Domestic Quality Standards and Trading Rules and Recommended Export Contract Specifications for U.S. Soybeans and Products

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INTRODUCTION

In this paper we will review the domestic standards for U .S. soybeans, soybean meal and soybean oil, delineate the appropriate responsible inspection entities, make recommendations as to informational factors in contracting, and minimum quality specifications to reduce risk and ensure product quality upon receipt. The focus of this paper will be soybeans that are destined for crushing, *i.e.*, the production of oil and soybean meal.

In order to make appropriate decisions on contractual quality specifications, it is best that one understand the inspection system and normal marketing practices of the supplier. Deviation from normal marketing practices and the choice among standard quality specifications can directly affect costs and risks. While the costs vary considerably with changing market conditions, the risks are more clearly defined. Hopefully, this paper will be helpful in evaluating and/or validating current contractual specifications for imports and domestic production.

SOYBEANS

The current U.S. Standards for Soybeans list six grade-limiting factors. They are test weight (bulk density), splits, total damaged soybeans, heat damaged, foreign material and soybeans of other colors. In addition, moisture is determined on each lot and the results appear on all official inspection certificates, and oil and protein analysis will be performed upon request. Of these eight factors, five determine quality and yield of end products and the other three are of little significance in determining quality or in causing deterioration. U.S. Standards for Soybeans are shown in Table 1.

Less Significant Standards Factors

1. Test Weight (Bulk Density)

Of the enumerated quality factors in Table 1, test weight is of the least significance in determining value or storability. Test weight is merely a measurement of the weight of a specific volume of soybeans. No published research has found a relationship of soybean bulk density to either oil or protein content. The only study showing a significant correlation was a study of 20 vessels received in Japan in 1975-76. The correlations between test weight and percent oil and percent protein was -0.69 and 0.15, respectively. These data show a rather strong inverse relationship for oil content, i.e., the lower the test weight the higher the oil content. No significant correlation was found for protein content. It has been argued that low test weight soybeans require more space to store a given weight resulting in higher costs of storage. This is true. However, it is unlikely that there is a significant difference in cost of storing 56 pounds versus 55 pounds test weight soybeans. It is the writer's opinion that test weight offers no information on which to determine economic value. Its utility rests solely in estimating the amount of soybeans in a known volume where actual weight is unknown. This information has value in itself, but has no affect on the quality or yield of oil or soybean meal from the soybeans being tested.

Table 1 United States Standards for Soybeans						
Grade	Minimum	Maximum Level of				
	Test Weight Per bushel (pounds)	Splits	Damaged Kernels		Foreign Material	Soybean of Other Colors
			Total Damaged	Heat Damaged		
U.S. No. 1	56	10	2.0	0.2	1	1
U.S. No. 2	54	20	3.0	0.5	2	2
U.S. No. 3	52	30	5.0	1.0	3	5
U.S. No. 4	49	40	8.0	3.0	5	10
U.S. Sample Grade: Do not meet requirements for U.S. Nos. 1,2,3, or 4; or, contains: a) stones that have an aggregate weight in excess of 0.2 % b) presence of glass c) three or more crotalaria seeds (*Crotalaria spp.*) d) two or more castor beans (*Ricinus communis L.*) e) four or more particles of unknown foreign, harmful or toxic substances t) ten or more pieces of animal waste or filth g) musty, sour or commercially objectionable foreign odor h) heating or is otherwise of distinctly low quality						
Source: Federal Grain Inspection Service, USDA						

2. Soybeans of other Colors

The second factor of limited value to the soybean crusher is soybeans of other colors. Commercial soybean varieties grown in the United States, when mature, have yellow or green seed coats and yellow cotyledons. Other than for factors related to immaturity, discoloration of the seed coat generally results from a viral or fungal infection. Bicoloration or "hilum bleeding" is caused by the soybean mosaic virus and purple seed stain or mottling is caused by a fungus (*Cercospora kikuchii*), both of which are confined to the seed coat and cause no deterioration of the seed or its constituents. Other types of discoloration caused by fungi are determined under damage interpretations and are considered damaged seed.

