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Information paper on EN 15316-3-3 Domestic Hot Water systems - Generation

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Domestic Hot Water (DHW) generation efficiencies range from 50% for old heaters to 90% for modern combi-boilers. In older systems, with an external storage tank, the DHW efficiency can go down to 25%. Major gains in energy reduction may easily be obtained by proper generator selection.

This paper gives a short introduction to the CEN standard EN 15316-3-3, calculating the losses from domestic hot water generation systems. It contains explanations on the calculation methods with details on the input and output data and on links with the other CEN standards.

1 > Scope of the standard

The standard gives methods for the calculation of heat losses, recoverable heat losses and the auxiliary energy of the domestic hot water generation system. The standard is the third part of a series of three standards for the calculation of domestic hot water system energy requirements and system efficiencies (see figure 1). The other standards deal with DHW requirements (EN 15316-3-1) and with DHW distribution systems (EN 15316-3-2). Solar systems are treated in EN 15316-4-3.

2 > Principle of the methods

Domestic hot water generation systems may consist of:

- Complete appliances of different types for single-family dwellings, including direct heated storage water heaters.
- Component-based appliances, including storage vessels, primary circulation pipes and heat generators.

Complete appliances for single-family dwellings may be gas-, oil-, wood- or biomass-fired, electrically heated or heated using a heat pump. Their DHW function may be independent (solo hot water heater) or combined with the heating function (combi-boiler). DHW may be heated directly (i.e. instantaneously) or indirectly, using a storage vessel. The efficiency and losses of all these appliances can be measured, applying one or more 24-hr test tapping patterns, in the way described by EN 13203-2. The efficiency and losses resulting from other patterns of usage may be found by interpolation or by using a correction factor.

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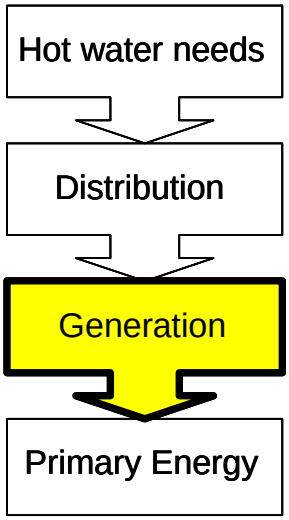

Figure 1: The calculation of hot water generation (losses and efficiency) is the last step in the DHW Energy calculation

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Direct heated storage water heaters may be used in all types of installation. Examples are direct gas- or oil-fired storage heaters and electric immersion heaters. The standard gives a method, based on laboratory measurements.

Component based appliances are in general indirectly heated storage systems. The efficiency and losses of all these appliances are determined by calculations for each component for the given hot water demand.

The heat requirement that must be fulfilled by the DHW generator is the sum of:

- domestic hot water requirements, according to EN 15316-3-1;
- heat losses from the distribution system, according to EN 15316-3-2.

This heat requirement may be reduced by the heat provided by a solar system.

If the heat generator also provides space heating, the performance of the heat generator should be calculated separately for operation during the summer period, when the space heating demand is zero, and the winter period, when both space heating and domestic hot water are provided.

Required inputs depend on the methods.

Resulting outputs are:

- heat losses in MJ/day or MJ/year and/or
- the annual efficiency of the DHW generator
- the recoverable heat losses
- the auxiliary energy.

The methods are set out below. For most methods a national annex is required, providing default values.

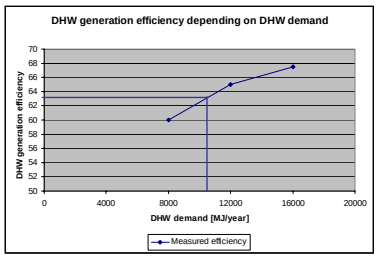

Figure 2: Example of the interpolation between measured efficiencies to obtain the efficiency for the DHW heat requirement.

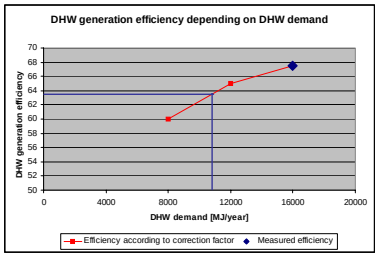

Figure 3: Example of the use of the correction factor for measured efficiencies to obtain the efficiency for the DHW heat requirement.

3 > Complete appliances

Complete appliances for single family dwellings

This method is defined in clause 8 of EN 15316-3-3. It requires measurement of the generation efficiency achieved for one or more 24-hr test tapping patterns. The efficiency and losses for other DHW demands may be found by interpolation or by a correction factor, as illustrated in the side bar (see figure 2 and figure 3).

The correction factor approach requires a national annex.

Direct heated storage water heaters

The efficiency of a direct gas fired domestic storage water heater should be obtained from tests in accordance with EN 89. If no efficiency values are available, minimum values may be provided in a National Annex. These values should not be lower than the default values given in Annex B.

The efficiency of a direct electrically heated domestic storage water heater should be obtained from tests made in accordance with pr EN 50440.

