REPUBLIC OF INDONESIA

MINISTRY OF COOPERATIVES, SMALL AND MEDIUM ENTERPRISES

INTEGRATED RICE PROCESSING PLANT
IN KARAWANG – WEST JAVA

LABORATORY QUALITY CONTROL OF RICE

Brigitte PONS (CIRAD – France)

Mars 2003

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Laboratory quality control of rice

Mrs PONS (CIRAD)

3-11 March 2003

Content

Training programme

Recommendations / Instructions for the installation of the laboratory

Quality conditions of paddy and milled rice bought and stored during 2003
Indonesian National Standard (BULOG)
(Norme : 01/SKB/BPPHP/TP.830/2003 January 2003
FEP-07/UP/01/2003)

Proposition of a simplified procedure for the determination of milling yield and rice specifications (starting from paddy)

Proposition of a simplified procedure for the determination rice specifications for paddy

Proposition of a simplified procedure for the determination milled rice specifications

Annexe : Training book
"Laboratory quality control of rice"

Training programme

The first part of the training course related to a general presentation of the various following topics:

- Structure of the rice grain
- Composition of the rice grain and its milling fractions
- Effect of various factors on milling quality of rice
- Preliminary steps for laboratory analysis
- Instructions for use the "Colombini" laboratory rice mill « G.150/R »

Then the local staff was separated in 2 groups:

- Post-harvest and rice quality approach (Mr. Dhanika & Mr. Warnan)
- Laboratory quality control (Mr. Makhum, Mr. Samiran & Mr. Suherwan)

During the following days, the activities go on with the specific topics :

- Methods of analysis for rice specifications :

Presentation and explanation of :

  - terms and definitions about the different states of rice,
  - terms and definitions about the size of rice,
  - terms and definitions about the defects of rice.
- Determination of the potential milling yield from paddy and from husked rice
- Elaboration of a specific procedure to analyse rices according to the Indonesian regulation (categories, minimum or maximum specifications for rice)
- Elaboration of the test report.

Many practical works were done on determination of the potential milling yield from paddy, husked rice and milling rice.

The correct adjustment of the laboratory equipment were look at carefully. The complete disassembling of the cone whitener was taught with the trainers so that they can understand the interest of the directives given and that they can be able, in the future, to change and to adjust the spares parts (rubber brakes) if necessary.

The interest of a correct adjustment of the equipment was discuss in relation to the evaluation of the quality of the rice sample, but also in relation to the composition of the grain and its milling fractions.

A training book was delivered to the trainers about all the different aspects of the laboratory quality control of rice (Annexe).

Note : Four testers for the measurement of the moisture content of grains were send with the laboratory material, but not found during the training.

Recommendations / Instructions for the installation of the laboratory

1 – Arrangement of the conditioned room at 20°C and 75 % HR.
This room will be fitted up with several shelves so that samples will be conditioned (and stored eventually) for a sufficient period to obtain a moisture content within the specified rang (13.0+/-1%). Samples should be spread and conditioned in perforated plates.
For example :

The relative humidity in this region is high during all the year and it could be interesting to install a dehumidifier as to get the recommended relative humidity (around 75%).

2 - Arrangement of the laboratory
This room will be fitted up with larders to put all the all the small materiel of the lab (sieves, plates with small cavity cells, analytical balances, moisture testers, ...)

3 – The laboratory equipment should be completed by :

- a plate with small cavity cells (4.2 mm) as recommended by the standard national Indonesian for the determination of "large broken kernel" after milling,
- a metal sieve with perforations minima 1.8 mm and maximum 2.0 mm as recommended by the standard national Indonesian for the determination of "small broken kernel" after milling.
- a vacuum cleaner for the cleaning of the laboratory rice mill to prevent an infestation by different insects.

4 – Translate from English into Indonesian the training book, recommendations and propositions elaborated in this report.

Quality conditions of paddy and milled rice bought and stored during 2003
Indonesian National Standard (BULOG)

(Norme : 01/SKB/BPPHP/TP.830/2003 January 2003
FEP-07/UP/01/2003)

1 - General, organoleptic and health specifications

Note if an odour, particular or foreign to rice, is detected, as well as the presence of all anomalies.
Verify the presence of living or dead insects by visual examination and report the weight.
Paddy shall be sound, clean and free from foreign odours or odour which indicates deterioration. They shall also be free from toxic or any harmful matter.
Additives and pesticides and other contaminants which can affect the visual and organoleptic aspects are forbidden.
Milled rice shall be clean and free from husk and bran.

2 - Specifications for paddy

N°	**Categories**	KOMPONEN MUTU	**% max.**
1	Moisture content	Kadar air	14
2	Foreign matter	Butir Hampa/Kotoran	3
3	Damaged kernel	Butir Kuning/Rusak	3
4	Chalky kernel	Butir Hijau/Mengapur	5
5	Red kernel	Butir Merah	3

3 - Specifications for milled rice

N°	**Categories**	KOMPONEN MUTU	**% max. Mutu III SNI**	**% max. Mutu IV SNI**
1	Whiteness	Derajat Sosoh (min)	95	95
2	Moisture content	Kadar air (max)	14	14
3	Head milled rice	Beras kepala (min)	84	78
	Whole kernel	Butir utuh (min)	40	35
4	Medium broken kernel	Butir patah (max)	15	20
5	Small broken kernel and chip	Butir menir (max)	1	2
6	Red kernel	Butir merah (max)	1	3
7	Heat-damaged kernel/damaged kernel	Butir kuning/rusak (max)	1	3
8	Chalky kernel	Butir mengapur (max)	1	3
9	Insect	Benda asing (max)	0.02	0.02
10	Paddy	Butir gabah (max)	1	1
11	Others varieties	Campuran varietas lain (max)	5	5

4 - Terms and definitions

The following terms and definitions are applied in national Indonesian trade.

Terms and definitions about the different states of rice

paddy, paddy rice, rough rice, ***butir gabah***
rice retaining its husk after threshing

husked rice, brown rice, cargo rice, ***beras pecah kulit***
paddy from which the husk only has been removed

milled rice, white rice, ***beras berish***
husked rice from which all or part of the bran and embryo have been removed by milling

Terms and definitions about the size of milled rice, butir beras

head milled rice, ***beras kapela***
milled kernel or part of kernel with a length greater than or equal to 6/10 of the average length of the test sample kernels (including whole kernel and large broken kernel)

whole kernel, ***butir utuh***
milled kernel without any broken part

large broken kernel, ***butir patah besar***
part of kernel with a length greater than or equal to 6/10 of the average length of the test sample kernels. The use of a plate with small cavity cells of 4.2 mm is recommended.

medium broken kernel, ***butir patah***
part of kernel with a length less than 6/10 but greater than 2/10 of the average length of the test sample kernels.

small broken kernel and chip, ***butir menir***
part of kernel with a length less than or equal to 2/10 of the average length of the test sample kernels. The use of a metal sieve with perforations minimal 1.8 mm and maximal 2.0 mm is recommended.

average length
arithmetic mean of the length of the test sample kernels that are not immature or malformed and without any broken parts.

Terms and definitions about the defects of rice

extraneous matter, foreign matter, ***kotoran***
organic and inorganic components other than kernels of rice
Organic extraneous matter are: foreign seeds, husks, bran, parts of straw, etc.
Inorganic extraneous matter are: stones, sand, dust, etc.

heat-damaged kernel and damaged kernel, ***butir kuning and butir rusah***
head rice or broken kernel that has changed its normal colour as a result of a microbiological alteration.
head rice or broken kernel showing evident deterioration due to moisture, pests, disease or other causes

chalky kernel, ***butir mengapur***
head rice or broken kernel whose whole surface has an opaque and floury appearance

red kernel, ***butir merah***
head rice or broken kernel having a red bran covering more than one-quarter of its surface

others varieties, ***campuran varietas tain***

Proposition of a simplified procedure for the determination of milling yield and rice specifications (starting from paddy)

First step : preparation of test sample

Reception/registry

↓

Sampling

↙ ↘

Determination of moisture content

Determination of foreign matter (fm)
Remove insects

Conditioning
(up to 13+/-)

Second step : adjustment of equipment

- testing husker adjustment
- testing milling adjustment

Third step : determination of milling yield and rice specifications (two samples)

- Mix and sampling (up to 105-110g each sample)	m0
- Remove foreign matter	mf
- Weigh the clean samples	m1
- Husk the paddy	
- Weigh the total husked rice	m2
- Mill the husked rice	
- Weigh the milled rice	m3
- Separate (with one of the milled sample):	
- head milled rice and whole kernel	m4
- whole milled rice	m4'
- medium broken kernel	m5
- small broken kernel	m6
and	
- Separate (with the other milled sample):	
- red kernel	m7
- heat damaged/damaged kernel	m8
- chalky kernel	m9
- paddy	m10
- others varieties	m11

