CEN Workshop
Solid Biofuels
Secretariat:SIS (Sweden)

Existing national standards on solid biofuels

The secretariat has received the following information/ material about existing national standards from the CEN members and the participants in the Workshop meeting on November 24 in Brussels. Among the material there are also standards on grill charcoal and peat for use in horticulture, but they are outside if they don't have any test methods.

1. **Norway**: The following Norwegian Standards will be published in January 1999

NS 3165 Biofuel - Cylindrical pellets of pure wood - Classification and requirements

NS 3166 Biofuel - Determination of mechanical strength of pellets

NS 3167 Biofuel - Determination of moisture content in laboratory samples of pellets.
(Tom Höseggen, NBR Norwegian Council for Building Standardization)

2. **Sweden**: Enclosed in annex A you will find a list of existing Swedish Standards and also a list of draft standards. As you notice some standards, i.e. sample and sample preparation, are based on ISO-standards. In the document "Recent Standardisation Work in Sweden Related to Measurement of Biomass Fuel Quality" (distributed by fax) Ms Margret Månsson, former convenor of the national working group "Test methods", describes the Swedish Standardisation work on Solid Biofuels and which standards that have been produced, particularly in the area of test methods.
(Lars Sjöberg, STG Swedish General Standards Institute)

3. **Austria**: An overview about existing standards in the field of solid biomass in Austria is presented in annex B.
(Wolfgang Koppensteiner, ON Österreichisches Normungsinstitut)

4. **Finland**: The fuel peat quality assurance manual in English, see annex C.
(Timo Nyronen, VAPO OY)

5. **Germany**: Two existing standards on biofuels:
DIN 51731 Testing on solid fuels - Compressed untreated wood - Requirements and Testing (1996)
DIN 51749 Grill charcoal and grill charcoal briquettes - Requirements - Tests (1985)
(Klaus Liphard - Convenor for all activities on solid fuels in Germany)

6. **Iceland**: No national standards on biofuel.
(Sveinn V. Olafsson, STRI, Icelandic Council for Standardization)

7. **Switzerland**: No national standards on biofuel.
(Beat Looser, SNV, Swiss Association for Standardization)

8. **France**: No standards are existing on definitions, properties or classifications for the use of solid biofuels. Some Quality charters on fuelwood are existing in local communities in order to facilitate commercial transactions.
But with 5% of the national primary energy consumption (i.e. 10 Mtoe), fuelwood is the second renewable energy after hydro-electricity. That's the reason, ADEME (under the responsibility of French ministries) will start in 1999 a labellization on biomass combustion devices on domestic use (this area represents about 8 Mtoe). A biomass classification will be very helpful to implement this project and to promote biofuels as alternative energies.
Mr Pierre Ballaire, ADEME, will be the French participant in CEN Workshop Solid Biofuels.

9. **Ireland**: They have at the moment four national standards for peat:
IS 400:1989 Moss Peat for Use in Horticulture - Specification and Test Methods
Specifies the technical delivery conditions, properties and test methods for moss peat for use in horticulture and landscaping. Physical and chemical characteristics of moss peat are covered as moss peat complying with this specification is required to have a minimum Sphagnum moss content, a test method to determine botanical composition is included.

IS 422:1989 Peat-based Products for Use in Horticulture - Specification and Test Methods
Specifies the technical delivery conditions, properties and test methods for four classes of peat-based product for use in horticulture. The product classes specified are Soil Conditioners, Lime-free and Growing Substrates, Seed Substrates and Mushroom Casings.

IS 423:1989 Peat Fibre - Specification and Test Methods
Specifies the technical delivery conditions, properties and test methods for peat fibre for industrial use. Properties covered include those of importance in environmental treatment application such as compressibility, water absorption and organic matter content.

IS 426:1990 Briquetted peat - Specification and Test Methods
Specifies the requirements, test methods and technical delivery conditions for briquetted peat for domestic and industrial use. Properties specified include moisture content, volatile matter, calorific value and ash and sulphur content.
(W.B. Burns, NSAI National Standards Authority of Ireland)

10. **Denmark**: No national standards on biofuel.
(Jörgen Hagelund, DS Danish Standard)

11. **United Kingdom**: Frank Thomas, BSI, has passed the question to the responsible Project Manager within BSI. Still no further answer.

No answers from: Belgium, Czech Republic, Greece, Italy, Luxembourg, Netherlands, Portugal and Spain.

SWEDISH STANDARDS ON BIOFUELS **Annex A**

SS 18 71 06 Biofuels and peat - Terminology (1991)

Scope: This standard specifies terms and definitions of solid biofuels, i.e. products based on wood fuels, energy crops, peat etc.

SS 18 71 13 Biofuels and peat - Sampling (1998) (ISO 1988 ≈)

Scope: This standard specifies methods of sampling for quality control of wood fuels, peat and upgraded forms (pellets and briquettes) of these.

SS 18 71 14 Biofuels and peat - Sample preparation (1992) (ISO 1988 ≈)

Scope: This standard specifies methods of preparation of samples quality control of wood fuels, peat and upgraded forms (pellets and briquettes) of these. The way of preparation from the first laboratory sample of 10 - 20 litres to the final analytical sample is described. The standard also describes general principles to consider when sampling.

SS 18 71 20 Biofuels and peat - Fuel pellets - Classification (1998)

Scope: This standard classifies fuel pellets into three categories where the main differences are size and ash content.

SS 18 71 23 Biofuels and peat - Fuel briquettes - Classification (1998)

Scope: This standard classifies fuel briquettes into three qualities: two for wood fuel briquettes (one for domestic use and one for big units using automatic feeding) and one quality where other raw materials than wood fuels are used.

SS 18 71 70 Biofuels and peat - Determination of total moisture content (1997)

Scope: This standard specifies a method for determination of total moisture content (weight %) in solid biofuels and peat.

SS 18 71 71 Biofuels - Determination of ash content (1984) (ISO 1171 ≈)

Scope: This standard specifies a method for determination of ash content in solid biofuels. The standard is based on the international standard ISO 1171-1981 Solid mineral fuels - Determination of ash.

SS 18 71 73 Biofuels - Calculation of analyses to different bases (1986) (ISO 1170 ≈)

Scope: This standard specifies relations to make calculations of analyses to different bases. The standard is mainly intended for determination calorific value and net calorific value (SS-ISO 1928), but can also easily be applied to standards for other analysis methods.

SS 18 71 74 Biofuels and peat - Determination of size distribution (1990)

Scope: This standard specifies a method for determination of size distribution according to the fragment size of solid biofuels and peat using a shaking sieve.

SS 18 71 75 Peat - Determination of mechanical strength of sod peat (1990)

Scope: This standard specifies a method for determination of mechanical strength of sod peat in a rotating drum.

SS 18 71 78 Biofuels and peat - Determination of raw bulk density and calculation of dry raw bulk density in a large container (1990)

Scope: This standard specifies a method for determination of raw bulk density and calculation of dry raw bulk density of material loaded in a large container. The standard is applicable on wood fuels and peat.

