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WHEAT QUALITY AND WHEAT PRICING



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WHEAT QUALITY AND WHEAT PRICING

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SECTION I

WHAT IS QUALITY?¹

Wheat quality is usually judged by its suitability for a particular purpose. There are many inherent properties of wheat and exogenous factors that determine whether or not a wheat produces a satisfactory end product. Wheat as produced is not the same as wheat as consumed. Between production and consumption, wheat must be stored, transported, cleaned, milled and processed into forms digestible by the human body.

Botanical Criteria of Wheat Quality

There are many wheat species throughout the world, but only three species have commercial value.

Common wheat (Triticum aestivum). This variety makes the most suitable flour for leavened breads or loaf breads.

Club wheat (T. compactum). This is a "soft wheat" that is best for chappatis, nan, biscuits, cakes and other unleavened products.

Durum wheat (T. durum). Durum is a "hard wheat" most suitable for pasta products such as macaroni and spaghetti.

Variety

Within each species, many varieties exist. Some varieties have better milling properties than others. New varieties are constantly introduced to improve yields, milling properties, and to avoid diseases and insects that can attack wheat. Price is frequently used as an inducement to change varieties. In Pakistan, about 16 varieties are in common use, but production is concentrated in about four varieties.

Physical Criteria of Quality

The physical characteristics are indicative of end use value such as milling yield. Processors may pay more for desired characteristics, less for wheat that will require additional costs for cleaning, drying, and sizing, or that will yield less of the desired end products.

Weight per unit volume. There is a direct correlation between weight and flour yield. Good quality wheat will weigh about 78 kg. per hectoliter.

¹Based on Lawrence Zeleny, "Criteria of Wheat Quality," in Wheat Chemistry and Technology, Y. Pomeranz, ed. American Association of Cereal Chemists, Inc., St. Paul, Minnesota, 1978.

Kernel weight. This is an alternative test of weight per volume. Units of 500 or 1000 sound kernels are weighed, and criteria set according to specie and variety.

Kernel size and shape. These factors affect milling yield. Milling machines are set to receive wheat of specific sizes. Wheat not within the specified ranges may pass through without being properly milled, or clog up machines and reduce milling efficiency. Resetting machines is too time consuming and expensive to be done for irregular lots of wheat.

Kernel hardness. Wheat is measured for hardness to judge its suitability for products to be made. Wheat of different hardness may be blended to get proper milling characteristics. Buyers are often willing to pay more to get a specific hardness to blend with the wheats they have on hand.

Vitreousness. This is related to the transparency of some wheat varieties. Vitreousness is roughly correlated with hardness and protein content, thus is a subjective measure of suitability used by some wheat buyers. Protein levels and hardness need to be measured by more objective testing methods.

Color. Wheat is classed as red or white, depending upon color of bran. The color is often used as subjective measure of species and varieties, but newer varieties often cross the distinctions formerly made between red and white wheats.

Damaged kernels. Kernels that are shrunken, broken or have insect damage yield less wheat, and are often removed during cleaning before milling. Wheat with a high percentage of brokens yields less flour and is worth less to the flour miller.

Impurities. Dirt, dust, small stones, weed seeds, and straw, items that are not wheat, accompany wheat as it is received from the producer. In Pakistan, the extraneous materials are frequently called "refractions." These items must be removed before milling, and thus reduce flour yields. Damaged grains, weed seeds and some refractions have value as animal feed.

Milling quality. This is an overall assessment of the properties of wheat. Testing for milling quality requires elaborate equipment and trained personnel. Where very specific characteristics of end products are required, testing for milling quality may be done. Buyers are willing to pay more for wheat meeting very precise specifications.

Chemical Measures of Quality

Wheat is composed of organic matter. It is possible to separate wheat into its basic compounds to identify characteristics that affect the quantity and desired attributes of end products.

Moisture content. Moisture content is directly related to the intrinsic value of wheat and is indicative of its suitability for storage. Wheat must contain less than 12% moisture to be suitable for long term storage. For milling, water

must be added to 13.5% to 14.5% to make flour or atta with good storage characteristics.

Protein content. Protein content varies with end use products. Hard wheat products have higher protein levels than "soft" products such as cookies and cake.
Protein quality. Proteins are composed of amino acids. Wheat proteins are "incomplete" in that they do not contain all amino acids essential for human nutrition. Wheat varieties vary in the proportions of amino acids. Protein quality also affects the gluten content. Gluten provides the elasticity or ability to stretch without tearing that is essential in making chappatis.

