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भारतीय मानक मसौदा

भंडारण प्रबंधन कोड
भाग 2 कृषि उत्पाद के रखरखाव और भंडारण में सामान्य देखभाल

[*आइ एस* 6151 *(भाग* 2*) का पहला पुनरीक्षण*]

Draft Indian Standard

STORAGE MANAGEMENT CODE
PART 2 GENERAL CARE IN HANDLING AND STORAGE OF AGRICULTURAL PRODUCE

[*First Revision of* 6151 (*Part* 2)]

ICS 55.220; 65.040.20

Foodgrains, Allied Products, and Other Agricultural Produce Sectional Committee, FAD 16	**Last Date of Comments:** 24 September 2024

FOREWORD

(*Formal clauses would be added later*)

Scientific storage of agricultural produce demands proper care of different commodities, construction of appropriate type of storage structures suitable for different commodities; hygienic transport, receipt, distribution and delivery of these commodities; maintenance of warehouse inspection records; etc. The standardized norms of storage management would help in overcoming issues related to general and specific care of agricultural commodities, calculation of storage space for various commodities, occupancy of storage structures, and calculation of cost of storage and construction. Such a code would, therefore, lead to overall improvement in storage at farmers', trade and government level and ultimately to overall economy in the storage of various agricultural commodities.

In India, there is a huge avoidable loss of agricultural produce during handling and storage. The loss may be due to improper handling or storage in structures not well equipped with provisions for minimizing the risk of infestation by insects, micro-organisms or rodents; seepage of ground and rain-water; and development of temperature gradient.

In addition to the insect pests given in Annex A, mites, psocids ants and termites, etc, also cause a nuisance at times in stored foodgrain. The presence of mites and psocids in large numbers gives the foodgrain a musty odour and due to their droppings, cast skins, etc, the foodgrain product becomes rancid and unwholesome.

Dampness or moisture affects stored foodgrain in several ways. Due to the absorption of excess moisture by foodgrain, its rate of respiration increases which produces more heat and the

foodgrain may start 'heating'. Even if the quantity of moist or dump foodgrain within a foodgrain mass be small, it may act as a centre for spreading 'heating'.

The process of such spreading of 'heating' takes place in the following manner:

> The heated air from the radiating point travels to cooler parts in the foodgrain mass, carrying along with it a higher percentage of moisture. The moisture brought by the heated air is condensed in the cooler parts resulting in the increase of the moisture content of the foodgrain there. With the increase of the moisture content in the foodgrain in cooler parts, the rate of respiration is accelerated and the original cooler parts start 'heating'. The phenomenon of transmission of moisture from one part to the other and subsequently, 'heating' continues in a cycle till arrested. Excessive 'heating' may result in cake formation. Micro-organisms also readily attack moist foodgrain. Increased moisture content of foodgrain due to dampness or moisture helps in the acceleration of insect breeding if the foodgrain is already infested. Sometimes, wet grain may sprout.

During transport, receipt and issue of agricultural produce avoidable losses often occur either due to negligence or ignorance on the part of the personnel handling the bags. Such losses may be due to spillage of foodgrain during loading and unloading, or due to faulty conveyance or vehicle, which may damage the bags, permitting the foodgrain to spill. The conveyances may be dirty and may contain deleterious contaminations or undesirable refractions which may be picked up by the bags of foodgrain transported in them. During rains, while transporting bags of agricultural produce, adequate protection may not be provided, and the foodgrain may become moist or wet which may subsequently result in its becoming heated, fungus attacked or caky. Though in India, vehicles are not earmarked for the transport of bags of foodgrain, in port towns and procuring or distributing centres, some vehicles are used continuously for a number of days for transporting bags of foodgrains. In such vehicles at times, bags containing insect infested commodities may be transported but, with appropriate disinfestation measures, insects may remain lurking in them. Such vehicles may thus form a source of insect infestation to the bags containing uninfested foodgrain.

The loss may, therefore, be avoided by scientific handling and storage. Besides the general norms of handling and storage of some agricultural produce, a number of them demand special care and arrangement.

With a view to providing general information on causes of loss in handling and storage of agricultural produce and guidelines on norms of scientific handling and storage of general and specific agricultural produce which would lead to better storage awareness and conditions in the country, this Indian Standard has been formulated.

This standard was published in 1971, and superseded IS 610 and IS 611 which dealt with foodgrains only and needed revision to incorporate the latest storage techniques and fumigation practices. The code covered an enlarged scope and also incorporated the relevant provisions given in the above standards.

In the current revision, the scope of the standard has been restricted to agricultural produce only and terminologies related to 'agricultural inputs' have been removed. In addition, following major changes have been incorporated:

i) guidelines for transit through head or shoulder loads or animal packs has been deleted, since animals are no longer used for transporting foodgrains;
ii) safe limits of moisture content for storage of various agricultural produce has been included in Table 2; and
iii) detailed precautions for storage of agricultural produce have been included; and
iv) Annex A regarding details of insect pests of stored agricultural commodities has been updated to categorize the insect pest as major and minor along with updation of pests and their images.

The other two parts of IS 6151 are as under:

Part 1 Terminology; and
Part 3 Specific care in handling and storage of agricultural produce.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 2022 'Rules for rounding off numerical values (*second revision*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

1 SCOPE

This standard (Part 2) prescribes general care in handling during transport, receipt and issue, and storage of agricultural produce.

NOTE – This standard does not deal with care of commodities which require cold storage.

2 REFERENCES

The standards given below contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of these standards.

IS No.	*Title*
IS 609 : 2020	Improvement of existing structures used or intended to be used for foodgrain storage — Code of Practice (*first revision*)
IS 631 : 1979	Specification for outdoor aluminium foodgrain storage bins (*first revision*)
IS 1943 : 1995	Textiles – A-twill jute bags (*second revision*)
IS 5503 (Part 1) : 1969	General requirements for silos for grain storage: Part 1 Constructional requirements
IS 5503 (Part 2) : 2020	General requirements for silos for grain storage part 2 Grain handling equipment and accessories (*first revision*)
IS 6151 (Part 1) : 2020	Storage management code Part 1 Terminology (*first revision*)
IS 7247 (Part 3) : 2023	Fumigation of agricultural produce — Code of practice Part 3 Aluminium phosphide (Phosphine) (*first revision*)
IS 7247 (Part 5) : 2023	Fumigation of agricultural produce — Code of practice Part 5 General requirements (*first revision*)
IS 16144: 2014	Foodgrain storage godowns – Code of practice

3 TERMINOLOGY

3.1 For the purpose of this standard, the definitions of terms given in Part 1 of this code shall apply. In addition, the following abbreviations have been used in the standard.

a) **BGSS —** Bag storage structure
b) **BKSS —** Bulk storage structure

4 REQUIREMENTS FOR BAGS FOR HANDLING AGRICULTURAL PRODUCE

4.1 Empty Gunny Bags for Filling of Agricultural Produce — Agricultural produce meant for transport shall be filled in sound, clean, insect-free and dry empty gunny bags. Empty gunny bags which are damaged due to moisture, or fungus, or are contaminated with deleterious substances, or those which have patches or cut portions exceeding 50 mm, shall not be used for transport of agricultural produce. Such of the empty gunny bags which have cut or torn portions not exceeding 50 mm, shall be so repaired that agricultural produce does not leak through them.

4.1.1 Empty gunny bags which have been used previously for storage or transport of agricultural produce shall be disinfested by dipping in a suitable insecticidal preparation or by fumigation [*see* IS 7247 (Part 3) and IS 7247 (Part 5)] before filling them with agricultural produce.

4.2 Uniformity of Bags — The bags of single consignment shall be of uniform size and weight, and shall contain the same type of agricultural produce. If the bags are slack, they shall be made up to the standard weight of the bags of the consignment prior to loading in conveyance.

4.3 Stitching of the Mouth of a Bag — The mouth of each bag meant for transport shall be stitched with machine or manually in which case the mouth shall be rolled over and given 14 stitches in each row. In case of machine stitching, 3-ply thread stitching with 18 twist giving about 5 stitches in 2.5 cm shall be used.

4.4 Protection Against Rain — Bags shall not be loaded or unloaded or otherwise handled in the open if it is raining.

4.5 Loss in Weight of Bags During Transport — During transport of a consignment of bags either in a vehicle, wagon or a boat, or in any other conveyance, no tolerance for loss in weight of total bags shall be allowed except in case of a cargo of a boat having been jettisoned during voyage. For determining loss in weight of bags during transport, as far as possible, 100 percent bags of a consignment meant for transport shall be weighed prior to loading in either a vehicle, wagon or a boat, or in any other conveyance, at the loading point, and then again re-weighed at the unloading point.

