ANTICSS Project
Deliverable D14 (D4.1):

Alternative test methods and approaches to unmask circumvention under EU Ecodesign and Energy labelling

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1 About the ANTICSS project

Objective of the research project ‘Anti-Circumvention of Standards for better market Surveillance (ANTICSS)’ is to assess and clearly define ‘circumvention’ in relation to EU Ecodesign and Energy labelling legislation and relevant harmonised standards.

The analysis of circumvention will be based on collecting and learning from cases of circumvention by literature research and dedicated expert interviews, as well as analysing existing EU Ecodesign and Energy labelling legislation and standardisation for possible loopholes. Also the potential relation between circumvention and so called ‘smart’ products with specific embedded software will be addressed by the project. Alternative test procedures to better detect circumvention by testing shall be developed and through testing a certain number of appliances within the ANTICSS project, the impacts 'if' and 'how much' energy consumption and/or functional performance modifications could be ascribed to circumvention will be assessed.

Based on the results, ANTICSS will provide practical capacity building measures for key actors of market surveillance and test laboratories, support communication and collaboration platforms between major stakeholders and provide policy recommendations for policy makers and standardisation bodies to prevent future circumvention under EU Ecodesign and Energy labelling. ANTICSS project is also designed to provide reliability to manufacturers by specifying potentially vague legislation and standards which might be interpreted differently by market actors and some of them taking unfair advantages so far. By overall awareness raising on circumvention among stakeholders, ANTICSS is supporting an effective EU legislation enforcement and thus increasing acceptance and trust of market actors and civil society into the Ecodesign and Energy labelling legislation.

Figure 1: ANTICSS Work Packages
2 ANTI CSS definition of circumvention and jeopardy effects

For better understanding, first the underlying ANTI CSS definitions of ‘circumvention’ and ‘jeopardy effects’ in relation to EU Ecodesign and Energy labelling legislation and related harmonised standards are presented. These definitions build the basis for the research within the ANTI CSS project, namely the categorisation of collected suspect behaviour cases and the assessment of circumvention impacts in laboratory testing1.

**DEFINITION OF ‘CIRCUMVENTION’**

„Circumvention is the act of designing a product or prescribing test instructions, leading to an alteration of the behaviour or the properties of the product, specifically in the test situation, in order to reach more favourable results for any of the parameters specified in the relevant delegated or implemented act, or included in any of the documentations provided for the product.”

The act of circumvention is relevant only under test conditions and can be executed e.g.

a) by automatic detection of the test situation and alteration of the product performance and/or resource consumption during test, or

b) by pre-set or manual alteration of the product, affecting performance and/or resource consumption during test or

c) by pre-set alteration of the performance within a short period after putting the product into service.

**DEFINITION OF ‘JEOPARDY EFFECTS’**

„Jeopardy effects encompass all aspects of products or test instructions, or interpretation of test results, which do not follow the goal of the EU ecodesign and/or energy labelling legislation of setting ecodesign requirements and providing reliable information about the resource consumption and/or performance of a product. These effects may not be classified as circumvention, but become possible due to loopholes or other weaknesses in standards or regulations.”

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1 Further details and examples can be found in the ANTI CSS Deliverable D8 “Definition of ‘circumvention’ and ‘jeopardy effects’ in relation to EU Ecodesign and Energy labelling legislation”, see https://www.anticircumvention.eu/storage/app/media/uploaded-files/D08_ANTICSS_Final-definitions_circumvention.pdf
3 Goal and approach of this work package

Objective of the current ANTICSS work package WP4 (“Assessment of circumvention impacts in laboratory testing”) is to analyse in detail those product categories that were pre-selected in the previous work package WP3 (“Detailed preparation for the investigation of concrete circumvention cases”), cf. section 2.1. This includes the further assessment of those reported cases being assigned by the ANTISS project team as circumvention or jeopardy effects, to decide about their potential for testing; followed by the development of alternative test procedures and the selection of models to be purchased for testing within ANTICSS for the following goals:

- Analysis whether the specific circumvention can be confirmed in laboratory tests through application of alternative test methods, and
- Assessing the magnitude respectively the impact of the circumvention in terms of effects on energy consumption and functional performance.

The results will be further fed into the next ANTICSS work packages as follows:

- Analysis of strategies how the specific circumvention approaches can easily be detected in the testing as basis for capacity building of MSAs in work package WP5 (“Capacity building for key actors in market surveillance”);
- Development of strategies and guidelines on how to prevent the specific types of circumvention by revision of standards and relevant legislation in work package WP6 (“Conclusions from circumvention investigation and policy recommendations”);
- Preparation of results and reports to be used for communication to stakeholders and the public in work package WP7 (“Dissemination and communications”).

3.1 Product categories pre-selected for alternative testing

Following to the projects´ team own knowledge, analysis of legislation and expert studies, and based on the cases of circumvention collected from stakeholders, at the end of the previous work package WP3, the ANTICSS project team has initially decided on 10 product categories to be tested by the

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2 During the period February to June 2019, the ANTICSS project team has organised a broad stakeholder consultation, approaching in total 278 experts from suppliers, market surveillance authorities, test laboratories as well as consumer and environmental NGOs to gain evidence or further insight into circumvention cases and feedback to the preliminary ANTICSS definitions of circumvention and jeopardy effects. In total, 38 organisations have provided their feedback and more than 30 specific samples of “suspect” product cases have been reported. The ANTICSS project team analysed these cases in detail to assess their allocation to the categories ‘circumvention’, ‘jeopardy effects’, ‘non-compliant’ or ‘compliant’.
Alternative test methods and approaches to unmask circumvention

The reported cases in these ten product categories have been analysed in further detail by the test laboratories being partners in the ANTICSS project team, applying a common procedure (cf. section 2.2). Based on the analysis (cf. section 3) as well as the ability to find products on the market equipped with certain technical features increasing the likelihood of circumvention, a final selection of product categories and cases has taken place (cf. section 4).

For these product categories and cases, in the following tasks of work package WP4, a number of certain product models will be purchased which shall then be tested within ANTICSS applying the alternative test procedures. The alternative test methods will be used to measure and calculate the same parameters as in the harmonised test methods but using a slightly different approach or test conditions with the aim to identify and by-pass any possible circumvention.

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3 Detailed background information about the applied approach for selecting these product categories can be found here: [https://www.anti-circumvention.eu/storage/app/media/uploaded-files/D13_ANTICSS_List-of-product-categories-for-testing.pdf](https://www.anti-circumvention.eu/storage/app/media/uploaded-files/D13_ANTICSS_List-of-product-categories-for-testing.pdf)

4 See separate Deliverable D4.2 „Model selection procedure“ published on [www.anti-circumvention.eu](http://www.anti-circumvention.eu)
3.2 Common procedure applied to all pre-selected product categories

For each of the product categories selected for alternative testing (see Table 1), the following steps were considered:

**Detailed analysis of the ‘circumvention’ and ‘jeopardy effects’ cases in each of the ten product categories to facilitate the model selection**

In each of the ten product categories, those cases collected in the previous work packages that were finally assigned by the ANTICSS project team to be either “circumvention (CV)” or a “jeopardy effect”, were analysed in detail in order to facilitate the following model selection for the testing in ANTICSS:

- Availability of information about the specific model or brand of the reported cases of circumvention or jeopardy effect?
- Specific technical features and/or constructive aspects of appliances that are related to the issue of circumvention or jeopardy effect?
- Any other specific conditions, test instructions or parameters that are related to the issue of circumvention or jeopardy effect (e.g. specific preparation requests in test instructions)?

**Detailed analysis of the Ecodesign or Energy label regulations, harmonised standards and/or transitional measurement methods**

For each of the ten product categories, the Ecodesign and Energy label regulation in force as well as the according harmonised standards or transitional measurement methods were selected. For some product categories, revisions of the Ecodesign and/or Energy label regulations and the corresponding test standards are announced. In these cases, the revised documents were also analysed to assess if they already address (and ideally solve) the issue of circumvention or jeopardy effect. If so, the respective cases were not chosen for testing in ANTICSS anymore. Even if the regulations and respective standards will come into force only in near future and the case of circumvention or jeopardy effect might still be applied at some products being on the market up to that time, possible impacts on the reduction of circumvention cannot be clearly assigned to the effects of the ANTICSS project then.

The analysis might also provide the result that the reported case is not feasible for testing in ANTICSS, e.g. if the initial categorization into circumvention or jeopardy effect does not withstand the detailed assessment, or if the issue seems to be irrelevant compared to other cases.

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Development of alternative test method(s)

The Ecodesign or Energy label regulations, harmonised standards and/or transitional measurement methods being currently in force\(^6\) for the product categories were taken as basis for developing alternative test procedures.

**Note:** For some product categories, already other alternative test procedures have been or are currently being developed by other organisations\(^7\).

If known and available, these test methods have been analysed if they could serve the purposes of ANTICSS as well. However, most of these tests were developed with the aim to **better represent the appliances’ use under real life conditions compared to the current standard test procedures. In contrast, the proposed ANTICSS alternative test procedures were designed to specifically address and unmask the appliances’ reported behaviour of circumvention or jeopardy effect.**

General examples, how the ANTICSS alternative test procedures specifically address the circumvention or jeopardy effects behaviour, see Table 2:

<table>
<thead>
<tr>
<th>Standard test condition</th>
<th>Potential circumvention</th>
<th>ANTICSS alternative test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rather fix ambient conditions (e.g. narrow voltage, frequency, or temperature ranges)</td>
<td>Appliances might be programmed in a way to detect being under standard test and automatically alter the behaviour or the properties specifically in the test situation then.</td>
<td>Slight variation of the ambient conditions.</td>
</tr>
<tr>
<td>Possibility of specific instructions or accessories applicable under standard test only</td>
<td>Appliances might achieve the labelled performance parameters only under test conditions.</td>
<td>Testing without the specific instructions or accessories.</td>
</tr>
<tr>
<td>Cycle based appliances to be tested for a defined number of test rounds as specified in the related standards</td>
<td>Appliances might be programmed in a way to perform the pre-set number of cycles with consuming significantly less resources and automatically alter the properties after this number of standard cycles.</td>
<td>Testing a certain number of cycles beyond the defined number of standard cycles.</td>
</tr>
</tbody>
</table>

\(^6\) All cases of circumvention or jeopardy effects reported to ANTICSS were related to the current regulations and standards. Also, the appliances on the market at the time of purchasing for the ANTICSS testing (December 2019) are still designed according to the current standards and regulations.

\(^7\) CLASP's Europe program has developed a new ten-minute test video which can serve to measure energy consumption of HDR televisions, and to function as an alternative test clip to the existing IEC 62087:2015 test video. This new HDR video was developed as part of a project called “Smart Testing of Energy Products” (STEP), which is funded by the ClimateWorks Foundation and the European Climate Foundation. The alternative test video takes into account and better reflects normal program content compared to the IEC 62087 standard test sequence. For more details, see [https://clasp.ngo/updates/2016/new-video-test-sequence-for-televisions](https://clasp.ngo/updates/2016/new-video-test-sequence-for-televisions)
With the alternative approaches those parameters of the standard that might be related to circumventing were varied. Note: It has to be taken into account that the validation of the alternative test methods proposed and applied within ANTICSS has not been performed so no indications on reproducibility and repeatability are currently available. Further, it is formally not possible to directly compare the measured energy consumption of the alternative test procedure with the results of the reference test. Differences might be rather small. However, some unexpected, abnormal changes in performance results might be a hint on circumvention. Depending on the results, the ANTICSS project team would have to assess a certain minimum difference beyond which the likelihood of circumvention increases.

In the following sections, for the ten product categories, each the cases of circumvention or jeopardy effects that were initially chosen for testing in ANTICSS as well as the proposed alternative test procedures to approach and detect the specific suspect behaviour are described in detail. At this stage, the proposed alternative testing methods are still theoretically; if necessary, e.g. in case of unexpected reactions during testing, they might be refined or adapted accordingly.

**Model selection and final decision on products to be tested within ANTICSS**

Based on the detailed analysis of the cases and proposal of alternative test procedures, in parallel the possibility to find products on the market equipped with certain technical features or any other specific conditions, test instructions or parameters that are related to the issue of circumvention or jeopardy effect was checked. If it was not possible to identify suitable products, it was finally decided not to choose the respective case for alternative testing within ANTICSS.

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8 See separate Deliverable D4.2 „Model selection procedure“ published on [www.anti-circumvention.eu](http://www.anti-circumvention.eu)
4 Detailed analysis and proposals for alternative test procedures

4.1 Space heaters

In the previous work packages of ANTICSS, two cases (numbered ‘Heaters 1’ and ‘Heaters 2’) were categorized as “jeopardy effect”. Within this work package, the cases were analysed to determine if they are appropriate to be selected for designing an alternative testing method.

Table 3: Summary of the two cases (jeopardy effects) reported in ANTICSS for the product category space heaters

<table>
<thead>
<tr>
<th>Case no.</th>
<th>Suspicious behaviour as reported to ANTICSS</th>
<th>ANTICSS categorisation</th>
<th>Case selected for designing an alternative test method?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heaters 1</td>
<td>Gas boilers and combi-boilers could be placed on the market with two possible installation configurations. The first configuration is a more classic configuration for a condensing boiler, where the connection with a condensation disposal system (drain tube or collection tank) is foreseen. The second configuration is an alternative configuration, where a by-pass, supplied by the boiler manufacturer with full installation and regulation instructions, is foreseen between the supply and return heat transfer fluid pipes, to decrease the condensation formation. As a result, a &quot;condensing boiler&quot; might become a &quot;quasi non-condensing boiler&quot; or &quot;non-condensing boiler&quot; with less condensation or even no condensation produced. However, since non-condensing boilers are less energy efficient than condensing ones and non-compliant with the ecodesign minimum efficiency requirements, the second configuration might result in potentially non-compliant boilers being placed on the market and installed in households.</td>
<td>Jeopardy effect</td>
<td>Yes</td>
</tr>
<tr>
<td>Heaters 2</td>
<td>The test methods for determination of the capacity and efficiency at for air-to-air heat pumps are described in the standard EN 14511. The standard EN14825 describes calculation methods to determine the averaged performance during the heating season, the Seasonal Coefficient of Performance (SCOP) factor. In case frosting takes place on the outdoor unit during the test, both the heating and defrosting period is included in the evaluation of the test.</td>
<td>Jeopardy effect</td>
<td>Yes</td>
</tr>
</tbody>
</table>
However, the evaluation period is limited to maximal three hours to limit the cost of the tests. The rated heat output (with corresponding efficiencies) that are used in the calculations can be defined freely (with some limitations) by the manufacturer. The efficiency of a heat pump normally increases with lower capacity, down to a certain limit. Therefore, to be able to declare the heat pump with a high efficiency on the Energy Label, it might be beneficial to declare the heat pump for a low capacity. In addition, according to the standards, if the manufacturer gives instructions for the setting of the frequency for the different test points, this setting shall be done.

In the reported case, it is suspected that the declared efficiencies for the products on the energy labels and supporting data sheets are considerably higher compared to what have been measured in real installations in the field, especially in cold and humid climates, which in such case would give the consumer misleading information.