Alpha amylase activity. Alpha amylase activity is important in leavened breads. Low alpha amylase is desired as bread will bake without large holes or air-pockets in it.

Fat acidity. Fatty acids accumulate in wheat over time. Tests for fatty acids are used to determine if wheat has been properly stored. High levels of fatty acid indicate poor storage conditions and that will cause flour products to have bad or off flavors and shorten shelf life of a product.

Crude fiber and ash. Ash concentrates in the wheat kernel on the outer layer of the endosperm, next to the bran. Excessive levels of ash are indicative of heavy insect infestations which alter the proportions of ash to protein. Large amounts of ash create tough, tasteless wheat products. The type of growing season also affects the quantity of ash in a product. Millers will often pay more for wheat that comes from areas having good growing conditions and lower ash content.

At any one time, each of the above factors may exercise influence on the price processors or consumers wish to pay. In most instances, moisture content, test weight, and percentage of foreign matter are the major factors in free market economies.

SECTION II

THE TASK OF MARKETING

To convert wheat as produced to wheat for human consumption, it is necessary to remove all material that is not wheat and convert the wheat into a form that the human body can assimilate. The damaged wheat kernels should also be removed as these are the major source of off flavors, spoilage, and insects in the flour. Whole sound wheat is then crushed and separated into its component parts to make flour. Some bran and wheat germ may be removed for palatability and to create flours that make the color and texture of wheat-based foods consumers want.

In economic terms, the process of converting wheat as produced to wheat (flour) as consumed creates utilities, or services that have value to the consumer. The growing of wheat and crushing wheat into flour creates form utilities. The costs of producing wheat and milling flour are unavoidable expenses that must be paid by society if wheat is to be produced and consumed.

Other utilities must also be created by a marketing system. Storage creates time utility by making wheat available when consumers want it, transportation creates place utility by taking wheat or flour from where it is produced to where it is needed, and buying and selling create a possession utility by transferring ownership of wheat and flour from those who have a surplus to those who want it.

The questions that must be answered are when and where should these services be performed and how should those involved in the creation of utilities be paid. A common mistake in many societies is to focus on production as the only source of value to consumers, and assume that those creating the time, place, and possession utilities are enriching themselves at expense of the producers and consumers. In the past, governments frequently performed marketing services and prohibited private buying and selling of essential commodities on the assumption that marketing is unnecessary, wasteful, and creates demand that is harmful to society. Many governments now realize that marketing creates value and are seeking to redefine their roles in the marketing process.

Production and marketing can be seen as a flow, with wheat flowing forward from the producer to assemblers, storage, and on to flour mills. Flour flows onward to bakeries, retail vendors, and consumers. A reverse flow of payments and market information goes back from consumers to producers. In most instances, prices received and willingness to repeat purchases are used as indicators of buyer satisfaction.

In a market oriented economy, the producer or "farm gate price" is the price paid by consumers minus the cost of the marketing services. The costs of market services are set by competition and demand of consumers for marketing services.

In controlled or monopolistic economies, the direct linkages or flows between the consumer price and producer price are broken. Monopolists control supplies and take excess profits. Governments subsidize marketing services or pay producers more than consumers are willing or able to pay. Governments may limit the

quality and variety of products that can be marketed. Consumers are unable to influence the range of products available to them. In these cases, producers and processors do not receive the correct information regarding the quantity and quality characteristics of products most desired by consumers.