SS 18 71 79 Peat - Determination of raw bulk density and calculation of dry raw bulk density (1990) (ISO 567 ≈)

Scope: This standard specifies a method for determination of raw bulk density and calculation of dry raw bulk density for peat. The standard is applicable for sod peat and milled peat.

SS 18 71 80 Biofuels and peat - Determination of mechanical strength for pellets(1990)

Scope: This standard specifies a method for determination of mechanical strength for pellets. (This standard is under revision. The revised version will be applicable on both pellets and briquettes.)

SS 18 71 84 Biofuels and peat - Determination of moisture content in the analysis sample (1990)

Scope: This standard specifies a method for determination of moisture content in the analysis sample. The method is only applicable for samples grinded to particle size < 1 mm.

Draft Swedish Standards on Solid Biofuels

SS 18 71 06 Biofuels - Terminology, edition 3

SS 18 71 14 Biofuels - Sample preparation, edition 2

SS 18 71 80 Biofuels - Determination of mechanical strength for pellets and briquettes, edition 2

SS 18 71 88 Solid fuels. Solid residues - Wet sieving of crushed residues, edition 1

SS 18 71 zz Solid fuels - Determination of short- and long-term leachability properties for solid residues from combustion of biomass fuels, edition 1.

Annex B

Overview about existing standards in the field of solid biomass in Austria:

ÖNORM M 7132: Energy-economical utilization of wood and bark as fuel – Definitions and proporties

Since there is an increasing imoprtance for wood as an energy-source this standard determines essential terms in this field and specifies the characteristics of wood as a fuels. This standard uses the terms of the Austrian forestry and wood trade usages. This is very important because of the economic traffic between producers, distributors and consumers and resulted in a positive developement of energy made from wood. This standard considers wood with and without bark as a raw material and by-products of the wood manufacturing without binders and coverings. In addition the needs for the development of heating installations can easily be carried out since there is a survey of the fuel technological proporties.

ÖNORM M 7133: Chipped wood for energetic purposes – Requirements and test specifications.

Standardized fuels with the property to flow like chipped wood allow the automatic supply of the fuel. This standard helps to define the condition of the fuel and is also adressed to the producers, distributors and consumers. It determines some classes for chipped wood (with and without bark) with the parameters water content, size, deposit, density and ash content. It defines the requirements and the test methods. Because of the regulation of the class of sizes it is possible to coordinate the machinery for manufacturing and use. This standard is very important for the manufacturing of cutting machines and heating installations with a power range up to 1 MW. This Standard has already essential during the preparation to simplifications and improvements in machines and facilities for manufacturing, automatic supply and use up of fuel.

ÖNORM M 7135: Compressed wood and compressed bark in natural state – Pellets and briquettes – Requirements and test specifications

This Standard serves to define the requirements and methods for the testing of wood pressings (wood briquettes, wood pellets). It is addressed to persons and organisations which manufacture, plan, sell, erect or use machinery, equipment, tools and entire plants having a connection with wood pressings, and to all persons and organisations involved in producing, purchasing, selling and utilising wood pressings.

Wood pressings made with bindings are not dealt with by this Standard.

The initiative for this standard came from the saw industry and the wood manufacturing industry. Pressings made of forestral biomass are a by-product for the industry and the reason for high interest. Therefore this product became marketable because there were new requirements and preconditions for consumers for expert and environmental-friendly combustion. This standard includes technical requirements and defines test specifications. The technical requirements are size and shape, density, water content,, ash content and net

caloric value. This standard described the preconditions for the launch of high quality briquettes and pellets and had therefore a very good acceptance.

In the following there are also some standards with only small relation to solid biomass:

ÖNORM M 7111: Concepts of energy economy - Energy of biomass organic waste, wind and geothermal energy

ÖNORM M 7550: Boilers for central heating up to 100°C – concepts, requirements, testing, marking of conformity

ÖNORM H 3010: Stoves for solid fuels – Definitions, requirements, testing, marking of confirmity

ÖNORM H 3011: Stoves for solid fuels – Requirements, definitions

ÖNORM M 9465-1: Emission limits for air contaminants of straw incinerating plants up to a rated heat output of 75 kW; requirements and testing on the site

ÖNORM M 9465-2: Emission limits for air contaminants of straw incinerating plants up to a rated heat output of 75 kW, requirements and testing on the test bench.

ÖNORM M 9466: Emission limits for air contaminants of wood incinerating plants of a nominal fuel heat output from 50 kW onwards – Requirements and testing on the site

QUALITY ASSURANCE MANUAL FOR FUEL PEAT 1991

Energiataloudellinen Yhdistys — Finnish Energy Economy Association

Lämpölaitosyhdistys ry. — Finnish District Heating Association

Turveteollisuusliitto ry. — Association of Finnish Peat Industry

QUALITY ASSURANCE MANUAL FOR FUEL PEAT 1991

Adopted for use for sod peat on 1 September 1991

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REMARKS

The shaded points are not included in the Quality Assurance Manual 1989, which is applied for milled fuel peat.

The long-term aim has been to combine and revise the manuals 1989 and 1991 in order to prepare a manual that comprises both milled fuel peat and sod peat.

1. PURPOSE

The purpose of this quality assurance manual is to define the procedure, by which the quality of fuel peat can be given and defined unambiguously and appropriately.

2. DEFINITIONS

2.1 Peat

Peat is a material formed from dead plant parts by decomposition in very moist conditions. Peat consists of dry matter and water (moisture). Dry matter consists of combustible fraction and ash-forming fraction. Peat contains variable amounts of non-humidified or poorly decomposed coarse plant parts (bog wood, dwarf shrubs, etc.).

2.2 Fuel peat

General name of peat products intended for energy production

2.2.1 Milled fuel peat

Fuel peat produced by milling peat from the surface of the peatland and by drying it on the peat field. Milled fuel peat is non-homogeneous in particle size and contains mainly pulverous peat as well as peat particles of various size. In addition to peat material, milled peat may also contain variable amounts of non-decomposed or poorly decomposed coarse plant parts (bog wood, dwarf shrubs, cotton grass, etc.) as well as impurities.

2.2.2 Sod peat

Fuel peat produced by extracting peat from the peat field, by processing it mechanically to sods and by drying the sods on the production field. The peat sods are fairly homogeneous in diameter, while the length of the sods varies. Sod peat may also contain variable amounts of fines loosened in the production and treatment stages, as well as impurities.

2.3 Impurities

Impurities include stones, metal pieces, plastics, and other corresponding material, which is not considered peat according to definition in chapter 2.1.

2.4 Delivery batch

The peat batch on which the essential quality requirements for fuel peat, controlled regularly daily, are focused (primarily moisture content as received, net calorific value, and energy density; marked as A in the column ”Method of verification)”, in

Appendices 1, 2 and 3. The delivery batch is the amount of peat delivered during 24 hours, unless otherwise agreed.

2.5 Single sample (increments)

The minimum amount of peat taken at a time to prepare a combined sample.