3. Splits

The third factor of limited value, except in exceptional circumstances, is splits. The rather broad limitation of 20% in U .S. #2 soybeans attests to the limited value of this factor. However, the negative effect on oil quality of splits increases directly with increased moisture content. Splits in the presence of high moisture (greater than 13%) lead to activation of the lipoxygenase enzyme, which in turn catalyzes oxidation of the oil fraction. This results in a breakdown of triglycerides in to diglycerides and free fatty acids. This effect is measured by higher acid values and results in higher oil losses during refining. One could conclude then that the relative importance of splits increases with increased moisture, temperature and duration of storage.

It is suggested that with proper purchasing specifications, adequate care in storage and “first in - first-out” inventory management, splits should not be a major concern.

Significant Standards Factors

1. Foreign Material

We will discuss the three grade limiting factors considered significant not necessarily in order of their importance. Of these, foreign material is most often of concern since export shipments contain near the maximum allowed by contract.

Foreign material is defined as all material which readily passes through an 8/64 inch (3.2 mm), round-hole, perforated sieve and any material other than soybeans remaining atop the sieve. The limitation in U.S. #2 soybeans is two percent. The presence of foreign material in soybeans adversely affects storability and drying/aeration efficiency, and, unless removed prior to processing, will affect the quality of both the oil and the protein meal.

Various foreign materials will segregate because of differences in particle size, shape, bulk density and adhesiveness. Because of dissimilarity in density, fine, more dense materials tend to accumulate near the impact point in the container being filled, forming a cone in the spout line. The coarser, lighter materials tend to migrate to the exterior of the storage container during loading. Therefore, the foreign material tends to concentrate during handling which can have a effect on storability which is related to its physical attributes The foreign material is generally more hygroscopic than the soybeans and may therefore be higher in moisture than the soybeans which can result on heating. Even during aeration, forced air will tend to flow around the spout line making aeration less efficient and temperature less uniform. The non-uniform temperatures in the storage mass can generate convection currents resulting in moisture migration and accumulation with subsequent quality deterioration.

In addition, if the foreign material is processed with the soybeans it can cause the production of poorer quality oil. In November 1987, the Federal Grain Inspection Service examined the oil content and oil quality of twenty samples of foreign material found in commercial lots of soybeans. The results of this analysis are shown in Table 2.

Table 2

Quantity and Quality of Oil Extracted from Foreign Material Fractions (as defined by FGIS)

Type FM	Oil Content (%)	Acid Value
Coarse (atop 8/64" sieve)	4.2	10.53
Fine (thru 8/64" sieve)	7.3	20.93
Source: Federal Grain Inspection Service, USDA		

Assuming this information represents average lots of #2 soybeans, one can make two general statements; (1) FM can adversely affect oil quality if not separated prior to extraction, and (2) for each percent increased FM extracted one might expect a 0.12 percent rise in acid value of the extracted oil.

If FM is extracted or removed prior to extraction then added back to the meal fraction one should expect a small increase in fiber and small decrease in protein content of the resulting meal.

2. Heat Damaged/Damaged Kernels Total

Probably the second most important factor of economic importance to the crusher is heat damage. For calculation and reporting, FGIS separates damage into three categories. Heat Damage (HT) is a separate grade-determining factor with a limit of 0.5% in U.S. Standards for Number 2 Soybeans. Insect stung or stink bug stung kernels is contained in the factor damaged kernel total (D KT), but is identified separately since it is calculated at one-fourth the rate of other types of damage. The third category is other damaged kernels and contains those types of damage caused by fungi, frost, immaturity and insects. Heat damaged, stink bug damaged and other damaged kernels combined have a limitation of 3.0% in U.S. Standards for Number 2 Soybeans.

Damage is determined by comparing soybeans appearing damaged in a 125 gram representative sample to a set of interpretive line slides (35mm color slides) placed on a special viewer. If individual soybeans appear equal to or worse than the damage depicted in the slide, it is considered damaged (cross-sectioning is often required to determine some types of damage).