### 4.1.1 Case Heaters 1: Condensing boilers with two possible installation configurations

The case ‘Heaters 1’ is relating to a condensing boiler or condensing combination boiler that is defined according to the regulations (EU) 811/2013 and 813/2013 as a boiler space heater or boiler combination heater in which, under normal operating conditions and at given operating water temperatures, the water vapour in the combustion products is partially condensed, in order to make use of the latent heat of this water vapour for heating purposes. The quantity of condensate is not defined, so independently of the amount of condensate the manufacturer can declare the boiler as a condensing boiler.

A standard gas-fired boiler works by burning natural gas in order to heat up the water; when natural gas is burned; the chemical reaction that takes place produces water vapour and carbon dioxide as by-products. These warm waste gases will travel through a flue and escape into the outside atmosphere, taking some valuable heat with them. Conventional boilers vary in efficiency from around 70 to 80%.

Condensing boilers, in comparison, can recover some of the heat that would usually be lost from the waste gases they give off. The waste gases travel through a heat exchanger, which cools and condenses them back into a liquid known as condensate. By doing this, it can recover some of the heat that would have otherwise been lost. The recovered heat is used to slightly warm up the cool water that returns from the radiators as it enters the boiler. A good condensing boiler can achieve energy efficiency of over 90%. Condensing boilers require an extra pipe to drain away the condensate liquid. Ideally this pipe should connect to an internal drain. If this isn’t possible it can be drained externally. The condensate is slightly acidic, so the pipe should be made of an appropriate material in order to prevent corrosion.
Figure 2 shows the basic principle of condensing and non-condensing boilers.

<table>
<thead>
<tr>
<th>Non-condensing boiler</th>
<th>Condensing boiler</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Non-condensing boiler diagram" /></td>
<td><img src="image2.png" alt="Condensing boiler diagram" /></td>
</tr>
</tbody>
</table>

Figure 2: Basic principle of a non-condensing and a condensing boiler

In ANTICSS, the reported case ‘Heaters 1’ shows the possibility to place a boiler on the market with two possible installation configurations. The first is a more classic configuration for a condensing boiler, where the connection with a condensation disposal system (drain tube or collection tank) is foreseen. The second configuration of the same appliance is an alternative configuration, where a by-pass, supplied by the boiler manufacturer with full installation and regulation instructions, is foreseen between the supply and return heat transfer fluid pipes, to decrease the condensation formation. As a result, a ‘condensing boiler’ might become a ‘quasi non-condensing boiler’ or a ‘non-condensing boiler’ with less or even no condensation produced. However, since non-condensing boilers are less energy efficient than condensing ones and non-compliant with the ecodesign minimum efficiency requirements, the second configuration might result in potentially non-compliant boilers being placed on the market and installed in households.

In order to analyse the case, also the Ecodesign and Energy labelling review study *Space and combination heaters – Review Study (July 2019) – Task 1*⁹ should be taken into consideration in which the problem of replacing non-condensing boilers (mainly so called C4 and C8 type boilers) connected to collective flues that operate under negative pressure and are not condensate-resistant was highlighted. Although the issue is comparable to that of so called B1 type boilers connected to a shared flue, the present regulation has not introduced lower efficiency limits for such non-

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condensing C4/C8 boilers. As a consequence, if a non-condensing C4/C8 boiler connected to a shared flue (designed to operate at negative pressure, and not condensate resistant) breaks down, this boiler cannot be replaced by a condensing boiler as that boiler operates under positive pressure and produces flue gases at lower temperatures, resulting in condensate within the chimney, possibly affecting the operation of other boilers connected to the same flue and the integrity of the flue duct.

As further consequence, the unavailability of non-condensing C4/C8 boilers for replacement has led to situations where improper installation of "modified" condensing boilers as described above occur.

It is to be underlined that the case was analysed in “GUIDELINES accompanying Regulation (EU) 811 & 812/2013, Regulation (EU) 813 & 814/2013 and Regulation (EU) 1187 & 1189/2015 (edition 2018)”¹⁰ and the following conclusion was achieved:

“Given that the product is placed on the market with two possible configurations, test reports should be available for both those configurations:

   For configuration 1: the more classic configuration for a condensing boiler, where the connection with a condensation disposal system (drain tube or collection tank) is foreseen;

   For configuration 2: the alternative configuration where a “bypass”, supplied by the boiler manufacturer with full installation and regulation instructions, is foreseen between the supply and return heat transfer fluid pipes, to decrease the condensation formation.

Both those 'products' need to be compliant with the Regulations 811/2013 and 813/2013, and two energy labels need to be provided. The values can be declared through two different product information sheets.

However, if the “bypass”, provided either as an accessory or directly with the boiler, does not directly or indirectly alter the energy efficiency of the boiler – but, for example, only modifies the distribution performance – it should not be considered as changing the boiler configuration. In this case, the boiler does not require any additional testing or additional conformity assessment, nor additional energy label(s) / declarations under Regulations 811/2013 and 813/2013. However, information about the function of the bypass should be provided, including information on why this does not alter the energy efficiency of the unit.”

PROPOSED ALTERNATIVE TESTING METHOD

According to the analysis of the previous sections, the parameter ‘seasonal space heating energy efficiency’ has been selected to develop an alternative test method.

A preliminary test shall be performed in order to calculate the seasonal space heating energy efficiency according to clause 9 of EN 15502-1:2012+A1:2015. The product shall be connected to a test rig with the by-pass (3-vie valve) switched off.

Taking the previous test as reference, the following additional, alternative tests shall be performed:

1. the boiler is considered as “condensing boiler”, the test at full load is performed at a return water temperature of 60ºC and a temperature difference of 20ºC whereas the test at partial load (using direct method) is performed at a return water temperature of 30ºC and a temperature difference of 20ºC; the by-pass (3-vie valve) is switched on.

2. the boiler is considered as “other boiler”, the test at full load is performed at a return water temperature of 60ºC and a temperature difference of 20ºC whereas the test at partial load (using direct method) is performed at a return water temperature of 50ºC and a temperature difference of 20ºC; the by-pass (3-vie valve) is switched on.

For each of the test conditions a verification of condensation according to clause 8.15 of EN 15502-1:2012+A1:2015 shall be performed to justify the classification of the appliance as condensing boiler.

In case that manufacturers supply the boiler with a by-pass valve and include instructions how to change the boiler configuration in the installation manual, the purpose of this alternative testing method is to evaluate the possible impact of the by-pass on the measurement and calculation results of the ‘seasonal space heating efficiency’, either by measuring the appliance as condensing boiler and comparing the switched on with the switched off status, or by classifying and measuring the appliance as other (i.e non-condensing) boiler instead.
4.1.2 Case Heaters 2: Space heaters – Air-to-water heat pump

The case ‘Heaters 2’ is related to an air-to-water heat pump which means, according to the definition in EN 14511-1:2013, an encased assembly or assemblies designed as a unit, using a vapour compression cycle driven by an electric compressor, to provide delivery of heat.

According to the Ecodesign and Energy label Regulations (EU) 811/2013 and 813/2013, the heat pump is defined as a space heater using ambient heat from an air source, water source or ground source, and/or waste heat for heat generation; a heat pump space heater may be equipped with one or more supplementary heaters using the Joule effect in electric resistance heating elements or the combustion of fossil and/or biomass fuels. Moreover, the heat pump combination heater means a heat pump space heater that is designed to also provide heat to deliver hot drinking or sanitary water at given temperature levels, quantities and flow rates during given intervals, and is connected to an external supply of drinking or sanitary water.

![Figure 3: Basic principle of a heat pump combination heater](image)

In the description of the reported case, the following factors have been identified as contributions of a potential mismatch between the ‘seasonal coefficient of performance’ (SCOP) measured in standard test condition and measured in real installations in the field:

1. Declaration of design load and declared capacity for heating/cooling;
2. Evaluation of the test when defrost occurs;
3. Setting of the compressor frequency during test.
DESIGN LOAD AND RATED CAPACITY

The **design load** means, for heating mode, the declared heating load ($P_{\text{designh}}$) [kW] at the reference design temperature, whereby $P_{\text{designh}}$ is equal to the part load at $T_j$ equal to $T_{\text{designh}}$; the reference design temperature ($T_{\text{designh}}$), for heating, means the outdoor temperature [°C] as described in Annex II, Table 3, at which the part load ratio shall be equal to 1, and which varies according the designated heating season (average/colder/warmer).

The **declared capacity** [kW] is the capacity of the vapour compression cycle of the unit for cooling ($P_{\text{c}(T_j)}$) or heating ($P_{\text{h}(T_j)}$), pertaining to an outdoor temperature $T_j$ and indoor temperature ($T_{\text{in}}$), as declared by the manufacturer.

The Commission Regulation (EU) 2016/2282 (amending Regulation (EU) no. 813/2013) and the Commission Regulation (EU) 2017/254 (amending Regulation (EU) no. 811/2013) don’t define the tolerances for those parameters whereas the test method described in the standard EN 14511-3 seems to be clear and without loophole.

DEFROST

When an air-to-water heat pump is operating, the outdoor air is relatively cool and the outdoor coil acts as an evaporator. Under certain conditions of temperature and relative humidity, frost might form on the surface of the outdoor coil. The layer of frost will interfere with the operation of the heat pump by making the pump work harder and, therefore, inefficiently. A heat pump has a cycle called a defrost cycle, which removes the frost from the outdoor coil. In the defrost cycle, the heat pump is automatically operated, for a moment, in cooling cycle. This action temporarily warms up the outdoor coil and melts the frost from the coil.

INVERTER TECHNOLOGY (FREQUENCY OF THE COMPRESSOR)

The inverter technology (DC) is the latest evolution of technology concerning the electro motors of the compressors. An inverter is used to control the speed of the compressor motor to continuously regulate the temperature. The DC inverter units have a variable-frequency drive that comprises an adjustable electrical inverter to control the speed of the compressor and the cooling / heating output. The drive converts the incoming AC to DC current and then through a modulation in an electrical inverter produces current of desired frequency. A microcontroller can sample each ambient air temperature and adjusts the speed of the compressor accordingly. This case was selected for alternative testing in the ANTICSS project considering that the declared efficiencies could be higher compared to what can be measured in real installations.

**4.1.2.1 Proposed alternative testing method**

The basic principle of an air-to-water heat pump for heaters (case ‘Heaters 1’) is rather similar to the air-to-water heat pump as used in room air conditioners (case ‘RAC 2’).
Taking into account the considerations and test methods developed for case RAC 2 in section 4.3.2, for the case ‘Heaters 2’ only the frequency of the compressor has been selected as parameter to develop an alternative test method for this product category.

The proposed alternative test method is based on the calculation of ‘seasonal coefficient of performance’ SCOP (verification of the effect of the variable speed compressor on measurements). In clause 11.6 of the EN 14825:2018 the compensation method is mentioned as alternative method when the settings of appliance (e.g. frequency of inverter) are not made available by the manufacturer. The following procedure, based on sub-clause 11.6.3 and Annex M, has been defined as alternative testing procedure within ANTICSS:

- The heating capacity shall be determined in accordance with the direct method at the water heat exchanger, by determination of the volume flow of the heat transfer medium, and the inlet and outlet temperatures (clause 4.1.1 of EN 14511-3:2018);
- Refrigerant piping according to EN 14825:2018;
- Measurements uncertainties according to EN 14825:2018;
- The default value (0.25) of degradation coefficient ($C_d$) shall be used as indicated in EN 14825:2018;
- Measurements of electric power input measured according to EN 14825:2018;
- $P_{dh}$ and $COP_d$ are determined for medium-temperature application according to the table 10 of EN 14825:2018;
- **Different to the standard procedure, in ANTICSS the test is performed in “unlocked” mode which means the frequency of the compressor is not fixed during test.**
  - for a heat pump including also a water pump inverter control, if manufacturer indicates a speed of the pump different from the maximum one to set on the control device for a given rating condition, then this speed shall be used (EN 14511-3:2018);
  - The setting of the thermostat on the indoor water(brine) side shall be as given by the manufacturer (clause 11.6.3 of EN 14825:2018);
  - The measured heating capacity shall be corrected for the heat from the circulating pump, in accordance with EN 14511-3.
  - The effective power input shall be obtained from the measured power input and the corrections from the heat from the circulating pump (clause 11.6.3 of EN 14825:2018);
  - The test shall be performed in accordance with EN 14511-3 considering the admissible deviations, and uncertainties of measurement.
  - A sampling interval of 15 s at the most is required in order to have real-time measurement of the duties (heating capacity and electrical duty). Due to water(brine) temperature cycling during the test, the heating capacity and the power input shall be obtained from a time-integration of the energy balance on several cycles (annex M of EN 14825:2018).

The purpose of this alternative testing method is to evaluate the possible impact of the variable speed compressor on the ‘seasonal coefficient of performance’ (SCOP).
4.2 Televsions

In the previous work packages of ANTICSS, one case (numbered ‘TV 1’) was assigned to the category ‘circumvention’ and three further cases (‘TV 2 to TV 4’) were categorized as ‘jeopardy effects’. Within this work package, the cases were analysed to determine if the issue still exists with the new ecodesign regulation and corresponding standard\textsuperscript{11}. If the issue persists, the cases were further analysed to determine if they are appropriate to be selected for designing an alternative testing method.

Table 4: Summary of the four cases (circumvention and jeopardy effects) reported in ANTICSS for the product category televisions

<table>
<thead>
<tr>
<th>Case no.</th>
<th>Suspicious behaviour as reported to ANTICSS</th>
<th>ANTICSS categorisation</th>
<th>Case selected for designing an alternative test method?</th>
</tr>
</thead>
<tbody>
<tr>
<td>TV 1</td>
<td>According to standard IEC 62087-2:2015, TV’s power input is measured at factory setting. In the reported case, it was observed that the power consumption increased, if the factory setting was adjusted manually for the first time. In concrete terms, the brightness value was 45 in factory settings, corresponding to 71 W. However, if the brightness decreased by one point to a value of 44, TV’s power increased to 90 W. Even if the brightness was set back to the factory setting (45), the power consumption remained high.</td>
<td>Circumvention</td>
<td>Yes</td>
</tr>
<tr>
<td>TV 2</td>
<td>According to standard IEC 62087-2:2015, the energy consumption of TVs is tested with default settings. The standardised test movie, which is used for measuring the energy consumption, only consists of fast-moving images. Prior to the start of the standardised test movie, a countdown clip is shown. This countdown lasts for 10 seconds and does not contain any fast-moving images. After the 10 seconds, the movie content is played. In the reported case, an automatic brightness adjustment function was activated by default. This function analysed the broadcast program and when fast moving images were detected, the brightness of the television was reduced automatically.</td>
<td>Jeopardy effect</td>
<td>Yes</td>
</tr>
</tbody>
</table>

\textsuperscript{11} Published online at https://ec.europa.eu/energy/en/regulation-laying-down-ecodesign-requirements-1-october-2019. Note that the regulation document code and the official publication date is still unknown at the moment of writing this report. The published revised regulations and respective standards will only come into force in near future, and circumvention might still be applied at some products being on the market up to that time. Nevertheless, the cases addressed by the revised regulation have not been taken into account in this work package of ANTICSS, as possible impacts on the reduction of circumvention cannot then be clearly related to the effects of the project.
## Alternative test methods

### and approaches to unmask circumvention

<table>
<thead>
<tr>
<th>Case no.</th>
<th>Suspicious behaviour as reported to ANTIcSS</th>
<th>ANTIcSS categorisation</th>
<th>Case selected for designing an alternative test method?</th>
</tr>
</thead>
<tbody>
<tr>
<td>TV 3</td>
<td>Some smart televisions have recently outsmarted efficiency policy. They reduce power when tested, permanently disable default energy savings features when the user adjusts picture quality settings and offer rich new content formats that are not yet incorporated into standard test methods. As a result, energy labels do not reflect actual energy consumption” (extract from Gregg Hardy et al (2018). Smart Devices Require Smarter Test Methods – The TV Example)</td>
<td>Jeopardy effect</td>
<td>Yes</td>
</tr>
<tr>
<td>TV 4</td>
<td>Standard IEC 62087:2015 says that the sound volume of a TV set shall to be ‘audible’ during testing. This term is vague and subjective. The sound volume has an impact on the energy consumption. Some manufacturers probably set the volume artificially low in the out of the box mode to reduce energy use. An example is given on page 12 of the document ‘Guidelines on television set testing’ from the ComplianTV EU project. This behaviour is playing on the subjectivity of the term ‘audible’. The IEC testing standard should prescribe more precisely what sound level is expected during the test, e.g. in terms of dB or with more details on what is meant by ‘audible’ (e.g. the sound should still be hearable by a human ear at 20 meters from the set).</td>
<td>Jeopardy effect</td>
<td>No¹²</td>
</tr>
</tbody>
</table>

### 4.2.1 Case TV 1: Setting of brightness

Prior to the alternative testing procedure, the appliance will be installed and parameters for the power consumption will be measured according to Ecodesign regulation 642/2009 and the harmonised standard IEC 62087-2:2015; tests will be conducted with factory settings according to the standard conditions.

