Quality Kit Manual

This manual accompanies the Rice Quality Assessment Kit

- Better understand the different aspects of grain quality
- Make better decisions in post harvest management

Postharvest Unit
International Rice Research Institute (IRRI)

Version January 2013
postharvest@irri.org

Table of contents

1 What is the quality kit?

The quality kit is a set of tools that help you measure the different characteristics that determine the quality of grain.

Quality is not always easy to define as it depends on the consumer and the intended end-use for the grain. All end-users want the best quality that they can afford. Lately, the demand by the consumer for better quality rice has increased, countries like Cambodia and Myanmar are trying to become major rice exporters and consequently there is a lot of pressure on producers and processors to produce better quality rice. The first step is to understand better the rice quality traits and the factors in rice production and processing which affect those quality traits. The next step is to enable farmers and processors to quantify rice quality so that they can identify problems and make the neccessary adjustments to minimize quality loss along the rice value chain. The IRRI Rice Quality Assessment Kit consists of a set of various tools that help measuring one or several paddy, milled rice or seed qualtiy traits. It is intended to be used in postharvest and other quality related training courses but several of the kits have already been purchased by millers and other value chain actors to help them in their daily tasks too.

For information on improving or maintaining rice quality, please visit IRRI's Rice Knowledge Bank at www.knowledgebank.irri.org.

2 Quality traits that can be measured using the Quality Kit

The IRRI Quality Kit can be used to quantify the following quality traits either by direct measurement or by calculation.

2.1 Direct Measurements

- Grain length, width
- 1000 grain weight
- Sample weights < 250g
- Volume < 100ml
- Whole and broken grains
- Grain moisture content
- Grain temperature
- Air temperature
- Air relative humidity

2.2 Visual Checks

- Insects, cracks, damage
- Estimated milling degree

2.3 Calculated Parameters

- Length/width ratio
- Seed lot purity
- Milling recovery
- Head rice recovery
- Milling degree
- Purity
- Insect infestation
- Save storage conditions
- Drying air properties
- Equilibrium moisture content
- Drying air temperature
- Others

3 What are the tools in the quality kit?

Graduated cylinder (Flask)

This cylinder for volumetric measurements is calibrated and is easy-to-read. Raised graduation allows precise measuring of the volume of grain samples.

Infrared thermometer

This non-contact thermometer can be used for monitoring grain temperature in post harvest processes like rice milling and drying.

Scale

This mini scale weighs paddy and rice samples in different modes: grams; ounces and penny weights

Caliper

The caliper can be used to measure the length and width of the grain

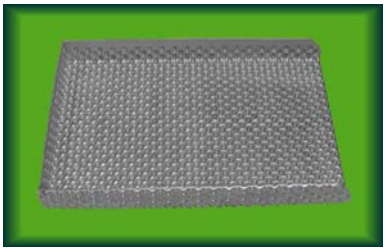
IRRI Moisture Tester

As an affordable alternative to commercial moisture meters, the IRRI moisture tester was designed by the IRRI Postharvest group as a decision making tool for moisture determination of paddy in postharvest operations and storage.

Rice Milling Chart

The rice milling chart indicates the level of polishing of the white rice. It range from 8 to 14% (10 to 12% is preferred).

Indent Sheet Grader



These trays are used to separate the broken rice (large and small) from the whole kernel. By oscillating the trays, broken rice remains in the indents while the head rice falls off the grader.

Magnifier

A lighted pop out/retractable pocket magnifier can double the magnification of the size of the item being viewed. Used for observing cracks, and insects in the grain.

