SolidStandards

Enhancing the implementation of quality and sustainability standards and certification schemes for solid biofuels (EIE/11/218)

D2.1g:

Straw module

Co-funded by the Intelligent Energy Europe Programme of the European Union

The SolidStandards project

The SolidStandards project addresses ongoing and recent developments related to solid biofuel quality and sustainability issues, in particular the development of related standards and certification systems. In the SolidStandards project, solid biofuel industry players will be informed and trained in the field of standards and certification and their feedback will be collected and provided to the related standardization committees and policy makers.

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About this document

This document is part of **Deliverable 2.1** of the SolidStandards project. It is the training guidebook for the straw module and provides background information to the corresponding presentation slides. This document was finalized in **July 2012 and updated in March 2013** by:

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Table of contents

1. Introduction

1.1. Normative references

This document serves as a guideline to facilitate the implementation of quality standards in the production and the transportation of straw bales according to EN 14961-1 and EN 15234-1. Greyed text is quoted directly from the standards. Still, for the application of this system the acquisition of in this document mentioned standards is indispensable. For further information please contact the national standardization institutes.

Update: Most European standards mentioned in this document will be superseded within the next years by EN ISO standards. A list, which shows the relationship between the numbers of now valid EN standards with future EN ISO standards, can be found in the Annex.

1.2. Straw supply chain

Straw is a residual product from harvesting of grain products like wheat, barley, rye and similar crops from agricultural land. A supply chain for large bales is described in the diagram and in pictures below.

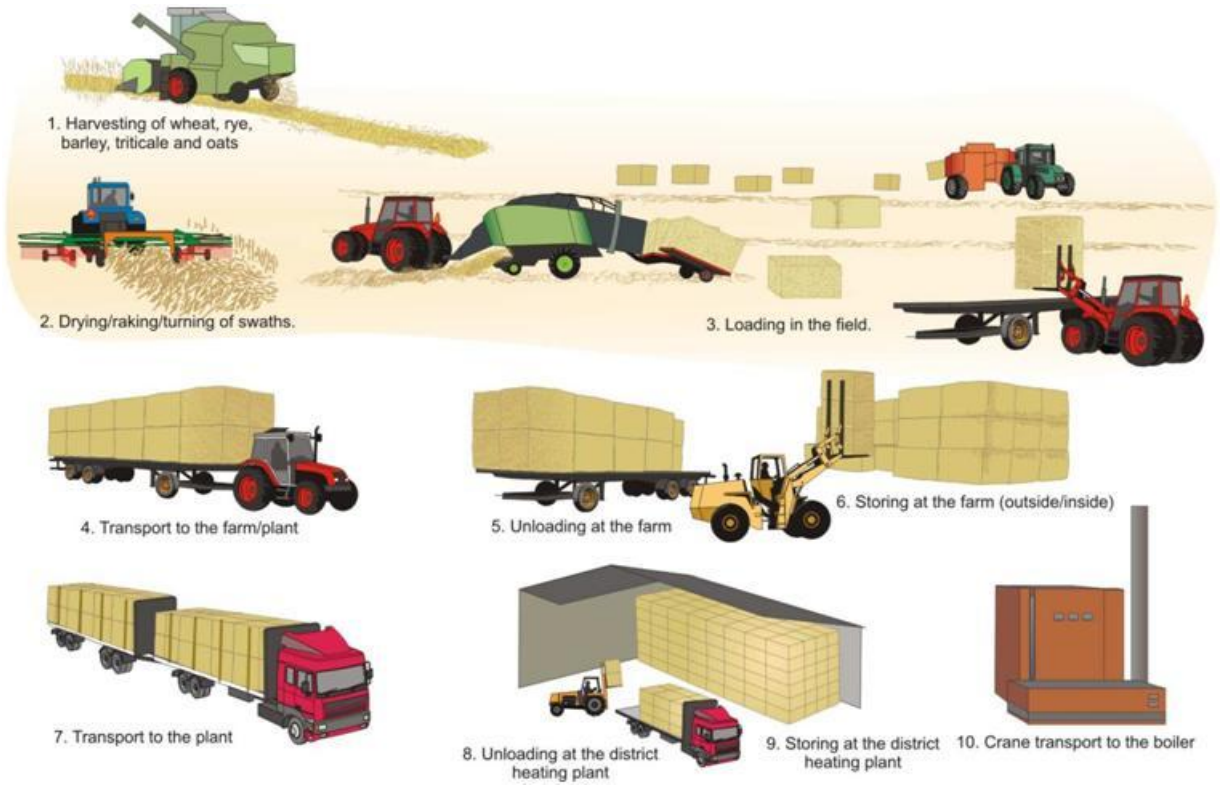


Figure 1: Diagram of straw supply chain (Source: Danish Technological Institute and VTT).

Figure 2: Cereal grain harvest - this harvester is equipped with a chaff cutter that has cut the straw to be ploughed back. The straw is normally left in the field behind the harvester (Source: BioPress/Torben Skøtt).

Figure 3: The straw lies in the field where it may be exposed to rain (weathering) which removes some of the water soluble alkali metals and chlorides and thus improves the combustion behaviour (Source: Biopix/N. Sloth).

Figure 4: The straw is collected and pressed into big bales that are temporarily left in the field to be collected later. One bale weighs approx. 500 kg (Source: Sønderjyllands Højspændingsværk).

Figure 5: The Big bales are collected and loaded onto lorries or trailers pulled by tractors (Source: Bygholm and Lars Nikolaisen).

