



J R C T E C H N I C A L R E P O R T S

Development of Green Public Procurement Criteria for Paints, Varnishes and Road Markings

Technical report and draft criteria
proposal

(JRC-IPTS)

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1 INTRODUCTION AND PROJECT BACKGROUND

Green Public Procurement (GPP) is defined in the Commission Communication “Public procurement for a better environment”¹ as “a process whereby public authorities seek to procure goods, services and works with a reduced environmental impact throughout their life cycle when compared to goods, services and works with the same primary function that would otherwise be procured”. This is a voluntary instrument, which public authorities can use to provide industry with incentives for developing and marketing more environmentally sound products.²

The European Commission's Directorate General for the Environment has initiated a project directed towards developing a joint evidence base for the EU policy making in the area of paints, varnishes and road markings. This study has been being carried out by the Joint Research Centre Institute for Prospective Technological Studies (JRC-IPTS) supported by Oakdene Hollins consultancy, in cooperation with all the interested parties.

The purpose of this project was to develop Green Public Procurement criteria for paints, including road markings in parallel to the revision of the EU Ecolabel criteria for indoor and outdoor paints and varnishes.

The results of the study and the milestones are available at the project's website (<http://susproc.jrc.ec.europa.eu/paints/>) and the proposal for the GPP criteria for the product group under study, is presented in (link to be added when published). The current working document summarises background information on paints environmental performance and explains the rationale behind the proposal of the GPP criteria.

The primary goals of establishing these criteria for paints are to promote in the public sphere purchasing products that have a lower environmental impact along their life cycle, are of high quality (have good performance and long durability), contain a limited amount of hazardous substances and volatile organic compounds. High quality and performance standards of the paint are required to ensure the longevity of the product and contribute that way to the significant reduction of the paints' overall life cycle impacts. The products covered by the GPP criteria should also bring public customers direct cost savings when evaluated using a life-cycle cost perspective (e.g. lower overall costs due to better durability and less frequent need of repainting).

The document consists of the following chapters: Chapter 1 introduces the project background; Chapter 2 presents briefly the product definition and scope; Chapter 3 shows market and cost considerations, including life cycle costing. It is followed by Chapter 4, which summarises approaches to procurement of products and services. A summary of the technical analysis in support of the proposed GPP criteria is presented in Chapter 5. The corresponding technical background report is available at the project's website³. Finally, the GPP criteria and their rationale are presented in Chapter 6.

1 Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions – Public procurement for a better environment, COM (2008) 400, available at: <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2008:0400:FIN:EN:PDF>.

2 GPP website http://ec.europa.eu/environment/gpp/what_en.htm.

3 “Revision of European Ecolabel and development of Green Public Procurement Criteria for Paints and Varnishes”, December 2012, available at: <http://susproc.jrc.ec.europa.eu/paints/stakeholders.html>.

2 PRODUCT DEFINITION AND SCOPE

2.1 Paints, varnishes and road markings

Within the context of this study, the definition of a paint used is the same with the one used in the EU Ecolabel criteria revision process and based on the definition of a coating given in the Directive 2004/42/CE⁴. 'Road markings' are additionally addressed as a specific product with distinct characteristics and performance requirements. The definition used for road markings is the outcome of the undertaken consultation based on the definitions from existing standards.

The **product group 'Paints, Varnishes and Road Markings'** shall comprise indoor and outdoor paints and varnishes, woodstains and related products, as defined below, intended for use by professional users (please note that these are not industrial users).

Paint and varnish products include, inter alia:

- Floor paints,
- Products which are tinted by distributors at the request of professional decorators,
- Tinting systems,
- Decorative paints in liquid or paste formulas which may have been pre- conditioned, tinted or prepared by the manufacturer to meet consumer's needs, including wood paints, wood and decking stains, masonry coatings and metal finishes primers and undercoats of such product systems as defined within Directive 2004/42/CE Annex I 1.1.d and 1.1.g.

The following product definitions are provided to support application of the criteria:

'Paint' means a pigmented coating material, in liquid or in paste form, which, when applied to a substrate, forms an opaque film having protective, decorative or specific technical properties.

'Decorative paints and varnishes' means paints and varnishes that are applied to buildings, their trim and fittings, for decorative and protective purposes. While their main function is decorative in nature, they also have a protective role.

'Masonry coatings' are coatings that produce a decorative and protective film for use on concrete, (paintable) brickwork, blockwork, rendering, calcium silicate or fibre-reinforced cement. They are mainly intended for exterior use, but may also be used internally, or on soffits and balcony ceilings.

'Varnish' means a clear coating material which, when applied to a substrate, forms a solid transparent film having protective, decorative or specific technical properties.

'Woodstains' (lasures) means coatings producing a transparent or semi-transparent (using substantially non-white pigment) film for decoration and protection of wood against weathering, enabling maintenance to be carried out easily.

'Tinting system' means a method of preparing coloured paints by mixing a 'base' with coloured tints.

'Road marking' means the application of paint systems or structural plastic systems to road surfaces in order to delineate traffic lanes, bays and signals, as well as to provide frictional properties and night time retro reflection. They are generally composed of a pigmented road marking material and a broadcast material which, together, may or may not form a film over the substrate. Mechanical markings such as cat's eyes are not included.

⁴ Directive 2004/42/CE of the European Parliament and of the Council of 21 April 2004 on the limitation of emissions of volatile organic compounds due to the use of organic solvents in certain paints and varnishes and vehicle refinishing products and amending Directive 1999/13/EC, OJ L43, 30.4.2004, p. 87.

The product group shall not comprise:

- anti-fouling coatings,
- wood preservation products,
- coatings for particular industrial and professional uses, including heavy-duty coatings,
- powder coatings,
- UV curable paint systems,
- paints primarily intended for vehicles,
- products that do not form film over the substrate, with the exemption of road markings,
- transparent chemical floor coatings using reactive resins as binders for thick layer coverings for industrial floors.

Supporting technical definitions relating to paint specifications are given below:

'White and light coloured' paints are those with a tri-stimulus (Y-value) >70%

'Gloss paints' are those which at an angle of incidence of 60° show a reflectance of ≥60

'Mid sheen paints' (also referred to as semi-gloss, satin, semi matt) are those which at an angle of incidence of 60° or at 85° show a reflectance of <60 and ≥10

'Matt paints' are those which at an angle of incidence of 85° show a reflectance of <10

'Dead matt paints' are those which at an angle of incidence of 85° show a reflectance of <5

'Transparent' and 'semi-transparent' means a film with a contrast ratio of < 98% at 120µ wet film thickness,

'Opaque' means a film with a contrast ratio of >98% at 120µ wet film thickness.

Follow-up from the stakeholders' consultation

➤ Definition of road markings

One of the issues mentioned was related to the fact that the previous definition of road markings did not specify clearly whether preformed products were included in the scope or not. Their inclusion was supported by the stakeholders.

The EN 1790⁵ refers to preformed road markings as follows:

"A particular category of road marking materials, used for horizontal signalisation, are preformed, i.e. manufactured products in sheet form, ready for use on the road. They can be applied by means of adhesives, pressure or heat, with or without the use of a primer. Preformed road marking materials can be linear, in pieces of a certain length or in rolls. They can also be cut out in the form of symbols or signs or parts of them, making it possible to assemble them on the road to achieve the desired shape.

Preformed road marking materials can be designed for use as permanent or temporary road markings. In both cases they can be applied with a view to later removal and therefore the specific property of "removability" can be required.

Preformed road marking products are defined as Tape, preformed Cold Plastic road marking or preformed Thermoplastic road marking with or without drop-on materials.

Except for Thermoplastic road markings with drop-on materials, all the other type of products are fully finished during manufacturing and do not change significantly their properties during application.

⁵ EN 1790 Road marking materials. Preformed road markings.

Thermoplastic road markings with drop-on materials need the addition of drop-on materials during application on the road and therefore they are in some way similar to thermoplastic products covered by EN 1871⁶.

It is proposed to add in the definition specific reference based on the above standard, which clearly indicates that preformed markings are included in the scope. The new definition is as follows:

'Road marking' means the application of paint systems or structural plastic systems to road surfaces in order to delineate traffic lanes, bays and signals, as well as to provide frictional properties and night time retro reflection. They are generally composed of a pigmented road marking material and a broadcast material which, together, may or may not form a film over the substrate. *Preformed road marking products defined as tape, preformed cold plastic road marking or preformed thermoplastic road marking with or without drop-on materials are also included in the scope.* Mechanical markings such as cat's eyes are not included.

2.2 Works contracts

The criteria are set not only on final products but covers in addition related painting and road marking works contracts. These can include one-off works contracts; call down contracts from a framework as well as cyclical, long-term painting services. All contracts shall be based on the use of paint products defined within the scope of this product group. The following contract definitions are used in this criteria set:

'Painting works' means when contractors, usually termed 'painters and decorators', are directly engaged to paint indoor or external surfaces on a one-off, call down or cyclical basis, including ongoing maintenance and remedial works.

'Road marking works' means when contractors, usually termed 'road marking operatives', are directly engaged to apply road markings on a one-off or cyclical basis, including maintenance and remedial works.

⁶EN 1871:2000 Road marking materials.Physical properties.

3 MARKET AND COST CONSIDERATIONS

3.1 Market considerations

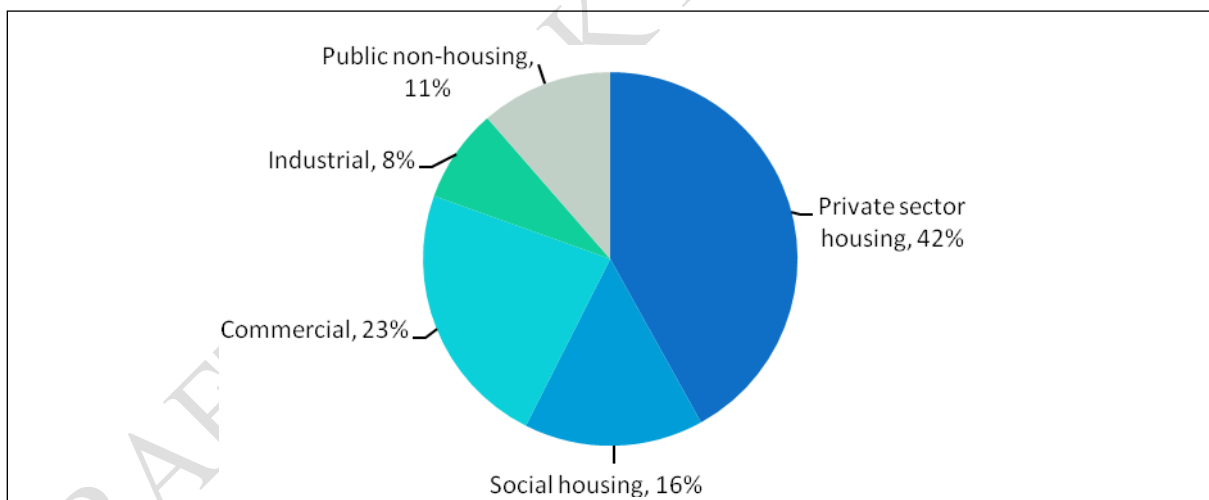
Public authorities are major consumers in Europe, spending "2 trillion euros annually, equivalent to some 19% of the EU's gross domestic product".⁷ Therefore, any shift of public spending towards products with lower environmental impacts has the potential to make an important contribution to more sustainable production and consumption. Green public procurement also has the potential to influence the market by providing industry with incentives for developing more environmentally-friendly technologies and products.

In the published technical report associated with the EU Ecolabel and development of the GPP criteria for paints (available at the project website⁸) is provided a detailed market analysis for paints. The report also includes estimates of future trends for these products. The below sections summarise the main information available for the public sphere and presents life cycle cost analysis.

Public procurement

In accordance with the findings of the Palmer market research report on paints, in terms of public procurement, 16% of the total market of paints is used for social housing and 11% for public non-housing. The shares of various sub-sectors in this market for the year 2006 are presented in Figure 1.

Figure 1: Trade paints market by sector 2006 (% share in sector)



Source: Trade paints market report, Great Britain, Palmer market research, 2007

Within the trade paints market, 86% of the volume of paint is for existing buildings (mainly redecoration) rather than on new buildings. This high figure is true across all sectors: for example, for social housing, 92% of paint used is for redecoration rather than on new buildings.

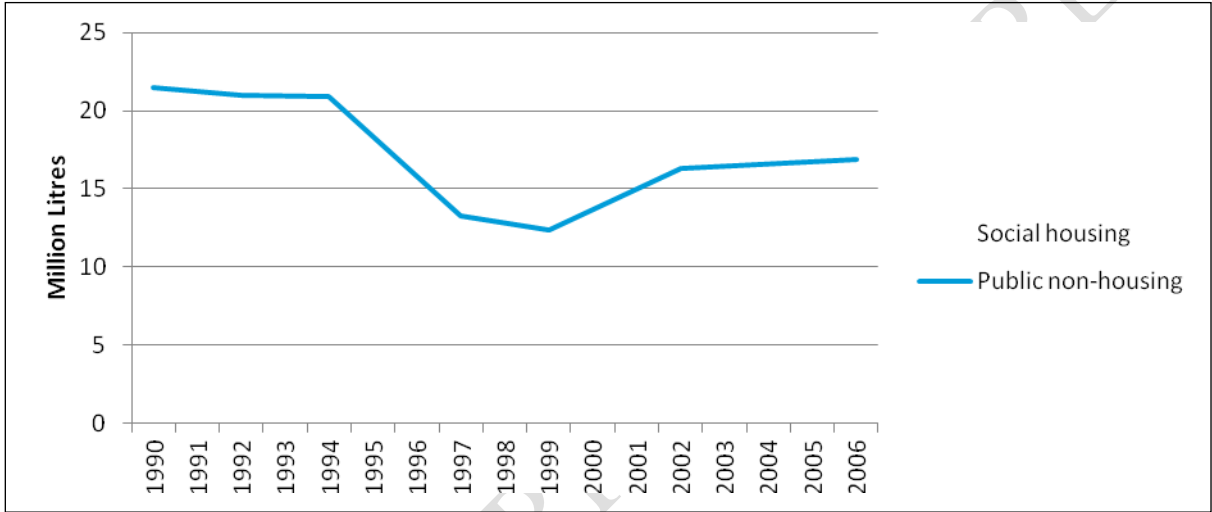
⁷ According to information available at the DG Environment website: http://ec.europa.eu/environment/gpp/what_en.htm, accessed April 2014.

⁸ "Revision of EU European Ecolabel and Development of EU Green Public Procurement Criteria for Indoor and Outdoor Paints and Varnishes" (June 2012), <http://susproc.jrc.ec.europa.eu/paints/stakeholders.html>.

The public sector across Europe does not usually procure paints and coatings directly from the manufacturer, but uses professional contractors, painters and construction companies. In turn, these contractors purchase their paint from manufacturers or through wholesale or distributor channels.

In 2006, only 14% of trade paint used in the social housing sector was applied by local authorities and public sector bodies, the remainder being applied by decorating firms and builders. Similarly, in the public non-housing sector most of the paint was applied by decorating firms, with local authorities and public sector bodies only accounting for 5%. This makes it difficult to trace the volume of that is used in the public sector. Figure 2 displays the trends in the paint trade market sector for social housing and public non-housing in Great Britain (Data for 2007-11 are forecasts only).

Figure 2: Trends in the trade paints market sector, public sector use in GB (2007-11)*



* Data are available for 1990,1992,1994,1997,1999,2002,2006.All other figures have been extrapolated from these data points.

Source: Trade paints market report, Great Britain, Palmer market research, 2007

The paints market is relatively steady and although Figure 2 shows volume changes, these are within a relatively small range. Between 1990 and 2006, public sector trade paint (in social housing and public non-housing) moved from a 26% share in the total trade paints market to a 27% share.

It is also not clear what is driving changes to paint use. A number of aspects could be having an impact on the amounts of trade paint used in the public sector, including economic, social and regulatory factors. For example, the UK Decent Homes Programme which set targets to improve all social sector homes by 2010, would have acted as a likely significant driver for increased paint use.

Currently, EU legislation (i.e. the Paints Directive 2004/42/EC) broadly specifies the types of paint that can be used within Europe, ensuring paints containing heavy metals or high VOC contents are not used. Some Member States have themselves set more stringent measures, again relating to these factors.

Europe’s GPP strategy may have an impact on the types of paints that are used. As demand for eco-friendly paints in the domestic paints market grows, it may be that more contractors offer customers the opportunity to choose from ranges of environmentally-friendly products. According to Greenbuild News portal, an example of this can be found in the UK, where Low Carbon Products Ltd. has developed a range of paints using between 90-95% recycled paint in each pot. Recycled paint is collected from commercial users and would otherwise have gone to landfill. The company supply the paint to public sector organisations as well as trade customers. Additions to the paint, including

anti-bacterial, anti-graffiti and anti-chewing gum properties, make the product suitable for health and public buildings.⁹

Within the UK, public sector is estimated to account for 23% of total sales of decorative paints in 2008. Across the EU there is, however, a lack of available data with regards to public procurement of paints and varnishes.

3.2 Cost considerations

In the development of Green Public Procurement criteria, one of the most important aspects to take into account is a life-cycle cost analysis of the best environmentally-performing products with respect to average products in the market. Cost considerations (using a life-cycle perspective) are very important in the public sphere as this contributes in the justification of public spending. Member states should be encouraged to make choices that are a good value in the long-term.

3.2.1 Introduction to life cycle costing

In order to allow public procurers to select the products that will be most cost-effective it is recommended to use a product life cycle perspective and apply a life cycle cost (LCC) approach. LCC considers the entire (physical) life cycle of a product, from production to disposal. Depending on the perspective taken in the LCC assessment, costs of different stages can be calculated with more or less detail. The use phase of the life cycle is relevant for the public procurers since this cost will be incurred. The production cost of the product to be purchased does not need to be calculated in detail, since the relevant cost element for the purchasing authority would be integrated in the final product price.

Many procured items, such as computers or printers, require electricity and consumables to function and the costs of these can often exceed the initial purchase cost of the item. For paints and varnishes the life time costs are generally only incurred at the point of painting. The main considerations for calculating the life cycle costs are the:

- cost of purchasing and delivery (e.g. cost per litre of paint or varnish as delivered)
- application performance (e.g. amount of paint required to cover a given surface area)
- lifetime performance (number of repaints required to maintain coverage over time)
- disposals costs (disposal of unused paints).

Costs that may theoretically be incurred but were not considered were:

- For outdoor paints, the change in thermal performance for the building:
 - The choice of colour is the dominant factor affecting thermal performance.
- Labour time and equipment cost for application of the paint:
 - It would be impossible to meaningfully establish costs and differentiate products based on this variable.
- Additional disposal costs at the end of life for the painted surface:
 - Disposal cost of the painted surfaces are unlikely to be affected by the paint that was applied
- Indoor paints: any energy saving from having a lighter painted room and therefore less use of artificial light.

The aforementioned costs have also environmental costs which are commonly studied under the frame of "environmental externalities" but these were not considered relevant for a report supporting the development of GPP criteria and were not included in the analysis.

⁹ For more information see <http://www.greenbuildnews.co.uk/article-details/Recycled-paint-range/209>.

It is important to highlight that in this context it is evident that when assessing the overall costs it is not sufficient to consider solely the advertised cost per litre of paint.

3.2.2 Functional unit and reference flow

Functional Unit

To calculate the life cycle cost of each paint it is necessary to define a functional unit of interest. The functional unit for this life cycle costing was chosen to be the cost of paint required to cover a 20 m² surface for a period of 21 years, given a baseline assumption that a repaint is required every 7 years to maintain sufficient coverage. This is the same functional unit that is applied to the life cycle assessment of the paints.

The variables that are required to calculate the functional unit are:

- cost per litre of paint
- spreading rate to meet performance criteria
- time between repaints to maintain performance criteria
- expected losses due to wastage
- disposal costs of waste paint.