2.6 Combined sample

General name for a sample formed by combining single increments taken from a peat batch. The combined sample may also be prepared by combining parts of increments (sub-samples) separated by dividing from homogenised single samples into one sample.

2.7 Laboratory sample

A sub-sample prepared from the combined sample taken from the delivery batch or its part by homogenising or dividing and sent to a laboratory. For comparison, several duplicate laboratory samples may be prepared from the combined sample, for example, for moisture determinations.

2.8 Moisture sample

A sub-sample prepared from the laboratory sample by homogenising and dividing for moisture determination.

2.9 Reserve sample

A sub-sample taken from the laboratory sample, stored for checking moisture determinations.

2.10 Calorific value sample

A sample prepared by combining sub-samples formed by homogenising and dividing from laboratory samples from an agreed period of not more than one month. Alternatively, the calorific value sample may be prepared by combining dried moisture samples.

2.11 Analysis sample

A sample prepared by crushing, homogenising and dividing from a calorific value sample. Determinations of calorific value, ash content and moisture content of the analysis sample, as well as necessary chemical analyses are carried out for this sample (ref. 4.10).

2.12 Oversized particles in milled fuel peat

Particles contained in milled fuel peat not passing the 200 x 200 mm openings of a vibratory grate.

2.13 Coarse fraction in milled fuel peat

The fraction of milled fuel peat passing the 200 x 200 mm openings of a vibratory grate, but not the 40 x 40 mm mesh screen.

2.14 Oversized pieces in sod peat

Pieces, inclusive woody material, contained in sod peat, exceeding the agreed sod size.

2.15 Fines in sod peat

The fraction of sod peat passing a 20 x 20 mm mesh sieve.

3 SAMPLING AND SAMPLE HANDLING

3.1 General

The purpose of sampling is to obtain a representative sample from the fuel batch concerned. The purpose of sample handling is to reduce the sample by preserving its representativeness. The requirements concerning the amount, volume and treatment of samples in chapters 3.4, 3.5 and 3.6 have been defined in such a way that the procedure is sufficient for the most demanding regular determination, i.e., for the moisture determination based on drying in a drying oven. Instead of this procedure, some other method equal to reliability and representativeness may be applied. In particular, if it is agreed that a method not requiring sampling is used for determining moisture, the sampling and treatment required for the determination of other characteristics may deviate from those presented in appropriate chapters.

The sampling equipment and methods used for commercial quality determinations should always be tested prior to their use in a mutually agreed way.

3.2 Sampling site

The primary sampling site is the delivery site of fuel peat. Should it be technically difficult to obtain a representative sample at the delivery site, a site should be chosen, where a representative sample can be taken from the peat batch most reliably and at moderate costs. The sample is obtained most reliably from a continuous peat stream.

Single samples (increments) should be taken (order of preference):

a) from a continuous peat stream; primarily in reception, but also during loading or reloading

b) mechanically direct from loads according to chapter 3.3.3

c) from a receiving station during discharge or from a receiving pocket immediately after unloading

d) during loading from a load scoop or from the slope of the stockpile

e) from the stockpile. Sampling from the stockpile for commercial purposes is not recommended, as it is difficult and laborious to obtain a reliable representative sample from the stockpile.

3.3 Sampling method

Sampling is the stage causing the greatest inaccuracy in the results of determination. Hence, particular attention should be paid to sampling, and it should be carried out systematically and with care. The most accurate result is obtained, if sampling can be performed mechanically, i.e., from a continuous fuel stream and from peat loads. Different sampling methods are listed in order of preference in the following chapters.

3.3.1 Mechanical sampling from a continuous peat stream

Single samples are taken mechanically in such a way that the whole cross-section of the peat stream is represented in the sample in principle of average.

Examples:

a) With a riffle scoop at the discharge end of a conveyor in such a way that the scoop moves at a constant speed of < 1.5 m/s through the whole stream of material falling from the conveyor, preferably rectilinearly. If the track of movement is circular, the radius of curvature calculated from the outer end of the scoop should be at least 5 times longer than the length of the riffle. The scoop should be empty at the start of sampling and should not be filled by more than ¾ of the height during the movement. The minimum width of the scoop should be 100 mm for milled peat and 300 mm for sod peat.

b) The sample from a non-continuous peat stream (scraper or screw etc. conveyors) can also be taken by opening the bottom of the conveyor over its whole width in such a way that the whole batch of peat is catched in the sample, for example, peat remaining between the scrapers.

3.3.2 Manual sampling from a continuous peat stream

The sample is taken manually from a continuous peat stream following the principles given above.

From a stopped conveyor, the whole cross-section of the peat stream is taken at the minimum length of 100 mm from milled peat, and of 300 mm from sod peat.

3.3.3 Mechanical sampling during loading, from a peat load or during discharge

Single samples are taken mechanically with sampling equipment of such a construction that the sample is representative.

3.3.4 Manual sampling during loading or discharge

When loading or discharging a load the samples are taken manually with a standard-sized scoop (see 3.5 a) systematically in such a way that no sorting or selection takes place.

At the receiving site the samples are collected from a falling peat stream or from a receiving pocket during unloading or immediately after that from the whole length of the load at even distances.

The sample should not be taken from the surface of a receiving pocket, load or heap, neither from the bottom or from lower slopes of heaps. Single increments should not be taken directly from the peat load, neither from a moving conveyor for safety reasons.

When loading, the sample is taken from the loading scoop. Should this be impossible, the sample can also be taken from the slope of the stockpile at equal distances.

When sampling sod peat manually, single sods should not be picked and the sample should contain fines in the same ratio as the peat batch subject to sampling.

3.4 Number of single samples (increments)

When sampling from a conveyor system, the minimum number of single samples should be 4 for each 100 m^3 of peat.

If sampling is performed for peat loads, single samples should be taken in continuous peat deliveries as follows:

Load size (m^3)	Number of single samples/load
< 50	2
50 - 100	4
> 100	6

If the average size of the delivery batch is < 300 m^3 or if load-specific characteristics (e.g., average moisture content of the load) are determined, the minimum number of single samples should be double.

3.5 Volume and sampling equipment of single samples

3.5.1 Milled peat

a) In mechanical or manual sampling from a continuous peat stream in such a way that the whole cross-section of the peat stream is represented in the sample in principle of average (3.3.1 and 3.3.2) or mechanically directly from the load (3.3.3), the minimum volume of a single sample should be 10 litres. If the peat stream is non-continuous (e.g., scraper or screw conveyors) the minimum volume of a single sample should be that of a one discontinuity batch (peat amount between the scrapers or in the turn-to-turn distance of screws).

b) In mechanical or manual sampling (3.3.3 and 3.3.4) during loading or discharge (e.g., large falling peat streams, receiving pocket, loading scoop, slope of a

stockpile) with a sampling scoop in such a way that the representativeness is based on taking single samples from different sites of a peat batch or a peat flow, the minimum volume of a single sample should be 1 litre.

