

Carriage of Grain Cargoes

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Introduction

This briefing deals with loss prevention measures for reducing the frequency and consequences of cargo damage claims from the carriage of grain cargoes.

This briefing is relevant to grain, barley, maize, American corn, oats, rye, sorghum, wheat, soya beans, seeds, bulk rice, millet, and other similar agricultural products. These are all cargoes where the grains or seeds have not been subjected to any mechanical or chemical extraction process.

All grain cargoes and seed cargoes that behave like grains must be carried strictly in accordance with the International Code for the Safe Carriage of Grain in Bulk (International Grain Code, 1991).

Disclaimer

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Carriage of Grain Cargoes

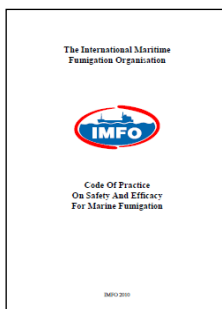
How grain cargoes can be damaged

- **Heat** – Other than the heat caused by self-heating associated with moisture content and cargo temperature on loading. Grain cargoes must be protected from surfaces where the temperature is likely to exceed 40°C – engine room bulkheads and any heated tank surface for example.



Heat damaged grain – stowed next to engine room bulkhead

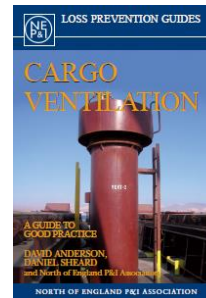
- **Infestation or contamination** – The presence of live or dead insects or pests, dead rodents, dead birds, already damaged cargo, or any debris. See The International Maritime Fumigation Organization – Code of Practice. <http://www.imfo.com/>.



- **Water ingress** – The hatch covers are not weathertight or there is water ingress from below – bilges or tank leak. See North Loss Prevention Guide – Hatch cover maintenance and operation.



- **Condensation** – from sweat. See North Loss Prevention Guide – Cargo Ventilation – three degree rule for hygroscopic agricultural cargoes only.



- **Mould** – If the average moisture content of the grain is high and the cargo temperature on loading is high – the condition of the cargo will eventually start to deteriorate. The cargo may self-heat, go mouldy and/or become caked.

Before loading – hold cleaning

For the loading of grain cargoes the holds must be 'grain clean' or 'hospital clean'. The industry accepted definitions of hospital clean and grain clean are provided by the [National Cargo Bureau](#) (NCB) as follows:

1. Hospital clean

Hospital clean is the most stringent, requiring the holds to have 100% intact paint coatings on all surfaces, including the tank top, all ladder rungs and undersides of hatches. The standard of hospital clean is a requirement for only a few certain grain cargoes and trades – for example rice in bulk. Generally, these high standards of cleanliness will only be met by vessels trading exclusively with such cargoes. It will rarely be required in the tramp trades.

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2. Grain clean

Grain clean is the most common requirement. A ship will be required to be grain clean for all grain or seed cargoes. Ships holds will be inspected for:

- Previous cargo residues and 'rub off' stains.
 - Loose rust and paint scale
 - Any other contaminants
 - Infestation
 - Odours
 - Moisture or leakage
1. All past cargo residues and any lashing materials are to be removed from the hold.
 2. Any loose paint or rust scale must be removed.
 3. It probably will be necessary to wash the hold - the holds must be dried after washing.
 4. The hold must be well ventilated to ensure that it is odour-free and gas-free.
 5. Flaking paintwork under the hatch coaming can result in a hold failing the grain survey.
 6. Ensure that any hot bulkheads - temperature over 40°C - are protected from contact with the grain cargo.



*Not grain clean –
loose rust and
debris on tank top*



*Not grain clean –
loose rust found by
surveyor*

Before loading – average moisture content

The average moisture content of grain cargoes should be between 10% and 16%. Each cargo may have different critical limits. For example corn/maize should not exceed 14% and soya beans should not exceed 13%. Check the cargo handling information for the general limit.