4 Characteristics that determine quality and how to measure them*

*Note: In this manual we describe only the quality characteristics that can be measured using the tool kit

4.1 Moisture content

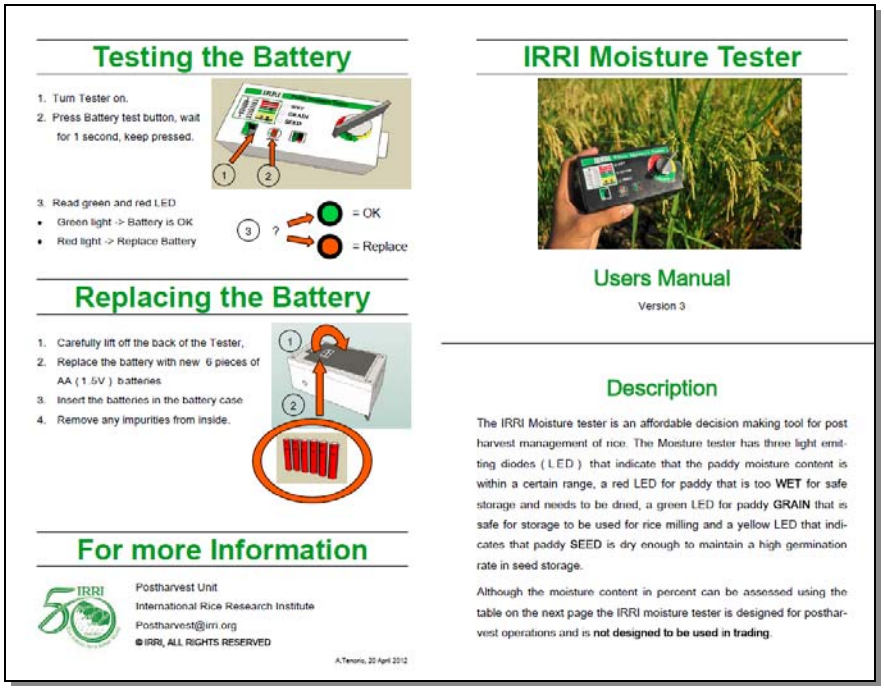
Moisture content (MC) is the weight of water contained in paddy or rice expressed in percent. It has a big influence on all aspects of paddy and rice quality.

- The optimal stage to **harvest** grain is between 20-25% grain moisture.
- Paddy grain should be **dried** to 14% MC as soon as possible after threshing.
- Paddy is at its optimum **milling** potential at an MC of 14%. Grains with higher MC are too soft and may be pulverized. Grain that is too dry becomes brittle and has greater breakage.
- If grain is to be **stored** safely for extended periods it must have less than 13-14% moisture.

How? *The moisture content is measured with IRRI's Moisture Tester.*

The IRRI Moisture Tester eter is a decision making tool which tells the user whether his grain needs to be dried (red range), is safe for storage of and good for milling (green range) or safe for seed storage (red range). Note that it is not intended for commercial purposes like trade. To operate IRRI's Moisture Tester choose the model contained in your quality kit below and follow the steps as shown in the operators' manual:

4.1.1 IRRI Moisture Tester Mark III



Testing the Battery

1. Turn Tester on.
2. Press Battery test button, wait for 1 second, keep pressed.

3. Read green and red LED
- Green light -> Battery is OK
- Red light -> Replace Battery

= OK
= Replace

Replacing the Battery

1. Carefully lift off the back of the Tester,
2. Replace the battery with new 6 pieces of AA (1.5V) batteries
3. Insert the batteries in the battery case
4. Remove any impurities from inside.