3.5.2 Sod peat

The minimum volume of a single sample from sod peat should be 5 litres.

3.5.3 Sampling equipment

In all modes of sampling the single samples should be taken in such a way that the minimum diameter of the sampling equipment or scoop is 100 mm for milled peat and 300 mm for sod peat.

The volume of a single sample (volumetric efficiency of the sampler or the sampling scoop) should be kept standard irrespective of peat grade.

In manual sampling the single samples are collected with a long-handled sampling scoop.

3.6 Sample preparation and handling

In sample handling and storage it should be taken care that the characteristics of the sample do not alter. The sample is stored in a tightly closed vessel in a cool place. The moisture possibly condensed on the walls of the sample vessel should be mixed in the sample prior to further treatment. A frozen sample is melted at room temperature prior to treatment.

A principle procedure of sampling and treatment for milled peat is presented in Appendix 4 and that for sod peat in Appendixes 5a and 5b.

3.6.1 Preparation of combined sample

The single samples taken from the same delivery batch or its part are combined to a sample in such a way that the procedure is appropriate with regard to the representativeness of sampling and sample handling. At least two approximately equal combined samples are prepared from a delivery batch of > 2 000 m^3, unless some other principle of preparing the combined sample is more appropriate.

The combined sample is formed per each deliverer and if necessary per each peat site or delivery site.

The combined sample may also consist of sub-samples obtained by homogenising and dividing the single samples.

3.6.2 Preparation of a laboratory sample

The combined sample is mixed and if necessary crushed, and then a required number of laboratory samples are separated from it with a reliable divider. The minimum volume of the laboratory sample should be 5 litres for milled peat and 2 litres for sod peat, and the particle size should be < 25 mm.

3.6.3 Preparation of a moisture sample

Two moisture samples of 0.3 - 1.0 litres are separated by dividing from the laboratory sample and dried in order to measure the moisture content. The size of the moisture samples is dependent on the method of moisture determination applied (see chapter 4.1).

The remainder of the laboratory sample (reserve sample) is stored air-tightly for a period agreed.

The determination of moisture content should be carried out within 24 hours from sampling.

3.6.4 Preparation of a calorific value sample

The sample for the determination of calorific value is prepared according Mode 1 or 2.

Mode 1:
- A sub-sample of about 0.5 l is separated from a dried moisture sample by weighting its size with the dry matter mass of a peat amount represented by the combined sample.
- Sub-samples are collected from an agreed period of no longer than one month (cf. 3.6.1) for each deliverer and, if necessary, for each delivery site.

Mode 2:
- A sub-sample of about 0.5 l is separated from the remainder (reserve sample) of the laboratory sample (chapter 3.6.3) by weighting its size with the amount of peat (mass or volume) as received represented by the combined sample
- Sub-samples are air-dried and collected from an agreed period of no longer than one month (3.6.1) for each deliverer and, if necessary, for each delivery site).

3.6.5 Preparation of analysis sample

A sub-sample of at least 5 litres is separated from the mixed calorific value sample and ground to the particle size of < 0.5 mm. An analysis sample of at least 0.5 l and a necessary number of duplicate samples are divided from the ground and mixed sub-sample for control analyses.

3.7 Marking of samples

All samples should be marked with information that enables an unambiguous identification of the samples, i.a., deliverer, delivery batch(es), sample name (e.g., laboratory sample) and peat amount represented by it, sampling date and if necessary site, as well as the sampler's name.

3.8 Sampling for the determination of coarse fraction (milled peat) and fines (sod peat)

Single samples of at least 10 l in volume are taken at even distances according to the procedure presented in chapter 3.5.3 to prepare a combined sample of at least 200 litres representing the whole delivery batch.

4 DETERMINATION OF CHARACTERISTICS

4.1 Total moisture content as received (M_{ar})

4.1.1 Drying oven method

The size of moisture samples is defined by the weighing accuracy applied. When the weighing accuracy is 0.01 g, two samples of 30 - 100 g are weighed and when the weighing accuracy is 0.1 g, two samples of 200 - 400 g are weighed.

The samples are dried in an air-conditioned drying oven at 105±2 °C to standard weight. In most cases, a drying time of 12 - 16 h is sufficient, when the sample layer is < 30 mm. Samples should not be dried for more than 24 hours. Possible dry samples existing in the oven shall be taken out before placing moist samples in the drying oven.

After drying the samples are let to cool to room temperature in an desiccator and then weighed. If there is no desiccator available, the samples can be weighed hot immediately after taking out of the drying oven.

Should moisture determinations be compared, the method to be applied should be agreed in advance (cooling in an desiccator / weighing hot).

When making moisture determinations it should be checked that the vessels to be used have not absorbed moisture and endure the drying temperature.

The moisture content of the samples is calculated for the mass change during drying according to formula (1):

$$M_{ar} = \frac{m_1 - m_2}{m_1} \times 100 \text{ wt\%} \qquad (1)$$

where M_{ar} is moisture content calculated for wet weight as received (wt%)
m_1 mass of wet sample (g)
m_2 mass of dried sample (g)

The difference of duplicate determinations should not deviate by more than 1/50 from the average of duplicate determinations.

As the final result, the average of duplicate determinations at an accuracy of 0.1 percentage unit is given.

4.1.2 Other methods

Other methods and applications of determining the total moisture content shall be agreed case by case.

4.2 Moisture content of analysis sample (M_{ad})

Two samples of 3 - 4 g are weighed from a homogenised analysis sample ground to < 0.5 mm particle size (at equilibrium moisture content) at an accuracy of at least 0.001 g. The samples are dried in an air-conditioned drying oven at 105±2°C to standard weight. The drying time is 3 hours. After the drying, the sample dishes are closed with a lid and let to cool to room temperature in an desiccator, and weighed.

The moisture content of the analysis sample is calculated as mass percentage for the mass change during drying as in chapter 4.1.1. The difference between two duplicate determinations shall not exceed 0.2 percentage units. As the final result, the moisture content of the analysis sample is given at an accuracy of 0.1 percentage units.

4.3 Calorific value

Standards ISO 1928 or DIN 51900 are primarily applied.

4.3.1 Gross calorific value (Q_{gr})

Means the heat produced by complete combustion of unit quantity of a fuel in such a way that

a) the water contained in the fuel prior to combustion and that formed from hydrogen during combustion are in liquid form
b) the temperature of the fuel and its combustion products is +25 °C
c) the combustion products of carbon and sulphur, carbon dioxide and sulphur dioxide are as gases and nitrogen has not been oxidised.