The **average** moisture content does not mean this:

DEAR SIR,

AS REQUESTED, PLEASE NOTE BELOW THE SPECIFICATIONS OF THE ABOVE MENTIONED PARCEL OF SOYBEAN IN BULK TO BE SHIPPED ON BOARD THE VESSEL UNDER YOUR COMMAND AT

PROPERTY	SPECIFICATION
FAT	MIN. 18,00%
MOISTURE	MAX. 14,00%
TOTAL DAMAGED	MAX. 8,00%
HEAT DAMAGED	MAX. 4,00%
FOREIGN MATTERS	MAX. 1,00%
BROKEN BEANS	MAX. 30,00%

This is just a general statement saying the average moisture content is assumed not to exceed a maximum of 14%.

An **average** moisture content of the cargo on loading should be available – for example:

COMMODITY	: Brazilian Soybeans
PACKING	: In Bulk
QUANTITY	: 62,189.345 MT

We certify as follows:	
SAMPLING:	
Sets of samples were collected uniformly and systematically, concurrently with loading, at the nearest practicable point to the vessel in accordance with the method laid down by FOSFA.	
QUALITY:	
One set of samples was then well mixed and reduced to average samples of the total shipped quantity. The results of analysis carried-out on this average samples are reported as follows:	
Specifications:	Results:
Oil Content :	20.27 %
Protein :	35.42 %
Foreign Material :	0.41 %
Moisture :	11.24 %
Total Damage Kernel :	5.21 %
Heat Damage Kernel :	0.60 %
Splits :	7.91 %

This cargo of soya beans has an **average** moisture content declared as 11.24%.

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General rule: Grain cargoes shipped with average moisture content in the region of 12 to 14% have a high risk of going mouldy during the voyage. The risk increases significantly if average moisture content exceeds 14%.

General rule: Grain cargoes with an average moisture content of 10% or below have a lower risk of going mouldy during the voyage.

Before loading – consider appointing a surveyor

Before the loading begins the Master should consider appointing a local expert surveyor to assist him.

The average moisture content of the grain cargo should be obtained before loading – a surveyor may be able to help obtain this information.

Before loading it will always be prudent to have the hatches tested for weathertightness by ultrasonic testing and to take photographic evidence of the cleanliness of the hatches. (See Chapter 3.6 of *Loss Prevention Guide – Hatch Cover Maintenance and Repair*).

- Loading cargo during rain or any wet weather conditions
- Caked lumps of grain – possible water damage prior to loading
- Continuous photographic records

On many occasions there may be problems with keeping a continuous visual inspection:

- There may be too much dust
- It may be difficult or impractical to obtain proper representative samples if needed
- It might require specialist equipment to obtain cargo temperatures
- There may be local knowledge in relation to the type of problems to be expected
- It may be useful to have an expert to suggest when and what to photograph

Under these circumstances the Master should consider using a local expert surveyor to assist him before loading begins and during loading.

During loading – continuous visual inspection

Once loading begins there should be a continuous visual inspection of the cargo looking out for:

- Good colour of the cargo showing apparent good condition
- Changes of colour
- Unusual odours or smells
- Infestation or contamination
- Cargo temperature
- Taking and storing samples – for testing should there be a claim on discharge

After loading – cargo temperature taken at time of loading

For most hygroscopic agricultural cargoes – particularly where there are full or almost full holds – the cargo temperature everywhere except at the sides of the stow will change very little and often not at all during the voyage.

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General rule: If the cargo temperature is measured at the time of loading the Master can be reasonably confident that the bulk of the cargo will stay at the same temperature throughout the voyage.