Fourth step : expression of results

Categories	Expression (%)
Foreign matter	mf/m0 x 100
Husked rice yield	m2/m1 x 100
Milled rice yield	m3/m1 x 100
Head milled rice and whole kernel	m4/m1 x 100
Whole kernel	m4'/m1 x 100
Medium broken kernel	M5/m1 x 100
Small broken kernel and chip	m6/m1 x 100
Red kernel	m7/m1 x 100
Heat-damaged kernel/damaged kernel	m8/m1 x 100
Chalky kernel	m9/m1 x 100
Insect	
Paddy	m10/m1 x 100
Others varieties	m11/m1 x 100

Proposition of a simplified procedure for the determination rice specifications for paddy

First step : preparation of test sample

Reception/registry

Sampling

Determination of moisture content

Determination of foreign matter (fm)
Remove insects (fi)

Conditioning
(up to 13+/-)

Second step : adjustment of equipment

- testing husker adjustment
- testing milling adjustment

Third step : determination rice specifications for paddy

- Mix and sampling (up to 105-110g) m0
- Remove foreign matter mf
- Weigh the clean samples m1
- Husk the paddy
- Weigh the total husked rice m2
- Mill the husked rice
- Weigh the milled rice m3
- Separate :
  - red kernel m7
  - heat damaged/damaged kernel m8
  - chalky kernel m9

Fourth step : expression of results

Categories	Expression (%)
Foreign matter	mf/m0 x 100
Red kernel	m7/m1 x 100
Heat-damaged kernel/damaged kernel	m8/m1 x 100
Chalky kernel	m9/m1 x 100
Insect	fi/m1 x 100

Proposition of a simplified procedure for the determination milled rice specifications

First step : preparation of test sample

- Reception/registry
- Mix and sampling (up to 100 - 110g) m0
- Determination of moisture content

Second step : determination milled rice specifications

- Remove foreign matter (fm)
- Remove insects (fi)
- Weigh the clean samples m1
- measurement of the whiteness
- Separate :
    - head milled rice and whole kernel m4
    - whole milled rice m4'
    - medium broken kernel m5
    - small broken kernel m6

and

- Separate :
    - red kernel m7
    - heat damaged/damaged kernel m8
    - chalky kernel m9
    - paddy m10
    - others varieties m11

Fourth step : expression of results

Categories	Expression (%)
Foreign matter	mf/m0 x 100
Head milled rice and whole kernel	m4/m1 x 100
Whole kernel	m4'/m1 x 100
Medium broken kernel	M5/m1 x 100
Small broken kernel and chip	m6/m1 x 100
Red kernel	m7/m1 x 100
Heat-damaged kernel/damaged kernel	m8/m1 x 100
Chalky kernel	m9/m1 x 100
Insect	fi/m0 x 100
Paddy	m10/m1 x 100
Others varieties	m11/m1 x 100

APPENDIX

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Content

Structure of the rice grain
Composition of the rice grain and its milling fractions

The **rice grain or rough rice**, commonly called a seed, consists of the true fruit or brown rice (caryopsis) and the hull, which encloses the brown rice.

The husk is formed from two specialised leaves :
- the lemma covering the dorsal part of the seed,
- the palea covering the ventral portion.

The husk is formed mostly of cellulosic and fibrous tissue and is covered with very hard glass-like spines.
Hull weight averages about 20% of total grain weight.

Brown rice consists mainly of the embryo and endosperm.
The surface contains several thin layers of differentiated tissues that enclose the embryo and endosperm.

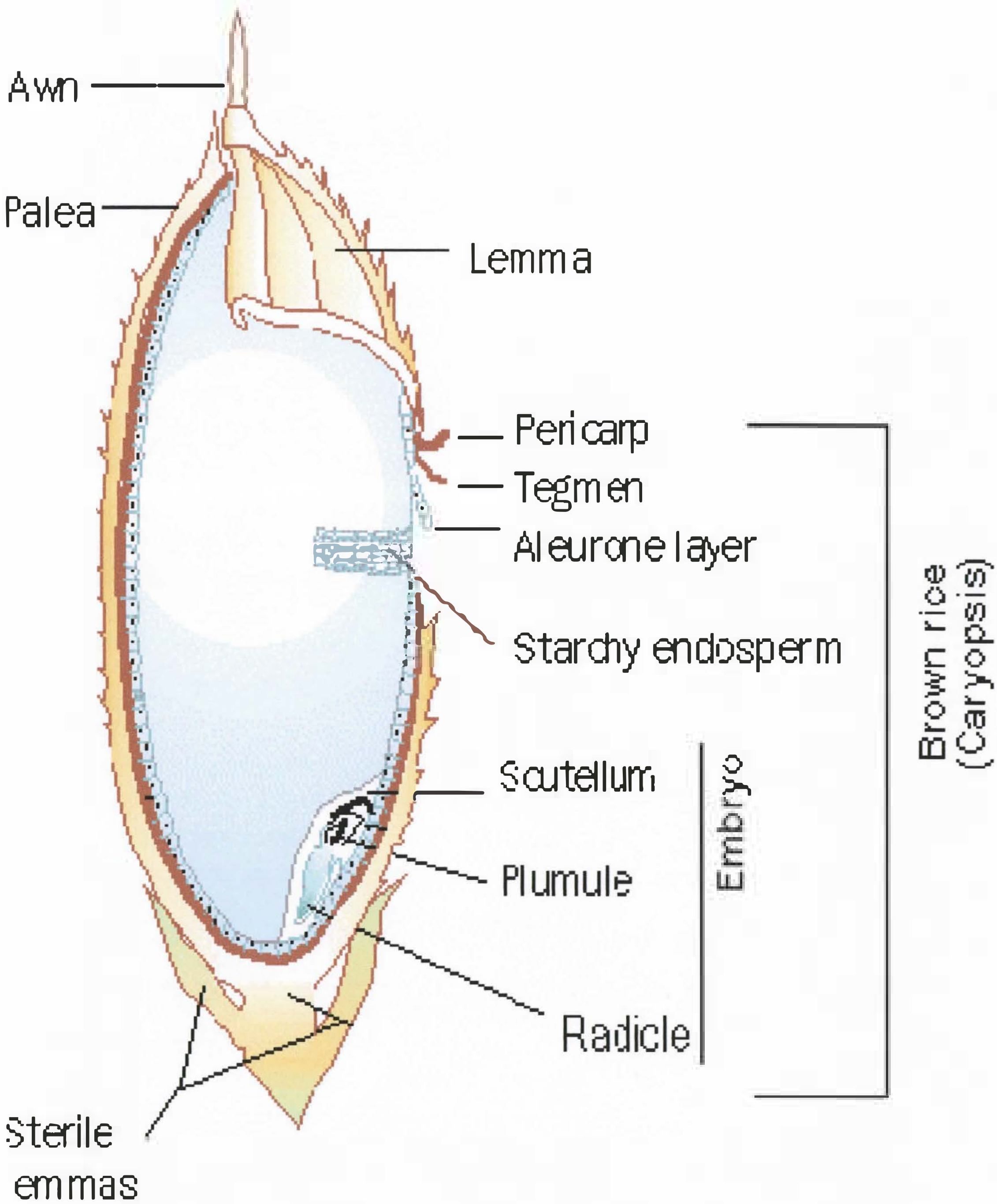
The **embryo or germ** is small and is located on the ventral part of the caryopsis. The embryo is attached with the endosperm by the **scutellum**, and serves as an absorbing and conducting organ for the nutrients carried from endosperm to the embryo during germination. It contains the embryonic leaves (plumule) and the embryonic primary root (radicle).

The **caryopsis** is enveloped :
- by a fibrous layer : the **pericarp**. The pericarp layer is a very hard tissue that is highly impermeable to the movement of oxygen, carbon dioxide, and water vapour. It is a very good protection against mould attack and oxidative and enzymatic deterioration of the underlying tissues,
- next to the pericarp is the **tegmen**, which is a layer several cells in thickness. These cells are less fibrous than the pericarp layer. They are rich in oil and protein,
- beneath the tegmen is the **aleurone layer**. This layer is very rich in protein, oil, vitamins with a relative small amount of starch.
- next to the aleurone layer lies the **starchy endosperm**. It is heavily loaded with compound starch granules and some protein. Proteins are more abundant in the outer cell layers. Opaque or chalky regions appear in the starchy endosperm of nonwaxy cultivars : is called a white core or white belly.

The weight distribution of various parts of brown rice is :
- pericarp, 1 to 2 %,
- aleurone layer, 4 to 6 %,
- germ, 2 to 3 %,
- endosperm, 89 to 94 %.

The caryopsis varies widely among cultivars in shape and size, length, width and thickness.
Japonica cultivars generally are bold or coarse and short-grain, whereas indica cultivars are usually long or medium.
A single grain weighs about 10-45 mg.

STRUCTURE OF RICE KERNEL



Effect of various factors on the milling quality of rice

Milling quality is vital in rice trade and influences the economic value of the grain. Rice is mainly consumed as whole grain. Milling quality usually includes total and head rice yields from a rice sample.
The final behaviour of rice during milling depends on the favourable or unfavourable factors affecting the grains between maturation in the field and industrial processing.

Milling quality is dependent on :

- the variety, with the physical and mechanical properties of grains,
- the weather conditions in the fields just before the harvest,
- the grain moisture content during harvesting,
- the engineering aspects. They include harvesting, handling, drying, storage, transport, milling operations,
- the grain moisture at the time of milling, …

Some of these aspects are developed.