Figure 6: The bales may be stored in an intermediate covered storage at a farm (barn) or in the field covered in plastic or in rare cases uncovered. It may also be transported directly to a local energy plant (Source: DONG Energy).

Figure 7: From the intermediate storage the bales are transported to an energy plant - the end user and unloaded in the storage. Usually, the bales are weighed and the moisture content is measured at this stage - either automatically (at large plants) or manually (Source: Sønderjyllands Højspændingsværk and BioPress/Torben Skøtt).

2. How to specify straw

2.1. Relevant standards

EN 14961-1:2010: Solid biofuels – Fuel specification and classes.
Part 1: General requirements

Following this standard, the general principle for specification is by origin and source, and by major traded form and properties.

Classification is flexible and hence the producer or the consumer may select from each property class. This classification does not bind different characteristics with each other. Some properties are normative (mandatory) some are informative (voluntary).

The 14961-series of European standards include supplementary parts (Part 2 though Part 6) for e.g. wood pellets, wood chips and other types of biomass fuels. These product standards specify properties, which are bound together to form a class, and these properties are normative. None of these product standards cover straw fuels handled in bales or loose form, thus for the majority of straw trade, producers and consumers have to use the general part 1 for the specification of the straw fuels.

An exception is straw pellets, which is covered by

EN 14961-6:2012 Solid biofuels - Fuel specifications and classes
Part 6: Non-woody pellets for non-industrial use

Straw is most often traded in bales; the following details refer to straw fuel delivered in bales, and specifications and classification refer to Part 1 of the EN 14961 series.

2.2. Definition (EN 14588)

Straw does not have its own terminology but falls under the term **herbaceous biomass**: biomass from plants that has a non-woody stem and which dies back at the end of the growing season.[1] Specifically, straw originates from **cereal crops**, i.e. annual crops grown with the main purpose to use the seed for food production.[2] This makes straw an **agricultural residue**, i.e. biomass residue originating from production, harvesting, and processing in farm areas.[3]

2.3. Specification

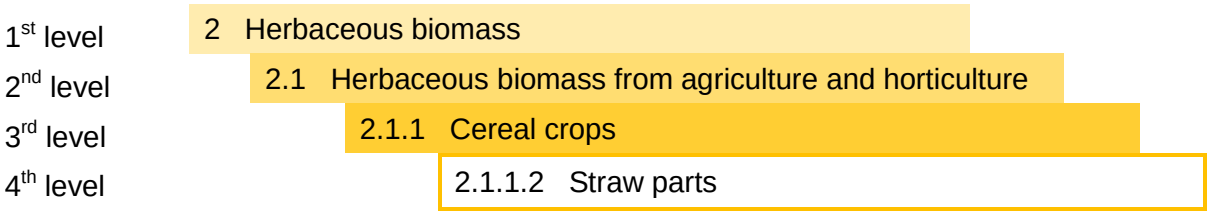
2.3.1. Origin and source (EN 14961-1, Table 1)

Structure of the classification system

Standard EN 14961-1 contains a system for the classification of origin and source of raw material for the production of solid biofuels. On the first level four biofuel types are defined: woody, herbaceous, and fruit biomass, furthermore mixtures and blends. On the second level the biofuel origin is specified, levels three and four give more detailed information. All in all 115 level-four-descriptions enable a detailed description of origin and source.

[1] EN 14588:2010, paragraph 4.92
[2] EN 14588:2010, paragraph 4.34
[3] EN 14588:2010, paragraph 4.2

Example of classification for straw material (for industrial use)



Technical properties may differ significantly from one species of cereal crops to another, which makes it highly appropriate to include the species in a specification of straw fuels (e. g. Straw from wheat, Straw from oats, Rice straw, Barley wholecrop, Grass, Cotton stalks, Whole plant harvested Miscanthus).

Using a specification according to Table 1 in EN 14961-1, automatically a lot of information is given. As an example, it is not necessary to state, that the product does not originate from industry, as reference to 2.1 in the second column in Table 1 rules out an industrial origin (group 2.2 being industrial origin).

Straw is not covered by the fuel classes for other solid biomass fuels in EN 14961 part 2 through Part 5. Thus straw fuels are not covered by a specific requirement to origin linked to a specific fuel class.

2.3.2. Traded form (EN 14961-1)

Straw traded for fuel purposes usually fall under one of the following traded forms - bales, pellets or chopped straw or energy grass. Other forms, which are rarely found in the market, are briquettes. Characteristics for these traded forms can be found in Table 2 in EN 14961-1:

The traded forms stated in Table 2 in EN 14961-1 are examples only. Other forms may occur, and typical sizes stated for bales are also examples only - a large variety of bale dimensions exist in the agricultural sector. Further specifications to bale size should be given according to property specification (see following section).

2.3.3. Specification of properties (EN 14961-1)

Property classes according to EN 14961-1

In Table 11 in EN 14961-1 straw in bales are defined by the following properties, divided into normative properties and informative properties.

Normative properties (mandatory, always to be specified)	
Dimensions for round bales (in m) - no method specified	
Classes: **see EN 14961-1, Table 11**	 **Figure 8: Round bales (Source: Böll, Hjarnø)**
Dimensions for square bales (in m) - no method specified	
Classes: **see EN 14961-1, Table 11**	 **Figure 9: Square bale (Source: Sønderjyllands Højspændingsværk)**
Bale density, BD (in kg/m^3) - no method specified	
Classes: **see EN 14961-1, Table 11**	 **Figure 10: Bales on weighbridge**

Moisture, M (in weight-% as received) - Analysis according to EN 14774-1 or 14774-2.