4.5.1 Failing 100 percent weighment of bags and in the absence of an agreement between the consigner, the transporting organization and the consignee, regarding the percentage of the bags to be weighed, the scale given in Table 1 is suggested as a guide for determining the total weight of the consignment.

Table 1 Suggested Scale for Weighing of Bags of a Consignment
(*Clauses* 4.5.1 *and* 4.5.2)

Sl. No.	Size of the consignment in number of bags	No. of bags to be weighed, picked at random	Permissible difference in average weight per bag at different weighing point in g
(1)	(2)	(3)	(4)
i)	Under 50	10	300
ii)	50 to 99	15	240
iii)	100 to 199	20	200
iv)	200 to 299	25	175
v)	300 to 499	30	150
vi)	500 to 999	50	125
vii)	1 000 to 5 000	100	100

NOTE — This table assumes normal variation of 450 g in the weight of individual bags and guarantees against loss in weight in 95 percent of cases.

4.5.2 If the total weight of a consignment is found to vary at any one weighing point from that at any other weighing point by more than the permissible difference specified in *col* 4 of Table 1, the consignment shall be considered to have undergone loss in weight during transit.

5 HANDLING OF AGRICULTURAL PRODUCE IN TRANSIT

5.1 Transport of bags by motor vehicle

5.1.1 *Vehicle* — A vehicle which is either damp, dirty or containing deleterious contamination shall not be used for the transport of bags.

5.1.1.1 The vehicle shall have a sound floor so that even if the bags burst or otherwise get damaged during transport, the agricultural produce does not spill out of vehicle. The floor of the vehicle shall be scrubbed clean and dry.

5.1.1.2 In case of bulk transport of agricultural produce, a sound, clean and dry sheet of a suitable size shall be spread in the vehicle so as to cover the entire floor space of the vehicle, where necessary, to avoid leakage.

5.1.1.3 If the same vehicle is used continuously for transporting bags, the floor and sides of the vehicle shall be sprayed with 0.5 percent malathion emulsion by the method prescribed in Annex B, on every seventh day of the continuous use of the vehicle.

5.1.2 *Loading of the Bags in the Vehicle* — A vehicle shall not be loaded to more than its certified capacity.

5.1.2.1 Prior to the commencement of loading of bags in the vehicle, sound, clean and dry sheets of suitable size shall be spread on the ground all along the passage from the loading point to the vehicle and also round about the vehicle so that all spillages of foodgrain during loading of the bags fall on the sheet and not on the ground. If the spillages are perfectly clean, they shall be bagged and put in the same consignment; if the spillages get dirty, they shall be treated as sweepings in the manner given under **5.1.2.2**.

5.1.2.2 *Sweepings* — Sweepings shall be sieved, winnowed and cleaned, and the sound foodgrain recovered. The recovered sound foodgrain shall be blended with rest of the grain and bagged. The remnants of the sweepings, after the recovery of the sound foodgrain, shall be disposed of by burning, dumping or diverted for industrial or manual use.

5.1.2.3 *Stacking of bags in the vehicle* — The bags shall be stacked in the vehicle according to a stack plan avoiding bays and lop-sided heaping and also ensuring compact and balanced stacking so as to make the bags least susceptible to movements and jerks due to the movement of the vehicle.

5.1.3 *Securing of Bags on the Vehicle* — The stack in the vehicle shall be tied securely so that when the vehicle is in motion, the bags do not get dislodged or drop out.

5.1.3.1 During rainy weather, the stack in the vehicle shall be covered with sound, clean and dry waterproof tarpaulins in such a manner that when it rains, the water does not reach the bags.

The loose edges of the tarpaulins covering the sides of the stack shall be well spread over so as to hang free over the sides of the vehicle and not tucked under the stack.

5.1.4 *Despatch Order* — The supervisor of the vehicle, before the vehicle leaves the despatching point, shall be handed over a despatch order bearing the following information:

a) date of despatch;
b) kind of vehicle;
c) vehicle number;
d) name of driver;
e) kind of agricultural produce;
f) total number of bags;
g) average weight of bags;
h) gross weight of a vehicle;
j) gross weight of the bags (if available);
k) despatching point;
m) receiving point;
n) approximate mileage between the despatching point and receiving point;
p) approximate time require for the vehicle to cover the distance;
q) signature of despatching authority, with designation; and
r) name and address of consignee.

5.1.5 *Checking of Contents of Despatching Order at the Unloading Point* — On arrival of the vehicle at the receiving point, the receiving authority shall check up all the information given in the despatch order (*see* **5.1.4**).

5.1.6 *Unloading of Bags from the Vehicle* — Prior to the commencement of unloading of the vehicle, sound, clean and dry sheets of suitable size shall be spread on the floor all along the passage from the vehicle to the unloading point and also round about the vehicle so that all spillages of foodgrain during unloading of the bags fall on the sheet and not on the ground. If the spillages are perfectly clean, they shall be bagged and put in the same consignment; If the spillages get dirty, they shall be treated as sweepings and shall be dealt with in the manner given under **5.1.2.2.**

5.2 Transport of Bags by Railway Wagon

5.2.1 *Storage of Bags at Despatching Station* — The floor, on which stacks are built, shall be dry and clean. As far as possible, care shall be taken to provide a place having a leak-proof roof and sound solidity built floor for the storage of bags. If the floor is not solidly built, or is otherwise unsuitable for the storage of foodgrain, dunnage of either old discarded rails or timber pallets or 10 cm x 10 cm timber squares shall be made perfectly of hard and well-seasoned timber, and shall not have such cracks in which insects may hide. The rails or the pallets or the squares shall be laid parallel to one another, and shall not be more than 15 cm apart. Before laying the dunnage, it shall be brushed clean.

5.2.1.1 The stack shall be stable. There shall be at least 75 cm clear space all round the stack. Deleterious substances shall not be placed in the vicinity of the stack.

5.2.1.2 If leak-proof roofed place for storage is not available, the stacks shall be covered with sound, clean and dry waterproof tarpaulins of suitable size in such a manner that no part of the stack is exposed to rain. The loose edges of the tarpaulins covering the sides of the stack shall

be well spread out on the ground abutting the stack and not tucked under the stack. In the event of rain, it shall be ascertained that no water reaches the bags.

5.2.2 *Wagon* — Wagon shall be of the closed type and shall be sound, leak-proof and without any structural defect. A wagon falling in any one of the following categories shall not be used for transport of bags:

a) Wagon having damaged floor, sides or roof, or otherwise structurally defective;
b) Wagon having defective doors, or having such doors which do not close properly, or which are not close fitting; and
c) Wagon having traces of deleterious contaminations, such as coal, sand, cement, mineral oils, chemical, bone meal, or some other deleterious material or commodity.

5.2.2.1 The floor, inner sides including the inside surface of the doors and ceiling of the wagon, shall be scrubbed clean.

5.2.3 *Loading of Bags in the Wagon* — Prior to the commencement of loading of bags in a wagon, its interior shall be thoroughly cleaned. If the spillages are perfectly clean, they shall be bagged and put in the same consignment; if the spillages get dirty, they shall be treated as sweepings and dealt with in the manner given under **5.1.2.2.**

5.2.3.1 *Stacking of bags in the wagon* — The bags shall be stacked in the wagon according to a stack plan avoiding bays and lop-sided heaping and also ensuring compact and balanced stacking so as to make the bags least susceptible to movements and jerks due to either movement or shunting of the wagon. Care shall also be taken that at least 30 cm clear space is left between the doors and the stack. Some buffer in the form of dummy bags filled with hay, husk of *bhoosa,* shall also be provided at the door. As far as possible, no other commodity shall be placed in the wagon containing bags of agricultural produce. However, if plenty of room is available in the wagon and some other commodities are to be placed, these commodities shall be only those which are not likely to have any deleterious effect on the agricultural produce.

5.2.3.2 Immediately after loading of the wagon is completed, the wagon shall be closed and scaled.

5.2.4 *Label for the wagon* — After sealing the wagon a label bearing the following information shall be fixed to the wagon:

a) wagon number;
b) date of despatch;
c) kind of agricultural produce;
d) number of bags;
e) average weight of a bag;
f) total weight of the bag;
g) despatching station;
h) receiving station;
j) address of the consigner; and
k) address of the consignee.

5.2.5 *Midway Trans-Shipment of Bags* — In the event of midway trans-shipment of bags from the original wagon, necessitated by damage to the original wagon, change of railway gauge, or

any other person, the bags of the original wagon, as far as possible, shall be loaded straightaway. If trans-shipment of the bags from the original wagon to the transferee wagon is not possible and the bags have to be unavoidably unloaded from the original wagon, the unloading of the bags shall be done in the manner given under **5.2.5.1**.

