposes only with use of chemical preservatives permitted by valid Czech and EU regulations, according to the stipulated procedure so that the quality of feed goods complies with veterinary, zootechnical and feed control regulations.
Suitability of packaging must be verified and the cleanness and mechanical integrity of the packages must be checked before filling. Goods must be stored in their packaging in such a way that it does not succumb to weather conditions (temperature, moisture penetration) and no material is lost for example due to bad stitching or puncturing of sacks (fungus control)**.**

Maximum Storage Time – The maximum period for which a certain type of goods may be stored without a change of basic quality indicators, while observing compliance with all principles for storing the respective type of crop.

Weight Loss (Shortage Norms) – These express the maximum permissible unavoidable shortages caused by a natural decline of amount or quality during the storage of individual types of grain crops and oilseeds.

Stock Clearing – A procedure which is carried out after the end of storage of a certain type of goods (may differ e.g. by the year of crop). The weight of the actually issued goods or the weight determined by weighing the remainder of stock is compared to the accounted weight. Stock clearing is carried out according to valid regulations, for example stocktaking guidelines.

Composite Sample – A composite lot sample composed of component samples from individual deliveries/shipments. In the case of bulk materials, it usually represents a lot under 200 tons, in the case of other types of goods the composite sample is defined by internal regulations.

Post-Harvest Ripening – In the case of plant products, this is the period after harvest in which growth substances gradually prevail over inhibitive substances. As a rule, the process is accompanied by a decrease of soluble substances (sugars, amino acids) and a decrease in breathing energy. The length of post-harvest ripening is a certain mark of class and strain and is

also dependant on the environment. In the case of favourable conditions, post-harvest ripening of all main classes takes place within 1.5 – 2 months.

Waste – a movable thing that the storage operator is disposing of or he has an intention or obligation to dispose it of, and it is classified according the Waste Disposal Law.

4. Definition of the Quality Parameters of Grain Crops and Oilseeds

The quality of grain crops, legumes, oilseeds and other agricultural products needs to be defined for purposes of their purchasing, sale and technological processing. Determination of quality parameters is important to determine price, including weight or price discounts or surcharges, as well as achieving storability of these products and maintaining their marketable quality.
For these reasons, in accordance with legal provisions and in co-operation with authorities and organisations in the Czech Republic, Czech Technical Standards (ČSN), or Company Standards (PN) are applied respectively.
Standards may be classified as regulation standards or subject standards.

4.1 Regulation standards

Regulation standards define the procedure for determining a specific quality indicator. They include Czech standards ČSN 46 1011-1 to 29 (for grain crops, legumes and oilseeds), the individual parts of which determine the method for the specific quality indicator, and international or European standards, adopted in many Czech technical standards.
Regulation standards serve for the testing or definition of the characteristics or quality indicators of individual commodities.

4.2 Subject standards

Subject standards define the requirements for characteristics of agricultural products, according to which they are submitted for further processing. For example, grain crops for food processing are governed by ČSN 46 1100-1 to 7. Requirements for grain crops for industrial processing (production of feed and compound feed) are defined in ČSN 46 12001 to 10.
The following text relates to some subject standards.

4.3 Food grade wheat crops – ČSN 46 1100

Each line of subject standards starts with Section 1: Common Provisions. The chapter Terms and Definitions states the basic terms and definitions of quality indicators relating to the specific line. The chapter Technical Requirements stipulates hygienic requirements, maximum pollutant contents (e.g. seeds of individual weeds), and the maximum permissible amounts of prohibited substances/products unwanted substances or accidental and polluting foreign substances, determined by the respective legal regulations.
The following section states a list of ČSN standards, which determine testing methods for food grade grain crops. This standard finally also treats the delivery of agricultural products with one very important principle – the manner of rounding with reference to the respective standard and conditions for transport and storage, including parameters of storage areas, storage methods and the extent of eventual treatment of grain crops.

- **Food grade wheat**

According to ČSN 46 1100-2, food grade wheat must not contain live pests in any development stage and foreign odours. It must not contain mouldy grains or grains which are starting to

mould (growth of mould must not be visible to the naked eye) or bug-damaged grains. The wheat must not be infected by stinking smut.
According to its use, food grade wheat is further divided into bakery wheat and cookie wheat. Each of these types of wheat has different quality parameters. The two types differ mainly in the values of quality indicators, these being content of nitrogenous substances (N-substances) and the sedimentation index (Zeleny test).

- **Bakery wheat**

Bakery wheat must contain at least 11.5 weight percent of N-substances and a sedimentation index (Zeleny test) of at least 30 ml. The content of N-substances is represented by the content of wet gluten. Gluten is a set of grain proteins, which swell when wet and create a continuous glutinous grid, which is flexible and tensible. This enables dough to increase its volume when inflated by yeasting gases, yielding voluminous, porous pastry after baking.