EN 14774-1 is the reference method while EN 14774-2 is a simplified method. Both methods are oven dry methods. In practice straw trade is often based on other measurement principles and performed in the reception facility at the combustion plant.

Classes: **see EN 14961-1, Table 11**

Figure 11: Drying oven according to method EN 14774-2 (Source: VTT)

Figure 12: Moisture monitoring at reception of straw at the plant (Source: Straw for Energy Production)

Ash, A (in weight-% of dry basis) - Analysis according to EN 14775

Classes: **see EN 14961-1, Table 11**

Figure 13: High temperature laboratory furnace according to method EN 14775 (Source: VTT)

Species of biomass

The plant species, from which the straw supply originates, has to be stated.

Figure 14: Wheat in field

Net calorific value, Q (in MJ/kg as received or kWh/m3 loose) - Analysis according to EN 14918

A minimum value for **Net calorific value** in MJ/kg as received or

A minimum value for **Energy density** in kWh/m^3 loose or MWh/m^3 loose has to be stated

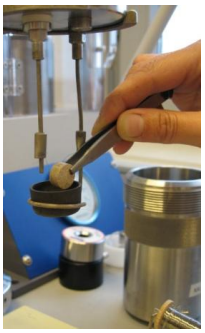


Figure 15: Analysis of calorific value (Source: FORCE Technology)

Informative properties (voluntary, but recommended to be stated)

Production method - no method specified

The 14961-1 standard recommends that a declaration is made on the production method, as it influences the size of straw particles in the bale. Examples for such a specification could be "chopped", or "harvested as a whole plant" or "threshed by rotation or oscillation" [4]

Figure 16: Baling

Binding type of bales - no method specified

The 14961-1 standard recommends that a specification is made on type and material used to hold bales. Examples: "net binding", "plastic strings". [5]

Chlorine, Cl (in weight-% on dry basis) - Analysis according to EN 15289

Classes: **see EN 14961-1, Table 11**

Figure 17: Analyzer for Cl according to method EN 15289 (Source: ENAS Oy)

Ash melting behaviour (ºC) - Analysis according to CEN/TS 15370-1

Ash melting behavior is an important property for combustion. If ash melts at low temperatures it can cause deposit formation, slagging and fouling and even shut down of boiler.

[4] EN 14961-1:2010, Table 11
[5] EN 14961-1:2010, Table 11

Fuel analysis and specification

When specifying a class within a property, the average numerical value from the whole lot (e.g. shipload, truckload, bag) shall determine which class is to be used. If the properties being specified are sufficiently known through information about the origin and handling, physical/chemical analyses may not be necessary.[6]

For the specification of the fuel one of the measures in the following order is recommended:

a) using typical values (e.g. laid down in annex B of EN 14961-1 or obtained by experience)

b) calculation of properties (e.g. by using typical values and considering documented specific values

c) carrying out of analysis (with simplified methods if available or with reference methods) [7]

The responsibility of the producer or supplier to provide correct and accurate information is exactly the same whether laboratory analysis is performed or not! [8]

2.3.4. Examples

Examples of straw fuel specifications according to EN 14961-1:

Example 1

Origin:	Wheat straw (2.1.1.2)
Traded form:	Big square bales
Properties:	Bale dimensions P3, Bale density BD120, Moisture M20, Ash A5.0, Species: wheat (Triticum spp.), Net calorific value Q minimum 13.3 MJ/kg at 20 % moisture

Example 2

Origin:	Rice straw (2.1.1.2)
Traded form:	Small square bales
Properties:	Bale dimensions P1, Bale density BD120, Moisture M15, Ash A10.0+ (maximum 15 %), Species: rice (Oryza spp.), Net calorific value Q minimum 12.9 MJ/kg at 15 % moisture

[6] EN 14961-1:2010, paragraph 7.2
[7] EN 14961-1:2010, paragraph 7.2
[8] EN 14961-1:2010, paragraph 7.2

3. How to guarantee a specific quality of straw

3.1. Relevant standards

EN 15234-1:2011 Solid biofuels – Fuel quality assurance.
Part 1: General requirements

3.2. How to implement EN 15234-1

3.2.1. General

Once the quality requirements for a specific solid biofuel have been specified, the next step is to give attention to how to obtain these quality requirements and how to create confidence that the requirements are fulfilled over time.

According to EN 15234-1 quality assurance and control aims at providing confidence that a stable quality (not necessarily a high quality) is continually achieved in accordance with the customer requirements.[9]

Quality control = controlling the quality of a product or process [10]

- on the basis of company requirements, standards, agreements, ...
- with the aim to enable the delivery of the product within agreed parameters in the most efficient and cost effective way
- by means of analyses, calculations, checklists, etc.

Quality assurance = reviewing the products and processes[11]

- on the basis of data provided from the quality control records
- using this data to provide confidence that products are produced within the required specification and processes are operated as they should be, and to assure that over a longer term either consistency is being maintained or that quality improvements are making the intended impact
- by means of exception reporting and handling of non-conforming materials

Procedure for the implementation of quality assurance measures

In addition to the transparent provision of information about origin and source as well as about solid biofuel properties, the implementation of appropriate measures to secure the customers confidence that the specifications are being realised is one of the core parts of the standard. Every step in the process chain has to be analysed on factors that may have an influence on the quality of products and processes.

