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Solid biofuels — A guide for a quality assurance system

ICS 75.160.10

British Standards

National foreword

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Solid biofuels - A guide for a quality assurance system

Biocombustibles solides - Guide du système d'assurance Qualité

Feste Biobrennstoffe - Leitlinie für ein Qualitätssicherungssystem

This Technical Report was approved by CEN on 22 January 2007. It has been drawn up by the Technical Committee CEN/TC 335.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
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EUROPÄISCHES KOMITEE FÜR NORMUNG

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Foreword

This document (CEN/TR 15569:2009) has been prepared by Technical Committee CEN/TC 335 "Solid Biofuels", the secretariat of which is held by SIS.

CEN/TC 335 has received a mandate from the European Commission (EC) to develop Standards for solid biofuels.

The documents produced by CEN/TC 335 Solid biofuels were based on the information available at the time when they were developed. The BioNorm project (EC part-funded) was designed to provide supporting information to CEN/TC 335 on solid biofuels. Part of the BioNorm Project (ENK6-CT2001-00556) was designed to fill the gaps in the understanding of Quality Assurance in this field [16].

This guide has been developed from the outcomes of the BioNorm-project by Working Group 2 of CEN/TC 335 and provides information on how to develop and implement a Quality Assurance system within the solid biofuels industry.

Introduction

Quality Assurance is defined as the “part of Quality Management focussed on providing confidence that quality requirements will be fulfilled” (CEN/TS 15234). To achieve this, the processes in the supply chain need to be in control. Effective control can be achieved, if Quality Assurance is being applied by each operator in the supply chain. A well designed Quality Assurance system for solid biofuels can contribute to a more transparent and efficient biofuel market. Based upon the requirements of the customer, and the known strengths and weaknesses of a raw material and a process, operators can demonstrate they have taken the measures to provide the desired quality. This establishes a confidence in the products. In this guide “product” refers to the solid biofuel.

Clause 4 sets out the reasoning behind using a Quality Assurance system for solid biofuels, and Clause 6 defines the intentions of this guide and its interconnection with the CEN/TS 15234, *Solid Biofuels — Fuel Quality Assurance*, from now on called "CEN/TS 15234" in this guide. The terms used in this guide are set out in CEN/TS 14588 and CEN/TS 15234.

Clause 7 sets out a step-by-step methodology to help operators within the solid biofuel supply chain to design a Quality Assurance System. The methodologies used in this guide are compliant with the requirements of CEN/TS 15234. However, this guide does not distinguish between different groups of operators (e.g. producer, supplier, etc.); it provides general guidance for the Quality Assurance applicable to each group of operators.

Annex A provides some guidance on the relevant parts of ISO 9001:2008 [1] and Annex B lists CEN/TC 335 Technical Specifications and Technical Reports.

It is recommended that a company specific manual is produced to reflect the Quality Assurance System.

The guidance and instructions given in this guide are recommendations, not requirements. The requirements to be fulfilled for Quality Assurance are set out in CEN/TS 15234.

1 Scope

This guide has been developed to provide information about the Solid Biofuel Quality Assurance, and presents a methodology that helps operators in the solid biofuels industry design an appropriate Quality Assurance system according to their demands. It acts as a supporting document for the application of CEN/TS 15234, *Solid biofuels — Fuel quality assurance,* developed by CEN/TC 335.

This guide is applicable for all operators dealing with solid biofuels within the scope of CEN/TC 335 from the following sources (CEN/TS 14961):

— products from agriculture and forestry;

— vegetable waste from agriculture and forestry;

— vegetable waste from food processing industry;

— wood waste, with the exception of wood waste which may contain halogenated organic compounds or heavy metals as a result of treatment with wood preservatives or coating, and which includes in particular such wood waste originated from construction and demolition waste;

— fibrous vegetable waste from virgin pulp production and from production of paper from pulp, if it is co-incinerated at the place of production and heat generated is recovered;

— cork waste.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

CEN/TS 14588:2003, *Solid biofuels — Terminology, definitions and descriptions*

CEN/TS 14961:2005, *Solid biofuels — Fuel specification and classes*

CEN/TS 15234:2006, *Solid biofuels — Fuel Quality Assurance*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in CEN/TS 14588:2003 and CEN/TS 15234:2006 (CEN—Terminology, definitions and descriptions for solid biofuels) and the following apply.

3.1
manual
process or site specific document reflecting all activities related to the quality assurance system implemented and applied in practise [16]

4 Background

4.1 General

The term “solid biofuel” encompasses a wide range of materials with different characteristics and properties, as well as supply chains. Standardisation of solid biofuel properties, their sampling and test methodologies will provide tools to facilitate the trade and use of solid biofuels within the market.

In order to increase the confidence of customers, it is essential that operators demonstrate that the specified quality is reached, and that adequate controls are in place throughout the supply chain. The specified quality can be influenced by a series of different factors, including technology and management of the processes.

Customers are becoming increasingly aware of the impact of variations in fuel quality; consequently, large customers often test for properties important to them. In extreme cases, deliveries may be rejected when the quality is outside an agreed specification tolerance. If operators want to avoid such rejections, they should introduce controls at suitable places across the whole supply chain, so called Critical Control Points (see 7.4)

By processing consistently, an operator will improve the stability, efficiency and effectiveness of the operation. The Quality Assurance System should be designed to support this. The effect of this will be to reduce the volume of sampling and testing required.

The term “specified quality” refers not only to fuel properties but also to the other customer requirements. Those requirements differ from case to case and can vary greatly. However, most fall within two sets of circumstances:

- small-scale end-users (especially domestic) who require high-grade fuels with narrow fuel specifications;
- large-scale end-users who can take advantage of lower-cost raw materials by the use of appropriately designed, fuel-flexible combustion plant [4].

It is important when designing and implementing a Quality Assurance System that it takes into consideration the existing operation. The Quality Assurance System should follow the process, not vice versa and be aware of the level and amount of sampling and testing required.

EXAMPLE: **Operational time of the die used in a pellet factory**

The longer the operational time the die runs in a pellet factory the more detrimental effect there is on the pellet quality due to ware on the die holes. Quality Assurance systems should require Quality Control data to be provided to assess the length of time the die has been running and hence the operational running time of each die and a comparison between the dies, can be reviewed against expected running times. From this data a number of different conclusions can be drawn and process changes made as appropriate.

Companies dealing with solid biofuels cover a wide range of activities. Some buy solid biomass, such as residues from agriculture and/or forestry and convert it into higher-grade biofuels, while others only need low-grade biofuels to produce electricity and heat. Each company requires a Quality Assurance System; however, their individual Quality Assurance requirements and systems are likely to be different in each case. This guide is recommended to cover the supply chain up to the delivery to the end-user.

4.2 Purpose of this guide

The purpose of this guide is to be of help when designing a Fuel Quality Assurance system based on CEN/TS 15234.

The approach and methods used in this guide are compatible with CEN/TS 15234 and gives an overview of the most relevant clauses in CEN/TS 15234 (see Table 1).

For those using or contemplating using EN ISO 9000:2005 [2] this document aims at bridging the gap between the generalised text of EN ISO 9001:2008 and the specific needs of operators in the solid biofuel market.

This guide does not discuss adaptations to production processes, nor does it set any pre-conditions in respect of specific technologies or technological processes.

5 Quality Assurance principles

5.1 General

Quality Management EN ISO 9000:2005/EN ISO 9001:2008 is based on four elements, as shown in Figure 1 below. The application of these elements and their different measures depends on the individual circumstances.