5.2.5.1 *Unloading of the bags* — Before the commencement of unloading of bags from the wagon, sound, clean and dry sheets of suitable size shall be spread on the floor all along the passage from the wagon to the unloading point and also just below the door of the wagon so that all spillages of foodgrain while unloading the bags fall on the sheets and not on the ground. If the spillages are perfectly clean, they shall be bagged and put in the same consignment; if the spillages get dirty, they shall be treated as sweepings and dealt with in the manner given under **5.1.2.2.**

5.2.5.2 *Storage of bags at trans-shipment station* — The unloaded bags at the trans-shipment station shall be stored according to the conditions prescribed under **5.2.1, 5.2.1.1** and **5.2.1.2.**

5.2.5.3 *Loading of bags in the transferee wagon* — At the time of reloading the bags into the transferee wagon, the provisions given under **5.2.3, 5.2.3.1** and **5.2.3.2** shall be followed.

5.2.6 *Care During Movement of Wagon* — At all intermediate stations enroute, the railway authorities shall provide adequate watch and ward arrangements for the safety of the wagon so that no tampering of the wagon or its seal, or pilferage of agricultural produce takes place.

5.2.7 *Inspection of Seal of the Wagon at the Receiving Station* — On arrival of the wagon at the destination, the seal of the wagon shall be examined and, if broken, necessary record shall be maintained by the railway authorities.

5.2.8 *Checking of Contents of the Label of the Wagon* — The contents of the label of the wagon (*see* **5.2.4**) shall be checked by the railway authorities at the destination and necessary record maintained by them.

5.2.9 *Unloading of Bags at the Receiving Station* — At the time of unloading the bags from the wagon, the provisions given under **5.2.5.1** shall be observed.

5.2.10 *Storage of Bags at the Receiving Station* — The bags shall be stored at the receiving station according to the conditions given under **5.2.1, 5.2.1.1** and **5.2.1.2.**

5.3 Transport of Bags by Country or Steam Boat

5.3.1 *Acceptance of Bags for Transport by Boat Authorities at Despatching Jetty* — The boat service authorities at the despatching jetty shall give priority to the work of despatching of bags.

5.3.2 *Storage of Bags at Despatching Jetty* — The provisions given under **5.2.1, 5.2.1.1** and **5.2.1.2** shall be observed.

5.3.3 *Place in the Boat for Stacking of Bags* — If the boat has got a hold, it shall be ascertained that the hold is leak-proof and dry and also that it does not contain any traces of deleterious contamination. The floor and sides of the hold, and also the planks used for covering the hold,

shall be scrubbed clean and sprayed with 0.5 percent malathion emulsion in the manner prescribed in Annex B, every time a fresh cargo of bags is placed on it.

5.3.4 *Loading of Bags in the Boat* — The boat shall not carry more cargo than its certified capacity.

5.3.4.1 Prior to the commencement of loading of bags in a boat, sound, clean and dry waterproof sheets of suitable size shall be spread on the jetty all along the passage from the loading point to the jetty and all along the passage from the boat and touching the jetty to the place for stacking of bags, so that all spillages of foodgrain during loading of bags fall on the sheets and not on the jetty or in the boat. If the spillages are clean, they shall be bagged and put in the same cargo; if the spillages get dirty they shall be treated as sweepings and dealt with in the manner given under **5.1.2.2.**

5.3.4.2 *Stacking of bags in the boat* — The bags shall be stacked in the hold or on the deck according to a stack plan, avoiding bays and lop-sided heaping and also ensuring compact and balanced stacking so as to make the bags least susceptible to movements of the boat.

5.3.4.3 If the bags are stacked on the deck, sound, clean and dry waterproof tarpaulins of suitable sizes shall be spread over the stack in such a manner that no part of the stack is exposed to rain or splashes of water. The loose edges of the tarpaulins covering the sides of the stack shall be well spread out on the floor abutting the stack and not tucked under the stack. A 75 cm clear space shall be left all-round the stack. Deleterious substances shall not be placed in the vicinity of the stack.

5.3.5 *Label for Cargo*

5.3.5.1 Each cargo of bags shall have a label bearing the following information:

a) name of the boat;
b) date of despatch;
c) kind of agricultural produce;
d) total number of bags;
e) average weight of a bag;
f) total weight of the bags;
g) despatching jetty;
h) address of the consigner; and
j) address of the consignee.

5.3.6 *Care During Voyage of the Boat* — Proper care shall be taken by the crew of the boat during the voyage of the boat so that the bags are not damaged en route, particularly by water.

5.3.7 *Checking of Contents of the Label for the Cargo of Bags at the Receiving Jetty* — The contents of the label for the cargo of the boat (*see* **5.3.5.1**) shall be checked by the boat service authorities at the receiving jetty and necessary record maintained by them.

5.3.8 *Unloading of Bags at the Receiving Jetty* — Prior to the commencement of unloading of the bags at the receiving jetty, sound, clean and dry waterproof sheets of suitable size shall be spread on the boat all along the passage from the jetty to the unloading point to the boat end touching the jetty and also from the jetty to the unloading point so that all spillages of

agricultural produce during unloading of the bags fall on the sheets and not on the boat or the jetty, If the spillages are perfectly clean, they shall be treated as sweepings, and dealt with in the manner given under **5.1.2.2.**

5.3.9 *Storage of Bags at the Receiving Jetty* — The bags shall be stored at the receiving jetty in the manner given under **5.2.1, 5.2.1.1** and **5.2.1.2.**

6 METHOD OF STORAGE

6.1 Agricultural produce shall be stored either in bags or in bulk. While the modern bag storage facilities may protect commodities from rodents and dampness, they are not bird-and insect-proof. Moreover, in these efficient fumigation may not be possible without special care. It is, therefore, recommended that, wherever possible, agricultural produce may be stored in bulk, which is economical in space and storage may be possible for periods from 2 to 5 years with ease of fumigation and mechanization of handling operations. however, certain agricultural produce like rice, sugar, certain oilseeds are not recommended for bulk storage, since they suffer loss in quality.

6.2 Bag storage structures like storage godowns (*see* IS 16144) and bulk storage structures like steel or aluminium bins (*see* IS 631) for farmer's storage and silos [*see* IS 5503 (Part 1) and IS 5503 (Part 2)] for trade and government purposes are suitable for scientific storage.

7 RECEIPT OF AGRICULTURAL PRODUCE FOR STORAGE

7.1 At the time of receipt, agricultural produce carriers like trucks, wagons or carts shall be carefully inspected for dump and infested agricultural produce.

7.2 Wagon or truck dumps receiving grain for storage should be provided with suitable sieves to separate hay, stones, etc.

7.3 Temporary sheds and weighing scales receiving bags or loose grain for storage should be cleaned prior to receipt of agricultural produce.

7.4 Wagon or truck dumps, temporary sheds and weighing scale should be provided protection against rain.

8 CARE PRIOR TO BAG STORAGE

8.1 Bag Storage

8.1.1 *Bags* — Bags used for storage shall be either new or sound second hand bags. As far as possible, B-twill bags shall be employed for foodgrains. However, A-twill bags (*see* IS 1943) shall be used for sugar.

8.1.1.1 After filling the bags, the mouth of each bag shall be hand stitched or machine stitched with at least 14 stitches in each line.

8.1.1.2 If sound second-hand bags are used, they shall be fumigated as per method prescribed in IS 7247 (Part 3) and IS 7247 (Part 5), before filling them with agricultural produce.

8.2 Examination and Segregation of Damaged Bags or Bags Containing Damaged Agricultural Produce

All bags, prior to storage, shall be examined, and such of the damaged bags or those containing damaged agricultural produce as given below, shall be segregated:

a) Bags which are cut, torn, slack or have deleterious contaminations; and
b) Bags which contain agricultural produce either damaged due to insect infestation, moisture, dampness or having deleterious refractions or contamination.

8.3 Damaged Bags

The damaged bags [*see* **8.2** (a)] shall be dealt with in the manner mentioned below:

a) Bags damaged due to moisture, fungus or deleterious contaminations, or those unduly damaged or cut shall be discarded and replaced.
b) Slack bags shall be made up to the average weight of bags of the lot.