Two types of paint are considered: a water-based vinyl emulsion and a water-based alkyd varnish; these are the paints investigated in the life cycle assessment portion of the work. Vinyl emulsion is used for both indoor and outdoor paints and will be analysed separately. With regard to road markings, the overall LCC is likely to be different due to length of time between repaints.

Reference flow of a baseline scenario

The reference flow is the amount of paint required to fulfil the functional unit being investigated. By calculating the reference flow and multiplying it by the cost per litre of paint, the full life cycle cost can be established.

The following sections discuss the factors affecting the reference flow of paint required to fulfil the functional unit.

Spreading rate

The current EU Ecolabel criteria state that white paints and light-coloured paints (including finishes, primers, undercoats and/or intermediates) shall have a spreading rate of at least 8 m² per litre of product for indoor paints and 6 m² per litre for outdoor paints. This is taken as the spreading value for the baseline costing. Therefore the reference flow to paint a single 20 m² surface using vinyl emulsion paint is 2.5 litres of paint indoors or 3.3 litres of paint outdoors.

Alkyd water-based varnishes typically apply a clear coating onto wooden surfaces. It is therefore not possible to define a spreading rate criterion that is based on opacity. Technical data sheets for a number of alkyd varnishes were used to calculate an estimated spreading ratio of 5.5 m² per litre^{10,11}. Therefore the baseline reference flow to paint a single 20 m² surface is 3.6 litres of paint.

10Cloverdale Paint, Technical specification data sheet, 593 Series, Waterborne Alkyd Varnish, available online at: http://www.cloverdalepaint.com/info/pdf_tds_ar/60-0080.pdf, accessed May 2014.

11Sherwin Williams, PROCLASSIC®Interior Waterbased Acrylic-Alkyd, Satin, B33-850 Series, available online at: <http://www.sherwin-williams.com/document/PDS/en/035777832301/>, accessed May 2014.

Time between repaints

The amount of time between repaints of a surface to maintain the required performance standard is a significant variable in calculating the reference flow of paint over the functional unit. The baseline assumption is that a repaint would be needed every 7 years, requiring three separate paint applications in order to satisfy the performance criteria over the 21 years stipulated in the functional unit. The baseline reference flow must therefore be multiplied by a factor of three to achieve this.

Expected losses due to wastage

A recent study of WRAP¹² highlights the problem of unused paint in the UK. In the Do-it-Yourself (DIY) market, an estimated 25% of all paint goes unused, whereas with trade this figure is 1.5%. Stakeholders involved in the consultation process believe that 25% is too high and a figure closer to 10% is more accurate.

For the GPP criteria it is most applicable to consider the trade waste percentage, which is relatively low at 1.5%.

The baseline reference flow for the amount of paint required must therefore be multiplied by a factor of 1.015 to take into account paint wastage. The reference flow for calculating the disposal costs of the paint are calculated by multiplying the reference flow before wastage by 0.015. This calculation assumes that the wastage rate is defined as the additional paint that is procured and then disposed of beyond the requirements to fulfil the tasks.

Reference flow for the functional unit

Table 1 shows the baseline total reference flows for the three scenarios that were discussed. The three scenarios, differentiated only by spreading rates, have very different reference flows. The alkyd scenario requires 45% more paint than the indoor vinyl emulsion scenario.

Table 1: Reference flows in litres for three paint scenarios

Scenario	To paint 20 m ²	Repaint 3 times	Paint wastage	Reference flow
Vinyl (Indoors)	2.5	7.5	0.11	7.61
Vinyl (Outdoors)	3.3	10.0	0.15	10.15
Alkyd	3.6	10.9	0.16	11.07

3.2.3 Life cycle costs of a baseline scenario

3.2.3.1 Cost per litre of paint

The cost per litre of paint is highly variable, depending on the brand, paint range and bulk purchasing discounts. The costs used for the baseline life cycle costing scenario were chosen as the likely cost to the decorating trade for high quality paint; this is shown in Table 2. Also indicated in the table are the ranges of prices that could be expected. Sensitivity analysis on the purchase cost is explored later.

¹²Lee P., Willis P, WRAP, Paint and woodcare products – distribution and delivery – A review of alternative supply chain approaches within UK paint and woodcare markets, Final Report, 2011.

Table 2: Representative costs of purchasing paint per litre for each scenario

Scenario	Range	Representative cost per litre
Vinyl (Indoors)	€3.00 - €12.00	€5.00
Vinyl (Outdoors)	€4.00 - €14.00	€6.00
Alkyd	€9.00 - €25.00	€15.00

3.2.3.2 Disposal costs of waste paint

Discussion with licensed waste disposal operators in the UK revealed that hazardous waste disposal costs approximately €1.10 - €1.90 per litre of solvent-based paint depending on its condition. Water-based paints are much less expensive to dispose of, at approximately €0.15 - €0.65 per litre. Solvent-based paints can therefore be ten times more expensive to dispose of than water-based alternatives (These costs are only representative and depend on factors such as the amount that is disposed of, the distance that it must be transported and the condition of the paint).

Better options for disposal of high quality paints are donation to reuse projects or take-back schemes. The cost of transporting the paint would be the only disposal cost incurred in these cases. Table 3 shows the estimated costs associated with waste disposal for the functional unit of paint. A range of costs has been calculated, representing both the minimum and maximum expected costs for non-hazardous and hazardous waste. The inclusion of the zero cost of disposing of paint through a reuse or take-back scheme is also shown.

Sensitivity to paint wastage rates and disposal costs are explored later.

Table 3: Costs associated with disposal for the paint wastage associated with the functional unit

Scenario	Paint wastage (litres)	Reuse / Take-back	Non-hazardous disposal		Hazardous disposal	
			€0.15 per litre	€0.65 per litre	€1.10 per litre	€1.90 per litre
Vinyl (Indoors)	0.11	0c	1.7c	7.2c	12.1c	20.9c
Vinyl (Outdoors)	0.15	0c	2.3c	9.8c	16.5c	28.5c
Alkyd	0.16	0c	2.4c	10.4c	17.6c	30.4c

3.2.3.3 Baseline life cycle cost

The baseline life cycle cost of fulfilling the functional unit, shown in Table 4, was calculated using the reference flows and the cost assumption discussed above.

It can be seen that there is wide variation in the life cycle costs for each scenario. The cost of fulfilling the functional unit using alkyd varnish incurs more than four times the cost of painting an indoor surface with a vinyl emulsion. The typical use scenario must be considered when comparing the price performance of the different paint types, the alkyd varnish would normally be used to

paint smaller wooden surfaces compared with the large surface areas typically covered by outdoor vinyl emulsion paints.

The disposal cost of the waste paint has been shown separately in the table; the costs were calculated at a rate of €0.65 per litre, the maximum estimated cost for non-hazardous waste disposal. This represents a very small proportion of the total life cycle cost; for the baseline scenarios it accounted for between 0.06% and 0.2% of the total cost.

Table 4: Baseline life cycle cost of the functional unit for the three scenarios

Scenario	Reference Flow (litres)	Representative cost per litre	Procurement cost for functional unit	Paint wastage (litres)	Disposal cost	Total cost
Vinyl (Indoors)	7.61	€5.00	€38.05	0.11	€0.07	€38.12
Vinyl (Outdoors)	10.15	€6.00	€60.90	0.15	€0.10	€61.00
Alkyd	11.07	€15.00	€166.05	0.16	€0.10	€166.15

3.2.4 Sensitivity analysis of life cycle cost to performance and cost criteria

3.2.4.1 Cost per litre of paint

The procurement cost of the paint will understandably have a large impact on the life cycle cost of fulfilling the functional unit. This will be demonstrated by showing the sensitivity of the life time cost to the purchase price of the paint. The costs used will be the identified minimum and maximum expected costs shown in Table 2.

Table 5 shows the impact on the life cycle cost of procuring paints and varnishes at the lowest expected procurement price. The life cycle cost falls in line with the price difference, e.g. a 40% price reduction per litre results in a 40% life cycle cost reduction. This demonstrates the dominance of the procurement cost vs. disposal cost for the baseline scenario.

Table 5: Sensitivity analysis to procurement cost, minimum pricing scenario

Scenario	Reference flow (litres)	Life cycle cost	Difference from LCC baseline
Vinyl (Indoors)	7.61	€22.91	-40%
Vinyl (Outdoors)	10.15	€40.70	-33%
Alkyd	11.07	€99.76	-40%

Table 6 shows the impact on the life cycle cost of purchasing at the greatest expected cost per litre.

Table 6: Sensitivity analysis to procurement cost, maximum pricing scenario

Scenario	Reference flow	Life cycle cost	Difference from
----------	----------------	-----------------	-----------------

	(litres)		LCC baseline
Vinyl (Indoors)	7.61	€91.42	+140%
Vinyl (Outdoors)	10.15	€142.20	+133%
Alkyd	11.07	€276.92	+67%

The actual cost per litre paint may fall outside of the range identified in Table 2.

3.2.4.2 Spreading rate

The baseline reference flow was calculated using the EU Ecolabel values set for spreading rate whilst maintaining the required coverage. Since this represents the minimum standard that needs to be achieved, there is no need to show the sensitivity to inferior spreading rates. Two scenarios for improved spreading rates will be shown: 30% and 50% improvements compared with the baseline.

Table 7 shows that with a modest improvement in spreading rate, that the life cycle costs of fulfilling the functional unit are reduced by 23%.

Table 7: Sensitivity analysis to spreading rates, 30% improvement

Scenario	Spreading rate (litres / m ²)	Reference flow (litres)	Life cycle cost
Vinyl (Indoors)	10.4	5.86	€29.34
Vinyl (Outdoors)	7.8	7.81	€46.92
Alkyd	7.2	8.52	€127.84

Table 8 shows the potential savings obtained by using a paint or varnish with a significantly improved spreading rate. For a 50% improvement in the spreading rate, the life cycle cost improvement over the baseline is 33% for all three types of paint.

Table 8: Sensitivity analysis to spreading rates, 50% improvement

Scenario	Spreading rate (litres / m ²)	Reference flow (litres)	Life cycle cost
Vinyl (Indoors)	12.0	5.08	€25.42
Vinyl (Outdoors)	9.0	6.77	€40.67
Alkyd	8.3	7.38	€110.80

3.2.4.3 Time between repaints

The amount of time between repaints of a surface to maintain the required performance standard is a significant variable in calculating the reference flow of paint over the functional unit. The baseline assumption is that a repaint would be required every seven years, requiring three separate paint applications in order to satisfy the performance criteria over the 21 years stipulated in the functional unit.

There are several GPP criteria that would affect the time between repaints such as the scrub resistance and the weathering resistance. The sensitivity to these criteria will be analysed by

investigating the single variable of time between repaints since there would be no distinction in the life cycle costing to which factor was causing the difference.

For the baseline life costing scenario the time between repaints was set at 7 years to maintain consistency with the life cycle assessment work. The functional unit period of 21 years was tailored to the 7 year cycle, thereby requiring the original paint applications and two repaints and thereby fully realising the benefits of the final repaint. For the sensitivity analysis the repaint period will be set at 4 and 10 years, representing a 3-year deviation either way from the baseline. For consistency the functional unit must remain constant despite not being perfectly divisible by the new repaint periods. There are two methods by which this can be compensated for: allow a non-integer number of repaints or strictly account for the number of repaints that would occur in the functional unit time frame. The latter method ignores the full benefit of the final repaint; in the case of the 10-year repaint cycle it would still require three repaints and therefore be identical to the baseline scenario. Given the assumption that the surface to be painted would last longer than the 21 years specified in the functional unit it would be reasonable to allow a non-integer number of repaints to accurately apportion the benefit of the final paint cycle to the functional unit. The non-integer method was used for this sensitivity analysis.3.2.2

Table 9 shows the worst case scenario for repaint periods: most paints would be expected to satisfy performance criteria up to 4 years. A repaint prior to this would be for aesthetic reasons rather than significant degradation of the paint. The number of repaints required to fulfil the functional unit would be 5.25 and result in a 75% increased cost over the baseline scenario. This scenario would also incur a 75% greater labour cost due to repainting.

Table 9: Sensitivity analysis to repaint periods, 4 year repaint period

Scenario	Reference flow (litres)	Life cycle cost
Vinyl (Indoors)	13.32	€66.74
Vinyl (Outdoors)	17.76	€106.75
Alkyd	19.38	€290.85

Table 10 shows a significantly improved repaint requirement scenario with repaints only required every 10 years; some heavy duty paints could even be expected to exceed this performance. The number of repaints required to fulfil the functional unit would be 2.1 and result in a 30% reduced cost over the baseline scenario. The 30% reduction in cost would also be realised for labour cost since fewer repaints are required.

Table 10: Sensitivity analysis to repaint periods, 10 year repaint period

Scenario	Reference flow (litres)	Life cycle cost
Vinyl (Indoors)	5.33	€26.69
Vinyl (Outdoors)	7.11	€42.70
Alkyd	7.75	€116.34

3.2.4.4 Expected losses due to wastage and disposal costs

Table 4 gave the breakdown life cycle cost assessment and showed that the disposal costs were negligible for the baseline scenario, given the assumption of a 1.5% paint wastage rate and a €0.65 per litre disposal cost.

This sensitivity analysis will explore the two variables in determining the cost of waste: the wastage rate and the disposal costs. The output is expressed in the percentage increased (or in one case decreased) cost over the baseline scenario.

Table 11 shows the sensitivity analysis for both vinyl paint scenarios: the minor differences between the indoor and outdoor scenarios did not warrant being analysed separately. The cost of paint wastage is insensitive to the cost of disposal, but is dominated by the cost of purchasing more paint than is needed to complete the task.

Table 11: Sensitivity analysis to paint wastage, non-hazardous vinyl emulsions

Vinyl	1.5% Wastage	5% Wastage	25% Wastage
€0.15 per litre	-0.1%	3.4%	23.7%
€0.65 per litre	0.0%	3.9%	26.2%

Table 12 shows the sensitivity analysis for the alkyd varnish. This was assessed separately since non-water-based alkyd varnish must be disposed of as hazardous waste which carries a much greater disposal cost. From the figures below it can be seen that the cost associated with paint wastage remains insensitive to disposal cost: a 1,250% increase in the cost of disposal only results in a modest 2.8% increase above baseline costs.

Table 12: Sensitivity analysis to paint wastage, hazardous and non-hazardous alkyd varnishes

Alkyd	1.5% Wastage	5% Wastage	25% Wastage
€0.15 per litre	0.0%	3.5%	23.4%
€0.65 per litre	0.0%	3.6%	24.2%
€1.10 per litre	0.1%	3.8%	24.9%
€1.90 per litre	0.2%	4.0%	26.2%

3.2.5 Conclusion

The life cycle cost of paints and varnishes were established by calculating the baseline cost of fulfilling the functional unit that was set in the life cycle assessment technical work. The life cycle cost considered the procurement cost, the spreading rate, the longevity of the finish and the paint wastage, which included the disposal cost.

It was found that all investigated factors had a large impact on the life cycle cost, with the exception of the disposal cost of waste paint. The majority of the cost from paint wastage occurred due to the additional paint that needed to be procured.

The analysis shows that the procurement cost cannot be considered in isolation and that even moderate improvements in performance can outweigh the additional cost of purchasing more expensive paint. A 20% price increase would, for example, be justified if the paint finish lasted 8.5 years or more compared with the baseline 7 years. Similarly the 20% price increase would be outweighed if a spreading of 9.6 m² per litre could be achieved instead of 8 m² per litre.

Whilst the quality and cost of the procured paint or varnish were dominant factors in determining the life cycle cost, it is essential to consider the impact of the application and the use phase. Correct cleaning and pre-treatment of the surfaces may significantly extend the life of the painted surface and be a cost-effective step to carry out. Skilled decorators should be able to achieve the

advertised spreading rates on suitable surfaces and leave a durable finish that will last a long time, whereas less skilled decorators may use more paint than is necessary and their work may not last as long. A labour cost saving may therefore not result in a life cycle cost saving.

The above described general observations, although done for decorative paints, apply also for road markings, with the durability and the times between repainting/refreshing being determinant in the overall life cycle costing.

DRAFT - WORK IN PROGRESS

4 TECHNICAL ANALYSIS

Information of the environmental performance of paints and varnishes along their whole life cycle is necessary to identify and address where the most significant impacts occur. This section details this information and identifies environmental areas of concerns which should be addressed through the GPP criteria.

4.1 Environmental evaluation and life cycle consideration for paints

Typically, when considering the life cycle of a product (in this case a paint), the production (incorporating material extraction, production and manufacturing), use and final disposal of the product must be taken into account. With regard to paint, the production stage can be well defined and, when analysed in isolation, is termed a cradle-to-gate analysis. This includes all of the impacts associated with the extraction and processing of the materials, formulation of the paint, packaging and shipping prior to use.

Within paint's use-phase, its performance during application and in use is critical. It affects the amount of paint needed to cover a surface and also the number of repaints necessary with a set time frame. These two effects have an impact on the amount of paint required and therefore the production phase of the LCA. Also within the use-phase is the direct release of emissions to the environment during painting and whilst in use.

At the end of life, following aspects need to be addressed:

- What amount of paint stay unused? This is important because it can have an impact on the overall performance of the paint and needs to be accounted within the performance characteristics. It also has its own environmental impact because it enters the waste stream for recovery or disposal.
- The fate of packaging material.
- The fate of the painted surface when it last reaches its end of life phase (e.g. end of life of the building), at which point the paint will enter the waste stream with that substrate or building material. In general the fate of the building material is more important in the environmental analysis than the fate of the paint itself (also due to allocation of the environmental impacts based on the weight ratio of paint/building component), though the presence of the paint might alter the alternative fates available to the substrate.

4.1.1 Review of available life cycle assessments for paints

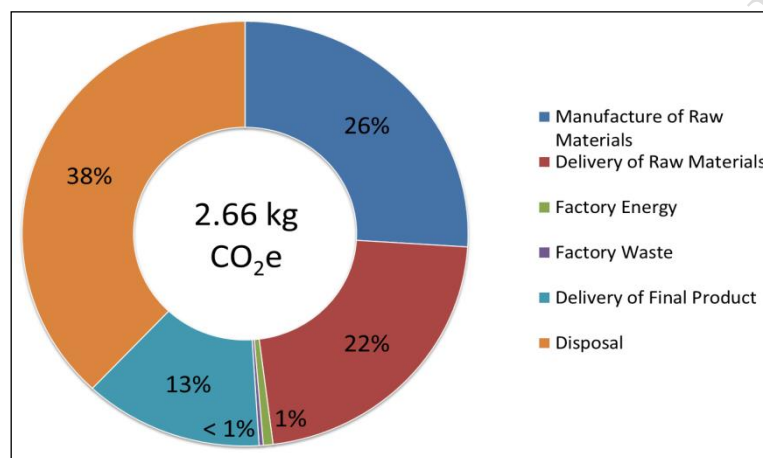
Seven separate paint life cycle assessments (LCAs) were identified and analysed. This section details their findings and comments on their suitability for determining the environmental 'hotspots' of paint for the Green Public Procurement.

A study by the Swedish Paint & Printing Ink Makers' Association (Sveff)¹³ examined three different paint formulations: a solvent-based varnish, a powder paint and a solvent-based alkyd. It examined the impact of paint production on greenhouse gas (GHG) emissions, low-level ozone, acidification and eutrophication. They found that, for solvent-based paints, the main constituents (solvent, binder and pigment) shared the environmental impact equally. Any surface treatment that extended the life of a product contributed most to the environmental benefit of the paint. The impact of transportation was negligible.

¹³ Sveff, Lifecycle assessment of paint: Summary of IVL Report B 1338-A, 2004.

In 2007, dcarbon8 performed a detailed carbon footprint for Jotun Paints for five of their products.¹⁴ Two key findings emerged from the analysis. The first was that the carbon footprints of solvent-based paint systems were approximately three times greater than those for a corresponding water-based paint. This was due to the added environmental cost associated with the production of the solvent compared with the relatively low costs associated with water. The second important finding was that the impact of end of life was significant: for water-based paints, where the environmental impact was relatively low, the impact of disposal at end of life could reach 38% of the total environmental impact of the paint. However, some caution should be taken with this figure because 'end of life' was imprecisely within the report and may include normal manufacturing processes. Figure 3 shows the breakdown of impacts by life cycle stage for one of the paint products that was investigated.

