



## Solid Biofuels Bulletin No. 4

# GRADED WOOD PELLETS



This bulletin, fourth in a series, introduces the different grades of wood pellets, their appropriate use and the important parameters that can affect the fuel characteristics. It provides information on the graded wood pellets as specified in the CAN/CSA-ISO 17225 Part 2: Graded wood pellets.

Wood pellets are a highly consistent biomass fuel allowing for easy handling and storage, as well as efficient energy conversion.

As a globally traded commodity, wood pellets are used for space heating in residential appliances, boilers, district heating plants and for electricity generation in large coal-burning power plants.

Wood pellets are small densified cylindrical granules produced by compression of sawdust. As a result, wood pellets are a consistent fuel that can easily be transported and are suited for automated fuel handling systems.

## Origins and Sources

Wood pellets are mainly produced from the by-products of traditional forestry operations such as sawmills and finished wood products manufacturing. Harvest residues are also used as raw material though to a much lesser extent. The highest quality sources tend to come from milling and manufacturing residues with little or no bark or ash content.

The CAN/CSA-ISO 17225 Part 2 Standard<sup>1</sup> classifies several grades of wood pellets based on the origins and source of raw materials. Raw biomass used in the production of high grade wood pellets, Grades A1 and A2 (residential or commercial applications), primarily comes from mill residues including sawdust, shavings and cut-offs (Classification 1.2.1) and stem wood (Classification 1.1.3). In addition to the above sources, Grade A2 allows for the use of logging residues (Classification 1.1.4) and whole trees without roots (Classification 1.1.1)<sup>2</sup>.

Sources of the raw biomass impacts fuel specifications. For example, A1 grade wood pellets contain low ash and nitrogen contents, while Grade A2 wood pellets have slightly higher ash and nitrogen content.

Grade B wood pellets are manufactured from more diverse sources, over and above those used for Grade A wood pellets, and can include bark (Classification 1.1.6), residues from thinning, pruning, and arboriculture operations in city parks (Classification 1.1.7), and chemically untreated used wood (Classification 1.3.1).

### Wood Pellets



The CAN/CSA-ISO 17225 Part 2 Standard also specifies Industrial Grade (I1, I2, I3) wood pellets based on origins, sources and properties, but these are outside the scope for this bulletin.

Both softwood and hardwood tree species can be sourced for wood pellets. It is anticipated that purposely grown woody crops such as poplar and willow grown on marginally productive land may be sourced for wood pellet production in the future. For further details on the origins and sources, refer to Natural Resources Canada Solid Biofuels Bulletin No.2 – Primer for Solid Biofuels<sup>2</sup>.

## Key Properties

The production of pellets starts with size reduction of the raw biomass source followed by drying. The material is then extruded under high pressure in pellet machines coming out as small cylinders typically with a 6 or 8 mm diameter, and a length of up to 40 mm. Small amounts of additives and binders can be blended with biomass material to improve the quality of wood pellets, though this is not common in Canada.

A buyer or user of graded wood pellets should consider several quality characteristics:

- **Diameter and Length (D and L)** – tested in the lab or production site. Two alternative diameters are produced: 6 mm and 8 mm ( $\pm 1$  mm). The length of the individual wood pellets should be larger than 3.15 mm, and less than or equal to 40 mm ( $3.15 < L \leq 40$  mm) with the maximum length not exceeding 45mm. The quantity of pellets longer than 40 mm can be up to 1% in weight.
- **Durability (DU) and Fines (F)** – determined in the lab by tumbling and screening the pellets. After tumbling, the quantity of pellets (in weight %) staying on the screening with the screen opening size greater than 3.15 mm determines the durability. The quantity of pellets passing through the screen with less than 3.15 mm opening size is defined as fines. Pellets handled in large quantities (bulk) experience some attrition, resulting in higher content of fines.
- **Bulk Density (BD)** – tested in the lab to provide guidance for sizing the storage space based on energy consumption needs. Minimum bulk density should be greater than or equal to 600 kg/m<sup>3</sup>. The actual bulk density of the pellets is often stated by the producer on the packaging. Rough estimates of bulk density can be made by weighing a known volume. When testing density, attempts should be made to minimize the void space between pellets by shaking and tapping pellets well.
- **Calorific value (Q) and Moisture Content (M)** – measured by lab testing. All grades of wood pellets must have moisture content less than 10% and a high calorific value greater than or equal to 18.6 MJ/kg (or low heating value of greater than or equal to 16.5 MJ/kg).
- **Ash Content (A)** – tested in the lab. For residential and commercial applications, ash content is low and increases from Grade A1 to A2 to B (Table 1). For residential stoves, furnaces and boilers, it is recommended to use wood pellets with low ash content.