Dried rough rice (paddy) is hygroscopic and reacts to every environment to which it is exposed. Grain moisture attempts to stay in equilibrium with the ambient temperature and relative humidity. The grain could absorb rapidly humidity.
"Checks" in rice grain begin at the centre of the kernel and progress towards the circumference. There may be single or multiple checks and fractures in many directions with the progress of checking. When the outer portion of the kernel absorbs moisture or increase in temperature, it is bound to expand. When the grain dries, its low-moisture outer surface contracts around a high-moisture interior. The grain interior should then be in compression while the exterior is in tension. Since the central portion is not elastic, internal pull begin, resulting in cracks and faults.
Even during and after harvest, each rough rice grain continually reacts with its environment.
The greater the proportion of the grains in a sample with cracks, the greater the amount of breakage of grains in milling.

Environment conditions in the field are responsible of the presence of grains fissured.
The weather conditions during the maturation of the grains to the harvest affect significantly the milling quality.
The rice grains develop cracks or internal fissures when the harvest moisture is low, the mature paddy is exposed to alternate wetting and drying conditions. They dry to low enough moisture during the day to develop fissures and then readsorbed moisture at night. When the drying grain drops below approximately 20% moisture content, grain moisture cycles with daily environment conditions. Dew produces checking. An increase temperature also produces checking.

Irrigation – Crop conditions
Irrigated crop gave significantly higher head and total milled rice.
A slow withdrawal of water at the beginning of the maturation period decrease the effect of weather conditions.

Harvesting time and harvest moisture
A good criterion for determination of the optimum harvest time of grains was found to be their moisture content. The optimum harvest moisture of grains is around 20-25%. In many the optimum time for harvesting may be specified by days after flowering, or by the sum of temperature after flowering. Low-moisture rice will fissure when subjected to any environment from which it can rapidly adsorb moisture.
An early harvest is generally better for the milling quality but the percent of immature grains increase. At the opposite, a later harvest increase the broken kernels during milling. Growers can

reduce risk of cracking caused by weather conditions and moisture harvest by drawing up a sowing programme and harvesting the rice when the moisture content of grains is optimal.

The manner and method of drying greatly influence the cracking in rice and the rice recovery. Some authors noted that no cracks appeared in paddy even during fast drying until its moisture content had dropped to 15 per cent. It has been postulated that starch is plastic above 15 % moisture and can dissipate the stress of differential expansion and contraction without damage. However, below this moisture, starch is brittle and cannot withstand the stress, and the grain releases it by cracking.

Varietal aspects : physical and mechanical properties of grains
Each rice variety has its own susceptibility to fissuring.
Grain dimensions influence fissure susceptibility: moisture stresses produce fissured grains more in bold varieties than in long-grain or long, slender-grain varieties. As a grain becomes more bold, the distance increases for moisture diffusion from its surface to its centre. Stresses from moisture adsorption may be proportional to grain width and thickness. The bold grain may be physically stronger because it is larger and, therefore, may resist milling stress better. Bold grains are much more sensitive to alternative drying and moistening periods, specially during ripening, than long grains. However, long grain and long slender-grain varieties are less resistant to breakage for mechanical reasons during threshing or milling.
Different rice varieties may have similar grain configurations but may not uniformly susceptible to fissured grains.
White-belly grains tend to crack more under stress conditions, probably due to their heterogeneous texture. On the other hand, the extreme resistance to cracking of complete chalky grains shows that less stress develops in a homogeneous soft chalky endosperm than in a homogeneous translucent grain.

Preliminary steps for laboratory analyses

Objective

To assess the milling quality of a rice sample.

The main characteristic is the head rice yield. However, a set of characteristics are measured : total milled yield which is the total quantity of whole and broken grains recovered from the sample, the head rice yield which is the quantity of whole grains recovered from the sample, the quantity of milled products, foreign matters, rices with defect, ...

To determine the quality of the whole bulk of rice, from which the sample has been taken, it is essential that the sample be truly representative and has not been damaged or changed during transport or storage.
It should :

- ✓ Contain the same elements present in the whole,
- ✓ Contain these elements in the right proportion,
- ✓ Maintain these elements in a stable condition.

The first two points involve proper sampling techniques ; the third is related to the preservation of the sample.

Different steps :

- ➢ Reception and registry of the sample
- ➢ Mix and divide the sample
- ➢ Determination of the moisture content. The acceptance range is a mass fraction of (13,0 +/- 1) %. If the moisture content is outside the acceptance range, the laboratory sample should be conditioned at ambient temperature (20°C +/- 1°C) and humidity around 68-70%) for a sufficient period to obtain a moisture content within the specified range,
- ➢ Specifications of the rice sample (organoleptic and health specifications, foreign matters, defects, different yields, ...)
- ➢ Determination of the potential milling yield
- ➢ Elaboration of the test report

RECEPTION AND REGISTRY

Each sample should be in a two pocket-bag :
One for analysis
One to be kept for reference

Once the sample enters the office, the responsible should :

- ✓ Stamp an identification number on the bags and on the relevant forms
- ✓ Record details of the sample and enter the date in a log book
- ✓ Keep one part of the sample (or reference or for an eventual second check in case of dispute)
- ✓ Send the second part of the sample to the laboratory to the analysis.

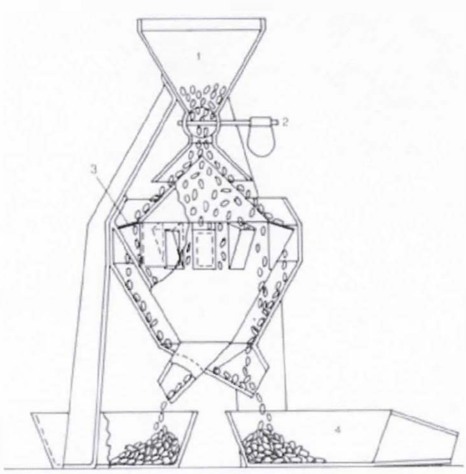
MIX AND DIVIDE THE SAMPLE

The representative sample collected from the bulk grain is in excess of the quantity required for laboratory tests and reference purposes.

The "laboratory sample" is mixed and reduced to get "test sample". "Test sample" is divided to get "test portion". Normative references specify precisely the quantity of each part. However, in a number of countries, precise rules specify the number of laboratory samples to be taken according to weight.

Sample mixers and dividers

- ✓ Mix the sample with a hand turned seed mixer.
- ✓ Divide the sample in a sample divider. The grain from the hopper (1) flours through a throttle (2) over the surface of a cone where it is collected by pockets (3) and is channelled into two containers (4).



This type of divider can also be used as a mixer.

By Hand :

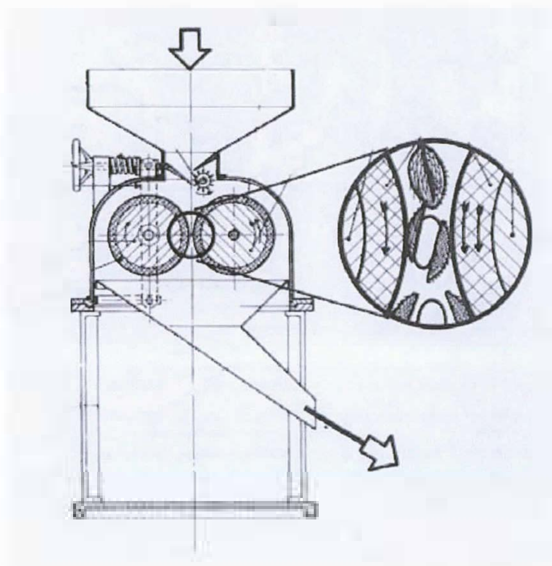
Rice samples can also be mixed and divided by hand if the samples is spread in a thin layer on a board and then divided and subdivided into even portions.

THE RUBBER ROLLER HUSKER

The **objective** of a dehusker machine is to remove the husk from the paddy grain with a minimum damage of the bran layer and, if possible, without breaking the brown rice grain.

Principle of operation

The grain of paddy is pressed between two rubber rolls which rotate in opposite directions and at different angular speeds. When the paddy is fed between the two rolls, the grains are caught under pressure by the rubber and because of the difference in speed, the husk is stripped off.



Rubber roll husker

THE WHITENING CONE

The **objective** of the whitening cone is to obtain milled rice from cargo rice with a minimum of broken milled grains.

Principle of operation

Germ, pericarp and tegmen are removed from husked rice grains.