Figure 3: Breakdown of carbon impact by life cycle stage for Jotashield Alkali Resistant Primer



Source: Adapted from the dcarbon8 report

A comprehensive study¹⁵ by VTT Building Technology examined the environmental impact of exterior coating systems. They examined coated wooden cladding over a period of one hundred years including:

- manufacture of raw materials for paint,
- manufacture of paints,
- transports,
- painting,
- care and renewal,
- recycling and final disposal.

Thirteen model paints were analysed (see Table 13). The study is comprehensive and is declared as complying with the now out-dated ISO 14041 standard for performing life cycle assessment. As part of the collection of data, major paint manufacturers were surveyed and, although these are comparatively old data (from the late 1990s), some of the model paints appear to be in use still today.

¹⁴ dcarbon8, Jotun Paints – Product Life Cycle Assessment, 2007.

¹⁵ VTT Building Technology, Environmental Impact of Coated Exterior Wooden Cladding, 1999.

Table 13: Paint formulations examined by VTT

Formulations	Solvent (mineral spirit or water)	Binder	Pigment	Extenders (CaCO ₃)	Additives
Alykyd (tall oil)					
1 SB priming oil	90%	10%			
2 SB undercoat	45%	25%	10% TiO ₂	20%	
3 Factory primer	65% H ₂ O	10%	15% TiO ₂	10%	
4 WB priming oil	90% H ₂ O	10%			
5 SB stain	77%	20%	3% iron oxide		
6 WB stain	77% H ₂ O	20%	3% iron oxide		
7 Opaque topcoat	20%	40%	20% TiO ₂	20%	
Linseed oil					
8 Primer	20% (turpentine)	50%	30% ZnO		
9 Opaque topcoat		45%	15% ZnO 15% TiO ₂	15% 10% talc	
10 Opaque topcoat		45%	30% yellow ochre 15% ZnO	10%	
Acrylic dispersion					
11 WB stain	77 – 82% H ₂ O	17.5%	3% iron oxide		
12 Opaque topcoat	50% H ₂ O	25%	15% TiO ₂	10%	
Other					
13 Swedish red paint	66% H ₂ O	8% rye 6% linseed oil	16% Falu red pigment		4% iron sulphate

Source: Adapted from the VTT report

The study examined the whole life cycle of the painting system including in-use data such as cleaning, repainting and the impact of the wood itself.

From this study, it was concluded that:

- Fillers (e.g. calcium carbonate or talc), pigments (e.g. ferric oxides, red or yellow ochres) and additives (e.g. ferric sulphate) provide only a minor contribution to the environmental burden of the paints.
- The organic solvent is responsible for the majority of impacts in paints, where there is a high content of white spirit (particularly in priming oils and stains). The environmental burdens (emissions and use of resources) are typically one third less in the corresponding water-borne products having alkyd as the binder.
- The environmental burdens of acrylate stains are roughly double compared with water-based alkyd stains.
- Solvent-based paints lead to a ten-fold increase in VOC release in use compared to water-based alternatives.
- The impact of titanium dioxide dominates for paints with a titanium dioxide concentration of 10% or greater.
- Manufacturing process was estimated at 10% of the total environmental burden.

An investigation of the lifetime of the product showed that the frequency of repainting had a proportional effect on the overall impact – an increase of three years in periods between repainting resulted in a 15% decrease in energy consumption.

A 1993 study by Ecobilan¹⁶, which was the basis for the development of the initial EU Ecolabel paints and varnishes study, assessed the environmental impact of 11 different paint formulations (Table 14). The information was provided by paint manufacturers. To remove performance variation and provide a fair comparison between paints, the study defined the functional unit as the amount of paint that is needed to cover a 20m² area to a 98% opacity.

Table 14: Paint formulations for the Ecobilan study

	Paint type	Solvent medium	Binder	Solvent type	Quantity of paint required for functional unit (litres)
A	Matt	Water	Styrene-acrylate		2.47
B	Glossy	Water	Styrene-acrylate		2.08
C	Semi-glossy	Solvent	Alkyd	White spirit >5%	1.90
D	Glossy	Solvent	Alkyd	Isoparaffin	1.96
E	Matt	Solvent	Styrene-acrylate	Isoparaffin	2.99
F	Glossy	Solvent	Alkyd	Isoparaffin	1.77
G	Glossy	Solvent	Alkyd	White spirit >1%	1.77
H	Matt	Solvent	Linseed oil	Isoparaffin	3.13
I	Matt	Water	Linseed oil emulsion		2.94
J	Glossy	Solvent	Alkyd (high content of solid matter)	White spirit >1%	1.163
K	Matt	Water	Styrene-acrylate (micro-voids)		2.17

Source: Adapted from the Ecobilan study

It was concluded that:

- the TiO₂, binder and solvent contributed most to the environmental impact of the paint,
- transport has a very low impact on the environmental impact of paints,
- water-based paints' environmental impact was less than those with organic solvents.

The comprehensive LCA database, Ecoinvent, contains three LCA datasets (covering the life cycle from cradle-to-gate) referring to paints:

- acrylic varnish, 87.5% in H₂O,
- alkyd paint, white, 60% in H₂O,
- alkyd paint, white, 60% in solvent.

¹⁶ European Ecolabel project for application to Paints and Varnishes, Volume 5, results of the extension phase, The Life Cycle, Analysis of eleven indoors decorative paints, ECOBILANCOMPANY, 1993

The data on product composition was taken from European manufacturers.¹⁷ The data for each of the individual components within the product process, such as electricity and chemicals, were updated via the Ecoinvent database. However, it should be highlighted that the paint formulations are relatively old (pre-1995) and not representative of the current market.

Results from the Ecoinvent LCAs broadly follow the results detailed in the other studies in this review. The binder and TiO₂ were the largest contributors to the environmental impact. Solvent also played an important role within the LCA of alkyd paint in solvent. Interestingly, the environmental burden of growing and producing soya oil for the alkyd paints produced different, but not necessarily less, environmental impact than corresponding synthetically produced binders. This meant that the impact of producing biologically derived binders were important within the LCA.

Summary

Based on the review of the identified LCAs described above, the following conclusions can be made:

- Solvent-based paints have a higher environmental impact than corresponding water-based paints.
- Extending the life of a product contributed most to the environmental benefit of the paint.
- The impact of transportation is negligible.
- The lack of inventory data on paint fillers, pigments and additives meant that the assessment of the environmental impact of these components is largely incomplete.
- Solvent-based paints can lead to a ten-fold increase in the release of VOCs compared to water-based paints.
- Where more than 10% TiO₂ is used, it is the most significant contributor to the environmental impact.
- Manufacturing impacts were vague within all examined studies.

4.1.2 Life cycle assessment of a paint

In addition to the information currently available from the references, a cradle-to-gate LCA was performed using the Ecoinvent database to identify environmental 'hotspots', particularly for paint ingredients. The initial goal was to perform a simplified LCA which could provide sufficient data to identify where environmental impacts of paint manufacture are. This section focuses on presenting the main environmental impact of the production phases of paint and final disposal of unused paint determined in this analysis. For the details of the LCA conducted please consult the Green Public Procurement Background Report from July 2012 available at the project website.¹⁸

4.1.2.1 Selection of paint

A key difficulty in defining the environmental impact of a paint is that there is no 'standard' paint formulation. One on-line paint product directory contains 10,000 different resin/polymer formulations, 9,000 additives and 4,500 pigments and fillers.¹⁹ This large number of different ingredients can be used in a variety of combinations giving rise to hundreds of thousands of different paint formulations. Clearly, assessing the environmental impact of all varieties of paints is impractical and a representative sample of products is needed.

17 Danken A and Chudacoff M., *Vergleichendeökologische Bewertung von Anstrichstoffen im Baubereich*, 1995.

18 Green Public Procurement Background Report, available online at:

<http://susproc.jrc.ec.europa.eu/paints/docs/GPP%20Paints%20Background%20Report%20FINAL.pdf>, July 2012.

19 SpecialChem4Coatings.com (website dedicated to Coatings and Inks formulation),

<http://www.specialchem4coatings.com/>.

Information provided within the PRODCOM database identified two paint types with the largest market share:

- **Water-based vinyl emulsions** which can be used for a diverse range of paint applications from wall paints and trim paints,
- **Water-based Alkyd emulsions** that are largely used in varnishes.

The BoM for the two sample paints are presented in Table 15 and Table 16. Based on the market analysis conducted in the framework of this project²⁰, these two paints represent approximately 50% of the entire European market share of paints.

The **functional unit** for this life cycle assessment was chosen to be the amount of paint required to cover a 20 m² surface for a period of 21 years, assuming that a repaint is required every 7 years to maintain coverage.

Table 15: Bill of materials for 1 kg of vinyl emulsion wall paint

Material	Amount (g)
Water	326
Binder: butyl acrylate	144.1
Binder: methyl methacrylate	117.9
Titanium dioxide	120
Filler (calcium carbonate)	272
Other additives (biocides, surfactants and defoamers)*	20

*These additional ingredients vary significantly on the type of paint used. Defining a paint formulation that is representative is not possible for these minor ingredients.

Table 16: Bill of materials for 1 kg of alkyd emulsion paint

Material	Amount (g)
Titanium dioxide	250
Alkyd emulsion: propylene glycol	90
Alkyd emulsion: phthalic anhydride	90
Alkyd emulsion: linoleic acid	120
Metal drier 8% cobalt solution	4.5
Thickener (organo-clay)	32
Additives (defoamer, biocide, dispersant)*	12.5
Water	401

* These additional ingredients vary significantly on the type of paint used. Defining a paint formulation that is representative is not possible for these minor ingredients.

4.1.2.2 Analysis and comparison

The impact assessment was performed using the IMPACT 2002+ method. IMPACT 2002+ is a combination of four methods: IMPACT 2002 (Pennington et al. 2005), Eco-indicator 99

²⁰For details, see the section on Market Analysis in the Technical background report available at <http://susproc.jrc.ec.europa.eu/paints/stakeholders.html>.

(Goedkoop and Spriensma, 2000, 2nd version, Egalitarian Factors), CML (Guinée et al. 2002) and IPCC. The data referred to the production of 8.25 kg of the respective paints; this is the reference flow required to fulfil the functional unit including 10% wastage.

4.1.2.2.1 Manufacturing

Table 17 and Table 18 detail various environmental impacts of the production of the two model paints and the disposal scenario. This view provides an overview of total paint impacts. The overall environmental impacts (single score) of producing both paint types are within 10% of each other. Due to any inaccuracies associated with the modelling, these differences are within the bounds of error and suggest that the overall effects of the manufacturing processes for these two paints are equivalent. Damage to the ecosystem caused by the alkyd emulsion paint is significantly higher than that caused by the corresponding vinyl paint. This is the only noticeable difference between the two products and is due to the sourcing, harvesting and processing of soya oil for linoleic acid. This can be balanced against the higher impacts on human health and energy for the completely synthetic paint (vinyl emulsion).

Table 17: Results from a simplified impact assessment on human health and ecosystem for the production of two model paint systems for the functional unit

Human Health / DALY				Ecosystems / PDF.m2.yr			
	Vinyl emulsion wall paint	Alkyd emulsion paints	Disposal		Vinyl emulsion wall paint	Alkyd emulsion paints	Disposal
Carcinogens	8.83E-07	6.77E-07	2.80E-08	Aquatic ecotoxicity	5.12E-02	5.71E-02	2.86E-03
Non-carcinogens	4.15E-07	7.10E-07	1.33E-07	Terrestrial ecotoxicity	1.51E+00	2.73E+00	8.48E-02
Respiratory inorganics	9.32E-06	1.10E-05	3.36E-07	Terrestrial acid/nutri	3.06E-01	4.00E-01	1.13E-02
Ionizing radiation	4.79E-08	8.91E-08	3.06E-09	Land occupation	7.58E-02	4.49E+00	5.30E-03
Ozone layer depletion	1.72E-09	2.64E-09	2.12E-10	Total	1.95E+00	7.67E+00	1.04E-01
Respiratory organics	2.86E-08	1.96E-08	7.24E-10				
Total	1.07E-05	1.25E-05	5.01E-07				

Table 18: Results from a simplified impact assessment of resource consumption and single score for the production and disposal of two model paint system for the functional unit

Resources / MJ Primary				Single Score / Pt			
	Vinyl emulsion wall paint	Alkyd emulsion paints	Disposal		Vinyl emulsion wall paint	Alkyd emulsion paints	Disposal
Non-renewable energy	4.26E+02	4.06E+02	1.64E+01	Human Health	1.51E-03	1.76E-03	7.07E-05
Mineral extraction	2.66E-01	3.47E-01	8.78E-03	Ecosystem quality	1.42E-04	5.60E-04	7.62E-06
Total	4.26E+02	4.07E+02	1.64E+01	Climate change	2.02E-03	1.93E-03	1.89E-04
				Resources	2.80E-03	2.67E-03	1.08E-04
				Total	6.47E-03	6.92E-03	

Furthermore, the analysis revealed that three biggest contributors to the environmental impact of paint production are: **binders, TiO₂ pigment** and paint plant **energy in production/formulation**. This mirrors the evidence provided by the LCAs review. About one quarter of the overall environmental impact of the paint is from the paint manufacturer (operating formulation plant), while the remaining 75% of the impact is within the paint manufacturer's supply chain.

A reduction in the amount of TiO₂ used could produce a significant reduction in the environmental impact of the paint. The environmental impact of TiO₂ production was modelled based on a 50:50 mix of material produced via the sulphate process and chloride process. As can be seen from the breakdown of the emissions from these two manufacturing routes, the environmental impacts are similar, with the sulphate route being slightly more environmentally damaging than the corresponding chloride route. Based on this analysis there is an argument that the EU Ecolabel could encourage more use of chloride-derived TiO₂. The formulation of the vinyl paint uses calcium carbonate filler in place of some of the TiO₂. This has reduced the impact of this paint meaning the contribution to the overall impact from TiO₂ is roughly half that of the corresponding alkyd paint.

A wide variety of binders is used, producing a range of properties that can be tailored to suit the performance needs of the paint. Binders include:

- Alkyds,
- Cellulose,
- Bitumens,
- Epoxies,
- Acrylics,
- Vinyls,
- Polyurethanes.

Where possible, limiting the use of binders would reduce the overall environmental impact of the paint (assuming a similar performance can be achieved). Where a choice of binders could be used, it is conceivable that a requirement could be set to use those which are less environmentally damaging. However, due to the wide variety of properties and uses dictated by the choice of binder, analysis on a case-by-case basis would be necessary to determine the most appropriate binder. This data does not exist and any research would only be valid for that particular application. With additional primary research, it would be possible to rank the environmental performance of all binder systems, but prescribing the binders used would be impractical within the GPP criteria because of the requirement for particular properties in the final product.

Some aspects of the environmental damage of the binder can be assessed. The hazardous nature of some of the binders and, in particular, some of the binder precursors are addressed through the hazardous substances criteria.

4.1.2.2.2 Use phase

Paint application and durability

Conclusions from the LCAs reviewed denote that the amount of paint used and the lifetime of the paint are important when considering their environmental impact.

A performance of paint can be investigated based on the following:

1. The overall amount that is necessary to use for painting a certain surface (and reach a predefined painting quality) and
2. The time that is needed until the next repaint.

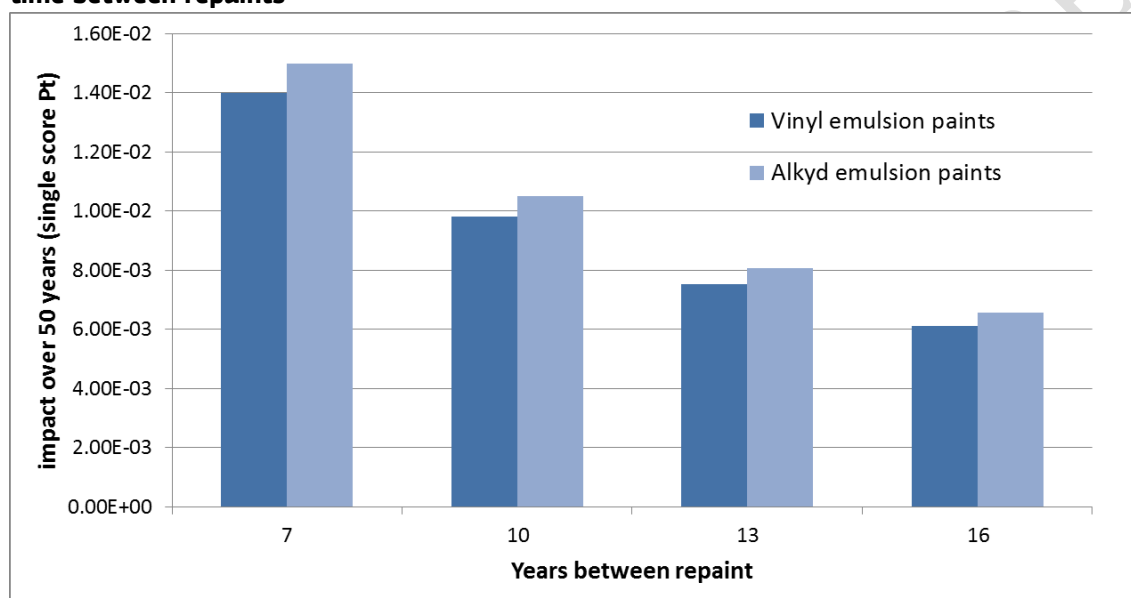
Paint with good performance characteristics will need to be used in smaller amount and afterwards the painted surface will require less frequent repaints. As a consequence, using a smaller amount of

paint results in a lower environmental impact related to the paint production, along with the release of air pollutants during application and the treatment of waste.

The effect of the lifetime of the use phase of the paints can be illustrated by examining the period needed between repaints. Figure 4 depicts the environmental benefits from increasing the performance of the paint resulting in increased periods between repaints. It shows the impact of covering 20m² of wall with 2.5 kg of paint over a 50 year timeframe.

The “base case” assumes 7 years between repaints. It should be noted that this model does not account for consumer behaviour; for example the investigation for the EU Ecolabel for buildings revealed that a major renovation takes place approximately every 15 years.

Figure 4: The effect on the environmental impact of improving performance and increasing time between repaints



Decreasing the frequency between repaints has a significant effect on reducing the environmental impact of the paint. A relatively minor increase in paint performance can lead to a significant reduction in the overall impact of the paint (over the modelled 50 year lifetime). In the example above, although there is a 7% difference in the environmental burden of the vinyl and alkyd emulsion paint, this is dwarfed by the savings made through the reduction in environmental burden by increasing the period between repaints. Even based on this simple approximation the importance of including **performance criteria** of paints seems to be evident.

4.1.2.2.3 Hazardous substances

In the LCA performed a cut-off limit of 5% w/w of the final paint was applied, which largely included the “additives” portion of the BoM. It is difficult to determine a representative assessment of the additives due to the large number of different chemicals that could be considered in this category and the diversity of their environmental impact. In order to overcome this limitation an investigation on some of these chemicals which are of concern to the environment and human health are discussed here. Of particular concern is the emission of hazardous and eco-toxic chemicals, both during production and during the application and use of the paint.

This section tries to highlight a limited number of chemicals which are considered to be of particular concern within the paints industry and for the environmental schemes. A large number of traditional paint ingredients are toxic or harmful. It is not the intention of this section to identify every

chemical which may be of concern but to investigate further and assess the environmental importance of taking an action within the GPP policy for the chemicals that have been highlighted through regulatory control and are of special importance for the stakeholders who participated in the criteria development process. These chemicals are currently addressed within the latest revision of the EU Ecolabel paints and varnishes criteria which were voted in November 2013.