[9] EN 15234-1: 2011, paragraph 6.1
[10] EN 15234-1: 2011, paragraph 6.2
[11] EN 15234-1: 2011, paragraph 6.2

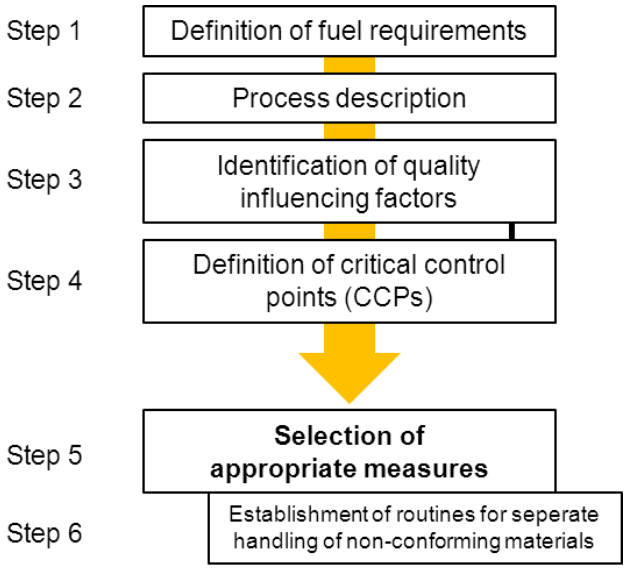


Figure 18: Procedure for the selection of appropriate quality assurance measures

As part of the implementation of this quality management system all measures taken to assure the fuel quality have to be documented and kept up-to-date. The documentation shall include at least:

- Allocation of responsibilities
- Training of the staff (concerning the required quality demands)
- Quality control in the production process
  - Raw material reception (e.g. documentation on the delivery note or the invoice)
  - Results of straw analyses (if necessary)
  - Outgoing straw (e.g. delivery agreement with the customer or documentation on the delivery note)
- Handling of non-conforming straw bales
- Complaint management system

Depending on the position of a market actor in the straw supply chain, there are different responsibilities for implementing fuel quality assurance.

The raw material supplier i.e. the straw producer is the first operator in the supply chain for solid biofuels and is responsible for preparing the documents of 'origin and source' of the raw material the first time. The documents shall be available and provided on justified request throughout the entire supply chain [12] and thus guarantee the traceability of the straw.

The straw trader has to check whether the properties of the received straw are in compliance with the product declaration given by the straw producer. The straw trader has to follow 6 consecutive steps to guarantee quality assurance and quality control throughout the whole supply chain. In the straw supply chain the producer and trader will often be the same legal entity.

The straw consumer has to check whether the properties of the received straw are in compliance with the product declaration given by the straw producer/trader.

[12] EN 15234-1:2011, paragraph 6.3

3.2.2. Implementation process

In the following the fuel quality implementation processes for the straw producer/trader are described on the basis of an example.

The example described in the following represents straw for non-industrial use according to EN 14961-1 and EN 15234-1 and is in some parts following the recommendations of EN 15234-4 (Quality assurance for wood chips) as the supply chain is similar.

Raw material supplier/straw producer

Start	Biomass first time traded as solid biofuel
Process	Classification of origin according to Table 1 in EN 14961-1:2010
Result	Declaration according to 15234-1:2011

Raw material - example 1

Start	 **Figure 19: Straw bales in field after harvest of grain.**
Process	Derivation of the source in Table 1 in EN 14961-1:2010 2 Herbaceous biomass 2.1 Herbaceous biomass from agriculture and horticulture 2.1.1 Cereal crops **2.1.1.2** Straw parts
Result	Please see next page

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Product declaration based on EN 14961-1:2010	
Supplier	Halm 80 ApS
Amount of delivery	2000 tons/month
Origin	Wheat straw 2.1.1.2
Chemically treated material	Yes No **x**
Country	Denmark, Eastern Fünen
Traded form	Straw bales
Determination of properties	
Dimensions (m)	L_1: 1.25-1.35 m L_2: 1.20-1.30 m L_3: 2.25-2.55 m
	M25
Moisture (w-%)	A5
Ash (w-%) dry	BD220
Bale density (kg/m^3)	Q13.0
Net calorific value as received (MJ/kg)	

To be stated e.g. on the invoice, delivery note, receiving slip, etc.

Raw material - example 2

Start

Figure 20: Whole plant energy crops being harvested and raked in field.

Process

Derivation of the source in Table 1 in EN 14961-1:2010

2 Herbaceous biomass

2.1 Herbaceous biomass from agriculture and horticulture

2.1.1 Cereal crops

2.1.1.1 Whole plant

Result

mandatory documentation !

Product declaration based on EN 14961-1:2010	
Supplier	Finns Helsæd I/S
Amount of delivery	1000 tons/month
Origin	Whole wheat 2.1.1.1
Chemically treated material	Yes No **x**
Country	Denmark, Southern Jutland
Traded form	Bales
Determination of properties	
Dimensions (m)	L_1: 1.25-1.35 m L_2: 1.20-1.30 m L_3: 2.25-2.55 m
Moisture (w-%)	M20
Ash (w-%) dry	A5
Bale density (kg/m^3)	BD220+ (240)
Net calorific value as received (MJ/kg)	Q14.0

To be stated e.g. on the invoice, delivery note, receiving slip, etc.