For more Information

Postharvest Unit
International Rice Research Institute
Postharvest@irri.org

A.Tenorio, 20 April 2012

IRRI Moisture Tester

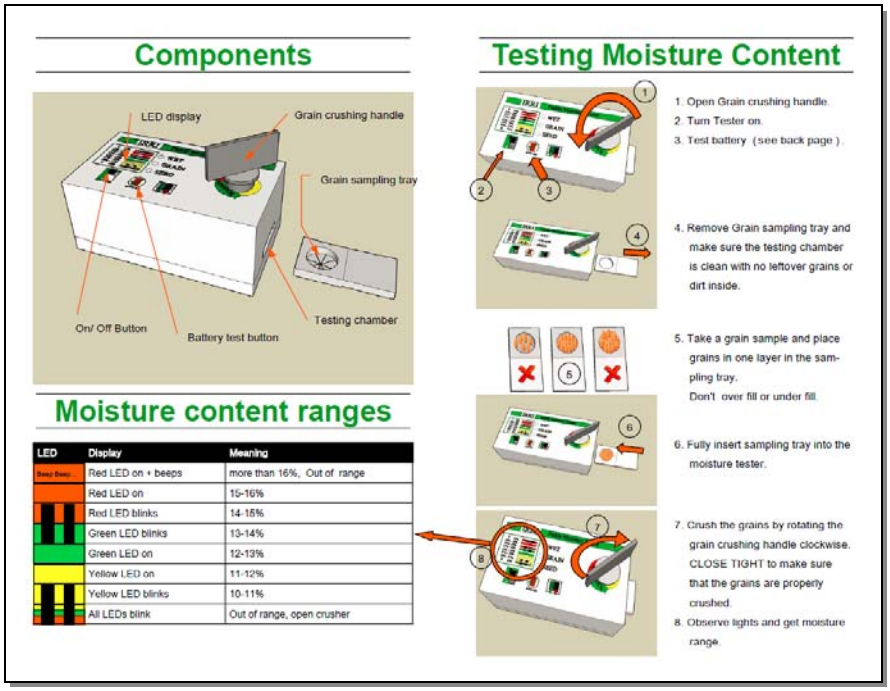
Users Manual

Version 3

Description

The IRRI Moisture tester is an affordable decision making tool for post harvest management of rice. The Moisture tester has three light emitting diodes (LED) that indicate that the paddy moisture content is within a certain range, a red LED for paddy that is too **WET** for safe storage and needs to be dried, a green LED for paddy **GRAIN** that is safe for storage to be used for rice milling and a yellow LED that indicates that paddy **SEED** is dry enough to maintain a high germination rate in seed storage.

Although the moisture content in percent can be assessed using the table on the next page the IRRI moisture tester is designed for postharvest operations and is **not designed to be used in trading**.



Components

LED display
Grain crushing handle
Grain sampling tray
On/ Off Button
Battery test button
Testing chamber

Moisture content ranges

LED	Display	Meaning
Beep Beep	Red LED on + beeps	more than 16%, Out of range
	Red LED on	15-16%
	Red LED blinks	14-15%
	Green LED blinks	13-14%
	Green LED on	12-13%
	Yellow LED on	11-12%
	Yellow LED blinks	10-11%
	All LEDs blink	Out of range, open crusher

Testing Moisture Content

1. Open Grain crushing handle.
2. Turn Tester on.
3. Test battery (see back page).

4. Remove Grain sampling tray and make sure the testing chamber is clean with no leftover grains or dirt inside.

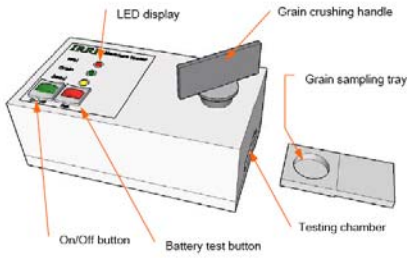
5. Take a grain sample and place grains in one layer in the sampling tray.
Don't over fill or under fill.

6. Fully insert sampling tray into the moisture tester.

7. Crush the grains by rotating the grain crushing handle clockwise. CLOSE TIGHT to make sure that the grains are properly crushed.
8. Observe lights and get moisture range.