- **Cookie wheat**

On the other hand, the maximum content of N-substances in cookie wheat is 11.5 weight percent and the maximum sedimentation index (Zeleny test) is 25 ml. Cookie wheat is used for cookies, crackers, biscuits etc. This is non-gluten wheat.

- **Durum wheat**

According to ČSN 46 1100-3, durum wheat, which is used for pastes, is defined by the glassiness of grains, which is actually the type of stored starch grains and protein particles in the endosperm and is determined by a section (farinatom) or transillumination. Glassy grains are dark in the section and transparent when transilluminated.
Another quality indicator determined mainly in the case of wheat is its specific density, called loose weight. This characteristic comprises a range of parameters and traits relating to the size and shape of cereal grains, grain surface and moisture content. The optimum specific density is 78 to 82 kg/hl.
To secure storability and better industrial processing of grain crops, it is necessary to use the method for determining impurities and contaminants described in ČSN 46 1011-6. The amount of unwanted substances (impurities and contaminants) in a sample is determined by various separation methods, of which sifting is the most important. Content of impurities and contaminants is defined for individual grain crops in the respective sections of ČSN 46 1100 and ČSN 46 1200.

- **Malting barley**

A revised standard for malting barley (ČSN 46 1100-5) is in force from January 1, 2006. The standard now includes strain purity as a new quality indicator and the evaluation method of malting barley grains has also changed. Quality is now determined only by grain oversize over a screen with 2.5 mm wide oblong openings. The term impurities was introduced, which is divided into grain impurities unusable for malting and grain impurities partly usable for malting. The content of N-substances of the malting barley must be at least 10.0 weight percent and at most 12% weight percent, the germinating capacity at least 96.0%, and grain oversize over a screen with 2.5 mm at least 85.0% weight percent.
Contaminants, foreign seeds and foreign substances were newly defined, and the method for determining N-substances, germination percent and germinating energy was changed.

4.4 Grain crops for feed – ČSN 46 1200-1

Grain crops, originally called feed grains, are destined for industrial processing as feed. Their moisture content should not exceed 14.5 weight per cent.

Besides the provisions defined in the common provisions for food grade grain crops, this new norm newly defines strain purity. This indicates the weight percentage of grains of the respective (declared) type of grains, found after removing impurities and the seeds of other botanical plant species which were not evaluated and classified as impurities. The strain purity is determined by 95.0 weight per cent, the content of impurities at maximum 12.0 weight per cent. For supply the value of covered grains is set to 2.5 weight per cent and impurities to 1.0 weight per cent.
In the case of grain crops supplied for feed purposes, further requirements are stipulated by Decree of the Ministry of Agriculture No. 451/2000 Coll., as amended, which stipulates the execution of Act No. 91/1996 Coll., on feed, as amended.

5. Storage Areas

5.1 Types of storage facilities

The basic and most suitable types of storage facilities are:

a) Silos,
b) Hangar-type storehouses,
c) Combined storehouses,
d) Floor-type storehouses.

5.2 General requirements for storage areas

Storage may be carried out only in specially designated and equipped storehouses. The storehouse must be constructed of durable materials and protected against birds and rodents. Areas designated for storage must be clean, dry, easily ventilated and free from mould, pests and foreign odours. Storage must not be performed together with substances or objects which could have an adverse effect on quality (e.g. aromatic or malodorous substances etc.). The stock must be sufficiently protected against adverse climate conditions. Roofs must be in perfect condition, windows paned and always fitted with protective insect nets, and the stored goods must not be exposed to direct sunlight. If the walls do not have sufficiently heat and moisture insulation, then the storage space must be separated from the walls.
Storage facilities must be equipped for separate storage of goods of various qualities and uses. Storage facilities must not contain inaccessible or blind places which could lead to the spreading of pests. The structure of storage facilities must enable regular dust removal, disinfection, insect control, rodent control and quality inspections. For the rodent control there must be a plan of traps stored by the silo foreman, well-marked and covered traps, and a verified evaluation of the efficiency. The storage facility must be equipped with adequate technology for quality maintenance and prevention of losses.

5.3 Types of storage

Basic types of storage:

- Short-term storage,
- Long-term storage.

This is not determined and defined by time, but by the technical conditions enabling storage without deterioration of quality. As a rule, the dividing line between short-term and long-term storage is considered to be 6 months.
According to storage technology, storage is classified as follows:

a) Dry storage (grain crops, legumes up to 14 % moisture and oilseeds up to 8 % moisture),
b) Storage with active ventilation (grain products - up to 17 % grain moisture),

c) Cooled storage,
d) Chemical-aided storage (for feed purposes only).