Straw trader

Start	Raw material specified by a 'declaration of origin and source'
Process	
Step 1	Define fuel requirements for the final product
Step 2	Document the steps in the process chain (process description)
Step 3	Identify factors influencing the fuel quality and company performance
Step 4	Identify and document Critical Control Points (CCP)
Step 5	Select appropriate measures to ensure the quality of the product (at CCP)
Step 6	Establish and document routines for separate handling of nonconforming materials and solid biofuels
Result	Product declaration according to EN 15234-1:2011

Straw trader - example

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Start	*The straw trader has to check whether the properties of the received straw is in compliance with the declaration of 'origin and source' given by the raw material supplier. If there does not exist a 'declaration of origin and source' the trader is responsible for preparing this declaration for the first time.* A straw producer contacts a straw trader to inform him that two loads of straw are available at one site ready to be collected. The trader gets the oral information that the two types are wheat straw from Fünen and wheat whole plant from Jutland. The written declaration of origin and source is usually included on the delivery note or the invoice after the transaction only.
Step 1	**Fuel requirements** *The fuel quality is described by the specification of the fuel in accordance with EN 14961-1 and should be the result of an agreement between the producer and his customer (or according to anticipated market demands).*[13] *Usually the fuel quality requirements are written in sales contracts. The straw trader shall determine key properties of the straw in accordance with the end-user needs.* A straw trader has a delivery contract with a CHP plant, that will only use straw baled in big bales, with a moisture content below 24% and an ash content of below 5%. The trader defines 'dimensions', 'moisture' and 'ash' as key properties, which need to be checked during the production process. The specification 'Straw bales P2-M24-A5.0' defines the maximum values of the required properties.

[13] EN 15234-1:2011, paragraph 6.4 a)

Step 2

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Process description

To document the steps in the process chain the straw trader can elaborate a flow diagram, in which she defines - based on the influencing factors (step 3) - Critical Control Points CCP (step 4).

Step 2, 3 and 4 should be part of a 'company-manual', which has to be elaborated independently of a specific commission for the usual processes of the company. A flow chart for straw production and transport including CCP's:

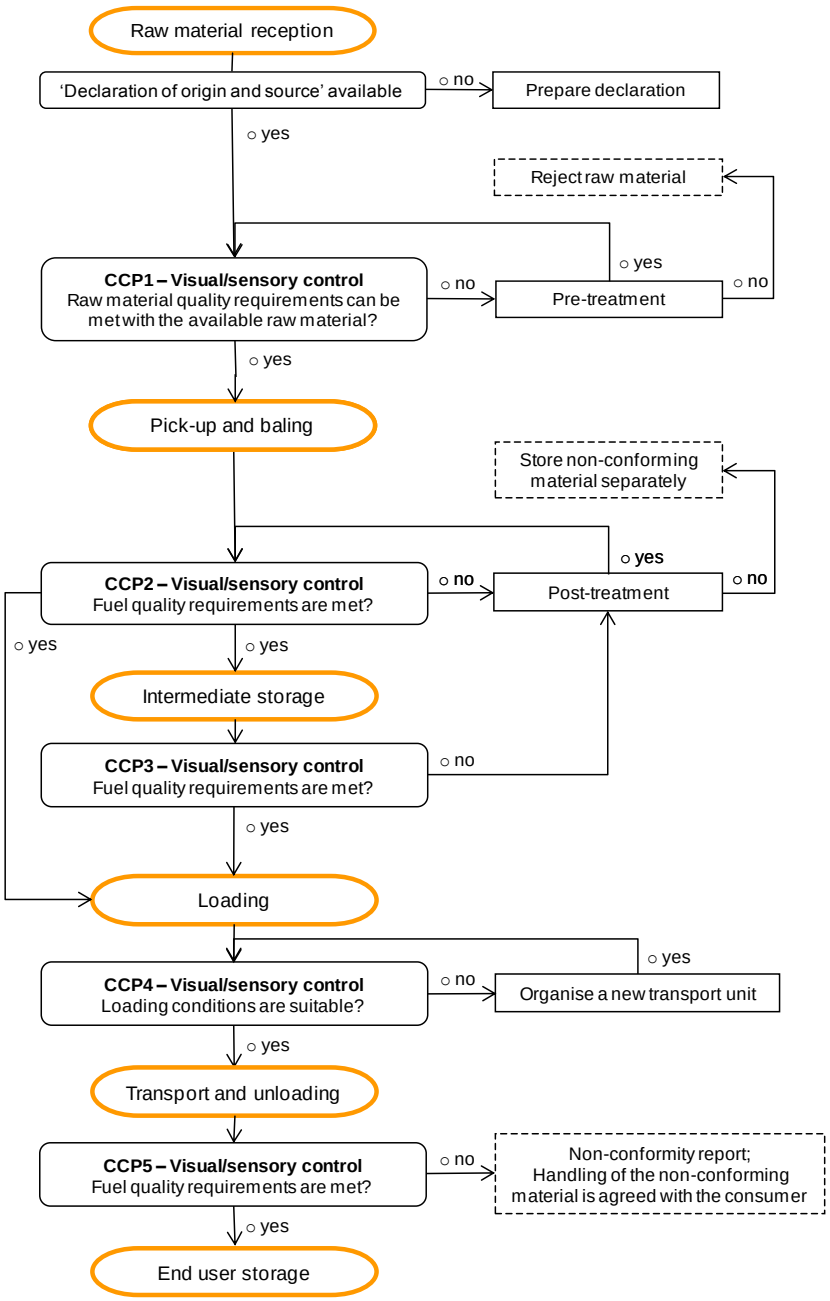

Figure 21: Process chain (step 2) and Critical Control Points CCP (step 4)

Step 3

Identification of quality influencing factors

All activities referring to both technical processes and management issues should be examined. The following factors determine the quality of the straw and its performance.