All but one of the 12 types of damage thus depicted has an effect on oil quality. Damage can result in higher acid values, higher peroxide values, higher non-hydratable phosphatides, off color and oil with a reduced shelf life. The lone exception is downy mildew, which is limited to seed surface infection. It is not known to have detrimental effects on processing or value in end use.

The twelve types of damage listed by FGIS are listed in Table 3.

Table 3

Types of Damage
(As defined by FGIS)

Badly Ground and/or Weather Damaged	Immature -Wafers
Badly Ground and/or Weather Damaged (Gray/Black)	Weevil or Insect Bored
Mold Damaged (Downy Mildew)	Mold Damaged (pink)
Frost Damaged	Damaged by Heat
Frost Damaged (Waxy)	Sprout Damaged
Heat Damaged Stink Bug or Insect Stung	
Source: Federal Grain Inspection Service, USDA	

Through research, FGIS correlated damage to free fatty acid (FFA) content of oil. The research was used to support a more strict interpretation of damage being imposed in September 1986. Predicted FFA value in soybeans containing 3% damage would be approximately 0.7%, below prevalent world trading rules for crude degummed soybean oil maximum of 0.75%.

Information Only Factors

1. Moisture

The most important storability factor in soybeans is moisture content. The interaction of moisture, temperature and time is responsible for by far the vast majority of storage related quality deterioration in soybeans. Proper moisture specification and storage management are the keys to successful long-term storage of soybeans. Dependent upon end use and ambient storage condition, there is a range of recommended moisture contents considered safe for storage. For direct food use or for use as seed, protein solubility and germination are important considerations. A moisture at or below 11 % is recommended for these uses. For solvent extraction 12.5-13% moisture is not likely to result in any loss of processing quality within a year. Average moisture beyond 13%, a blend of widely divergent moisture lots, or storage conditions that lead to moisture migration and accumulation can often result in serious quality deterioration in a relatively short time span.

Moisture is not a grade-limiting factor but is mandatory information in all official inspections. It is determined by use of a Motomco 919 moisture meter on whole sample basis (inclusing FM). The moisture meter is calibrated to an air-oven method.

2. Protein and Oil

The newest informational factors for soybeans in U .S. grain standards are protein and oil content. Effective September 4, 1989, FGIS began analysis of protein and oil content upon request. If a party to a contract does not request such information, an analysis will not be performed. FGIS uses near infrared reflectance (transmittance) technology to make the analysis. Various constituents in soybeans absorb different light spectra at varying rates. The NIR instrument uses this principle in the near infrared spectrum of light to correlate different spectra absorption rates to the protein and oil constituents, which is then calibrated to traditional wet chemistry methodology. Reproducibility of results is reported by FGIS is presented in Table 4.

Table 4

FGIS Analysis of the Reproducibility of Results Of Near Infrared Reflectance Equipment In Measuring Oil and Protein Content in Soybeans

Factor	*67% Confidence*	*95% Confidence*
Oil	0.5	1.0
Protein	0.6	1.2

This means that a given protein result will fall within 0.6 percentage points of the wet chemistry methodology (combustion method for protein; Soxtec for oil) two-thirds of the time, or within ±1.2 percentage points 95 percent of the time. Most of this variability is due to sampling error, not the accuracy of the instrument, per se. The same sample presented to the same instrument a hundred times should not vary more than ±0.05 percentage points from the original result.

There are five instruments that have been approved for measuring protein and oil in official Inspections. Four are reflectance type fixed filter instruments requiring a finely ground sample. The approved grinder must be cleaned after each use and must be on a slow feed, resulting in a restriction on the number of samples run per hour to a maximum of eight per grinder. The fifth instrument is a transmittance-type instrument with a scanning monochrometer that analyzes the sample of FM-free whole soybeans. Costs of instruments range from a low of about US $10,000 to a high of US $41,000 for the transmittance-type instrument.

FGIS has indicated that there will be no additional inspection fees charged at export to provide this information. Results will be reported to the nearest tenth percent on a standard 13% moisture basis or other moisture basis, if desired.