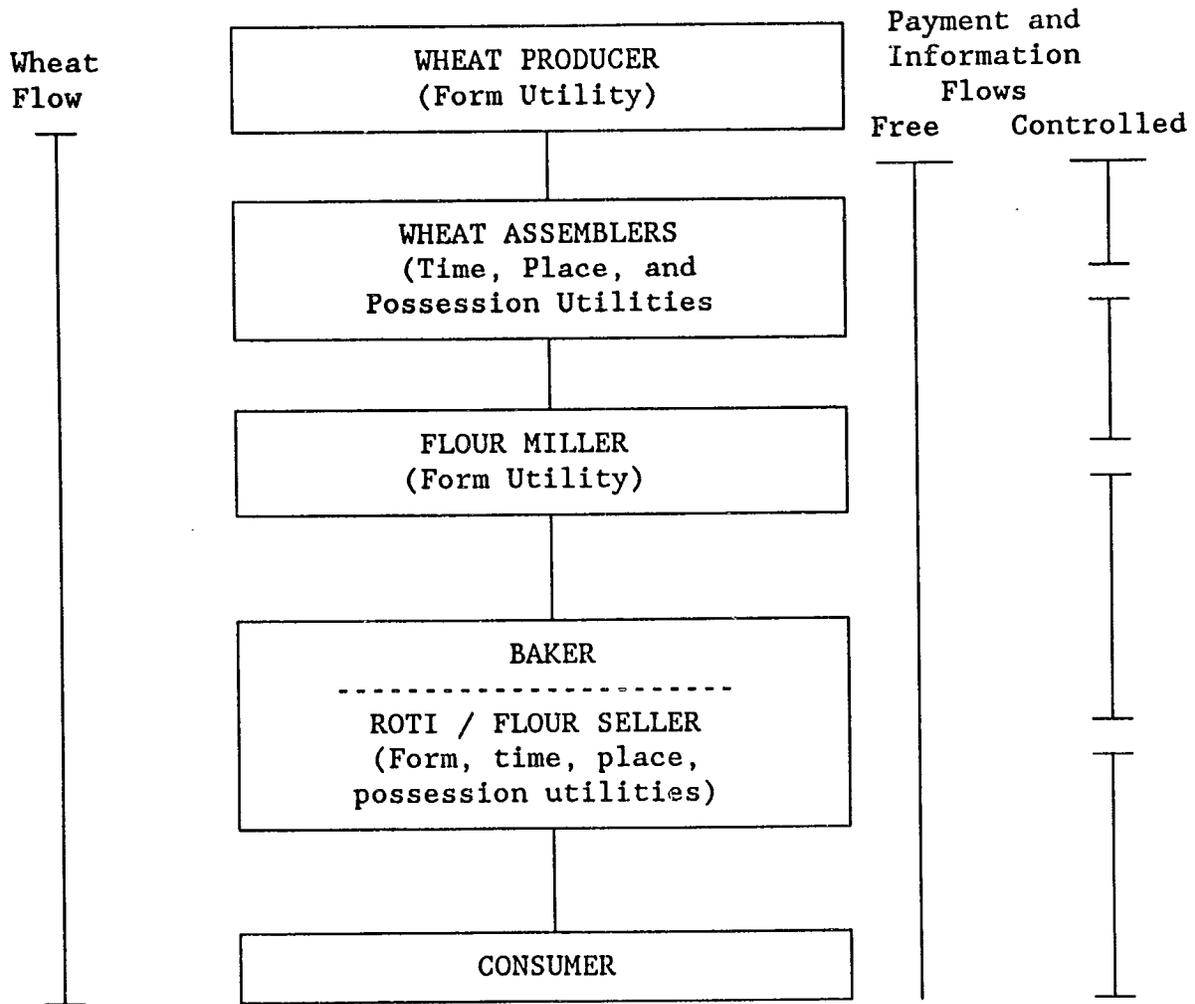


FIGURE 1. The Wheat Marketing Chain

SECTION III

PRESENT PROBLEMS IN WHEAT MARKETING

A fundamental problem of the Pakistan wheat economy is the failure to adequately recognize that wheat as produced is not the same as wheat for human consumption. Wheat as produced is an admixture of whole sound wheat kernels, (triticum aestivum), broken kernels, insect infested and damaged kernels, other food grains, dirt, wheat straw and leaves, weed seeds, and other materials. The wheat kernel itself contains both moisture and dry matter in the form of protein, starch, and minerals.

Since 1947, there has been a fourfold increase in Pakistan wheat production. Yields per hectare have more than doubled with new varieties, fertilizers, irrigation, and management systems. Mechanical reapers, threshers, and combines have compressed the harvest season from over two months to less than one month. Government-owned storage has increased by about 100,000 MT per year. Storage methods changed with the introduction of silos, open bulkheads, and bag-cum-bulk godowns. Wheat transport shifted from rail to trucks. Derationing has increased competitiveness and quality in the flour milling industry. A wider variety of wheat based products are being consumed. Population growth and rising incomes increase the demand for wheat by more than three percent each year.

The only constants in four decades of change have been the use of bags as the basic means of transport and storage, the Fair Average Quality (FAQ) procurement standards, and No Loss Policy in the management of publicly held grain stocks.

