

CEN-CENELEC TC10
Material Efficiency Aspects for Ecodesign'

Secretary Enquiry (new work item 65688 / prEN 45559)

To: National Standardisation Bodies

Secretary Enquiry

CEN/CLC European Standard

prEN 45559 - Methods for providing information relating to material efficiency aspects of energy related products

National Standardisation Bodies are invited to comment on the document. Comments can be considered only if form sheet (FormComments.doc) is used.

National Standardisation Bodies shall upload their comments, as a reply to this document on the Collaboration tool, no later than 2017-11-13.

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45 Foreword

46 The dual logo CEN-CENELEC standardization deliverables, in the numerical range of 45550 – 45559,
47 have been developed under standardization request M/543 of the European Commission and will apply
48 to Energy-related Products (ErP).

49 Topics covered in the above standardization request are product durability, reparability, reusability,
50 upgradability, recyclability, recycled content, ability to remanufacture, product lifespan, and critical raw
51 material together with associated communication. While various topics in the context of material
52 efficiency are covered in these CEN-CENELEC deliverables, other subjects of material efficiency are
53 not covered, despite their potential impact on material efficiency. Examples of topics not covered
54 include for instance renewable resources.

55 The standardization deliverables are horizontal in nature and describe or define fundamental
56 principles, concepts, terminology or technical characteristics, relevant to a number of technical
57 committees.

58 The primary addressee of most of these standardization deliverables, including the present standard,
59 are product-specific technical committees of ErP.

60 Introduction

61 More specifically, the standard presented here aims to set up a general methodology on the
62 communication of material efficiency aspects of energy related products. It is intended to be used by
63 product specific technical committee as input for the development of a communication strategy at
64 product-specific level.

65 This standard is related to nearly all other standardization deliverables developed under the
66 standardization request M/543. While the other standardization deliverables will provide methodologies
67 to assess or measure specific material efficiency aspects, this standard focusses on the
68 communication methodology of the various material efficiency aspects.

69 The material efficiency information to be communicated shall be verifiable and take into account the
70 intended audience (consumers, professionals or market surveillance authorities).

71

72 1 Scope

73 This European Standard establishes a common methodology for the provision of information related
74 to material efficiency aspects of energy related products.

75 This European Standard does not include product-specific provisions, which shall be dealt with in
76 product specific standards. It is intended that product specific provisions that are related to material
77 efficiency aspects be based on and use the principles and procedures of this European Standard.

78

79 2 Normative references

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

- 83
- CEN-CLC prTR 45550 - Definitions related to material efficiency

- 84 • CEN-CLC prTR 45551 - Guide on how to use generic material efficiency standards when writing
85 energy related product specific standardization deliverables
- 86 • CEN-CLC prEN 45552 - General method for the assessment of the durability of energy-related
87 products
- 88 • CEN-CLC prEN 45553 - General method for the assessment of the ability to re-manufacture
89 energy-related products
- 90 • CEN-CLC prEN 45554 - General methods for the assessment of the ability to repair, reuse and
91 upgrade energy-related products
- 92 • CEN-CLC prEN 45555- General methods for assessing the recyclability and recoverability of
93 energy-related products
- 94 • CEN-CLC prEN 45556 - General method for assessing the proportion of re-used components
95 in energy-related product
- 96 • CEN-CLC prEN 45557 - General method for assessing the proportion of recycled material
97 content in energy-related products
- 98 • CEN-CLC prEN 45558 - General method to declare the use of critical raw materials in energy-
99 related products

101 3 Terms and definitions

102 For the purposes of this document, the following terms and definitions apply:

103 3.1

104 **consumer**

105 natural (also called physical) person purchasing products or services for personal or private use

106 [SOURCE ISO 16759:2013, 3.4.1]

108 3.2

109 **manufacturer**

110 natural (also called physical) or legal person placing a product on the market, regardless of whether
111 this person acts as the actual producer, the importer, or an authorized representative of the actual
112 producer

113 3.3

114 **professional**

115 natural (also called physical) or legal person with recognized qualifications to perform certain
116 operations in relation to the product

117 Note 1 to entry: these include but are not limited to installers, repairers, recyclers, (re-)manufacturers, maintenance operators,
118 upgrade services, reuse-operators