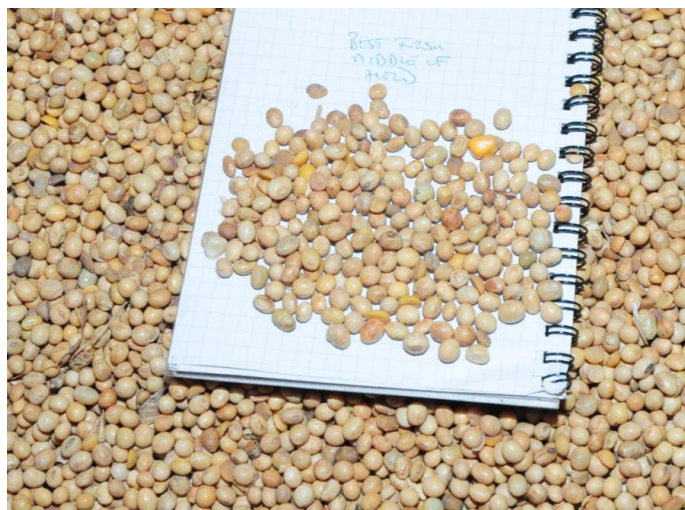
This temperature will also be needed to apply the three degree rule for ventilation.

General rule: The higher the average moisture content % and the higher the cargo temperature on loading – the less time the cargo can be stored without risk of going mouldy.

Example: Approximate storage time in days that soya bean cargoes can be stored before they start going mouldy:

Average moisture content	Cargo Temperature on loading		
	16°C	21°C	27°C
12%	240 days	125 days	70 days
14%	75 days	45 days	20 days
16%	35 days	20 days	10 days

Source: [North Dakota State University](http://www.ndsu.edu)



Cargo colour on loading – soya beans



Cargo colour on discharge (56 day voyage) – soya beans



Cargo colour on loading – soya beans



Cargo colour on discharge (56 day voyage) – soya beans

Carriage of Grain Cargoes

During the voyage – fumigation

Fumigation must be carried out in accordance with IMO Recommendations on the safe use of pesticides in ships.

The only marine fumigant that can be used for in transit fumigation is Phosphine (Hydrogen phosphide).

The Master must retain overall responsibility for the safety of the crew as per SOLAS V Regulation 34.

Fumigation of the cargo at the load port - will be under the control of the 'fumigator in charge' who will discuss the fumigation plan in detail with the Master prior to fumigation and inform the Master in writing of all spaces to be fumigated and all other spaces to be considered hazardous during fumigation.

Fumigation during the voyage – the fumigator in charge and the Master should produce a voyage safety plan (VSP) to ensure that all the relevant safety measures and recommendations are followed.

Degassing and checking results at the discharge port – should be done according to the guidance given by the fumigator in charge at the load port and included with the VSP. For example there should be clear written instructions on how to handle and dispose of any fumigant containers or fumigation residues.

General rule: Apart from the dangers from fumigation gases – most grain cargoes may deplete the oxygen levels in cargos holds and possibly in adjacent spaces. All cargo holds and adjacent spaces must be treated as enclosed spaces and subject to controlled entry.

During the voyage – ventilation

Ventilation of agricultural products should follow the 'three degree rule'.

Three-degree rule: If the temperature of the outside air is at least 3 °C below that of the cargo temperature

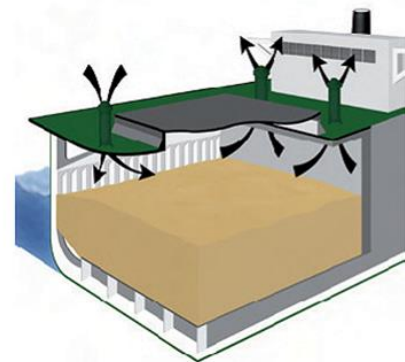
taken at loading - Masters may safely ventilate the cargo. Provided the weather and spray conditions allow - the cargo should be ventilated if the three degree rule applies.

The temperature of the outside air *will* change between day and night and during the voyage. It is not difficult to measure the temperature of the outside air. It can be done simply by reading the dry-bulb thermometer on the bridge, although ideally the temperature should be measured close to the inlet ventilators.

The three-degree rule does not require anyone to go into the holds during the voyage.