The concern for these chemicals is centred on their emission and associated impacts in the paint's use phase and their release, rather than on their production. Several of the identified chemicals of concern and their influence on the environment or human health are briefly described below.

Alkylphenoethoxylates (APEOs)

APEOs are non-ionic surfactants, which have an emulsifying and dispersing effect when processing paints, and in binders, **dispersion** aids, thickeners, driers, antifoam agents and pigment pastes.²¹ APEOs are produced in large volumes, with uses that lead to widespread release to the aquatic environment. They are highly toxic to aquatic organisms, and in the environment degrade to more environmentally persistent compounds. These chemicals have been detected in human breast milk, blood, and urine and are associated with reproductive and developmental effects in rodents.²²

Perfluorinated alkyl sulfonates (PFAS)

PFAS is the collective name for a group of fluorinated surfactants. Similar to APEOs, these are used in dispersants, thickeners, driers and pigment pastes. Of particular concern is perfluorooctane sulfonate (PFOS), which has been analysed in a limited number of European environmental and food samples and has been shown to bio-accumulate in fish. This bio-accumulation seems to be an important source of human exposure to PFOS.²³

Following absorption, PFOS is slowly eliminated and therefore accumulates in the body. PFOS shows moderate acute toxicity. In sub-acute and chronic studies the liver was the major target organ and developmental toxicity was also seen. Other sensitive effects were changes in thyroid hormones.²⁴

Formaldehyde

Formaldehyde donors are used as a biocide in water-based paints (particularly protecting the head-space within the paint pot). Formaldehyde can cause irritation of the skin, eyes, nose, and throat. High levels of exposure may cause some types of cancers; for example, some studies of people exposed to formaldehyde in the workplace found more cases of cancer of the nose and throat than expected. In animal studies, rats exposed to high levels of formaldehyde in air developed nose cancer.²⁵ Formaldehyde is often used as proxy, a reference indicator for other similar chemical structure substances which are not covered in the life cycle impact assessment models (no characterisation factor determined).

21Nurmi T., Kannianen K., Paints and how they affect the environment, 2008.

22U.S. Environmental Protection Agency, Nonylphenol (NP) and NonylphenolEthoxylates (NPEs) Action Plan, 2010, available online at: http://www.epa.gov/oppt/existingchemicals/pubs/actionplans/RIN2070-ZA09_NP-NPEs%20Action%20Plan_Final_2010-08-09.pdf, accessed May 2014.

23Scientific Opinion of the Panel on Contaminants in the Food chain, European Food Safety Authority, Perfluorooctane sulfonate (PFOS), perfluorooctanoic acid (PFOA) and their salts, 2008.

24European Food Safety Authority, Perfluorooctane sulfonate (PFOS), perfluorooctanoic acid (PFOA) and their salts, Scientific Opinion of the Panel on Contaminants in the Food chain, 2008.

25Agency for toxic substances and disease registry, Formaldehyde Factsheet, 1999, available online at: <http://www.atsdr.cdc.gov/tfacts111.pdf>, accessed May 2014.

Halogenated organic solvents

A halogenated solvent is an organic solvent, molecules of which contain halogens: chlorine (Cl), fluorine (F), bromine (Br) or iodine (I).²⁶ They can be found in the paint industry in thinners, strippers and solvents. They are used as they are largely non-flammable, though if they do combust they can produce toxic gases. Risk to health from using halogenated organic solvents in paint includes dermatitis and eye irritation. More serious exposure via vapours or high levels of the solvents can lead to kidney and liver damage, heart irregularities, and they are potentially carcinogenic.²⁷

Phthalates

Phthalates are commonly found in PVC where they are used as plasticisers, giving the plastic desired physical properties. They can be also used in paints to alter the overall finish of the paint. Several phthalates have been shown to be endocrine inhibitors; this can cause cancerous tumours, birth defects, and other developmental disorders. Some phthalates are in the candidate list to be classified as Substances of Very High Concern (SVHC). There is some guidance provided by the EU that certain phthalates, in particular di-isononyl phthalate (DINP) and di-isodecyl phthalate (DIDP) have no associated health risks.²⁸ Stakeholders provided information that although DINP does not have an official classification, some manufacturers classify it as toxic to reproduction, skin and eye irritant.

The determination of the health risks associated with phthalates relates mainly to plastic products rather than paints. Therefore decisive conclusions on the effect and exposure to phthalates within paints cannot be drawn.

Heavy metals

In large quantities, heavy metals are considered carcinogenic and hazardous to human health.²⁹ Although present in the environment, and necessary for human health in small amounts, any large concentration can cause acute or chronic toxicity.³⁰ As they are elements, they cannot be broken down and therefore will persist in the environment.³¹ When absorbed by humans, they have been shown to have detrimental effects on kidney function, reproductive organs and the nervous system, particularly in unborn infants and young children. The use of some of these metals is now subject to regulation from REACH which came into effect on 1 June 2007.³²

Cadmium: Cadmium is used as a colorant in paint pigment³³ and levels are controlled by EU regulations except in the use of certain items coloured for safety reasons.³⁴ Paint that contains a level of cadmium (as a pigment) higher than 0.01% by mass is prohibited. If the paint contains a high level of zinc, the residual concentration of cadmium must be as low as possible, in any case not higher than 0.1% by mass.³⁵

26 Kopeliovich D., Classification of Solvents, Substances & Technologies website, available online at: http://www.substech.com/dokuwiki/doku.php?id=classification_of_solvents, accessed May 2014.

27 Childs B., Eckmann A., Plasma Science and Fusion Center, Office of Environment, Safety, and Health, Massachusetts Institute of Technology, Standard Operating Procedures for Use of Halogenated Solvents and Products Containing Halogenated Solvents, available online at: <http://www.psf.mit.edu/esh/halosolv.html>, accessed online May 2014

28 Commission Communication on the results of the risk evaluation and the risk reduction strategies for the substances: Dibutylphthalate; 3,4-Dichloroaniline; Di-'isodecyl' phthalate; 1,2-Benzenedicarboxylic acid, di-C9-11-branched alkyl esters, C10-rich; Di-'isononyl' phthalate; 1,2-Benzenedicarboxylic acid, di-C8-10-branched alkyl esters, C9-rich; Ethylenediaminetetraacetate; Methyl acetate; Monochloroacetic acid; n-Pentane; Tetrasodiummethylenediaminetetraacetate, OJ C90, 13.4.2006, p. 5

29 Air Pollution Information System website, Heavy Metals, available online at: http://www.apis.ac.uk/overview/pollutants/overview_HM.htm, accessed May 2014

30 <http://www.lef.org/protocols/prtcl-156.shtml>

31 http://www.apis.ac.uk/overview/pollutants/overview_HM.htm

32 <http://www.hse.gov.uk/foi/internalops/fod/oc/200-299/253-11.htm>

33 HSE, web leaflet INDG391(rev1), revised 03/10

34 http://eur-lex.europa.eu/LexUriServ/site/en/oj/2007/l_136/l_13620070529en00030280.pdf

35 www.cbi.eu/?pag=85&doc=416&typ=mid_document

Lead: Lead-based paints were banned for sale for use by the general public in the EU in 1992³⁶, although some specialist uses for industry and the military are still permitted. Lead had originally been used in paint as a pigment and drying agent. White lead was predominantly used as the white pigment in primer type paints. The lead-based pigments (lead tetroxide/calcium plumbate, or "red lead") were used as an anti-corrosive primer agent in paint used on metal³⁷. Nowadays the exposure to, or removal of, old leaded paint can still present a hazard to human health.

Chromium VI: This is a group of compounds which has a low (acid) or neutral pH. Zinc, lead and calcium chromates form the most important compounds in the group. Calcium chromates are rarely used in paints nowadays. Zinc chromates are often used in primer paints as they have high anti-corrosive properties.³⁸ Lead chromates are used in topcoat paints and occasionally in primer paints.³⁹ Cr II is an unstable compound and therefore little used in paint. Cr III is used in paints as a green pigment or as a protective coating on metals (anti-corrosive). It may cause some respiratory difficulties or skin reactions but is not considered highly harmful.

Use of lead chromate pigments in paints and coatings, in road markings and sign paints is being phased out in Europe under the REACH Regulation⁴⁰. Nevertheless, REACH allows companies to apply for an Authorisation for use of these pigments in specific end-uses for which no reasonably substitutes were found. According to information from the British Coatings Federation (BCF) which looked the regulatory side for road markings⁴¹ *There has been an Authorisation Application to argue for the continued use of two lead pigments in industrial paints (for use on machines, vehicles, structures, signs, road furniture, etc.) or as road marking. The British Coatings Federation (BCF) has opposed the Application on the grounds that, as there are many alternatives to these pigments on the market, they can be substituted. It is appreciated, however, that none of these alternatives give completely the same properties as lead pigments and some changes will have to be made by applicators. The vast majority of BCF industrial coatings members, large and small, have moved, or want to move away from lead, and are ready to use alternatives, as long as there is a level playing field and any ban is properly policed. Of course some of the multinationals have already moved or committed to move away from lead globally, and in Australia (for example), all lead paints are banned*.

Mercury: In the past, phenyl mercuric acetate was commonly used as a fungicide in water-based latex paints, to prevent the growth of bacteria.⁴² Its use in paint was banned in the USA in 1991.⁴³ In the UK, paint companies have voluntarily removed mercury from paints, though its use is still legal.

Arsenic: Arsenic is well known for its poisonous properties. It is not used in paint production today, although traces may rarely still be found in green paint pigment, particularly on artists' frescoes or canvases.

Barium: Synthetic barium sulphate is used as a filler in the paint and varnish industry and can also be an element in white pigment. Its inertness and high density qualities make it useful to improve the consistency and handling properties of paint.⁴⁴

Selenium: Selenium is normally extracted as a by-product of copper production.⁴⁵ One of the main applications for selenium is for pigmentation in glass manufacture to colour and decolourise glass,

36 Marketing and Use Directive (89/677/EEC) through the Environmental Protection (Controls on Injurious Substances) Regulations 1992 (Statutory Instrument 1992/31)

37 <http://www.rsc.org/chemistryworld/News/2007/August/21080701.asp>

38 HSE Information Sheets: Chromate Primer Paints, engineering sheet number 32

39 HSE Information Sheets: Chromate Primer Paints, engineering sheet number 32

40 Regulation EC 1907/2006 on the Registration, Evaluation, Authorisation and Restriction of Chemicals

41 Wayne Smith, from the British Coatings Federation (BCF),

42 UNECE, www.unece.org/.../TFHMs_3.ProductsReviewChapter.draft.05.04.06

43 <http://www.epa.gov/hg/consumer.htm#pai>

44 <http://www.nanopartikel.info/cms/Wissensbasis/Bariumsulfat>

45 <http://www.mmta.co.uk/metals/Se/>

and also in paint, which comprises approximately 40% of the selenium demand. It is used in the photovoltaic industry and demand is therefore predicted to rise in the future.⁴⁶

Antimony: This metal is found in paint pigments, as well as in batteries, ceramics and glass.⁴⁷ It was initially used by make-up artists for black face paint, known as 'kohl'. Nowadays it is valued in paint for its flame-retardant properties.⁴⁸

Volatile aromatic hydrocarbons (VAHs)

VAHs include compounds such as benzene⁴⁹, toluene and benzaldehyde, and are used as solvents in paints. They can have severe effects on the human body and the environment including having an effect on the reproductive system and carcinogenic.

Volatile organic solvents (VOCs)

VOCs are used as solvents within paints to help keep them stable prior to use and to aid in spreading and delivery of the paint to the substrate. VOCs encompass a wide variety of compounds and are generally classed as organic substances with a boiling point less than 250°C.⁵⁰ VOCs generally evaporate or sublime from the paint during and after application. The release of these emissions can cause eye, nose, and throat irritation along with headaches and loss of co-ordination. There is a diversity of compounds encompassed by this classification, and more extreme reactions can also present, in particular: damage to liver, kidney, and central nervous system and some are suspected or known to cause cancer in humans.⁵¹

Isothiazolinone compounds

Isothiazolinone compounds are found in wood coatings⁵² and in some paint formulations. They are a broad spectrum fungicide, algicide and bacteriostat used in solvent-based coatings, surface protection products and other xylene-compatible products.⁵³ For people susceptible to their effects, the compounds can cause irritation to the skin and mucous membranes.⁵⁴ The extent to which they do this depends greatly on the level of concentration in the product used and the method of exposure.⁵⁵

4.1.2.2.4 End of life phase

The environmental impacts associated in the end-of-life phase of the paint, as modelled in the streamlined assessment, is low compared to impacts in the production and manufacturing phase. This end-of-life phase, however, only models the impacts related to the processes involved in the incineration of the paint (and their associated environmental impacts). The environmental impacts associated with the production of the paint residuals are not expressly incorporated within the end-of-life phase of the current model (they are incorporated, but not highlighted, within the production phase).

46 Minor Metals Trade Association, Selenium

47 <http://www.lenntech.com/processes/heavy/heavy-metals/heavy-metals.htm>

48 Minor Metals Trade Association, Antimony

49 Preventing disease through healthy environments, Exposure to benzene – a major public health concern, WHO, available at: <http://www.who.int/ipcs/features/benzene.pdf>.

50 Directive 2004/42/CE

51 <http://www.epa.gov/iaq/voc.html>

52 Revision of European Ecolabel and Development of Green Public Procurement Criteria for Indoor and Outdoor Paints and Varnishes, October 2011

53 Akros Chemicals, <http://www.akros.com/products/europeproductrange/productsbycategory/microbiocides.aspx>

54 Consumer exposure to biocides - identification of relevant sources and evaluation of possible health effects, Stefan Hahn, February 2010

55 Consumer exposure to biocides - identification of relevant sources and evaluation of possible health effects, Stefan Hahn, February 2010

The unused paint has a significant environmental impact and it is therefore important to further investigate (including the impact of production). As mentioned above, there is significant debate over the average amount of paint wasted during application, with the current streamlined assessment assuming a conservative 10% level of wastage. A recent study of WRAP⁵⁶ highlights the problem of unused paint in the UK. In the domestic market, an estimated 25% of all paint goes unused, whereas wastage in trade use is 1.5%. Scaling up to Europe, this equates to approximately 900,000 tonnes of unused paint wasted every year, suggesting that approximately 12% of the environmental burden of paint is from wasted paint.

Stakeholders provided information that the amount of unused paint from professional application, i.e. also public procurement, is lower than in the private sector. According to their experience 1.5% value shall be representative. Thus the assumption used in the study may be too high. Information for cross-checking of this value is however very scarce and difficult to verify.

In any case, any reduction in the amount of unused paint would have a significant reduction on the environmental impact of the paint and paint industry. Possible methods to achieve this reduction include:

- The sale of appropriate quantities of paint using different sized tins or bespoke dosing systems or correctly conveying the amount of paint required by the user to prevent over-ordering.
- Where paint is not needed, the appropriate reuse (where possible) will also reduce the environmental impact.
- Take-back schemes are available (usually run by the charitable sector) that could limit wasted paint.

The development of take-back schemes for paints has also seen a recent increase. Crown Paints, for example, is the UK's largest independent decorative paint manufacturers and has recently promoted a scheme which allows trade customers to return used Crown paint cans to store when they purchase new paint. A 'can-back' scheme has also been piloted where used paint containers are collected at Crown retailers and either reused or recycled back into the supply chain for the production of new paint containers. The process of granulating and recycling of used plastic paint containers is also being introduced on a larger scale by Crown paints.⁵⁷

A variety of other companies also run schemes through which unwanted paint can be returned to the supplier. For example, Paint+, which operates across the UK, takes back unused paint free of charge to be sold or donated.⁵⁸ There are also a number of charitable organizations who collect unwanted paint and use it in community projects.⁵⁹ Further schemes operate overseas, for example CalRecycle operates a paint reuse facility in California.⁶⁰

An additional problem is that waste paint can be considered a hazardous material and therefore disposal should be appropriately controlled.

Used paint pots present a recycling challenge as they invariably contain leftover paint inside. It appears that the composition of paint pots (both steel and plastic) enables them to be readily recycled. However, containers are very unlikely to be in a sufficiently clean condition for this to be

56 Lee P., Willis P, WRAP, Paint and woodcare products – distribution and delivery – A review of alternative supply chain approaches within UK paint and woodcare markets, Final Report, 2011.

57 Crown Paints, Crown Paints Launches Carbon Revolution at Ecobuild, 2011. Available at: <http://www.crowntrade.co.uk/LatestNews/LatestNewsStories/Pages/CrownPaintsLaunchesCarbonRevolutionatEcobuild.aspx>

58 Paint +, Returned paint put to good use. Available at: <http://www.paintplusuk.com/104/returned-paint-put-to-good-use/>

59 Community RePaint. Available at: http://www.communityrepaint.org.uk/Where_Get_Paint.php

60 <http://www.calrecycle.ca.gov/condemo/paint/>

achieved. In general in the UK, spent paint pots are sent to landfill⁶¹ with efforts directed towards the reuse of left over paint rather than the recycling of the pots.⁶²

Recycling of paint pots does appear to be possible in the trade sector but requires specialist equipment and is not suitable for the DIY market.⁶³ The recovery of energy appears to be a favoured route to dispose of plastic paint pots, for example using them as cement kiln furnaces for fuel.⁶⁴ Metal containers are mainly recovered for reuse.

4.1.3 Non-LCA impacts – Indoor air quality

Already studies in the 1980s in the USA⁶⁵ showed that the contamination of indoor air by some of the most commonly encountered organic pollutants (VOCs) was between two and five times that found in outside air irrespective of whether it was in a rural or industrial environment. The importance of evaluating indoor air quality rises particularly in the recent years.

In the framework of the revision of the EU Ecolabel criteria revision there was a request from several stakeholders to change the testing procedure for VOCs and other compounds (including formaldehyde) from in-can measurements to Indoor Air Quality (IAQ) testing. IAQ tests the emissions of substances of interest from the paint during the drying process and when the paint is in use. This method has the advantage of eliminating concerns that suppliers to the paint manufacturers do not completely disclose the content of ingredients. It however, requires significant additional costs associated with independent testing.

New national legislation in some MS, in particular the regulations in France and Germany and the Regulation 305/2011/EU on construction products⁶⁶ push companies to provide IAQ testing results for certain products.

The French regulations require mandatory testing and labelling of paints for IAQ⁶⁷ through the scheme, called ANSES.⁶⁸ It requires testing to measure the emissions of paint in a sealed room 28 days after application. The resultant classification system is similar to that implemented for energy efficiency of white goods (C to A+). Table 19 shows the concentrations of measured emissions from paints and the classification under the French regulations.

Table 19: Classification of IAQ based on emissions from paint under the French testing system ($\mu\text{g m}^{-3}$)

Substances/Emissions class	A+	A	B	C
Formaldehyde	<10	<60	<120	>120
Acetaldehyde	<200	<300	<400	>400
Toluene	<300	<450	<600	>600
Tetrachloroethene	<250	<350	<500	>500

61 <http://www.thisisgloucestershire.co.uk/ways-recycling-paint-tins-users-urge/story-11893909-detail/story.html>

62 http://www.recyclenow.com/what_can_i_do_today/can_it_be_recycled/liquids_and_chemicals/paint.html

63 <http://www.hankinson.co.uk/news/hankinson-recycling-centre/>

64 http://www.leics.gov.uk/index/environment/waste/recycling_sites_and_permits/recycling_household_waste_sites/recycling_information.htm

65 EPA's Office of Research and Development's "Total Exposure Assessment Methodology (TEAM) Study" (Volumes I through IV, completed in 1985)

66 Regulation (EU) No 305/2011 of the European Parliament and of the Council of 9 March 2011 laying down harmonised conditions for the marketing of construction products and repealing Council Directive 89/106/EEC, OJ L 88/5.

67 http://www.eco-institut.de/fileadmin/contents/International_Labeling/VOC/Arrete_etiquetage_2011.pdf.