¹² According to the analysing ANTIcSS test lab, the measured sound volume only has a rather small share (1%) on the overall energy consumption. The standard 1 kHz tone to be used according to Ecodesign regulation 642/2009 and the harmonised standard IEC 62087-2:2015 for measuring the sound volume only has a power input of about 0.2 W, as it only includes high frequencies compared to more realistic noise signals with a broader spectrum of audible frequencies (20 Hz to 20 kHz) that require more energy. Further, according to the expert of the test laboratory, the reported case was a specific technical problem of that product.
ALTERNATIVE TESTING PROCEDURE: After that, the settings of luminance and backlight will be changed and then reset again to the factory settings. The same parameters for the power consumption will be measured after these changes and compared to the results of the corresponding tests performed under initial factory settings. The purpose of this alternative testing method is to evaluate if the factory settings are possibly targeted to meet the requirements of the standard testing only.

Previous testing showed clearly different results for TV appliances with recognition of the test loop and without recognition of the test loop after changing the settings in luminance and backlight and resetting to factory settings (cf. Figure 4).

Figure 4: Results of TV testing with test loop recognition (left) and without test loop recognition (right)

4.2.2 Cases TV 2 and TV 3: Alternative test loop / test loop recognition

Prior to the alternative testing procedure, the appliance will be installed and parameters for the power consumption will be measured according to Ecodesign regulation 642/2009 and the harmonised standard IEC 62087-2:2015; the power consumption will be noted for the 10-minute loop of the dynamic test sequence according to IEC 62087-2:2015.

The 10 minutes sequence of the test video to be used for the standard measurement according to IEC 62087-2 is far away from the average TV viewing. It includes hard cuts every few seconds which makes it easy to recognize this sequence as a test video and to implement special functions to reduce the luminance (backlight or OLED) during this loop which decrease the power consumption specifically in the test situation.

ALTERNATIVE TESTING PROCEDURE: The power consumption will be measured using the same standard video loop but starting the measurement only 3 minutes later compared to the standard measurement. The purpose of this alternative testing method is to evaluate the possible effects of adaptations under test; if for example a reduction of the brightness takes place during the first minutes of the testing (see left picture of Figure 4), the test results would be slightly different if this period would not be taken into account when measurement starts only after the reduction is already finished (see right picture of Figure 4).
4.3 Room air conditioning

In the previous work packages of ANTICSS, two cases (numbered ‘RAC 1’ and ‘RAC 2’) were categorized as “jeopardy effect”. Within this work package, the cases were further analysed to determine if they are appropriate to be selected for designing an alternative testing method.

Table 5: Summary of the two cases (jeopardy effects) reported in ANTICSS for the product category room air conditioners

<table>
<thead>
<tr>
<th>Case no.</th>
<th>Suspicious behaviour as reported to ANTICSS</th>
<th>ANTICSS categorisation</th>
<th>Case selected for designing an alternative test method?</th>
</tr>
</thead>
<tbody>
<tr>
<td>RAC 1</td>
<td>The EER (energy efficiency ratio) is a measure of energy efficiency (cooling capacity divided by power input). The higher the value the more efficient is the appliance. In the reported case, the EER value measured by the manufacturer, which is given in the test report of the technical documentation, is 2.5 and consequently below the declared value of 2.6. The measured value in the MSA laboratory (EER= 2.72) fully confirms the declared value. However, the manufacturer has achieved a better product positioning by misusing the verification tolerance. Further, the model could not be placed on the market due to non-compliance with ecodesign minimum requirements if declared correctly, since the correct EER (2.5) is lower than the minimum requirements of 2.6. The cooling power measured by the manufacturer in the test report of the technical documentation is 2.8 kW. This value is 5% lower than the declared value of 3.0 kW. The measured value in the MSA laboratory is 2.83 kW, confirming the result of the manufacturer test report, but not the declared value of the cooling capacity. This means that the consumer purchases a model with a cooling capacity lower than the declared value. The cooling capacity is not listed in the verification Annex of the eco-design / energy labelling regulations, nor in the currently harmonised EN standard, therefore MSAs may ignore this parameter (not to be verified for the ecodesign / labelling regulations) due also to the lack of verification tolerance. However, the latest interpretation is that when no tolerance is defined in a regulation then tolerance is zero and the declared value has to comply with the measured value. For this model the mere verification through laboratory testing (with no documental inspection) would result in a compliant product for both ecodesign and energy labelling, because the result of the MSA laboratory testing and the EER declared values are within the permitted tolerance. Because of the reduced cooling power in comparison to the declared value, it is easier to achieve compliance with ecodesign requirements and labelling.</td>
<td>Jeopardy effect</td>
<td>No</td>
</tr>
</tbody>
</table>
Alternative test methods and approaches to unmask circumvention

| RAC 2 | 1. The test methods for determination of the capacity and efficiency for air-to-air heat pumps are described in the standard EN 14511. The standard EN14825 describes calculation methods to determine the averaged performance during the heating season, the Seasonal Coefficient of Performance (SCOP) factor.  
   2. In case frosting take place on the outdoor unit during the test, both the heating and defrosting period is included in the evaluation of the test. However, the evaluation period is limited to maximally three hours to limit the cost of the tests. The rated heat output (with corresponding efficiencies) that are used in the ηs calculations can be defined freely (with some limitations) by the manufacturer. The efficiency of a heat pump normally increases with lower capacity, down to a certain limit. Therefore, to be able to declare the heat pump with a high efficiency on the Energy Label, it might be beneficial to declare the heat pump for a low capacity. In addition, according to the standards, if the manufacturer gives instructions for the setting of the frequency for the different test points, this setting shall be done.  
   3. We suspect or have the perception that the declared efficiencies for the products on the energy labels and supporting data sheets are considerably higher compared to what have been measured in real installations in the field, especially in cold and humid climates, which in such case would give the consumer misleading information. |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Jeopardy effect</td>
<td>Yes</td>
<td></td>
</tr>
</tbody>
</table>

4.3.1 Case RAC 1: Misuse of tolerances

The case RAC 1 is related to a single duct air conditioner which means, according to the definition in EN 14511-1:2013, an air conditioner in which, during cooling or heating, the condenser or evaporator intake air is introduced from the space containing the unit and discharged outside this space (see picture below for a principle of operation - source: dudegrows.com).

![Operation principle of a single duct air conditioner](image-url)
According to the information disclosed, the product can only be operated in cooling mode, and the Global Warming Potential GWP of the refrigerant is higher than 150. The parameters involved in the jeopardy effect are:

- cooling capacity;
- EER\textsubscript{rated} (energy efficiency ratio).

The two parameters are linked together being the EER\textsubscript{rated} defined as declared capacity for cooling [kW] divided by the rated power input for cooling [kW] of the unit, when providing cooling at standard rating conditions (ref. 3.35 - EN 14511-1:2018). The declared cooling capacity is defined as capacity of the vapour compression cycle of the unit at standard rating conditions (ref. 3.52 - EN 14511-1:2018) and represents the heat given off the heat transfer medium to the unit, per unit of time whereas the rated power input is defined as cooling power input of the vapour compression cycle of the unit at standard rating conditions (ref. 3.61 - EN 14511-1:2018) consisting in the electrical power input of the unit obtained from power input for operation of the compressor and any power input for defrosting, control and safety devices and for conveying devices (e.g. fans and pumps). In case of a single duct air conditioner, working in cooling mode, standard condition means 35°C of indoor air temperature (dry bulb) and 35°C of outdoor air temperature (dry bulb) as defined in the Ecodesign and Energy labelling Regulations and in the corresponding standard EN 14511-2:2013.

The Commission Regulation (EU) 2016/2282 (amending Regulation (EU) no. 206/2012) and the Commission Regulation (EU) 2017/254 (amending Regulation (EU) no. 626/2011) define the rules for product compliance verification by MSA and the tolerances to be used for the verification of the parameters requested by the Regulation. Tolerances are defined for the following parameters:

- seasonal energy efficiency ratio (SEER);
- seasonal coefficient of performance (SCOP);
- power consumption in off mode;
- power consumption in standby mode;
- energy efficiency ratio (EER\textsubscript{rated});
- coefficient of performance (COP\textsubscript{rated}); and
- sound power level.

The tolerances for cooling or heating capacity are excluded from those annexes. The reported case has been classified as jeopardy effect due to a loophole in the legislation (and in the standard) concerning this lack of verification tolerances for cooling and heating capacity.

After this detailed analysis, the case RAC 1 has finally not been selected for alternative testing within ANTICCSS because the ‘jeopardy effect’ can be identified by checking the technical documentation and not by testing the appliance.
4.3.2 Case RAC 2: Room air conditioning – Air-to-water heat pump

The case is related to an air-to-air heat pump that means, according to the definition in EN 14511-1:2013, an encased assembly or assemblies designed as a unit, using a vapour compression cycle driven by an electric compressor, to provide delivery of heat. According to the Ecodesign and Energy labelling Regulations the heat pump is defined as reversible air conditioner capable of both cooling and heating function. In the specific case the heat transfer medium is the air for both sides (indoor and outdoor).

![Figure 6: Operation principle of an air-to-air heat pump](image)

In the description of the case RAC 2 the following factors have been identified as contributions of a potential mismatch between the ‘seasonal coefficient of performance’ (SCOP) measured in standard test condition and in real installations in the field:

1. declaration of design load and declared capacity for heating/cooling;
2. evaluation of the test when defrost occurs;
3. setting of the frequency of compressor during test.

**Design load and rated capacity**

The design load means, for heating mode, the declared heating load \( P_{\text{designh}} \) [kW] at the reference design temperature, whereby \( P_{\text{designh}} \) is equal to the part load at \( T_j \) equal to \( T_{\text{designh}} \); the reference design temperature \( T_{\text{designh}} \), for heating, means the outdoor temperature \(^\circ\text{C}\) as described in Annex II, Table 3, at which the part load ratio shall be equal to 1, and which varies according the designated heating season (average/colder/warmer).
The declared capacity [kW] is the capacity of the vapour compression cycle of the unit for cooling ($P_{dC(T_{ij})}$) or heating ($P_{dH(T_{ij})}$), pertaining to an outdoor temperature $T_{ij}$ and indoor temperature ($T_{in}$), as declared by the manufacturer;

The Commission Regulation (EU) 2016/2282 (amending Regulation (EU) no. 206/2012) and the Commission Regulation (EU) 2017/254 (amending Regulation (EU) no. 626/2011) don’t define the tolerances for those parameters whereas the test method described in the standard EN 14511-3 seems to be clear and without loophole.

**DEFROST**

When a heat pump is operating in the heating mode, the outdoor air is relatively cool and the outdoor coil acts as an evaporator. Under certain conditions of temperature and relative humidity, frost might form on the surface of the outdoor coil. The layer of frost will interfere with the operation of the heat pump by making the pump work harder and, therefore, inefficiently. A heat pump has a cycle called a defrost cycle, which removes the frost from the outdoor coil. In the defrost cycle, the heat pump is automatically operated, for a moment, in cooling cycle. This action temporarily warms up the outdoor coil and melts the frost from the coil.

The output measurements for heating capacity change between enthalpy and calorimetric methods. In case of the calorimetric method, the test procedure consists of two periods: an equilibrium period, and a data collection period. The duration of the data collection differs depending upon whether the heat pump’s operation is steady state or transient (defrost).

If defrost occurs before the start of the data collection period, or if the quantity $\%\Delta T$ exceeds 2.5 % during the data collection period, the heating capacity test shall be designated a transient test (see 4.4.5 of EN 14511-3:2013). Likewise, if the heat pump initiates a defrost cycle during the equilibrium period or during the data collection period, the heating capacity test shall be designated a transient test. If the above conditions do not occur and the test tolerances specified are satisfied during both the equilibrium period and the data collection period, then the heat capacity test shall be designated a steady state test and shall be terminated after at least 70 minutes of data collection, otherwise the data collection period shall be extended until 3 hours have elapsed or until the heat pump completes three complete cycles during the period, whichever occurs first. If at an elapsed time of 3 hours, the heat pump is conducting a defrost cycle, the cycle shall be completed before terminating the collection of data. A complete cycle consists of a heating period and a defrost period; from defrost termination to defrost termination.
Considering that defrost occurs in the field could be more realistic includes, in any case, a defrost in the data collection period. There are two main conditions that could affect the defrost phenomena:

1. improved defrost control, i.e. ‘hidden’ software detecting the standard condition adapting / optimizing the operation to avoid defrost during the standard test period, especially at the low capacities that they are declared for on the Energy Label;
2. environmental conditions (humidity, heating capacity required) and testing conditions (e.g. frequency of compressor fixed).

**INVERTER TECHNOLOGY (FREQUENCY OF THE COMPRESSOR)**

The inverter technology (DC) is the latest evolution of technology concerning the electro motors of the compressors. An inverter is used to control the speed of the compressor motor to continuously regulate the temperature. The DC inverter units have a variable-frequency drive that comprises an adjustable electrical inverter to control the speed of the compressor and the cooling / heating output. The drive converts the incoming AC current to DC and then through a modulation in an electrical inverter produces current of desired frequency. A microcontroller can sample each ambient air temperature and adjust accordingly the speed of the compressor.