120 4 Material Efficiency Communication Methodology

121 When planning a strategy to deliver information of material efficiency aspects, added clarity and
122 consistency can be gained by breaking down that information in the various individual contributors,
123 namely the different material efficiency topics, the specific material efficiency content to be

124 communicated, the corresponding confidentiality levels, the audiences that are likely to receive the
 125 information, and the communication vehicles and their location that are best suited to deliver the
 126 information. This concept is exemplified in Figure 1 below:



127

128 **Figure 1 — Concept for the material efficiency communication strategy inputs**

129 The methodology proposed here is intended to support determining the strategy for communication of
 130 material efficiency aspects of specific energy related products (or product groups), when preparing
 131 product specific standards. Each of these aspects will be addressed in more detail in the following
 132 sections.

133

134 **4.1 Material Efficiency Topics**

135 Material efficiency topics as proposed by the standardization request M/543 have been consolidated
 136 by the material efficiency CEN-CENELEC standards in the numerical range of 45552 – 45558.

137 With respect to communication strategy, product specific standards shall determine which of the
 138 different material efficiency topics are relevant and/or applicable to that specific product (group) and
 139 the metrics associated to it.

140 The material efficiency aspects are divided in seven main topics relevant for communication activities:

141 **Durability:** as presented in EN 45552 - General method for the assessment of the durability of energy-
 142 related products

143 **Ability to re-manufacture:** as presented in EN 45553 - General method for the assessment of the
 144 ability to re-manufacture energy-related products

145 **Ability to repair, reuse and upgrade:** as presented in EN 45554 - General methods for the
 146 assessment of the ability to repair, reuse and upgrade energy-related products

147 **Recyclability and recoverability:** as presented in EN 45555- General methods for assessing the
 148 recyclability and recoverability of energy-related products

149 **Proportion of re-used components:** as presented in EN 45556 - General method for assessing the
 150 proportion of re-used components in energy-related product

151 **Proportion of recycled material:** as presented in EN 45557 - General method for assessing the
 152 proportion of recycled material content in energy-related products

153 **Use of critical raw materials:** as presented in EN 45558 - General method to declare the use of
154 critical raw materials in energy-related products

155

156 **4.2 Content associated with the material efficiency topics**

157 << **NOTE to NATIONAL COMMITTEES:** The content presented here below will be or has been prepared and
158 is owned by the specific WG dealing with that specific material efficiency topic. As such, technical comments on
159 communication-related content cannot and will not be handled in this this Information standard. When evaluating
160 this specific sub-clauses (4.2.1 – 4.2.7), please provide only editorial comment directly to the specific material
161 efficiency standard >>

162 All specific material efficiency CEN-CENELEC standards as listed in the previous clause (4.1) shall
163 include an overview of the typical content that can be expected to be communicated to the different
164 stakeholders. Based on the provided content, product specific TCs shall further detail that content in
165 product specific standards.

166 Examples of content can be quantitative (% , mass, etc.) or can be qualitative (e.g. test reports,
167 manuals, etc.). Details of the types of content are specific to each topic. The next sub-clauses provide
168 an overview of the types of information content that can be expected to be addressed under the product
169 specific standards when preparing their communication strategy.

170 Note that in case a contradiction would exist between below information and the communication
171 content provided by the material efficiency specific standard, the latter has precedence over the former.

172

173 **4.2.1 Durability communication-related content**

174 < the communication content for this topic is under preparation by the WG and is expected to be
175 included in this next round of comments >

176

177 **4.2.2 Ability to re-manufacture communication-related content**

178 < the communication content for this topic is under preparation by the specific WG and is expected to
179 be included in this standard in the next round of comments >

180

181 **4.2.3 Ability to repair, reuse and upgrade communication-related content**

182 < the communication content for this topic is under preparation by the specific WG and is expected to
183 be included in this standard in the next round of comments >

184

185 **4.2.4 Recyclability and recoverability communication-related content**

186 < the communication content is under preparation by the specific WG and is expected to be included
187 in this standard in the next round of comments >

188

189 **4.2.5 Proportion of re-used components communication-related content**

190 < the communication content for this topic is under preparation by the specific WG and is expected to
191 be included in this standard in the next round of comments >

192

193 4.2.6 Proportion of recycled material communication-related content

194 < the communication content for this topic is under preparation by the specific WG and is expected to
195 be included in this standard in the next round of comments >