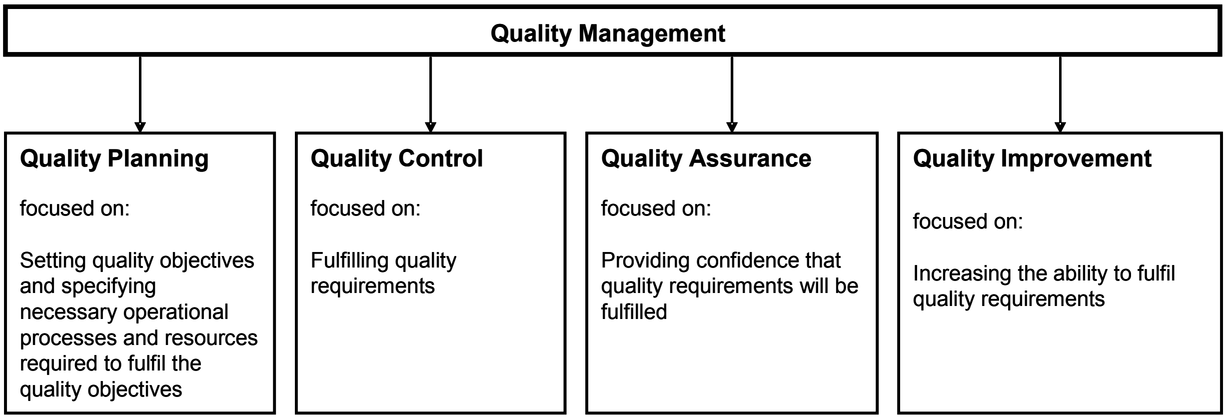


Figure 1 — EN ISO 9000:2005 - Main elements of Quality Management

Each of these elements has its own measures and approaches. The Technical Specification for Fuel Quality Assurance (CEN/TS 15234) covers Quality Control and Quality Assurance.

5.2 Comparison of Quality Control and Quality Assurance

It is important to understand the differences between Quality Control and Quality Assurance.

Quality Control is fundamentally about controlling the quality of a product or process to enable the delivery of the product or service within agreed parameters in the most efficient and effective way. The consequences of having good Quality Control will be a cost effective product and process.

EXAMPLE 1: **Quality control of a pellet factory**

A pellet factory operator will sample and record the pellet moisture content over the shift. If the moisture alters outside given parameters the process will be adjusted to bring the moisture content back within specification. If the process of drying the feedstock is known to be problematic and the operator does not monitor the moisture content in an appropriate timescale, the company could have produced many hours worth of non-conforming pellets before the issue is picked up. If the problem occurred in the first hour and the test is carried out at the end of a twelve-hour shift, there could be eleven hours worth of product that is non-conforming. This is potentially very costly to the company.

EXAMPLE 2: **Quality control of a wood chip producer**

A wood chip producer has an agreement with a customer to provide no more than 5 % oversized chips. When the chipper blades are blunt the producer knows the chipper makes out of specification chips. If the producer has a tendency to keep using the same blades without sharpening them or changing them to reduce the chipper's downtime, the consequences could be to produce more than the 5 % oversized chips that the customer requires, with the potential outcome of the chips being rejected, a blending of additional material has to take place or a reduction in price to keep the customer happy.

Quality Assurance on the other hand, is about reviewing the products and processes, primarily through data provided from the Quality Control records and using this data

a) to establish that products are produced within the required specification and processes are operated as they should be, and

b) over a longer term assures either consistency is being maintained (stability in process results) or that quality improvements are making the required impact.

Quality Assurance tools are excellent at providing data that allows the company to manage a process through exception reporting.

NOTE Exception Reporting – reporting issues or activities that fall outside the normal pattern or are outside the selected minimum or maximum range. Exception reporting enables the quality team to only investigate those incidences that are outside the norm. Exception Reporting also reduces the volume of data to be reviewed.

From the two examples above for Quality Control, practical examples of Quality Assurance will be demonstrated:

EXAMPLE 3: **Quality assurance of a pellet factory**

In the example of the pellet factory, if the processing moisture content data was trended and shown to be a particular problem every three weeks on a particular nightshift, the issue could be identified as being a particular delivery of feedstock or that a particular operator who co-insides with that shift requires additional training.

EXAMPLE 4: **Quality assurance of a wood chip producer**

The chip producer after reviewing a series of months customer service and blade sharpening data realises that his customer’s satisfaction is reduced at the same time as the chipper blades’ running hours have been extended over a specific number of hours, however, the producer now has an understanding of the additional blade running hours before there is a detrimental effect on his customer service and the cost benefits over the life of the blades due to the time saved and additional life gained by extending the run hours between blade sharpening or change.

By trending and reviewing the data through the Quality Assurance system, these issues are more easily established.

Quality Assurance measures should

— be simple to operate;

— not cause undue bureaucracy;

— support regimes for cost reductions.

However, as stated, Quality Control is important in assessing the properties of the fuel produced and the processes used.

In the context of the CEN/TS 15234, Quality Control includes the selection and use of appropriate sampling and sample reduction techniques, as well as test methods for physical and chemical properties.

5.3 Previous, Current and Following Processes

Solid biofuel supply chains consist of one or several processes. Each process can either be a single operation or multiple operations. The operations may be distributed among different companies (external customer) or within the same company or department (internal customer). In this guide, the customer is defined as the next operator in the process, whether within the organisation or across separate organisations (Figure 2). This document is specifically looking at the Current process, however, it is important to understand the relationship between the Previous and the Current Process, as well as the Current Process and the Following Process.

Each Following Process step (Customer) within the supply chain can be involved in defining the specified quality. Figure 3 illustrates that using a typical pellet production and is shown from the producers´ point of view.

For ease of understanding and identification, in this guide, the Current Process is shown in a heavy Bold Box.