Figure 8 shows the room temperature during the operation of a fixed-speed unit and inverter unit.
According to EN 14511-3:2013 clause 4.2.2.1, “for inverter type control units, the setting of the frequency shall be done for each rating condition. The manufacturer shall provide in the documentation information about how to obtain the necessary data to set the required frequencies”. The standard defines to fix the frequency of the compressor for each rating condition resulting in heat pump behaviour being different from the real life. Anyway, this condition can help the testing laboratory to maintain the stability condition (table 4 and table 5 of EN 14511-3:2013).

Moreover, the same concept could be applied to a motor fan considering the clause 4.4.1.2 of EN 14511-3:2013 “for inverter type control units, if the manufacturer indicates a speed of the fan different from the maximum one to set on the control device for a given rating condition, then this speed shall be used”.

Such possibility is confirmed by the Regulation – in Annex I point 3.b of Regulation (EU) 2012/206 there is written “The manufacturer of air conditioners and comfort fans shall provide laboratories performing market surveillance checks, upon request, the necessary information on the setting of the unit as applied for the establishment of declared capacities, SEER/EER, SCOP/COP values and service values and provide contact information for obtaining such information.”

The case RAC 2 was selected for testing considering that the declared efficiencies could be higher compared to what can be measured in real installations. There are several possible reasons for the divergences on the measured values and the explanation could be a combination of the reasons listed below:
1. the non-ideal distribution of heat in the house due to the floor plan of the house.

2. the heat pumps are declared and labelled for much lower capacities and warmer climate than they are normally used in some countries.

3. the heat pump operates differently with different performance when the frequency is set or fixed during laboratory tests compared to conditions in the field when the normal control system of the heat pump is in operation.

4. the standard tests in the laboratory are not long enough for frosting and thereby defrosting to take place, especially at low capacities.

The 3rd and 4th factor have been selected for the development of alternative test methods within ANTICSS. The following restriction has to be taken into account: The exact time of defrosting, due to a potentially hidden software or product behaviour in testing conditions, cannot be defined so a hypothesis of timing, balanced with the test cost, is proposed.

PROPOSED ALTERNATIVE TESTING METHODS

According to the analysis of the previous sections, the following parameters can be taken into consideration for developing an alternative test method:

1. $COP_d$ (verification of the effect of the defrost on measurements);

2. SEER (verification of the effect of the variable speed compressor due to inverter technology on measurements);

General conditions during test according to EN 14825:2018 and EN 14511-3:2018:

- Refrigerant piping according to EN 14825:2018;
- Measurements uncertainties according to EN 14825:2018 (NOTE: in 1.3.3 it has to be verified if the uncertainties required can be achieved);
- The default value (0,25) of degradation coefficient (Cd) shall be used;
- Measurements of electric power input according to EN 14825:2018;
- Test apparatus according to EN 14511-3:2018.

PROPOSED ALTERNATIVE METHOD FOR DETERMINING $COP_d$ (VERIFICATION OF THE EFFECT OF THE DEFROST ON MEASUREMENTS)

The value of $COP_d$ is calculated in condition B for all three reference design climate: average, warmer and colder. The test procedure of measurements for the heating capacity differs from clause 4.4.4 of EN 14511-3:2018 by the following:
Step 1

The test room reconditioning apparatus and the heat pump under test shall be operated until the test tolerances specified in Table 6. During a period of half an hour, the heat pump shall operate, while meeting the test tolerances specified in Table 6, except a defrost occurs during this period in which case the test tolerances specified in Table 7 apply. It is recommended to terminate step 1 with a manually or automatically induced defrost cycle.

<table>
<thead>
<tr>
<th>Measured quantity</th>
<th>Variation of arithmetic mean values</th>
<th>Variation of individual mean values</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Inlet temperature (dry bulb)</td>
<td>±0,3K</td>
<td>±1,0K</td>
</tr>
<tr>
<td>- Inlet temperature (wet bulb)</td>
<td>±0,4K</td>
<td>±1,0K</td>
</tr>
<tr>
<td>- Temperature difference</td>
<td>±0,3K</td>
<td>---</td>
</tr>
</tbody>
</table>

Step 2

If a defrost occurs in the previous step, the heat pump shall operate for one hour meeting the test tolerances specified in Table 6. If defrost doesn’t occur, it is not necessary to wait for a complete duration of this step.

Step 3

The data collection period shall be extended up to 8 hours\(^\text{13}\). A complete cycle consists of a heating period and a defrost period; from defrost termination to defrost termination.

Only the data from the completed cycles that occurred during 8 hours are used for heating capacity calculation (Figure 9 and Figure 10). If at an elapsed time of 8 hours, the heat pump is conducting a defrost cycle, the cycle shall be completed before ending the data recording (Figure 11).

The test tolerances specified in Table 7 shall be achieved during the data collection period. The test tolerances are specified for two sub-intervals. Interval H consists of data collected during each heating interval, with the exception of the first 10 min after defrost termination. Interval D consists of data collected during each defrost cycle plus the first 10 min of the subsequent heating interval.

\(^{13}\) (1) the test duration should be defined to include at least a defrost event in the collection data.
Table 7: Variations allowed in heating capacity tests when using the transient test procedure

<table>
<thead>
<tr>
<th>Variation of arithmetical mean values</th>
<th>Variation of individual mean values</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>H</strong></td>
<td><strong>D</strong></td>
</tr>
<tr>
<td>Temperature of air entering indoor</td>
<td></td>
</tr>
<tr>
<td>- dry-bulb</td>
<td>±0,6K</td>
</tr>
<tr>
<td>- wet-bulb</td>
<td>±1,5K</td>
</tr>
<tr>
<td>- temperature difference</td>
<td></td>
</tr>
<tr>
<td></td>
<td>±0,6K</td>
</tr>
<tr>
<td></td>
<td>±1,0K</td>
</tr>
<tr>
<td></td>
<td>±1,0K</td>
</tr>
<tr>
<td></td>
<td>±2,5K</td>
</tr>
<tr>
<td></td>
<td>---</td>
</tr>
</tbody>
</table>

Step 4

The difference between the leaving and entering temperatures of the heat transfer medium at the indoor heat exchanger shall be measured. For each interval of 5 minutes during the data collection period, an average temperature difference shall be calculated, $\Delta T_i (\tau)$. The average temperature difference for the first 5 minutes of the data collection period, $\Delta T_i (\tau=0)$, shall be saved for the purpose of calculating the following percent change:

$\% \Delta T = \left[ \frac{\Delta T_i (\tau = 0) - \Delta T_i (\tau)}{\Delta T_i (\tau = 0)} \right]$  

If after 8 hours, the quantity of $\% \Delta T$ does not exceed 2.5% and the test tolerances specified in Table 6 are satisfied, the heating capacity is calculated from the data collected during last 70 min.

Figure 9: Transient heating capacity tests with one complete cycle during the data collection period
Proposed alternative method for determining SEER (verification of the effect of the variable speed compressor on measurements)

The test procedure is based on EN 14511-3:2018 and EN 14825:2018 but the control unit of the air conditioner is left free to change the frequency of the compressor according to the algorithm defined by the manufacturer. In clause 11.6 of EN 14825:2018 the compensation method is mentioned as alternative method when the settings of appliance (e.g. frequency of inverter) are not made available by the manufacturer but clause 11.6.3 and Annex M refer only to air-to-water(brine), water(brine)-to-water(brine) and DX-to-water(brine) units.
Concerning air-to-air appliances, a procedure for compensation method in EN 14511-3 is missing, therefore the following applies:

- the test is performed in part load condition A, B, C according to table 2 of EN 14825:2018;
- the test is performed in an “unlocked” mode that means the frequency of the compressor is not fixed during test.
- for heat pumps including also a fan inverter control, if manufacturer indicates a speed of the fan different from the maximum one to set on the control device for a given rating condition, then this speed shall be used (clause 4.4.1.2 of EN 14511-3:2013);
- the indoor test room is given an fixed thermal load (the heat pump will adjust its speed or the power input to meet the load. Because the control unit of the test room generated a fixed heating capacity, the indoor room temperatures could fluctuate);
- the heat pump is adjusted with the remote controller to achieve a close match to the indoor-unit room temperatures required by the test standard (the final remote temperature setting may show a different value to the actual room condition).
- outdoor room conditions are maintained at the same as the standard test conditions;
- the indoor-unit room as well as the outdoor-unit room shall be set to the desired test conditions. After the temperatures of the indoor-unit room and outdoor unit room are stabilised, the heat pump shall be operated at the set room temperatures.
- In partial load conditions the control unit of the indoor-unit room shall be locked to produce effective “partial” heating output to obtain the designated partial load (the remote controller would need to be reset in order to keep the indoor room at the required condition as per the test standard).
- Once stable operation was obtained, the cooling capacity was calculated according to EN 14511-3:2018.

NOTE: Test results are dependent on the temperature sensor of the unit being tested and on the setting of the indoor temperature, therefore it has to be verified if the deviation tolerances defined in the standard are satisfied. It has to be verified if the measurement error introduced, due to the adjustment of the thermal load caused by the thermal inertia of the testing room, is acceptable. The capability (e.g. reaction time) of the testing room and instruments can affect the measurements.
4.4 Domestic freezers and refrigerator-freezers

In the previous work packages of ANTICSS, six cases in the product categories domestic refrigerators, refrigerator-freezers and freezers (numbered ‘Cold 1’ to ‘Cold 6’) were assigned to the category ‘jeopardy effects’. A summary of the cases is presented in Table 8. Within this work package, the cases were analysed to determine if the issue still exists with the new ecodesign regulation\textsuperscript{14} or new EN 62552:2020 standard. If the issue persists, the cases were further analysed to determine if they are appropriate to be selected for designing an alternative testing method.

Table 8: Summary of the six cases (jeopardy effects) reported in ANTICSS for the product categories domestic refrigerators, refrigerator-freezers and freezers

<table>
<thead>
<tr>
<th>Case no.</th>
<th>Suspicious behaviour as reported to ANTICSS</th>
<th>ANTICSS categorisation</th>
<th>Case selected for designing an alternative test method?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cold 1</td>
<td>According to regulations 643/2009 and 1060/2010, the nominal temperature of chill compartments for calculating the energy efficiency index (EEI) is set at 0 °C, while during the test the maximum package temperature must be equal or below 3.0°C. In practice during the energy consumption test, the chill temperature is mostly set as high as allowed by the standard (up to 3.0°C) to save energy. Further, measuring the storage volume of the chill compartment in accordance to EN IEC 62552:2013 may result in a total storage volume greater than the real volume. This implies a better EEI.</td>
<td>Jeopardy effect</td>
<td>No; the new regulation and new EN 62552:2020 standard already addresses the issue\textsuperscript{15}.</td>
</tr>
<tr>
<td>Cold 2</td>
<td>During the energy consumption test according to EN IEC 62552:2013, the energy consumption is reduced by an automatic activation of the holiday mode. This function is activated in case the door remains closed for a longer period (e.g. in case of holidays). Therefore, the energy consumption is also reduced in real use in certain appliances.</td>
<td>Jeopardy effect</td>
<td>Yes, for the product category “domestic freezers and refrigerator-freezers”. Note: the case and the developed alternative test procedure are also applicable</td>
</tr>
</tbody>
</table>

\textsuperscript{14} Published at https://ec.europa.eu/energy/en/regulation-laying-down-ecodesign-requirements-1-october-2019. Note that the regulation document code and the official publication date is still unknown at the moment of writing. The published revised regulations and respective standards will only come into force in near future, and circumvention might still be applied at some products being on the market up to that time. Nevertheless, the cases addressed by the revised regulation have not been taken into account in this work package of ANTICSS, as possible impacts on the reduction of circumvention cannot then be clearly related to the effects of the project.

\textsuperscript{15} For the new regulation and new EN 62552:2020 standard, the reference chill temperature is set to 2.0°C, resulting that the interpolated chill temperature should be at 2.0°C or lower. Furthermore, the definition of a chill compartment is stricter. It must meet the requirements of the chill verification test before it can be declared as a chill compartment. Furthermore, the definition of volume will not be considered as (useable) storage volume anymore but as all volume which needs to be refrigerated inside the compartment, with a few exceptions. This definition is more transparent and results in less discussion points. The change in the definition of the volume could confuse consumers, since it is quite possible that cabinet X with a larger volume has less useable volume compared to cabinet Y.
### Case 3
The display of a controller is activated each time the door of the refrigerator is opened and remains active for a longer period unless it is switched-off by pressing a button next to the controller. The display cannot be deactivated permanently. The user manual states the energy consumption increase when the display of the controller is left up. It is most likely that the consumer will not continuously repeat the extra action required to obtain the declared energy consumption.

**Jeopardy effect**
Yes, for the product category “domestic refrigerators” (see section 5.6). Note: the case and the developed alternative test procedure are also applicable to the product category “domestic freezers and refrigerator-freezers”

### Case 4
In some frost-free refrigerator-freezers there are two or more operation modes programmed. The "normal" mode is mostly active when door openings are detected, and an "ECO" mode is activated when the door is kept closed for a longer period. The appliance is automatically switching between the modes.

**Jeopardy effect**
Yes, for the product category “domestic freezers and refrigerator-freezers”. Note: the case and alternative test procedure are also applicable to the product category “domestic refrigerators”

### Case 5
Some frost-free refrigerator-freezers are programmed with a cool-down function. Purpose of the cool-down function is to minimize the temperature increase on the frozen food caused by defrost. In some cases, the cool-down starts just after the maximum testing time specified by EN IEC 62552:2013 resulting that the extra energy consumption of this function is not incorporated in the test result.

**Jeopardy effect**
No; the new regulation and new EN 62552:2020 standard already addresses the issue.\(^\text{16}\)

### Case 6
The interpolation procedure stated in EN IEC 62552:2013 makes it possible to choose more favorable thermostat settings for calculating the energy consumption. Due to the interpolation the interpolated temperatures could be higher than the target temperature. Therefore, the manufacturer can test the appliance and use the most favorable results for the declaration of conformity.

**Jeopardy effect**
No; the new regulation and new EN 62552:2020 standard already addresses the issue.\(^\text{17}\)

---

\(^\text{16}\) In the new regulation and new EN62552:2020 standard, the overall daily energy consumption value consists out of steady state tests, defrost tests and several auxiliary tests. The defrost test incorporates all irregular behaviour of the cabinet around defrost, resulting that the cool-down function will be included in the result since this is considered as an irregularity.

\(^\text{17}\) The new regulation and new EN62552:2020 revised the interpolation procedure. According to this procedure, the interpolated temperature for all compartments must be at or below the target temperature. Therefore, it is not possible anymore to use results above the target temperature.
4.4.1 Cases Cold 2 and Cold 4: Multiple operating modes / holiday mode present

In some frost-free refrigerator-freezers, there are two or more operation modes programmed. The "normal" mode is mostly active when door openings are detected, and an "ECO" mode is activated when the door is kept closed for a longer period. The appliance is automatically switching between the modes according to the managing algorithm of this specific doors’ behaviour. Note that the naming used by manufacturers for these modes is not consistent. In one of the reported cases, the “ECO” mode is called “holiday mode”; the reported cases Cold 2 and Cold 4 can thus be considered as synonymous cases. The appliance of the reported suspicious case switches to the "ECO" mode during the energy consumption tests, since it reacts on the lack of door openings, which is prescribed by the EN62552:2013 standard. In the case reported, the measured energy consumption is reduced by 12% when the "ECO" mode is activated. Possible differences of the "ECO" mode compared to the “normal” mode:

- Longer defrost interval (which reduces the energy consumption),
- Shorter defrost heater activation time (which reduces the energy consumption),
- Internal fans not running continuously (which reduces the energy consumption and the compartment temperatures measured differ at the same controller setting).