4.1.2 IRRI Moisture Tester Mark II

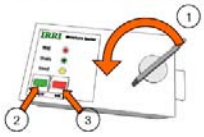
Components



Moisture content ranges

LED	Display	Meaning
beep beep...	Red LED on + beeps	more than 16%, Out of range
	Red LED on	15-16%
	Red LED blinks	14-15%
	Green LED blinks	13-14%
	Green LED on	12-13%
	Yellow LED on	11-12%
	Yellow LED blinks	10-11%
	All LEDs blink	Out of range, open crusher

Testing Moisture Content



1. Open Grain crushing handle.
2. Turn Tester on.
3. Test battery (see back page).

4. Remove Grain sampling tray and make sure the testing chamber is clean with no leftover grains or dirt inside.

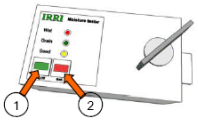
5. Take a grain sample and place grains in one layer in the sampling tray.
Don't over fill or under fill.

6. Fully insert sampling tray into the moisture tester.

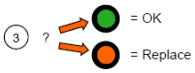
7. Crush the grains by rotating the Grain crushing handle clockwise. CLOSE TIGHT to make sure that the grains are properly crushed.
8. Observe lights and get moisture range.

Testing the Battery

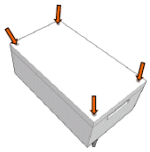
1. Turn Tester on.
2. Press Battery test button, wait for 1 second, keep pressed.



3. Read green and red LED
- Green light -> Battery is OK
- Red light -> Replace Battery



Replacing the Battery



1. Open the four screws at the back of the Tester.
2. Carefully lift off the back of the Tester, make sure that you don't pull any wires off.
3. Replace the battery with a new 9V block battery.
4. Remove any grain leftovers from inside.
5. Replace the back and re-fasten the screws.

For more Information

Post harvest Unit
International Rice Research Institute
IRRIPostHarvest@cgiar.org

M.Gummert, 12 September 2008

IRRI Moisture Tester

Users Manual

Version Mark II

Description

The IRRI Moisture tester was designed for testing paddy moisture content easily as an affordable decision making tool for post harvest management of rice. The Moisture tester has three light emitting diodes (LED) that indicate that the paddy moisture content is within a certain range, a red LED for paddy that is too **WET** for safe storage and needs to be dried, a green LED for paddy **Grain** that is safe for storage to be used for rice milling and a yellow LED that indicates that paddy **SEED** is dry enough to maintain a high germination rate in seed storage.

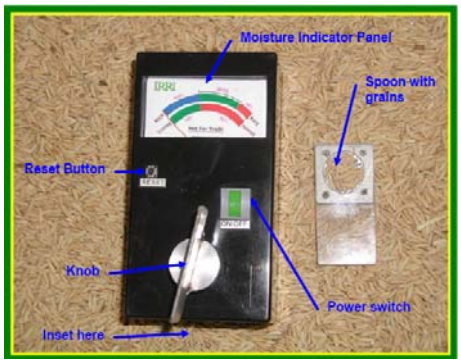
Although the moisture content in percent can be assessed using the table on the next page the IRRI moisture tester is a decision making tool for postharvest operations and is **not designed to be used in trading**.

4.1.3 IRRI Moisture Tester, analog unit

If your quality kit has an older version of the IRRI moisture meter follow the instructions below.

Testing moisture content:

1. Press power switch.
2. Press reset button (without grain in spoon). Needle should deflect fully to left of the dial.
3. Insert spoon with grains covering the base.
   (a) FOR RICE: 14-16 grains - single layer
   (b) FOR COFFEE: 4-6 beans
4. Turn knob clockwise until sample is ground. (e.g. hand tight knob + 3/4 turn more).
5. Read moisture on the indicator panel.



To test another sample:

1. Press reset button.
2. Put new grain samples into spoon and insert the spoon.
3. Turn knob clockwise until sample is ground.
4. Read moisture on the indicator panel.

To test battery:

1. Insert spoon with no grains in it.
2. Turn knob clockwise until bolt touches the plate.
3. Needle should deflect to maximum. If not replace battery.

To replace the battery:

1. Remove the back plate.
2. Replace the 9 volt alkaline battery.
3. Re-secure the back plate.

4.2 Degree of purity (dockage)

Purity is related to the presence of **dockage** in the grain. Dockage refers to material other than paddy and includes chaff, stones, weed seeds, soil, rice straw, stalks, etc. These impurities generally come from the field or from the drying floor.