68 Agencenationale de sécurité sanitaire de l'alimentation, de l'environnement et du travail.

Xylene	<200	<300	<400	>400
1,2,4-Trimethylbenzene	<1000	<1500	<2000	>2000
1,4-Dichlorbenzene	<60	<90	<120	>120
Ethylbenzene	<750	<1000	<1500	>1500
2-Butoxyethanol	<1000	<1500	<2000	>2000
Styrene	<250	<350	<500	>500
Total VOC	<1000	<1500	<2000	>2000

The German AgBB⁶⁹ system, Health-related Evaluation of Emissions of Volatile Organic Compounds (VOC and SVOC) from Building Products, sets out restrictions on the level of emissions allowed for construction products (in particular flooring but can be applied to paints). An extensive list of chemicals is regulated, with limits described as “Lowest Concentrations of Interest” (LCI). Unlike the French system, these are maximum emission levels designed to remove the most polluting paints from the environment.

The development of the national schemes contributed to an EU-level harmonisation project by the Joint Research Centre (JRC), Institute for Health and Consumer Protection (IHCP) in Ispra. The project favours the LCI approach and aimed at delivering acceptable levels of emissions on 170 chemicals.⁷⁰ The ultimate goal is an EU-wide harmonised standard for IAQ that will apply to all building materials. The latest findings of this initiative were recently published in the report 'Harmonisation framework for health based evaluation of indoor emissions from construction products in the European Union using the EU-LCI concept'.⁷¹

A related but separate committee has been established under the European Committee for Standardisation (CEN) to develop a harmonised testing procedure for IAQ. This is in a response to the European Construction Products Directive (CPD) which requires manufacturers of construction products to declare “regulated properties” in CE marking. In addition to traditional properties such as mechanical strength and fire safety, CPD refers also to the protection of hygiene, health and environment, which is interpreted to include air emissions⁷².

Early 2014 it was decided that CPD will not cover paints and varnishes, thus they are no mandated tests for IAQ. Nevertheless, it is considered that *“they can be dealt with in a similar manner to construction products due to their emission properties”*⁷³ GPP is a voluntary scheme which aims to go beyond regulatory framework and favour better environmentally products. Therefore, including IAQ testing for GPP paints and varnishes seems reasonable in this context. Additionally, in the GPP criteria for buildings IAQ criterion is established for various subcomponents of a building. In order to seek for harmonisation this current proposal is kept.

69 Committee for Health-related Evaluation of Building Products (Ausschuss zur gesundheitlichen Bewertung von Bauprodukten).

70 Minutes of the 8th Indoor Air Quality (IAQ) Expert Group meeting 14 June 2011 – Luxembourg.

71 Kephelopoulou S., Geiss O., Annys E., Carrer P., Coutilides R., Crump D., Däumling C., De Brouwere K., De Lathauwer D., Dommaschk N., Gloeckner M., Harrison P., Heinzow B., Jaechk R., Johanson G., Le Guern S., Rousselle C., Sateri J., Schuster A., Scutaru A.M., Tappler P., Uhl, M., Witterseh, T., Wolkoff, P., ECA report no. 29 on "Harmonisation framework for health-based evaluation of indoor emissions from construction products in the European Union using the EU-LCI concept", EUR 26168 EN. Luxembourg: Publications Office of the European Union, 2013. JRC83683.

Harmonisation framework for health based evaluation of indoor emissions from construction products in the European Union using the EU-LCI concept.

72 Evaluation of a horizontal approach to assess the possible release of dangerous substances from construction products in support of requirements from the construction products directive, Energy Research Centre of the Netherlands, 2008.

73 See description of the standard available at: <http://www.beuth.de/en/standard/din-en-16402/186065113>.

In 2013 the standard EN 16402 titled 'Paints and varnishes - Assessment of emissions of substances from coatings into indoor air - Sampling, conditioning and testing' was approved. It specifies "a reference method for the determination of emissions from coatings into indoor air. This method is applicable to volatile organic compounds, semi-volatile organic compounds and volatile aldehydes. It describes the overall procedure and makes use of existing standards mainly by normative reference complemented when necessary with additional or modified normative requirements".⁷⁴

4.2 Environmental evaluation and life cycle consideration for road markings

In accordance with EN 1436⁷⁵ **road markings** form a part of the means for horizontal signalization. They include longitudinal markings, arrows, transverse markings, text and symbols on the surface of the road and can be 'provided by the application of paint, thermoplastic materials or cold hardening materials, preformed lines and symbols or by other means'. Road markings can be applied with or without the addition of glass beads. Majority of road markings are white or yellow.

Glass beads are tiny spherical glass balls used to achieve the retroreflection of the marking when the road marking is illuminated by vehicle headlamps. This retroreflection can also be improved, particularly for wet or rainy conditions, by special properties produced e.g. by the texture of the surface (in structured markings) or addition of large glass beads. Application of surface texture causes additionally that wheels of the passing vehicle can produce acoustic or vibration effects.

Glass beads are dropped on top of freshly applied conventional paints and durable materials such as epoxies or can be mixed in with marking before it is applied. Glass beads can be treated or untreated. If, treated, a coating on their surface enables the bead to sink into the paint. The untreated beads float on the surface. If a portion of the beads is placed on the surface and in the marking this ensures continued retroreflectivity as the paint wears.

There are various material technologies with different solidification methods used in road marking systems. According to information collected from industry among them there are:

- Water-borne paints – sprayed on the road surface, dry physically by evaporation of water, form a thin layer,
- Solvent-borne paints – sprayed on the road surface, dry physically by evaporation of solvent, form a thin layer,
- Thermoplastics – applied in the molten state at about 200°C, either sprayed on (thin layer) or casted on as a melt (thick layer), solidifying by cooling,
- Reactive road marking systems (the so-called 2-component cold plastics) – mixed with a second hardener component. They are applied at ambient temperatures (are sprayed on (thin layer) or casted on (thick layer)) and solidify by chemical curing into an inert duroplastic polymer.

Some road markings form a film over the substrate (flat spray applied thin layer road markings or flat extruded thick layer road markings) and some do not. Examples of the later ones are agglomerated or structured road markings. They provide specific safety and performance features and require significantly less amount of material (about 2 kg/m² for a structured line compared to 5-6 kg/m² for a flat line). Conventional products like water- and solvent-based paints are in general considered to have a shorter life span than durable products, like thermoplastics, cold plastics or epoxy markings.

74 European Committee for Standardisation website, Information regarding EN 16402:2013, available at:http://standards.cen.eu/dyn/www/f?p=204:110:0:::FSP_PROJECT:32045&cs=1C0890484F8DC05BB85B52607AC1F9CFB, accessed May 2014.

75 EN 1436:2007+A1, Road marking materials - Road marking performance for road users.

There are two types of markings - Type I and Type II. EN 1436 defines type II road markings as 'markings with special properties intended to enhance the retroreflection in wet or rainy conditions'. Type I road markings do not necessarily have such special properties

Follow-up from the stakeholders' consultation

Stakeholders provided comments which highlighted the variety of systems used in different geographical locations. For instance in the UK most road markings in are hot melt thermoplastics. According to information provided in Greece approximately 90% of road marking used in this MS are solvent-based acrylics, as due to "hot climate and high substrate temperatures hot melt and water-based road markings had given bad results (clack stripes from tyres)".

Stakeholders pointed out also differentiating conditions of use and related to them need of application of different systems. For instance in densely populated countries as Germany traffic wear resistance of the road marking system is of higher importance than in the north of Finland or south of Italy, where the population density is significantly lower. Also in the drier southern countries high wet visibility may not be of the same relevance as in the regions with high precipitation.

It was pointed out that in e.g. in Germany, which has many highly frequented roads, public procurers prefer very durable systems with high retro-reflectivity at night and in wet conditions (the so-called Type II markings). The German regulations for road markings (ZTV M 13) require rather high retro-reflectivity (class R4 in dry and R3 in wet condition according to EN1436), which has implications for the minimum layer thickness. Type II markings, which are applied in thicker layers, both as flat (up to 2 mm) or textured road markings in form of agglomerates (from 2 kg/m²) or profile markings (above 7mm). According to information from Germany, the later ones provide highest durability and enhanced safety performance (e. g. rumble effect) if compared with flat paint systems applied in thin layers.

4.2.1 Comparative life cycle assessments on selected road marking systems

Very few life cycle assessments have been conducted (by the industry) to determine the environmental performance of these systems. A summary of their main findings is given below.

4.2.1.1 A comparative cradle-to-grave LCA study for four types of road markings

Results of a recent comparative cradle-to-grave LCA study^{76, 77, 78} of the four major binder-based material technologies has been provided to the project team by the stakeholders. It was a cross-industry LCA study, reviewed and certified by an independent expert panel according to ISO 14040 and ISO 14044.

The following environmental impact categories were analysed:

- Global warming potential (GWP100) [kg CO₂-equiv.],
- Acidification potential (AP) [kg SO₂-equiv.],
- Eutrophication potential (EP) [kg phosphate-equiv.],
- Photochemical ozone creation potential (POCP) [kg ethene-equiv.],
- Human toxicity potential (HTP) [kg DCB-equiv.],
- Terrestrial ecotoxicity potential (TETP) [kg DCB-equiv.],
- Freshwater aquatic ecotoxicity potential (FAETP) [kg DCB-equiv.],

76 Evonik Industries AG, Life Cycle Assessment of Road Marking Substances and Systems, 2011.

77 Intertraffic Wourld, 'Life cycle under the lens', Annual Showcase, 2012.

78 Evonik, Vergleichende Ökobilanz-Studie für Straßenmarkierungssysteme“, 77. Lacktagung, Bremerhaven, 2012.

-
- Primary energy demand as an additional criterion.

The analysis was conducted on a marked one-kilometre road section equipped with a middle stripe and two edge lines with 280m² marked area in total for an evaluation period of 10 years.

The results are presented, as provided by the stakeholders:

'Typical material formulations in characteristic application scenarios have been modelled using the data of corresponding official approval test certificates held by a major local manufacturer of all evaluated technologies. These certificates issued by the German Bundesanstalt für Straßenwesen (BASt – Federal Highway Research Institute) define, for instance, both the marking material and the broadcasted glass bead aggregate mixture along with the proper specific consumption per square meter that must be applied in practice on the road to comply with German performance standards.

These standards – DIN EN 1436 and ZTV M 02 – specify minimum thickness and performance figures, such as coefficient of retro-reflected luminance (RL) of the road marking, for example. Safety markings with high wet night-time visibility – so-called Type II markings – are characterised by a coefficient RL measured at a wet condition of at least 35mcd/m²lx, for instance. The service life of such road markings is given by the time during which retroreflection remains above this threshold under traffic load.

In use-service life (lifetime) of the various systems on a typical German federal road bearing an average traffic of about 10000 to 15000 vehicles per day has been taken from empirical observations. It is noteworthy that these empirical figures are well in line with independent publications on relative lifetime of road marking systems.⁷⁹

For all the systems, the environmental impact of the production, including the contributions of raw materials and energies up to the formulator's factory gate ("cradle to gate"), was first analysed per kilogram of produced road marking material. The analysis was then extended to the entire life cycle, through application and repainting, all the way to disposal ("cradle to grave") with impacts calculated per kilometre and per 10 years.

"Cradle to gate" examination: *The environmental impact up to the factory gate is determined by the contributions of the formulation raw materials, while the formulation process as such and transportation, packaging, and wastes play a subordinate role. Among the formulation raw materials, energy-intensively produced substances such as the titanium dioxide pigment, glass beads in the case of CP and TP, solvents in the case of solvent-based paints, and the binder itself contribute the most to the ecological impact. The analysis shows that toxicological environmental impacts cannot be deduced exclusively from the statutory hazardous-substance classification of the formulation components. For example, the main contribution to the human toxicity potential per kilogram of cold plastic formulation arises not from the reactive resin binder, but from the titanium dioxide pigment in the formulation. The human toxicity potential per kilogram of water-based paint is not considerably lower since it contains similar amount of titanium dioxide.⁸⁰*

"Cradle to grave" examination: *The question of the environmental impacts arising per kilometre of marked road over an observation period of 10 years for the choice of a particular product alternative investigated safety markings with enhanced wet night-time visibility (type II), for instance. The study considered the following marking scenarios, which correspond in practice to the major applications: Thin layer (CSP, TSP, SB, WB), thick layer flat line (CP, TP) and thick layer agglomerates (CP, TP).*

Thin layer: *All the four road marking systems respectively binder technologies can be considered for laying of thin-layer road markings. Transports, application and disposal do not contribute*

79 Ökopol und IER Universität Stuttgart "European directive limiting the VOC content in certain products – Report on potential extensions of the directive covering road markings – Review of Directive 2004/42/EC, published 2011.

80 Human toxicity impact of TiO₂ originates from its production process, among others energy consumption for this process.

significantly, except for thermoplastic application where the material needs to be heated up to about 200°C to melt process it. However, Solvent-based or water-based systems have proven in practice to be much less durable than cold-spray plastics, so that significantly more material is consumed for the maintenance of a marking over a 10-year period. Spray applied thermoplastics are also durable, but in this case a long lifetime is achieved at the cost of high material consumption per application. It is evident from Figure 5 that for all systems the consumption of marking material and drop-on material dominates the life cycle assessment, while transport and application contribute much less to the global warming potential. This applies even to thermo spray plastic, which is processed at temperatures that may exceed 200°C. Similar trends have been found for Type I and Type II spray systems.

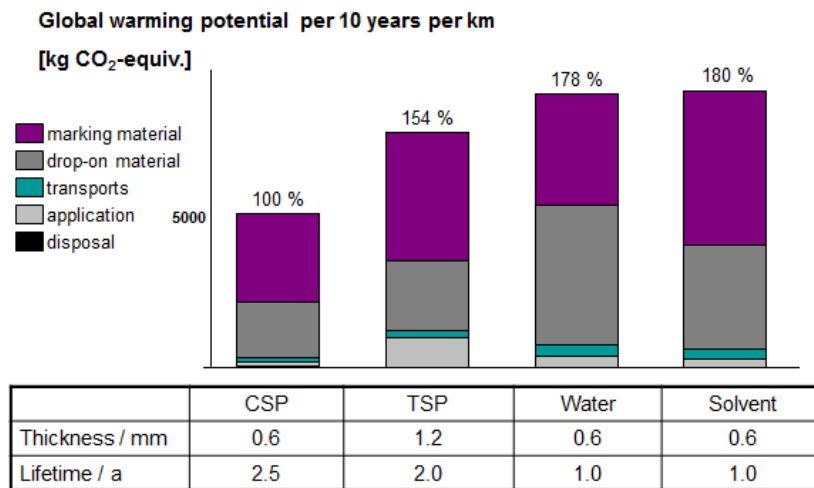


Figure 5: Global warming potential of various spray applied road markings per 10 years and road kilometre

Source: Evonik, 2011

In the same way, the long lifetime of cold-spray plastic compared with competitive systems has a positive impact also for all the other environmental effects investigated, as Figure 6 clearly shows.

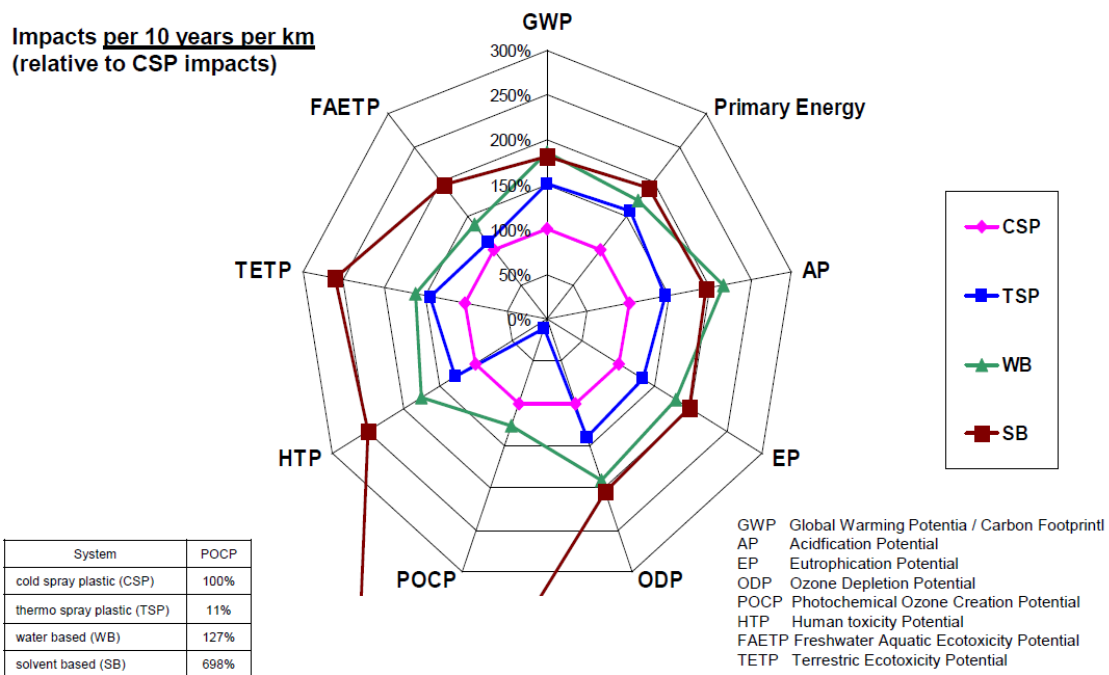


Figure 6: The ecological impacts of various road markings per 10 years and road kilometre relative to the corresponding impact of a road marking made of cold spray plastic (CSP)

Source: Evonik, 2011

Cold-spray plastic is designated as a hazardous substance, and purely for this reason is generally considered to be less environmentally compatible than water-based or thermoplastic marking systems. This assumption is not upheld by the present study.

Even in regard to toxicological environmental impacts, no disadvantages have been found for marking with cold spray plastic as compared with thermo spray plastic or water-based paint.

The photochemical ozone creation potential (POCP) of a material determines ground level ozone formation, which is implicated in, for example, respiratory ailments in summer smog. The advantages of water-based over solvent-based paints in regard to POCP are often cited, and are evident also in the present study. The extension of the investigation to cold-spray plastic and thermo spray plastic shows, however, that these systems also offer attractive alternatives in regard to POCP. For thermoplastic application, possible contributions from, for example, products of thermal decomposition or evaporation must also be investigated in the future; these have not been considered in the present study. The low POCP of, for example, cold-spray plastic, on the other hand, results from its long useful life.

Thick-layer: *Thick-layer markings can be executed as flat lines as well as profiled or structured surfaces, or in the form of regular agglomerates of road markings. Type II road markings with enhanced night-time visibility at wet nights have been analysed.*

Flat-line markings: *The simplest case of a flat-line marking of, for example, 3 mm layer thickness can be executed with either cold plastic or thermoplastic, both having the same lifetime in practice. The two systems have a similar effect on the environmental impacts studied. Improvement of the environmental impacts by reduction of layer thickness- with no reduction in lifetime -has been reported and is technically possible for cold plastic flat-line markings.*

Structured road markings: The study of a thick-layer agglomerate road marking shows how strongly the life cycle assessment of marking systems is determined by the application conditions and usage or wear characteristics. Figure 7 shows a comparison of the impacts on the global warming potential for the following cases:

- Cold plastic (CP) agglomerates are applied and after the end of their useful life are removed and then renewed in the same way as thick layers.
- Cold plastic (CP) agglomerate is refreshed several times after the end of its useful life with thin-layer cold-spray plastic (CSP), with a lifetime that is then shorter.
- Thermoplastic (TP) agglomerates are applied, and after the end of their lifetime are removed and then renewed in the same way as thick layers. The great benefits of the refreshment technology are obvious. Due to the specific wear characteristic of the material refreshment of thermoplastic is not feasible.