The FAQ wheat standards were adopted from the prevailing standards used by private grain exchanges up to 1942. The government assumed control of grain marketing due to wartime shortages and a famine that hit the Asian subcontinent. After independence, the government retained control of distribution of several essential commodities, and the grain exchanges never reopened.

The FAQ sets limits to moisture content, foreign matter, damaged grains, and other factors as shown in Table I. The major problem, however, is that the FAQ standards have never been defined by law, nor have any objective procedures for sampling, testing, and grading of wheat been defined. In government procurement all wheat inspection is visual; that is, the government looks at the wheat and determines the relative proportions of sound wheat, foreign materials, damaged grains, etc., from a cursory examination. This places the producer at a disadvantage and gives rise to many malpractices in the present system.

The Storage Technology Development and Transfer Project (STDT) has undertaken surveys of wheat as it comes from the threshing machine, combine, or enters the market for the past two years. A third wheat quality survey will be taken during the 1990 harvest season. The results of the past two years' survey are presented in Table 1. Wheat samples collected during the survey were objectively analyzed according to internationally accepted methods to determine the wheat quality. Table 1 shows that the quality of wheat as produced is better than the FAQ standards.

The ultimate objective of the STDT project surveys, taken in cooperation with the Pest Management Research Institute, Karachi, is to develop Pakistani standards and testing procedures for wheat quality. A STDT project report² summarizes the wheat procurement and storage situation in Pakistan, with recommendations, objective grading and testing procedures. The present problems and opportunities can be illustrated in the following two examples.

Impact of FAQ on Producers

The present "fair average quality" system is not necessarily fair to producers. Producers are not paid uniformly for the value of usable wheat. Sellers who are not penalized for delivering grain that exceeds FAQ maximums are overpaid. On the other hand, sellers who have wheat below FAQ specifications are underpaid.

Table 2 illustrates the inequities which now exist in the FAQ procurement system. In the 1989 season, assume that three wheat producers delivered one metric ton of wheat of varying quality. The support price was Rs. 2125 per ton (based upon a standard of one percent foreign matter and 10% maximum moisture content). Lot A should have been rejected and lots B and C priced differently by the FAQ price adjustments. However, under the typical FAQ inspection, the procurement center accepts all wheat "as is" and pays each seller the posted price.³

Producer A's wheat contains 30 kilograms of excess foreign matter and 21 kg. of excess moisture. In effect, producer A was paid for 51.9 kg. of moisture and foreign matter at Rs. 2.125 per kg., or Rs. 110.29.

Producer B's wheat matches the specifications precisely. The procurement center receives 1,000 kilograms of usable wheat (including the allowable 10 kg. FM). Producer B neither gained nor lost according to the specifications but did lose relative to producer A.

Producer C lost relative to both A and B. The 1000 kg. of low moisture wheat would weigh 1022 kilograms if the moisture content is standardized to 10 percent. In effect, the procurement center gained 22 kilograms of wheat free from producer C. Producer C received Rs. 47.00 less than the true value of his wheat. If producer C had adulterated his wheat to equal that of producer A, he could have received Rs. 158 more.

²Impact of Fair Average Quality Procurement Procedures and No Loss Policy on Public Sector Storage of Wheat, Report No. 3, Food and Feed Grains Institute, Kansas State University, Rev. October, 1989.

³A sample of procurement center records examined by the STDT Project in September, 1989, showed 597 transactions totaling 17,201.7 MT, received in 172,017 100 kg. bags at Rs. 85 per 40/kg.

To Clean

The following are advantages of marketing clean wheat in a free market economy:

- Clean grains have a higher market price than uncleaned grains.
- Cleaning removes material which encourages growth of insect populations. Storage losses and protection costs are reduced.
- Better use of storage space; foreign material occupies twice as much space as grain of equal weight.
- Transport costs are reduced.
- Grain cleanings have value as animal feed and for other uses.

Grain will be cleaned when the market value of clean grain exceeds the market value of uncleaned grain by amounts greater than the cost of cleaning.

Or Not to Clean

In Pakistan, government held grain stocks are not cleaned because pricing and accounting policies do not permit quality/price differences or changes in recorded inventory volumes after the grain is purchased. However, private buyers recognize the effects of moisture content and foreign material on mill costs and yields. Flour millers frequently make price offers to private traders conditional on the quantity of "refractions" in a shipment with rupees per bag discounts for excess amounts. The discounts seem to be informal and subjectively applied, with the receiving mill being the judge of what is excessive.