Unclean paddy increases the time taken to clean and process the grain. Foreign matter in the grain reduces milling recoveries and the quality of rice, and increases the wear and tear on milling machinery.

How?

Measure dockage with the help of the scale

1. Take a sample of 100 grams by using the scale from the kit.
2. Remove light foreign matter, stones, weed and seeds from a 100gm sample.
3. Obtain the total weight then compute the dockage percentage as follows: $\% \ Dockage = \frac{Wt \ of \ \ dockage}{Total \ \ wt \ of \ \ sample} \ x \ 100$

Paddy containing dockage

See appendix for quality standards (Philippines)

4.3 Variety purity/ Grain dimensions

A mixture of varieties causes difficulties at milling and usually results in reduced capacity, excessive breakage, lower milled rice recovery and reduced head rice.

Different sizes and shaped grains make it more difficult to adjust the hullers and polishers to produce whole grains. This results in low initial de-hulling efficiencies, a higher percentage of re-circulated paddy, non-uniform whitening, and a lower grade of milled rice.

Grain dimensions or grain size and shape (length-width ratio) are a very stable varietal property. Long slender grains normally have greater breakage than short, bold grains and consequently have a lower mill rice recovery. The grain dimensions will also dictate to some degree the type of milling equipment needed. As an example, the Japanese designed milling equipment may be better suited to short-bold grains.

Mixed paddy (left) and pure paddy (right)

How? *Measuring grain dimensions with the caliper*

1. Collect 20 paddy samples at random from each replicate
2. Use the caliper or photographic enlarger to measure the dimensions to obtain the average length and width of the paddy grains.
3. Obtain the paddy shape, by using the following equation:

$$Length\ to\ width\ ratio\ (L/W) = \frac{Average\ paddy\ length, mm}{Average\ paddy\ width, mm}$$

Example of a grain

Paddy can be classified based on the International Organization for Standardization (ISO) for paddy.

Scale	Shape	L/W ratio
1	Slender	Over 3.0
3	Medium	2.1 – 3.0
5	Bold	1.1 – 2.0
9	Round	1.0 or less

4.4 Cracked grain

Overexposure of mature paddy to fluctuating temperature and moisture conditions leads to development of fissures and cracks in individual kernels. Cracks in the kernel are the most important factor contributing to rice breakage during milling. This results in reduced milled rice recovery and head rice yields.

How?

Measuring the amount of cracked grains with the crack detector

1. Take a random sample of 100 grains
2. Using the Paddy Crack Detector, count the number of cracked grains in this 100-grain sample
3. Then compute the % cracked grains using the equation:

$$\%\ Cracked\ \ grains = \frac{No.of\ cracked\ grains}{100 grains}\ x\ 100$$

Cracks in grain as seen through a red light filter

See appendix for quality standards (Philippines)

4.5 Immature Grains

The amount of immature paddy grains in a sample has a major affect on head rice yield and quality.

The immature rice kernels are very slender and chalky and this results in excessive production of bran, broken grains and brewer's rice.

How? *Measure the amount of immature grains with the help of the scale*

1. Select a 25gm grain sample

2. Select, segregate and weigh the immature grains in sample.

Segregating the grain

3. Calculate the percentage immature grains in the sample using the formula:

$$\%\ \mathrm{Im}\, mature\ grains = \frac{Wt\ of\ \ immature\ grains}{Total\ \ weight\ of\ \ samples}\ x\,100$$

Milk and dough grain are considered immature grain

See appendix for quality standards (Philippines)

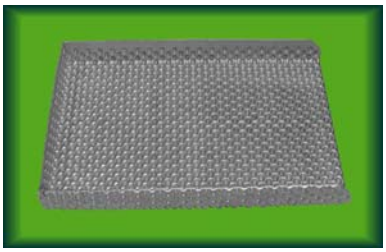
4.6 Head rice/ Broken grain percentage after milling

The head rice percentage is the volume or weight of head grain or whole kernel in the rice lot. Head rice normally includes broken kernels that are 75-80% of the whole kernel. High head rice yield is one of the most important criteria for measuring milled rice quality.