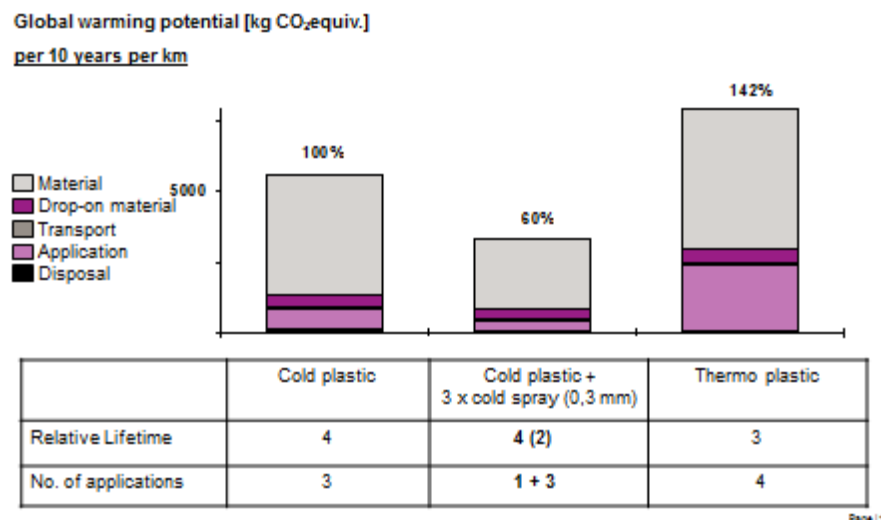


Figure 7: Environmental impacts for structured road markings with cold plastic (CP) or initial application of cold plastic refreshed three times with 0.3 mm cold-spray plastic (CP+ 3 x CSP), or thermoplastic (TP)

Source: Evonik, 2011

Conclusions:

- The use phase is dominating the overall environmental impacts.
- In-use service live, respectively durability of the road marking system is most crucial to reduce environmental impacts of road marking.
- Resource efficient technologies such as thin layer spray refreshment of structured thick layer road markings provide significant impacts savings.
- Solvents contribute most significant to POCP.

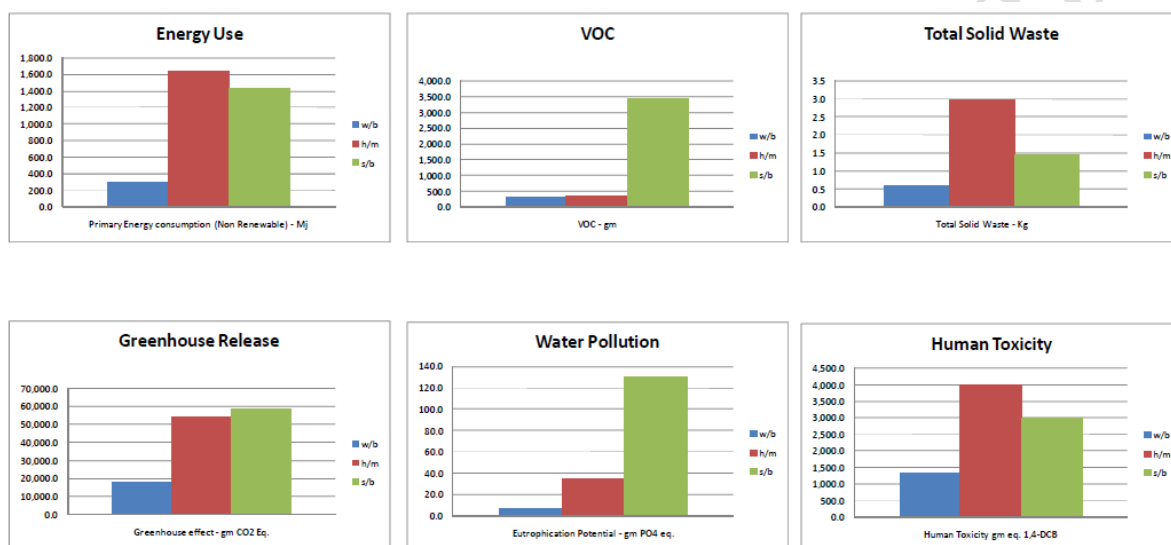
There are various indirect environmental and social benefits from application of durable road marking systems that have not been accounted for in this study. More durable road markings require less frequent repainting and thus reduce the frequency of work zones on the roads. Road marking work is mainly repainting work done on single lanes while other lanes of the road are still under traffic. Work zone accidents are major threats to health and safety of the workers and the

public travelling along. The use of more durable road marking systems contributes to accident reduction.⁸¹

4.2.1.2 A comparative cradle-to-grave LCA study for solvent-based, water-based and hot melt paint

Dow⁸² looked at solvent-based, water-based and hot melt paint (to cover 1 m² of highway with white colour reflective traffic markings for 10 years). Solvent-based paint carried large impacts in all six areas (energy use, VOC, total solid waste, GHG release, water pollution and toxicity to humans), with latex paint being the least harmful, especially regarding VOCs and water pollution.

Figure 8: A comparative life cycle assessment for road markings in the second study



Source: Simon Ward, Dow Coatings, 2011

This LCA commented on the following points:

Water-based paints (w/b above)

- Binders contribute the most significant impacts except water and VOC.
- TiO₂ contributes most water consumption and impacts on many other categories, reflecting its environmental impact.
- The production process contributes a relatively small impact compared to hot melt inputs.

Solvent-based paints (s/b above)

- Binders and VOC as per water-based.
- Solvents contribute most VOC, energy input and environmental and human toxicity.

81 Provided by the stakeholder, contributing author in the study. [to be summarised, if more LCA studies on these 4 systems are found]

82 Simon Ward, Dow Coatings, 'Life Cycle Assessment (LCA) as a tool to evaluate the environmental impact of water-based, solvent-based and Hot Melt Road Marking Materials', 2011 New Zealand Roadmarking Federation/RIAA Roadmarking Conference, Rotorua, New Zealand, 2001, available at: http://www.nzrf.co.nz/techdocs/conferencepapers2011/comparison_of_lifecycles.pdf, accessed May 2014.

-
- The production process contributes relatively small impact compared to hot melt inputs.

Hot Melt (h/m above)

- Similar to water-based paint, production for repaint contributes the most impact for all impact categories.
- The thickness of application is also a major factor relative to paint.
- The application stage contributes most to the greenhouse effect.⁸³

Water-based paints had the lowest overall environmental impact in the above study.

A second study comparing water-based versus solvent-based road marking paints was conducted by Prosign Group⁸⁴. The functional unit selected in the study was defined as follows: 'Covering of 1 m² of the road surface throughout its life cycle (10 years)'.⁸⁵ 19 environmental impact indicators were used, out of which for the comparative presentation of the results 6 indicators were selected:

- Greenhouse gas emissions (climate change),
- Volatile organic compound emissions,
- Eutrophication of the aquatic environment (asphyxia of aquatic fauna),
- Energy consumed,
- Potential toxicity,
- Waste generation.

Beside the baseline-reference scenario (i.e. application of only one initial layer, for each paint, 4 layers over a 10-year period for water-based paints and 5 layers – for solvent-based paints) two alternative scenarios were analysed for the application of an initial layer, followed by maintenance layers (1 initial layer and 9 maintenance layers):

- Alternative 1 (occurs frequently): The applier observes the recommended proportions for both paints.
- Alternative 2 (occurs occasionally): The applier uses the same quantity for both paints.

The results obtained in the study showed that for the reference scenario the environmental and health impacts analysed were at least 30% lower for water-based paints than those associated with the solvent-based road markings. For example, VOC emissions were 88% lower, especially during the application phase, for the water-based products, the results of eutrophication of the aquatic environment was by approximately 50% lower, energy consumed by nearly 60%.

In the analysis of the first alternative scenario, water-based paint continues to perform better, from the environmental point of view, than the solvent-based paint. In case of the second alternative scenario either both paints obtained equivalent results or the water-based road marking performed better than the solvent-based one for majority of indicators.

⁸³ Note that this information is provided by a manufacturer promoting water-based paints.

⁸⁴ Prosign Group, The ecoprofile of Typhon, available online at: paint http://www.e-prosign.com/admin/images/upload_document/plaquette%20anglais_docd_73.pdf, accessed May 2014.

⁸⁵ To make the results easier to read, the functional unit was applied to the marking of 1 kilometre of roadway with two continuous 0.10-m edge lines and one discontinuous centre line (3 m of painted surface, 10 m of intervening space). This gives a total area of 223 m² of road markings with a life cycle of 10 years (life cycle of the road surface).

4.2.1.3 Summary of life cycle consideration for road markings

The main conclusions which can be drawn from the above-described studies can be summarised as follows:

- Use phase is dominating phase in the overall environmental impact of road markings,
- Extending the functional life time of the marking, i.e. its durability and related time before refreshments/need of repainting play a crucial to reduce environmental impacts of road markings,
- Solvent-based products contribute most significant to VOC emissions.
- Water-based products perform better if compared with solvent-based one in various impacts categories.
- Among the raw materials, energy-intensive ingredients such as the titanium dioxide pigment, glass beads, solvents, and the binder itself contribute the most to the environmental impact.

Based on the main points drawn from the analyses it is clear that the performance of road markings should play an important role in the GPP criteria in order to minimise environmental impacts related to them. Also the titanium dioxide pigment content, glass beads used as broadcast material, solvents, and the binder itself shall be addressed. In later chapters (in the criteria rationale) also other features of relevance, not covered by the above analyses, are discussed (e.g. presence of certain metals in broadcast material).

4.2.2 End of life and removal of road markings

Waste from removal of yellow thermoplastic and yellow painted traffic stripe- and pavement-marking contains lead chromate in concentrations between 350 and 1000 mg/kg. These residues may contain heavy metals that exceed established safety thresholds and may produce toxic fumes when heated.⁸⁶ There is evidence of a move away from these chemicals (for example it was pointed out by national association that newer yellow road marking systems, used in Germany as temporary road markings, does not contain heavy metal compounds like lead chromate) but they still can be in use.

Some methods of line removal - such as the heated compressed air lance - produce fumes and smoke which, although not thought to be highly toxic, nonetheless carry a health/environmental hazard. Hydro-blasting is a newer technique whereby the waste elements are drawn by vacuum into a water tank, and then filtered for appropriate disposal.⁸⁷

⁸⁶Center for Environmental Excellence by the American Association of State Highway and Transportation Officials, 'The Compendium of Environmental Stewardship Practices in Construction and Maintenance', Chapter 5.5. Pavement Marking, available online at: http://environment.transportation.org/environmental_issues/construct_maint_prac/compendium/manual/5_5.aspx#tooltip, accessed May 2014.

⁸⁷Clean Break Ltd, England and Wales, 'Road Marking Removal efficiently, cleanly, environmentally friendly', available online at: www.markout.co.uk, accessed May 2014.

4.3 Summary of the key environmental considerations of paints and road markings

Based on the information gathered and analysed the following environmental impacts are associated with paint and road markings:

Table 20: Key environmental considerations linked to GPP for paints and road markings

Conclusion	Significance	Addressable in GPP
In-use durability	Very High	Yes, through performance criteria but indirectly
Unused paint and waste of paint	Very High	Yes, through mandating services to minimise wastage
Solvent-based paints have a higher environmental impact than water-based paints (and also other systems in the case of road markings)	High	Yes, by controlling the amount of VOC present in the paint
TiO₂ manufacture is an important environmental impact of paint production	Medium/High	Yes, reducing TiO ₂ use can be achieved for paints but balancing with potential quality/performance loss is needed
Binder manufacture is an important environmental impact of paint production	Medium	No, technical information is currently not available to support requirements. Dictating the conditions for binder use may stifle innovation.
Additives have a wide range of health and environmental implications.	Medium	Yes, encouraging manufacturers to use alternatives whenever possible. Introducing restrictions on use of certain chemicals/chemicals function groups and regarding hazardous classification of the final product.
Paints emit volatile organic compounds which reduce indoor air quality (relevant for indoor paints only)	Medium	Yes, by ensuring high indoor air quality

5 GREEN PUBLIC PROCUREMENT CRITERIA

The Communication on Green Public Procurement states that the GPP criteria shall be determined on a scientific basis considering the whole life cycle of products. In the frame of the project an analysis of available scientific evidence for paints and road markings and additional environmental evaluation using LCA of various stages of the product life for paints has been completed, as described in the technical background document available on the project's website⁸⁸ and summarised in section 4 (Technical analysis). Within data uncertainties and methodological limitations, the analysis allowed for identifying the main issues contributing to the environmental impacts.

Based on the analysis conducted the key issues to be considered for GPP criteria are proposed and presented in the following chapter. The GPP criteria proposal has been developed separately for:

1. Paints and varnishes,
2. Road markings,
3. Paint and road marking work contracts.

According to the Communication (2008) 400 Public procurement for a better environment⁸⁹, *"The core criteria are designed to allow easy application of GPP, focussing on the key area(s) of environmental performance of a product and aimed at keeping administrative costs for companies to a minimum. The "comprehensive" GPP criteria take into account more aspects or higher levels of environmental performance, for use by authorities that want to go further in supporting environmental and innovation goals. Since "core" criteria form the basis of the "comprehensive" criteria, this distinction between "core" and "comprehensive" will reflect differences in terms of ambition and availability of green products whilst at the same time pushing markets to evolve in the same direction"*.

Different environmental areas are addressed in the GPP criteria proposal for paints, varnishes and road markings. They encompass mainly product formulation and content of specific compounds, emissions from the product, performance characteristics and issues related to end-of life phase. The criteria which are considered, from an LCA point of view, as addressing the key environmental impact parameters, are proposed as both – core and comprehensive. An overview of all the proposed GPP criteria is presented in Table 21.

In this chapter we present, for each criterion, proposed requirements, specific limit values and verification procedure. The rationale for the development of the parameters and values are based on the results of the life-cycle environmental assessments and reviewed studies, existing environmental schemes for this product group and information provided by stakeholders along the consultation process.

Besides core and comprehensive criteria, award criteria can be used for two purposes: in the first place when a purchaser is not sure that the market will be able to supply products or services that comply with all requirements, and in the second place when a purchaser wants to stimulate the suppliers to come forward with offers that promise a better performance. If used in that way, award criteria can be regarded as a method of stimulating innovation.

An overview of the proposed criteria is given in Table 21. The rationale substantiating the proposal and further explanations are given in below sections.

Table 21: Overview of Green Public Procurement criteria proposal for paints, varnishes and road markings

⁸⁸ The report is available at the project website: <http://susproc.jrc.ec.europa.eu/paints/stakeholders.html>.

⁸⁹ Available under: <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2008:0400:FIN:EN:PDF>.

		Criterion	Core	Comprehensive
PAINTS AND VARNISHES				
TECHNICAL SPECIFICATIONS	1	Paint formulation		
	1.1	White pigment content	X	X
	1.2	Content of Volatile Organic Compounds	X	X
	1.3	Product hazard labelling	X	X
	1.4	Hazardous ingredients	X	X
	2	Efficiency of application and durability		
	2.1	Spreading rate	X	X
	2.2	Wet scrub resistance (indoor paints)		X
	2.3	Weathering resistance (outdoor paints)	X	X
	2.4	Fungal and algal resistance (outdoor paints)	X	X
	2.5	Abrasion resistance of floor paints (indoor and outdoor paints)	X	X
AWARD CRITERIA	1	Content of Semi Volatile Organic Compounds		X
	2	Indoor Air Quality: Indoor paints	X	X
	3	Distribution and take-back	X	X
CONTRACT PERFORMANCE CLAUSES	1	Technical advice and site inspections	X	X
ROAD MARKINGS				
TECHNICAL SPECIFICATIONS	1	Road marking formulation		
	1.1	Content of Volatile Organic Compounds (VOC's)	X	X
	1.2	Product hazard labelling	X	X
	1.3	Hazardous ingredients	X	X
	2	Content of hazardous ingredients in broadcast material	X	X
	3	Quality and durability of road marking system – Minimum abrasion resistance	X	X
AWARD CRITERIA	1	Road marking formulation – White pigment (titanium dioxide) content	X	X
	2	Broadcast material – Recycled glass content		X
	3	Distribution and take-back	X	X
CONTRACT PERFORMANCE CLAUSES	1	Technical support and site inspections	X	X
PAINT AND ROAD MARKING WORKS CONTRACTS				
SELECTION CRITERIA	1	Competencies of the tenderer	X	X
	2	Use of paints or road markings meeting the EU GPP criteria	X	X

TECHNICAL SPECIFICATIONS	1	Management of residual paint or road marking	X	X
AWARD CRITERIA	1	Efficiency of application and durability		
	1.1	Provision of warranties	X	X
	1.2	Long-term painting contracts		X
	2	Management of residual paint or road marking – re-use and recycling		X
CONTRACT PERFORMANCE CLAUSES	1	Management of paint or road marking usage and application	X	X

Follow-up from the stakeholders' consultation

➤ Paints

In general the comments received from the stakeholders along the consultation process referred to details of the proposed criteria, mainly alignment with the EU Ecolabel and strictness of the proposed values. One bigger change in the new set is the removal of the requirements on energy consumption from titanium dioxide production due to lack of consensus over the proposal, which is a new approach when compared with the EU Ecolabel. It is however proposed to take up this subject in the future revisions of the EU Ecolabel and GPP criteria. For more detail see section 5.1.2.4.

Single issues raised by the stakeholders and amendments made are addressed in the sections presenting the rationale of each criterion.

➤ Road markings

A brief summary of the main comments follows, whilst specific comments on criteria formulation are addressed per criterion in the respective section of this report (rationale of each single criterion).

Generally, the comments received from some stakeholders regarding road markings criteria indicated that the latter did not take into account special characteristics of solvent-borne coatings and road marking systems applied in thicker layers. Additionally, some stakeholders highlighted the importance of addressing properly aspects of the product life cycle performance as well as potential trade-offs between environmental and product performance/driver's safety benefits.

It was highlighted that in the last draft proposal there was a focus on TiO₂ and solvents. These are however the main environmental hotspots for this product group and need to be addressed through GPP.

It was pointed out that the comprehensive criteria proposal would risk to favour only thin Type I water-borne systems that may have low durability. The necessity to take a system approach and focus on the durability of the road marking system was suggested.

Moreover, the stakeholders emphasized that the road markings are systems composed of pigmented material and drop-on material that are required to provide the functionality of the product leading in improving road safety. Therefore, the criteria should more clearly indicate which elements of the road marking system are addressed through which criteria. And in general, the GPP shall address the road marking system as a whole.

Finally, it was added that the environmental impact of the application process should be considered as this could be higher than the environmental impact of the product itself, for instance impacts from SVOC from melt processing of thermoplastics at 200°C. However, there was no supplementary evidence and information provided on this point and there is lack of published information available to establish a requirement on this point. The LCA quoted in the report (see section 4.2.1) shown that the consumption of marking material and drop-on material dominates the life cycle assessment,

while transport and application contribute much less to the global warming potential, which also applies thermos-spray plastic, which is processed at temperatures above 200°C.

Conducting an LCA for the entire system could be an option to better evaluate the entire road marking systems, it is however considered premature at present. Many tenderers, especially SMEs could lack expertise and common rules would need to be established. This possibility should however be considered in the future, shall this expertise and a common set of product category rules be available.

DRAFT - WORK IN PROGRESS

5.1 PAINTS AND VARNISHES

In the following sections core and comprehensive criteria for the *purchase of paints with a reduced environmental impact* are presented. First, technical specifications are addressed, followed by award criteria and contract performance clauses. For each proposal a brief explanation on the substantiating rationale or additional information regarding specific aspects are provided.