4.3.2 Principle of determination

About 1 g of air-dry (equilibrium moisture content) analysis sample is weighed and burned in oxygen atmosphere in a calorimetric bomb immersed in a liquid bath, and the heat released is measured. The moisture content of the analysis sample is determined simultaneously, and with the aid of this value the calorific value of the air-dry sample is converted to correspond to that of an absolutely dry sample. As the result, the gross calorific value as the average of two duplicate determinations for an absolutely dry sample is given, calculated according to formula (2). The difference between two duplicate determinations shall not be exceed 0.120 MJ/kg.

$$Q_{gr,\,d} = Q_{gr,ad} \times \frac{100}{100 - M_{ad}} \qquad (2)$$

where $Q_{gr,d}$ is gross calorific value, dry basis (MJ/kg)

$Q_{gr,ad}$ gross calorific value of air-dry (analysis-dry) sample (MJ/kg)
M_{ad} analysis moisture content of the (air-dry) sample (wt%)

4.3.3 Net calorific value ($Q_{net,d}$)

The net calorific value of an absolutely dry fuel is obtained from the corresponding gross calorific value according to formula (3):

$$Q_{net,d} = Q_{gr,d} - 0.02441 \times M \quad (3)$$

where $Q_{net,d}$ is net calorific value, dry basis (MJ/kg)
$Q_{gr,d}$ gross calorific value, dry basis (MJ/kg)
0.2441 (MJ/kg) a correcting factor due to heat of vaporization of water (+25 °C)
M water amount formed by combustion of hydrogen contained in peat dry matter (wt%)

If no hydrogen determination is made, a value of 5.6 wt% is used for the hydrogen content of peat, i.e., the value of M is 50.0.

In this case the net calorific value is calculated according to formula (4):

$$Q_{net,d} = Q_{gr,d} - 1.22$$

where $Q_{net,d}$ is net calorific value, dry basis (MJ/kg)
$Q_{gr,d}$ gross calorific value, dry basis (MJ/kg)
1.22 (MJ/kg) correcting factor due to heat of vaporization of water formed from hydrogen in combustion (+25 °C), when the hydrogen content is 5.6 wt%

4.3.4 Net calorific value of peat as received ($Q_{net,ar}$)

Net calorific value as received is calculated according to formula (5):

$$Q_{net,\,ar} = Q_{net,d} \times \frac{100 - M_{ar}}{100} - 0.02441 \times M_{ar} \quad (5)$$

where $Q_{net,ar}$ is net calorific value of peat as received (MJ/kg)
$Q_{net,d}$ net calorific value, dry basis (MJ/kg)
M_{ar} total moisture content of peat as received (%)
0.02441 (MJ/kg) correcting factor due to heat of vaporization of water (+25 °C)

4.3.5 Energy density as received (E_{ar})

The energy density as received is calculated according to formula (6):

$$E_{ar} = \frac{1}{3600} \times Q_{net,ar} \times D_{ar} \quad (6)$$

where E_{ar} is energy density of peat as received (MWh/m^3)
$Q_{net,ar}$ net calorific value of peat as received (MJ/kg)

D_{ar} volume weight of peat as received (kg/m^3)
$\frac{1}{3600}$ reduction factor of energy units (MWH/MJ)

4.3.6 Amount of energy delivered (W)

The energy amount delivered, W, (MWh) is calculated according to formula (7)

$$W = \frac{Q_{net,ar}}{3.6} \times m \qquad (7)$$

where $\frac{Q_{net,ar}}{3.6}$ is the conversion of the net calorific value as received (MJ/kg) into units MWh/t
m mass of peat delivered (t).

Other determination methods of energy delivered and their applications shall be agreed separately case by case.

4.4 Ash

4.4.1 Ash content (Ad)

The method is based on ISO 1171 and DIN 51719 standard methods. 1 - 2 g of dry (or at equilibrium moisture content, air dry) analysis sample is weighed at an accuracy of 0.0001 g into a combustion crucible. (Simultaneously, samples are weighed from the analysis sample at equilibrium moisture content for the determination of analysis moisture content.) Crucibles of 30 - 40 mm in diameter and 10 - 20 mm in height are used as combustion crucibles. The crucible with contents is placed in the furnace at room temperature. The temperature of the furnace is raised to about 500 °c within 60 minutes. During the next 60 minutes the temperature is further raised to 815±15 °C and the sample is kept at this temperature at least for 60 minutes. After the combustion the crucible with contents is cooled in an desiccator and weighed. Two duplicate determinations are made for the samples, and the difference between the ash contents calculated on the basis of these determinations shall not exceed 0.2 percentage units, or else the determination shall be repeated.

The ash content of the sample is calculated according to formula (8):

$$A_d = \frac{m_2 \times 100}{m_1} \times \frac{100}{100 - M_{ad}} \text{ wt\%} \qquad (8)$$

where A_d is ash content, dry basis (%)
m_1 t mass of the sample at analysis moisture content
m_2 mass of the combustion residue (g)
M_{ad} analysis moisture content of the sample (%).

As the final result, the percentage of ash content, dry basis, is given to the nearest 0.1 wt%

4.4.2 Ash fusion behaviour

The determination is carried out according to standards ISO540, DIN 51730 or ASTM D 1857. The softening, hemispherical and fluid temperatures are determined in oxidising atmosphere.

4.4.3 Composition of ash

The following components are determined for heated ash either with different analysers or according to standards DIN 51729, ASTM D 3682 and ASTM D 2795:

Fe_2O_3, SiO_2, Al2O_3, CaO, K_2O, Na2O, SO_4 and P_2O_5.

The accuracy is 0.1 percentage units.

4.5 Volume and bulk density

The volume of a load is determined at the receiving site prior to discharge by verifying the filling height of the container or by some other corresponding measurement in the vehicle. If such a measurement is not made, the real volume marked in the transport documents is considered the volume of the load.

Bulk density as received (D_{ar}) is obtained by dividing the weighed mass of the load with its volume.

The parties shall agree on the methods of weight and volume determinations.

4.6 Oversized lumps in milled fuel peat

The proportion of oversized lumps is determined by weighing the proportion of peat batch that does not pass the vibratory grate (non-arching) with 200 mm x 200 mm openings at the receiving station. The percentage of the mass of the peat batch concerned is given as the result.

If the coarse screen of the receiving station is not compatible with the vibratory grate with 200 mm x 200 mm openings (non-arching) recommended in this manual, the determination should be carried out with a sieving device the properties of which are closest to those of the recommended grate.

If there is no coarse screen (grate or corresponding pre-sieving equipment) available at the receiving station, the sum of large lumps and coarse material is determined by weighing the material retained on a fine (disc, etc.) sieve. The result is given as percentage of the mass of the peat batch concerned.

The size of a single large lump is ascertained by measuring the maximum dimension of the lump and by determining its volume.

4.7 Coarse fraction in milled fuel peat

The proportion of coarse fraction is determined primarily for a sample collected separately for this purpose or alternatively by weighing the material retained on the fine (disc etc.) sieve of the receiving station.

If the proportion of coarse material is determined for a sample collected separately, the sample should be collected from the peat stream passed the coarse screen. If this is not possible (e.g., there is no coarse screen available), the particles that would not pass the vibratory grate with 200 mm x 200 mm openings are removed from the sample. The sample should not be melted prior to sieving. The sample is sieved using a 40 x 40 mm mesh screen. The result is given as percentage of the material retained on the screen of the mass of the peat batch concerned.