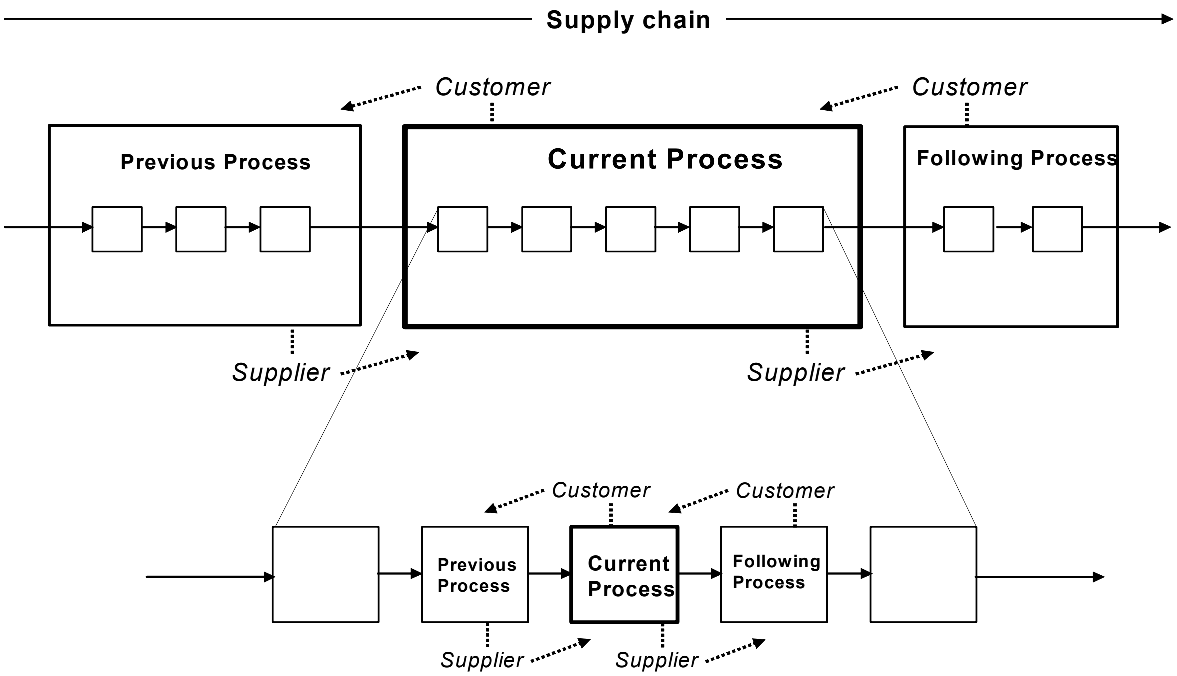


Figure 2 — Descriptions of the Previous, Current and Following Processes

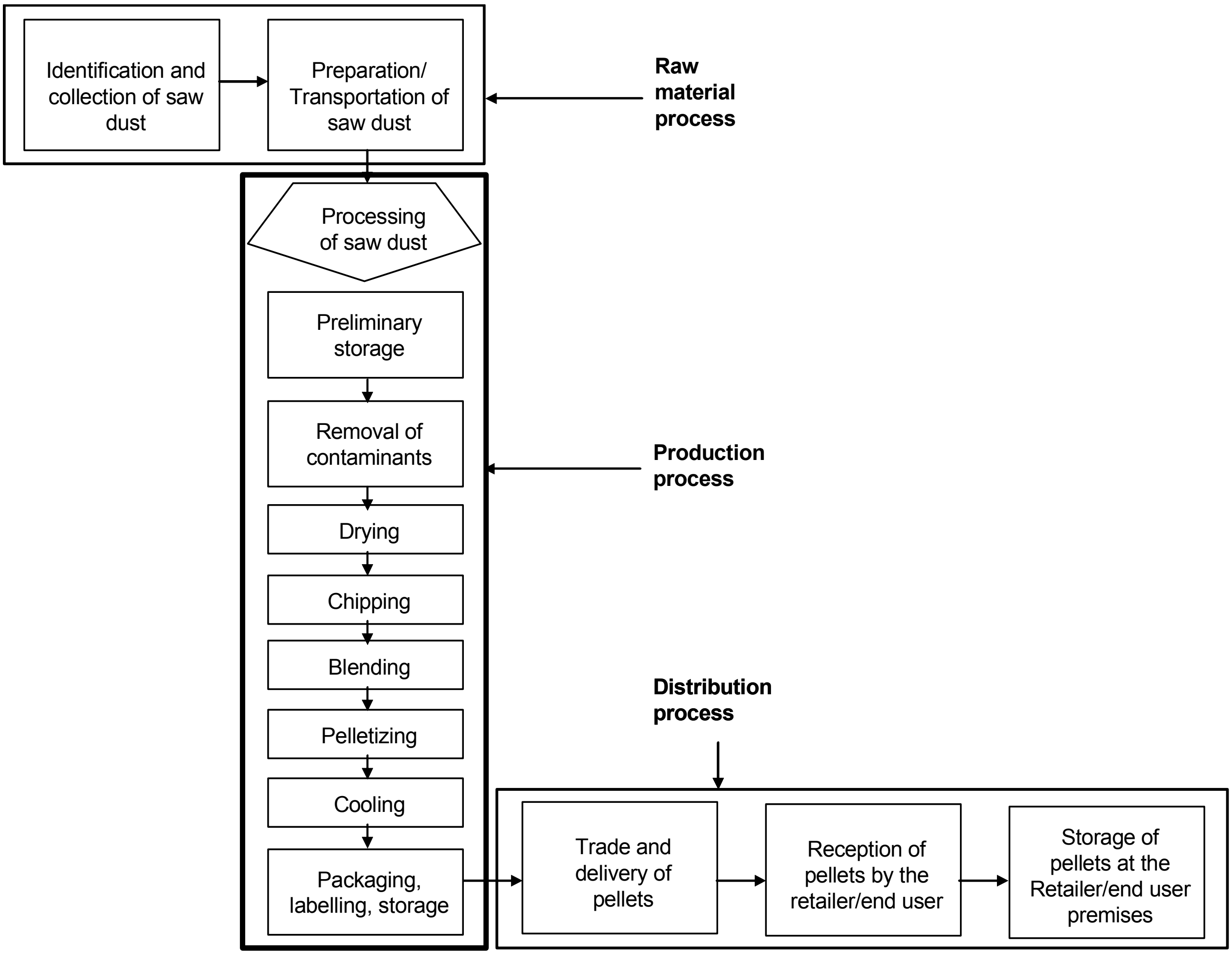


Figure 3 — Example of the process steps in a pellet factory

5.4 Quality requirements

Quality Assurance aims to provide confidence that a stable or defined quality is continually achieved in accordance with the customer requirements. It means that specified requirements are fulfilled; however, it does not necessarily mean a high product quality. Customer requirements include, among other things, a specified fuel quality and in many circumstance the quality of the performance of the company, in relation to the service (such as timing, logistics and proper documentation).

Quality performance is mainly controlled by a company's management [6, 7]. The Quality Assurance System should ensure the product or service is provided within agreed tolerances and service parameters.

EXAMPLE: **Quality requirement of raw material moisture content in pellet production**

If a pellet producer requires sawdust at 10 w-% moisture content, because the company does not have a dryer. There is no point for the raw material supplier, providing the sawdust at 30 w-% (problems in production) or 5 w-% (causes unnecessary extra costs for raw material supplier).

For solid biofuels to be accepted in the marketplace, it is important that the customer requirements, in terms of the fuel properties, are fulfilled whether or not those requirements follow a fuel specification.

The quality of solid biofuels can be defined in terms of a number of key properties that relate to the suitability of the fuel for a specific use. The selection of these indicators can differ from case to case, depending on the application, the production processes and the occurrence of natural variations in the fuel characteristics.

Quality of performance means that you should consider asking the following questions:

a) How does the company recognise and fulfil the customer needs?

b) Is the work carried out both effectively, efficiently and within specification?

c) Are the customer requirements consistently met or exceeded?

d) How does the company operate in terms of specific product costs per unit?

Quality of the performance, within this guide, refers to the process and product performance, utilizing among others; documentation, timing and logistical issues. Figure 4 illustrates the various performance documentation requirements along the solid biofuel supply chain [6, 7].