Broken grain has normally only half the value of head rice. To a large extent, the characteristics of the paddy determine the potential head rice yield although the milling process is responsible for some losses and damage to the grain.

How?

Measure the amount of broken grains with the help of the Grain Grader



1. Select 25 gram random sample of grain. [A]
2. Using a grain grader separate the broken grain from the whole grains. For the calculation of the percentage of 'brokens' and the percentage of head rice recovery, a grain is considered to be a whole grain if it is 75% or larger of the grain.
3. Weigh the 'brokens' separated from the sample. [B]
4. Compute the percentage of the 'brokens' using the following equation:

$$\%\ Brokens[C] = \frac{Wt\ of\ broken\ grains[B]}{Wt\ of\ milled\ sample[A]}\ x\ 100$$

(Given the percentage of 'brokens', the percentage of whole grains can be calculated by subtracting the percentage of 'brokens' [C] from 100%. This is the percentage of head rice recovery.)

See appendix for quality standards (Philippines)

4.7 Whiteness after milling

This characteristic is a combination of varietal physical characteristics and the degree of milling. In milling, the whitening and polishing greatly affect the whiteness of the grain.

During whitening, the silver skin and the bran layer of the brown rice is removed. Polishing is undertaken after whitening to improve the appearance of the white rice. During polishing some of the bran particles stick to the surface of the rice which polishes and gives a shinier appearance.

How? *Measure the whiteness of the grain with the Rice Milling Chart*

1. Measure the grain whiteness using the Whiteness Meter.

Different whiteness of milled rice

5 Worksheet for quality determination

This sheet can help when testing the quality of paddy.

Collect two samples of approximately 500 grams of fresh paddy, and determine with the help of the tools the following characteristics by following the procedures as described above. Use the sheet to record your findings on:

- Moisture content
- Grain dimensions (L/W ratio)
- Dockage
- Cracked grains
- Unfilled or immature grains
- Discolored or damaged grains

Quality of paddy worksheet

Parameters	Sample 1			Sample 2		
	No. grains (start)	No. grains (finish)	(%)	No. grains (start)	No. grains (finish)	(%)
Moisture (oven)						
Moisture (meter)						
L/W ratio						
Dockage						
Cracked grains						
Immature grains						
Discolored/damaged						

6 Appendix: Tables and graphs

Table 1: Quality standards for milled rice in the Philippines (National Food Authority)

Grade Specifications	GRADE			
	Premium	Grade 1	Grade 2	Grade 3
Head rice (min %)	95.00	80.00	65.00	50.00
Brokens (max %)	4.90	19.75	34.50	49.00
Brewers (max %)	0.10	0.25	0.50	1.00
Defectives: • Damaged grains, max % • Discolored grains, max % • Chalky and immature grains, max % • Red grains, max % • Red streaked grains, max % Foreign matter (max 5) Paddy (max no./kg) Moisture content (max %)	 0 0.50 2.00 0 1.00 0 1 14.00	 0.25 2.00 5.00 0.25 3.00 0.10 8 14.00	 0.50 4.00 10.00 0.50 5.00 0.20 10 14.00	 2.00 8.00 15.00 2.00 10.00 0.50 15 14.00

Equilibrium moisture content

In storage, the final moisture content of seed depends on the temperature and relative humidity of the air that surrounds the grain. The final grain moisture content resulting from storage is called the 'equilibrium moisture content' or EMC.

The following table shows the EMC of paddy under different storage conditions. The marked areas represent the desirable environmental conditions for storage of paddy for food purposes in the tropics. If grain is not protected against humidity in the air, grain moisture content will rise leading to quality deterioration.