8.4 Damaged Agricultural Produce

Bags containing damaged agricultural produce [*see* **8.2** (b)] shall be dealt with in the manner mentioned below:

a) *Insect-Infested Agricultural Produce* — Bags containing insect infested agricultural produce shall be fumigated [*see* IS 7247 (Part 3) and IS 7247 (Part 5)].
b) *Moist Agricultural Produce* — If the moisture content exceeds the level given in Table 2, agricultural produce shall be treated to safe moisture level. Drying of agricultural produce may be done either in the sun or by means of mechanical driers. However, rice shall not be dried in the sun.
c) *Heated Agricultural Produce* — If the agricultural produce feels hot on the palm of hand, but no cake formation has set in, it shall be aerated by spreading in layers not exceeding 2.5 cm in thickness on a smooth plastered, dry and clean floor inside the BGSS. In no case shall heated agricultural produce be exposed to the sun.
d) *Fungus-Attacked, Caky or Sprouting Agricultural Produce* — Such agricultural produce shall be disposed of for animal feed or industrial use, as the case may be.
e) *Agricultural Produce Containing Deleterious Refractions or Contaminants* — Agricultural produce contaminated with pesticide shall be either disposed of for industrial purpose (conversion to inedible products) or dumped in manure pits. Contaminants like fertilizers and coal shall be suitably removed before agricultural produce is used for human or animal consumption.

Table 2 Safe Limits of Moisture Content for Storage of Agricultural Produce
[*Clauses* 8.4.2 (*b*) *and* 10.1.2]

Sl. No.	Commodity	Moisture, Percent
(1)	(2)	(3)
	Cereals and Millets	
i)	Paddy	14.0
ii)	Raw rice	14.0

iii)	Boiled rice	14.0
iv)	Wheat	12.0
v)	*Jowar*	12.0
vi)	Maize	12.0
vii)	Barley	12.0
viii)	*Ragi*	12.0
ix)	*Bajra*	12.0
	Pulses	
x)	Pulses (whole)	12.0
xi)	Pulses (broken)	12.0
xii)	Gram *Kabuli*	12.0
xiii)	Gram *Desi*	12.0
	Milled Products and Bran	
xiv)	Wheat *Atta*	12.5
xv)	*Maida*	12.5
xvi)	*Besan*	12.5
xvii)	*Rava or Suji*	13.5
xviii)	Rice bran	10.0
xix)	Maize bran	10.0
	Spices and narcotics	
xx)	Turmeric	12.0
xxi)	Coriander	10.0
xxii)	Black pepper	10.0
xxiii)	Chillies	10.0
xxiv)	Cumin seed	10.0
xxv)	Fenugreek (whole)	10.0
xxvi)	Fennel seed	11.0
xxvii)	Coffee	9.0
xxviii)	Tobacco	10.0
xxix)	Cloves	12.0
	Oilseeds and Cakes	
xxx)	Groundnut pods	6.0-7.0
xxxi)	Mustard	7.0
xxxii)	Milling copra	5.0-8.0
xxxiii)	Decorticated groundnut oilcake	8.0-10
xxxiv)	Groundnut oilcake	10.0
xxxv)	Mustard oilcake	10.0
xxxvi)	Cottonseed oilcake	10.0
xxxvii)	Coconut oilcake	10.0
xxxviii)	Sesamum oilcake	10.0
xxxix)	Linseed oilcake	10.0
xl)	Castor seed oilcake	8.0
	Root Crops and Starch	
xli)	Arrowroot	13.0
xlii)	Edible tapioca	13.0
xliii)	Sago (*Saboodana*)	12.0

8.5 Preparation of BGSS

Before storage of agricultural produce, disinfestation of vacant BGSS shall be done, as per the method suggested in Annex A of IS 609.

8.6 Capacity of BGSS

In order to avoid overloading of storage space, the capacity of a BGSS shall be roughly estimated at the rate of 10 bags (each bag weighing approximately 93.2 kg to 102.6 kg) per 0.6 m^2 if stacked 15 bags high, 10 bags per 0.65 m^2 if stacked 12 bags high, and 10 bags for 0.7 m^2 if stacked 10 bags high.

8.6.1 While estimating the height of the stacks, care shall be taken to see that a minimum of 2 m clear space is left between the top surface of the stack and the inside surface of the roof (or ceiling).

8.6.2 The maximum height to which the bags of agricultural produce may be placed in a stack depends upon the load bearing capacity of floor, nature of commodity, strength of container, etc. However, for practical purpose, the maximum general height of stacks for different agricultural produce shall not exceed the limits given in Table 3.

Table 3
Maximum Stack Height for Bag Storage of Agricultural Produce
(*Clauses* 8.6.2)

S. No.	Agricultural produce	Maximum General Stack Height (Bags) – Unit	Approximate Height in Metres
(1)	(2)	(3)	(4)
i)	Sugar (packed in A-twill bags)	24	6
ii)	Turmeric	18	4.5
iii)	Wheat, maize, barley, paddy, oats, grain and other unmilled whole pulses, sorghum, other millets, oilseeds, oilcakes, and coffee seeds	16	4
iv)	Spices, cotton bales, groundnut, and rice, rice bran, and milled pulses	14	3.5
v)	Wheat flour, gram flour, semolina, broken pulses, other milled products, cashew nut kernels	12	3
vi)	Tamarind and jaggery chips in bags	6	1.5
vii)	Jaggery lumps	—	1 to 1.5

8.6.3 *Stack space* — Depending upon the capacity of the BGSS, and size of fumigation cover available, the floor area shall be marked into a number of rectangular or square stack spaces. Care shall be taken to leave alleyways of 75 cm minimum width between the stacks and walls and also in between the stacks. The width of the alleyways in front of door opening should be 150 cm. The length and breadth of a stack shall be not more than 9 m and 6 m, respectively.

8.7 Dunnage

Dunnage comprising either timber pallets, timber squares, mattings or a layer of polythene sheet sandwitched between two layers of mattings shall be laid on each stack space. The pallets or squares shall be made preferably of hard and well-seasoned timber and shall be free from any cracks which may harbour insects. They shall be laid parallel to each other and shall be not more than 15 cm apart. Before laying the dunnage it shall be brushed clean.

8.7.1 Squares shall be exactly equal to either the length or the breadth of the stack space.

8.7.2 In absence of timber pallets or square, 2 to 3 layers of mattings or a layer of polythene sheet sandwiched between two layers of bamboo matting shall be used.

8.7.3 After laying the dunnage, the floor space between them as well as the dunnage itself shall be sprayed with 0.5 percent malathion emulsion.

8.8 Stacking of Bags

8.8.1 *Bags* — All bags in a given stack shall be of uniform size and weight.

8.8.2 *Building of Stack* —The stack shall be built over the dunnage as laid on the stack spaces.

8.8.2.1 The stack shall be so built that when completed, it is stable and perfectly cuboid in shape and also that all peripheral bags on the faces of the stack are in one plane without any face of the stack bulging outward or inward at any point.

8.8.2.2 Care shall be taken to see that the stitched mouth of the bags shall not face the peripheral side of the stack.

8.8.2.3 After the completion of a stack, it shall be sprayed with alumimium phosphide as per the method prescribed in IS 7247 (Part 3) and IS 7247 (Part 5).

8.8.3 All spillages during building of a stack shall be collected and separately dealt with as sweepings in the manner given under **5.1.2.2** and not thrown over or placed in the stack.

9 CARE DURING BAG STORAGE

9.1 The inside of the BGSS shall be kept thoroughly clean, and sweepings collected from time to time shall be dealt with as given under **5.1.2.2.**

9.2 *Accessories for Storage* — Empty bags, tarpaulins, dunnage and such other accessories, not in use shall also be treated for disinfestation purposes, where there is little likelihood of their becoming infested. They shall be treated by the method prescribed in IS 7247 (Part 3) and IS 7247 (Part 5).

9.3 Empty second-hand gunny bags shall be made up in rolls of 20 bags each and stored at one place. As and when necessity arises, empty second-hand gunny bags shall be treated by the method prescribed in IS 7247 (Part 3) and IS 7247 (Part 5).

9.4 Periodical Inspection and Treatment of Stacks — Each stack shall be inspected at least once in two weeks to check the condition of agricultural produce. Agricultural produce may be inspected for any increase in moisture content and temperature, and damage by pests. A list of principal major and minor insects of stored agricultural produce with their scientific and common names and distinguishing characteristics and nature of damage caused by them is given in Annex A.

9.4.1 Draw a sample of 500 g (250 g from top and 250 g from four sides) from 40 to 50 bags taken at random from each stack of 1 000 bags. In this composite sample look for insect infestation of major and minor insect pests and excess moisture.

9.4.1.1 *Classification of infestation* — The insect infestation shall be classified as negligible, moderate or heavy depending upon number of major and minor pests found in the sample of 500 g. The stack having moderate infestation shall be fumigated [*see* IS 7247 (Part 3) and IS 7247 (Part 5)].

9.4.1.2 If rats are observed doing damage, their points of entry in the BGSS shall be checked up and necessary measures to protect their ingress as given in IS 609, adopted. In addition, poison baiting by the method prescribed in Annex C of this standard shall be taken recourse to inside the BGSS.