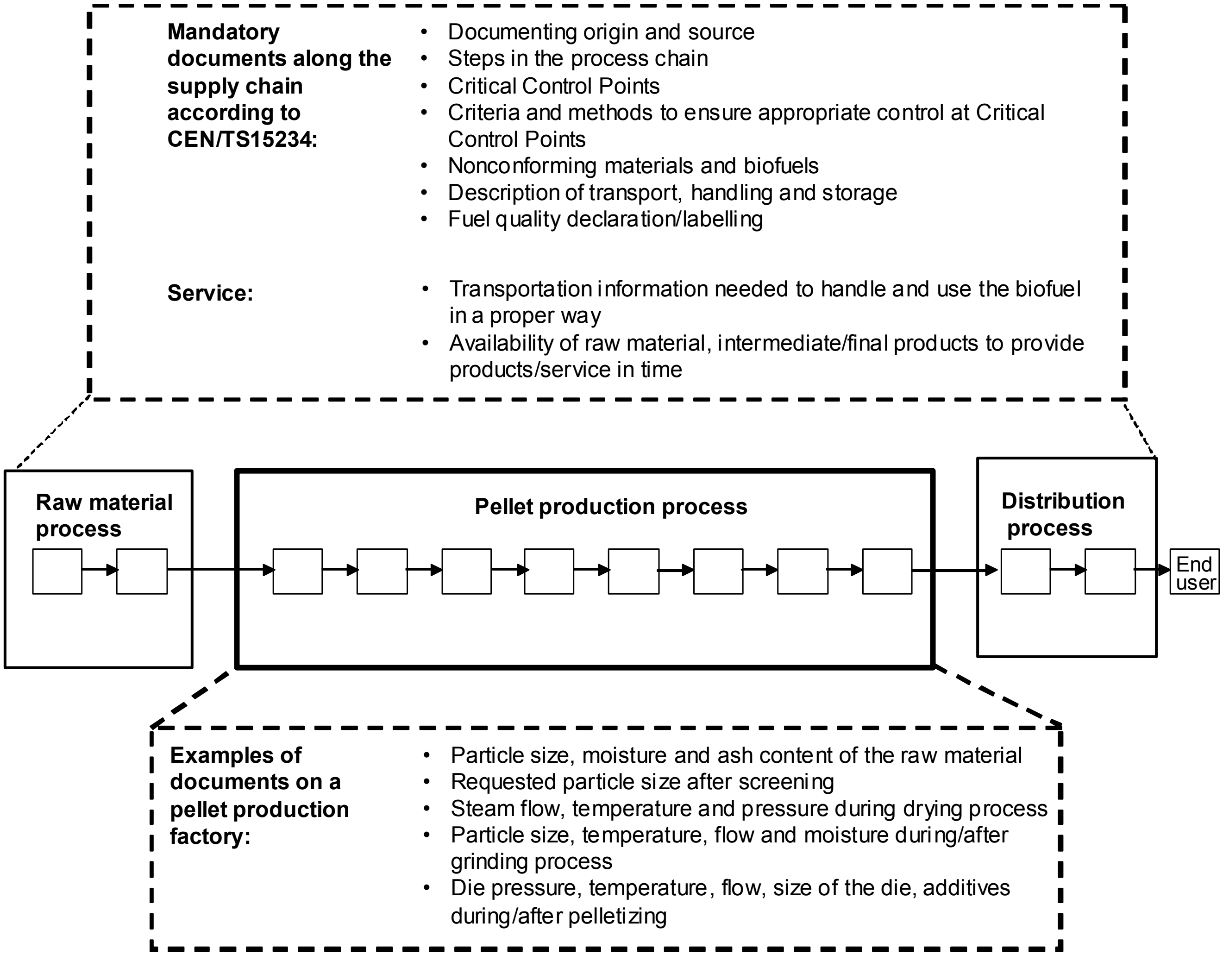


Figure 4 — Solid biofuel supply chain – Performance documentation requirements

The documenting of information on raw materials, intermediate products, final products and the production process parameters may be extremely useful for the proper treatment of the material during the production process. It can also provide an insight into the strengths and weaknesses of the production process, which may assist in improving the product quality and process effectiveness and efficiency.

6 Designing a system for solid biofuels quality assurance

6.1 General

This clause describes a methodology that operators can use to design an appropriate Quality Assurance system. The methodology provided, is compliant with the approach of CEN/TS 15234, however, the required specifications of Step 2 in CEN/TS 15234 have been expanded on within this guide to emphasise the importance of product quality and the supply chain companies' performance.

The methodology ensures an efficient and effective control of the processes and provides useful control mechanisms throughout the supply chain by integrating the processes before and after the current process [3, 4]. The process steps are identified and documented for a Quality Assurance Manual. This manual can demonstrate to third parties that the solid biofuel supply chain processes are identified, managed and under control when the Quality Assurance manual is being adhered to. Table 1 sets out the requirements for documenting the process. It is recommended that these documents are used as the basis for the manual. Figure 4 is explained in more detail in the following text.

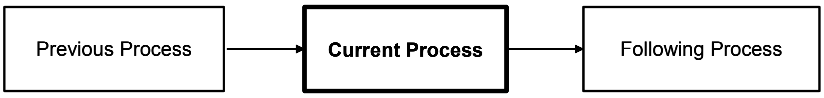
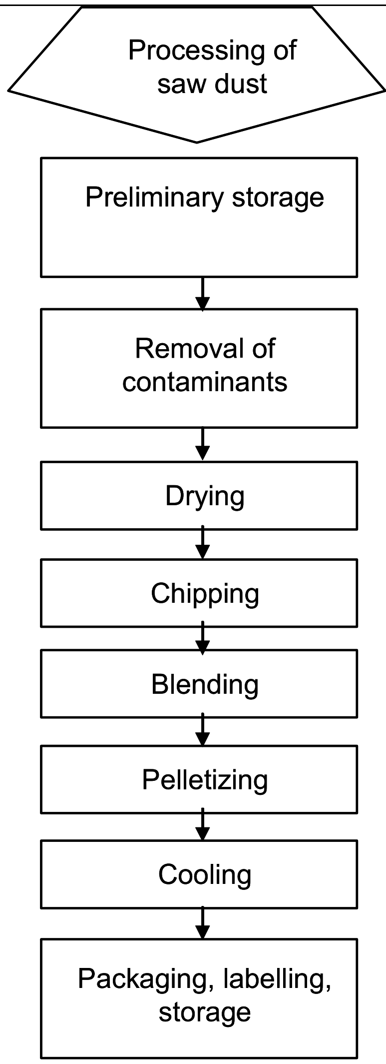
An appropriate Quality Assurance system can reduce the frequency of testing and hence costs, as it gives confidence that the processes are operating within production tolerances. Wherever possible, means should be sought to exempt parties from unnecessary procedures. Nevertheless, good practice dictates the drafting of flow diagrams or similar processes to identify the key stages in the production cycle [4] and ensure that the stages in the production process provide the required levels of management, control and information. The Quality Assurance system and hence manual, should therefore replicate the production or service processes required to meet the customers and company's business requirements. To support the Quality Assurance system and Quality Control functions in the company a degree of sampling and testing will be inevitable. However, the application of sampling and test methods is expensive and should be applied carefully and not as a matter of routine.

Table 1 — Recommended documentation for a Quality Assurance system

Recommended documents	References to sections below
Process	Description of the process (6.2)
Requirement of input materials Requirement for output materials	Requirements to be specified of a Previous Process (6.3) Requirements necessary to achieve the process successfully (6.3)
Allocation of responsibilities	Description of process (6.2) Allocation of responsibilities (6.4a)
Critical Control Points and Quality Control measures applied Processes and test results	Identification of Critical Control Points and application of Quality Control measures (6.5) Properly documenting processes and test results (6.6c))
Non-conforming materials and products	System for dealing with non-conforming materials and products (6.7)

NOTE Data needs to be important, required and meaningful. While many Critical Control Points will be required permanently to provide specific, mandatory information, others may be required on a temporary basis while issues are being resolved at specific points in the process. It is important to ensure the Quality Assurance system allows for a non-prescriptive approach to problem solving to allow short-term problems to be resolved and improvements in the process to be made, without them becoming permanent data recording points.

6.2 Step 1 – Description of process chain

Step in methodology approach	**Step 1** **Description of process chain** 	
Description	**What to do?**	**Guidance**
   Previous Process	Illustration of the process chain from the beginning to the end Determine the inputs and their origins	 Determine and document all material flows of the input and determine the origin and source according to Table 1 in CEN/TS 14961:2005.
Current Process	Define and document the responsibilities throughout the Current Process NOTE The responsibilities should be in terms of position/role in the organisation not a named individual.	
Following Process	Determine the outputs from the Current Process	Determine and document all outputs from the Current Process (raw material, intermediate products and final products).

Supporting information for Step 1 – Description of process chain

The first step in the creation of a Fuel Quality Assurance system is to describe the production process. As this description forms the basis of a more detailed assessment on where quality is/can be influenced, a sufficient level of detail must be included. Hence, the description of the production process is critically important when subsequently drafting a Quality Assurance system.

It is advisable to use a visual presentation (flow diagram) of all the process steps to be considered as shown on the previous page.

It is important to gain the right balance between an overly detailed description, and one that does not fully appreciate the significance of the data within the context of the Quality Assurance system.

When describing the process chain it may be helpful to split the structure into distinct actions or functions and by reviewing the information in relation to the responsibilities within the supply chain.

For service or trading companies, it can also be helpful to use the existing company documents as a starting point. Existing documents have been shown to be useful for identifying administrative tasks and often cover issues that are also important to the company's Quality Assurance.

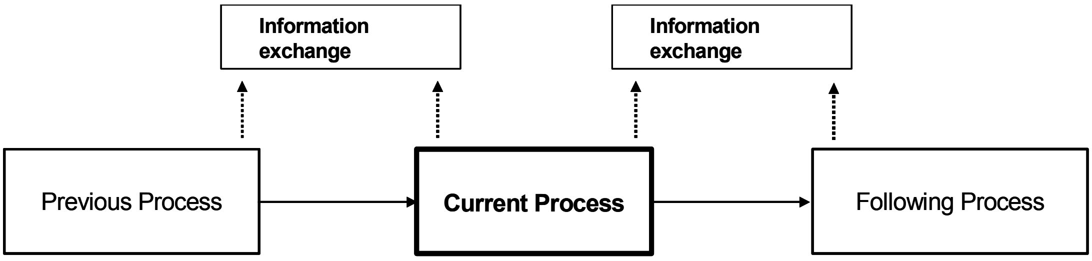
NOTE Examples of documents for fuel specifications of pellets, olive cakes, wood chips, hog fuel and straw bales are given in Annex B of CEN/TS 15234:2006.