	Storage Temperature (°Celcius)						
Relative Humidity	**22°C**	**24°C**	**28°C**	**32°C**	**36°C**	**40°C**	**44°C**
50%	11.2	10.9	10.7	10.5	10.2	10.0	9.9
55%	11.7	11.5	11.2	11.0	10.8	10.6	10.4
60%	12.3	12.0	11.8	11.6	11.4	11.2	11.0
65%	12.7	12.6	12.4	12.2	12.0	11.8	11.6
70%	*13.5*	13.3	13.1	12.8	12.6	12.5	12.3
75%	14.3	*14.0*	*13.8*	13.6	13.4	13.2	13.0
77%	14.6	14.3	*14.1*	***13.9***	13.7	13.5	13.4
79%	14.9	14.7	14.5	14.3	*14.1*	*13.9*	13.7
81%	15.3	15.1	14.9	14.6	14.5	14.3	*14.1*
83%	15.7	15.7	15.3	15.1	14.9	14.7	14.5
85%	16.1	15.9	15.7	***15.5***	15.3	15.1	15.0
87%	16.6	16.4	16.2	16.0	15.8	15.6	15.5
89%	17.2	17.0	16.8	16.6	16.4	16.2	16.1
91%	17.9	17.7	17.5	17.3	17.1	16.9	16.7

International Standards (ISO 7301)

Rice – Specification

1. Scope

This International Standard lays down the minimum specifications for rice (*Oryza sativa L.)* of the following types: husked rice, husked parboiled rice, milled rice and milled parboiled rice, suitable for human consumption, directly or after reconditioning, and which is the subject of international trade.

2. Normative references

The following standards contain provisions, which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards listed below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 712: 1985, Cereals and cereal products – Determination of moisture content (Routine reference method).

ISO 950: 1979, Cereals – Sampling (as grain).

3. Definitions

For the purposes of this International Standard, the following definitions apply.

3.1. Paddy: paddy rice: rough rice: Rice retaining its husk after threshing.

3.2. Husked rice: cargo rice[1]: Paddy from which the husk only has been removed.

The processes of husking and handling, particularly of parboiled rice, may result in some loss of bran.

3.3. Milled rice: Rice obtained after milling which involves removing all or part of the bran and germ from the husked rice.

It could further be classified into the following degrees of milling.

a) Under-milled rice: Rice obtained by milling husked rice but not to the degree necessary to meet the requirements of well-milled rice.

b) Well-milled rice: Rice obtained by milling husked rice in such a way that some of the germ, and all the external layers and most of the internal layers of the bran have been removed.

c) extra-well-milled rice: Rice obtained by milling husked rice in such a way that almost all the germ, and all the external layers and the largest part of the internal layers of the bran, and some of the endosperm, have been removed.

3.4. Parboiled rice: Rice, the starch of which has been fully gelatinized by soaking paddy or husked rice in water followed by a heat treatment and a drying process.

3.5. Glutinous rice: waxy rice: Special varieties of rice (*Oryza sativa* L. *glutinosa*) the kernels of which have a white and opaque appearance. The starch of glutinous rice consists almost entirely of amylopectin. It has a tendency to stick together after cooking.

[1] The term “brown rice” is sometimes used as a synonym.

3.6. Size of kernels, broken kernels and chips

3.6.1. Whole kernel: Kernel without any broken part.

3.6.2. Head rice: Kernel, the length of which is greater than or equal to three quarters of the average length of the corresponding whole kernel.

3.6.3. Large broken kernel: Fragment of kernel, the length of which is less than three-quarters but greater than one-half of the average length of the corresponding whole kernel.

3.6.4. Medium broken kernel: Fragment of kernel, the length of which is less than or equal to one-half but greater than one-quarter of the average length of the corresponding whole kernel.

3.6.5. Small broken kernel: Fragment of kernel, the length of which is less than or equal to one-quarter of the average length of the corresponding whole kernel but which does not pass through a metal sieve with round perforations 1.4 mm in diameter.