Suggested Soybean Contract Specifications

As the purchase decision is formulated, the only document that has the force of law is the purchase contract. This document must contain the minimum quality specification acceptable to the buyer to which the seller must comply. There are a number of standard contracts for the sale of U.S. soybeans including the North American Export Grain Association (NAEGA) contracts for FOB and CIF shipments. Our recommendations represent only the barest minimum quality specifications for soybeans that will be used by the soybean crushing industry in the production of edible oil and soybean meal for animal feeding. Soybeans used for production of soy foods for human consumption are beyond the scope of this paper.

Following then are our contract specification recommendations:

1. U.S. Number 2 Yellow Soybeans

For crushing purposes the standard U.S. Number 2 Yellow Soybeans are perfectly adequate for the production of soybean meal for animal feeding and soybean oil for further refining. Significant deviation to a less stringent specification, while lowering the price, will increase the risk of production of poorer quality products are products that are unacceptable in the market. Conversely, specifications with more stringent requirements typically require price premiums that more than offset the economic advantages gained by the higher standard. That is not to say that less or more stringent specifications are not utilized by importers of U.S. soybeans. But in those cases, reasons are expressed which mayor may not be economic.

There are a number of examples of differing contract specifications. Taiwan buyers in recent years have specified a minimum oil and protein content, with a scale of discounts if the minimum specifications were not met. In 1987 Japanese buyers specified a lower foreign material. This practice was discontinued since the price premium was higher than the economic return. A specific German processor buys U.S. Number 2 soybeans, but specifies a maximum one percent foreign material. Another German processor in the past had consistently, and still today on occasion, purchased U.S. Number 3 Soybeans.

2. Moisture

Dependent upon the desired end use and the storage condition, season of year and anticipated time lapse before consumption or processing, there are a number of possible recommendations as to contract specifications for moisture. Unless stored in a cool climate, deterioration risks rise rapidly when moisture exceeds 13%. Large importers of U.S. soybeans, Japan being one example, typically limit moisture to a maximum of 13.5% .In a tropical or semitropical climate with anticipated extended storage the recommendation would be lowered to 13 % .In most years, U.S. exports of soybeans contain moisture well below 13%.

Further, the risk of deterioration during ocean transport increases as the moisture level increases or the as moisture variability increases. This is particularly the case in the long transportation times to Asia. Contrary to common perception there is no detectable increase in the average moisture content of soybeans during ocean transportation. There are reports, however of moisture migration, condensation and accumulation especially during winter months when cold cargoes pass through warm tropical waters and the hot sun of the tropics falling on the hatch covers. Deterioration may result, but there is not an increase in the average moisture level. A lower moisture specification will limit this risk.

3. Oil & Protein Content

If there are specific reasons why a buyer may wish to specify minimum oil and protein contents, it is recommended that the contract be based upon a sliding scale of discounts and/or premiums. Stating absolute minimums, even at reasonable levels, may limit the ability of the seller to find sufficient quantities of soybeans meeting both standards. Thus, the price premium required may be prohibitive. The sliding scale provides flexibility, yet compensates the buyer if minimum oil and protein levels are not met. The sliding scale as a concept is explained in Table 5.

Even if minimum levels of oil and protein are not specified, since the service is free, the contract should specify oil and protein analysis by FGIS. Although this will not affect the quality delivered, the buyer gains significant information to determine value or end use preference with documentation arrival, long before the vessel arrives in port.

Table 5

Sliding Scale Discounts Concept

Factor	*Minimum*	*Discount*
Oil	19.0*	2% of contract price per each half percent of oil below minimum
Protein	35.0*	1% of contract price per half percent of protein below minimum
*Basis 13% moisture		

3. Inspection Certification

Likewise, the contract should require a copy of the Inspection Log as part of the required documentation. This no cost requirement provides much more detailed information on the shipment than the export inspection certificate alone. The Export Inspection Certificate describes only the weight, stowage and the averages of the quality factors. The Inspection Log shows a sublot-by-sublot inspection results, and thus may identify variability that may be important in how the soybeans are stored (segregation) and processed.