4.8 Oversized lumps in sod peat

The proportion of oversized lumps is determined by taking a sufficient amount of separate samples that represent the average of the load. Large bodies are then separated from these samples. The size and exact number of samples as well as the sampling method should be agreed case by case.

The size of a single oversized lump is verified by measuring the maximum dimension of the lump.

The amount of oversized lumps verified by weighing the large lumps separated and by giving their percentage of the mass of the sample.

4.9 Sod size of sod peat

The diameter and length of single sods chosen at random from the load are measured.

4.10 Proportion of fines in sod peat

The proportion of fines is determined for a separate sample of at least 200 litres (see 3.8) that represents the average of the load. The sample is melted if it contains frozen peat lumps. The sample is sieved with a 20 x 20 mm mesh sieve and the proportion passing the sieve is weighed. The percentage of the material passed the sieve of the mass of the sample is given as the result.

4.11 Chemical analyses

The chemical analyses can be carried out either with different analysers or with the following methods:

Sulphur	ISO 334, DIN 51724, ASTM D 4239
Carbon and hydrogen	ISO 609 or ISO 625, DIN 51721
Nitrogen	ISO 332 or ISO 333, DIN 51722
Phosphorus	ISO 622, DIN 51725

Chlorine	ISO 587, DIN 51727
Volatile matter	ISO 562, DIN 51720
Heavy metals	not decided

The parties should agree on chemical analyses separately case by case.

5 DEFINITION OF THE QUALITY OF FUEL PEAT

5.1 General

The quality of fuel peat may be determined (i.e., by giving limit values for different characteristics)

a) by giving the quality class chosen from Appendix 1 (milled fuel peat) or Appendix 3 (sod peat)

b) by referring to Appendix 2 (milled fuel peat) and giving the limit values chosen on the basis of Appendix 2, at least for moisture content, net calorific value and energy density as received and for ash content.

It is recommended to define the quality limits case by case as regards mechanical properties of fuel peat (i.a., large bodies, coarse fraction, particle size), if the method of determining these properties differs from that required in this manual (Appendices 1, 2 and 3).

In case a) the quality class of a milled peat batch is considered to be the class that simultaneously meets the requirements presented in chapters 5.2, 5.3 and 5.4. The quality class of a sod peat batch is considered to be the class that simultaneously meets the requirements presented in chapters 5.2 and 5.3 or 5.2 and 5.4.

5.2 Moisture content as received (M_{ar}, wt%

The limits for the average moisture content of the delivery batch are defined. **The lower limit cannot be < 40 wt% for milled fuel peat and < 30 wt% for sod peat unless the receiving plant has been designed for the safe processing of peat below these limits.**

When the delivery batch consists of more than one load, the average moisture content of the single load of milled fuel peat can range within the following limits: J6 38.0 - 65.0 wt%, J8 38.0 - 63.0 wt%, J10 38.0 - 60.0 wt%.

5.3 Net calorific value as received ($Q_{net,ar}$, MJ/kg)

The minimum calculatory average of calorific value of the delivery batch is defined according to chapter 4.3.4 (formula (5)) using the moisture value determined for the delivery batch as in chapter 5.2 and the calorific value $Q_{net,d}$. determined for an analytical sample collected during an agreed period of no more than a month (chapters 3.6.4 and 3.6.5),

5.4 Energy density as received (E_{ar}, MWh/m^3)

The minimum value of calculatory energy density is determined for the delivery batch. The calculation is carried out according to chapter 4.3.5 (formula (6)) using the calorific value according to chapter 5.3.

5.5 Net calorific value, dry basis ($Qn_{et,d}$, MJ/kg)

The minimum value given concerns the calorific value determined for an analysis sample collected during an agreed period of no more than a month (chapters 4.3.1 - 4.3.3).

5.6 Bulk density (D_{ar}, kg/m^3)

The limits given concern the bulk density of a single load (chapter 4.5).

5.7 Ash content (A_d, %)

The lower limit value given in Appendix 1 concerns the ash content determined for an analysis sample collected during a period of no longer than a month (chapters 3.6.4 and 3.6.5) and the higher limit value the ash content determined for a sample collected from a single delivery batch or a sample collected during a period of no more than a month from one delivery site.

When applying Appendix 2 each of the above-mentioned limit values can be chosen separately from the alternatives given in the appendix.

5.8 Ash fusion behaviour

This value is given in advance, if the deliverer-specific value of hemispherical temperature is lower than +1 120 °C on a monthly level.

5.9 Sulphur content

This value is given in advance, if the deliverer-specific value of sulphur content exceeds 0.30 wt%, dry basis, on a monthly level.

5.10 Oversized lumps in milled fuel peat

The limit value for the proportion of oversized lumps and for the dimension and volume limits of the largest lump concern a load.

If the coarse sieve of the receiving station is not a non-arching vibratory grate with 200 mm x 200 mm openings according to this manual, the limit value of large lumps (together with the determination method, see chapter 4.6) is defined case by case in such a way that it corresponds to the values given in Appendices 1 and 2 considering the properties of the sieving equipment.

If there is no coarse sieve available at the receiving stations, the limit value is defined for the sum of the proportions of large lumps and coarse material case by case in such a way that it corresponds to the sum of the limit values given in Appendices 1 and 2.

5.11 Coarse fraction of milled fuel peat

The limit value given concerns the delivery batch.

The coarse fraction shall not contain lumps of the maximum length of >1 000 mm, although these lumps passed the grate with 200 mm x 200 mm openings.

If the fraction of coarse material is controlled, instead of separate sampling and sieve analysis, by measuring the fraction retained on the fine-mesh sieve at the receiving station, the limit value is defined for this proportion case by case (together with the determination method, see chapter 4.7), which corresponds to the limit value based on sieve analysis given in Appendices 1 and 2.

5.12 Oversized lumps in sod peat

The maximum dimension and proportion of the largest lump given on row 8 of Appendix 3 concern a load.

Sod peat shall not contain oversized lumps more than the percentage given on row 8 of Appendix 3.

The maximum dimension limits for the largest allowable size of lumps are also given in this line.

5.13 Sod size of sod peat

The average dimensions given for the diameter and length concern single sods chosen at random from a load (chapter 4.9).

5.14 Proportion of fines in sod peat

The maximum value in per cents by weight concerns a load (chapter 4.10).

5.15 Impurities

Appropriate methods should be used and care taken in the production, storage and deliveries of fuel peat to avoid impurities, snow, ice and frozen peat among the fuel peat delivery batch.

As regards sod peat, particular attention should be paid to impurities.

5.16 Smouldering or burning peat

Smouldering or burning peat should not be delivered.

5.17 Homogeneity of quality

Considering technical and economical limitations the peat delivered should be as homogeneous in quality as possible. Particular attention should be paid to the homogeneity of moisture content.

As regards sod peat, the deliverer should aim at keeping the average moisture content of successive loads within the following limits: maximum range of variation 10 weight percentage units in class P9, 9 wt% units in P11, 7 wt% units in P13 and 6 wt% units in P15.