196

197 4.2.7 Use of critical raw materials communication-related content

198 Information on the use of regulated CRMs in energy-related products should be communicated in the
199 supply chain to all downstream users and should be collected by manufacturers of the Energy-related
200 Products. Typical information that can be available after collection of the data is (depending on the
201 specific requirements in the applicable legislation):

- 202 • Name of the substance or substance group
- 203 • The amount (in mass or mass %) in the product or product part
- 204 • If known, the location (in the product) where the substance is found

205 CRM data shall be made available by the manufacturer to authorities for surveillance purposes.

206 A summary of the data shall be provided to relevant professionals like recycling operators. Unless
207 otherwise stipulated in the legislation, the exact form how the information will be provided shall be
208 agreed upon with recyclers. Examples are:

- 209 • Amounts or ranges of CRM in the product type or family
- 210 • Typical location in the product (e.g. PCBs)

211

212 4.3 Confidentiality Levels

213 The purpose of establishing different levels of confidentiality for material efficiency aspects is to create
214 a framework for communicating material efficiency data based on its (level of) sensitivity for the
215 manufacturer and relevance for targeted audience. Material efficiency aspects can be shared
216 according to three levels, depending on the type and sensitivity of information with the receiver in mind,
217 as presented in Table 1 and Figure 2.

218 Which level of confidentiality is appropriate needs to be assessed in the product specific standard. The
219 level will depend, among others, on product type, market needs, regulations and sensitivity of the data
220 (incl. product safety aspects).

221 Note: the owner of the information (e.g. the manufacturer) is ultimately responsible for the classification of the information
222 into the different levels of confidentiality.

223

224 **Table 1 — Confidentiality Levels and typical examples of material efficiency information**

Level	Confidentiality	Information Availability
LEVEL 3	CONFIDENTIAL	under non-disclosure agreement or for surveillance purposes as mandated by legislation
LEVEL 2	RESTRICTED	upon contractual agreements
LEVEL 1	PUBLIC	to anyone

225

226 For a concrete example of information made available at different confidentiality levels, please see
227 ANNEX A.

228
229 **4.3.1 Level 3 – CONFIDENTIAL**

230 The data is classified as CONFIDENTIAL when the unauthorized disclosure, alteration or destruction
231 of that data could cause a significant level of risk to the manufacturer or its affiliates, as well as risks
232 to third parties. Confidential data is highly sensitive or valuable information, both proprietary and
233 personal. The highest level of security controls should be applied to confidential data.

234
235 **4.3.2 Level 2 - RESTRICTED**

236 The data is classified as RESTRICTED when the unauthorized disclosure, alteration or destruction of
237 that data could result in a moderate level of risk to the manufacturer or its affiliates, as well as risks to
238 third parties. Restricted information whose unauthorized disclosure, particularly outside the
239 organization, would be inappropriate and inconvenient. Restricted information can be shared by the
240 manufacturer with authorised third parties.

241
242 **4.3.3 Level 1 - PUBLIC**

243 The data is classified as PUBLIC when the unauthorized disclosure, alteration or destruction of that
244 data would result in little or no risk to the manufacturer and its affiliates, to third parties or customers.
245 Information that can be broadly distributed without causing damage to the organization, its employees
246 and stakeholders. These documents can be disclosed or passed to persons outside the organization.

247
248 **4.4 Audience**

249 Three key audience groups are defined in this European Standard, representing the numerous
250 receivers of material efficiency information of Energy related Products. Product specific technical
251 committees shall consider all three categories when developing their product (group) specific
252 communication strategy.

- 253
- Consumer
 - Professionals
 - Surveillance Authorities
- 254
255
256

257 **4.5 Communication Means**

258 **4.5.1 Vehicles of communication**

259 After identifying the communication objectives in relation to the content of the material efficiency topics
260 to be delivered and to whom, technical committees shall consider the best vehicle to use to
261 communicate that information. Examples of communication vehicles are:

- 262
- Technical Documentation (for surveillance purposes)
 - Product documentation like user or repair manuals (can be available online or in physical form with the product)
 - Websites
- 263
264
265

- 266 • Information materials like posters, data-sheets, brochures, etc.
- 267 • Declarations
- 268 • Databases
- 269 • Mark/Label □
- 270 • Product Application software
- 271 • Phone, Hotline, Chat□
- 272 • QR-code
- 273 • RFID
- 274 • Etc.