Two physical principles are used to mill rice :

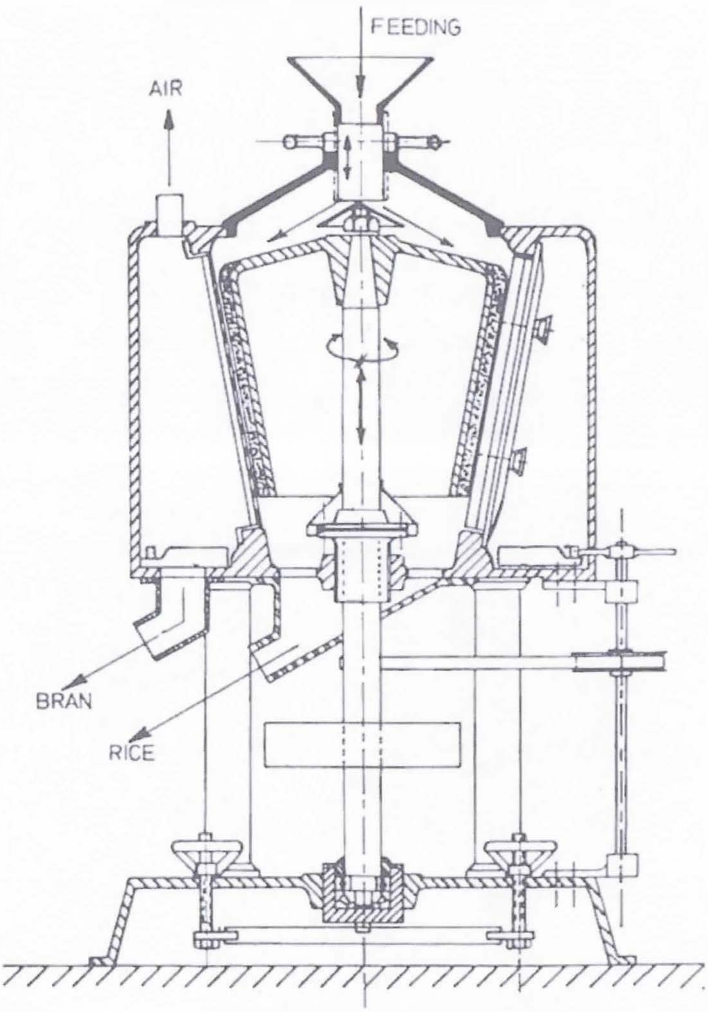
- the abrasion : the whitening cone removed the outer layers and the germ by flaking
- the friction : kernels rubs against the others and against other part of the machine.

The whitening cone removes the outer layers and the germ by flaking an skinning and by doing both together.

This machine basically consists of a cone-shaped cast iron cylinder with an abrasive coating. The cone is fixed on a vertical shaft that rotates either clockwise or counterclock-wise. A wire screen is fixed around the entire cone.

The rotating whitening cone is vertically adjustable so the clearance between the abrasive coating of the cone and the wire screen can be adjusted. This adjustment depends on the variety or rice, the conditions of the grain, the process method, and the wear of the coating. The rubber brakes in the wire-screen frame are adjustable and their clearance with the cone surface is only about 2-3 mn.

The brown rice is fed into the centre of the machine through a small hopper. By centrifugal force the rice is fed between the cone and the wire screen. If no rubber brakes were installed, the rice would very quickly pass through the free space between the cone and wire screen and nothing would happen. However, the presence of the rubber brakes prevents the immediate discharge of the rice. The resistance built up by these brakes brings the grain under pressure and presses it against the abrasive coating of the cone and against the wire screen. This friction removes part of the bran layer. The bran passes through the wire screen and drops into the cone housing. The partly or fully whitened rice leaves the cone, falls into a self-unloading discharge spout, and is fed to a bin for further processing. The bran is scraped from the bottom of the cone housing by a rotating scraper and is unloaded into a spout for bran discharge.
Air is sucked through this machine to cool the grain and at the same time to remove part of the bran. This makes it necessary to blow the air to a cyclone for bran separation.
Vertical adjustment of the rotating cone is done manually. The entire shaft-cone assembly is moved by moving the housing of the shaft end-bearing. A simple had wheel adjustment, which is mounted on the base of the cone frame, is used to lift or lower the steel bar that supports the bearing housing.



Abrasive whitening cone

COSTRUZIONI MECCANICHE COLOMBINI

Disk Husker Sheller - Rubber Roller Sheller

INSTRUCTIONS FOR USE OF THE LABORATORY RICE MILL "G. 150/R" WITH PNEUMATIC CIRCULATION

For a good working of the LAB. RICE-MILL, it is necessary to know thouroughly the several adjustment needed by the machines ; high efficiency can obtained, if the are properly affected.

1. Check the right tension of belts. If necessary, operate the special belt-tighteners on motor to obtained best results.
2. Check the direction of rotation of machines, which is to follow the arrow thereon.

A - ADJUSTMENT OF THE G.390/R MODEL MINI TESTER HUSKER

The equipment, when viewed roller side, is equipped with three adjusting devices :

1. Hopper opening or closing shutter. The shutter must be completely open during husking or completely closed when the equipment doesn't work.
2. On the right side of the equipment a plastic handle operates the adjustment of the valve of the revolving feeder.
3. Always, on the right side another flow adjusting handle adjusts the adjustment handle for roll clearance in order to get them near or away according to need. The rod locked to this adjustment handle has a two-position support. With the rod position on "UP", the rolls are near and the clearance may be adjusted by screwing or unscrewing the rod. With the rod on "DOWN" the rolls are completely separated for the equipment idling or stop.

Pressure regulation of roll automatic opening, when foreign matters (stones, etc) eventually come in operates the automatic resetting of rolls in their position during husking operation. Such an adjustment is executed through a spring locked on the rod end. According to necessity this spring is more or less compressed by a hexagon nut which must be locked in its turn by another nut.

This spring along with the hexagon nuts is mounted on the left, behind the rolls. The above automatic device prevents the equipment from being damaged by the mentioned foreign matters.

Should the husked paddy be whitened later on the whitening machine will carry out the husking of such grains without leaving any trace.

The rolls will be exactly positioned for work when the clearance between them equals the thickness of a postcard and such a postcard may slide in this clearance supporting a slight resistance.

B - ADJUSTMENT OF THE WHITENING CONE

The whitening cone has six rubber brakes, placed on its circumference. Each of them is adjustable by 3 hexagon headed screw. The use of the central one is to lock the brake, while the use of the other screw, mounted on the brackets (upper and lower), is to adjust the brakes by pushing them outside or withdrawing them, as well as to secure parallelism by sight (photos 1 and 2).
In case you should push the rubbers forward, you have to slightly unscrew the screw of the central bracket, and screw up the other two.
Otherwise (re-entry of rubbers), unscrew the two screw (upper and lower) and screw up the central one.

Adjustment of rubbers is effected by taking off cap of the whitening cone, and taking the abrasive cone. Out of the conical seat of shaft. So you can have a complete view of the whole series of rubber. With a special small rod, 3 mm thick (which can also be wooden one) you determine the jut of the brake by setting the thickness rod on the rotating cone housing, by the side of the brake (photo 3).
Then adjust the rubber, so that it should be on a level with the control rod for its whole length. Put back the cone and the cap again, and tighten their screw.

Brakes can taken away from the cone and made to approach it, by a motion of vertical translation of the central shaft, on witch the cone is mounted. These movement are regulated by the lower bearing flywheel (photo 4), allowing, -through rotation in either direction- the cone to be lifted (disconnection from brakes) or lowered (approaching brakes).

The position of the cone as regards the brakes can be adjusted by getting some initial samples, starting form a distance of about 2 mm between cone and brakes. In case you should notice an excess of working in the product, you have to lift the done (a greater distance form brakes). In case of insufficient working of product, you have to lower the cone (a shorter distance form brakes).

σσσσσσσσσσσσ

Any machine made in our machine-shop is tested and tried before forwarding by getting several samples (inevitably with Italian rice only), in order to verify that it is in perfect working order.

Photo 1

Photo 2

Photo 3

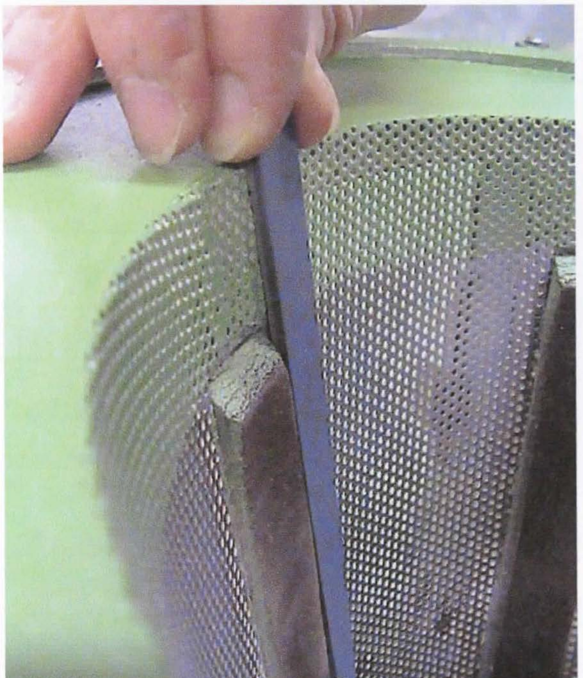


Photo 4

Methods of analysis for rice specifications
(husked and milled rice)

1 - Scope
This paper gives the minimum specifications for rice *(Oryza sativa* L.) which is the subject of international trade.
It is applicable to the following types : husked rice and milled rice, not parboiled, intended for direct human consumption.
It is not applicable to other products derived from rice, nor to waxy rice (glutinous rice).