QUALITY CLASSIFICATION FOR FUEL PEAT

Table 1. QUALITY CLASSES FOR MILLED FUEL PEAT
LIMIT VALUES OF CHARACTERISTICS
Approved for use in the Quality classification for fuel peat 1989

	Characteristics	Focus of limit value	Limit values					Verific method
			Unit	Accu-racy	Quality class J6	J8	J10	- scope freque
1.	Moisture as received	Delivery batch						
		-minimum	wt%	0.1	40.0	40.0	40.0	A, 1 da
		-maximum	wt%	0.1	60.0	56.0	50.0	A, 1 da
		Single load						
		- minimum	wt%	0.1	38.0	38.0	38.0	C
		- maximum	wt%	0.1	65.0	63.0	60.0	
2.	Net calorific value as received	Delivery batch, minimum	MJ/kg	0.1	6.0	8.0	10.0	A, 1 da
3.	Energy density as received	Delivery batch, minimum	MWh/m^3	0.01	0.50	0.70	0.80	A, 1 da
4.	Net calorific value for dry matter	Monthly batch, minimum	MJ/kg	0.01	18.00	18.00	19.00	B, 1 da
5.	Ash content for dry matter	Monthly batch, maximum	wt%	0.1	10.0	10.0	10.0	B, 1/mo
		Delivery batch and monthly batch from one delivery site, maximum	wt%	0.1	15.0	15.0	15.0	C
6.	Ash fusion behaviour	Monthly batch, hemispherical temperature, minimum	°C	10	+1120	+1120	+1120	C
7.	Sulphur content for dry matter	Monthly batch, maximum	wt%	0.01	0.30	0.30	0.30	B, 1/m
8.	Oversized lumps	Load, fraction remaining on a vibratory grate of 200 x 200 mm	wt%	0.2	1.0	1.0	0.5	C
		mesh size, maximum	m	0.1	1.0	1.0	1.0	C
		Maximum allowable dimension and volume of a single lump	m^3		0.2	0.2	0.2	C
9.	Coarse fraction	Delivery batch, passing a vibratory grate of 200 x 200 mm mesh size, while the fraction remaining on a screen of 40 x 40 mm mesh size no more than	wt%	1	6	6	6	C
10.	Bulk density		kg/m^3	10	200	220	240	
			kg/m^3	10	450	450	450	

Limit values The value of characteristic is considered to be in conformity with the given value, if it does not differ from the limit value by more than a half of the accuracy given to an unfavourable direction.

Scope
A. Regular determination of a characteristic, covering the whole peat quantity for the assessment of the commercial value of peat
B. Regular determination of a characteristic, covering the whole peat quantity, not directly associated with the commercial value of peat
C. The characteristic is determined at random or when necessary.

Frequency The given frequency is the minimum frequency for the determination of the characteristic.

DEFINITION OF LIMIT VALUES FOR MILLED PEAT CHARACTERISTICS WITH THE AID OF QUALITY CLASSIFICATION

Approved for use in the quality assurance manual for fuel peat 1989

The quality class desired (J6, J8 or J10) is chosen from Table 1. The following characteristics are now definined:

1. the minimum and maximum limits for the moisture content as received for a delivery batch and a single load

2. the minimum value of net calorific value for peat as received in a delivery batch

3. the minimum value of energy density for peat as received in a delivery batch

4. the minimum value of net calorific value for dry matter in a monthly batch

5. maximum values of ash content for dry matter in monthly and delivery batches

6. the minimum hemispherical temperature of ash for a monthly batch

7. the maximum value of sulphur content for dry matter in a monthly batch

8. the maximum amount of oversized lumps in a load and the maximum allowable dimension and volume of a single lump

9. the maximum value of the fraction of coarse material in a delivery batch

10. the minimum and maximum values of bulk density for a load.

QUALITY CLASSIFICATION FOR FUEL PEAT

Table 2. OPTIONAL LIMIT VALUES OF CHARACTERISTICS FOR MILLED FUEL PEAT

Approved for use in the Quality classification for fuel peat 1989

	Characteristics	Focus of limit value	Limit values			Verific method
			Unit	Accu-racy	Alternatives	- scope freque
1.	Moisture as received	Delivery batch				
		-minimum	wt%	0.1	To be chosen from the	A, 1 da
		-maximum	wt%	0.1	quality option scheme	A, 1 da
		Single load			To be proportioned to	
		- minimum	wt%	0.1	the limit values chosen	C
		- maximum	wt%	0.1	for the delivery batch	
2.	Net calorific value as received	Delivery batch, minimum	MJ/kg	0.1	Is chosen from the quality option scheme	A, 1 da
3.	Energy density as received	Delivery batch, minimum	MWh/m^3	0.01	Is chosen from the quality option scheme	A, 1 da
4.	Net calorific value for dry matter	Monthly batch, minimum	MJ/kg	0.01	18.00 unless otherwise agreed in advance	B, 1 da
5.	Ash content for dry matter	Monthly batch, maximum	wt%	0.1	6.0 8.0 10.0 12.0 16.0 20.0	B, 1/mo
		Delivery batch and monthly batch from one delivery site, maximum	wt%	0.1	6.0 8.0 10.0 12.0 16.0 20.0	C
6.	Ash fusion behaviour	Monthly batch, hemispherical temperature, minimum	°C	10	+1120 unless otherwise agreed in advance	C
7.	Sulphur content for dry matter	Monthly batch, maximum	wt%	0.01	0.30 unless otherwise agreed in advance	B, 1/m
8.	Oversized lumps	Load, fraction remaining on a vibratory grate of 200 x 200 mm mesh size, maximum	wt%	0.2	1.0 unless otherwise agreed in advance	C
		Maximum allowable dimension	m	0.1	1.0 0 unless otherwise agreed in advance	C
		and volume of a single lump	m^3		0.2 0 unless otherwise agreed in advance	C
9.	Coarse fraction	Delivery batch, passing a vibratory of 200 x 200 mm mesh size, while the fraction remaining on a screen of 40 x 40 mm mesh size no more than	wt%	1	6 0 unless otherwise agreed in advance	C
10.	Bulk density		kg/m^3	10	200 unless otherwise	
			kg/m^3	10	450 agreed in advance	

Limit values The value of characteristic is considered to be in conformity with the given value, if it does not differ from the limit value by more than a half of the accuracy given to an unfavourable direction.

Scope
A. Regular determination of a characteristic, covering the whole peat quantity for the assessment of the commercial value of peat
B. Regular determination of a characteristic, covering the whole peat quantity, not directly associated with the commercial value of peat
C. The characteristic is determined at random or when necessary.

Frequency The given frequency is the minimum frequency for the determination of the characteristic.

DEFINITION OF OPTIONAL LIMIT VALUES FOR THE CHARACTERISTICS OF MILLED FUEL PEAT

Approved for use in the quality assurance manual for fuel peat 1989

The limit values of characteristics are defined according to Table 2, also applying the quality option scheme for characteristics 1 - 3.