275
 276 The above is not an exhaustive list. Besides, new and improved technologies can be developed after
 277 the publication of this standard. They shall be considered among the above vehicles taking into
 278 consideration their suitability to deliver the information in question to the specific audience. More
 279 extensive explanation of some of the vehicles listed above is provided in Annex B.

280 281 **4.5.2 Location**

282 Depending on the type, amount, time and addressee of information, different locations might be better
 283 suited to provide the necessary information. Information that is intended to support the consumer in a
 284 purchase decision is best placed in locations where consumers collect information about products,
 285 such as on manufacturer websites or at the point of sale, i.e. close to the exhibited product.
 286 Maintenance or repair information for consumers could be made available on designated websites or
 287 in the product documentation. Information for professionals might be best provided through databases,
 288 websites or upon request.

289 Possible locations for material efficiency information can be (non-exhaustive list):

- 290 • Online through a webpage
- 291 • Delivered with the product (physical or electronically)
- 292 • On the product packaging
- 293 • On the product
- 294 • Database
- 295 • At the point of sale
- 296 • Direct contact
- 297 • Manufacturer archives
- 298 • Etc.

299 300 **4.5.3 Considerations and Limitations of different communication solutions**

301 The exact communication solution would depend on a variety of aspects and considerations, as shown
 302 in the diagram of Figure 3 below:

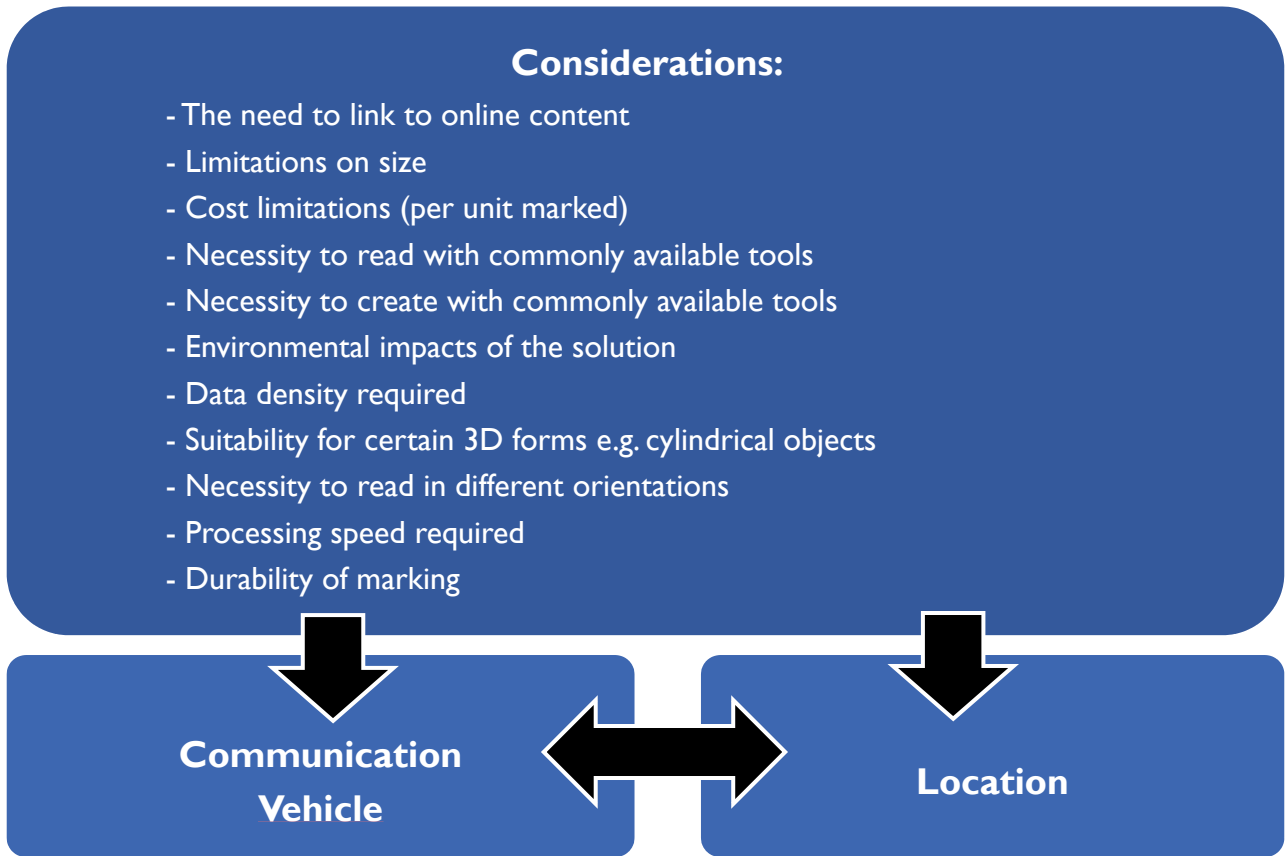


Figure 3 — Limitations of different means of communication

4.5.4 Considerations on the suitability of communications means per receiver type

- **Consumer:** suitable communication types for consumers will be communication readily available at point of sale or that can be searched in easy to access websites.
- **Professionals:** online information is likely to be the most suitable approach (websites).
- **Surveillance Authorities:** (physical) letters, email correspondence and databases.

CONSUMER <i>Readily available at point of sale / online</i>	PROFESSIONAL <i>Online authorized or public</i>	SURVEILLANCE <i>Available upon request</i>
<ul style="list-style-type: none"> • Leaflets, brochures, posters • Public website • Product Packaging (labels, QR code, etc.) • On the product (labels, QR-code, etc.) • ... 	<p>Recyclers:</p> <ul style="list-style-type: none"> • Database or free access website • Marking on product or component <p>Repairers:</p> <ul style="list-style-type: none"> • Website (authorized or public) • Manual (repair, disassemble) • On the product 	<ul style="list-style-type: none"> • Website (public/authorized) • In Manuals • On the product • On the product packaging

Figure 4 — Examples of communications means per receiver type

315 **4.6 Material Efficiency Communication Matrix**

316 Possible inputs to the material efficiency communication matrix as discussed in the previous sections
 317 are summarised in Table 2 below:

318 **Table 2 — Inputs to the Material Efficiency Communication Matrix**

Material Efficiency Topic	Material Efficiency Content	Confidentiality Levels	Audience	Communication Vehicles	Location
<ul style="list-style-type: none"> • Durability • Reparability, upgradability and reuse • Remanufacturability • Recyclability • Proportion of re-used components • Proportion of recycled materials • Use of CRM 	<ul style="list-style-type: none"> • Test reports • Repair manual • Instructions on how to disassemble (key) components • Location and quantity of toxic substances and/or CRMs and advised recycling information • 	<ul style="list-style-type: none"> • Confidential • Restricted • Public 	<ul style="list-style-type: none"> • Consumer • Professional • Surveillance Authorities 	<ul style="list-style-type: none"> • Technical Document. • Mark/Label • Information materials like posters, data-sheets, brochures, etc. • Manuals • Phone, Hotline, Chat • Social Media Networks • Apps • Website • Databases • Declaration • QR-code • Bar-Code • RFID • ... 	<ul style="list-style-type: none"> • Manufacturer archives • On/In package • On/In product • Online • Direct contact • At point of sale • ...

319

320 Based on above and all previous clauses, when preparing the material efficiency communication
 321 strategy of a product specific standard, product-specific technical committees shall fill in the template
 322 provided here below as to ensure that standardised and complete set of information is collected. The
 323 use of this template is to support the product TCs to gather all communication aspects in a standardized
 324 and structured way.

325 An example of a completed template for a specific product (vacuum cleaner) is provided in Annex A of
 326 this standard.

327

328 **Table 3 — TEMPLATE for creation of Material Efficiency Communication Matrix**

Material Efficiency Topic	Material Efficiency Content	Confidentiality	Audience	Communication Vehicle	Location

329

330 **5 Considerations on the aggregation of material efficiency aspects**

331 Material efficiency aspects that may be communicated are, amongst others, product durability,
332 reparability, reusability, recyclability, recycled content, ability to remanufacture and upgradability. As
333 appropriate, standards have been or will be established defining product (group) specific contents.