2 - Normative references
ISO 7301, *Rice - Specification*
ISO 712, *Cereals and cereal products — Determination of moisture content — Routine reference method*
ISO 5223, *Test sieves for cereals*
ISO 13690:1999, *Cereals, pulses and milled products — Sampling of static batches*

3 - Terms and definitions
The following terms and definitions are applied in international trade.

Terms and definitions about the different states of rice

3.1 paddy, paddy rice, rough rice
rice retaining its husk after threshing

3.2 husked rice, brown rice, cargo rice
paddy from which the husk only has been removed
(NOTE : the processes of husking and handling may result in some loss of bran)

3.3 milled rice, white rice
husked rice from which all or part of the bran and embryo have been removed by milling
(NOTE : It should further be classified into the following degrees of milling)

3.3.1 undermilled rice
rice obtained by milling husked rice but not to the degree necessary to meet the requirements of well-milled rice

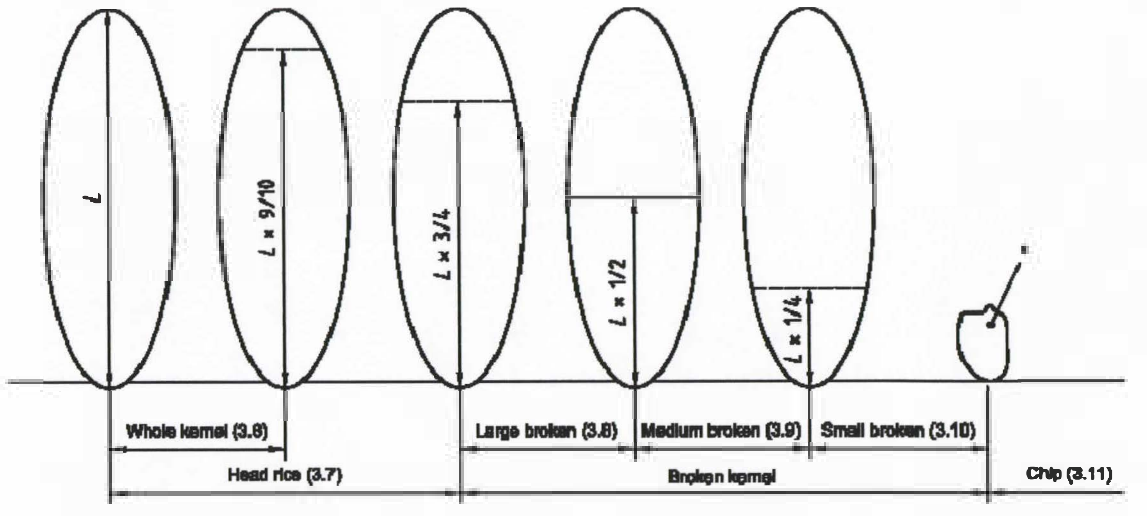
3.3.2 well-milled rice
rice obtained by milling husked rice in such a way that most of the bran and part of the embryo have been removed

3.3.3 extra-well-milled rice
rice obtained by milling husked rice in such a way that all of the bran and almost all of the embryo have been removed

3.4 parboiled rice
husked or milled rice processed from paddy or husked rice that has been soaked in water and subjected to a heat treatment so that the starch is fully gelatinised, followed by a drying process

3.5 waxy rice, glutinous rice
varieties of rice whose kernels have a white and opaque appearance
(The starch of waxy rice consists almost entirely of amylopectin)

Terms and definitions about the size of rice



[a] Not passing through a round perforation of 1,4 mm in diameter.

Key

L is the average length (3.12)

Figure 1 — Size of kernels, broken kernels and chips

3.6 whole kernel

husked or milled kernel without any broken part, or part of kernel with a length greater than or equal to nine-tenths of the average length (3.12) of the test sample kernels

3.7 head rice

whole kernel (3.6) or part of kernel with a length greater than or equal to three-quarters of the average length (3.12) of the test sample kernels

3.8 large broken kernel

part of kernel with a length less than three-quarters but greater than one-half of the average length (3.12) of the test sample kernels

3.9 medium broken kernel

part of kernel with a length less than or equal to one-half but greater than one-quarter of the average length (3.12) of the test sample kernels

3.10 small broken kernel

part of kernel with a length less than or equal to one-quarter of the average length (3.12) of the test sample kernels but which does not pass through a metal sieve with round perforations in diameter

3.11 chip

part of kernel which passes through a metal sieve with round perforations in diameter 1,4 mm in diameter

3.12 average length

arithmetic mean of the length of the test sample kernels that are not immature or malformed (3.16) and without any broken parts

Terms and definitions about the defects of rice

3.13 extraneous matter
organic and inorganic components other than kernels of rice
Note 1 : Organic extraneous matter are: foreign seeds, husks, bran, parts of straw, etc.
Note 2 : Inorganic extraneous matter are: stones, sand, dust, etc.

3.14 heat-damaged kernel
head rice or broken kernel that has changed its normal colour as a result of a microbiological heating
This category includes kernel that is yellow/dark yellow in the case of non-parboiled rice and orange/dark orange in the case of parboiled rice, due to a microbiological alteration.

3.15 damaged kernel
head rice or broken kernel showing evident deterioration due to moisture, pests, disease or other causes, but excluding heat-damaged kernels (3.14)

3.16 immature kernel, malformed kernel
head rice or broken kernel which is unripe and/or badly developed

3.17 chalky kernel
head rice or broken kernel of non-parboiled rice, except waxy rice (3.5), whose whole surface has an opaque and floury appearance

3.18 red kernel
head rice or broken kernel having a red bran covering more than one-quarter of its surface

3.19 red-streaked kernel
head rice or broken kernel with red bran streaks of length 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

3.20 partly gelatinised kernel
head rice or broken kernel of parboiled rice which is not fully gelatinised and shows a distinct white opaque area

3.21 peck
head rice or broken kernel of parboiled rice of which more than one-quarter of the surface is dark brown or black in colour due to the parboiling process

4 - Methods of analysis for rice specifications

4.1 Principle
Manual separation and weighing of the broken kernels and of the categories in Table 1.

4.2 Apparatus
4.2.1 Sample divider, conical sampler or multiple-slot sampler
4.2.2 Metal sieve, with round perforation in diameter in accordance with ISO 5223.
4.2.3 Tweezers, scalpel and **paintbrush**
4.2.4 Small bowls

4.2.5 Balance, capable of weighing to the nearest .
4.2.6 Tray, or other means, coloured in contrast with the colour of the rice to be evaluated.
4.2.7 Micrometer, or other measuring device not deforming the kernels and capable of being read to the nearest.

4.3 Sampling
A recommended sampling method is given in ISO 13690.
It is important that the laboratory receive a sample which is truly representative of the lot and has not been damaged or changed during transport or storage.

Note : The packaging material shall not transmit any smell or taste, and shall not contain substances which may damage the product or constitute a health risk. If bags are used, they shall be clean, sufficiently strong and well stitched.

4.4 Procedure

4.4.1 General, organoleptic and health specifications
Note if an odour, particular or foreign to rice, is detected, as well as the presence of all anomalies.
Verify the presence of living or dead insects by visual examination and report their number.

Note : Kernels of rice, husked or milled, broken or not, shall be sound, clean and free from foreign odours or odour which indicates deterioration. They shall also be free from toxic or any harmful matter.
The levels of additives and pesticides 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 FAO/WHO Codex Alimentarius.
The presence of living insects which are visible to the naked eye is not allowed.

4.4.2 Preparation of test sample
Weigh and carefully mix the laboratory sample to make it as uniform as possible. Then proceed to reduce it, if necessary, using a sample divider (4.2.1) to obtain a quantity of about.
Divide the test sample so obtained into two equal test portions of about 400g, using the sample divider (4.2.1).

4.4.3 Physical and chemical specifications
The mass fraction of moisture shall be not greater than 15.0% (m/m). The moisture content shall be determined in accordance with ISO 712.
The defect tolerance for the categories considered, and determined in accordance with the method described, shall not exceed the limits given in Table 1 (ISO 7301).

4.4.4 Determination

4.4.4.1 General
When a kernel has several defects, it shall be classified in the category where the maximum permissible value is the lowest (see Table 1).
All parts of kernels which get stuck in the perforations of a sieve shall be considered to be retained by the sieve.

4.4.4.2 Average length

On one of the two test portions (4.4.2):

a) separate two sets of 100 kernels without any broken part, by random sampling;

b) measure the length of the kernels using the micrometer (4.2.7) and calculate the arithmetic means of the length for both sets of kernels *(L1 and L2)*;

c) calculate the average length (3.12) of the two sets of kernels *((L1 + L2)/2)* ; if the value of *(100(L1 +L2)/L)* is higher than 2, return all the kernels to the tray and repeat from step a);

d) return all the kernels to the test portion.