The storage types mainly apply to bulk goods, but also to goods stored packed, where the storage type and storage time is determined by the type and condition of the packaging. Packaging must be functionally adequate and hygienically safe.

5.4 Rules of storage – Minimum requirements

Each storage operator must have implemented rules of storage (guideline) covering at least the following issues:

a) Description of the storage facilities, assignment of persons responsible for storage including stipulation of responsibilities and rights,
b) Preparation of storage areas,
c) Receipt, adjustment and storage of goods – Procedures,
d) Treatment of stored goods – Procedures,
e) Inspection of stored goods – Procedures.
   - In the post-harvest ripening period, temperature must be measured daily for at least two weeks. Otherwise, temperature must be measured twice per week,
f) Operational records of stock
   - (temperature log, drying log, handling log, operation log with daily records, reception, release, weighing log, records of waste disposal),
g) Principles for releasing from stock,
h) Fire safety, work safety and health protection, environmental protection,
i) Principles of care for storage facilities and their equipment,
j) Basic provisions of the rules of storage: Specification and example of rules of storage including sampling plan (see Appendix 1).

5.5 Preparation of storage areas

a) The following must be done before goods are stored:
   - Storage facility properly cleaned (dust and dirt removed) and sanitised at least once per year,
   - Cleanliness and order maintained in all areas of the storage facility,
   - All technological residues removed from the storage facility as per valid regulations,
b) After stocking out, the following must be cleaned (dust and dirt removed):
   - Storage areas,
   - All technical equipment and structures,
   - Surface of electrical installation,
c) Technical and technological equipment must me continuously maintained in a fully operational state and capable of delivering full performance.

5.6 Personnel – Requirements on storage facility personnel

Storage facility personnel must be expertly trained and knowledgeable of respective rules and standards. Responsible personnel must be appointed to individual storage facilities and their responsibilities and rights specified.

6. Receipt, Treatment and Storage of Goods

6.1 Standard receipt procedure

The deliveries to the storage facility must be healthy, free of pests, noxious odours, mouldy grains, mycotoxins, mildewy grains, and pesticides residues. In the case of bulk goods, standard practice is that a worker verifies cleanliness of the receipt bin, transport line set-up and storage container or storage area level before receipt. In the case of other goods, the worker checks the area designated for storage.

The storage operator must have defined the:

a) Method of receipt for individual deliveries including weight verification,
b) Quality control method (see Quality Control Plan, stated in the Principles of Good Manufacturing Practice and Hygiene for Feed Manufacturers),
c) Post-harvest treatment of received goods – a specific worker must be appointed to decide on the method (see Principles of Good Practice for post-harvest treatment of grain crops, legumes and oilseeds),
d) Course of action to be applied in the case that a delivery is not in accordance with the declaration, or if packaging is damaged (in the case of packed goods),
e) Course of action to be applied in the case that the content of mycotoxins exceeds the maximum values set by the EC requirements,
f) Course of action to be applied in the case that live pests are discovered. In the case of storage, access is possible only to separate areas which enable sanitation treatment,
g) Method for separate storage according to type, use and purpose. Goods with different storage possibilities (due to different moisture content etc.) may not be stored together.

It is suitable to specialise individual storehouses and storage areas with respect to their technological equipment. Specialisation or determination of storage of a certain type of goods must always be carried out in accordance with their fire safety characteristics.

6.2 Weighing

A standard procedure to verify the weight of deliveries is to weigh each sub-delivery on verified and calibrated weights in the course of each storing and warehouse release.

6.3 Sampling and quality control

The delivery must not have the content of mycotoxins exceeding the maximum limit set by the requirements of EC or the Czech Republic. The storage operator must have a defined Quality Control Plan (see 5.1b) for entry, inter-operation and output checks. The Quality Control Plan must include requirements defined in 6.40.0 of the Principles of Good Manufacturing and Hygiene Practice for Compound Feed Producers.

7. Storage

7.1 Basic rules of storage

Temperature, odours and pest occurrence are to be monitored throughout the entire storage process. If a fault is discovered, remedial measures must be applied immediately.

The manner of storage of packed goods must be defined, including layering of packaging and pallets.

The stored goods must be accessible.

Individual types of goods and deliveries must be labelled. The designated use of goods must be clearly marked. In the case of packed goods, the storage and disposal of packaging material must also be defined (may also be resolved in the waste disposal plan).

7.2 Quality control of stored goods

In the case of plant products in the post-harvest ripening period, temperature must be measured daily for at least two weeks. Later, temperature must be measured at least twice per week. As a rule, it is necessary to secure that the temperature of the stored material does not exceed 25 ºC. Measures must be applied in the case of a rapid increase in temperature. After these measures, temperature must be measured daily for an adequate period.