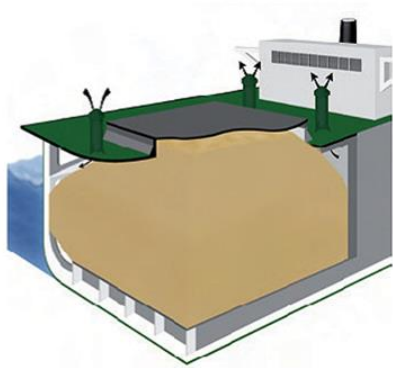
How effective is ventilation – Whether using mechanical ventilation or natural ventilation there are many cargoes where the average ventilation will not penetrate the stow. For all grain cargoes the best that can be achieved is for the air to circulate over or around the cargo - the ventilation system will not force air through the cargo itself.

General rule: When the three degree rule applies for grain cargoes – ventilation will probably only replace air within a hold with air from outside - the air will come in at one end, move through the empty space above the cargo, and exit at the other end.



Ventilating air only moves over a bulk cargo and not through it – 99% of the cargo will not be affected by ventilation.

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Very little ventilation can be achieved in a full hold – but it is better to ventilate rather than risk a claim from not ventilating.

During the voyage – record keeping

The Master should keep comprehensive records throughout the voyage of outside air temperature, the weather conditions, and the times of any ventilation carried out. If it is possible to effectively monitor the hold temperature or cargo temperature – these figures should also be recorded.

The Master may have obtained the average moisture content of the cargo before loading and will have recorded the cargo temperature on loading. These two figures should be noted in any record keeping.

Comprehensive and accurate records are essential for good contemporaneous evidence.

Discharge – consider appointing a surveyor

If the average moisture content is high and the cargo temperature on loading is high – then there is a high risk that some or all of the cargo will have gone mouldy during the voyage.

Ventilation may have been carried out at all times when the three degree rule allowed but only the surface of the cargo has been prevented from heating or going mouldy.

Ventilation may have been prevented by weather or have been ineffective. In which case the surface of the cargo may also show signs of heating or going mouldy.

On opening the hatches for discharge and during discharge there should be a continuous visual inspection of the cargo looking out for:

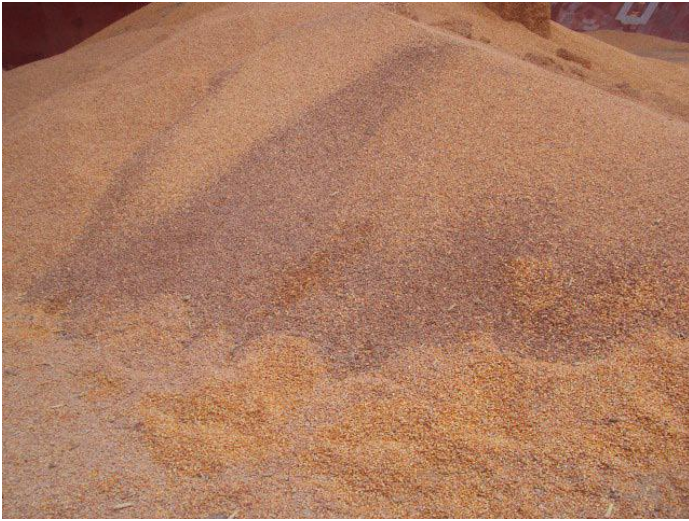
- Signs of self-heating on the surface or in the body of the cargo
- Changes of colour in the cargo
- Mouldy cargo
- Caked or wet cargo
- Unusual odours or smells
- Infestation or contamination not noted during loading
- Cargo temperature
- Taking samples and/or testing samples – should there be a claim on discharge
- Discharging cargo during rain or any wet weather conditions
- Continuous photographic records

Under these circumstances the Master should consider using a local expert surveyor to assist him before the hatches are opened for discharge and during the discharge of the cargo.



Grain cargo - wet damage from leaking hatch cover

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Discoloured grain mixed with sound grain



Checking and recording cargo temperature



Mouldy grain cargo



Checking cargo condition in the grab



Cargo sample taken by surveyor

More information

Please contact the loss prevention department for more information loss.prevention@nepia.com



Thanks to [Brookes Bell Group](#) for providing assistance with this briefing.