4.4.4.3 Husked rice (Figure A.1)

- Weigh one of the test portions (4.4.2) to the nearest 0.1g (m_w) and spread it on the tray (4.2.6).
- Separate the organic extraneous matter (3.13), the inorganic extraneous matter (3.13), the paddy (3.1), the milled rice, non-parboiled (3.3), the husked rice, parboiled (3.4), and the milled rice, parboiled (3.4), into small bowls (4.2.4), with the aid of tweezers, scalpel and paintbrush (4.2.3).
- Weigh the six fractions so obtained to the nearest (m_1, m_2, m_3, m_4, m_5 and m_6).

- Divide the second test portion with the divider (4.2.1) in order to obtain four different aliquot parts of about each.
- Weigh the first aliquot part to the nearest 0.01g (m_x).
- Spread it out and separate the damaged kernels (3.15), the immature and/or malformed kernels (3.16) and the red kernels (3.18) into small bowls. Weigh the three fractions so obtained to the nearest 0.01g (m_7, m_8 and m_9).
- Weigh the second aliquot part to the nearest 0.01g (m_y).
- Separate the chips (3.11) by the metal sieve (4.2.2), then spread out the remainder and separate the broken kernels, classifying them into large broken kernels (3.8), medium broken kernels (3.9) and small broken kernels (3.10). Put the fractions so obtained into small bowls. Weigh the four fractions to the nearest 0.01g (m_{10}, m_{11}, m_{12} and m_{13}).
- Proceed with the laboratory milling of a third aliquot part. Weigh the obtained milled rice to the nearest 0.01g (m_z).
- Spread it out and separate the heat-damaged kernels (3.14), the chalky kernels (3.17) and waxy rice (3.5) into small bowls. Weigh the three fractions so obtained to the nearest 0.01g (m_{14}, m_{15} and m_{16}).

4.4.4.4 Milled white rice (Figure A.2)

- Weigh one of the test portions (4.4.2) to the nearest 0.1g (m_w).
- Spread it on the tray (4.2.6). Separate the organic extraneous matter (3.13), the inorganic extraneous matter (3.13), the paddy (3.1), the husked rice, non-parboiled (3.2), the husked rice, parboiled (3.4), and the milled rice, parboiled (3.4) into small bowls (4.2.4), with the aid of tweezers, scalpel and paintbrush (4.2.3). Weigh the six fractions so obtained to the nearest 0.01g (m_1, m_2, m_3, m_4, m_5 and m_6).

- Divide the second test portion with the divider (4.2.1) in order to obtain four different aliquot parts of about 100g each.
- Weigh the first aliquot part to the nearest 0.01g (m_x). Spread it out and separate the heat-damaged kernels (3.14), the damaged kernels (3.15), the immature and/or malformed kernels (3.16), the chalky kernels (3.17), the red kernels (3.18), together with the red-streaked kernels (3.19), and the waxy rice (3.5) into small bowls. Weigh the six fractions so obtained to the nearest 0.01g (m_7, m_8, m_9, m_{10}, m_{11} and m_{16}).
- Weigh the second aliquot part to the nearest 0.01g (m_y).

- Separate the chips (3.11) by the metal sieve (4.2.2), then spread out the remainder and separate the broken kernels, classifying them into large broken kernels (3.8), medium broken kernels (3.9) and small broken kernels (3.10). Put the fractions so obtained into small bowls. Weigh the four fractions to the nearest 0.01g (m_{12}, m_{13}, m_{14} and m_{15}).

4.5 Expression of results

Express the result obtained for the categories given in Table 2 as mass fraction, in percentage, of the product as received.

Report the result for each category to one decimal place by rounding it to the nearest integral multiple.

4.6 Test report

The test report shall specify:

- all information necessary for the complete identification of the sample;
- the sampling method used, if known;
- the sample mass;
- the test method used, with reference to the International Standard;
- the date of analysis;
- any operating details not specified here, or regarded as optional, together with details of any incidents likely to have influenced the results;
- the test results obtained.

Note : Contract specifications

All commercial contracts shall show clearly the following:

a) the total percentage of broken kernels permitted, classified according to the agreed categories, and the relative proportion of each category.

b) the total percentage permitted of all the categories and the method to use for the determination.

Table 1 – Specification of rice

Categories	Reference to the definition	Husked rice non-parboiled max. % (mass fraction)	Milled rice non-parboiled max. % (mass fraction)
Extraneous matter:			
organic	3.13, Note 1	1,0	0,5
inorganic	3.13, Note 2	0,5	0,5
Paddy	3.1	2,5	0,3
Husked rice, non-parboiled	3.2	Not applicable	1,0
Milled rice, non-parboiled	3.3	1,0	Not applicable
Husked rice, parboiled	3.2 and 3.4	1,0	1,0
Milled rice, parboiled	3.3 and 3.4	1,0	1,0
Chips	3.11	0,1	0,1
Heat-damaged kernels	3.14	2,0[a]	2,0
Damaged kernels	3.15	4,0	3,0
Immature and/or malformed kernels	3.16	8,0	2,0
Chalky kernels	3.17	5,0[a]	5,0
Red kernels and red-streaked kernels	3.18 and 3.19	12,0[b]	12,0
Partly gelatinized kernels	3.20	Not applicable	Not applicable
Pecks	3.21	Not applicable	Not applicable
Waxy rice	3:5	1,0[a]	1,0

[a] After milling.

[b] Only full red husked (cargo) rice is considered here.

Table 2 – Expression of results

Categories	Husked rice non-parboiled[a]	Milled rice non-parboiled[b]
Organic extraneous matter (3.13, Note 1)	$\frac{m_1 \times 100}{m_w}$	$\frac{m_1 \times 100}{m_w}$
Inorganic extraneous matter (3.13, Note 2)	$\frac{m_2 \times 100}{m_w}$	$\frac{m_2 \times 100}{m_w}$
Paddy (3.1)	$\frac{m_3 \times 100}{m_w}$	$\frac{m_3 \times 100}{m_w}$
Husked rice, non-parboiled (3.2)	Not applicable	$\frac{m_4 \times 100}{m_w}$
Milled rice, non-parboiled (3.3)	$\frac{m_4 \times 100}{m_w}$	Not applicable
Husked rice, parboiled (3.4)	$\frac{m_5 \times 100}{m_w}$	$\frac{m_5 \times 100}{m_w}$
Milled rice, parboiled (3.4)	$\frac{m_6 \times 100}{m_w}$	$\frac{m_6 \times 100}{m_w}$
Heat-damaged kernels (3.14)	$\frac{m_{14} \times 100}{m_z}$	$\frac{m_7 \times 100}{m_x}$
Damaged kernels (3.15)	$\frac{m_7 \times 100}{m_x}$	$\frac{m_8 \times 100}{m_x}$
Immature and/or malformed kernels (3.16)	$\frac{m_8 \times 100}{m_x}$	$\frac{m_9 \times 100}{m_x}$
Chalky kernels (3.17)	$\frac{m_{15} \times 100}{m_z}$	$\frac{m_{10} \times 100}{m_x}$
Partly gelatinized kernels (3.20)	Not applicable	Not applicable
Pecks (3.21)	Not applicable	Not applicable
Red and red-streaked kernels (3.18) and (3.19)	$\frac{m_9 \times 100}{m_x}$	$\frac{m_{11} \times 100}{m_x}$
Waxy rice (3.5)	$\frac{m_{16} \times 100}{m_z}$	$\frac{m_{16} \times 100}{m_x}$
Large broken kernels (3.8)	$\frac{m_{10} \times 100}{m_y}$	$\frac{m_{12} \times 100}{m_y}$
Medium broken kernels (3.9)	$\frac{m_{11} \times 100}{m_y}$	$\frac{m_{13} \times 100}{m_y}$
Small broken kernels (3.10)	$\frac{m_{12} \times 100}{m_y}$	$\frac{m_{14} \times 100}{m_y}$
Chips (3.11)	$\frac{m_{13} \times 100}{m_y}$	$\frac{m_{15} \times 100}{m_y}$

[a] For the meaning of the symbols, refer to Figure A.1.

[b] For the meaning of the symbols, refer to Figure A.2.