This alternative may be used for defining the quality of milled fuel peat when limit values deviating from the quality classes J6, J8 or J10 are required for peat. Depending on the case, the limit values chosen from the quality option scheme may be more stringent or looser than the corresponding values when choosing a quality class (J6, J8 or J10).

The purpose of this alternative is to leave more room to choose maximum and/or minimum values for the characteristics of milled fuel peat than when applying quality classes J6, J8 or J10. For example, the quality option scheme enables the application of the maximum allowable moisture content of 41.0 - 60.0 wt%.

Directions for use of the quality option scheme

The minimum/maximum values of characteristics of milled fuel peat defined on the basis of the quality option scheme focus primarily as those of the quality classes (Table 2).

The first characteristic chosen from the quality option scheme is MAXIMUM ALLOWABLE MOISTURE CONTENT OF PEAT AS RECEIVED (e.g. 56.0 wt%) and MINIMUM ALLOWABLE MOISTURE CONTENT OF PEAT AS RECEIVED (e.g. 40.0 wt%, which is the minimum possible limit).

The next characteristic chosen is MINIMUM OF NET CALORIFIC VALUE AS RECEIVED MJ/kg. This value is chosen from the upper grid of the scheme by moving from the maximum allowable moisture content of the delivery batch chosen towards the right until the darkened (allowable) area. The possible minimum values of net calorific value are read from the MJ/kg scale (horizontal axle above). (For example, the maximum moisture content chosen above was 56.0 wt%. Accordingly, possible minimum net calorific values would be 7.0 - 8.5 MJ/kg. In this example, 7.0 MJ/kg is chosen for the minimum net calorific value.)

Then MINIMUM VALUE OF ENERGY DENSITY AS RECEIVED MWh/m^3 is chosen from the lower grid of the scheme. Possible alternatives are seen on the MWh/m^3 scale at the squares of the column corresponding the chosen MJ/kg value. (In the example case, the minimum value of 7.0 MJ/kg was chosen for the net calorific value. The corresponding column gives the possible values of energy density, i.e. 0.50 - 0.80 MWh/m^3. In this particular example, 0.70 MWh/m^3 is chosen for the minimum value.

MAXIMUM VALUES OF ASH CONTENT are chosen from the alternatives given in Table 2. The maximum value of ash content can be defined separately for a delivery batch and for a larger batch (e.g., a monthly one). Possible alternatives are 6.0 wt%, 8.0 wt%, 10.0 wt%, 12.0 wt%, 15.0 wt%, and 20.0 wt%. (In the example case 10.0 wt% is chosen for the maximum value of ash content.)

QUALITY CLASSIFICATION MANUAL FOR FUEL PEAT

Table 3. LIMIT VALUES OF CHARACTERISTICS FOR SOD PEAT

	Characteristics	Focus of limit value	Limit values						Verifi metho
			Unit	Accu-racy	Quality class P9	P11	P13	P15 *	- scop freq
1.	Moisture as received	Delivery batch -minimum	wt%	0.1	35.0	30.0	27.0 **	20.0 **	A, 1
		-maximum	wt%	0.1	53.0	47.0	40.0	33.0	A, 1
2.	Net calorific value as received ***	Delivery batch, minimum	MJ/kg	0.1	9.0	11.0	13.0	15.0	A, 1
3.	Energy density as received ***	Delivery batch, minimum	MWh/m^3	0.01	1.00	1.15	1.30	1.5	A, 1
4.	Net calorific value for dry matter	Monthly batch, minimum	MJ/kg	0.01	18.00	19.00	19.00	20.00	B, 1/
5.	Ash content for dry matter	Monthly batch, maximum	wt%	0.1	10.0	15.01 12.00	8.0	6.0	B, 1/
		Delivery batch and monthly batch from one delivery site, maximum	wt%	0.1	15.0	8.0.0			C
6.	Ash fusion behaviour	Monthly batch, hemispherical temperature, minimum	°C	10	+1120 unless otherwise agreed in advance				C
7.	Sulphur content for dry matter	Monthly batch, maximum	wt%	0.01	0.30 unless otherwise agreed in advance				B, 1/
8.	Oversized lumps	Load, maximum dimension	m	0.2	300	300	300	200	C
		maximum proportion	wt%	0.1	1.0 unless otherwise agreed in advance	1.0	1.0	1.0	
9.	Sod size	Average dimensions							C
		- diameter	mm	10	20 - 80 unless otherwise				
		- length	mm	10	80 - 200 agreed in advance				
10.	Proportion of fines	Load, maximum proportion of fines passing a 20 - 20 mm mesh screen	wt%	1	20	15	5**** or 10	5****	C
					unless otherwise agreed in advance				
11.	Bulk density	Load							
		- minimum	kg/m^3	10	280	280	300	300	C
		- maximum	kg/m^3	10	550	550	520	500	

REMARKS * Small use class, for which the way of verification (scope and frequency) are agreed case by case

** Special limit for chapter 5.2

*** Agreed in delivery contract, either MJ/kg or MWh/m^3, not both simultaneously

Additional remark: Consequently, MJ/kg and MWh/m^3 values have not been synchronised with each other
**** Screened when loading

Limit values The value of characteristic is considered to be in conformity with the given value, if it does not differ from the limit value by more than a half of the accuracy given to an unfavourable direction.

Scope
A. Regular determination of a characteristic, covering the whole peat quantity for the assessment of the commercial value of peat
B. Regular determination of a characteristic, covering the whole peat quantity, not directly associated with the commercial value of peat
C. The characteristic is determined at random or when necessary.

Frequency The given frequency is the minimum frequency for the determination of the characteristic

SYMBOLS AND ABBREVIATIONS

The symbols and abbreviations are mainly in accordance with

- INTERNATIONAL STANDARD (ISO) SOLID MINERAL FUELS
- SI Unit of Measure System

M_{ar} total moisture content as received, ISO 589 - 1981
M = moisture
$_{ar}$ = as received

M_{ad} moisture content of analysis sample, ISO 331 - 1983
$_{ad}$ = analysis dry

Q_{gr} gross calorific value (higher heating value), ISO 1928 - 1976
Q = symbol of heat energy in thermodynamics
Qgr = gross calorific value
$Q_{gr,d}$ = gross calorific value for dry matter (dry sample), $_d$ = dry
$Q_{gr,ad}$ = gross calorific value for analysis-dry (air-dry) sample, ad = analysis dry

Q_{net} net calorific value, (lower heating value), ISO 1928 - 1976
Q_{net} = net calorific value
$Q_{net,d}$ = net calorific value for dry matter, $_d$ = dry
$Q_{net,ar}$ = net calorific value as received, $_{ar}$ = as received

E_{ar} Energy density as received (energy units/volume unit)

W Energy quantity delivered
W = energy symbol as in the SI system

A_d Ash content for dry matter, ISO 1171 - 1981

A = ash
$_{d}$ = dry

D_{ar} Bulk density as received (volume weight)
D = density
$_{ar}$ = as received