5.1.1 TECHNICAL SPECIFICATIONS FOR PAINTS AND VARNISHES

5.1.1.1 Criterion 1 Paint formulation

5.1.1.1.1 Criterion 1.1 White pigment content

Core criteria	Comprehensive criteria
TECHNICAL SPECIFICATIONS	
<p>Paints shall have a white pigment content (white inorganic pigments with a refractive index higher than 1,8) per m² of dry film equal to or lower than 38 g/m² for indoor paints, with the exception of indoor wall paints claiming Class 1 wet scrub resistance (WSR) for which 40 g/m² shall apply, and 40 g/m² for all outdoor paints.</p> <p>Undercoats and primers shall have a white pigment content (white inorganic pigments with a refractive index higher than 1,8) per m² of dry film equal to or lower than 25 g/m².</p> <p><i>This requirement does not apply to transparent and semi-transparent coatings.</i></p> <p>Verification: The tenderer shall provide documentation for the paint formulation, supported by testing results, showing that the content of white pigments is compliant with this criterion.</p>	<p>Paints shall have a white pigment content (white inorganic pigments with a refractive index higher than 1,8) per m² of dry film equal to or lower than 36 g/m² for indoor products and 38 g/m² for outdoor products, with the exception of indoor wall paints claiming Class 1 wet scrub resistance (WSR) for which 40 g/m² shall apply.</p> <p>Undercoats and primers shall have a white pigment content (white inorganic pigments with a refractive index higher than 1,8) per m² of dry film equal to or lower than 25g/m².</p> <p><i>This requirement does not apply to transparent and semi-transparent coatings.</i></p> <p>Verification: The tenderer shall provide documentation for the paint formulation, supported by testing results, showing that the content of white pigments is compliant with this criterion.</p>

Rationale

Hiding power of the paint can be defined as the ability of paint to hide a surface, colour or stain over which it is applied. It is a property which enables it to obliterate beyond recognition any background over which it may be spread".⁹⁰ Hiding power is provided by the paint's pigment. As shown in the LCA review section, reduction in the use of pigment in paints, particularly titanium dioxide, is desirable because it is a major contributor to the paint's environmental impact.

Pigment has an effect on the opacity of paint; therefore any reduction in use must be balanced against a reduction in the performance. Paint spreading performance is linked to the amount of pigment added to the paint. In the framework of the EU Ecolabel revision anonymised data were collected for EU Ecolabel paints from the competent bodies responsible for the verification of the compliance of products with Ecolabel criteria (see Table 22).

Table 22: Amount of TiO₂ per m² of EU Ecolabel paints

Type	Number of paints	Average white pigment (g/m ²)	Standard deviation (g/m ²)	Current EU Ecolabel threshold (g/m ²)
Indoor	58	23.5	8.6	36
Outdoor	12	18.1	13.3	38

Analysis of the cumulative frequency shows that amounts of titanium dioxide vary in submitted paints, with only a small proportion of paints having greater than 30g/m² of white pigment (see Figure 9). It was nevertheless commented by the stakeholders that that these figures are low and that the amount of TiO₂ in paint in Southern Europe is considerably higher.

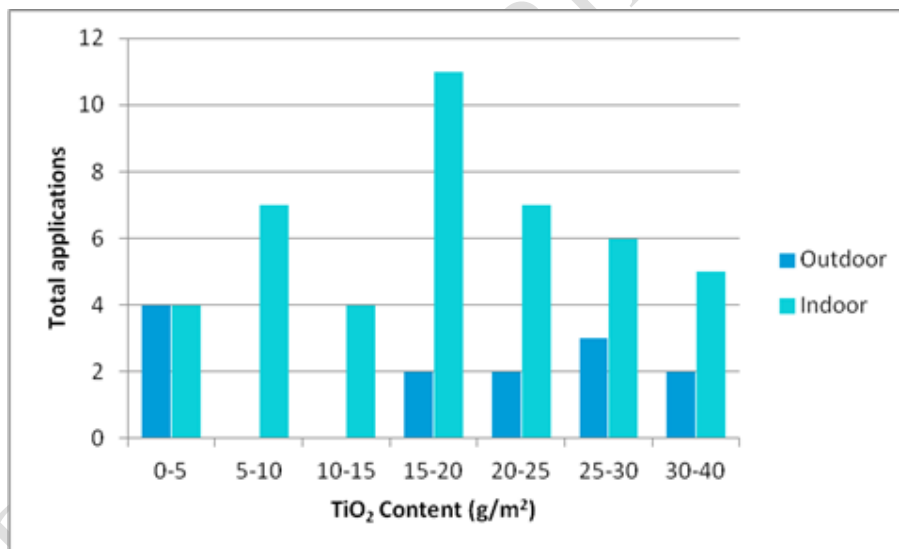


Figure 9: TiO₂ content in EU Ecolabel paints

Based on the further consultation with stakeholders new threshold values for the EU Ecolabel paints have been set. It is proposed that the limit values for the **comprehensive** Green Public

⁹⁰ Henry A. Gardner, George G. Sward, ASTM International, 1972.

Procurement **criteria** shall be aligned with the recently adopted (June 2014) EU Ecolabel thresholds for TiO₂ content, i.e.

Comprehensive criterion: Paints shall have a white pigment content (white inorganic pigments with a refractive index higher than 1,8) per m² of dry film equal to or lower than 36 g/m² for indoor products and 38 g/m² for outdoor products, with the exception of indoor wall and ceiling paints claiming Class 1 WSR⁹¹ for which 40 g/m² shall apply. Undercoats and primers shall have a white pigment content (white inorganic pigments with a refractive index higher than 1,8) per m² of dry film equal to or lower than 25g/m².

Regarding the **core criterion** slightly less stringent value of 38 and 40 g/m², which were also discussed along the criteria development process for indoor and outdoor paints, respectively, are proposed. For undercoats and primers the value consistent with the EU Ecolabel criteria is proposed as this was agreed for this kind of products along the consultation process. Due to the fact that stakeholders' feedback on the applicable values for this criterion was very limited, further input was sought.

The criterion proposal is formulated as follows:

Core criterion: Paints shall have a white pigment content (white inorganic pigments with a refractive index higher than 1,8) per m² of dry film equal to or lower than 38 g/m² for indoor paints, with the exception of indoor wall and ceiling paints claiming Class 1 WSR⁹² for which 40 g/m² shall apply, and 40 g/m² for all outdoor paints. Undercoats and primers shall have a white pigment content (white inorganic pigments with a refractive index higher than 1,8) per m² of dry film equal to or lower than 25 g/m².

Regarding **verification** of compliance of the tendered product the tenderer shall provide documentation for the paint formulation, supported by testing results, showing that the content of white pigments is compliant with this criterion. An additional requirement for testing is appropriate in order to strengthen the compliance for procurers.

Follow-up from the stakeholders' consultation

In general there were not many comments regarding the proposed values. Only one stakeholder asked for higher limit for undercoats, while another found the proposed values too high. However, no supplementary technical information was provided. The comprehensive criterion is aligned with the EU Ecolabel criteria, while the core criteria are less strict. It is proposed not to change the values given in the core and comprehensive criterion.

Following the comments received a note was added in the criterion that the requirement on TiO₂ content does not apply to transparent and semi-transparent coatings.

5.1.1.1.2 Criterion 1.2 Content of Volatile Organic Compounds (VOC's)

Core criteria	Comprehensive criteria
TECHNICAL SPECIFICATIONS	
The maximum content of Volatile Organic Compounds (VOCs) shall not exceed the limits given in Table 23. The content of VOCs shall be determined for the	The maximum content of Volatile Organic Compounds (VOCs) shall not exceed the limits given in Table 24. The content of VOCs shall be determined for the

91 WSR = wet scrub resistance.
92 WSR = wet scrub resistance.

ready to use product and shall include any recommended additions prior to application such as colourants and/or thinners.

Table 23 VOC content limits

Product description (with subcategory denotation according to Directive 2004/CE/42)	VOC limits (g/l including water)
a. Interior matt walls and ceilings (Gloss <25@60°)	15
b. Interior glossy walls and ceilings (Gloss >25@60°)	60
c. Exterior walls of mineral substrate	30
d. Interior/Exterior trim and cladding paints for wood and metal	90
e. Interior trim varnishes and woodstains, including opaque woodstains	75
e. Exterior trim varnishes and woodstains, including opaque woodstains	90
f. Interior and Exterior minimal build woodstains	75
g. Primers	15
h. Binding primers	15
i. One-pack performance coatings	100
j. Two-pack reactive performance coatings for specific end use such as floors	100
Decorative effect coatings	90
Anti-rust paints	80

Verification:

The tenderer shall provide a test report carried out according to ISO 11890-2 or equivalent, or for products with a VOC content of less than 1.0g/l, ISO 17895 or equivalent. In principle the calculation will also be accepted as a proof of compliance, however the contracting authority reserves the right to request test results.

ready to use product and shall include any recommended additions prior to application such as colourants and/or thinners.

Table 24 VOC content limits

Product description (with subcategory denotation according to Directive 2004/CE/42)	VOC limits (g/l including water)
a. Interior matt walls and ceilings (Gloss <25@60°)	10
b. Interior glossy walls and ceilings (Gloss >25@60°)	40
c. Exterior walls of mineral substrate	25
d. Interior/Exterior trim and cladding paints for wood and metal	80
e. Interior trim varnishes and woodstains, including opaque woodstains	65
e. Exterior trim varnishes and woodstains, including opaque woodstains	75
f. Interior and Exterior minimal build woodstains	50
g. Primers	15
h. Binding primers	15
i. One-pack performance coatings	80
j. Two-pack reactive performance coatings for specific end use such as floors	80
Decorative effect coatings	80
Anti-rust paints	80

Verification:

The tenderer shall provide a test report carried out according to ISO 11890-2 or equivalent, or for products with a VOC content of less than 1.0g/l, ISO 17895 or equivalent. In principle the calculation will also be accepted as a proof of compliance, however the contracting authority reserves the right to request test results.

Rationale

Volatile Organic Compounds (VOCs) are used as solvents within paints to help keeping the mixture stable prior use and aiding in spreading and delivery of the paint to the substrate. As described in section 4.1.2.2.3, they encompass a wide variety of compounds, which generally evaporate or sublime from the paint during and after application. VOCs have been identified as substances with negative effect with regards to global warming, ozone layer depletion, fauna and flora degradation.

Moreover, many VOCs have short- and long-term adverse health (e.g. respiratory) and other environmental effects.⁹³ VOCs emissions can cause among others eye, nose, and throat irritation, headaches and loss of coordination. More severe reactions to VOCs exposure enclose damage to liver, kidney and central nervous system. Some are suspected to be carcinogenic.

As shown in the technical analysis section, solvent based paints have a higher environmental impact than water based paints. This is mainly due to the use of solvents. Content of VOCs was identified as an environmental hot spot in the LCA studies. Therefore, in order to ensure that more environmentally friendly paints are purchased by the public authorities it is proposed to require that tenderers offer only paints with reduced amount of VOCs in the formulation. It should be noted that, since public awareness on this aspect is high, paint industry has been working for years towards the reduction of VOCs in their products.

Data on VOC content of the EU Ecolabel paints and varnishes was collected and analysed as part of the revision of the EU Ecolabel (It should be highlighted that the EU Ecolabel for paints is a successful product group with over 1150 products awarded in 2010). The results are presented in Table 25. This was used as the starting point for proposals and can be used as an indication of the performance of the best performing products on the market.

Table 25: Data on VOCs content of EU Ecolabel paints and varnishes

Type	Competent body data		
	Average (g/l including water)	Standard deviation (g/l including water)	No. of EU Ecolabel licenses
Pack performance coatings	77.8	21.6	8
Exterior trim and cladding paints for wood and metal including undercoats	41.2	2.7	10
Exterior trim varnishes and wood-stains, including opaque woodstains	12.0	7.9	23
Interior Matt (walls/ceiling) (Gloss < 25@60 °)	2.9	3.4	60
Interior minimum build woodstains	42.5	14.8	6
Interior trim and cladding paints for wood and metal including undercoats	70.9	18.3	16
Interior trim varnishes and wood-stains, including opaque woodstains	46.9	23.8	35
Primers (indoor)	5.0	0.0	2

The Paints Directive 2004/42/EC sets mandatory VOC limits for various types of paints. In the current study data gathered from dossiers of successful EU Ecolabel applications have been provided as anonymised data from the Competent Bodies and analysed. The outcomes of this analysis and further stakeholders consultation substantiated the proposed limits, which go beyond the values set by the directive (see Table 25). VOC content shall be measured at the point of application and must include any additional solvent added to the paint prior to application.

⁹³For more details see a section of 'An Introduction to Indoor Air Quality (IAQ) - Volatile Organic Compounds (VOCs)', available online at the US Environmental Protection Agency website: <http://www.epa.gov/iaq/voc.html>.

Thus, in the GPP criteria the rather more strict values, which are aligned with recently adopted new EU Ecolabel criteria limit values for VOCs⁹⁴, are proposed only for the **comprehensive criteria** set; while rather less strict thresholds, which were applied in the previous EU Ecolabel criteria⁹⁵ (with the exception of the value for 'Exterior walls of mineral substrate' where a lower threshold of 30 g/l is proposed) are now proposed for the **core criteria** (see Table 26 below). These limit values were obligatory for EU Ecolabel licence holders since 2008. They are lower than the ones indicated in the directive.

Table 26: Comparison of VOC content limits in 2004/42/EC Directive and 2008 and 2014 EU Ecolabel criteria

Product description (with subcategory denotation according to Directive 2004/CE/42)	VOC limits from 2004/42/EC Directive (g/l including water)	VOCs limits in 2008 EU Ecolabel Decision (g/l including water)	VOCs limits in 2014 EU Ecolabel Decision (g/l including water)
a. Interior matt walls and ceilings (Gloss <25@60°)	30	15	10
b. Interior glossy walls and ceilings (Gloss >25@60°)	100	60	40
c. Exterior walls of mineral substrate	40	30	25
d. Interior/Exterior trim and cladding paints for wood and metal	130	90	80
e. Interior trim varnishes and woodstains, including opaque woodstains	130	75	65
e. Exterior trim varnishes and woodstains, including opaque woodstains	130	90	75
f. Interior and Exterior minimal build woodstains	130	75	50
g. Primers	30	15	15
h. Binding primers	30	15	15
i. One-pack performance coatings	140	100	80
j. Two-pack reactive performance coatings for specific end use such as floors	140	100	80
l. Decorative effect coatings	200	90	80
Anti-rust paints	-	80	80

Regarding **verification** it is considered that calculations would be difficult to verify by a procurer without additional technical input (although this method was accepted in the EU Ecolabel). Therefore it is considered that for the public procurement test results provide greater assurance without any need for technical expertise. The VOC content shall be determined using the methods

94Commission Decision of 28 May 2014 establishing the ecological criteria for the award of the EU Ecolabel for indoor and outdoor paints and varnishes (2014/312/EU).

95Commission Decision of 13 August 2008 establishing the ecological criteria for the award of the Community eco-label to indoor paints and varnishes (2009/544/EC).

given in ISO 11890-2⁹⁶ or, alternatively for products with a VOC content of less than 1.0g/l, the methods given in ISO 17895⁹⁷ or equivalent. The two testing methods mentioned are specified in the Directive 2004/42/EC.

Follow up from stakeholders' consultation

Limited but contradicting feedback was received from the stakeholders regarding the proposed thresholds. Some agreed with the proposal; few considered it as too strict or too loose. No additional technical evidence was however provided to substantiate changing the proposed values. As explained above, the proposal is based on the developments in the EU Ecolabel schemes and it is considered feasible along the EU Ecolabel consultation.

The content of VOC is one of the key environmental aspects for paints thus it is considered appropriate to keep the values low. In general it is considered that the level of strictness of the comprehensive criteria should correspond to the level of strictness of the EU Ecolabel criteria, as it is done in the current proposal. The comprehensive ones are aligned with the old EU Ecolabel criteria, with which a numerous of paint products could comply (the paints and varnishes product group is one of the most successful in the EU Ecolabel scheme).

Comments were received regarding the inclusion in the verification process (besides the testing) also the calculation option. This approach was allowed in the EU Ecolabel criteria and a harmonisation between both tools was requested. A respective change was incorporated into the proposal, though it is recognised (and it was the motivation behind the previous proposal) that not all procurers may have the expertise and experience to verify the correctness of the provided calculations. Therefore an additional clause was added: "In principle the calculation will also be accepted as a proof of compliance, however the contracting authority reserves the right to request test results".

Finally, one stakeholder asked for exemption for using solvent-based products in old buildings which are renovated and in historical buildings where the intention is to restore the surface as close as possible to the original one. For instance it was explained that in old buildings trim parts are often painted with high gloss materials (typical >80 GU at 20°), which cannot be achieved by waterborne alternatives. The following technical rationale was provided: "*the film-forming process of solvent borne alkyds versus waterborne technologies differs. The development of the surface tension of the wet paint during drying has an impact on the final end result with respect to gloss. For solvent borne paints this development differs from waterborne paints. Consequently leading to a different result. Especially when doing restorations, the end result should be as close as possible to the original. Therefore it is of importance to be able to use materials which are based on similar technology as the original*". Such a situation could be solved through an additional guidance to the criteria document, which would specify that criteria should not apply in some specific situations like the case of restoration of historical buildings as mentioned above.

96 ISO 11890-2 Paints and varnishes – Determination of volatile organic compound (VOC) content -- Part 2: Gas-chromatographic method.

97 ISO 17895 Paints and varnishes – Determination of the volatile organic compound content of low-VOC emulsion paints (in-can VOC).