- *The effectiveness of preliminary inspection of the raw material*
- *How the material is harvested, stored and processed*
- *The knowledge, competence and qualification of the staff* [14]

Influencing factors	Influenced fuel property
Raw material • Crop species • Part of plant • Weathering	• Ash content • Ash composition • Calorific value • Moisture content • Content of chloride and potassium
Production - collection and baling • Equipment	• Dimensions
Intermediate storage • Coverage	• Moisture content • Calorific value
Transport • Equipment - coverage	• Moisture content • Calorific value
Possible contamination with other products/fuels	• All
Knowledge, competence and qualification of the staff	• All

Step 4

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Definition of critical control points

Critical Control Points are points within or between processes at which properties can be most readily assessed and that offer the greatest potential for quality improvement.[15]

Example: Please see Figure 21 in step 2.

Step 5

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Selection of appropriate quality assurance measures

Appropriate measures to give confidence to the customer, that the specifications are being realized, include - besides product control - the following management issues:

- *Allocation of responsibilities*
- *Training of staff*
- *Work instructions*
- *Establishment of quality control measures*
- *Proper documentation of processes and test results*
- *System of procedures for complaints* [16]

[14] EN 15234-1:2011, paragraph 6.4 c)
[15] EN 15234-1:2011, paragraph 6.4 d)
[16] EN 15234-1:2011, paragraph 6.4 e)

Example:
In the 'company-manual' it is defined that the manager of the trading company is quality manager at the same time and is responsible for the training of the staff and the allocation of responsibilities. Work instructions exist for each Critical Control Point (CCP). Based on the flow diagram of the production process a checklist was elaborated to assure that quality issues are taken into consideration and documented at all times.

Step 5 - **CCP1/CCP2 (straw production and baling)**

Before collecting the straw and pressing it to bales, the producer (who is in many cases the same as the raw material provider) must check the conditions of the raw material with special focus on moisture and colour.

- *Visual and other sensory inspection of the raw material*[17] *in the field in combination with experience on the recent weather conditions before and after harvest*

Example:

A producer arrives at a field with newly harvested wheat straw. The cut straw seems yellow and fresh and the soil is damp. After two weeks of heavy rain falls but with a new weather forecast predicting 5 days of dry weather with westerly winds the producer delays baling the straw in this field for a week.

Step 5 – **CCP3 (storage)**

Stored straw should be covered or otherwise protected from precipitation.[18]

Example:

A straw producer has pressed this years harvest straw into bales. As his contract with the heating plant defines regular delivery depending on the heat demand over the coming heating season he transports the main part into his storage hall and piles the remainder up outside in a field, covering the top with PEHD film and secures it from moving.

Step 5 – **CCP4/CCP5 (loading/unloading)**

At loading degradation of the fuel must be avoided. It must be secured that the fuel is not contaminated or mixed with e.g. plastics from the cover or gravel/stones from the surface.

Storage and transport equipment must be checked regularly (suitability and cleanliness).

Stored/delivered straw bales should be covered or otherwise protected from precipitation. [19]

[17] EN 15234-4:2012, paragraph 5.6.1
[18] EN 15234-4:2012, paragraph 5.6.2
[19] EN 15234-4:2012, paragraph 5.6.2

Step 6

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- *If a batch of straw is not fulfilling the requirements (due to e.g. excessive contents of moisture), these batches have to be handled separately from conforming ones.*
- *New measurement processes could be applied to achieve compliance with the required fuel properties.*
- *All necessary information has to be documented.*
- *If nonconformity of the product is discovered at the premises of the consumer in connection with delivery, a nonconformity report is generated and handling of the nonconforming lot is agreed with the consumer.*[20]

Example:

During reception of some straw bales a trader realises by visual inspection and random measurement that one lot of the straw is partially too moist. He decides to store it nevertheless but finds a separate part of the store to place the material and applies the reduced payment scheme for the supplier. The checklist for the storage is filled in accordingly to document the whereabouts of the material.

Result

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If the trader delivers straw to end-consumers the product declaration/labelling must as a minimum include:

- *Supplier (body or enterprise) including contact information*
- *A reference to the appropriate part of EN 15234-1*
- *Origin and source (according to EN 14961-1)*
- *Country/countries (locations) of origin*
- *Traded form (e.g. big bales)*
- *Specification of properties (according to EN 14961-1)*
- *Normative properties*
- *(Informative properties)*
- *Chemically treated material (yes/no)*
- *Signature, date, place (The product declaration can be approved electronically. Signature and date can be approved by signing of the waybill in accordance with the appropriate part of EN 14961)*

With the product declaration the supplier confirms, that the properties of the end-product are in accordance with the requirements of the respective part of EN 14961 according to EN 15234-1. The supplier must date the declaration and keep the record for a minimum of one year after the delivery.[21]

[20] EN 15234-4:2012, paragraph 5.7
[21] EN 15234-1:2012, paragraph 7

Product declaration - straw	
Supplier	Halm 80 ApS
Amount of delivery	2000 tons/month
Origin	Wheat straw 2.1.1.2
Chemically treated material	No
Country	Denmark, Eastern Fünen
Traded form	Straw bales
Determination of properties	
Dimensions (m) Moisture (w-%) Ash (w-%) dry Bale density (kg/m^3) Net calorific value as received (MJ/kg)	L_1: 1.25-1.35 m L_2: 1.20-1.30 m L_3: 2.25-2.55 m M25 A5 BD220 Q13.0
Production method Chlorine content (w-%) dry	Crop has been threshed and weathered Cl 0.4
Signature of assigned person	Niels Jeppesen

4. Sustainability aspects of straw production

Being an agricultural residue, straw does normally not require separate sustainability criteria. Making use of the energy content in the straw is more sustainable than burning the straw in the fields or letting the straw decompose on the fields with no recovery of the energy.