334 Material efficiency aspects may be communicated individually or in aggregated form. However, to avoid
335 that individual aspects could unfairly be claimed better than others, trade-offs between the different
336 material efficiency aspects relevant to the product shall be investigated by the technical committee of
337 product (group) specific standard.

338

339

Annex A (informative)

EXAMPLE - Vacuum Cleaner

340
341
342
343

344 The Ecodesign regulation on Vacuum Cleaners (666/2013) is an example of an ecodesign regulation
345 already containing material efficiency related requirements. This annex outlines these requirements
346 and shows how they map to the Material Efficiency Communication Matrix approach. Additionally,
347 requirements under the WEEE Directive (2012/19/EU) for end of life management are also included to
348 complement the example.

349 **A.1 Mandated communication of material efficiency aspects**

350 **A.1.1 Durability**

351 **A.1.1.1 Legal Requirements**

- 352 • Durability of the Hose: the hose, if any, shall be durable so that it is still useable after 40 000
353 oscillations under strain
- 354 • Operational Lifetime of the Motor: operational motor lifetime shall be greater than or equal to
355 500 hours

356 **A.1.1.2 Information to be provided by manufacturers**

357 Technical documentation, booklet of instructions and free access websites of manufacturers:

- 358 • Short title or reference to the measurement and calculation methods used to establish
359 compliance with the durability requirements

360 Technical documentation and a part for professionals of the free access websites of manufacturers:

- 361 • Information relevant for non-destructive disassembly for maintenance purposes, in particular
362 in relation to the hose, suction inlet, motor, casing and cable

363 **A.1.2 End-of-life Management**

364 Technical documentation and a part for professionals of the free access websites of manufacturers:

- 365 • Dismantling: information relevant for dismantling, in particular in relation to the motor and any
366 batteries,
- 367 • End-of-life Management: information relevant for recycling, recovery and disposal at end-of-
368 life

369 Additional requirements under the Article 15 of the WEEE Directive (2012/19/EU), on Information for
370 treatment facilities:

371 ... This information shall identify, as far as it is needed by centres which prepare for re-use and
372 treatment and recycling facilities in order to comply with the provisions of this Directive, the
373 different EEE components and materials, as well as the location of dangerous substances and
374 mixtures in EEE. It shall be made available to centres which prepare for re-use and treatment
375 and recycling facilities by producers of EEE in the form of manuals or by means of electronic
376 media (e.g. CD-ROM, online services).

377

Table A.1 — Material Efficiency Communication Matrix for Vacuum Cleaner

Topic	Content	Confidentiality	Audience	Communication Vehicle	Location
Product Durability	Assessment of the durability of the hose and motor	Confidential	Surveillance Authorities	Technical File	Manufacturer archives
Product Durability	Title or reference to the assessment of the durability of the hose and motor	Public	<ul style="list-style-type: none"> • Consumer • Professional • Surveillance Authorities 	<ul style="list-style-type: none"> • Technical Document. • Free access website • Instructions manual 	<ul style="list-style-type: none"> • Manufacturer archives • Online • In package
Product Durability and/or Ability to repair, reuse, upgrade	Non-destructive disassembly for maintenance purposes, especially hose, suction inlet, motor, casing and cable	Restricted	<ul style="list-style-type: none"> • Professional • Surveillance Authorities 	<ul style="list-style-type: none"> • Technical Document. • A part for professionals of the free access website 	<ul style="list-style-type: none"> • Manufacturer archives • Online
Ability to repair, reuse, upgrade	Information relevant for dismantling, in particular in relation to the motor and any batteries	Restricted	<ul style="list-style-type: none"> • Professional • Surveillance Authorities 	<ul style="list-style-type: none"> • Technical Document. • A part for professionals of the free access website 	<ul style="list-style-type: none"> • Manufacturer archives • Online
Recyclability and Recoverability	Information relevant for recycling and recovery	Restricted	<ul style="list-style-type: none"> • Professional • Surveillance Authorities 	<ul style="list-style-type: none"> • Technical Document. • A part for professionals of the free access website 	<ul style="list-style-type: none"> • Manufacturer archives • Online
Recyclability and Recoverability	Information relevant for disposal at end-of-life	Public	<ul style="list-style-type: none"> • Consumers 	<ul style="list-style-type: none"> • Instructions manual • Aggregated websites with restricted access 	<ul style="list-style-type: none"> • In/on package

380
381
382
383

Annex B (informative)

Information on technology options for communication vehicles

384 **B.1 Typical Communication Vehicles**

385 There are a number of technological solutions available that enable the communication of large amount
386 of data in a small format and the tracking of assets. For the purpose of Ecodesign, such solutions can
387 be useful for tracking e.g. key components or materials, for providing a means of linking to online end-
388 of-life product information, recycling aspects, or for communicating information to a consumer.