The most efficient mode is active during the conformity testing, while in real life "ECO" is only active for a limited time, depending on the duration the doors actually remain closed at home.

The new regulation and the new standard EN62552:2020 include the possibility to have a variable defrost interval, i.e. the interval length between defrosts may vary. In the conformity documents, manufacturers are obligated to declare the type of defrost programmed in their appliances. The type of defrosting is now considered in the calculations of the Annual Energy consumption (AE), i.e. in case the appliance is programmed with the variable defrost type, the length the defrost interval used for the AE calculation is based on a certain ratio between the minimum and maximum interval time programmed. The standard does not mention anything about multiple modes and which one to test. However, continuously measuring in the "normal" mode is not possible, while this mode results in the highest energy consumption of the appliance. If a mix of both modes is used for the interpolation procedure, it will most likely generate incompatible results.

**PROPOSED ALTERNATIVE TESTING METHODS**

It is not possible for a test lab to select the operating mode for testing; therefore, the alternative test procedures are designed with the aim to trigger the controller to switch between its programmed operating modes by several aspects:

- Door switch,
- Internal temperature fluctuations,
- Unstable input voltage, or
- Unstable ambient conditions.
For each of these aspects a procedure is proposed to check if multiple control modes are present. Note: It is possible that modes are triggered by events or aspects not mentioned above and which are not yet discovered within the ANTICSS project. Therefore, during the testing, care needs to be taken not to limit testing only to the mentioned test procedures of this chapter.

Prior to the alternative testing procedures, the following reference tests needs to be conducted:
1. Installation of the appliance according to EN IEC 62552:2013 (longer measurement time) or IEC 62552:2015\(^\text{18}\) (shorter measurement time).
2. Log the temperatures and input power of the appliance.
3. Perform reference tests at standardized conditions:
   i. Energy consumption test
   ii. (Storage) Temperature test

**Triggered by the door switch\(^\text{19}\)**

4. Bypass the door switch with a controllable switch unit, which makes it possible to simulate the door openings of the cabinet via software. Do not damage the cabinet’s insulation or internal walls.
   i. In case this is not possible, perform the test with physical door openings. Preferably open the door just that it triggers the door switch in order to minimize the impact of cold air falling out of the compartment.
5. Simulate the amount of door openings for a number of times per hour via the software.
6. Make sure that all doors remain closed during the tests.
7. Perform the test at the same ambient condition as the reference tests.
8. Log the temperatures and input power of the appliance.
9. Analyze the behaviour of the appliance. Some hints for checking are given below:
   a. Additional component activation
   b. Measured temperature inside the refrigerated compartments
   c. Defrost heater behaviour
   d. Component behaviour
   e. Other aspects...

\(^{18}\) Note that IEC 62552:2015 + draft amendments is the basis for the new EN 62552:2020 which will be the harmonized standard for the new regulation.

\(^{19}\) Note that the STEP project conducted tests for refrigerators and refrigerator-freezers according to their own designed alternative test method. This method contains similarities with the alternative test method **Triggered by the door switch** designed within the ANTICSS project. More detailed information about the STEP project can be found at [http://www.toptenuk.org/private/documentation/closing-the-reality-gap](http://www.toptenuk.org/private/documentation/closing-the-reality-gap)
Alternative test methods
and approaches to unmask circumvention

Triggered by internal temperature fluctuations

4. Introduce irregular fluctuating internal compartment temperatures by either:
   a. Physically opening the door of the appliance. Do this several times in a day.
   b. Install a heater inside the compartment and fluctuate the temperature by activating
      the heater randomly throughout the test.
5. Perform the test at the same ambient condition as the reference tests.
6. Log the temperatures and input power of the appliance.
7. Analyze the behaviour of the appliance. Some hints for checking are given below:
   a. Additional component activation
   b. Measured temperature inside the refrigerated compartments
   c. Defrost heater behaviour
   d. Component behaviour
   e. Other aspects...

Triggered by unstable input voltage

4. Use a non-stabilized mains power supply.
5. Log the temperatures and input power of the appliance.
6. Analyze the behaviour of the appliance. Some hints for checking are given below:
   a. Additional component activation
   b. Measured temperature spread inside the refrigerated compartments
   c. Defrost heater behaviour
   d. Component behaviour
   e. Other aspects...

Triggered by unstable ambient conditions

4. Use unstable ambient conditions, preferably that the average ambient temperature of the test period is equal to the ambient temperature used during the reference tests. E.g.
   - Hour 1 to 4 of the test $T_{ambient	ext{ alternative}} = T_{ambient	ext{ reference}} - 5°C.$
   - Hour 4 to 8 of the test $T_{ambient	ext{ alternative}} = T_{ambient	ext{ reference}} - 3°C.$
   - Hour 8 to 12 of the test $T_{ambient	ext{ alternative}} = T_{ambient	ext{ reference}} - 1°C.$
   - Hour 12 to 16 of the test $T_{ambient	ext{ alternative}} = T_{ambient	ext{ reference}} + 1°C.$
   - Hour 16 to 20 of the test $T_{ambient	ext{ alternative}} = T_{ambient	ext{ reference}} + 3°C.$
   - Hour 20 to 24 of the test $T_{ambient	ext{ alternative}} = T_{ambient	ext{ reference}} + 5°C.$
5. Log the temperatures and input power of the appliance.
6. Analyze the behaviour of the appliance. Some hints for checking are given below:
Alternative test methods and approaches to unmask circumvention

- Additional component activation
- Measured temperature spread inside the refrigerated compartments
- Defrost heater behaviour
- Component behaviour
- Other aspects...

Care should be taken when comparing the alternative test results to the results of the reference test. For example during the *Triggered by internal temperature fluctuations* test method, the heat input of the heater to the compartment can be measured. Logically it is assumed that you can subtract the heat input from the measured energy consumption. However, the required work (electrical power) of the refrigerator to transport the introduced heat by the heater to the ambient is not 1:1, and it is impossible to determine what the exact ratio is. Therefore, the assumption that you can subtract the heat input directly from the measured energy consumption is not valid. Main goal of these alternative test methods, however, is to verify if the appliance is not operating in a different operating mode compared with the reference tests. The results of the alternative methods will also provide information to derive an estimation of the impact on the declared energy consumption for the different operating modes present.

Note: The above proposed alternative testing methods are in general also applicable for the product category domestic refrigerators.
4.5 Domestic refrigerators

In the previous work packages of ANTICSS, six cases in the product categories domestic refrigerators, refrigerator-freezers and freezers (numbered ‘Cold 1’ to ‘Cold 6’) were assigned to the category ‘jeopardy effects’. A summary of the cases is presented in Table 8 of previous section 4.4. In the product category ‘domestic refrigerators, for case Cold 3 an alternative test procedure has been developed.

4.5.1 Case Cold 3: Display is continuously activated

The display of a controller is activated each time the door of the appliance is opened and remains active for a longer period unless it is switched-off by pressing a button. The display cannot be deactivated permanently. The user manual states that the energy consumption increases when the display of the controller is lid up. According to the standard ‘the refrigerating appliance shall be set up as in service in accordance with the manufacturer’s instructions.’ It is most likely that the consumer will not continuously repeat the extra action required to obtain the declared energy consumption.

The new regulation and new EN 62552:2020 standard states the following:

"The appliance shall be set up in accordance with the instructions, except where these conflict with the requirements of this standard."

Since the user manual states that you need to turn off the display to save energy, it has to be done also under test. Note that this requirement is not in conflict with the standard and is therefore allowed. However, it is disputable if the consumer will follow this procedure to save energy.

**ALTERNATIVE TESTING METHOD**

The increased annual energy consumption due to the continuous activation of the display will be calculated by the following formula.

\[
AE_{increased} = AE_{conformity\ test} + \frac{E_{display} \times 24 \times X}{1000}
\]

Where

- \(AE_{increased}\) is the annual energy consumption considering the display input power [kWh/year]
- \(AE_{conformity\ test}\) is the annual energy consumption measured during the conformity tests [kWh/year]
- \(E_{display}\) is the input power of the display [W]
- \(X\) is the amount of days it is estimated that the display is activated [-]
$E_{\text{display}}$ is measured during an off cycle of the cooling system, while switching the display on and off. The difference of the measured input power is accounted to the display.

The purpose of this alternative testing method is to evaluate impact on additional energy consumption of the display that has to be turned off under standard testing but will rather be continuously activated in daily use.

Note: The above proposed alternative testing method is in general also applicable for the product category domestic freezers and refrigerators-freezers.
4.6 Domestic dishwashers

In the previous work packages of ANTICSS, three cases (numbered ‘Dish 1’ to ‘Dish 3’) were assigned to the category ‘circumvention’ and one further case (‘Dish 4’) was categorized as ‘jeopardy effect’. Within this work package, the cases were analysed to determine if the issue still exists with the new ecodesign regulation and corresponding standard\textsuperscript{20}. If the issue persists, the cases were further analysed to determine if they are appropriate to be selected for designing an alternative testing method.

Table 9: Summary of the four cases (circumvention and jeopardy effects) reported in ANTICSS for the product category domestic dishwashers

<table>
<thead>
<tr>
<th>Case no.</th>
<th>Suspicious behaviour as reported to ANTICSS</th>
<th>ANTICSS categorisation</th>
<th>Case selected for designing an alternative test method?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dish 1</td>
<td>For energy consumption and performance tests, automatic dishwashers have to be loaded with the indicated number of place settings which are soiled in accordance with standard EN 50242. With regard to the loading and the settings of the machine, the standard requests to follow manufacturer’s instructions. In the reported case, a separate ‘bowl’ support, which is marked as ‘only for standard tests’ or similar on the packaging, is supplied with the machine. This support is attached to the saucer support prongs in the upper rack when loading to the full 15 place settings (Energy Label load as specified by the manufacturer). The support is not mentioned anywhere else than in the standard loading plan supplied separately by the manufacturer meaning that it is not intended for use by consumers.</td>
<td>Circumvention</td>
<td>Yes</td>
</tr>
<tr>
<td>Dish 2</td>
<td>In the reported case, a specific instruction how to adjust the appliance for tests in laboratories (three dedicated programme runs) is given in the instruction of use (Information for testing institutes only). All three programs should be done at the same day. The test can be started at the next day. After 12 hours it is ensured that the appliance has reached room temperature. These specific instructions might serve as indication for the appliance to detect being under the test situation.</td>
<td>Circumvention</td>
<td>Yes</td>
</tr>
</tbody>
</table>

\textsuperscript{20} Published online at https://ec.europa.eu/energy/en/regulation-laying-down-ecodesign-requirements-1-october-2019. Note that the regulation document code and the official publication date is still unknown at the moment of writing this report. The published revised regulations and respective standards will only come into force in near future, and circumvention might still be applied at some products being on the market up to that time. Nevertheless, the cases addressed by the revised regulation have not been taken into account in this work package of ANTICSS, as possible impacts on the reduction of circumvention cannot then be clearly related to the effects of the project.
### Case no. Suspicious behaviour as reported to ANTCSS

| Dish 3 | According to regulation or standard “The dishwasher manufacturer’s instructions regarding installation and use shall be followed.”

In many dishwashers (from multiple manufacturers) it is necessary to remove or alter the position of many of the “accessories” fitted to the appliance when supplied. For example, when multiple cup racks are present it may be necessary to remove one or more sections and reposition them – in many cases this is not a straightforward task and may risk breaking some of the components – it is highly unlikely that a consumer would do the same. In the example quoted, multiple push on supports and components need to be removed from the dishwasher as supplied – if the parts are not removed then the “standard” load will not fit in the appliance. The dishwasher as supplied cannot be loaded with the claimed full capacity (16ps).

Instructions on removal of all the relevant parts are only given in the ‘Instructions for Test Laboratories’ and unlikely to be carried out by the consumer in day to day use. The dishwasher cannot be tested at claimed capacity without removing the accessories – as supplied it does not have the claimed capacity but requires special set-up to achieve this. |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Circumvention</td>
<td>Yes</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dish 4</th>
<th>The product is fitted with a water storage tank that maintains the water (it is not clear if rinsing water or water coming from the water mains) inside the appliance also after the test. The water is used during the next washing cycle so the appliance heat up a minimum quantity of water at 15°C being the remaining part stored inside the appliance at ambient temperature (20 to 23°C) from last cycle. It is a boundary situation in which the test conditions have been identified to be in compliance with legislation (and the standard) but do not reflect the real performance of the product because the standard test conditions could be considered altered. Probably, it cannot be perceived by consumers in daily life but could affect the market segment of the product.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jeopardy effect</td>
<td>Yes</td>
</tr>
</tbody>
</table>

### 4.6.1 Case Dish 1: Separate ‘bowl’ support only for standard testing

Prior to the alternative testing procedure, the appliance will be installed according to the harmonised standard EN 50242:2016 and tests will be conducted according to the standard conditions. This includes the installation of a separate ‘bowl’ support, which is marked as ‘only for standard tests’ or similar on the packaging according to the manufacturer’s instructions. All the parameters required in the Ecodesign / Energy label regulations will be measured within 3 cycles (i.e. energy efficiency, energy and water consumption, programme duration and drying efficiency).
The energy consumption will also be calculated based on the number of usable place settings with using the bowl support.

**ALTERNATIVE TESTING PROCEDURE:** Then, the tests will be performed according to EN 50242:2016 without installation of the separate bowl support. In this case, the same parameters as in the previous tests will be measured and will be compared with the corresponding tests performed with the bowl support. The energy consumption will also be calculated based on the number of usable place settings without using the bowl support.

The purpose of this alternative testing method is to evaluate the possible effects of not using the additional bowl support and the resulting reduction of capacity (e.g. 15 instead of 16 place settings) on the cleaning and drying performance, as well as the increase of the specific energy consumption per dish.

### 4.6.2 Case Dish 2: Specific pre-treatment according to manufacturer’s instructions

Prior to the alternative testing procedure, the appliance will be installed according to the harmonised standard EN 50242:2016 and tests will be conducted according to the standard conditions. This includes following the manufacturer’s instructions (information for testing institutes only) for a specifically required pre-treatment. All the parameters required in the Ecodesign / Energy label regulations will be measured within 3 cycles (i.e. energy efficiency, energy and water consumption, programme duration and drying efficiency).

**ALTERNATIVE TESTING PROCEDURE:** Then, the tests will be performed according to EN 50242:2016 with modified pre-treatment of the machine. In this case, the same parameters as in the previous tests will be measured and will be compared with the corresponding tests at standardized conditions as performed before.

The purpose of this analysis is to check if and how the special preparation or handling has an impact to the energy efficiency or other performance parameters of the appliance compared to the declared values. It will be assessed if the dishwasher recognizes through the specific pre-treatment being under test condition and is automatically reducing energy and/or water consumption or increasing the performance accordingly.