Some stakeholders have the view that all the carbon and nutrients should be retained in the soil i.e. that all straw should be ploughed into the soil in order to maintain a fertile soil. However, experience from various countries show that removing a large share of the straw for energy purposes is not a problem to the physical composition of the soil.

On the nutrient aspect, phosphorus that is accessible for the plants is becoming a scarce nutrient. Hence, attention should be given to conversion technologies that maintain the accessibility of the nutrients i.e. convert the biomass at a relatively low temperature.

Annex

Overview of European standards and international standards on solid biofuels

As of January 2014

Below table provides an overview of European and international standards on solid biofuels. The European Standards are developed in CEN/TC 335 "Solid biofuels". Most of the standards on the work programme of CEN/TC 335 have been formally published as European (EN) standards. The international standards are developed in ISO/TC 238 "Solid biofuels". The standards on the work programme of ISO/TC 238 are either still under development or the process should formally be initiated. The list of (future) international standards is based on the information available at the so-called ISO Project Portal (31 January 2013); the work programme may extend in future. The work programme of ISO/TC 238 shows much overlap with the work programme of CEN/TC 335, noting that differences exist. For example, where the European standards on fuel specifications and classes (EN 14961 series) focus on non-industrial use, the international standards on this topic (future ISO 17225 series) enlarge the scope to industrial use as well.

European standards (EN) *If dated, the (draft) standard is published and publicly available*		**International standards (ISO)** *If dated, the (draft) standard is published and publicly available*	
Terminology		**Terminology**	
EN 14588:2010	Solid biofuels – Terminology, definitions and descriptions	ISO/DIS 16559: 2013 01 31	Solid biofuels -- Terminology, definitions and descriptions
Fuel specifications and classes		**Fuel specifications and classes**	
EN 14961-1:2010	Solid biofuels – Fuel specifications and classes – Part 1: General requirements	ISO/FDIS 17225-1: 2013 11 28	Solid biofuels -- Fuel specifications and classes -- Part 1: General requirements
EN 14961-2:2011	Solid biofuels – Fuel specifications and classes – Part 2: Wood pellets for non-industrial use	ISO/FDIS 17225-2: 2013 11 28	Solid biofuels -- Fuel specifications and classes -- Part 2: Graded wood pellets
EN 14961-3:2011	Solid biofuels – Fuel specifications and classes – Part 3: Wood briquettes for non-industrial use	ISO/FDIS 17225-3: 2013 11 28	Solid biofuels -- Fuel specifications and classes -- Part 3: Graded wood briquettes
EN 14961-4:2011	Solid biofuels – Fuel specifications and classes – Part 4: Wood chips for non-industrial use	ISO/FDIS 17225-4: 2013 11 28	Solid biofuels -- Fuel specifications and classes -- Part 4: Graded wood chips
EN 14961-5:2011	Solid biofuels – Fuel specifications and classes – Part 5: Firewood for non-industrial use	ISO/FDIS 17225-5: 2013 11 28	Solid biofuels -- Fuel specifications and classes -- Part 5: Graded firewood
EN 14961-6:2012	Solid biofuels – Fuel specifications and classes – Part 6: Non-woody pellets for non-industrial use	ISO/FDIS 17225-6: 2013 11 28	Solid biofuels -- Fuel specifications and classes -- Part 6: Graded non-woody pellets

European standards (EN)

If dated, the (draft) standard is published and publicly available

Fuel quality assurance

EN 15234-1:2011	Solid biofuels – Fuel quality assurance – Part 1: General requirements
EN 15234-2:2012	Solid biofuels – Fuel quality assurance – Part 2: Wood pellets for non-industrial use
EN 15234-3:2012	Solid biofuels – Fuel quality assurance – Part 3: Wood briquettes for non-industrial use
EN 15234-4:2012	Solid biofuels – Fuel quality assurance – Part 4: Wood chips for non-industrial use
EN 15234-5:2012	Solid biofuels – Fuel quality assurance – Part 5: Firewood for non-industrial use
EN 15234-6:2012	Solid biofuels – Fuel quality assurance – Part 6: Non-woody pellets for non-industrial use

Sample and sample preparation

EN 14778:2011	Solid biofuels – Sampling
EN 14780:2011	Solid biofuels – Sample preparation

Physical and mechanical properties

EN 14774-1:2009	Solid biofuels – Determination of moisture content – Oven dry method – Part 1: Total moisture – Reference method
EN 14774-2:2009	Solid biofuels – Determination of moisture content – Oven dry method – Part 2: Total moisture – Simplified method
EN 14774-3:2009	Solid biofuels – Determination of moisture content – Oven dry method – Part 3: Moisture in general analysis sample

International standards (ISO)

If dated, the (draft) standard is published and publicly available

ISO/FDIS 17225-7: 2013 11 28	Solid biofuels -- Fuel specifications and classes -- Part 7: Graded non-woody briquettes