In the course of storage, a so-called inter-operation check is carried out according to elaborated quality control plans. This check must precisely determine the extent and interval of inspections of the stored material. The stipulated quality indicators recorded at individual stages of the storage process must be probative and traceable. As a rule, the quality indicators and their values are determined according to contractual conditions and the purpose of use, with regard to valid technical standards.

Measuring and monitoring in the course of the storage process and especially determination of individual quality indicators is carried out on designated and approved, regularly verified, calibrated and checked equipment.

7.3 Treatment of goods

The purpose is to prevent deterioration or damage of the goods. Handling must be carried out so that various types of goods are not mixed.

Basic goods treatment operations:

- Cooling by affining, manipulation,
- Ventilation,
- Sanitation and mould prevention treatment,
- Cooling,
- Cleaning.

All of these operations are carried out according to stipulated technological and operating procedures and are properly chronologically recorded.

Goods and storage areas must be secured against abuse or contamination by undesirable micro-organisms, mould, rodents, birds or moisture.

The “active ventilation” system is special operation within goods treatment, used mainly for plant products.

Principles of active ventilation:

1. Apply active ventilation in the case of grain crops with a maximum moisture content of 17 % (15 % in the case of rye and corn),
2. Start ventilation immediately after stocking in,
3. Ventilate using cool air (at least 5 ºC colder than the temperature of the stored goods) for cooling purposes,
4. Ventilation must prevent an increase of temperature due to self-heating,
5. Observe basic technological procedures for active ventilation according to the selected types of storehouses (halls and silos) and installed ventilator power.

7.4 Loss on weight (deficit standards)

This must be stipulated in stocktaking provisions in accordance with the related valid regulations. The deficit standards are used only in cases when after release of goods and a properly carried-out cleaning a difference is found between the real and accounting stock. During the storage losses on weight are caused by respiration, scatter, mechanical damages, and improper storage. The weight of plant products reduces due to drying of grains. Respiration, scatter, and mechanical damages are natural losses.

8. Release from Stock

8.1 Release of goods

The stored goods are assorted in the storage facilities according to quality indicators and according to short-term/long-term storage (after treatment) with precise records.

As a rule, required quality indicators are verified before release. As part of the release of goods, the delivery is weighed and samples are taken (shipping inspection).

The storage operator shall specifically determine the technological treatment and release procedure in their guideline.

8.2 Shipping inspection

Carried out according to the elaborated Quality Control Plan (see 5.1.b) – shipping inspection process.

9. Claims, Non-Compliant Products

If the quality indicators of the goods during receipt or release do not meet the stated requirements, further action (receipt, release) is suspended. Measures to remedy the discovered discrepancies or to verify them are taken immediately.

It is necessary that the operator has elaborated claims regulations or a similar guideline with specification of the resolution of at least the following procedures.

- Precise procedure for the withdrawal or return of delivered goods,
- Procedure for facultative compensation,
- Quality verification of the withdrawn delivery and manner of non-compliance remedy (if possible),
- Determination of how goods which cannot be remedied will be handled.

10. Transport

Goods and shipments are usually sent by lorries or rail cars. The carriers must comply with the basic requirements for transport according to the purpose of the transported goods. Goods from suppliers must be transported in clean, covered vehicles. The last three shipments transported in the vehicle must be traceable and verifiable. This means that the vehicles must not be used to transport shipments which could disvalue the transported product, and they must be thoroughly cleaned. Disinfection using permitted agents is used in the case of contamination by moulds or micro-organisms. During transport, it must be secured that the quality or hygienic safety of the transported product is not damaged due to weather conditions, and that bulk material does not fall or pour out due to bad sealing and consequently decrease in weight.

Precise chronological records of transport must be kept, these must secure traceability of individual shipments.

Due to the importance of this field, standards for goods transport are covered by independent "Principles of Good Practice in Transport"

11. Waste

This means waste generated during the storage process, activities and operation of the storage facility. Waste is divided into:

- Hazardous waste,
- Other waste.

Every storage operator must have a guideline (or other respective directive) on waste management by course of valid legislation. These provisions aim towards active environmental protection.

Waste management means the collection, concentration, gathering, buyout, sorting, transport, storage, treatment, utilisation and disposal of waste.

General rules for handling individual types of waste:

- All waste must be consistently sorted according to type and category when created, secured against deterioration, theft or unwanted leakage into the surrounding environment,
- Waste may be concentrated only in concentration means in such a way that they do not mix together or escape into the surrounding environment,
- Utilisation of waste must be preferred against disposal,
- All workers in individual storage facilities and workplaces must be briefed on the manner of handling waste created during their work.

The storage operator shall keep precise and complete records on hazardous wastes and other waste.