### 4.6.3 Case Dish 3: Removal or alteration of the position of “accessories”

Prior to the alternative testing procedure, the appliance will be installed according to the harmonised standard EN 50242:2016 and tests will be conducted according to the standard conditions. This includes following the manufacturer’s instructions for the specifically required removal or alteration of the position of many of the “accessories” fitted to the appliance when supplied (information for testing institutes only).
All the parameters required in the Ecodesign / Energy label regulations will be measured within 3 cycles (i.e. energy efficiency, energy and water consumption, programme duration and drying efficiency). The energy consumption will also be calculated based on the number of usable place settings with removing the accessories.

**Alternative testing procedure:** Then, the tests will be performed according to EN 50242:2016 without removing or altering the accessories and the machine will be loaded to the maximum number of place settings which is possible under that condition. In this case, the same parameters as in the previous tests will be measured and will be compared with the corresponding tests at standardized conditions as performed before. The energy consumption will also be calculated based on the number of usable place settings without removing the accessories.

The purpose of this analysis is to check if and how the special preparation or handling has an impact to the energy efficiency or other performance parameters of the appliance compared to the declared values. The purpose of this alternative testing method is to evaluate the possible effects of not removing or altering the accessories and the resulting reduction of capacity (e.g. 15 instead of 16 place settings) on the cleaning and drying performance, as well as the increase of the specific energy consumption per dish.

4.6.4 Case Dish 4: Dishwasher with water tank

Prior to the alternative testing procedure, the appliance will be installed according to the harmonised standard EN 50242:2016 with the water tank, and tests will be conducted according to the standard conditions with 23°C room and 15°C water temperature. All the parameters required in the Ecodesign / Energy label regulations will be measured within 3 cycles with each one cycle performed per day (i.e. energy efficiency, energy and water consumption, programme duration and drying efficiency).

**Alternative testing procedure:** Then, the tests will be performed according to EN 50242:2016, but the time between the test cycles will be each three days (according to the standard, up to four days may be between two test cycles, but usually, each day a test cycle is performed). The same parameters as in the previous tests will be measured and will be compared with the corresponding tests at standardized conditions as performed before.

The purpose of this alternative testing method is to evaluate the possible energy saving effect of the water tank which might only be reached through a daily use (which is reached in the standard conditions) compared to the energy and water consumption if the time between the tests runs would be up to 48 hours.
4.7 Domestic washing machines

In the previous work packages of ANTICSS, two cases (numbered ‘Wash 1’ and ‘Wash 2’) were categorized as “jeopardy effect”, and two further cases (numbered ‘Wash 3’ and “Wash 4” were assigned to the category “hypothetical circumvention”. Within this work package, these cases were analysed to determine if the issue still exists with the new ecodesign regulation and/or standard. If the issue persists, the cases were further analysed to determine if they are appropriate to be selected for designing an alternative testing method.

Table 10: Summary of the four cases (hypothetical circumvention and jeopardy effects) reported in ANTICSS for the product category domestic washing machines

<table>
<thead>
<tr>
<th>Case no.</th>
<th>Suspicious behaviour as reported to ANTICSS</th>
<th>ANTICSS categorisation</th>
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<tbody>
<tr>
<td>Wash 1</td>
<td>&quot;Energy consumption of a washing machine is predominantly influenced by the washing temperature. The higher the temperature, the higher is the energy consumption. In order to save energy without compromising washing performance, the washing temperature may be lowered in favour of the amount of detergent, agitation of the load or cycle times. In the reported case, two different suspect behaviours have been described. 1) First, the actual temperature of the water during the washing process in the eco-programme is lower than stated in the programme name. To fulfil the requirements concerning washing index (performance of a washing machine measured under predefined conditions in relation to the performance of a reference machine) as specified in regulation 1015/2010, losses in washing performance are compensated by higher agitation of the load and cycle times of more than six hours. In real life, such programmes are seldom selected due to long cycle times. Neither the relevant regulations 1015/2010 and 1061/2010 nor the standard 60456:2017 specify the actual temperature in the washing process or limit the programme duration.</td>
<td>Jeopardy effect</td>
<td>1) Temperature and programme duration: No, as the new ecodesign regulation already addresses the issue.</td>
</tr>
</tbody>
</table>

21 Published online at [https://ec.europa.eu/energy/en/regulation-laying-down-ecodesign-requirements-1-october-2019](https://ec.europa.eu/energy/en/regulation-laying-down-ecodesign-requirements-1-october-2019). Note that the regulation document code and the official publication date is still unknown at the moment of writing. The published revised regulations and respective standards will only come into force in near future, and circumvention might still be applied at some products being on the market up to that time. Nevertheless, the cases addressed by the revised Regulation have not been taken into account in this work package of ANTICSS, as possible impacts on the reduction of circumvention cannot then be clearly related to the effects of the project.
### Alternative test methods and approaches to unmask circumvention

#### Case no. | Suspicious behaviour as reported to ANTICSS | ANTICSS categorisation | Case selected for designing an alternative test method?
--- | --- | --- | ---
2) | Secondly, the indicated loading capacity of washing machines was stated as suspect behaviour. Some appliances have rated capacities of 10 kg or even more. In these cases, the calculation of the EEI is more advantageous. In real life, however, consumers seldom load such a machine to its full extent. The relevant regulations do not specify an upper limit of the capacity. | Jeopardy effect | 2) Loading capacity: Yes

**Wash 2**
A washing machine with two front doors is object of the reported case. The upper drum is smaller with a capacity of 4 kg; the lower drum has a capacity of 8 kg.

Energy labelling and ecodesign requirements for washing machines are based on 60 °C and 40 °C cotton standard programmes, which have to be indicated on the front / display of the machines. Even though the smaller drum in the reported washing machine is able to perform the same or equivalent washing programmes as the larger one, it is declared to not being able to perform 60°C and 40°C cotton standard programmes. Therefore, the energy and water consumption and the functional performance of the upper drum cannot be measured and shown to the consumers via the energy labelling. The consumer is misguided by the energy label, which refers only to a part of the appliance and not to the whole appliance. Consumers, who are not that familiar with energy labelling, do not know this.

**Jeopardy effect**
No, as the new ecodesign regulation already addresses the issue.

**Wash 3**
White goods may theoretically comprise hidden software / sensors that detect the specific ambient conditions of the standard and run specific algorithms that result in lower resource consumption (energy, water, etc.)

**circumvention (hypothetical)**
Yes

**Wash 4**
White goods may theoretically comprise hidden software that runs a certain algorithm for a pre-set number of cycles that consumes significantly less resources. Since, products tested by MSAs are “new” products; this algorithm may cover all test runs performed within market surveillance testing. However, in real life conditions, although consumers will experience this reduced consumption, it will be for a limited time and the device will revert to a different algorithm and run it for the rest of its use life

**circumvention (hypothetical)**
No. It is not possible to determine the exact duration (or number of cycles) after which the change in the behaviour of the machine will occur. The period for performing the tests within ANTICSS project is very tight and the alternative test could be a very time-consuming process, so it has been
4.7.1 Case Wash 1.2: Loading Capacity

It is very usual to see washing machines with a capacity of 9 kg, 10 kg or even larger. These machines achieve more easily a higher value of the energy efficiency index (EEI) and therefore a more favourable energy efficiency class. In “real life”, consumers usually do not fill the washing machine to the maximum capacity. This effect is even more visible and important for larger capacity machines. In addition, in some cases, test laboratories have encountered difficulties to introduce the declared full load inside the drum. This case was classified as “jeopardy effect” in the previous work package of the ANTICSS project.

4.7.1.1 Current situation in the EE or ED regulation /harmonised standard

Point 1 of Annex VII to regulation nº1061/2010 (energy labelling of household washing machines) states the following:

<table>
<thead>
<tr>
<th>Case no.</th>
<th>Suspicious behaviour as reported to ANTICSS</th>
<th>ANTICSS categorisation</th>
<th>Case selected for designing an alternative test method?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>decided to prioritize the other cases.</td>
</tr>
</tbody>
</table>
As it is explained before and it can be deducted from the formula of the energy efficiency index, the machines with higher rated capacities achieve more easily a higher value of the energy efficiency index (EEI) and therefore a more favourable energy efficiency class.

4.7.1.2 Results of pre-tests

FFII-LCOE, responsible test laboratory for analysing the product group washing machines within this work package, has performed some pre-tests and the results have been used for designing the alternative testing method. The rated capacity of the washing machine under test was 9 kg and the standard 60 °C and 40 °C cotton programmes according to the EL/ED regulations are called “Algodón ECO 60” and “Algodón ECO 40”, respectively.

This is the summary of the results:
**First step:** The standard 60 °C cotton programme (Algodón ECO 60) was compared with the “normal” 60 °C cotton programme (Algodón 60)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
<th>Algodón ECO 60</th>
<th>Algodón 60</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated capacity</td>
<td>g</td>
<td>9000</td>
<td>9000</td>
</tr>
<tr>
<td>Mass of base load</td>
<td>g</td>
<td>8491</td>
<td>8360</td>
</tr>
<tr>
<td>Water consumption during main wash</td>
<td>l</td>
<td>18,6</td>
<td>19,2</td>
</tr>
<tr>
<td>Total water consumption</td>
<td>l</td>
<td>49,9</td>
<td>85,2</td>
</tr>
<tr>
<td>Total energy consumption</td>
<td>kWh</td>
<td>0,941</td>
<td>0,920</td>
</tr>
<tr>
<td>Max. temperature during main wash</td>
<td>ºC</td>
<td>61,2</td>
<td>60,8</td>
</tr>
<tr>
<td>Min. temperature during main wash</td>
<td>ºC</td>
<td>35,4</td>
<td>37,2</td>
</tr>
<tr>
<td>Main wash duration</td>
<td>Min</td>
<td>168</td>
<td>100</td>
</tr>
<tr>
<td>Programme time</td>
<td>Min</td>
<td>210</td>
<td>146</td>
</tr>
<tr>
<td>Spin speed</td>
<td>rpm</td>
<td>1176</td>
<td>1206</td>
</tr>
<tr>
<td>Mass of base load after spin extraction</td>
<td>g</td>
<td>13150</td>
<td>13084</td>
</tr>
</tbody>
</table>

The results for the energy consumption are very similar. The water consumption in the non-standard programme is much higher; on the other hand, the main wash duration and the programme time of the standard programme are higher.

**Second step:** A reduced load was used as rated capacity. The reduced load was 6 kg, which is a load more commonly used by consumers. The following cycles were performed:

- Treatment 60°C; full load (6 kg): 2 test runs
- Treatment 40°C; half load (3 kg): 1 test run

These cycles were compared to the same treatments with the rated capacity according to the standard (9 kg for full load and 4.5 kg for half load).
Table 12: Comparison of the test results for the cotton programme Algodón ECO 60 with full rated capacity (9 kg) and reduced capacity (6 kg) for the full load cycles

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
<th>Algodón ECO 60 Full load Rated capacity: 9 kg</th>
<th>Algodón ECO 60 Full load Reduced capacity: 6 kg Test run1</th>
<th>Algodón ECO 60 Full load Reduced capacity: 6 kg Test run2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated capacity</td>
<td>g</td>
<td>9000</td>
<td>6000</td>
<td>6000</td>
</tr>
<tr>
<td>Mass of base load</td>
<td>g</td>
<td>8491</td>
<td>5664</td>
<td>5609</td>
</tr>
<tr>
<td>Water consumption during main wash</td>
<td>l</td>
<td>18,6</td>
<td>18,8</td>
<td>18,7</td>
</tr>
<tr>
<td>Total water consumption</td>
<td>l</td>
<td>49,9</td>
<td>48,7</td>
<td>48,7</td>
</tr>
<tr>
<td>Total energy consumption</td>
<td>kWh</td>
<td>0,941</td>
<td>1,011</td>
<td>1,015</td>
</tr>
<tr>
<td>Max. temperature during main wash</td>
<td>ºC</td>
<td>61,2</td>
<td>47,8</td>
<td>48,5</td>
</tr>
<tr>
<td>Min. temperature during main wash</td>
<td>ºC</td>
<td>35,4</td>
<td>36,1</td>
<td>36,2</td>
</tr>
<tr>
<td>Main wash duration</td>
<td>Min</td>
<td>168</td>
<td>179</td>
<td>179</td>
</tr>
<tr>
<td>Programme time</td>
<td>Min</td>
<td>210</td>
<td>217</td>
<td>219</td>
</tr>
<tr>
<td>Spin speed</td>
<td>rpm</td>
<td>1176</td>
<td>1205</td>
<td>1206</td>
</tr>
<tr>
<td>Mass of base load after spin extraction</td>
<td>g</td>
<td>13150</td>
<td>8651</td>
<td>8600</td>
</tr>
</tbody>
</table>
Table 13: Comparison of the test results for the cotton programme Algodón ECO 40 with half rated capacity (4.5 kg) and reduced capacity (3 kg) for the half load cycles

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
<th>Algodón ECO 40 Half load Rated capacity: 4.5 kg</th>
<th>Algodón ECO 40 Half load Reduced capacity: 3 kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated capacity (half load)</td>
<td>g</td>
<td>4500</td>
<td>3000</td>
</tr>
<tr>
<td>Mass of base load</td>
<td>g</td>
<td>4221</td>
<td>2825</td>
</tr>
<tr>
<td>Water consumption during main wash</td>
<td>l</td>
<td>12.5</td>
<td>12.4</td>
</tr>
<tr>
<td>Total water consumption</td>
<td>l</td>
<td>36.5</td>
<td>36.5</td>
</tr>
<tr>
<td>Total energy consumption</td>
<td>kWh</td>
<td>0.373</td>
<td>0.395</td>
</tr>
<tr>
<td>Max. temperature during main wash</td>
<td>ºC</td>
<td>33.5</td>
<td>29.6</td>
</tr>
<tr>
<td>Min. temperature during main wash</td>
<td>ºC</td>
<td>24.3</td>
<td>24.2</td>
</tr>
<tr>
<td>Main wash duration</td>
<td>Min</td>
<td>175</td>
<td>178</td>
</tr>
<tr>
<td>Programme time</td>
<td>Min</td>
<td>216</td>
<td>218</td>
</tr>
<tr>
<td>Spin speed</td>
<td>rpm</td>
<td>--</td>
<td>1208</td>
</tr>
<tr>
<td>Mass of base load after spin extraction</td>
<td>g</td>
<td>6568</td>
<td>4480</td>
</tr>
</tbody>
</table>

If a lower load than the rated capacity (but different to the half load according to the standard) is used, the results are not the expected ones. In this case, a 6 kg load was used, that is next to 4.5 kg (half load for the rated capacity). This load is more commonly used by consumers.

With a lower load, it is expected that the energy and the water consumption were reduced, but, in both treatments with the reduced load the water consumption is maintained, the energy consumption is higher and the temperature during the wash is lower. This is especially significant in the “Treatment 60 ºC; full load”.
4.7.1.3 Proposed alternative testing method

Prior to the alternative testing procedure, the tests according to the harmonised standard EN 60456:2016 will be conducted with the rated capacity. All the parameters required in the EL/ED regulations will be measured (i.e. washing performance, spin speed, residual moisture content, temperature of water during the main wash, programme time, water consumption, etc.)