SOYBEAN MEAL

Soybean meal is considered a processed product or a by-product; therefore, governmental standards were never established to describe the product. In U.S. domestic markets the trading rules adopted by the National Oilseed Processors Association (NOPA) serve as "de facto" standards for soybean oil and soybean meal.

For soybean meal, NOPA trading rules prescribe are two designations of quality, i.e., 44% protein meal, and dehulled, high protein meal. The specifications for both types of meal are shown in Tables 6 and 7.

Table 6

NOPA Trading Rules
44% Protein Soybean Meal

Factor	*Specification*
Protein	Minimum 44.0%
Fat	Minimum 0.5%
Fiber	Maximum 7.0%
Moisture	Maximum 12.0%

Table 7

NOPA Trading Rules
Dehulled Soybean Meal

Factor	*Specification*
Protein	Minimum 47.5 – 49.0%*
Fat	Minimum 0.5%
Fiber	Maximum 3.3 – 3.5%*
Moisture	Maximum 12.0%

** Determined by buyer and seller at time of sale*

Under the trading rules there is no provision for urease activity or other specification to insure proper heat treatment to inactivate anti-nutritional factors (trypsin inhibitors) present in raw soybean meal. Most feed manufacturers would prescribe this additional specification in the contract. The typical urease specification in the U.S. market where the animal species to be fed is non-ruminants is a pH rise of no less than 0.05 units but no more than 2.0 units (Caskey Knapp test). If the soybean meal is to be fed to ruminants in combination with molasses and urea, a pH rise of 0.12 or less is desired. Sufficient data is not available to make recommendations on urease activity for soybean meal fed to fish and prawns, but is probably similar to non-ruminant livestock. Less than a 0.05 unit increase in pH suggests that there is a good chance the protein and amino acids were damaged from overheating.

The trading rule for moisture is a maximum 12%, however the rules allow moisture up to 12.5% without discount. Only when the moisture exceeds 12.5% is the discount applied and then it is applied back to a base of 12%. The discounts are two times the delivered invoice price if between 12 and 13% moisture, and 22 times the invoice if above 13% moisture.

The trading rules further prescribe that a non-nutritive, inert, non-toxic conditioning agent to improve flowability can be added up to a maximum of 0.5% by weight. The conditioning agent must be shown as an added ingredient. The material most often used in the past for this purpose has been calcium carbonate (ground limestone). This is an important constituent especially in swine nutrition where the calcium/phosphorus ratio is a critical consideration. More recently this flow agent has been ball clay (bentonite clay).

There are specified penalties in domestic markets, with cargo rejection possible under certain conditions, if minimum specifications are not met. Samples for trade dispute settlement are drawn at point of origin and referee laboratories are specified in the trading rules.

At export, NOPA trading rules do not specify minimum quality standards, principally due to the varying specifications of some buyers who may wish to purchase poorer quality than the minimum specified by NOPA rules. The trading rules do, however, restrict blending to soybean mill feed, soybean mill run, and soybean hulls, and provide rules for sampling and weighing. The majority of soybean meal traded in international markets is traded under Grain and Feed Trade Association (GAFTA) contracts. For U.S. soybean meal GAFTA 100 contract is used for C.I.F. terms and GAFTA 119 for F.O.B. terms. There are a number of quality specifications that can be utilized under these contracts to include minimum protein as well as minimum "pro-fat" (a minimum value of protein plus fat).

Sampling and analysis of soybean meal at export is typically performed by an independent superintendence company and its certificates accepted as final by buyer and seller. The finality of the certificate is absolute in the absence, naturally, of fraud or collusion. The risk of deterioration in transit due to "inherent vice" is totally the buyers. Buyers can limit risk in this regard by specifications in the contract.

The most important considerations in purchasing soybean are all related to economics. Many would argue that the most important such consideration should be whether to purchase 44% protein soybean meal or dehulled soybean meal. What I will present here is an economic case for purchasing dehulled soybean meal.