12. Environmental Protection and Fire Safety

12.1 **The storage operators** must integrate legal requirements for air protection into their own regulations. Pollution sources must be categorised according to the relevant legal provisions. The storage operator must secure that the valid emission limits will not be exceeded (according to Decree No. 356/2002 Coll.).

12.2 **The storage operators** must have implemented regulations for the realisation of legal provisions in the field of water protection and water management with the goal of securing safe management of water and minimisation of the risk of water pollution.

12.3 **The storage operators** must have distinctly stipulated organisational procedures for fire safety, control and measures according to Government decree No. 406/2004 Coll., on detailed requirements for securing work safety and health protection in an environment with a risk of explosion.

13. Packaging Management

In cases when the storage operator accepts, stores or issues packaged goods, the storage operator must have a distinctly elaborated own regulation for packaging management by course of Act. No. 94/2004 Coll. and valid decrees, including precise and complete records.

Appendix 1

Rules of Storage

Article I
Opening clause

1. These Rules of Storage determine the conditions and manner of operating the storage facility .....……..... (name and location), which is operated by .....……..….. (precise name of operator according to the Commercial Register, Company ID No.)

2. These Rules of Storage were approved by .....……..... (state the approving authority in detail – organisation, name, position etc., date etc.)

Article II
Organisation of receipt and release of goods and Operator's responsibilities

A. Receipt of goods and Operator's responsibilities

1. The storage accepts the following types of goods for storage:
   - List types of goods including their purpose of use.

2. Maximum permitted capacity: ..... tons

3. Operator's officers in charge:
   1. Name: ..... Position: .....
   1. Name: ..... Position: .....

4. Handling of goods receipt:

4.1 Goods received for storage are taken over by the officers in charge, who shall carry out receipt and check the delivery note, weigh the goods and take samples according to the sampling plan.

4.2 After determining the values of quality indicators, the respective worker shall issue a receipt for the respective sub-delivery and send it to the receipt area designed for receipt of goods into the storage facility. The goods are stored using the technological equipment.

4.3 The weight of the delivery, term and quality at receipt as well as possibly the storage period and price are negotiated before the goods are physically delivered to the storage facility.

4.4 Receipt of goods and delivery to the storage facility takes place in the negotiated day. After receipt of each delivery, the storage operator shall determine the weight and quality indicators according to the samples taken during receipt.

4.5 The storage facility is responsible for the stored goods until its issue to another authorised person.

B. Release of goods

Takes place according to the negotiated conditions with regard to the technological equipment of the storage facility, negotiated conditions (.....…....., or other rules determined by the storage operator).

Article III
Regulations for sampling during receipt and release of goods

Procedure and manner of sample taking for quality evaluation of indicators, preparation of samples, evaluation of goods quality and storage of samples takes place according to the **Sampling plan**:

1. Place of taking: .....……
2. Sampled material: .....
3. Goal of sampling:

Determination of the average value of monitored quality indicators in the sampling amount during receipt (receiving inspection) and expedition (shipping inspection).

4. Sampling procedure

The authorised worker proceeds in accordance with e.g. ČSN ISO 13690, PN 186/93, in the case of plant samples: ON 461013 in its full wording, etc. (further procedures or application of ČSN ISO standards is to be determined by the storage operator).

5. Sampling tools

(e.g. semi-automatic. pneumatic sampling tool, manual double pipe sampling tool, mechanical sample divider, paper packages, plastic bottles etc.).

5.1 Sampling method

As a rule, after bulk material is uncovered, the sampler checks the delivery for visible defects and takes samples of the goods at least in five places of the surface. If possible, the sampling tool must penetrate the entire height of the sampled material. Sub-samples are collected in a collecting container.

In the case of a manual double pipe sampling tool, the sampler shall bury the tool into the material in a vertical direction. He/she then rotates the pipe to uncover its openings and waits until the sampling tool is filled. He/she then closes and removes the sampling tool and pours the sampled material into the sample collector (In the case of packaged goods and other goods, these principles are applied proportionately and a precise procedure is determined).

5.2 Number of partial samples

Amount	Number of sampling units	Number of sampling places
Up to 15 tons	1	5
15 – 30 tons	1	8
Above 30 tons	1	11

6. Treatment of partial samples

The sampler decreases the size of the partial samples stored in the sampling container by means of a sample divider to an overall sample of the delivery. The maximum batch weight for one

overall sample is 200 tons. Using the mechanical separator to stir and evenly divide the overall sample, 3 samples are created (as a rule) with a minimum weight of 1.2 kg in the case of grain crops, 0.5 kg in the case of oilseeds, according to the storage operator's decision in the case of other goods. The samples are put into paper packages and labelled with the following information:

- Type of goods,
- Quality,
- Customer, supplier,
- Amount,
- Date taken (e.g. receipt, release).