**ALTERNATIVE TESTING PROCEDURE:** Then, the tests will be performed according to EN60456:2016 with a load of 6 kg instead of the rated capacity (full load) declared by the manufacturer. In this case, the same parameters as in the previous tests will be measured and will be compared with the corresponding tests performed at rated capacity.

The EEI will be calculated in both cases.

The purposes of the alternative testing method are to check if unexpected results (i.e. higher energy consumption despite less load, etc.) can be related to the use of “fictitious” bigger capacities for obtaining a better EEI, i.e. perfection of the appliance only for the rated capacities (full and half load) for testing purposes.
4.7.2 Case Wash 3: Hidden software

White goods may theoretically comprise hidden software/sensors that detect the specific ambient testing conditions of the standard procedure and run specific algorithms that results in lower resource consumption (energy, water, etc.)

This case was classified as “hypothetical circumvention” in the previous work packages of the ANTICSS project. Although no specific case was reported to the ANTICSS project team, it was decided to develop and apply an alternative test procedure within this work package as this case could be applicable also for other product categories.

4.7.2.1 Proposed alternative testing method

Prior to the alternative testing procedure, the tests according to the harmonised standard EN 60456:2016 will be conducted with the rated capacity. According to this standard, the tests have to be performed with a stable supply voltage of 230V ±1%. All the parameters required in the EL/ED regulations will be measured (i.e. washing performance, spin speed, residual moisture content, temperature of water during the main wash, programme time, water consumption, etc.).

**ALTERNATIVE TESTING PROCEDURE:** Then, the **supply voltage** to each test washing machine shall be maintained throughout the test at 230V ± 6%.

A test series of 4 tests is carried out on the test washing machine with 3 different treatments as follows:

- Treatment 40°C; half load: 1 test run
- Treatment 60°C; half load: 1 test run
- Treatment 60°C; full load: 2 test runs

All the parameters required in the EU Regulations and measured in the harmonised standard will be measured (i.e. EEI, washing performance, spin speed, residual moisture content, temperature of water during the main wash, water consumption, etc.) and will be compared with the corresponding tests performed with a stable supply voltage according to the standard (230V± 1%)

The purposes of this analysis are to

- see how the variation of the supply voltage, more likely to happen in real life conditions, can influence the energy and functional performance of the washing machine
- analyse if the rather narrow ambient conditions in the harmonised standard conditions trigger the activation of any possible hidden software/sensors that can cause lower resource consumption (energy, water, etc.).
4.8 Household tumble driers

In the previous work packages of ANTICSS, one case (numbered ‘Drier 1’) was categorized as “circumvention”, and two further cases (numbered ‘Drier 2’ and “Drier 3”) were assigned to the category “hypothetical circumvention”. Within this work package, the cases were analysed to determine if they are appropriate to be selected for designing an alternative testing method.

Table 14: Summary of the three cases (circumvention and hypothetical circumvention) reported in ANTICSS for the product category household tumble driers

<table>
<thead>
<tr>
<th>Case no.</th>
<th>Suspicious behaviour as reported to ANTICSS</th>
<th>ANTICSS categorisation</th>
<th>Case selected for designing an alternative test method?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drier 1</td>
<td>Some tumble dryers have a statement in the instructions regarding special preparation before commencing tests to EN61121. These specific instructions might serve as indication for the appliance to detect being under the test situation and could trigger a performance profile different to the “norm”.</td>
<td>Circumvention</td>
<td>Yes</td>
</tr>
<tr>
<td>Drier 2</td>
<td>White goods may theoretically comprise hidden software/sensors that detect the specific ambient testing conditions of the standard and run specific algorithms that results in lower resource consumption (energy, water, etc.).</td>
<td>circumvention (hypothetical)</td>
<td>Yes</td>
</tr>
<tr>
<td>Drier 3</td>
<td>“White goods may theoretically comprise hidden software that runs a certain algorithm for a pre-set number of cycles that consumes significantly less resources. Since, products tested by MSAs are “new” products this algorithm may cover all test runs performed within market surveillance testing. However, in real life conditions, although consumers will experience this reduced consumption, it will be for a limited time and the device will revert to a different algorithm and run it for the rest of its use life</td>
<td>circumvention (hypothetical)</td>
<td>No. It is not possible to determine the exact duration (or number of cycles) after which the change in the behaviour of the machine will occur. The period for performing the tests within ANTICSS project is very tight and the alternative test could be a very time-consuming process, so it has been decided to prioritize the other cases.</td>
</tr>
</tbody>
</table>
4.8.1 Case Drier 1: Special preparation before testing

Some tumble dryers have a statement in the instructions regarding special preparation before commencing tests to EN61121. It is possible that this specific set of requirements could trigger a different performance profile to the “norm”.

4.8.1.1 Proposed alternative testing method

Prior to the alternative testing procedure, the tests will be conducted according to the harmonised standard EN 61121:2013 with the special preparation according to the manufacturer’s instructions. All the parameters required in the EL/ED regulations will be measured (i.e. EEI, moisture content, energy consumption, programme time etc.).

**ALTERNATIVE TESTING PROCEDURE:** Then, the alternative testing method will consist on performing the tests according to EN61121:2013 without applying the special preparation required by the manufacturer. All the parameters required in the EU Regulations and measured in the harmonised standard will be measured (i.e. EEI, moisture content, energy consumption, programme time etc.) and will be compared with the corresponding tests performed with the special preparation according to the manufacturer’s instructions.

The purpose of this analysis is to check how the special preparation mandated by the manufacturer affects the energy and functional performance of the tumble drier.
4.8.2 Case Drier 2: Hidden software

White goods may theoretically comprise hidden software/sensors that detect the specific ambient testing conditions of the standard and run specific algorithms that result in lower resource consumption (energy, water, etc.).

4.8.2.1 Proposed alternative testing method

Prior to the alternative testing procedure, the tests according to the harmonised standard EN 61121:2013 will be conducted with the rated capacity. According to this standard, the tests have to be performed with a stable supply voltage of 230V ±1%. All the parameters required in the EL/ED regulations will be measured (i.e. EEI, moisture content, energy consumption, programme time etc.).

**Alternative testing procedure:** Then, the supply voltage to each test tumble dryer shall be maintained throughout the test at 230V ± 6%. A test series of 4 tests is carried out on the tumble dryer with 2 different treatments as follows:

- Treatment full: 2 test runs
- Treatment half: 2 test runs

All the parameters required in the EU Regulations and measured in the harmonised standard will be measured (i.e. EEI, moisture content, energy consumption, programme time etc.) and will be compared with the corresponding tests performed with a stable supply voltage according to the standard (230V ±1%).

The purposes of this analysis are to

- see how the variation of the supply voltage, more likely to happen in real life conditions, can influence the energy and functional performance of the tumble dryer;
- analyse if the rather narrow ambient conditions in the harmonised standard conditions trigger the activation of any possible hidden software/sensors that can cause lower resource consumption (energy, water, etc.).
4.9 Solid fuel local space heaters

In the previous work packages of ANTICSS, one case (numbered ‘SFLSH 1’) was categorized as “circumvention”. Within this work package, the case was analysed in further detail to determine if it is appropriate to be selected for designing an alternative testing method.

Table 15: Summary of the case (circumvention) reported in ANTICSS for the product category solid fuel local space heaters

<table>
<thead>
<tr>
<th>Case no.</th>
<th>Suspicious behaviour as reported to ANTICSS</th>
<th>ANTICSS categorisation</th>
<th>Case selected for designing an alternative test method?</th>
</tr>
</thead>
<tbody>
<tr>
<td>SFLSH 1</td>
<td>During an inspection campaign, suspicious behaviour with regard to solid fuel boilers has been observed. Some producers applied modifications on products tested such as a different combustion air circuit, additional aluminium tape sealing on the air entrance or a modified baffle in the air exhaust duct. As a result, the performance is improved. However, these modifications were not applied to the whole production chain, but only to the products tested in order to get the CE marking. According to an expert responsible for market surveillance, it is common to do such modifications to reach the performance requested. However, producers are responsible to adapt the whole production line to these modifications to ensure that all appliances are able to obtain the same performances than the tested sample. Despite the requirement explained in the European standard saying that the tested sample for CE marking must be representative of the production, some manufacturer don’t produce appliances like the one used for CE certification tests.</td>
<td>Circumvention</td>
<td>No, see following explanation</td>
</tr>
</tbody>
</table>

The case is related to a solid fuel local space heater, defined according to the Regulation as a space heating device that emits heat by direct heat transfer or by direct heat transfer in combination with heat transfer to a fluid, in order to reach and maintain a certain level of human thermal comfort within an enclosed space in which the product is situated. The heating device is equipped with one or more heat generators that convert solid fuels directly into heat. In the description of the case it is defined as “solid fuels boiler” but this specific product is included in the ENER 15 (Regulation (EU) 2015/1187 and Regulation (EU) 2015/1189) being defined in a different way (“product equipped with one or more solid fuel heat generators that provides heat to a water-based central heating system in order to reach and maintain at a desired level the indoor temperature”).
The description of the product suggests one of the following product types being involved in the circumvention:

- residential room heaters fired by solid fuel;
- residential open fires fired by solid fuel;
- inset appliances fired by solid fuel.

These appliances provide heat into the space where they are installed. Additionally, where fitted with a boiler, they also provide domestic hot water and/or central heating. According to the standards, these appliances may burn either solid mineral fuels, peat briquettes, natural or manufactured wood logs or be multi-fuel in accordance with the appliance manufacturer’s instructions.

The case is relating to any possible modification of the product between testing for conformity assessment (e.g. initial type testing according to Regulation (EU) 305/2011) and serial production found in the EU market. The modification identified in the description could affect directly the useful efficiency of the product.

The modification of the useful efficiency could be obtained in a different way, for example:

1. Considering an additional aluminium tape sealing on the air entrance (ref. B in Figure 12) being the combustion speed approximately proportional to the amount of air flowing through the openings therefore, having a controlled combustion speed, theoretically, there is a complete combustion (increasing in CO\textsubscript{2}) and the temperature of the combustion products is contained. The growth of CO\textsubscript{2} and the control of the temperature contribute to the reduction of thermal heat losses (Q\textsubscript{a}) and chemical heat losses (Q\textsubscript{b}) producing an increase of efficiency.

   \[
   Q_a = (t_a - t_r) \times \left[ \left( \frac{C_{pmd}*(C-C_r)}{0,536+(CO+CO_2)} \right) + \left[ \frac{C_{pmH2O}*1,224+(9H+W)}{100} \right] \right]
   \]

   \[
   Q_b = \frac{12644+CO*(C-C_r)}{0,536+(CO_2+CO)} \times 100
   \]

2. Using modified or additional baffle in the air exhaust duct or combustion chamber (ref. E in Figure 12) the flue gas temperature (T\textsubscript{a}) is reduced due to the dissipation of the heat. The decrease of T\textsubscript{a} contributes to the reduction of thermal heat losses (Q\textsubscript{a}) producing an increase of efficiency being the efficiency itself calculated as below:

   \[
   \eta = 100 - (q_a + q_b + q_c)
   \]
3. Using an extended flue gas outlet or fluepipe. In this case increasing the distance between enclosure of the heater and the measurement section, the flue gas temperature ($T_a$) is reduced increasing the efficiency accordingly. For this reason, the extended flue gas outlet or fluepipe is a fixed and indispensable part of the appliance and shall not be extended for type test purposes only.

![Diagram of the product](image)

- **A** Appliance
- **B** Air entrance
- **C** Flue gas connector
- **D** Measurement section
- **E** Additional baffle

Figure 12: Example of the product

After more detailed analysis of the reported case, which was initially categorized as circumvention by the ANTICSS team, the case was finally considered within this work package as being non-compliant for which **no alternative testing will be proposed in ANTICSS anymore**. **Justification:**

The product under investigation is different from the prototype product tested in the manufacturer test report for conformity assessment; the manufacturer has not provided any type of calculation or engineering analysis to correlate the initial test results of the “prototype” with the product under investigation. On the one hand, the modification identified between the prototype and the product under investigation could affect directly the useful efficiency of the improved product by the reduction of thermal, and heat losses ($Q_a$) and chemical heat losses ($Q_b$). Moreover since no ecodesign requirements on emissions to air are applicable for the product category until 2022, the increase in CO$_2$ emissions will not be considered while the increased energy efficiency due to the technological modifications – if any – will allow the “prototype” to meet more easily the ecodesign minimum efficiency requirements and to achieve a better positioning according to energy labelling. On the other hand, applying alternative testing of the product placed on the market is not recommended since the outcome of such alternative test could only state a worse energy efficiency compared with the prototype. However, this different behaviour is due to clearly visible technological improvements and not to a hidden circumvention behaviour: The non-compliance of the product placed on the market is not due to the presence of the technological improvements but to the fact that the sample (the prototype) tested in the test report used by the manufacturer for the conformity assessment is too different from the product placed on the market, and the manufacturer has not provided any proof (i.e. calculation on the basis of design, or extrapolation, etc.) of the link existing between the two samples.
4.10 Domestic ovens

In the previous work packages of ANTICSS, one case (numbered ‘Oven 1’) was categorized as “circumvention”, and two further cases (numbered “Oven 2” and “Oven 3”) were assigned to the category “jeopardy effect”. Within this work package, the cases were analysed to determine if they are appropriate to be selected for designing an alternative testing method.

Table 16: Summary of the three cases (circumvention and jeopardy effects) reported in ANTICSS for the product category domestic ovens

<table>
<thead>
<tr>
<th>Case no.</th>
<th>Suspicious behaviour as reported to ANTICSS</th>
<th>ANTICSS categorisation</th>
<th>Case selected for designing an alternative test method?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oven 1</td>
<td>The point 6.2.1 of standard EN 60350-1 states the following: “Removable items specified in the user instructions to be not essential for the operation of the appliance in the manner for which it is intended shall be removed before measurement is carried out.” In some ovens, the measurement of the volume had been done removing the shelf guides, because according to some recipes included in the user manual the cooking compartment must be empty. Higher volume implies better EEI.</td>
<td>Circumvention</td>
<td>Yes</td>
</tr>
<tr>
<td>Oven 2</td>
<td>According to point 7.4 of standard EN 60350-1, to measure the energy consumption of the oven, the temperature rise in the centre of the oven has to reach the 3 different temperatures, but in the last step, it is allowed not to reach the higher temperature set in the standard. This situation implies lower energy consumption.</td>
<td>Jeopardy effect</td>
<td>Yes</td>
</tr>
<tr>
<td>Oven 3</td>
<td>Many oven models have an electronic control, which, for example, constantly readjusts the oven interior temperature according to the manufacturer’s program settings and adapts it to the respective situation. The test cycle according to EN 60350-1 consists of a subsequent temperature measurement of the empty oven in conjunction with the previously performed energy consumption measurement. The first step of the cycle (measurement of the energy consumption) is done with the oven loaded with a brick and necessarily after this step, the door has to be opened to remove the brick for the next step (temperature measurement of the empty oven).</td>
<td>Jeopardy effect</td>
<td>Yes</td>
</tr>
</tbody>
</table>
The measurements by an MSA of 7 oven models analogous in ECO mode to EN 60350-1 provides the impression that the first opening of the loaded oven in 6 oven models was a control-relevant event and led to a changed regulatory behavior: The opening (and re-closing) of the oven door caused a significant increase of the temperature in the interior of the oven and the set temperature value result was increased. So, the measurement of the energy consumption was performed with a lower temperature.