6.3 Step 2 – Description of customers requirements

<table>
<tr><td>Step in methodology approach</td><td colspan="2">

Step 2

Description of customers requirements



</td></tr>
<tr><td>Description</td><td>What to do?</td><td>Guidance</td></tr>
<tr><td>Information exchange</td><td>Determine the requirements for Product and Performance

Verify the Abilities of the Current Process to achieve the required product and performance requirements</td><td>

Product. Determine and document the product requirements referring to CEN/TS 14961 for the final solid biofuel:

<table>
<tr><th>Fuel parameter</th><th>Relevance to customers?</th><th>Requirements according to CEN/TS 14961</th></tr>
<tr><td>Origin</td><td>yes/no</td><td>XY</td></tr>
<tr><td>Particle size distribution (P)</td><td>yes/no</td><td>XY</td></tr>
<tr><td>Moisture content (M)</td><td>yes/no</td><td>XY</td></tr>
<tr><td>Ash content (A)</td><td>yes/no</td><td>XY</td></tr>
<tr><td>etc.</td><td>yes/no</td><td>XY</td></tr>
</table>

Quality declarations: Information required by the supplier should be provided and transferred along the supply chain to be incorporated in to the final Quality Declaration, see Annex C in CEN/TS 15234:2006.

Performance. Determine the performance requirements, e.g.:

a) Information that should be documented*;*

b) Establish information required from the *Previous Process* to allow the *Current Process* to perform it's function appropriately*;*

c) Identify the detail of the information that should be documented, including;

- production technology issues,
- sampling and test methods required,
- laboratory information, requirements for labelling, traceability documents for the origin and source of the raw materials*,* and
- quality certificates*,*

</td></tr>
</table>

Step 2 continued		
Description	**What to do?**	**Guidance**
		- timely data transfer to the Following Process ensures that the correct information is available to continue the process - ensure documents transferred are filled in appropriately - provision of adequate storage, processing, transportation and packaging to meet the conditions. The information provided or requested should be sufficiently detailed to enable the process to continue without stoppages. NOTE Good practice should ensure that the Previous Process understands the next process, with particular reference to the supply chain requirements and delivers the information promptly. This reduces the need for the Current Process having to request data before they can continue. **Ability** Verify the Current Process' potential to fulfil the Following Processes product or service requirements (i.e. the expected product quality or service that is necessary for the Following Process to perform its function to the agreed performance). Examine the relevant processes (machines and equipment), resources (staff and their skills) and logistics, to meet the Following Processes requirements. Ensure that there are appropriate systems in place to prepare and maintain the documents required to give traceability across the solid biofuel supply chain.

Supporting information for Step 2 – Description of customers requirements

It is fundamental to the understanding of Quality Assurance that the Current Process is thought of as both a customer to the Previous Process and a supplier to the Following Process (independent of whether the process has single or multiple processes within it). The Following Process is then the next customer in the supply chain (see Figure 2). Therefore, the customer is not always the end-user of the final product and the product requirements may not necessarily be the requirements of a product specification, they may relate to other specific issues that effect the Following Process requirements. It is therefore important to ensure that the Following Processes (next operator) in the supply chain have all their requirements identified and provided by the Previous Process to ensure they can fulfil their part of the process efficiently and effectively; see Clause 6.

If adequate technical specifications for the biofuel cannot be provided for the fuel, key properties of the final product should be determined either by utilising the standards that specify which fuels can be used, or by the fuel supplier's knowledge of the end-user requirements, which can define such specifications. Such an indirect approach is to be understood as a requirement of a Following Process or step.

The following issues have to be considered when determining the key fuel properties:

- use of the biofuel (i.e. requirements from the conversion unit);
- conformance of the fuel with an existing standard or other requirements;
- legal restraints and regulations concerning emissions limits and other environmental issues;

— possible impact on the fuel quality when mixing and blending different raw materials and raw material qualities, along with potential for degradation of the fuel during transportation and storage.

The minimum requirements, specifications and tolerable deviations from these values have to be accurately described for the raw materials or intermediate products delivered. The delivery batch has to be in accordance with the delivery agreement, and recorded on the appropriate delivery documents. In principle the raw materials, intermediate and final products can be classified in accordance with CEN/TS 14961.

All operators within the supply chain should:

— consider the effects of drawing on and using stocks of raw materials;

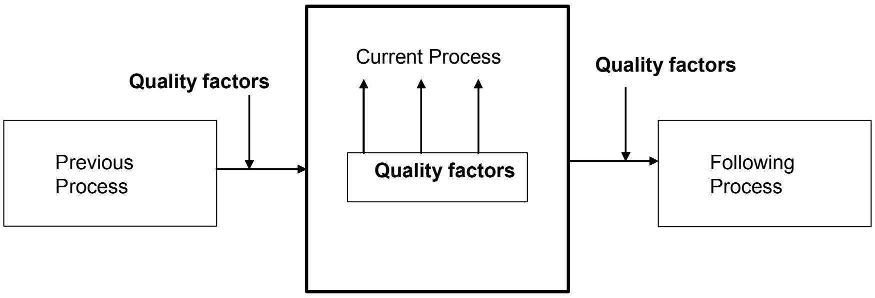
— assess the likely levels of compliance within CEN/TS 14961 of the materials that will be fed to their plant, taking account of the likely variability of the relevant properties of the feedstock, and other factors that may influence the process (including blending of the raw materials);

— take into consideration documentation and logistics requirements, since the properties of the fuel have a great impact on the logistics of handling and storing of the fuel .

NOTE Examples of documents for fuel specifications of pellets, olive cakes, wood chips, hog fuel and straw bales are given in Annex B of CEN/TS 15234:2006.

6.4 Step 3 – Analysis of quality influencing factors

<table>
<tr><td>Step in methodology approach</td><td colspan="2">Step 3

Analysis of quality influencing factors

</td></tr>
<tr><td>Description</td><td>What to do?</td><td>Guidance</td></tr>
<tr><td>Product and Performance factors</td><td>Determine the influencing factors for the quality required</td><td>Determine the relevant factors which affect the product quality and quality of performance, e.g.:
a) The effectiveness of the preliminary inspection for the required fuel sources;
b) The effectiveness of the checking for the incoming loads;
c) The appropriateness of the applied methods for handling, storing and processing the materials;
d) The Quality Control measures adopted;
e) How effective the company manages and operationally control the business and processes;
f) The qualifications and knowledge of the staff.

The influence of each process step in relation to the product quality can be identified using the table structure below. Consider for each step, whether the influence on the product quality is significant or insignificant, by ticking the appropriate boxes in the table. The steps mentioned in the table illustrate the affect on different properties during the steps within the chain considered. To have more understanding of the influencing factors it may be appropriate to identify the actual individual process steps and rate the influence on a scale of 1 to 5 (1 being most influential).