7. Quality testing

7.1 Unaided evaluation of goods quality includes at least:

- Evaluation of colour,
- Evaluation of odour,
- Occurrence of pests.

7.2 Determination of moisture content

Moisture content is determined on a stated verified measurement tool.

7.3 Determination of other quality indicators

(to be determined by the operator according to the type of goods/material – the method and equipment to be used must always be stated).

7.4 The determined values of quality indicators are recorded.

Article IV
Reports on the state of stored goods

Records of the movement of goods are kept in the handling book or by another suitable means (e.g. electronically).

Article V
Inspections in the course of storage

1. In the course of storage, the temperature of stored bulk material is carried out at least twice per week and the results are recorded in the temperature log.

2. Samples are taken of bulk goods in the course of work operations from the material flow on a determined and marked place of sampling, or by means of depth sampling tools.

3. Samples taken are handed over to a place where they are analysed (laboratory) for an inter-operational inspection. This shall include at least an unaided evaluation of goods quality and determination of moisture content. The results are recorded. After the inter-operational inspection is finished, the samples are not stored further.

Article VI
Operating records

	Document name	Archiving time
1.	**Temperature log** (recorded temperatures).	1 year
2	**Handling log** (records on all movement of goods).	1 year
3	**Operating log** (daily continuous and chronological records on the operation of the storage facility, e.g. sanitation procedures, faults and their removal etc.	5 years
4	**Weighing logs**	5 years
5	**Waste disposal records**	5 years
6	**Lab journals** (records on determined quality parameters according to individual batches.	5 years
7	**Other records according to the operator's rules for:** - fire safety, work safety and health protection - environmental protection - maintenance and revisions	According to internal directive

Article VII
Principles of care for storage facilities and their equipment

A maintenance plan is usually made out for at least 1 year. In the case of technology sets, the interval for maintenance of individual appliances and equipment is determined including responsibilities.

Article VIII
Other principles and regulations

In this place the operator shall determine and resolve other issues necessary according to the material and storage facility conditions.

Appendix 2

Rules of Good Practice for post-harvest treatment of gain crops, and oilseeds for all storage operators and producers with own storage facilities

These rules respect the essentials of the Codex Alimentarius, ČSN EN ISO 22 000, GMP (Good Manufacturing Practice) and GTP (Good Trading Practice), which follow the provisions of HACCP (**Hazard Analysis and Critical Control Points**).

Table of Contents

1. Introduction

Post-harvest treatment represents the specific treatment of grains, and oilseeds designated for direct sale or long-term storage. The goal of this good practice is to provide the storage operator with base material and rules for determining their own procedures.
The post-harvest treatment of harvested grains and oilseeds includes the following procedures (based on determined moisture content and impurity and contaminant content):
- Pre-cleaning,
- Drying,
- Cleaning,
- Active ventilation,
- Chemical preservation,
- Anti-fungus treatment.

The goal of post-harvest treatment is final storage moisture content of max. 14% in the case of grains, max. 8% for oilseeds and removal of organic and mineral impurities from the grain.

2. Current situation

A majority of producers in the Czech Republic are equipped with post-harvest lines with pre-cleaning and cleaning capacities and approximately half is equipped with drying capacities. Silo storage facilities have complete cleaning and drying capacities.

3. Definitions and terms

Pre-cleaning	- Separates coarse contaminants and light impurities,
Drying	- Lowers moisture content to the moisture content for storage,
Cleaning	- Use of sieve cleaners to achieve the required amount of contaminants and impurities,
Active ventilation	- An aeration system which maintains the required temperature of stored grain crops,
Chemical preservation	- Use of chemical preserving agents for stored grain crops with a moisture content exceeding 14 %,
Anti-fungus treatment	- Application of an agent which inhibits the growth of fungi and their spores.

4. Pre-cleaning

To remove coarse contaminants, drum or cylinder pre-cleaners are used, which separate these contaminants using rotary sieves and air jets. The pre cleaning of grain crops which are to be dried is very important. This separates the moistest part of the contaminants and the moisture content of the grain for drying is markedly lowered. If the moisture content of the harvested grain does not exceed 14%, it may be stored after pre-cleaning. The output of the pre-cleaner depends on the grain moisture and contamination. The pre-cleaner operators must be acquainted with the functions of the appliance. The operators regulate the grain flow and air speed, taking care that grain is not sucked out into the waste.

5. Drying

5.1 General requirements
Moisture is one of the most important quality indicators, because the intensity of biological processes taking place on plant products determine on moisture.
Moisture may be freely distributed or bound in the product. Bound water is physically or chemically bound to the basic substance of the product. In the case of grain, this makes up 14 – 15%, the bound moisture of oilseed rape amounts to 8%. If the moisture content is higher, free water appears and accelerates all biological processes.
Drying is a process which lowers the moisture (free water) of harvested and stored products to the level necessary for long-term storage.