3.6.6. Chip: Fragment of kernel which passes through a metal sieve with round perforations 1.4 mm in diameter.

3.7. Extraneous matter: Organic and inorganic components other than kernels of rice, whole or broken

3.8. Heat-damaged kernels: Kernels, whole or broken , that have changed their normal color as a result of heating. This category includes whole or broken kernels that are yellow due to alteration. Parboiled rice in a batch of non-parboiled rice is also included in this category.

3.9. Damaged kernels: Kernels, whole or broken, showing obvious deterioration due to moisture, pests, disease or other causes, but excluding heat-damaged kernels (3.8).

3.10. Immature kernels: Kernels, whole or broken, which are unripe and/or underdeveloped.

3.11. Chalky kernels: Kernels, whole or broken, except for glutinous rice, of which at least three-quarters of the surface has an opaque and floury appearance.

3.12. Red kernels: Kernels, whole or broken, having a re coloration covering more than one-quarter of their surface, but excluding heat-damaged kernels (3.8).

3.13. Red-streaked kernels: Kernels, whole or broken, with red streaks, the lengths of which are greater than or equal to one-half of that of the whole kernel, but where the surface covered by these red streaks is less than one-quarter of the total surface.

3.14. Pecks: Kernels, whole or broken, of parboiled rice of which more than one-quarter of the surface is dark brown or black in color.

3.15. Other kinds of rice

3.15.1 Paddy in husked rice, in husked parboiled rice, in milled rice and in milled parboiled rice.

3.15.2 Husked rice in husked parboiled rice, in milled rice and in milled parboiled rice.

3.15.3 Milled rice in husked parboiled rice and in milled parboiled rice.

3.15.4 Glutinous in non-glutinous rice.

4. Specification

4.1 General, organoleptic and health characteristics

Kernels of rice, whether or not parboiled, husked or milled, and whether or not whole or broken, shall be sound, clean and free from foreign odors or odor which indicates deterioration.

The levels of additives and pesticide residues and other contaminants shall not exceed the maximum limits permitted by the national regulations of the country of destination or, in their absence, by the joint FAO/WHO Commission of Codes Alimentarius.

The presence of living insects, which are visible to the naked eye, is not permitted.

4.2 Physical and chemical characteristics

4.2.1 The moisture content, determined in accordance with ISO 712, shall be not greater than 15% (m/m)

Note: Lower moisture contents may be required for certain destinations depending on the climate, duration of transport and storage. For further details, see ISO 6322, parts 1, 2 and 3.

4.2.2 The maximum contents of extraneous matter, defective kernels and other kinds of rice in husked and milled rice, whether or not parboiled, and determined in accordance with the method described in annex A, shall be not greater than the values specified in table 1.

4.2.3 All commercial contracts should be clearly the total percentage of broken kernels permitted, classified according to the agreed categories, and the relative proportions of each category, and the total percentage of extraneous matter and of defective kernels, determined in accordance with the method described in Annex A.

The proportion of chips shall not exceed 0.1%.

Table 1

Defect	Reference to the definition	Husked rice	Milled rice (non-glutinous)	Husked parboiled rice	Milled parboiled rice
Extraneous matter a) organic b) inorganic	3.7	 1.5 0.5	 0.5 0.5	 1.5 0.5	 0.5 0.5
Paddy	3.1	2.5	0.3	2.5	0.3
Husked rice	3.2	-	1.0	-	1.0
Milled rice	3.3	-	-	2.0	2.0
Heat-damaged kernels	3.8	4.0	3.0	8.0	6.0
Damaged kernels	3.9	4.0	3.0	4.0	3.0
Immature kernels	3.10	12.0	2.0	12.0	2.0
Chalky kernels	3.11	11.0	11.0	-	-
Red kernels	3.12	12.0	4.0	12.0	4.0
Red-streaked kernels	3.13	-	8.0	0	8.0
Glutinous rice	3.5	1.0	1.0	1.0	1.0
Pecks	3.14	-	-	4.0	2.0
After milling					