4.10.1 Case Oven 1: Measurement of the volume without the shelf guides

The point 6.2.1 of standard EN 60350-1 states the following:

“Removable items specified in the user instructions to be not essential for the operation of the appliance in the manner for which it is intended shall be removed before measurement is carried out.”

In some ovens, the measurement of the volume had been done removing the shelf guides, because according to some recipes included in the user manual the cooking compartment must be empty. Higher volume implies better EEI

4.10.1.1 Proposed alternative testing procedure

Prior to the alternative testing procedure, the tests according to the harmonised standard EN 60350-1:2016 will be conducted. All the parameters required in the EL/ED regulations will be measured and the IEE will be calculated.

**ALTERNATIVE TESTING PROCEDURE:** Then, the volume of the oven will be measured with the shelf guides in their position and the EEI will be calculated.

With this alternative testing method, we will be able to quantify how the difference in the measurement of the volume affects the EEI (and the corresponding energy efficiency class).
4.10.2 Case Oven 2: Maximum temperature in the centre of the oven

According to point 7.4 of standard EN 60350-1, to measure the energy consumption of the oven, the temperature rise in the centre of the oven has to reach the following temperatures, but in the last step, it is allowed not to reach the higher temperature set in the standard ($\Delta T_3$). This situation implies lower energy consumption.

### Table 1 – settings

<table>
<thead>
<tr>
<th>temperature rise</th>
<th>Conventional ($i_C$)</th>
<th>Forced air circulation ($i_F$)</th>
<th>Hot steam ($i_H$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\Delta T_1$</td>
<td>(140 ± 10) K</td>
<td>(135 ± 10) K</td>
<td>(135 ± 10) K</td>
</tr>
<tr>
<td>$\Delta T_2$</td>
<td>(180 ± 10) K</td>
<td>(155 ± 10) K</td>
<td>(155 ± 10) K</td>
</tr>
<tr>
<td>$\Delta T_3$</td>
<td>(220 ± 10) K</td>
<td>(175 ± 10) K</td>
<td>(175 ± 10) K</td>
</tr>
</tbody>
</table>

* Or the maximum temperature rise if this value cannot be reached.

4.10.2.1 Proposed alternative testing procedure

Prior to the alternative testing procedure, the tests according to the harmonised standard EN 60350-1:2016 will be conducted. All the parameters required in the EL/ED regulations will be measured and the EEI will be calculated.

**ALTERNATIVE TESTING PROCEDURE:** Then, the tests will be repeated reducing the higher temperature that has to be reached in the centre of the oven and the energy consumption will be measured in this condition. So, the table 1 of standard EN 60350-1 will be modified in the following way:

### Table 1 – settings

<table>
<thead>
<tr>
<th>temperature rise</th>
<th>Conventional ($i_C$)</th>
<th>Forced air circulation ($i_F$)</th>
<th>Hot steam ($i_H$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\Delta T_1$</td>
<td>(140 ± 10) K</td>
<td>(135 ± 10) K</td>
<td>(135 ± 10) K</td>
</tr>
<tr>
<td>$\Delta T_2$</td>
<td>(180 ± 10) K</td>
<td>(155 ± 10) K</td>
<td>(155 ± 10) K</td>
</tr>
<tr>
<td>$\Delta T_3$</td>
<td>200 ± 10) K</td>
<td>165 ± 10) K</td>
<td>165 ± 10) K</td>
</tr>
</tbody>
</table>
Then, the EEI will be calculated.

Maintaining the note that allows not reaching the higher temperature set in the standard ($\Delta T_3$) is not fair for those ovens that are capable to reach that temperature. With this method, we will be able to quantify how the EEI of these ovens would be improved if they were tested in the same conditions as the ovens that cannot reach the highest temperature of table 1 of EN 60350-1:2016.

4.10.3 Case Oven 3: Measurement of the energy consumption. Electronic control

Many oven models have an electronic control, which, for example, constantly readjusts the oven interior temperature according to the manufacturer's program settings and adapts it to the respective situation.

The test cycle according to EN 60350-1 consists of a subsequent temperature measurement of the empty oven in conjunction with the previously performed energy consumption measurement. The first step of the cycle (measurement of the energy consumption) is done with the oven loaded with a brick and necessarily after this step, the door has to be opened to remove the brick for the next step (temperature measurement of the empty oven).

The measurements by an MSA of 7 oven models analogous in ECO mode to EN 60350-1 provide the impression that in 6 of the tested oven models the first opening of the loaded oven was a control-relevant event and led to a changed regulatory behaviour: The opening (and re-closing) of the oven door caused a significant increase of the temperature in the interior of the oven and the set temperature value result was increased. So, the measurement of the energy consumption was performed with a lower temperature. The same measurements were performed in a non-ECO mode and there was no difference between the temperatures of the two steps of the test cycle.

4.10.3.1 Proposed alternative testing procedure

Prior to the alternative testing procedure, the tests will be conducted according to the harmonised standard EN 60350-1:2016. All the parameters required in the EL/ED regulations will be measured and the EEI will be calculated. The test cycle according to EN 60350-1:2016 consists of a subsequent temperature measurement of the empty oven (sub-clause 7.4.3.2) in conjunction with the previously performed energy consumption measurement (sub-clause 7.4.3.1).

**ALTERNATIVE TESTING PROCEDURE:** The alternative testing method will consist of modifying the second step of the measurement (sub-clause 7.4.3.2: “Checking the oven temperature”) for considering it a separate measurement.
For this, the measurement of the empty oven will be performed by starting the test with the appliance at ambient temperature (23 ± 2) °C. This measurement will be conducted on a different day than the measurement of the energy consumption for ensuring that the whole appliance (this includes the material and the insulation) is at ambient temperature.

This alternative testing method tries to avoid that the software detects the opening of the door when removing the brick and changes the behaviour of the oven.

Note: CEN-CENELEC TC 59X is currently also developing a new method for measuring the energy consumption in ovens (TC59X/Sec0733/NP). This method was analysed but it was considered not being adequate to solve this specific issue for the purposes of ANTICSS.
5 Final product categories and cases to be tested in ANTICSS

The following table summarizes the product categories and cases finally chosen for applying the alternative test methods developed within the ANTICSS project.

Table 17: Final overview of cases (circumvention or jeopardy effects) tested in ANTICSS

<table>
<thead>
<tr>
<th>Lot</th>
<th>Product category</th>
<th>Case</th>
<th>ANTICSS categorisation</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENER 1</td>
<td>Space heaters</td>
<td>Heaters 2 – Variable speed compressor</td>
<td>Jeopardy effect</td>
</tr>
<tr>
<td>ENER 5</td>
<td>Televisions</td>
<td>TV 1 – Setting of brightness</td>
<td>Circumvention</td>
</tr>
<tr>
<td></td>
<td></td>
<td>TV 2 / 3 – Test loop recognition</td>
<td>Jeopardy effect</td>
</tr>
<tr>
<td>ENER 10</td>
<td>Room air conditioning</td>
<td>RAC 2 – 1) Defrost</td>
<td>Jeopardy effect</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2) Variable speed compressor</td>
<td></td>
</tr>
<tr>
<td>ENER 13</td>
<td>Domestic freezers and refrigerators-f</td>
<td>COLD 2 / 4 – Multiple operation modes / holiday mode</td>
<td>Jeopardy effect</td>
</tr>
<tr>
<td></td>
<td>refrigerators</td>
<td>COLD 3 – Display is continuously activated</td>
<td>Jeopardy effect</td>
</tr>
<tr>
<td>ENER 14</td>
<td>Domestic dishwashers</td>
<td>DISH 1 – Separate bowl support</td>
<td>Circumvention</td>
</tr>
<tr>
<td></td>
<td></td>
<td>DISH 2 – Specific pre-treatment before testing</td>
<td>Circumvention</td>
</tr>
<tr>
<td></td>
<td></td>
<td>DISH 3 – Removal / alteration of accessories</td>
<td>Circumvention</td>
</tr>
<tr>
<td></td>
<td></td>
<td>DISH 4 – Dishwasher with water tank</td>
<td>Jeopardy effect</td>
</tr>
<tr>
<td>ENER 14</td>
<td>Domestic washing machines</td>
<td>WASH 1.2 – Loading capacity</td>
<td>Jeopardy effect</td>
</tr>
<tr>
<td></td>
<td></td>
<td>WASH 3 – Hidden software</td>
<td>Circumvention (hypothetical)</td>
</tr>
<tr>
<td>ENER 16</td>
<td>Household tumble driers</td>
<td>DRIER 1 – Special preparation before testing</td>
<td>Circumvention</td>
</tr>
<tr>
<td></td>
<td></td>
<td>DRIER 2 – Hidden Software</td>
<td>(hypothetical)</td>
</tr>
<tr>
<td>ENER 22</td>
<td>Domestic ovens</td>
<td>OVEN 1 – Volume without shelf guides</td>
<td>Circumvention</td>
</tr>
<tr>
<td></td>
<td></td>
<td>OVEN 2 – Maximum temperature in centre of oven</td>
<td>Jeopardy effect</td>
</tr>
<tr>
<td></td>
<td></td>
<td>OVEN 3 – Electronic control</td>
<td></td>
</tr>
</tbody>
</table>

From the initially pre-selected ten product categories (cf. section 3), two product categories are not included in the final selection anymore due to the following reasons:

- **ENER 13 / Domestic refrigerators**: It was not possible to detect refrigerators on the market equipped with the technical features related to Case COLD 3, but only refrigerator-freezers models; thus, it was decided to test this case on refrigerators-freezers instead.

- **ENER 20 / Solid fuel local space heaters**: After more detailed analysis of the reported case, which was initially categorized as circumvention by the ANTICSS team, the case was finally considered within this work package as being non-compliant for which no alternative testing will be proposed in ANTICSS anymore.
Finally, for the product category **ENER 1**, it was not possible to detect any condensing boilers on the market related to the described **Case Heaters 1**. Background:

Gas boilers/combi-boilers, covered by Regulations 811 and 813/2013, could be placed on the market with two possible installation configurations, both described in detail in the product's instruction manual:

- **Configuration 1**: more classic configuration for a condensing boiler, where the connection with a condensation disposal system (drain tube or collection tank) is foreseen and
- **Configuration 2**: where a by-pass, either supplied by the boiler manufacturer with full installation and regulation instructions, or as an "accessory" for the condensing boiler, but with no reference or recommendation for its installation or its effect when installed (this is particularly true when the boiler pipes are already prearranged for the bypass installation). In the figure below – taken from the installer and user manual in the release of February 2016 – for the specific boiler model the second configuration is named ‘FCR function’ or ‘reduced condensation function’. It is foreseen between the supply and return heat transfer fluid pipes, to decrease or even completely avoid the formation of condensation.

![Figure 13: Extract from an installer and user manual (February 2016): including the configuration of a ‘FCR function’](image)

The issue was brought to the attention of the European Commission and the ADCO Ecodesign and Energy labelling Groups at the end of 2016. The outcome of the discussion was that given that the product is placed on the market with two possible configurations, test reports (showing the compliance with the Ecodesign minimum efficiency requirements) should be available for both those configurations, showing that both 'products' need to be compliant and two labels need to be provided. The values can be declared through two different product information sheets. In addition it was concluded that, since not always "bypasses" have an impact on the boiler energy efficiency and to avoid useless multiple testing, when these "bypasses" or devices (such as 3-way valve) provided either as accessories or directly with the boiler, do not directly or indirectly alter the heat generator energy efficiency of the boiler but are only meant for example to modify the distribution performance, they are not considered to change the boiler configuration and therefore do not
require any additional testing or additional conformity assessment, nor additional energy label(s)/declarations under Regulations 811 and 813/2013. These conclusions where included in the GUIDELINES accompanying Regulation (EU) 811 & 812/2013, Regulation (EU) 813 & 814/2013 and Regulation (EU) 1187 & 1189/2015 (edition 2018).

The case was reported during the ANTICSS collection of suspect circumvention cases to assess if the use of by-pass/devices altering the configuration of boilers/combi-boilers was still used by manufacturers and it was decided to test the Case ‘Heaters 1’ according to an alternative test procedure developed within ANTICSS, see section 4.1.1.

However, throughout the process of selecting models for this case, it was not possible to find any condensing boilers through market research where the manufacturer declares that it is possible to reduce (or even avoid) the formation of condensing water by means of a by-pass or any other type of technical feature. It seems that such boilers cannot be found on the market anymore. A reason for this is very likely the clarification in the “GUIDELINES accompanying Regulation (EU) 811 & 812/2013, Regulation (EU) 813 & 814/2013 and Regulation (EU) 1187 & 1189/2015 (edition 2018)” that in both configurations (with and without the by-pass working) the products shall comply with the minimum ecodesign efficiency requirements (see above) has very likely discouraged the manufacturer to place these products on the market as there is a risk that with the by-pass working the efficiency is lower than the minimum requirements. In fact, for the same combi boiler of the Figure above the new installer manual, in the release of April 2017, was already considering the reduction of the condensation formation only via the increase of the space heating and sanitary water temperature, but NOT via any type of by-pass or similar device (pre-installed or sold as an accessory) potentially altering the configuration of the boiler.

Figure 14: Extract from an installer and user manual (April 2017): not including the configuration of a ‘FCR function’ anymore

The possible alternative solution to fully randomize the selection of three condensing boilers instead for testing within ANTICSS would dramatically increase the risk of not finding circumvention at all. Therefore, it was decided that this product category will be dropped from being tested due to the impossibility to find products on the market with the specific features related to this case.

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Austria: BMDW - Bundesministerium für Digitalisierung und Wirtschaftsstandort
Belgium: ECOS - European Environmental Citizens Organisation for Standardisation
Belgium: BHTC - Service public federal sante publique, securite de la chaine alimentaire et environnement
Czech Republic: SEVEn - SEVEn, the Energy Efficiency Center, z.u.
Czech Republic: SEIA - Státní energetická inspekcí
Germany: OEKO - Oeko-Institut e.V., Institute for Applied Ecology
Germany: GRS - Regierung von Schwaben – Gewerbeaufsichtsamt
Germany: UBONN - Rheinische Friedrich-Wilhelms-Universitat Bonn
Germany: VDE - VDE Prüf- und Zertifizierungsinstitut GmbH
Italy: ENEA- Agenzia nazionale per le nuove tecnologie, l'energia e lo sviluppo economico sostenibile
Italy: CCIAA Mi - Camera di commercio industria artigianato agricoltura
Italy: IMQ - Istituto Italiano del Marchio di Qualità S.p.A.
Netherlands: Re/gent - Re/gent B.V.
Netherlands: NVWA - Nederlandse voedsel en warenautoriteit
Portugal: ADENE - Adene-agencia para a energia
Portugal: ASAE - Autoridade seguranca alimentar e economica
Spain: FFII – LCOE - Fundacion para el fomento de la innovacion industrial
Spain: CM - Comunidad de Madrid