

1. Overview

Nut-in-shell (NIS) is typically sold either for processing to kernel or for use as sawn NIS. Specifications may vary according to final use. Sawn NIS is made by placing a saw cut around most of the circumference of the shell. The product is often then dipped in a flavouring solution and then dried or roasted. Consumers can remove the shell from the product by hand or by using a key.

NIS for use as sawn NIS is typically sold by grade and size. The grades are defined by the level of defective nuts in the consignment. The size is defined by the diameter of the NIS which is expressed as sizing screen sizes. The visual appearance of the shell is important for sawn NIS. A minimum sound kernel recovery is also often specified. In some cases, NIS for use as sawn NIS may be sold using sound and unsound kernel recovery specifications instead of grade. The sections below provide further detail.

NIS for use in kernel production is typically supplied based on a sound kernel recovery and unsound kernel recovery. There is normally a limit set for the smallest acceptable diameter. Shell visual appearance is not as important when processing to kernel. In some cases, NIS for use in kernel production may be sold using specification for grade and size.

This standard covers both types of end usage.

A visual guide that sets out photos of NIS typically classified as unsound NIS has been developed to support this product standard.

This standard and visual guide provides a framework for interested parties to develop specifications for commercial and legislative purposes which will help the industry to provide consistent and high-quality macadamias to the market.

The following sections provide specifications and definitions.

2. Sizing

Final usage – sawn NIS

Typically, NIS sold for use as sawn NIS will use the standard NIS sizes listed below:

- 18-20mm NIS is greater than 18mm and less than 20mm
- 20-22mm NIS is greater than 20mm and less than 22mm
- 22mm+ NIS is greater than 22mm
- 22-24mm NIS is greater than 22mm and less than 24mm
- 24-26mm NIS is greater than 24mm and less than 26mm
- 26mm+ NIS is greater than 26mm

Sizes other than the standard may be used, but the product must be labelled accordingly. The standard requires that the product be descriptively labelled using the following terminology:

- NIS = Macadamia nut-in-shell
- Size range in mm – for example NIS 22-24mm

NIS may be sized on round hole screens, bar screens, roller sizers or equivalent methods.

In the case of round hole screens, the size range indicates that the product will pass across a hole of the smaller diameter and through a hole of the larger specified diameter.

In the case of bar or roller sizing, the size range indicates that the product will pass across bars or rollers spaced at the smaller specified gap and through bars or rollers spaced at the bigger specified gap.

Undersized NIS – The specification governing a sale should provide an allowance for undersize NIS. The size of this allowance is subject to negotiation between buyer and seller. A typical allowance for the percentage of NIS that can be under the specified size is less than 15% of NIS by weight.

Final usage – kernel

NIS contracts for kernel production may use the standard sizes listed in the previous section. Alternatively, the contract may allow any size of NIS above a specified minimum diameter. The buyer and seller will negotiate the minimum size but typically this will be 17mm or 18mm.

3. Grades

Final usage – sawn NIS

Macadamias for use as sawn NIS are typically sold by grade. These grades are based on the level of defective NIS. This may be defined as either the number of defective nut-in-shell in 100 nuts or as an unsound kernel recovery.

The nut-in-shell visual guide that forms part of this standard provides examples of damaged and marked shell.

The WMO kernel **and** visual standard provides details of kernel that is unsound.

Examples of NIS grades are:

Method one based on 100 nut method

- **Premium grade** – maximum of 5 defective nuts in 100.
- **Standard grade** – maximum of 10 defective nuts in 100.

Method two based on USK% (Global Specification)

- **Premium grade** – less than 2% unsound kernel recovery.
- **Standard grade** – greater than 2% and less than 4% unsound kernel recovery.

Grades other than these may be specified by stating the maximum defective nuts in 100 or the unsound kernel recovery.

The grade of an NIS shipment is determined by representative sampling and testing of the NIS, as defined in Section 7, NIS sampling.

A minimum kernel recovery may also be specified by negotiation between buyer and seller.

Final usage – kernel

Contracts for the sale of NIS used to produce kernel may stipulate a sound kernel recovery (SKR) and unsound kernel recovery (USKR) or a grade based on the count of defective nut-in-shell in 100 nuts or unsound kernel recovery.

The definition of SKR and USKR are provided in table 1.

Limits on SKR and USKR or count of defective nuts are negotiated and agreed to between the buyer and seller.

4. Moisture content

The moisture content specification for NIS shipments is provided in the table below.

This standard allows the moisture content of NIS shipments to be specified as NIS moisture or kernel moisture content. Macadamia shell rapidly releases and absorbs water from the atmosphere, whereas kernel releases and absorbs water more slowly. Consequently, NIS moisture content may rapidly move up and down with relative humidity with little effect on kernel moisture. The moisture content of kernel is an important factor in maintaining shelf-life and preventing mould and decay. Specifying kernel moisture content improves protection for the kernel and provides a more stable measurement.

5. Physical specifications at the point of packing

Table 1. Macadamia NIS acceptable limits

Moisture content	Maximum 2% kernel moisture content, which is equivalent to approximately 4% NIS moisture content. NIS moisture content is the moisture content of the whole nut including the shell.
NIS – external appearance	All final usages • Brown in colour. • The shell should be intact with no visible kernel. • Superficial cracks or slight superficial damage are not considered defects. • The shell should be clean and free from any foreign material including husk. Final usage Sawn NIS • The allowable percentage of shells with major marks and scratches may be defined in the contract.
Appearance and taste – kernel inside the NIS	As per the WMO kernel standard and visual guide. Both premium and commercial are classified as edible kernel.