389 Explanation of the most common currently used technologies is provided here below (note this is not
390 a finite list and new technological solutions may become available that are not listed in this annex):

391 **B.1.1 QR-code**

392 Abbreviated from Quick Response Code. This is a type of matrix or two-dimensional barcode consisting
393 of black squares arranged in a square grid on a white background, which can be read by an imaging
394 device such as a camera. The data (or web link) is then extracted from patterns that are present in
395 both horizontal and vertical components of the image. QR codes have a greater storage capacity than
396 standard barcodes. Different types of QR codes exist including smaller micro QR codes and more data
397 dense coloured QR codes (HCC2D). Some QR solutions may require a license, and some may not be
398 suitable for curved surfaces. They can usually be read in different orientations.

399 **B.1.2 Bar-Code**

400 a machine-readable code in the form of numbers and a pattern of parallel lines of varying widths that
401 is designed to be scanned by an imaging device so that the data can be extracted. A bar code can
402 only be read in one orientation.

403 **B.1.3 RFID**

404 Abbreviated from Radio-frequency identification (RFID). This technology uses electromagnetic fields
405 to automatically identify and track tags containing electronically stored information attached to objects.
406 The tag has a small antenna which emits a radio frequency signal that is picked up and read by a
407 wireless RFID reader. RFID is especially useful in situations where large quantities of goods must be
408 moved or tracked (without the need for individual scanning or orientation of the goods). Tags vary
409 greatly in size, shape and capabilities. The active RFID tag variation has its own battery, continuously
410 broadcasting its signal with a much broader (up to a mile) working range – because of this it is much
411 larger than a normal RFID tag.

412 **B.1.4 NFC**

413 Near Field Communication (NFC) is a short-range wireless connectivity standard (Ecma-340, ISO/IEC
414 18092) that uses magnetic field induction to enable communication between devices when they're
415 touched together, or brought within a few centimeters of each other. Jointly developed by Philips and
416 Sony, the standard specifies a way for the devices to establish a peer-to-peer (P2P) network to
417 exchange data. After the P2P network has been configured, another wireless communication
418 technology, such as Bluetooth or Wi-Fi, can be used for longer range communication or for transferring
419 larger amounts of data.

420 Here are some examples of how NFC can be used:

- 421 • Taking pictures with a cell phone with a built in camera, and touch an enabled computer or
- 422 television set to transmit the images for display;

- 423
- Download applications or games to a handheld device by touching the computer;
- 424
- In conjunction with another wireless technology, it is possible to transfer large files between two
- 425
- devices, such as a laptop and a desktop, simply by touching the two together.

426

427 **B.2 Information on technology options for communication vehicles**

428 Below table compare the different technology options so that the most suitable could be considered,
429 depending on the application.

430

431

Table B.1 – Communication technology options

	Means of directing users to online content?	Less than (specify min. size)?	Low cost of creation per unit?	Readable with commonly available tools?	Creation with commonly available tools?	Minimal environmental impacts?	High data density?	Suitable for cylindrical objects (ie. rectangle poss)?	Ability to read in different orientations?	High processing speed?	Ability to track items enclosed within an assembly?	Real time location tracking?	Durable to damage?	Limited lifetime?
QR code	✓		✓	✓	✓	✓	✓	✗	✓	✗	✗	✗	✓	✗
Micro QR code				✓		✓	✗					✗		✗
IQR code	✓			✓		✓		✓				✗		✗
High Capacity Colored 2-Dimensional Code	✓			✓		✓	✓					✗		✗
Bar code	✗			✓		✓	✗	✓	✗	✗	✗	✗	✗	✗
Passive RFID	✗		✗	✗	✗	✗	✗	✓	✓	✓	✓	✓		
Active RFID	✗		✗	✗	✗	✗		✓	✓	✓		✓		✓
NFC				✓					✓		✓	✗		

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