**TABLE 1.** Key specifications of graded wood pellets based on the CAN/CSA-ISO 17225 Part 2 Standard

Property Class	Unit	Grade A1*	Grade A2*	Grade B*
Diameter, D	mm	6 $\pm$ 1 or 8 $\pm$ 1	6 $\pm$ 1 or 8 $\pm$ 1	6 $\pm$ 1 or 8 $\pm$ 1
Length**, L	mm	3.15 $\leq$ L $\leq$ 40	3.15 $\leq$ L $\leq$ 40	3.15 $\leq$ L $\leq$ 40
Moisture, M	% of weight	$\leq$ 10	$\leq$ 10	$\leq$ 10
Ash, A	% of weight	$\leq$ 0.7	$\leq$ 1.2	$\leq$ 2.0
Durability, DU	% of weight	$\geq$ 97.5	$\geq$ 97.5	$\geq$ 96.5
Fines Content, F	% of weight	$\leq$ 1	$\leq$ 1	$\leq$ 1
High Calorific Value, Q	MJ/kg	$\geq$ 18.6	$\geq$ 18.6	$\geq$ 18.6
Bulk Density, BD	kg/m <sup>3</sup>	600 $\leq$ BD $\leq$ 750	600 $\leq$ BD $\leq$ 750	600 $\leq$ BD $\leq$ 750

\* Suitable for residential and commercial applications.

\*\*Maximum length of wood pellets shall be  $\leq$  45 mm. Amount of pellets longer than 40 mm can be 5% weight. Further restrictions may be stipulated by the supplier of the combustion equipment regarding ash characteristics of the pellets, such as ash melting temperature, to minimize damage to equipment.

## Specifications of Properties for Graded Wood Pellets

Graded wood pellets conform to specific feedstock sources as well as the quality requirements as stipulated in the CAN/CSA-ISO 17225 Part 2 Standard. Table 1 shows various properties and specifications for Graded wood pellets as detailed in the CAN/CSA-ISO 17225 Part 2: Graded wood pellets. A family of CAN/CSA-ISO testing standards is available to confirm compliance of the wood pellets with the grade, see Bulletin No.3 – CAN/CSA-ISO Solid Biofuels Standards<sup>2</sup>.

## Certification of Wood Pellets

The European certification ENplus<sup>3</sup> for wood pellets was adopted in Canada in 2013 under the acronym CANplus<sup>4</sup>. The ENplus and CANplus seals account for the whole wood pellet supply chain, from production to delivery to the final customer, to ensure high quality. Both ENplus and CANplus schemes define wood pellet quality classes following the ISO 17225 Part 2 Standard: A1, A2 and B. Examples of the two certification system logos are shown below:



Pellet Fuel Institute (PFI) in the USA has also developed standard specifications for residential and commercial grade wood pellets<sup>5</sup>. The PFI wood pellet standard forms the basis of a third party accredited certification program. While the ENplus, CANplus or PFI certifications are mandatory in the USA, the certification under ENplus and CANplus are currently voluntary in Canada (except Quebec<sup>7</sup>). Quebec requires wood pellets used in residential appliances to meet the same certification requirements set in the USA.

## Safe Handling and Storage of Wood Pellets

Wood pellets require closed storage, such as silos or storage tanks to keep them dry. During storage, chemical, physical and biological processes can take place including water absorption, off-gassing, oxygen depletion and self heating. Off-gassing can lead to production of toxic gases including carbon monoxide (CO) which is a poisonous, odorless, tasteless and non-irritating gas. As a result, bulk storage spaces need to be well ventilated with

exhaust away from areas where people are present. As an additional safety measure CO detectors should be installed in and around the storage area. Personal protective equipment should be worn if entry into large storage areas is necessary.

Temperature measurements in large storage piles are recommended to monitor heat build up.

Dust can be generated while handling wood pellets. In large volumes dust may cause respiratory problems if inhaled, and constitutes a risk for fires and explosions. An extensive Safety Data Sheet (SDS) is available for wood pellets in bags and there is a separate SDS for wood pellets in bulk. SDS documents contain information on the potential hazards (health, fire reactivity and environmental) and how to work safely with wood pellets.

Standards and guidelines for safe handling and storage of wood pellets of all scales are currently under development by ISO/Technical Committee 238<sup>6</sup>.

## References & Links

1. CSA Group – [www.csagroup.org](http://www.csagroup.org) for the CAN/CSA-ISO 17225 Solid Biofuels-Fuel specifications and classes – Part 1 General Requirements and Part 2 Graded wood pellets.
2. Natural Resources Canada – [www.nrcan.gc.ca](http://www.nrcan.gc.ca) for the Solid Biofuels Bulletins Series.
3. European Pellet Council <http://www.pelletcouncil.eu>
4. Wood Pellet Association of Canada <http://www.pellet.org>
5. Pellet Fuels Institute <http://www.pelletheat.org>
6. ISO Technical Committee 238 Solid Biofuels [http://www.iso.org/iso/iso\\_technical\\_committee%3Fcommid%3D554401](http://www.iso.org/iso/iso_technical_committee%3Fcommid%3D554401)
7. <http://legisquebec.gouv.qc.ca/en/ShowDoc/cr/Q-2,%20r.%201>

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