<table>
<tr><th>Fuel parameter</th><th>Step 1: influential? Yes/No</th><th>Step 2: influential? Yes/No</th><th>Step X</th></tr>
<tr><td>Particle size distribution (P)</td><td></td><td></td><td></td></tr>
<tr><td>Moisture content (M)</td><td></td><td></td><td></td></tr>
<tr><td>Net calorific value ($q_{p,net}$)</td><td></td><td></td><td></td></tr>
<tr><td>Others</td><td></td><td></td><td></td></tr>
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</table>

Supporting information for Step 3 – Analysis of quality influencing factors

a. The effectiveness of the preliminary inspection for the fuel sources. This is of importance to establish the general suitability of the sources of solid biofuels. General evidence of suitability can be obtained from the knowledge of the types of biofuel, or the composition of a blend of materials from different sources. However, in most cases some properties must be checked by a programme of sampling and testing.

b. The effectiveness of the checking for the incoming loads. This ensures the loads are of the types already identified as suitable, and that the delivery notes are in order. The check should also be supported where necessary with sampling and testing procedures. The methods applied, their precision, in particular sampling and sample reduction and the frequency with which the tests are carried out, are all of great significance. The frequency of the tests can be greatly reduced if there is evidence of continuous compliance to a specification and therefore no likely relevant changes.

c. The appropriateness of the applied methods for handling, storing and processing the material. The buildings and equipment for solid biofuel production/processing have to be designed and implemented so that the solid biofuel produced has the properties specified. Reference must be made to both the impact on the technical quality of the fuel and the quality of performance of the operational unit. The conditions in which the raw materials and final biofuels are processed and stored must be designed and operated in such a way as to avoid or minimise adverse environmental impacts. Such factors might include: noise or air pollution, water and/or land contamination arising from inadequate design and/or operation of the conversion plant, poor control of storage areas, etc.

d. The Quality Control measures adopted. The frequency of testing should be managed to accomplish the appropriate levels of control in the most efficient and cost effective way.

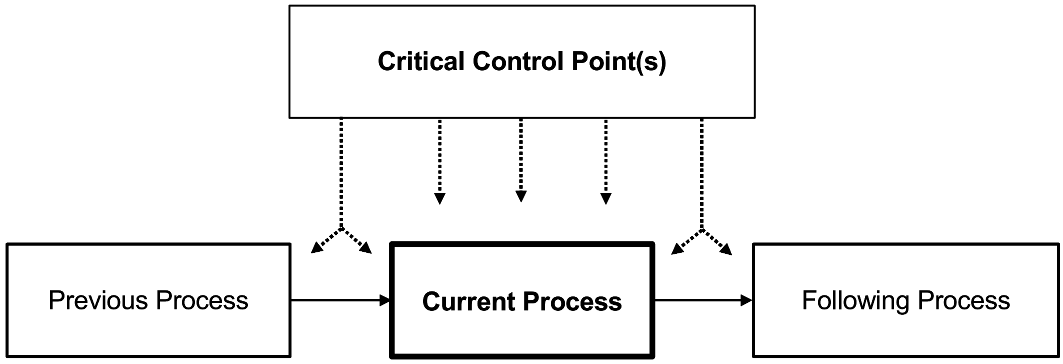
e. Company's management and responsibilities. The responsibility for the biofuel within the supply chain is transferred from one operator to the next operator by the mutual agreement (either through negotiation of the contract or through agreed operational priorities). The management has thereby:

- to compile an organisational structure: Which function is responsible for which task;
- to analyse the customer requirements both for the product quality and quality of performance;
- to compile the quality objectives and product requirements to enable the operators to check for product compliance. This could be achieved using exemplars and test pieces;
- to compile process instructions and work descriptions (where appropriate, either as written instructions or in a diagrammatic form);
- to check if the required quality is reached, utilizing internal audits and random sampling of products, processes and documentation;
- to check if the documents ensure the required traceability;
- to check if the legal regulations and standards are met.

f. The qualifications and knowledge of the staff. The staff need to understand the possible interactions between the process steps and the quality of the fuel, environmental regulations and the relevant regulations on occupational health and safety. The systematic training of staff is an effective way of ensuring that staff are kept up to date.

NOTE Examples of documents for fuel specifications of pellets, olive cakes, wood chips, hog fuel and straw bales are given in Annex B of CEN/TS 15234:2006.

6.5 Step 4 – Identification of Critical Control Points

<table>
<tr><td>Step in methodology approach</td><td colspan="2">Step 4
Identification of Critical Control Points

</td></tr>
<tr><td>Description</td><td>What to do?</td><td>Guidance</td></tr>
<tr><td>Critical Control Points for Quality Control</td><td>Identify Critical Control Points</td><td>Identify and document the Critical Control Points and determine the Quality Control measures. Detail the procedures for each Critical Control Point. The use of Critical Control Points have two functions:
• Provides information needed as a manufacturing record or for declaring the quality / specification of a product or process.
Critical Control Points may also be used for process problem solving (as demonstrated in the example below). These are temporary Critical Control Points that are put in place to identify what is happening in the process and to enable error correction through the understanding of what is going wrong and what needs to be amended. Once the issue has been satisfactorily resolved they can be removed
EXAMPLE: Critical Control Point in pellet production
If a hammer mill starts to jam intermittently, it may be appropriate to monitor and record when the problem arises and what feed stock was being fed into it. By reviewing this data it is likely that a trend or pattern will point to the issue or fault. Once resolved there is no point in still recording data from this point.</td></tr>
</table>

Supporting information for Step 4 – Identification of Critical Control Points

To provide confidence to customers, it is important to identify the relevant Critical Control Points in the production chain(s). The relevance of the Critical Control Points will ensure that appropriate data are collected and used or reviewed. e.g. to provide a declaration for the fines content in a bag leaving the factory, the samples for analysis must be collected after the production.

Critical Control Points are points within or between processes at which relevant properties and process values can be most readily assessed. e.g.:

— The point(s) at which raw materials are collected/purchased;

— The point(s) at which raw materials are pre-processed and loaded for delivery to the next point in the chain;

- During production processing and between processes;
- Within the premises of the final supplier;
- The points at which the condition of the material is (or can be) changed deliberately;
- The point at which the final product is loaded for delivery;
- The point(s) of delivery at the end users' premises.

At each Critical Control Point its influence on the product or process and the consequences for managing the process through work instructions, sample and test methods could be determined and illustrated in the Table 2.

Table 2 — List of the Critical Control Points and their influence to the product and process

Critical Control Points	Influenced parameter	Requirements	Work instruction / sample, test method	Staff responsible
Collection of raw material	Durability, conversion, ash melting…	…	No …/Test…	…
Loading	Creation of dust…	…	No. …/Test…	…
etc. …	etc. …	…	No. …/Test…	…

EXAMPLE: **Wood chip production from small-sized trees**.

The supplier is a co-operative, whose members are farmers. The end-user is a small district heating plant (500 kW boiler).

Critical Control Points	Influenced parameter	Requirements	Work instruction / sample, test method	Staff responsible
Cutting and forest haulage of trees (Manual feeling)	Impurities	Avoid stones and sand when loading trees to trailer	Use cutting frame and pile on strip road Follow sustainable forestry instructions	Farmers A, B, C
Piling of trees near road-side (seasoning for drying)	Impurities, moisture content	Avoid stones and sand Cover piles with kraft paper	Follow piling instructions X Measure store size and inform the co-operative	Farmers A, B, C
Chipping and loading chips	Impurities Moisture content Particle size	No stones and sand M35 is required P45 is required	Avoid sand and stones Check chipper blades regularly	Farmer D (chipper owner)
On-road transportation and unloading at heating station	Avoid dusting Bulk density	No stones and sand Moisture content M35 is required P45 is required	Unloading according to the instructions from plant staff Sampling and analysis of moisture content and bulk density Visual checking of quality (Trade is based on bulk density, volume and moisture content)	Farmer F (transportation and unloading of chips) Plant operator analyses the moisture content and bulk density of each load.

It is the responsibility of the Current Process to inform the Previous Process of any problems incurred though non-conforming input materials. This information flow demonstrates the processors responsibility to receiving a quality product and ensures there is minimal impact on the Current Process achieving their desired outputs.

By reviewing and sharing the data from the input Critical Control Points, the supplier will benefit from improved input materials and processes.

NOTE In some cases, a judgement is required as to the value and practicality of achieving the required quality of data. For instance to verify the delivery of pellets or woodchips, it has to be balanced between the relevance of a parameter and the efforts to determine the property. Testing is expensive, and it should not be carried out as a matter of routine if there are other satisfactory methods of achieving the same results. There should also be an understanding of the costs involved in providing the data and a decision as to whether the costs of data collection become uneconomic.