The drying mode depends on the:
a) Type of crop and its characteristics,
b) Designated purpose of the dried material,
c) Initial moisture.

Although the critical function of large-capacity dryers is automated, it is necessary to observe the stated technological procedures for individual types of crops, safety and fire safety measures determined my technical standards and operational rules.

5.2 Drying of grains
Safe storage of grains requires the moisture content to be lowered to 14 %. One drying run lowers the moisture content by 3 – 4 %. It is thus important to separate the grain before drying into groups with moisture content below 18 % and above 18 %. It is not economical to harvest grain with moisture content exceeding 20 %. Currently nearly all used dryers utilise down-pouring, hot-air drying with indirect air heating.
The dryer operators monitor the drying process and record the moisture content before and after drying. The storage operator shall determine the place of sampling for taking samples before and after drying. If the entry moisture exceeds 18%, it is necessary to repeat the drying process. According to the dryer type, serial drying from chamber to chamber may also be used, which decreases the moisture by a larger percentage in one run, with approximately half the output. This type of dryer has two independent drying and cooling chambers. The manner of drying shall be decided by the worker in charge.

Recommended temperatures for drying

Type of crop	Temperature of drying air in °C in the drying area		Grain heating in °C in the drying area	
	I.	II.	I.	II.
Food grade wheat	85 – 95	90 – 120	45	50
Malting barley	85 – 95	90 – 120	40	45
Wheat	90 - 110	90 – 130	50	55
Barley	90 - 110	90 – 130	50	55
Rye	90 – 110	90 – 130	50	55
Corn	90 – 120	90 – 140	50	55

If the initial moisture is higher, a higher air temperature is applied according to the table. Drying of food grade wheat and malting barley requires special care, the lowered grain heating must be respected so that the quality and germinating capacity of the grain is not decreased. The output temperature of the dried grain must be lower by 5 ºC than the temperature of the surrounding air.
By course of HACCP and GMP (GTP), the drying temperature is a critical point affecting grain quality.

6. Cleaning

The content of impurities and contaminants must follow the respective ČSN or the parameters negotiated in the sales contract. Grains are pre-cleaned and dried if necessary. The worker in charge is responsible for the sample taking of the part which is designed for cleaning. The respective screens are selected according to the parameters. The amount of impurities and contaminants determines the respective sieves and grain flow to the cleaner so that the impurities, weak grains and contaminants are separated.

Cleaners use sieves, with 1.8 – 1.9 mm screen holes for rye, 2.0 mm for feed grains, 2.2 mm for food grade wheat, 2.5 mm for malting barley and 3.5 round screen holes for oilseed rape.
The cleaning quality depends on proper set-up of the cleaning appliance; the operators must thus be duly acquainted with the machine's functions and proper screen selection.
The operators check the cleaning process and take care that valuable grain does not appear in the coarse contaminants, and sets the air flow so that a minimum of valuable grain appeared in the contaminants flying away from the machine. A worker in charge checks the cleaning quality by taking periodical samples, once in 40 – 60 minutes.

7. Active ventilation

Active ventilation is a forced change of air in the intergranular space by means of ventilators. Two types are used in hangar storage facilities:
- Subsurface air channels covered by grids. The spacing between channels is 2 – 3 m,
- Over-surface system, where ventilation pipes are connected from the embedded ventilator to the opposite wall. The operators must secure that the transporter does not move the pipe when storing goods, which would interrupt the air flow. The operators must also secure uniform storage throughout the storage surface and evening of the top layer.

CAUTION: The operators must know the maximum storage height (determined by the stress analysis of the storehouse)!

<u>In silos, active ventilation is secured by 2 types:</u>

- Central air system with branch lines to individual cells,
- Separate ventilator for each cell.

According to the silo's equipment, the operation of individual ventilators may be directed from a PC, on which the operators may set up the required engine parameters according to the operator's guidelines, in dependence on the outside temperature and humidity.

Technological procedure for active ventilation:

- Ventilation of stored grains is commenced immediately after any quantity is stored in a cell,
- When ventilating dry grain for cooling, the air used for ventilation must be at least 5 ℃ colder than the temperature of the grain. This is carried out irrespective of the relative humidity of intake air, mainly at night,
- Partial drying of moist grain is carried out irrespective of the relative humidity of intake air,
- Wet grain which is to be dried is ventilated continuously to prevent self-heating,
- To prevent the occurrence of condensate on the grain surface in cells, it is necessary to carry out so-called spinning, i.e. a partial bypassing from cell to cell for approximately 15 minutes once per week. The temperatures in individual layers are balanced faster and the entire lot is partially homogenized,
- To prevent the occurrence of condensate on the grain surface in hall-type storage facilities, it is necessary to run the ventilators in reverse mode. As a rule, ventilation in reverse mode is carried out approximately one quarter of the time during the highest day temperatures (from 12:00 to 18:00) – the greenhouse effect may also be utilised. This speeds up the drying and cooling of grain and prevents its deterioration in the surface layers.