Fuel quality assurance

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Sample and sample preparation

ISO/NP 18135	Solid biofuels -- Sampling
ISO/NP 14780	Solid biofuels -- Sample preparation

Physical and mechanical properties

ISO/DIS 18134-1: 2013 09 19	Solid biofuels -- Determination of moisture content -- Oven dry method -- Part 1: Total moisture -- Reference method
ISO/DIS 18134-2: 2013 09 19	Solid biofuels -- Determination of moisture content -- Oven dry method -- Part 2: Total moisture - Simplified method
ISO/DIS 18134-3: 2013 09 19	Solid biofuels -- Determination of moisture content -- Oven dry method -- Part 3: Moisture in general analysis sample

European standards (EN)

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EN 14775:2009	Solid biofuels – Determination of ash content
EN 14918:2009	Solid biofuels – Determination of calorific value
EN 15103:2009	Solid biofuels – Determination of bulk density
EN 15148:2009	Solid biofuels – Determination of the content of volatile matter
EN 15149-1:2010	Solid biofuels – Determination of particle size distribution – Part 1: Oscillating screen method using sieve apertures of 1 mm and above
EN 15149-2:2010	Solid biofuels – Determination of particle size distribution – Part 2: Vibrating screen method using sieve apertures of 3,15 mm and below
CEN/TS 15149-3: 2006	Solid Biofuels – Methods for the determination of particle size distribution – Part 3: Rotary screen method
EN 15150:2011	Solid biofuels – Determination of particle density
EN 15210-1:2009	Solid biofuels – Determination of mechanical durability of pellets and briquettes – Part 1: Pellets
EN 15210-2:2010	Solid biofuels – Determination of mechanical durability of pellets and briquettes – Part 2: Briquettes
EN 16126:2012	Solid biofuels – Determination of particle size distribution of disintegrated pellets
EN 16127:2012	Solid biofuels – Determination of length and diameter for pellets and cylindrical briquettes

International standards (ISO)

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ISO/DIS 18122: 2013 09 19	Solid biofuels -- Determination of ash content
ISO/NP 18125	Solid biofuels -- Determination of calorific value
ISO/DIS 17828: 2013 11 01	Solid biofuels -- Determination of bulk density
ISO/DIS 18123: 2013 11 01	Solid biofuels -- Determination of the content of volatile matter
ISO/CD 17827-1	Solid biofuels -- Determination of particle size distribution for uncompressed fuels -- Part 1: Horizontally oscillating screen using sieve for classification of samples with a top aperture of 3.15 mm and above
ISO/CD 17827-2	Solid biofuels -- Determination of particle size distribution for uncompressed fuels -- Part 2: Vertically vibrating screen using sieve for classification of samples
ISO/DIS 18847: 2013-06-19	Solid biofuels -- Determination of particle density
ISO/DIS 17831-1: 2013 11 01	Solid biofuels -- Methods for the determination of mechanical durability of pellets and briquettes -- Part 1: Pellets
ISO/DIS 17831-2: 2013 11 01	Solid biofuels -- Methods for the determination of mechanical durability of pellets and briquettes -- Part 2: Briquettes
ISO/CD 17830	Solid biofuels -- Determination of particle size distribution of disintegrated pellets
ISO/DIS 17829: 2012-11-22	Solid biofuels -- Determination of length and diameter of pellets
ISO/CD 18846	Solid biofuels -- Determination of fines content in quantities of pellets -- Manual sieve method using 3,15 mm sieve aperture

European standards (EN)

If dated, the (draft) standard is published and publicly available

Chemical analysis

EN 15104:2011	Solid biofuels – Determination of total content of carbon, hydrogen and nitrogen – Instrumental methods
EN 15105:2011	Solid biofuels – Determination of the water soluble chloride, sodium and potassium content
EN 15289:2011	Solid biofuels – Determination of total content of sulfur and chlorine
EN 15290:2011	Solid biofuels – Determination of major elements – Al, Ca, Fe, Mg, P, K, Si, Na and Ti
EN 15296:2011	Solid biofuels – Conversion of analytical results from one basis to another
EN 15297:2011	Solid biofuels – Determination of minor elements – As, Cd, Co, Cr, Cu, Hg, Mn, Mo, Ni, Pb, Sb, V and Zn

International standards (ISO)

If dated, the (draft) standard is published and publicly available

Chemical analysis

ISO/DIS 16948: 2013 04 15	Solid biofuels -- Determination of total content of carbon, hydrogen and nitrogen
ISO/DIS 16995: 2013 04 15	Solid biofuels -- Determination of the water soluble content of chloride, sodium and potassium
ISO/DIS 16994: 2013 04 15	Solid biofuels -- Determination of total content of sulphur and chlorine
ISO/DIS 16967: 2013 04 01	Solid biofuels -- Determination of major elements
ISO/DIS 16993: 2013 04 15	Solid biofuels -- Conversion of analytical results from one basis to another
ISO/DIS 16968: 2013 04 01	Solid biofuels -- Determination of minor elements
ISO/CD 16996	Solid biofuels -- Determination of elemental composition by X-ray fluorescence

ISO/CD	Committee Draft developed by ISO (draft available for members only)
ISO/DIS	Draft International Standard (draft available for public enquiry)
ISO/FDIS	Final Draft International Standard (draft available for public enquiry)
ISO/NP	New Project by ISO, but standard development to be initiated