Efforts should be concentrated on providing data

a) where new (previously untried) sources of raw materials are being used;

b) at Critical Control Points.

It may be possible to reduce the rates of testing to very low levels when staff gain experience with the raw materials, the process and the products. A number of parameters characterising the solid biofuel, such as the amount of decay, the presence of soil, foreign elements etc. can be inspected, monitored and controlled by visual or other sensory inspections. The relevant list of CEN Technical Specifications for test and sampling methods can be found in Annex B.

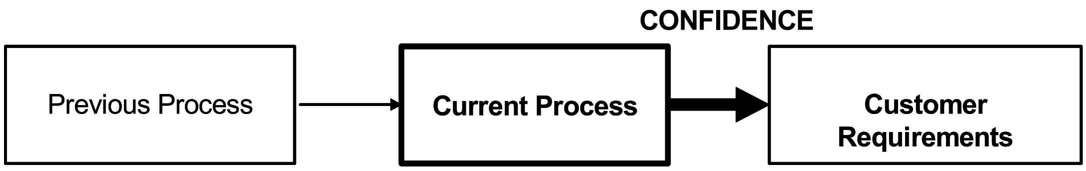
It is important to maintain the sampling and measuring devices and to have them regularly calibrated in order to ensure the accuracy of the data taken. Analysis laboratories should be able to demonstrate that their test results are reliable and give evidence that their test results do not suffer an excessive bias.

NOTE Examples of documents for fuel specifications of pellets, olive cakes, wood chips, hog fuel and straw bales are given in Annex B of CEN/TS 15234:2006.

6.6 Step 5 – Selection of appropriate Quality Assurance measures

<table>
<tr><td>Step in methodology approach</td><td colspan="2">Step 5

Selection of appropriate Quality Assurance measures


</td></tr>
<tr><td>Description</td><td>What to do?</td><td>Guidance/Recommended actions</td></tr>
<tr><td>CONFIDENCE</td><td>Selection of appropriate Quality Assurance measures</td><td>Select appropriate measures and detailed procedures for collecting for each quality assurance measure.

Guidance

a) Allocation of responsibilities for collecting data, analysis and reviewing the results (position responsible; e.g. quality manager);

b) Detailing of work instructions for the correct collection and analysis of the data;

c) Proper documenting of the processes and test results;

d) Staff Training ;

e) System for complaints procedures.

Analysis and corrective action

f) Preliminary inspection of raw material suppliers and formulating acceptance criteria;

g) Customer satisfaction surveys, appropriate analysis and implementation of customer responses;

h) Maintenance of the Quality Assurance system to ensure the data collection, analysis and implementation of corrective actions is taken seriously in the organisation and the results create positive outcomes for the products, processes and those operating them;

i) Quality Assurance meetings to establish a protocol for the Quality Assurance to operate within.</td></tr>
</table>

Supporting information for Step 5 – Selection of appropriate Quality Assurance measures

Guidance

a. Allocation of responsibilities. The allocation of responsibilities could be accomplished in connection with the description of the process chain as shown in 6.2 and/or as described under 6.5.

b. Detailing work instructions. Working instructions and operational procedures should cover each operation, e.g. transportation, preparation processes, sampling, test procedures and maintenance. Where Critical Control Points are established, clear instructions should be available for the collection and recording of the data shown in 6.5.

c. Proper documenting of processes and test results. By having all the appropriate documentation throughout the supply chain, including test results, properly filled in, the operator(s) can demonstrate quality control to their customers and customers can gain confidence in the processes. The benefits of Quality Assurance systems cannot be delivered without proper and appropriate documents with sufficient, however, not over detailed requirements. These documents need careful preparation, trialling and refinement before implementing and require reviewing throughout the life of the production-system. In general, the following documents should be considered and some of them are mandatory according to Table 1 in CEN/TS 15234:2006:

- Document of origin and source (according to Table 1 in CEN/TS 14961:2005 e.g. logging residues 1.1.3);
- Sample documentation and labelling (e.g. sampling and sample reduction methods applied and frequency of sampling (e.g. sampling plans, preparation of the lab samples);
- Property reports, quality declarations and package labelling (e.g. traded form; quality and amount with references to the testing methods applied);
- Transportation documents (e.g. supplier of the raw materials, verification of origin, an accurate description of the raw materials);
- Documents with information needed to handle/use the biofuel in a proper way; this should be supplied to the next operator in the supply chain as well as to the end user (e.g. storage conditions for pellets at end-users premises).

NOTE Examples of fuel quality declarations are given in Annex C of CEN/TS 15234:2006.

In principle, each operator throughout the supply chain is responsible for documenting and filing all relevant information under their specific ownership.

For example:

- The source(s) and the type(s) of material and for blends, their composition (according to Table 1 in CEN/TS 14961:2005);
- The handling procedure and the starting and finishing locations;
- The dates of the key process steps and the results of Quality Control measures.

d. Staff training. To ensure the required quality is provided, the staff must be appropriately skilled; that is supported through training. Therefore, it is advisable to provide training guidance in a form that is appropriate and in a form that explains the activities and equipment, with special regard to quality issues. It is good practice to develop procedures and training schemes for staff development. Where a task is critical to the process, or is complex, it is particularly advisable that these are written down in the form of a procedure diagram or description that can be used for refreshing and training staff.

e. System for complaints procedures. Information from complaints can be useful to determine quality influencing factors. After receiving specific complaints, it often becomes clear what should be improved and what issue is influencing the quality or product output. A document for feedback can act to determine the customers' satisfaction/dissatisfaction. Such a feedback document should be periodically and on a regular basis used to ensure the Quality Assurance system is working correctly.

Analysis and corrective action

There are many different techniques available for analysing and establishing corrective actions. Dependant on the organisation, organisation size, staff capabilities and requirements for the assessment process, a selection of tools can be utilised. It is important to select tools and results that can be easily carried out and understood across the whole organisation. If the information is not presented in an understandable way to those most in need of using it (i.e. usually operators) then the benefits will be lost and the Quality Assurance system may be viewed as a waste of time, money and the additional bureaucracy impedes the workflow.

f. Preliminary inspection of raw material suppliers and formulating acceptance criteria. It is advisable to inspect and evaluate the suppliers´ capabilities and the raw materials coming from every new supplier before the first delivery into the process. Appropriate procedures for acceptance should be defined and established. The acceptance criteria could include information, such as:

- A list of source materials that can be accepted and quality requirements for each type of material;
- General aspects about the delivery, such as opening hours, cleaning procedures for vehicles;
- Goods Receiving procedures for the materials.

When a supplier has been evaluated and accepted as a supplier, it may be necessary to make further visits and/or take samples on a random basis at the suppliers´ premises to ensure the supplier is continuing to supply the materials offered under the contract.

g. Customer satisfaction. The organisation should determine the customer satisfaction. The success depends on each single unit of the supply chain performing to agreed quality or performance criteria. Therefore persons responsible for single units of the supply chain should work in close cooperation with the Previous Process and the Following Process units to ensure a good information exchange; traceability is maintained and information is available to others in the supply chain (subject to confidentially not being breached). This could be tested using a customer survey feedback system, reviews and implementation process.

h. Maintenance of the Quality Assurance system. The Quality Assurance system should be maintained and updated as necessary. If modifications to the system have been carried out, changes must be marked in the Quality Assurance manual and the staff made aware of the changes that affect their part of the process.

i. Quality Assurance meetings. It is appropriate and effective to introduce meetings with customers to regularly evaluate their satisfaction. It can be understood as a preventive action by anticipating any issues that may arise. Any Quality Assurance manual, developed by an operator, should suggest a fixed agenda for such a meeting to secure a good dialogue between the operator and the customer. A Quality Assurance meeting could also be established within the company under the auspices of training, see 6.6d). This would provide a forum for discussing issues arising from the process data collected and customer satisfaction responses related to Quality Assurance [4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14 and 15].