9.4.1.3 If it is observed that damage is being caused by dampness due either to seepage of water from the floor or from the walls of the BGSS or due to leakage of rain-water, the source of dampness or rain shall be removed by adopting necessary measures for protection against ingress of dampness or rain as given in IS 609. Also the stack shall be broken and the damaged agricultural produce segregated and undamaged agricultural produce salvaged.

9.4.2 Each stack shall be periodically fumigated [*see* IS 7247 (Part 3) and IS 7247 (Part 5)].

9.4.3 All cut bags in the stacks shall be either suitably repaired or replaced.

9.4.4 Each stack shall bear a tally card giving details of date of receipt; origin; kind of agricultural produce; number of bags and average weight of each bag; nature of dunnage provided; date of dispatch; date of inspection; condition of grain and nature of infestation; category of infestation; treatment, if any; and signature and remarks of the inspector.

9.4.5 It is recommended that an agricultural produce storage warehouse sanitation check list as prescribed in Annex D shall be maintained at all warehouses. This shall assist inspectors in maintaining cleanliness in warehouses and carrying out timely operations.

9.4.6 Special care involved in storage of various agricultural produce shall be as laid down in Part 3 of this standard.

10 CARE PRIOR TO BULK STORAGE

10.1 Examination and Segregation of Damaged Agricultural Produce — Agricultural produce prior to storage shall be examined for damage due to moisture, insect pests, etc, or deleterious refractions and contamination, and shall be segregated.

10.1.1 Agricultural produce damaged with insect pests, rodents, moisture, etc, shall be dealt with in the manner given in **8.4 (a)** and **8.4 (b).** Agricultural produce containing deleterious refractions or contaminants shall be dealt with in the manner prescribed under **8.4 (e).**

10.1.2 It shall be ascertained before filling in agricultural produce that the moisture content does not exceed the moisture levels given in Table 2.

10.2 Preparation of BKSS

10.2.1 Before filling in the agricultural produce, the BKSS shall be thoroughly cleaned and disinfested.

10.2.2 Prior to filling in agricultural produce, the temperature sensory devices, fumigation system, air controlling accessories and other openings, if provided inside a BKSS, shall be thoroughly checked and repaired, if necessary.

10.3 Filling of Agricultural Produce in BKSS

10.3.1 Agricultural produce shall be filled in a BKSS taking care to leave about 30 cm from the ceiling, irrespective of the type of structure. While loading agricultural produce, some of the covers on opening of the roof should be removed as an escape for trapped air.

10.3.2 All spillages during the filling of the foodgrain in the BKSS shall be collected and separately dealt with as sweepings in the manner given under **5.1.2.2** and never allowed to be mixed up with the bulk of foodgrain**.**

11 CARE DURING BULK STORAGE

11.1 Inspection and Treatment — Agricultural produce in BKSS shall be regularly inspected at monthly intervals.

11.1.1 Opening of BKSS — In case the agricultural produce is previously treated, all the openings of the BKSS above the level of the agricultural produce mass stored inside shall be thrown open. These openings shall be kept open for a period of about 12 hours, during which period, nobody shall be allowed to approach them, unless wearing a mask.

11.1.2 After the openings have thus been kept open for about 12 hours, samples of the stored agricultural produce shall be drawn from 10 different points within the grain mass as far removed from one another as practicable. These samples shall be drawn with the help of a bulk sampling tube. The sampling tube shall be of sufficient length so as to be able to reach the bottom of the stored AGM mass. Each sample shall be examined separately for:

a) Moisture content;
b) Heating;
c) Fungus attack and cake formation; and
d) Insect infestation.

11.2 Classification of Infestation – Classification of agricultural produce for insect infestation shall be done as given in **8.4 (a).** In case of infestation demands treatment, the structure shall be closed and the agricultural produce shall be fumigated as per guidelines laid down in IS 7247 (Part 3) and IS 7247 (Part 5)

12 ISSUING OF AGRICULTURAL PRODUCE

12.1 At the time of issue of bags, the most important criterion in determining priority of issue, irrespective of the fact whether agricultural produce was received earlier or later, shall be the extent of damage to the agricultural produce. To illustrate: agricultural produce which is most damaged shall be issued first while the least damaged or sound agricultural produce issued last. Also, small lots of agricultural produce left over from larger lots after earlier issues shall be given priority in issue.

12.1.1 The stack shall be so broken as to cause least disturbance to bags. After taking out the bags to be delivered the stack shall be properly rebuilt.

12.2 Sometimes due to dampness, damaged agricultural produce placed in the interior of the stack, is not readily discernable during storage. Such damaged agricultural produce shall be dealt with as given under **8.4 (b), 8.4 (c)** and **8.4 (d)** as the case may demand. This shall be observed at the time of issue.

12.3 After issue of foodgrain, the BGSS and BKSS shall be thoroughly cleaned and disinfested.

13 SAFETY PRECAUTIONS

13.1 Good hygiene at the storage depot is the most important in maintaining grain quality.

13.2 Individual sheds should be kept clean by sweeping the floor, removing cobwebs, dust, and collecting spilled grains in *palla* bags on a daily basis.

13.3 Alleyways & gangways should always be kept free for adequate aeration.

13.4 Unserviceable articles and old gunnies must not remain in sheds and be shifted to isolation sheds once found redundant.

13.5 Godowns should be cleaned before storage of new crops. All cracks, crevices, and holes in the floors, walls, and ceilings should be properly sealed.

13.6 Godown/shed should be water/ seepage proof.

13.7 Walls, crevices, and wooden pallets should be sprayed with approved insecticide before re-use.

13.8 Proper dunnage materials like wooden /plastic crates or other suitable materials must be used.

13.9 Foodgrains should be kept in stores that are rat-proof. All rat burrows should be closed with a mixture of broken glass pieces and mud and then plastered with mud/cement.

13.10 Trucks or trollies used for the transportation of foodgrains should be free from insect infestation.

13.11 Proper stacking of bags helps in grain protection from attack of insect pest.

13.12 Inspect the stored grain at least once in a fortnight for signs of insect infestation like adult insect, eggs, pupa/ pupal cases, faecal materials, webbings, frass, and holes on the grain. Under good conditions, the duration of the development cycle from egg to adult is 18 - 25 days for beetles and 28 - 35 days for moths. In unfavourable conditions, this period may be extended to several months.

13.13 Aeration of stored foodgrains dissipates heat given out by the respiratory activity of the grains. It also changes the ecology and disturbs insect growth and development and insect activity is suppressed. During bright sunny days and clear weather, all the gates of the godowns should be kept open.

13.14 Insect activity and fertility are also affected by the change in light. Moths are most active at dawn and at dusk. Inspections to check and control flying insects are best made at these times. Artificial light can help to reduce the movement and fertility of moths.

13.15 Light traps can also help in the early detection of insect pest attacks/populations.

ANNEX A
(*Forward and Clause* **9.4**)
INSECT PESTS OF STORED AGRICULTURAL COMMODITIES

A-1 INTRODUCTION

A-1.1 Stored grains and milled products like cereals, pulses, oil seeds, spices, copra, tobacco, cocoa, flour, oilseed extractions, processed and packaged food are subjected to attack by a group of insect pests that have adopted themselves to a diet of dried vegetable material. These pests damage the food and make it unfit for human consumption. The tropical climatic conditions as in India are more conducive to continuous occurrence of stored grain pests throughout the year. Many of them are able to live and thrive on foods that are almost devoid of water.

A-1.2 A number of insect pests get access to grain storage at various stages of processing of foodgrains/seeds like standing crops in the field, thrashing yards, transit and storage. There are about 1 000 species mainly from order *Coleoptera* and *Lepidoptera* being associated with stored food material in different parts of the world. They cause substantial qualitative and quantitative losses by damaging and contaminating the foodgrains. Losses caused by insects include not only the direct consumption of kernels, but also include accumulations of frass, exuviae, webbing, dead insects and undesirable odours. Insect-induced changes in the storage environment may cause warm, moist 'hotspots' that are suitable for the development of storage fungi that cause further losses. Worldwide losses in stored products, caused by insects, have been estimated to be between five and ten percent.

A-2 CLASSIFICATION OF PESTS

A-2.1 Based on feeding habits the stored grain pests are classified as: Primary and secondary pests.

A-2.2 Primary/major pests are those that are capable of penetrating and infesting intact kernels of grain, and have immature stages that can readily develop within a kernel of grain.

A-2.3 Secondary/minor pests cannot infest sound grain but feed on broken kernels, debris, higher moisture weed seeds, and grain damaged by primary insect pests.