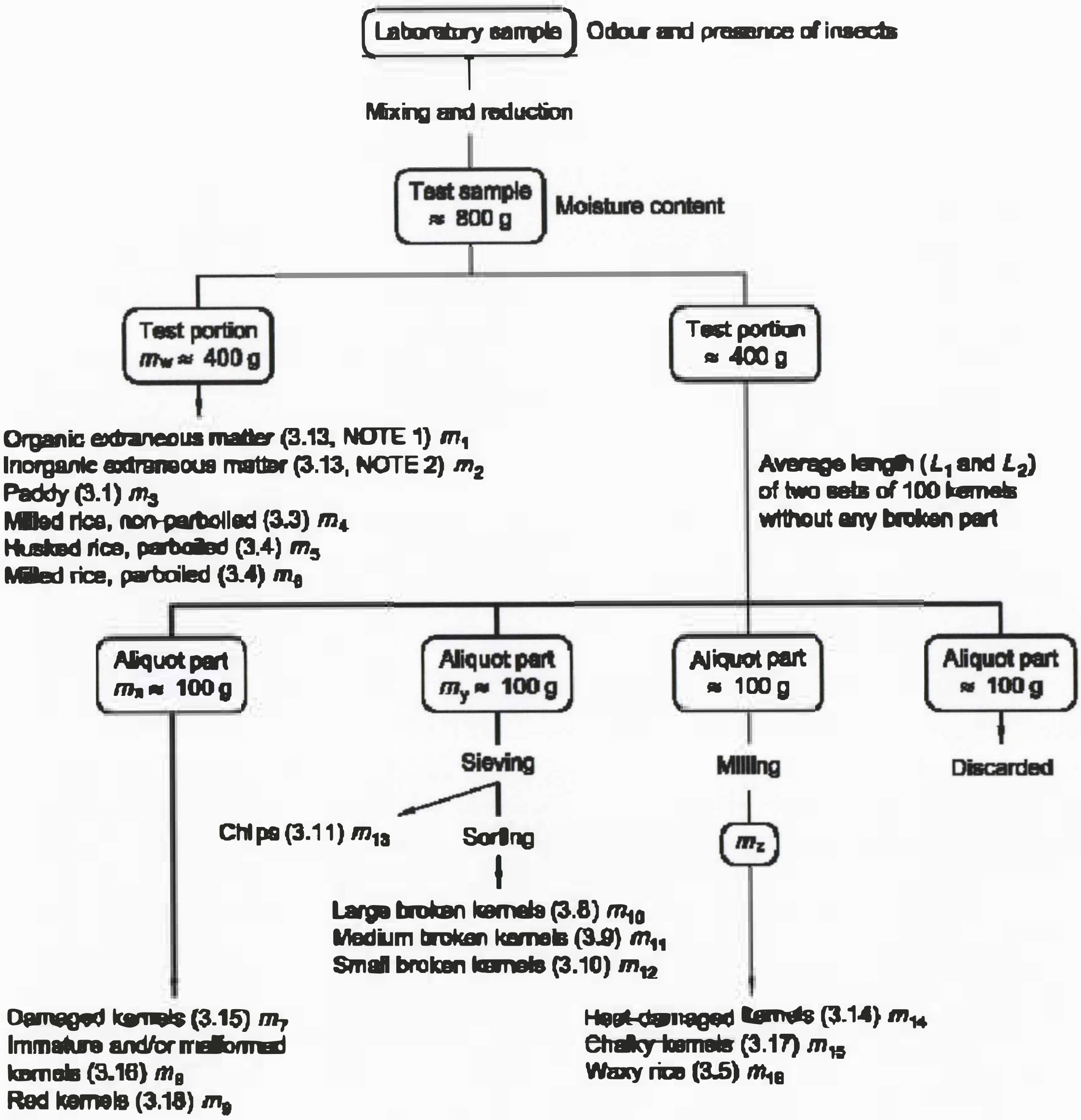


Figure A.1 — Scheme of procedure for husked rice, non-parboiled

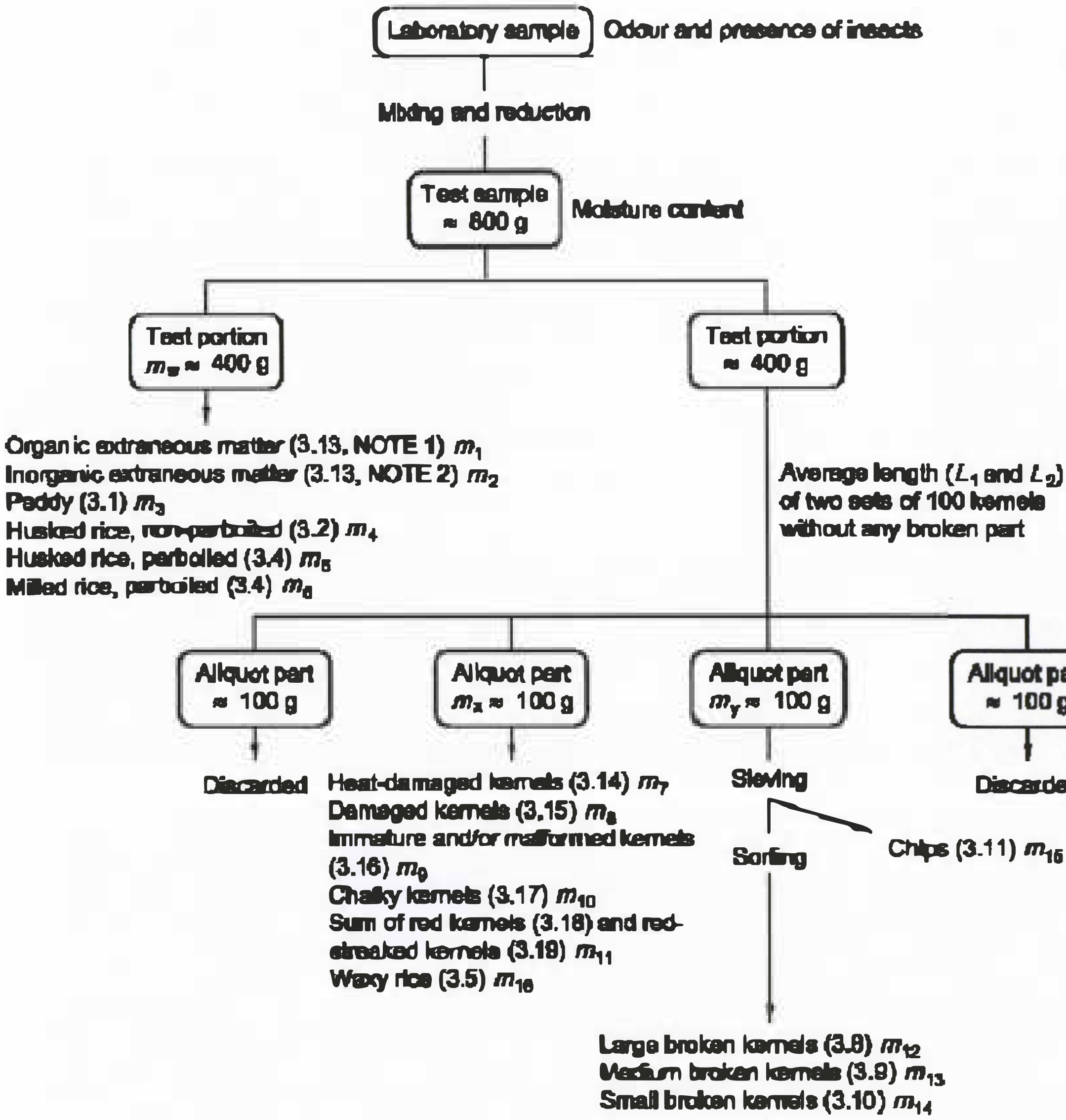


Figure A.2 — Scheme of procedure for milled rice, non-parboiled

Determination of the potential milling yield from paddy and from husked rice

1 - Principle
The husk is mechanically removed from paddy. The resultant husked rice is then weighed. Next, the pericarp and germ are mechanically removed from the husked rice to a fixed reduction in mass and the resulting milled head rice is weighed.

2 - Normative references
ISO 6646, Rice – Determination of the potential milling yield from paddy and from husked rice.
ISO 712, Cereals and cereal products — Determination of moisture content — Routine reference method.
ISO 7301, Rice — Specification.

3 - Terms and definitions
All the following terms and definitions are given in ISO 7301.

3.1 husked rice yield : amount of husked rice obtained from paddy
3.2 milled rice yield : amount of milled rice (head rice, broken kernels and chips) obtained from paddy or husked rice
3.3 milled head rice yield : amount of milled head rice obtained from paddy or husked rice

4 - Apparatus
Usual laboratory apparatus and, in particular, the following :
4.1 Sample divider, conical sampler or multiple-slot sampler with distribution system.
4.2 Testing husker, suitable for removal of the husk from paddy without damaging the kernels.
4.3 Abrasive testing mill, suitable for removal of the pericarp and germ from husked rice.
4.4 Small bowls.
4.5 Balance, capable of weighing to the nearest 0,01 g.

5 - Preparation of test sample
It is important the laboratory receive a sample which is truly representative and has not been damaged or changed during transport or storage.

The laboratory sample shall have a mass of not less than 1,5 kg.
Carefully mix the laboratory sample to make it as homogeneous as possible, then reduce it through a sample divider to obtain the test sample.
Determine the moisture content of the test sample according to ISO 712. The acceptance range is a mass fraction of (13,0 _ 1,0) %.
If the moisture content is outside the acceptance range, the laboratory sample should be conditioned at ambient temperature and humidity for a sufficient period to obtain a moisture content within the specified range.

6 - Procedure

6 - 1 - Adjustment of equipment

Testing husker adjustment

Adjustment of the test equipment shall be carried out prior to the determination.

The testing husker shall be considered correctly adjusted when, subsequent to dehusking of rice samples with grain dimensions similar to those of the laboratory sample, the following are not present :

- husked rice with damage to the pericarp,
- grains of paddy or husked rice in the separated husk,
- a lot of husk particles in the husked rice.