Foreign matter	The target for foreign matter is 0%. The seller and buyer may agree to specify a tolerance. Foreign material includes any product that is not kernel or shell.
Loose shells, broken shells, and empty nut-in-shell	Typical specification is maximum 1% by weight.
Sound kernel recovery	• All shipments must meet or exceed the sound kernel recovery negotiated and agreed to between the buyer and the seller. • Sound kernel is the addition of premium and commercial grade kernel (edible kernel). These grades are defined in the WMO kernel standard and visual guide. • Sound kernel recovery is calculated using the following formula: - $\text{Sound kernel recovery (SKR\%)} = \frac{\text{sound kernel weight}}{\text{NIS weight}} \times 100$ - This test is to be performed at an NIS moisture between 3.5% and 4% or kernel moisture between 1.5% and 2%
Unsound count, unsound kernel recovery and NIS with visual defects	1. All shipments must comply with the unsound count and/or USKR negotiated and agreed to between the buyer and seller. In some cases, limits may also be imposed by legislation within the buyer or sellers' country. 2. Unsound count equals the number of NIS in 100 nuts that contain unsound kernel or no kernel. 3. Unsound kernel recovery (USKR%) is calculated using the following formula: $\text{unsound kernel recovery} = \frac{\text{unsound kernel weight}}{\text{NIS weight}} \times 100$. 4. The WMO kernel standard and visual guide defines unsound kernel. 5. The buyer and seller or country legislation may also define a limit on nuts that display external defects. 6. Nuts with external defects include NIS that exhibit large cracks, insect damage, open micropile, rodent damaged nuts, black or dark NIS, grey or faded NIS, nut-in-husk, nut with adhering husk, nut exhibiting visible mould or germinated NIS. The nut-in-shell visual guide provides examples of external defects.

6. Country of origin

All macadamia nuts sold must be labelled with either the country of origin or the country of processing. This labelling must comply with the applicable legislation.

7. NIS sampling

All NIS must be representatively sampled and tested using methods that provide a reliable prediction of the following items where specified for the consignment.

1. Sound kernel recovery
2. Unsound kernel recovery
3. Unsound count
4. NIS/kernel moisture content
5. Percentage under and over size
6. Foreign material and loose shell

The size of each lot shall not exceed 5 tonne per sample and the sample size for the lot shall be at least 500g.

8. Food safety

It is the intention that the NIS sold, as per this Product Standard, must be further processed and for that reason it is the buyer's responsibility to ensure that the final product is compliant with all regulatory requirements with regards to food safety. The seller must ensure that they, and their supply chain, use good manufacturing practices and recognised food safety methodology to reduce the likelihood of introducing a food safety risk to the product. Traceability of the product must be maintained. If the product has a known food safety issue it must be declared to the buyer.

9. Agrichemical residue testing

All macadamia NIS sold must conform to the maximum residue levels (MRLs) for agricultural chemicals in the buyer's country.

10. Bulk packaging specifications for NIS

All macadamia NIS must be packaged in clean food grade packaging material. Examples of formats are:

1. Poly woven bags
2. Cardboard cartons with or without a liner
3. Jute bags

The weight of each packaging unit is negotiated and agreed to between the buyer and seller. Common formats are 25kg, 500kg and 1200kg bags.

11. Packing and labelling

All packaging must comply with the regulatory standards of the buyer's country. It is recommended that all bulk packaging display the following information:

- Packer or seller's name, address, and contact details

- Country of origin or country of processing (as per the applicable legislation)
- Product size (typically required for sawn NIS final usage)
- Product grade (typically required for sawn NIS final usage)
- Lot code or unique code
- Net weight
- The packing or production date

It is also recommended that the shipment documentation, product specification or packaging label display the following:

- Recommended storage conditions
- Allergen statement as required by legislation

12. Shelf-life standards

Macadamia nuts are a perishable product and shelf-life is determined by storage conditions, temperature, humidity, and handling practices.

It is recommended that the seller specify the expected shelf-life or provide a best before date for each batch of NIS. The specified shelf-life may be conditional on storage in specific conditions.

Macadamias with peroxide values ranging from 0 to less than or equal to 2meq/kg will give an estimated shelf-life of two years when packed/processed as kernel (WMO Kernel Standard, <https://www.worldmacadamia.com/final-kernel-product-testing/>).

At the time of packing, nut-in-shell product should have not more than a maximum peroxide value of 3meq/kg of oil (approved test method ISO 18321:2015 or equivalent).

Product exhibiting peroxide values near the maximum value may experience significantly reduced shelf-life. Shelf-life of this product will be shortened even further with increased storage temperatures and relative humidities.

Where long shelf-life is important it is recommended to specify NIS with lower peroxide values.

13. Final product storage

As macadamia NIS is a perishable food product, it should be handled and stored in accordance with best practices to protect product safety, quality, and shelf life, including avoiding direct sunlight and preferably storing under controlled temperature and relative humidity conditions.