It is not possible to precisely determine the length of active ventilation, which depends on the type of grain, its moisture, temperature, amount etc. The operator usually lays down a procedure for achieving maximum quality.

Ventilation has three stages:

Stage I
In this stage, active ventilation is continuously in operation. This is the period from storage into the cells or hall-type storehouse. The first stage may be considered completed in the case that:
- Post-harvest ripening has ended,
- Possible condensation of moisture on the surface layer has been prevented,
- The moisture of stored grains in the surface layers was lowered under 16 %,
- The temperature of the entire volume of stored grains decreased to approximately 20º C.

For the entire time of Stage I, relatively fast drying takes place because the high-pressure ventilator heats the air, which decreases its relative humidity and increases its absorption capacity. For the entire period of active ventilation, decrease of moisture in the grain is the control variable.

Stage II
In the second stage, ventilation is interrupted. Ventilators are operated only when the air is favourable, especially its relative humidity. The air temperature is lower than the temperature in individual cells or in various places of the pile. This stage may be considered completed if:
- The moisture content in the upper layers is lower than 15 %,
- The temperature of the entire volume of stored grains decreased below 18º C.

Stage III
In the last stage, ventilation is also interrupted. For the final values of grains for long-term storage, very cold winter air is used. This stage is completed when the temperature in the entire volume is lower than 10º C.

8. Chemical preservation

Utilised mainly in production. Permitted chemical agents applied to the grain effectively inhibit the physiological activity of the grain and its microflora. Not used for feed purposes. Agents based on organic acids serve for long-term grain preservation. They cause corrosion of steel parts and are thus used mainly in hangar-type storehouses. They are applied by spraying onto the grain flow on a conveyor, when flowing from the conveyor or on an en-masse conveyor. When applying chemical preservation, all safety regulations must be observed and safety documents must be at hand. The operator must be briefed on the principles of handling agents, their correct storage, dosage, application and hazardous characteristics by a worker in charge. The same applies to fungicides, see chapter 9.

9. Anti-fungus treatment of grains

The application of fungicides which inhibit fungus occurrence and stop their growth. They also destroy spores to stop the production of mycotoxins.
The active substances in fungus inhibitors include propionic acid, ammonia propionate and other organic acids and their salts. The agent must secure in-depth effect, i.e. overcome the grain's surface tension and enter the grain, it thus must include a special wetting agent. Anti-fungus treatment secures three effects:

- Preservation – Lasting preservation of the grain and prevention of fungus growth for up to 12 months,
- Elimination of fungi – Immediate elimination of fungus growth,
- Acidification – Penetration of the fungi cell wall and entry of the active ingredient inside the fungi.

The user must require the agent's safety documents, know its ingredients and the ratios of individual acids. Application is secured by a spraying device (supplied by the vendor of the agent), which secures the required dosage. After the application is carried out, active ventilation is no longer used and the protective period before release must be observed.

10. Quality inspection in the course of technological treatment

Drying check – Samples are taken by the worker operating the drying appliance, until the limit values for storage are achieved. The limit values for grain are 14 % moisture content in the case of storehouses without active ventilation and 16 % moisture content in the case of storehouses with active ventilation, and 8 % for oilseed rape.

Cleaning check – The content of impurities and contaminants, eventually the density of food grade grains, or percentage on the screen and the undersize percentage in the case of malting barley. A person in charge takes the samples and hand them over to the laboratory. This person marks the type of product, date, place of storage, or the analyses which are to be carried out, on the label or packaging. Results are recorded in the laboratory log and they may be used for declaring quality. Samples are not archived.

Fining check – Fining is carried out with the purpose of compacting, airing or gaining samples for quality evaluation by the laboratory. Non-aided evaluation of the sample is carried out as well.

11. Record-keeping

The respective records must be kept for all treatment procedures carried out on the goods (drying, cleaning, active ventilation, chemical preservation, anti-fungus measures, fining etc.). These records must be archived for the period determined by an internal directive.

12. Requirements for technical equipment

The used technical equipment must be in such a condition as to prevent any contamination of the goods (dripping oil etc.). The equipment must be secured against the entry of animals (birds etc.).

13. Process measuring and monitoring

Measuring and monitoring is secured using measuring and monitoring technology, which is approved, regularly checked calibrated etc. for this purpose. Measuring and monitoring of the post-harvest treatment procedure is determined by the operator in an internal directive.

BOHEMIAN-MORAVIAN UNION OF
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