Testing mill adjustment

Adjustment of the test equipment shall be carried out prior to the determination.

Adjust the testing mill by milling rice samples of grain dimensions similar to those of the laboratory sample in order to remove a mass fraction of (f ±0,5) % of the husked rice so that the mass of milled head rice minus the mass of milled whole kernels is $\leq$ 3,0 % (head rice includes whole kernels). The value of f shall be agreed by the parties involved.

6 - 2 - Determination of husked rice yield (Figure A.1)

a - Take the test sample and divide it to give a portion suitable for the equipment. Weigh it to the nearest 0,01 g.

b - Spread the paddy and remove any extraneous matter.

c - Dehusk the paddy in the testing husker. If a lot of grains of paddy are not dehusked, they shall be separated from the husked rice and passed through the testing husker again.

d - Weigh the total yield of husked rice to the nearest 0,01 g.

6 - 3 - Determination of milled head rice yield

6 – 3 – 1 - Starting from paddy or parboiled paddy (Figure A.2)

a - Operate according to 6.2 to obtain the husked rice.

b - Divide the husked rice to give a portion suitable for the equipment. Weigh and record the mass to nearest 0,01 g. A minimum of 100 g is recommended.

c - Thoroughly clean the testing mill. Introduce the husked rice sample and mill it for the time necessary to remove the mass fraction (f _ 0,5) % of its total mass. The milling time has to be predetermined by trials on each test sample.

d - Weigh the obtained milled rice and record the mass to the nearest 0,01 g.

e - Separate the head rice from the broken kernels and place the two fractions in separate bowls.

f - Weigh the head rice and record the mass to the nearest 0,01 g.

6 – 3 – 2 - Starting from husked rice or from husked parboiled rice (Figure A.3)

a - Take the test sample and divide it to give a portion suitable for the equipment. Weigh it to the nearest 0,01 g. A minimum of 100 g is recommended.

b - Spread the husked rice and remove any extraneous matter.

c - Continue as given in 6.3.1.c

7 - Expression of results

Calculate the results as quotients to four decimal places according to Table 1.

Table 1 — Calculation of milling yields

Yield	Mass (m) of test portion starting from paddy	Mass (m) of test portion starting from husked rice [a]
Y_0 (husked rice)	m_y/m_x	m_z/m_y
Y_1 (milled rice)	m_l/m_w	m_l/m_z
Y_2 (milled head rice)	m_2/m_w	m_2/m_z
[a] Including extraneous matter		

Refer to the scheme of the procedure given in Figure A.1 or A.2 for paddy; Figure A.3 for husked rice.

Express the results of yields as percentages, referred to the starting material, as follows:

- potential yield of husked rice (Y_h), $Y_h = Y_0 \times 100\ \%$
- potential yield of milled rice (Y_m), $Y_m = Y_0\,(100-f)\ \%$
- potential yield of milled head rice (Y_{mh}), $Y_{mh} = Y_0 Y_2\,(100-f)/Y_1\ \%$

Calculate the results for each category to two decimal places, and report them to the nearest 0,1 %.

8 – Precision

Repeatability

The absolute difference between two independent single test results, obtained using the same method on identical test material in the same laboratory by the same operator using the same equipment within a short interval of time, will in not more than 5 % of cases :

- for husked rice, 1 %
- for milled head rice, 2 %.

Reproducibility

The absolute differences between two single test results, obtained using the same method on identical test material in different laboratories with different operators using different equipment, will in not more than 5 % of cases :

- for husked rice, 3 %
- for milled head rice, 5 %.

9 - Test report

The test report shall specify :

- all information necessary for the complete identification of the sample,
- the sampling method used, if known
- the test method used, (with reference to the test method used),
- all operating details not specified in the test method used, or regarded as optional, together with details of any incidents which may have influenced the test result(s),
- the test result(s) obtained; or if the repeatability has been checked, the final quoted result obtained.

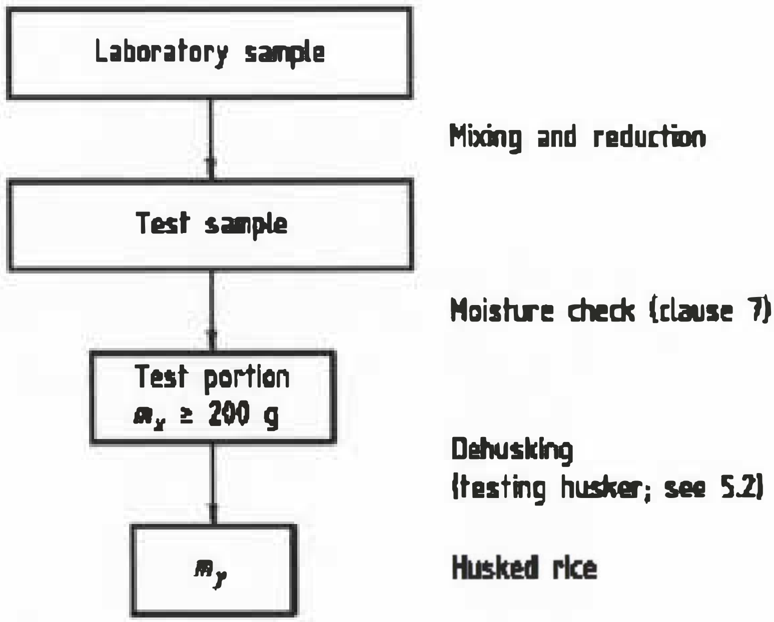


Figure A.1 — Starting from paddy or parboiled paddy: yield of husked rice

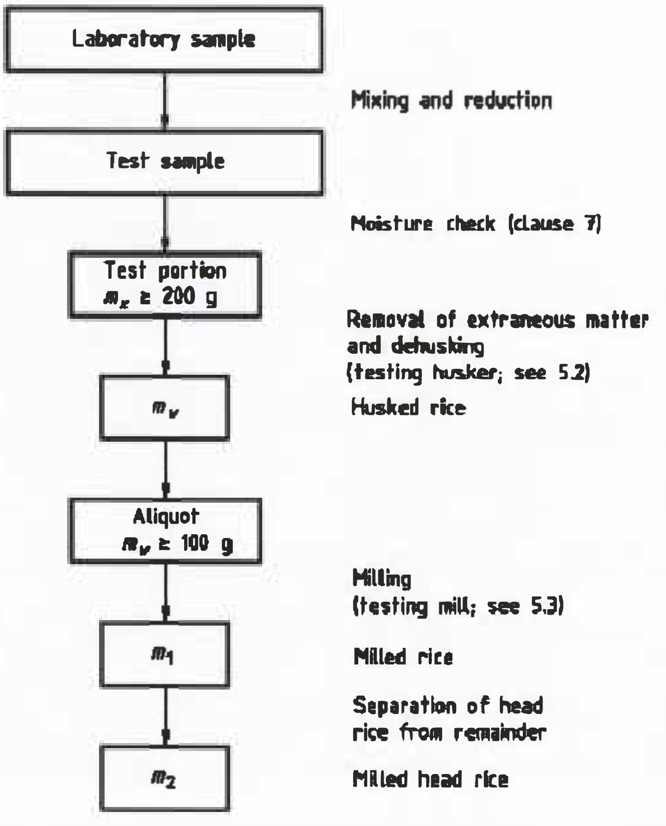


Figure A.2 — Starting from paddy or parboiled paddy: yield of husked rice, milled rice and milled head rice

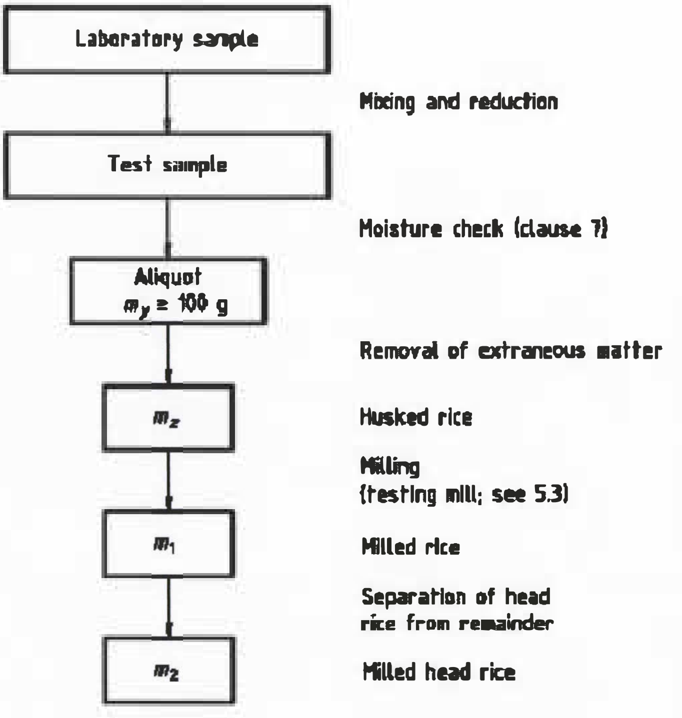


Figure A.3 —Starting from husked rice or husked parboiled rice: yield of milled rice and milled head rice

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