As one would expect the higher the protein level the higher the price of soybean meal in terms of price per ton. This does not, however, mean that it is more expensive in terms of cost per unit of protein or cost per unit of nutrient in the diet. The cost per unit of protein should be calculated on the cost of soybean meal delivered to the feed mill.

Table 8 defmes the units of protein contained in several differing qualities of soybean meal. Meal A, purchased on a 44% "pro-fat" contract contains 40.5% protein; Meal B contains 44% protein; and Meal C is dehulled soybean meal containing 48% protein.

Table 8

Amount of Protein Contained Per Ton in Soybean Meals of Varying Quality Specifications

Sample	*Type of Soybean Meal*	*Total Protein (kg/MT)*
Meal A	44% Profat (40.5% Protein)	405
Meal B	44% Protein	440
Meal C	Dehulled (48% Protein)	480

To determine the cost per unit of protein, the total price at the feed mill is divided by the amount of protein received. While the price per metric ton will vary at the F.O.B. port, the cost for ocean freight and local transportation will be the same. Import duty and other taxes are normally based upon landed tonnage or value. These duties may vary. Table 9 compares the three types of soybean meal based on cost per unit of protein delivered.

Table 9

Economic Comparison of Cost Per Unit of Protein Of Three Types of Soybean Meal ($US)

Cost Factor	*40.5 % Protein*	*44% Protein*	*48% Protein*
Price $US/MT FOB	$228	$235	$245
Ocean Freight	40	40	40
Unloading, local freight	10	10	10
Cost at Feed Mill	278	285	295
Price ÷ Kg of Protein	$278/405 Kg	$285/440 Kg	$295/480 Kg
Price per Kg of Protein at Feed Mill	$0.686	$0.648	$0.615

Based on the comparative costs presented in Table 9 it is obvious that the logical choice should be dehulled (48% Protein) soybean meal. Although it costs $17/MT more than 44% profat and $10 more than 44% protein soybean meal, its price per unit of delivered protein is decidedly lower.

As demonstrated in Table 10, the variation in protein content between 40.5% and 44% protein soybean meal is not 3.5%. In fact, 44% protein is more than 6% higher than 40.5% (3.5 + 41.5). The far right column demonstrates the added value of purchasing 48% protein soybean meal versus 44% profat. That is, at the feed mill even after paying the higher price for 48% protein soybean meal the feed mill receives 8.25% more value by purchasing 48% meal.

Further advantages of dehulled soybean meal are not reflected in the above analysis. These factors include lower fiber, higher metabolizable energy, and lower coefficients of variability. This latter attribute enables the feed miller to make lower allowances for variations, translating into less over formulating and better utilization of the protein.

Table 10

Variation in Quantity and Value of Soybean Meals of Differing Protein Contents to supply 10,000 MT of Protein

Type of Soybean Meal	*Variation in Protein (%)*	*MT Soybean Meal*	*Variation in Value (%)*
44 Profat (41.5)	0	24,096	0
44% Protein	6.02	22,727	3.31
Dehulled (48%)	14.77	20,833	8.25

Recommended Purchase Specifications for Soybean Meal

Based on the foregoing quality considerations and economic analyses, it is recommended that the soybean meal buyer specify at a minimum soybean meal quality characteristics as shown in Table 11.

Table 11

Recommended Purchase Contract Specifications For US Soybean Meal

Factor	*Specification*
Protein	Minimum 48%
Fat	Minimum 0.5%
Fiber	Maximum 3.3%
Moisture	Maximum 12%
Urease Activity	pH rise between 0.12 and 2.0 units

It is the recommendation of the author that buyers specify quality no lower than that contained in NOPA domestic trading rules, and that a minimum specification for proper heat treatment also be incorporated into the contract. This presumes that the purchaser will buy dehulled soybean meal and that the meal will be fed to non-ruminants.