A-3 MAJOR INSECT PESTS

a) Rice weevil (*Sitophilus* spp)
b) Lesser grain borer (*Rhizopertha dominica)*
c) Khapra beetle (*Trogoderma granarium)*
d) Pulse beetle (*Callosobruchus* spp)
e) Angoumois grain moth (*Sitotroga cerealella)*
f) Warehouse/Almond moth (*Ephestia cautella)*

A-3.1 Rice Weevil (*Sitophilus oryzae*) – It is a major pest of whole cereal grains and cereal products besides peas, chestnuts, cotton seeds. The weevils also feed on biscuits, waffles, bread & tobacco. Adult is 2.5 mm – 3.5 mm long, body reddish brown with a long snout, having four distinct light reddish spot on the four wings. Life cycle requires 25 days at 30°C and 70 percent relative humidity but it takes 15 weeks at 18°C, breeding stops below 15°C. Eggs are laid singly in the prepared hole in grain and covered with waxy plug, larvae immobile generally not seen as they develop inside the single grain where it pupates till emergence of adults. Adults

live 2-3 months; each female lays 300 - 400 eggs during this period. Since larvae feed and develop inside single grains are generally not visible. Adults rarely fly, but climb vertical surfaces (e.g. glass jar). Both larvae and adult are capable of causing damage.

A-3.2 Lesser Grain Borer (*Rhizopertha dominica*) – It is a small but highly destructive, major pest of whole cereal grains, other seeds. This also feeds on dried potatoes, tapioca and herbs. Adult is 2-3 mm long with club like antennae, black, brown with cylindrical body, head pointing downwards and not visible in dorsal view. It has got powerful mandibles to bore through whole grains. Life Cycle is completed in 25 days at 34°C. and 70 percent relative humidity, but it takes seven weeks at 22°C. breeding stops below 18°C females lay between 200 – 400 eggs on grain surface. Eggs are laid in clusters. Larvae in initial stages are mobile but become immobile when older, adult beetles are strong flyers. Young larvae (white with brown heads) initially feed outside then bore into the grain, eating out entire starchy interior and the seed coat leaving irregularly shaped holes. Adults live for 2 - 3 months. Both larvae and adult are capable of causing damage.

A-3.3 Khapra beetle (*Trogoderma granaries*) – It is a voracious feeder of all types of cereal grains, cereal products, pulses, nuts, oilseed cake, fish meal etc. The larvae completely consume the inner contents of the grains, just leaving the outer shell. Generally adult are convex in shape, 2 mm to 3 mm long with light markings on wings. Larvae are typically hairy. Life cycle is completed in 27 days at 32°C. and 70 percent relative humidity as the larva has the ability to undergo facultative diapause, the life cycle varies from 4 weeks to several years depending up on the temperature and the food supply. Eggs are laid at random, larvae mobile concealed in cracks and crevices cost skins left throughout the infested food. can survive unfavourable condition for several years. adult short lived, does not feed. Adults do not cause any damage; larvae are only damaging.

A-3.4 Pulse beetle (*Callosobruchus maculatus*) – It is a serious pest of Cow pea beans, peas, mung beans etc. Adults are (upto 4 mm) long, reddish brown with black and grey marking,

characteristic shape, covered in short hairs, long antennae. Life cycle is completed in 21 days at 32°C, 90 percent relative humidity. Eggs are struck outside the beans. Larvae on hatching bore into the seed, make round window before pupation. Adults come out through this window but do not feed. Adults have got short lifespan of only 10 –12 days during which about 100 eggs are laid, which are easily spotted as white spots on the outside of pulses. Wing covers (elytra) do not fully cover the abdomen. Adults may also lay eggs on mature seed pods in a standing crop.

A-3.5 Almond Moth (*Ephestia cautella*) – It feeds on a range of stored foods, notably cereals and cereal products particularly maize grains. It also causes damage to stored products through contamination with the silk webbing it produces and faecal pellets, cast skins and egg shells. Adult moth is 8mm to 10mm long, has a wing expanse of 15 mm to 20 mm. When at rest with closed wings it is 10 mm to 13 mm; wings are dirty white to greyish in colour. Life cycle is completed in 28 days at 30°C. and 75 percent relative humidity. Female lays 100 - 270 eggs at random. Larvae mobile, produce extensive silk webbing visible on grain surface. Adults are short-lived and harmless.

A-3.6 Angoumois grain moth (*Sitotroga cerealella*) – It causes serious damage to paddy, jowar, wheat, barley and maize, particularly in the upper layer grains in bags, bins etc. Infestation of standing maize crop before harvest is quite common. Adult moth is 5 mm to 7mm long with silver grey to grey brown wings which tapers to a point. It has a wing expanse of 10 mm to 14 mm, when at rest with close wing it is 6 mm to 9 mm. Wings have long fringe of fine hairs along the posterior edge. Life Cycle is completed in 30 days at 30°C, 75 percent relative humidity. Eggs are laid on the grain surface, larvae immobile, develop in concealed form with in a single grain, adult moth short lived, does not feed, flies but lays 150 - 300 eggs near the germ surface. This pest does not create webbing. Moth is sensitive to low temperature.

A-4 MINOR INSECT PESTS

a) Red flour beetle Tribolium *castaneum* & *T confusum*;
b) Saw toothed grain beetle *Oryzaephilus surinamenssis*;
c) Long headed flour beetle *Letheticus oryzae*;
d) Flat grain beetle *Laemophloeus minutus* (*Cryptolestes* sp.);
e) Drug store beetle *Stegobium paniceum*;
f) Cigarette beetle *Lasioderma serricorne*; and
g) Grain lice/psocids *Liposcelis* sp.

A-4.1 Rust red flour beetle (*Tribolium castaneum*) – The red flour beetle attacks Maize, Rice, Oats, Wheat, Groundnut, Brazil nut, Barley, Walnuts, Lentil, Beans, Peas, Almond, Rye, Sorghum, besides a wide range of dried stored products It is an oblong beetle, 3 mm to 4 mm long, red brown todark brown in colour. Antennae with three large segments at top edge. Life cycle is completed in 20 days at 35°C., 75 percent relative humidity but life cycle completed in 11 weeks at 22°C. Female lays upto 1000 eggs loosely in the food stuff, larvae is whitish to yellow brown. pupa remains loosely in the grain and naked. Adults are very active fliers particularly in the evening. The life span of adults ranges from 200 days to 2 years. Both larvae and adult attack the milled/processed food.

A-4.2 Saw toothed grain beetle, (*Oryzaephilus Surinam*) – Infests cereal grains, grain products oilseeds, processed products, peanuts and dried fruits as well as chocolate, drugs, and tobacco. Adults are very flattened dark brown up to 3mm long to grey, six tooth like projection on each side of the thorax. Life Cycle is completed in 20 days at 33°C. and 80 percent relative humidity but it takes 17 weeks at 20°C, reproduction stops below 17.5°C. Females lay 300 - 400 eggs loosely throughout the grain at random in the food stuff. Eggs hatch in 3 - 5 days and the larvae are not easily visible but feed extensively. Adults rarely fly having average life span of about 6 -10 months. Both adult and larvae but grains having higher percentage of foreign matter /broken grains are more susceptible.

A-4.3 Longheaded flour beetle (*Latheticus oryzae*) – It is a pest of whole grain and milled products including wheat, barley, corn, oilseeds, flour, oatmeal, pasta macaroni, cassava and beans Adults are flat / slender shape., 3 mm in length, yellowish to brown colour, having large

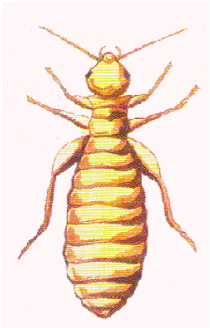
head short antennae with five, segmented club. Larvae are pale yellow/ creamy in colour with a dark head capsule. Life cycle is completed in 22 days at 35°C and 85 percent relative humidity. 25ºC is the minimum temperature required for its development. Females lay eggs at random throughout the food source. Larvae actively move through the food. The presence of this pest in large numbers is indicative of poor quality of old grains. This pest is also identifiable from the typical smell of quinones secreted from its abdominal glands. Adults are photo positive i.e. attracted to lights. Both adults and larvae feed on the commodity.

A-4.4 Flat grain beetles (*Cryptolestes* spp.) – It attacks Wheat, barley, rye, triticale, oats, and occasionally milled products. Adults are very flat, small, shiny reddish brown colour with very long thin hair like antennae, smaller than other major stored grain pests (2 mm long).Larvae are white/ yellow white 1 to 4 mm in length, and have a slightly darker projected last segment (urogomphi). It takes a duration of 23 days at 33 °C from egg to adult**,** however it can take even 13 weeks at 70 percent relative humidity and 20 °C since breeding stops at 17.5°C upto 300 eggs per female, laid at random, larvae mobile not concealed. adults fly readily and can live for several months' Heavy infestations may cause grain to heat and spoil. Grain below 12 percent moisture content, or relative humidity below 40 percent, will restrict development. Adults will not fly below 21 °C. Both adult and larvae feed on germ and endosperm.