6.7 Step 6 – Routines for separate handling nonconforming materials and biofuels

<table>
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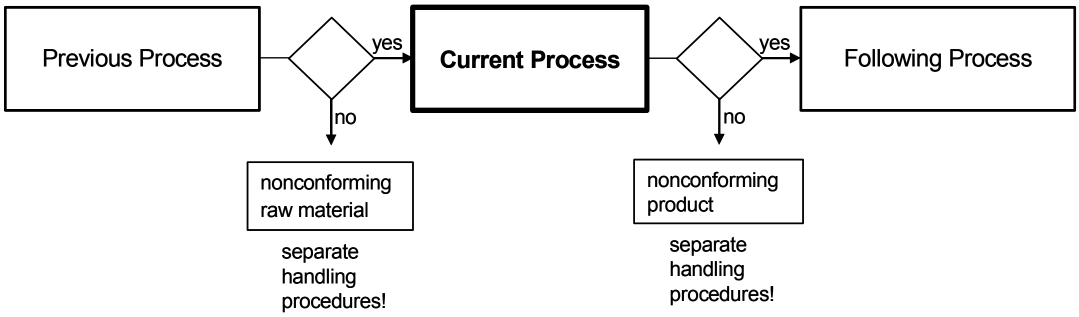
Routines for separate handling of nonconforming materials and biofuels

</td></tr>
<tr><td>Description</td><td>What to do?</td><td>Guidance/Recommended actions</td></tr>
<tr><td>Nonconforming materials and biofuels</td><td>Identify nonconforming materials and biofuels and select the appropriate measures for separate handling of the materials</td><td>Identify nonconforming materials and biofuels and select appropriate measures for the handling and detailing procedures for processing the nonconforming item(s).</td></tr>
</table>

Supporting information for Step 6 – Routines for separate handling of nonconforming materials and biofuels

If the visual or other sensory inspections/tests of the raw material or biofuel does not conform to specification, that load shall be immediately rejected. Loads that have been tipped in a temporary storage area, and for which test results show nonconformity, should be removed from the temporary storage area or suitably segregated. By confining the material or biofuel initially, it allows a decision to be made as to whether it can be utilised in another process or be redefined as a different product, or has to be discarded.

NOTE Examples for routines of separate handling of nonconformity of pellets, olive cakes, wood chips, hog fuel and straw bales are given in Annex B of CEN/TS 15234:2006. Additionally a form for documenting nonconformity is given in Annex D of CEN/TS 15234:2006.

Annex A
(informative)

EN ISO 9001:2008 – Useful cross references within this guide

This appendix helps the user of this guide to interpret the requirements of EN ISO 9001:2008 by providing references to EN ISO 9001:2008 in the above text. It ensures that the method described in this guide can be integrated in an existing EN ISO 9001:2008 Quality Management system where necessary. For some of the issues listed in Table A1, a general approach is sufficient, while the approach for other issues is inherently associated with the specific characteristics of solid biofuels. For further assistance please refer to EN ISO 9004:2000 [3].

Table A1 - Quality Management system requirements in ISO 9001, with general or specific approaches

Quality system requirements in EN ISO 9001:2008	General or *specific* approach for solid biofuels	References for *specific* approaches to (sub)-chapters above
4. Quality Management system		
4.1. General requirements	General	
4.2. Documentation requirements	*Specific*	*Table 1, 6.5, 6.6c*
5. Management responsibilities		
5.1. Management commitment	General	
5.2. Customer focus	*Specific*	*6.3, 6.6e, 6.6g, 6.6i*
5.3. Quality policy	General	
5.4. Planning	General	
5.5. Responsibility, authority and communication	*Specific*	*6.4e, 6.6a*
5.6. Management review	General	
6. Resource management		
6.1 Provision of resources	General	
6.2 Human resources	*Specific*	*6.4f, 6.6d*
6.3 Infrastructure	*Specific*	*6.4c*
6.4 Work environment	*Specific*	*6.4c*
7. Product realisation		
7.1 Planning of product realisation	*Specific*	*6.2, 6.3, 6.4*
7.2 Customer related processes	*Specific*	*6.3, 6.4*
7.3 Design and development	*Specific*	*6.4*
7.4 Purchasing	*Specific*	*6.3, 6.5*
7.5 Production and service provision	General	
7.6 Control of monitoring and measuring devices	*Specific*	*6.5*
8. Measurement, analysis and improvement		
8.1 General	General	
8.2 Monitoring and measurement	*Specific*	*6.6e, 6.6g, 6.6i*
8.3 Control of nonconforming product	*Specific*	*6.7*
8.4 Analysis of data	*Specific*	*6.6e, 6.6f, 6.6h, 6.6i*
8.5 Improvement	General	

Annex B
(informative)

List of CEN/TC 335 Technical Specifications

Terminology

CEN/TS 14588, Solid biofuels — Terminology, definitions and descriptions

Fuel specifications and classes, fuel quality assurance

CEN/TS 14961, Solid biofuels — Fuel specifications and classes

CEN/TS 15234, Solid Biofuels — Fuel quality assurance

CEN/TR:15569, Solid Biofuels — A guide for a quality assurance system,

Sampling and sample reduction

CEN/TS 14778-1, Solid Biofuels — Sampling — Part 1: Methods for sampling

CEN/TS 14778-2, Solid Biofuels — Sampling — Part 2: Methods of sampling particulate material transported in lorries

CEN/TS 14779, Solid Biofuels — Sampling — Methods for preparing sampling plans and sampling certificates

CEN/TS 14780, Solid Biofuels — Methods for sample preparation

Mechanical and physical properties

CEN/TS 14774-1, Solid biofuels — Methods for the determination of moisture content — Oven dry method — Part 1: Total moisture — Reference method.

CEN/TS 14774-2, Solid biofuels — Methods for the determination of moisture content — Oven dry method — Part 2: Total moisture — Simplified method

CEN/TS 14774-3, Solid biofuels — Methods for the determination of moisture content — Oven dry method — Part 3: Moisture for general analysis sample

CEN/TS 14775, Solid biofuels — Method for the determination of ash content

CEN/TS 14918, Solid Biofuels — Method for the determination of calorific value

CEN/TS 15103, Solid Biofuels — Methods for the determination of bulk density

CEN/TS 15148, Solid Biofuels — Methods for determination of the content of volatile matter.

CEN/TS 15149-1, Solid Biofuels. Methods for the determination of particle size distribution — Part 1: Oscillating screen method using sieve apertures of 3,15 mm and above

CEN/TS 15149-2, Solid Biofuels — Methods for the determination of particle size distribution — Part 2: Vibrating screen method using sieve apertures of 3,15 mm and below

CEN/TS 15149-3, Solid Biofuels — Methods for determination of particle size distribution — Part 3: Rotary screen method

CEN/ TS 15150, Solid Biofuels — Methods for the determination of the particle density

CEN/TS 15210-1, Solid Biofuels — Methods for the determination of mechanical durability of pellets and briquettes — Part 1: Pellets

CEN/TS 15210-2, Solid Biofuels — Methods for the determination of mechanical durability of pellets and briquettes — Part 2: Briquettes

CEN/TS 15370-1, Solid Biofuels — Method for the determination of ash melting behaviour — Part 1: Characteristic temperatures method

WI00335024, Solid Biofuels — Methods for the determination of bridging properties

WI00335032, Solid Biofuels — Method for determination of particle size distribution of disintegrated pellets

Chemical properties

CEN/TS 15104, Solid Biofuels — Determination of total content of carbon, hydrogen and nitrogen — Instrumental methods

CEN/TS 15105, Solid Biofuels — Methods for the determination of the water soluble content of chloride, sodium and potassium

CEN/TS 15289, Solid Biofuels — Determination of total content of sulphur and chlorine

CEN/TS 15290, Solid Biofuels — Determination of major elements

CEN/TS 15296, Solid Biofuels — Calculation of analyses to different bases

CEN/TS 15297, Solid Biofuels — Determination of minor elements

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