SOYBEAN OIL TRADING RULES

Soybean oil like soybean meal is not covered by governmentally prescribed standards. There are a number of standard specifications for soybean oil that could be used in international trade. For the domestic market, NOPA has generated export trading rules for three types of soybean oil; i.e., crude degummed, once refined and fully refined. For crude degummed and once refined oils only NOPA trading rules are in common use in the U.S. For fully refined oils there are two other standard specifications issued by governmental agencies which do not carry the weight of an "official" U.S. standards and are not widely used in private trade. In practice, end users have their own specifications for fully refined oils and only use NOPA trade rules as the absolute minimum values on which to build their own more stringent requirements.

Crude soybean oil is sold as a degummed oil because of the tendency of gums to settle out during transportation cause numerous difficulties with emptying and cleaning the transportation equipment. NOPA specifications for crude degumrned soybean oil are as shown in Table 12.

Table 12

NOPA Trading Rules
Crude De-Gummed Soybean Oil

Factor	*Specification*
Unsaponifiable Matter	1.5% maximum
Free Fatty Acids	0.75% maximum
Moisture, Volatile Matter and Insoluble Impurities	0.3% maximum
Flash Point	121°C maximum
Phosphorus	0.02% maximum
Marine Oils	Absent

Crude degummed soybean oil sold for export must be pure soybean oil. It must be produced from fair average quality crude soybean oil from which the major portion of the gums naturally present has been removed by hydration and physical separation. It must be equal in quality to soybean oil produced for domestic consumption.

Once refined oil is not a commonly traded commodity since most buyers are interested in doing their own refining to finished product and will buy crude degumrned or have no refining capacity and would buy fully refined (refined, bleached and deodorized, RBD). However, for those interested NOPA trading rules for once refined soybean oil are shown in Table 13.

Table 13

NOPA Trading Rules
Once Refined Soybean Oil

Factor	*Specification*
Appearance	Clear and brilliant at 21-29°C
Settlings	Essentially absent at 21-28°
Moisture and Volatile Matter	0.10% maximum
Free Fatty Acids	0.10% maximum
Color (Lovibond)	Less than 3.5 red, not green
Flash Point	121°C minimum
Unsaponifiable Matter	1.5% maximum
Marine Oils	Absent

Once refined soybean oil sold for export must be pure soybean oil. It must be produced from fair average quality crude soybean oil from which essentially all of the free fatty acids and non-oil substances have been removed by chemical treatments and physical separation. The NOPA analytical requirements for fully refined soybean oil are shown in Table 14.

Table 14

NOPA Trading Rules
Fully Refined Oil

Factor	*Specification*
Color (Lovibond)	20 yellow/2.0 red maximum
Free Fatty Acid	0.05% maximum
Peroxide Value	2.0 milliequivalents/Kg
Cold Test	5.5 hours minimum
Fat Stability	8 hours – 3.5 milliequivalents/Kg
Moisture and Volatile Matter	0.10% maximum
Preservatives	GRAS permitted
Marine Oils	Absent
Appearance	Clear and brilliant at 21-29°C
Settlings	Absent
Taste/Odor	Bland and free from foreign undesirable odors

The terms of the contract should specify the analytical methodology to be employed, if specifying other than standard trading rules which specify the methods of analysis (and sampling). Independent surveyors, samplers and weighers should also be specified in the contract. It is also possible to leave this selection to the discretion of the seller.

A large proportion of oilseeds, oils and fats are traded under contracts issued by Federation of Oils, Seeds and Fats Associations International (FOSFA). FOSFA International sees its main functions as issuing standard contracts and keeping them current. In 1982 it was estimated that as much as 85% of the total amount traded internationally of oilseeds, oils and fats were transacted under terms of FOSFA contracts. Like GAFTA, it is located in London and plays an important 11o1e in commodity arbitrations.

OTHER CONSIDERATIONS

Protein Digestibility and Amino Acid Composition of Soybean Meal

There is a considerable body of evidence that the variability in the digestibility of U.S. soybean meal is very small and near the optimal level. There is strong evidence that there is much more variability in the digestibility of soybean meal produced in Brazil, Argentina and especially India. Lower digestibility results in sub optimal protein accretion in the gut of non-ruminants and a lower than optimal animal production efficiency which equates to lower profitability.