Value of Cleaned Grain in Flour Milling

The task of the flour miller is to disassemble the wheat kernel into the most profitable uses. Raw wheat can be made into a variety of products, atta or whole wheat flour, maida or white flours, sujji, bran, animal feeds, snack foods, and the like. Each product has its own set of demands, production costs, etc. The quantities of each product produced is limited by the physical composition of the wheat. The three principal components of a wheat are endosperm, 83.0%; bran, 14.5%; and germ, 2.5%.

The majority of flour millers in Pakistan purchase from the open market when market supplies are available, normally May to October. Prices paid are close to official procurement prices, with adjustments made for quality, delivery, and other factors. Wheat is purchased from the provincial food departments at other times of the year.

Millers must accept wheat "as is" when buying from provincial food departments. Under the circumstances, millers are unable to set or maintain quality standards. Very few flour mills have grading and inspection equipment or maintain flour testing laboratories.

Millers do recognize the benefits of good quality wheat from their milling records. Table 3 indicates the benefit per 100 kg. millers receive from wheat with low foreign matter and damaged grains.

The most efficient flour milling occurs with grains at about 14.0%-14.5% moisture content. Wheat in storage has a moisture content of eight percent to 11%. The flour miller will gain weight from adding moisture. Foreign matter and broken and damaged grains will reduce weight. FM, shrunken, broken, and other food grains tolerances are from one to over 11% under present FAQ standards. In practice, these limits are frequently exceeded.

How flour millers gain or lose depends upon the initial moisture content and other quality factors. After cleaning, moisture is added, and the wheat is placed in bins for 12 to 24 hours to "temper." Tempering allows the wheat to absorb moisture to the desired level. As is shown in Table 4, when wheat with low moisture and foreign matter is used, the miller will have a net weight gain after cleaning and addition, increasing moisture content to the 14 percent. If the price paid for the wheat is Rs. 2,125 per 100 kg. regardless of quality, the effective cost per 100 kg. of wheat as milled in varies from Rs. 200.43 to Rs. 216.08 (8% MC, 1% FM to 12% MC, 4% FM).

TABLE 1

Comparisons of 1988 and 1989 Wheat Surveys in the
Punjab and FAQ Procurement Standards

	Grain Quality Surveys		Standard	FAQ	
	1988	1989			Maximum
Foreign Matter	1.27%	1.60%	0.5%		1.0%
Damaged Grain	1.62%	1.49%	3.0%		5.0%
Other Food Grains	1.33%	1.68%	3.0%		5.0%
Weeviled	0.01%	0.00%	0.0%		3.0%
Moisture Content	8.28%	7.63%	10.0%		11.0%

TABLE 2

Inequities in FAQ Payments to Producers

Producer	Foreign Matter Percent	Humidity Percent	Usable Wheat (Kg.)	Over (Under) Payment
A	4.0	12.0	948.1	110.29
B	1.0	10.0	1,000.0	0.00
C	1.0	8.0	1,022.2	(47.22)

Source: Own calculations

TABLE 3

Gain or Loss in Kilograms per 100 kg. of Wheat Tempered to 1 %
Moisture from Wheat with Varying Moisture and Foreign
Matter Content 1/

Initial FM/Other	Initial Moisture Content				
	8.0%	9.0%	10.0%	11.0%	12. %
	-----Kilograms Gained-----				
1.0%	6.98	5.81	4.65	3.49	2. 3
2.0%	5.91	4.76	3.60	2.45	1. 0
3.0%	4.84	3.70	2.56	1.42	0. 8
.0%	3.77	2.64	1.51	0.38	(0. 4)

1/ Standardized to 10 percent moisture, 1 percent FM before tempering.

TABLE 4

Cost per 100/kg Clean Wheat Entering Processing from Wheat with
Varying Moisture and FM Content. 1/

Initial FM Percent	Initial Moisture Content				
	8.0%	9.0%	10.0%	11.0%	12.0%
1.0%	200.43	202.63	204.88	207.18	209.53
2.0%	202.48	204.70	206.97	209.29	211.67
3.0%	204.56	206.81	209.10	211.45	213.85
4.0%	206.69	208.96	211.28	213.65	216.08

1/ Standardized to 10 percent moisture, 1 percent FM before tempering. Release price is Rs. 230/100 kg. without bags.