The energy required to maintain the hot water temperature is assumed to be equal to the heat loss to the surroundings. The calculation method is described in Annex C. If values of the parameters for determining the stand-by heat loss are not available, default values must be provided in a National Annex.

For older systems, where no manufacturer's data is available and measurements cannot be made, the values to be used must be given in a National Annex.

4 > Component based appliances

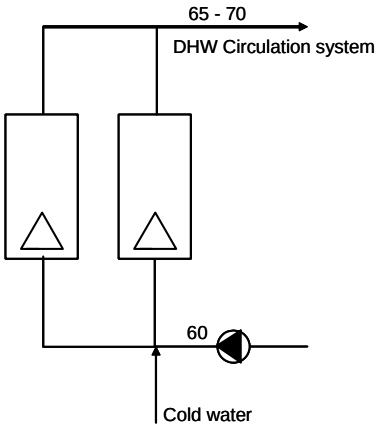

Figure 4: Example of a DHW generator with direct heated storage water heaters. The heat requirement is fulfilled by both heaters together.

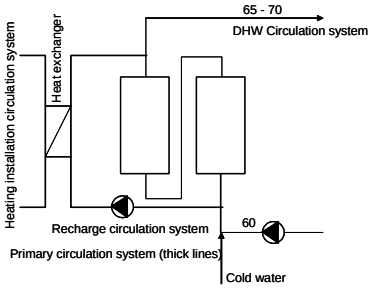

Figure 5: Example of a DHW generator with a heat exchanger and recharge circulation system.

Component based appliances are in general indirectly heated storage systems. Different types of system lay-out may occur, illustrated in the side bar (figures 4 and 5).

The efficiency and losses of all these appliances are determined by the calculation of the efficiency and losses of each component for the given hot water requirement.

Storage vessels

The method used to determine storage losses is defined in Section 6 of EN 15316-3-3. The storage heat loss is calculated from a stand-by heat loss value, which is corrected for temperature difference. If no measured standby loss values are available, default values from a national annex may be applied, based on storage volume and insulation type and thickness.

Primary circulation pipes

Primary circulation pipes are discussed in Section 7 of EN 15316-3-3. Primary circulation systems are often equipped with a heat exchanger and with a recharge circulation system (see Figure 5). Other configurations may occur. Circulation systems may be operated continuously or at intervals.

A simple method for estimating the heat losses from primary circulation pipes is to use a fixed representative value. Appropriate values must be given in a National Annex.

Detailed methods for calculating the heat loss from pipes are given in EN15316-3-2 (see Information Paper P100). These methods should be followed for calculating the heat loss from primary circulation pipes. If possible, the actual length of the pipes should be used. If no detailed pipe network plan is available, representative values can be used. These values must be given in a National Annex

Heat generators

The total heat loss from a boiler is based on the nominal output efficiency, the stand-by heat loss and the nominal heat output. The calculation method is given in Annex A.

A National Annex may specify default values, if specific test results are not available. For older boilers, for which the efficiency and the stand-by heat loss values may not be known, values may be given in a National Annex.

Auxiliary energy

This method is defined in Section 9 of EN 15316-3-3. Electrical energy is required for the circulation pump(s).

If the circulation pump is contained within the heat generator, the energy required is considered as part of the auxiliary energy for the heat generator. The auxiliary energy measurement, made in accordance with an appropriate appliance standard for the heat generator, should then be used.

If a separate circulation pump is applied, the auxiliary energy requirement should be determined separately. The circulation pump may also be used in the space heating system. Care must be taken to avoid duplicating the energy requirement.

A simplified estimation method or a detailed calculation method may be applied. Methods for calculating the auxiliary energy for circulation loops are given in pr EN15316-3-2 (see information paper P100). Details and default values to be used will be given in a National Annex.

5 > FAQ

What is the relevance of DHW generation efficiencies in total DHW energy needs?

Domestic Hot Water (DHW) generation efficiencies range from 50% for old heaters to 90% for modern combi-boilers. In older systems, with an external storage tank, the DHW efficiency can go down to 25%. Major gains in energy reduction may easily be obtained by proper generator selection.

Is a national annex required for this standard?

Yes it is. Each country must provide appropriate default values for both methods, especially for existing DHW generators, because these values may differ between countries.

Have the methods been validated?

Basically yes. Both methods are based on well-established physical principles.

For complete appliances, efficiencies are measured using realistic tapping patterns. For the component method, accuracy is dependent on correct assessment of the heat loss coefficients of vessels and pipes.

6 > References

1. EN 15316-3-1 Domestic Hot Water systems – Characterisation of needs (tapping requirements)
2. EN 15316-3-2 Domestic Hot Water systems – Distribution
3. EN 15316-3-3 Domestic Hot Water systems – Generation
4. EN 15316-4-3 Energy requirements and efficiencies of thermal solar systems
5. EN 13203-2 Gas-fired domestic appliances producing hot water. Appliances not exceeding 70 kW heat input and 300 l water storage capacity. Assessment of energy consumption
6. EN 89 Gas-fired storage water heaters for sanitary use
7. prEN 50440 Efficiency of domestic electrical storage water heaters

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