There is also growing evidence that the level of essential amino acids, particularly lysine, in U.S. soybean meal is superior to South American-produced meals or meals produced from South American soybeans in third country locations.

It should be in the interest of the importers, and more importantly, users of soybeans and meal to examine these issues to determine what product(s) from which sources offers the best economic return in terms of animal performance and economic returns. We at ASA offer to customers such information as we have that would assist in making better-informed decisions.

Solvent Residues in Meal and Oil

Over time there have been a number of inquiries as to the disposition of the solvents used in soybean oil extraction, and as to the levels of benzene contained in commercial solvents used in the U.S. Following is a discussion of that issue.

Commercial hexanes used in the U .S. for extraction of oil-bearing seeds is actually a blend of constituents: N-Hexane, 3 Methyl Pentane, 2 Methyl Pentane and Methyl Cyclopentane. N-Hexane is considered a neurotoxin with proven toxic effects at high concentrations. The U.S. Occupational Health and Safety Administration (OSHA) has placed a ceiling of exposure in the workplace at 500 ppm with a time weighted average not to exceed 50 ppm. Benzene, another light hydrocarbon and a suspected carcinogen, can be found in very small quantities (less than 100 ppm) as a contaminant in commercial hexanes marketed in the U.S. The time weighted average workplace maximum exposure for benzene has been set by OHSA at 10 ppm. It has been reported that samples of hexane from some non-U.S. production contain benzene levels exceeding one percent by volume.

Hexane has a narrow distillation range of about 4.5°C, and, dependent upon the blend, can range from about 65° to 71°C. Benzene, on the other hand, has a boiling point of 80.1°C with a commensurately higher specific gravity.

Residual hexane in soybean meal has been studied extensively, but primarily from the point of view of hexane losses as an expense item or as an air pollution source, not from a quality or feed and food safety standpoint. With newer equipment, particularly the Schumacher-type desolventizer/toaster unit, residual levels of hexane can be expected to be less than 500 ppm immediately after processing. With older type equipment the range can reach 1000 ppm. With elapse of time after processing and handling, this level tends to decrease appreciably because of the volatility of hexane. In fully refined soybean oil (including deodorization), residual hexane is typically not detectable (below 0.05 ppm). Unfortunately, there is no public data on residual hexane levels of crude or refined but undeodorized oils. There are no established tolerances by the U.S. Food and Drug Administration for residual solvents in edible oils.

In the case of both meal and oil, the residual levels of hexane at time of consumption by animals or by humans are so low as to present no risk. This is provided that the hexane is of such a quality that benzene contamination is sufficiently low to present no hazard. Since benzene has a boiling point about 11°C higher than N-hexane, the probability of residual solvent containing levels of benzene disproportionately higher than its presence in the original hexane is fairly high.

With continued reuse of solvent in processing the concentration of heavier, less volatile fractions would tend to increase, resulting in concentrations of benzene in solvent in actual use higher than was measured in the product prior to use. The issue then is one of hexane purity not unsafe levels of residual hexane in the products produced by solvent extraction.

CONCLUSION

The U .S. market for soybeans and soybean products is well established with quality standards specified by either government decree or industry adopted trading rules. As a result of such an open system the U.S. has the ability to provide a wide array of quality of soybeans and soybean products desired and specified by buyers with varied end use requirements.

Deviation from "normal" quality specifications can either increase or decrease product costs and can decrease or increase the probability of product degradation or the buyer’s risk of obtaining an unsuitable or less desirable product. The deviation from normal specification should be weighed in light of increased economic returns and/or decreased risks. Lower quality specifications reduces price but usually increases risk. Higher quality specifications increase price but may or may not increase end product yield and quality commensurate with the increased cost.

We have mentioned in the text of this paper recommendations for contract specifications that increase quality information to the buyer and minimum quality specifications that balance cost with risk. We would hope the information contained herein provides a clear enough overview of the U.S. export quality specifications sufficient for determining or verifying appropriate contract specifications for U.S. soybeans and soybean products.