SECTION IV

CHANGING THE SYSTEM

A means of encouraging the delivery of higher quality of wheat to the buyer is to pay all producers equally for the quantity of usable wheat delivered. In most countries, the seller is charged for the cost of cleaning or drying to standardize the wheat to a predetermined level. In the following table, the producer will receive the same price for usable amount of wheat delivered in wheat of varying quality characteristics.

Table 5 assumes that the support price is based upon 9.0% moisture content and 1.0% foreign matter. The combined percentages equal 10.0% (9.0%MC + 1.0%FM). A premium of 1.0% of the support price is paid each percentage point below 10.0%. Similarly, a 1.0% percent price penalty is levied for each 1.0% the combination of MC%+FM% exceeds 10%. The maximum combination of MC%+FM% acceptable in Table 5 is 14.0%.

The price table is based on intervals of .5% of 1.0%. The percentages of moisture content and foreign matter are objectively determined by moisture meters and weighing of the foreign matter recovered from a combination of sieves. The results are rounded to the nearest .5% of 1.0%.

If the quality of the 1990 crop is the same as the 1989 Punjab crop, producers would receive a price of Rs. 241.00 per 100 kg, based on a 1989 moisture content of 7.65% and FM of 1.62%, rounded to 7.5% and 1.5% respectively. This represents an increase over the base price of Rs. 240.00 of about .4 of 1.0%. The median price premium available above the base price is about Rs. 243.70, rounded to Rs. 244.00, in Table 5, or about 1.7%.

According to supply price elasticities developed by Pinkney⁴, each 1.25% increase in price will increase procurement by 90,000 tons. If prices are paid on quality basis, procurement might be expected to increase by 36,000 to 100,000 tons if wheat is marketed at the base standard or above. The procurement increases will be offset by discouraging producers whose wheat is discounted. However, these producers have the option of screening the wheat to the FAQ base standard or above.

Pakistan produces high quality wheat. However, the benefits of quality in production are not reflected in the present marketing system. The wheat support price is set on the basis of an inadequately defined set of standards (FAQ). Further, the FAQ standards themselves are lower than the quality of wheat being produced.

⁴Thomas C. Pinkney, The Multiple Effects of Procurement Price on Production and Procurement of Wheat in Pakistan. The Pakistan Development Review, 28:2, 1989, pp 95-119.

Producers are not rewarded for delivering quality wheat to government procurement centers or the middlemen. The discrepancy between the FAQ standards and present wheat quality provides opportunities for malpractices in the marketing system that add to costs and lower the quality of wheat products available to the consumers. In private grain trading, buyers do make informal adjustments in price, based upon their estimates of yields of finished product and costs of correcting perceived deficiencies.

The problems of standards, testing, and grading is not restricted to wheat alone. It is common in rice, maize, oilseeds, and other grains and legumes. It is hoped that these problems can be addressed through formulation of grades based upon the factors deemed important by producers, processors and consumers. Objective methods of grading and testing must be used. The markets must have some flexibility in prices to encourage production and delivery of higher quality grains and to penalize those who abuse the system.

TABLE 5

Alternative Pricing Charts for Wheat

Support Price per 100 Kg. --- Rs. 240.00	Quality Basis					
	Moisture 9.0% Foreign Matter 1.0%			Discount/Premium per 1.0% Change from Base Amount Rs. 2.40		
Percent Moisture	Percent Foreign Matter					
	0.5%	1.0%	1.5%	2.0%	2.5%	3.0%
7.0	246.00	245.00	244.00	242.00	241.00	<u>240.00</u>
7.5	245.00	244.00	242.00	241.00	<u>240.00</u>	239.00
8.0	244.00	242.00	241.00	<u>240.00</u>	239.00	238.00
8.5	242.00	241.00	<u>240.00</u>	239.00	238.00	236.00
9.0	241.00	<u>240.00</u>	239.00	238.00	236.00	235.00
9.5	<u>240.00</u>	239.00	238.00	236.00	235.00	234.00
10.0	239.00	238.00	236.00	235.00	234.00	233.00
10.5	238.00	236.00	235.00	234.00	233.00	232.00
11.0	236.00	235.00	234.00	233.00	232.00	230.00

Above 11.0% MC, 3.0% FM not accepted