A-4.5 Drug store beetle (*Stegobium paniceum*) – It attacks dried plant products. The adult is about 2 to 3.5 mm long. It is oval-shaped and brown in colour. Head of this beetle is not properly visible from dorsal side as such it appears as if it is humped. The wing covers are having parallel rows of deep pits. Life cycle is completed in 40 days at 30 °C, 60 to 90 percent relative humidity. 75 eggs are laid at once, and the larval period is very long sometimes even up to several months depending on the type of available food source. Larvae are immobile. The adult beetles are short lived; photo positive do not feed but can fly. It can also feed on a different type of dried foods and spices; it is also known as the biscuit or bread beetle. Larvae are only damaging stage.

A-4.6 Cigarette beetle (*Lasioderma serricorne*) – It attacks mainly tobacco/ tobacco products but also attacks oilcake, oilseeds, spices, drugs, grains, cereal products, dried fruit, sage, flour, furniture, pepper, ginger, dried fish, dried meat, fish meal, rice, figs, yeast and some animal products. Adult is 2 mm to 3 mm long, usually light brown. The head is bent down and barely visible from above. This gives the beetle a rounded or "humped" appearance. oval, smooth, not shining, antennae long and saw light. Life Cycle is completed in 26 days at random, larvae immobile, sometimes concealed burrows into stored food. Adults are strong flyer, attractive to light, short lived (25 days) and do not feed on commodity. This cannot tolerate the cold; adults die within 6 days at 4 °C, and eggs can survive upto 5 days at 0 °C to 5 °C. Eggs are laid at they may cause indirect damage by to surrounding structures. Larvae feed directly on commodity and contaminate it with frass (excrement) and also damage package by burrowing.

A-4.7 Grain lice / Psocids (*Liposcelis* sp.) – These are very small, soft-bodied and opaque, pale coloured (up to 1mm long) and flattened with long antennae, often appear as a 'moving carpet of dust' on grain or storage structures. Life cycle from egg to adult takes about 21 days at 30°C and 70 percent relative humidity. Eggs are laid on grain surface, hatching to nymphs that moult through to adult stage. Warm, humid conditions increases activity. More common in the higher humidity of coastal regions than in drier inland areas. Commodities having high moisture content and affected with mould, offer better environment for the development of psocids. It infests a wide range of grains, commodities and storage facilities. Psocids are basically and affect the germ portion of the grains, having high moisture contents. Damage is generally manageable with regular aeration. Psocids infest a range of commodities including wheat, barley, sorghum, maize, rice beans pulses, oilseeds and cassava.



ANNEX B
(*Clauses* **5.1.1.3** *and* **5.3.3**)

METHOD FOR SPRAYING VEHICLES, BOATS, WALLS, ETC

B-1 MATERIAL

B-1.1 The material used for spraying shall be malathion emulsifiable concentrate (50 percent).

B-2 EQUIPMENT

B-2.1 Sprayer — A suitable sprayer.

B-2.2 Respirator, Mask and Overalls — Each operator shall be provided with a suitable respirator, a mask to protect his/her eyes, and overalls.

B-3 PROCEDURE

B-3.1 For spraying, select such a time when the weather is calm. For spraying the floor and the sides of the vehicle, park the vehicle in a garage. If a garage is not available, park the vehicle on the leeward side of a high building so that the spray is not blown away by the wind during the operation of spraying. In case of a wagon, keep its door closed during the operation of spraying.

B-3.2 Sweep clean the surface which has to be sprayed. Take 10 ml of malathion emulsifiable concentrate (50 percent) for one litre of water to obtain 0.5 percent emulsion, and work the sprayer in such a manner that its nozzle is at a reasonable distance from the surface to be sprayed, and also that the deposit of the material on the surface is uniform.

B-4 PRECAUTION

B-4.1 The operators should wash their hands, neck and other parts of the body likely to be exposed after wearing the overalls and the mask, prior to spraying as well as after finishing the operation.

ANNEX C
(*Clause* **9.4.1.2**)

METHOD FOR POISON BAITING OF RATS

C-1 GENERAL

C-1.1 Out of the group of rats, which generally attack stored agricultural produce, the following six species are common in India:

a) *Rattus rattus* (the black rat);
b) *Rattus norvegicus* (the brown rat);
c) *Mus musculus* (the house mouse);
d) *Bandicota bandicota*;

e) *Bandicota bengalensis* (the common bandicoots); and
f) *Gerbillus* spp. (the common field rat).

C-1.1.1 These species of rats can be distinguished by their various characteristics, but from the point of view of damage to stored agricultural produce the distinction between the species is immaterial. Rats are very fast breeders. A single female can produce five litters in a year, each litter containing 9 young ones, which begin to breed within a period of two months from their birth. It is estimated that one pair of rats can produce as many as 800 offsprings during the course of one year. Rats not only deprive us of our agricultural produce by consuming it but also by spoiling the agricultural produce by nibbling it into broken, and by contaminating it with their droppings. In bag storage godowns particularly, they are additionally harmful because they cut the bags, with the result that when bags are moved from one place to another or trans-shipped, considerable quantities of agricultural produce are lost through bleeding of the damaged bags.

C-1.2 Poison baiting is carried out by the use of a bait base and a poison.

C-1.2.1 *Bait Base* — The bait base may comprise the same agricultural produce as stored in the BGSS, or other foodstuff, such as flour, *atta*, gram flour, freshly boiled rice or biscuit meal. There is no universally acceptable bait for all rodents. Proper selection of bait is very essential for good results, which depends upon the season, species to be controlled, other food material available in the place of control and when the control work is undertaken. The bait base, to be used either for preparing poison bait (*see* **C-4**) or for pre-baiting (*see* **C-5.1.1**), shall be freshly moistened and given a touch of raw coconut oil. If unmilled foodgrain is to be used as bait base, the foodgrain shall be soaked in water for a few hours till it becomes soft, and then spread out on a piece of gunny in order to remove the free droplets of water.

C-1.2.2 *Poison* — Various poisonous substances are available which may broadly be classified as single dose (acute) or multiple dose (chronic) poisons. A number of poisons fall under these groups but comparatively a few of them are widely used for rodent control work. Following poisons may be used for protection of agricultural produce from rats.

C-1.2.2.1 *Single-dose poisons* — Zinc phosphide, in the proportion of 2.5 percent by weight to the bait base.

C-1.2.2.2 *Multiple-dose poisons* (*anticoagulants*) — Hydroxy coumarins, namely, warfarin, fumarin, etc.

Anticoagulant poisons cause internal and external haemorrhage when consumed for several days. As the symptoms of poisoning appear only gradually, rats do not feel bait shyness. No pre-baiting is necessary when anticoagulants are used. Commercially, anticoagulants are available in three forms, namely, concentrate; water-soluble compound; and ready-mixed bait. For preparation of baits, one part of 0.5 percent concentrate or 0.5 percent water soluble compounds is to be mixed with 19 parts of bait base or water. Simultaneous use of both dry and liquid baits is more effective when density of rat population is very high. The poison baits containing poison other than zinc phosphide shall be suitably coloured with a warning colour.

C-2 EQUIPMENT

C-2.1 Buckets or Galvanized Iron Drums — of suitable size, according to quantity of the poison bait to be prepared.

C-2.2 Ladles —For taking out the poison bait from the buckets or galvanized iron drums and placing the poison bait (*see* **C-4**) in containers for poison bait (*see* **C-2.3**).

C-2.3 Containers for Poison Bait — Readymade bait trays and cups are also available commercially and may be used. Alternatively, pieces of rejected cans or pipes may be used.

C-2.4 Rubber Gloves — A pair for each operator.

C-3 PRECAUTIONS

C-3.1 The poison (*see* **C-1.2.2**) and the poison bait (*see* **C-4**) shall not be touched with bare hands. The operators shall wash their hands thoroughly with soap and water after handling the poison or poison bait. The poison when not in use shall be kept under lock and key under the supervision of a responsible person. The unused poison bait left over in the evenings or that collected in the mornings from BGSS, shall be buried under the supervision of a responsible person.

C-3.2 Care shall be taken that the poison or poison bait does not contaminate the agricultural produce. If the agricultural produce gets contaminated, it shall be destroyed or buried under the supervision of a responsible person.

C-4 PROCEDURE FOR PREPARING BAIT

C-4.1 Weigh out the required quantity of the moistened bait base (*see* **C-1.2.1**) and place it in a bucket or galvanized iron drum (*see* **C-2.1**) of a suitable size so that the bait base does not occupy more than half the capacity of the bucket or drum. Next, weigh out the required quantity of the poison to be used according to the proportion given against each poison under **C-1.2.2**. Sprinkle this quantity of the poison over the moistened bait base kept in the bucket or drum. Thoroughly mix the poison and the bait base.

C-5 PROCEDURE FOR BAITING

C-5.1 Single-Dose Poison

C-5.1.1 *Pre-baiting* — Place, at dusk, about 50 g of bait base (without the poison), in containers (*see* **C-2.3**) in the BGSS at different points near the suspected rat runs. Close and lock the BGSS. Watch the following morning whether the bait base has been eaten during the night by the rats. Remove the containers in the morning and throw away the bait base left in the containers. Repeat this process by placing fresh quantities of the same type of bait base (without the poison) at the same points in the BGSS as on the previous day, for a few successive days till it becomes certain that the rats have started eating the unpoisoned bait base.

C-5.1.2 *Poison Baiting* — When during the process of pre-baiting (*see* **C-5.1.1**), it has been ascertained that rats have started eating the unpoisoned bait base, replace the bait base with freshly prepared poison bait (*see* **C-4**), and continue with the procedure of placing the poison bait in the evenings and removing it the next morning, as given under **D-5.1.1**, for another few days till it is observed that rats no longer eat the poison bait.

C-5.1.3 *Follow-up Treatment* — Follow up the treatment of pre-baiting and baiting cycle in succession (*see* **C-5.1.1** and **C-5.1.2**) after a period of about a week or ten days from the last date of poison baiting, till it is observed that the rat menace in the BGSS has been eradicated. The follow-up treatment shall be done at least twice after the first pre-baiting and baiting cycle given under **C-5.1.1** and **C-5.1.2**.

C-5.2 Multiple-Dose Poisons

C-5.2.1 Small quantity of sugar may also be added to the bait to make it more palatable.

C-5.2.2 In case of dry baits, place the prepared bait or ready-to-use bait in bait cups at various points along the rat runs, at the rate of 200 g per spot. In a small house, one or two placements may be sufficient, whereas in warehouses and industrial establishments, the number of placements depends upon the size of the establishment and severity of rodent damage.

C-5.2.3 Liquid baits should be placed in shallow containers at the rate of 0.25 litre per container. Place the containers along rat runs.

C-5.2.4 Leave the baits as long as possible. Replenish the baits as and when necessary. Due to slow action of anticoagulants, the kill may be obtained only after 8 to 10 days of continuous feeding. Mice may take even 20 days.

C-5.2.5 In order to ensure maximum intake of baits by rats and to safeguard against any hazards, it is recommended that permanent bait stations, in which the bait trays/cups are to be kept, may be fixed. A simple bait station may be used. Poison bait containers may be placed in these stations. The poison bait may also be placed directly in the bait stations made of empty powder cans or earthen pots. Necessary arrangements may be made to firmly fix them.

C-5.3 In the follow-up treatment, it is advantageous to use another bait base and another poison than what has been used previously.

ANNEX D
(*Clause* **9.4.5**)

AGRICULTURAL PRODUCE STORAGE WAREHOUSE SANITATION CHECK LIST

D-1 WAREHOUSE CONSTRUCTION AND UTILIZATION

D-1.1 Storage capacity————tonnes————m^2————

D-1.2 Agricultural produce in Storage————————————————————
_____

D-1.3 Type of Storage:
Bulk (flat) ———————— ;
Bagged————————;
Bag Bulk head————————.

D-2 CONDITION OF WAREHOUSE PERIMETER

D-2.1 Railroad tracks:
a) Debris present Yes /No*
b) Grain accumulations Yes /No*

D-2.2 Truck roading docks:
a) Debris present Yes/No*
b) Grain accumulations Yes /No*

D-2.3 Trash piles on grounds or near warehouse Yes/No*

D-2.4 Rodent signs on warehouse grounds Yes /No*

D-2.5 Birds nesting, or roosting under canopies Yes /No*

D-3 MAINTENANCE OF WAREHOUSE EXTERIORS

D-3.1 Canopies in need of repair Yes/No*

D-3.2 Holes in walls through which birds can enter Yes /No*

D-3.3 Holes in walls at floor level giving access to rodents Yes/No*

D-3.4 Doors are not tight fitting to exclude rodents Yes/No*

D-3.5 Broken windows or sky lights Yes/No*

D-3.6 Windows or doors in need of screens Yes/No*

D-3.7 Roof or walls leak when it rains Yes/No*

D-4 MAINTENANCE OF WAREHOUSE INTERIORS

D-4.1 Do floor areas require cleaning Yes/No*

D-4.2 Do walls require cleaning Yes/No*

D-4.3 Do overhead areas require cleaning Yes/No*

D-4.4 Are there cracks in floors or walls which accumulate grain Yes/No*

D-5 AGRICULTURAL PRODUCE INSPECTION PROCEDURES

D-5.1 Is agricultural produce sampled and inspected before receiving it in the warehouse:

a) Moisture is determined Yes /No*
b) Agricultural produce is graded Yes /No*
c) Agricultural produce checked for insects Yes /No*
d) Agricultural produce is checked for evidence of rodents (pellets-----) Yes/No*
e) Agricultural produce is checked for off-odorsYes /No*

D-5.2 Is agricultural produce in storage routinely inspected:

a) For moisture (frequency-----) Yes/No*
b) For temperature (frequency-----) Yes /No*
c) For insects (frequency--------) Yes/No*

D-5.3 Standards are established for maximum insect-and/or rodent evidence Yes/No*

D-5.4 Grain is fumigated if insects noted Yes/No*

D-6 AGRICULTURAL PRODUCE STORAGE PRACTICES

D-6.1 Bagged agricultural produce is stored on palletsYes/No*

D-6.2 Bagged agricultural produce is stored in orderly fashion Yes/No*

D-6.3 Stacks of bagged agricultural produce as recommended for different agricultural produce Yes/No*

D-6.4 Stacks of bagged agricultural produce are at least 1 metre below overhead structures Yes/No*

D-6.5 Stacks of bagged agricultural produce are stored at least 75 cm from all walls and at least 75 cm between stacks Yes /No*

D-6.6 Broken bags of agricultural produce in stacks not noted Yes/No*

D-6.7 Is agricultural produce cleaned when received Yes/No*

D-7 INSECT CONDITIONS

D-7.1 Moths noted flying in warehouse Yes /No*

D-7.2 Adult insects or larvae noted:
a) On floors or walls Yes/No*
b) On outsides of bags of agricultural produce Yes /No*
c) In accumulations of spilled agricultural produce Yes/No*
d) In samples taken from stacks of agricultural produce (on separate sheet list lots of agricultural produce sampled and insects present, if any) Yes/No*

D-7.3 Insect tracks in dust on walls, floors and overhead areas Yes/No*

D-8 RODENT, BIRD AND/OR MICROBIAL CONDITIONS

D-8.1 Live or dead rodents noted in warehouse Yes /No*

D-8.2 Rodent pellets noted in warehouse or on bags of agricultural produce Yes/No*

D-8.3 Rodent urine stains on bags Yes/No*

D-8.4 Rodent chewed bags Yes /No*

D-8.5 Rodent tracks noted in dust Yes/No*

D-8.6 Birds noted in warehouse Yes/No*
D-8.7 Bird droppings on bags, floors and overhead areas Yes /No *

D-8.8 Moulded or sprouted agricultural produce noted Yes /No*

D-9 PEST CONTROL

D-9.1 Insect

D-9.1.1 Regularly scheduled residual spraying of warehouse practiced:
a) Frequency---------- Yes/No*
b) Insecticide used---------- Yes/No*

D-9.1.2 Is warehouse being treated with smokes or fogs:
a) Frequency---------- Yes/No*
b) Insecticide used ---------- Yes/No*

D-9.1.3 Grain fumigated when received:
Fumigant used---------- Yes/No*

D-9.1.4 Protective treatment applied when received:
a) Applied to bags ---------- Yes/No*
b) Applied to grain - ---------- Yes/No*
c) Material applied---------- Yes/No*

D-9.1.5 Agricultural produce fumigated as required Yes/No*

D-9.2 Rodent

D-9.2.1 Rodent bait stations maintained on warehouse exterior Yes/No*

D-9.2.2 Rodent bait stations maintained on warehouse interior Yes/No*

D-9.2.3 Rodent traps maintained on warehouse interior Yes/No*

D-9.2.4 Bait stations serviced with fresh bait regularly:
a) Type of bait used---------- Yes/No*
b) Frequency of service---------- Yes/No*

D-9.3 Birds

D-9.3.1 Baits in use (Type----------) Yes/No*

D-9.3.2 Traps in use Yes/No*

D-10 RECOMMENDATIONS /REMARKS