5.1.1.1.3 Criterion 1.3 Product hazard labelling

Core criteria	Comprehensive criteria																															
TECHNICAL SPECIFICATIONS																																
<p>The final product shall not be classified and labelled as being acutely toxic, a specific target organ toxicant, carcinogenic, mutagenic or toxic for reproduction, hazardous to the environment, in accordance with Regulation (EC) No 1272/2008, as indicated in Table 27.</p> <p>Table 27: Final product classification</p> <table border="1"> <tr> <td>Acute toxicity</td> <td>Acute Tox. 1 Acute Tox. 2 Acute Tox. 3</td> </tr> <tr> <td>Specific target organ toxicity – repeated exposure Specific target organ toxicity – single exposure</td> <td>STOT RE 1 or 2 STOT SE 1, 2 or 3</td> </tr> <tr> <td>Carcinogenicity</td> <td>Carc. 1A Carc. 1B Carc. 2</td> </tr> <tr> <td>Germ cell mutagenicity</td> <td>Muta. 1A Muta. 1B Muta. 2</td> </tr> <tr> <td>Reproductive toxicity</td> <td>Repr. 1A Repr. 1B Repr. 2</td> </tr> <tr> <td rowspan="2">Hazardous to the aquatic environment</td> <td>Aquatic Acute 1</td> </tr> <tr> <td>Aquatic Chronic 1 or 2</td> </tr> </table> <p>or shall not carry a precautionary statements required for products with these classifications. The corresponding packaging labels are provided for reference in Annex 2 (of the criteria document).</p> <p>Verification: Tenderers shall provide appropriate documentation from the paint manufacturer confirming that the products to be supplied are not classified and/or do not require labelling with the listed hazards. The documentation can include calculations of mixture classification carried out in accordance with the rules provided in the CLP Regulation</p>	Acute toxicity	Acute Tox. 1 Acute Tox. 2 Acute Tox. 3	Specific target organ toxicity – repeated exposure Specific target organ toxicity – single exposure	STOT RE 1 or 2 STOT SE 1, 2 or 3	Carcinogenicity	Carc. 1A Carc. 1B Carc. 2	Germ cell mutagenicity	Muta. 1A Muta. 1B Muta. 2	Reproductive toxicity	Repr. 1A Repr. 1B Repr. 2	Hazardous to the aquatic environment	Aquatic Acute 1	Aquatic Chronic 1 or 2	<p>The final product shall not be classified and labelled as being acutely toxic, a specific target organ toxicant, a respiratory or skin sensitizer, or carcinogenic, mutagenic or toxic for reproduction hazardous to the environment, in accordance with Regulation (EC) No 1272/2008, as indicated in Table 28.</p> <p>Table 28: Final product classification</p> <table border="1"> <tr> <td>Acute toxicity</td> <td>Acute Tox. 1 Acute Tox. 2 Acute Tox. 3</td> </tr> <tr> <td>Specific target organ toxicity – repeated exposure Specific target organ toxicity – single exposure</td> <td>STOT RE 1 or 2 STOT SE 1, 2 or 3</td> </tr> <tr> <td>Carcinogenicity</td> <td>Carc. 1A Carc. 1B Carc. 2</td> </tr> <tr> <td>Germ cell mutagenicity</td> <td>Muta. 1A Muta. 1B Muta. 2</td> </tr> <tr> <td>Reproductive toxicity</td> <td>Repr. 1A Repr. 1B Repr. 2</td> </tr> <tr> <td rowspan="3">Hazardous to the aquatic environment</td> <td>Aquatic Acute 1</td> </tr> <tr> <td>Aquatic Chronic 1 or 2</td> </tr> <tr> <td>Aquatic Chronic toxicity 3</td> </tr> <tr> <td>Respiratory sensitization</td> <td>Resp. Sens. 1, 1A or 1B</td> </tr> <tr> <td>Skin sensitization</td> <td>Skin Sens. 1 , 1A or 1B</td> </tr> </table> <p>or shall not carry a precautionary statements required for products with these classifications. The corresponding packaging labels are provided for reference in Annex 2 (of the criteria document).</p> <p>Verification: Tenderers shall provide appropriate documentation from the paint manufacturer</p>	Acute toxicity	Acute Tox. 1 Acute Tox. 2 Acute Tox. 3	Specific target organ toxicity – repeated exposure Specific target organ toxicity – single exposure	STOT RE 1 or 2 STOT SE 1, 2 or 3	Carcinogenicity	Carc. 1A Carc. 1B Carc. 2	Germ cell mutagenicity	Muta. 1A Muta. 1B Muta. 2	Reproductive toxicity	Repr. 1A Repr. 1B Repr. 2	Hazardous to the aquatic environment	Aquatic Acute 1	Aquatic Chronic 1 or 2	Aquatic Chronic toxicity 3	Respiratory sensitization	Resp. Sens. 1, 1A or 1B	Skin sensitization	Skin Sens. 1 , 1A or 1B
Acute toxicity	Acute Tox. 1 Acute Tox. 2 Acute Tox. 3																															
Specific target organ toxicity – repeated exposure Specific target organ toxicity – single exposure	STOT RE 1 or 2 STOT SE 1, 2 or 3																															
Carcinogenicity	Carc. 1A Carc. 1B Carc. 2																															
Germ cell mutagenicity	Muta. 1A Muta. 1B Muta. 2																															
Reproductive toxicity	Repr. 1A Repr. 1B Repr. 2																															
Hazardous to the aquatic environment	Aquatic Acute 1																															
	Aquatic Chronic 1 or 2																															
Acute toxicity	Acute Tox. 1 Acute Tox. 2 Acute Tox. 3																															
Specific target organ toxicity – repeated exposure Specific target organ toxicity – single exposure	STOT RE 1 or 2 STOT SE 1, 2 or 3																															
Carcinogenicity	Carc. 1A Carc. 1B Carc. 2																															
Germ cell mutagenicity	Muta. 1A Muta. 1B Muta. 2																															
Reproductive toxicity	Repr. 1A Repr. 1B Repr. 2																															
Hazardous to the aquatic environment	Aquatic Acute 1																															
	Aquatic Chronic 1 or 2																															
	Aquatic Chronic toxicity 3																															
Respiratory sensitization	Resp. Sens. 1, 1A or 1B																															
Skin sensitization	Skin Sens. 1 , 1A or 1B																															

and/or Safety Data Sheets.	confirming that the products to be supplied are not classified and/or do not require labelling with the listed hazards. The documentation can include calculations of mixture classification carried out in accordance with the rules provided in the CLP Regulation and/or Safety Data Sheets.
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Rationale

Paints are products formulated as a mixture consisting of very high number of various compounds; i.e. binders, solvents, pigments and additives. Among additives there are e.g. driers, biocides, fungicides plasticisers, emulsifiers, UV stabilizers, anti-skinning agents or corrosion inhibitors. As mentioned in section 4.1.2.1, an online paint product directory⁹⁸ contains in 10,000 different resin/polymer formulations, 9,000 additives and 4,500 pigments and fillers. This results in a very wide range of different paint formulations. It is therefore not straightforward to control the content of paint products.

The Dangerous Substances Directive (DSD)⁹⁹ is an EU legislation concerning chemical safety introduced in 1967. It is applied to chemicals and mixtures of chemicals. DSD lists the classes of substances or preparations that are considered to be dangerous. Some of these classes were linked with a hazard symbol and/or a code. The new Classification, Labelling and Packaging (CLP) Regulation¹⁰⁰ replaces the current system of classification of substances and mixtures. A transition period where both these legal acts are in force applies until 31 May 2015. This means that products can be still found on the market that display the old labels.

This proposed criterion excluding certain product hazard classification and labelling is considered as a safety net to ensure that the public authorities do not purchase products which are classified as hazardous to human health or the environment¹⁰¹; i.e. which are:

- Acutely toxic,
- A specific target organ toxicant,
- Carcinogenic, mutagenic or toxic for reproduction,
- Hazardous to the environment (H400, H410, H411)
- Respiratory or skin sensitizers (only in comprehensive criteria set).

Very similar requirements were set also in the old EU Ecolabel for paints and varnishes (see Criterion 5 – Restriction of hazardous substances and mixtures in the Decision 2014/312/EU).

Table 29 presents respective final product classifications in both CLP Regulation and DSD Directive.

98 Available at SpecialChem website: <http://www.specialchem4coatings.com/>.

99 Council Directive 67/548/EEC of 27 June 1967 on the approximation of laws, regulations and administrative provisions relating to the classification, packaging and labelling of dangerous substances.

100 Regulation (EC) No 1272/2008 of the European Parliament and of the Council of 16 December 2008 on classification, labelling and packaging of substances and mixtures, amending and repealing Directives 67/548/EEC and 1999/45/EC, and amending Regulation (EC) No 1907/2006.

101 In accordance with Regulation (EC) No 1272/2008 of the European Parliament and of the Council (the 'CLP Regulation') or Council Directive 67/548/EC (the 'DSD Directive').

Table 29: Final product classification equivalence in CLP and DSD Directives addressed in GPP core criteria

CLP Mixture classification	DSD equivalent
Acutely toxic	T or T+
Specific Target Organ Toxicant	T, T+ or Xn
A Carcinogen, Mutagen or Reproductive toxicant	Carcinogen, Mutagen or Reproductive toxicant categories 1-3
H400, H410, H411	N

It is considered that it can be useful for procurers to easily identify the labels, so it is also proposed to include the label within the appendix of the criteria for easy reference. Given the transition period between the two systems, it was initially proposed to highlight in the criteria the equivalence between labels under CLP and DSD (see Annex I of the criteria text). However, as the criteria will not be valid before June 2015 the reference to the DSD can be removed.

In addition to the labelling that may need to be displayed on the product, for certain categories of hazards the manufacturer may also be required to display on the product certain precautionary statements. For example in the case of the four categories of hazards to the aquatic environment P273 precautionary statement mentioned in Figure 10, would read 'Avoid release to the environment'.



CHRONIC				
	Category 1	Category 2	Category 3	Category 4
GHS Pictograms			No pictogram is used	No pictogram is used
Signal Word	Warning	No signal word is used	No signal word is used	No signal word is used
Hazard Statement	H410: Very toxic to aquatic life with long lasting effects	H411: Toxic to aquatic life with long lasting effects	H412: Harmful to aquatic life with long lasting effects	H413: May cause long lasting harmful effects to aquatic life
Precautionary Statement Prevention	P273	P273	P273	P273
Precautionary Statement Response	P391	P391		
Precautionary Statement Storage				
Precautionary Statement Disposal	P501	P501	P501	P501

Figure 10: Extract from CLP classification and labelling requirements for hazards to the aquatic environment

Source: CLP Regulation 1272/2008

Exclusion of the classification as proposed above is required in the GPP **core criteria** set. In the **comprehensive** set of criteria, beside the above given requirement, two additional ones are proposed. Firstly, purchased paints shall not be classified as respiratory or skin sensitizers. Secondly, the requirement regarding labelling as hazardous for the environment is made stricter to cover not only the classification (as in core criteria) as:

- H400 Very toxic to aquatic life,
- H410 Very toxic to aquatic life with long lasting effects,
- H411 Toxic to aquatic life with long lasting effects,

But also:

- H412 Harmful to aquatic life with long lasting effects.

Hazard classification addressed in the GPP comprehensive criteria are given in Table 30.

Table 30: Final product classification equivalence in CLP and DSD Directives addressed in GPP comprehensive criteria

CLP Mixture classification	DSD equivalent
Acutely toxic	T or T+
Specific Target Organ Toxicant	T, T+ or Xn
A respiratory or skin sensitizer	According to CLP labelling rules
A Carcinogen, Mutagen or Reproductive toxicant	Carcinogen, Mutagen or Reproductive toxicant categories 1-3
Hazardous to the environment (H400, H410, H411, H412)	N with the addition of R52-53 (H412) Harmful to aquatic life with long lasting effects

It is worth adding that in the EU Ecolabel criteria for paints and varnishes¹⁰² requirements regarding ingredients and related hazards are much stricter than the ones proposed for GPP (in both this section and in section 5.1.1.1.4).

In the EU Ecolabel scheme the Regulation 66/2010¹⁰³ requires that:

The EU Ecolabel may not be awarded to goods containing substances or preparations/mixtures meeting the criteria for classification as toxic, hazardous to the environment, carcinogenic, mutagenic or toxic for reproduction (CMR), in accordance with Regulation (EC) No 1272/2008 of the European Parliament and of the Council of 16 December 2008 on classification, labelling and packaging of substances and mixtures, nor to goods containing substances referred to in Article 57 of Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), establishing a European Chemicals Agency.

The EU Ecolabel restricts a wide range of hazardous ingredients. The EU Ecolabel Competent Bodies have however the expertise to check and verify compliance of the products with such a criterion. This may not be the case for public procurers; therefore it is considered that a focus on the classification and labelling of the final product should be more straight forward and meaningful to verify. Whilst a limited number of ingredients are included in this criteria set (see also the criterion 1.4 below), the main focus is proposed to be on the overall products performance.

¹⁰² Available online at the project website: <http://susproc.jrc.ec.europa.eu/paints/stakeholders.html>; their adoption is foreseen in the coming weeks.

¹⁰³ Regulation (EC) 66/2010 of the European Parliament and of the Council of 25 November 2009 on the EU Ecolabel, OJ 27 30.1.2010, p. 1.

The same logic has been applied to the respective criteria set for road marking products.

Regarding the **verification** of compliance tenderers need to provide calculation for a tendered product (carried out in accordance with the rules provided in the CLP Regulation or alternatively (prior to 1st June 2015) in the DSD Directive) which confirm that the products to be supplied are not classified and do not require labelling as acutely toxic, specific target organ toxicant, a respiratory or skin sensitizer (for comprehensive criteria only), a carcinogen, mutagen or reproductive toxicant, or hazardous to the environment.

Follow-up from the stakeholders' consultation

The following comments were provided to the draft proposal:

- One of the stakeholders proposed to include the requirement on respiratory or skin sensitizers' properties in the core criteria, and not only comprehensive criteria, and similarly the exclusion of classification of the product as harmful to aquatic life with long lasting effects. It was emphasized that the requirements in the GPP are less strict than in the EU Ecolabel. This issue was addressed in the rationale section above. In order to keep the core criteria at lower ambition level than the comprehensive ones and in the light of no additional feedback on such changes, the current proposal is kept.
- It was also asked to restrict the respiratory sensitization and skin sensitization to indoor paints only. It is however proposed to keep it aligned with the EU Ecolabel criteria, as this is a precautionary measure specially set for the workers protection.
- It was asked to include the verification by means of Safety Data Sheets, which is also allowed in the EU Ecolabel. A respective statement was introduced.

Furthermore, as some stakeholders found the presentation of excluded hazards in the previous criteria draft a bit difficult to understand, in the revised criteria the table which presents the excluded hazards in a clearer way is proposed (see Table 30). The reference to DSD, as mentioned above, is now removed as from June 2015 the provisions of the DSD for the transition period will expire.

Table 31: Final product classification addressed in GPP comprehensive criteria

Acute toxicity	Acute Tox. 1 Acute Tox. 2 Acute Tox. 3
Specific target organ toxicity – repeated exposure Specific target organ toxicity – single exposure	STOT RE 1 or 2 STOT SE 1, 2 or 3
Carcinogenicity	Carc. 1A Carc. 1B Carc. 2
Germ cell mutagenicity	Muta. 1A Muta. 1B Muta. 2
Reproductive toxicity	Repr. 1A Repr. 1B Repr. 2
Hazardous to the aquatic environment	Aquatic Acute 1
	Aquatic Chronic 1 or 2
	Aquatic Chronic toxicity 3
Respiratory sensitization	Resp. Sens. 1, 1A or 1B
Skin sensitization	Skin Sens. 1, 1A or 1B

5.1.1.1.4 Criterion 1.4 Hazardous ingredients

Core criteria	Comprehensive criteria																		
TECHNICAL SPECIFICATIONS																			
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<p>The tenderer shall provide appropriate documentation from the paint manufacturer confirming compliance with the criterion. Compliance with maximum concentration limits established in the criteria can be verified using Safety Data Sheets obtained from raw material suppliers and Safety Data Sheets for mixture. Additionally:</p> <ul style="list-style-type: none"> – for formaldehyde: A test report shall be provided based on the use of the Merckoquant method or high-performance liquid chromatography (HPLC) method (See annex 3 of the criteria), – for metals: for which a test report shall be provided based on the use of ISO 3856 series or equivalent, – for preservatives: If requested by the contracting authority, a test report shall be provided confirming that the preservatives used are non-bioaccumulative. 	<p>Phthalates: <i>The following phthalates shall not be intentionally added as plasticisers:</i> DEHP (Bis-(2-ethylhexyl)-phthalate) BBP (Butylbenzylphthalate) DBP (Dibutylphthalate) DMEP (Bis2-methoxyethyl) phthalate DIBP (Diisobutylphthalate) DIHP (Di-C6-8-branchedalkylphthalates) DHNUP (Di-C7-11-branchedalkylphthalates) DHP (Di-n-hexylphthalate)</p>	0.010% per phthalate
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Rationale

As mentioned above paint products contain a wide range of compounds, many of which have hazardous properties and can have harmful effects to human health and the environment. The most important ones; e.g. many preservatives, formaldehyde, phthalates and some metals, have been described in section 4.1.2.2.3 on hazardous substances. It is in general considered important to set restrictions on the use of certain hazardous substance groups in the "green" paints purchased by public authorities. The requirements on hazardous ingredients set in the EU Ecolabel scheme are

very comprehensive. Intensive consultation in this area has been conducted along the EU Ecolabel criteria developments process. Restrictions of specific substances and substance groups, and respective limit values were discussed with industry, Member States and other interested parties. For more information on the process of setting these restrictions please consult the Technical Background Report – Revision of the EU European Ecolabel for Indoor and Outdoor Paints and Varnishes available at the JRC dedicated project website¹⁰⁴.

It was however considered too complex (and difficult to verify by the public authorities) to apply directly all the EU Ecolabel restrictions for the purpose of Green Public Procurement. Thus, the most important elements are proposed to be taken up. The chosen ingredients or their groups are of high concern due to their classification as either hazardous to the aquatic environment, acute toxins or CMR (carcinogenic, mutagenic, reproductive toxic).

In the **core criteria** this include restrictions on free formaldehyde, phthalates: DEHP, BBP, DBP, DIBP, DIHP, DHNUP, DHP and DMEP (see Table 34 for full names) and metals (cadmium, lead, chromium VI, mercury, arsenic, selenium) above certain concentrations (0.010% for formaldehyde and 0.010 % for phthalates and metals).

Table 34: Phthalates proposed to be restricted in GPP paints

Name	CAS number	Acronym
Di(2-ethylhexyl)-phthalate	117-81-7	DEHP
Butylbenzylphthalate	85-68-7	BBP
Dibutylphthalate	84-74-2	DBP
Di-iso-butylphthalate	84-69-5	DIBP
Di-C6-8-branched alkylphthalates	71888-89-6	DIHP
Di-C7-11-branched alkylphthalates	68515-42-4	DHNUP
Di-n-hexylphthalate	84-75-3	DHP
Di-(2-methoxyethyl)-phthalate	117-82-8	DMEP

In the **comprehensive criteria** a stricter approach is proposed. Beside more stringent limit value for free formaldehyde (0.0010% - aligned with the requirements in the new EU Ecolabel criteria for paints and varnishes, with exception of situation where formaldehyde donors are required or are present in polymer dispersions, in this case the 0.010% applies) also additional restrictions on the use of preservatives and surfactants are proposed. These restrictions are based on intensive discussions, particularly in relation to the use of preservatives and surfactants in paint products. Restricting their use is challenging as, although they are of concern as hazards to the aquatic environment, they constitute essential ingredients of paints and varnishes. The restriction adopted by the EU Ecolabel therefore needed to be carefully considered in order not to be too selective on the market.

For the restrictions it is proposed that the preservatives used shall not be bioaccumulative and any associated risk mitigation measures shall be implemented. In addition, use of dry film preservatives is only allowed in areas of high humidity and for outdoor applications. For surfactants it is required that they can only be used at or below the concentration limit of 0.1% for white paints and 0.3% for colour paints.

Regarding **verification**, the tenderer shall provide appropriate documentation proving compliance with the requirements. The dossier can include Safety Data Sheets obtained from raw material

104 Technical background report, October 2013, available online at: <http://susproc.jrc.ec.europa.eu/paints/stakeholders.html>.

suppliers. Additionally, for two of the substance groups chosen for restrictions (i.e. formaldehyde and metals) test methods have been specified to provide high level of assurance to procurers.

Follow-up from the stakeholders' consultation

Following the consultation process the following changes have been made:

- In the section regarding dry-film preservatives the specific restriction, aligned with the EU Ecolabel criteria was added. It was noted by the stakeholders if no dry-film preservatives are used in outdoor paints the coatings have a shorter life time, and require more frequent re-painting.
- In general the stakeholders asked to keep the comprehensive criteria and related limits for the hazardous ingredients (like surfactants, phthalates, biocides etc.) equal to those of EU ecolabel criteria in order to avoid confusion. Thus the following have been aligned:
 - The requirements on formaldehyde
 - The derogation for specific metal compounds
 - The requirements on preservatives was introduced in core criteria (however, the less strict thresholds, aligned with the CLP values for BCF and Log Kow shall be used, which makes the verification easier.)

One of the stakeholders stated that bio-accumulation is not always available and could create difficulty to the industry. Nevertheless, information regarding bioaccumulative potential is contained in the section 12 of Safety data Sheets in (Ecological information). This requirement is also aligned with the EU Ecolabel criteria and it gained stakeholders acceptance thus it is proposed to keep it.

5.1.1.2 Criterion 2 Efficiency of application and durability

As shown in the section summarising the environmental assessment of paints (chapter 4.1) the in-use durability plays a key role in determining the environmental impact of paints. Paint performance during application and in use is very important, as it affects the amount of paint needed to cover a given surface and also impacts the frequency of repaints needed within a set time frame. These two aspects directly influence the environmental impact on the painting service and contribute to the overall environmental profile of the paint evaluated from a life cycle perspective.

Within this criteria area the requirements are proposed for the following aspects:

- Spreading rate,
- Wet scrub resistance (for indoor paints),
- Weathering resistance (for outdoor paints),
- Fungal and algal resistance (for outdoor paints),
- Abrasion resistance of floor paints (for indoor and outdoor paints).

They have been considered as the most important for ensuring high performance and durability of the paint products.

5.1.1.2.1 Criterion 2.1 Spreading rate

Core criteria	Comprehensive criteria
TECHNICAL SPECIFICATIONS	
The paint shall achieve an efficient spreading rate according to the applicable performance requirement in Table 35.	The paint shall achieve an efficient spreading rate according to the applicable performance requirement in Table 36.

Table 35 Spreading rates for specific paint products

Type of paint	Spreading rate ¹
White paints and light-coloured paints (including finishes and intermediates)	indoor: 8 outdoor: 6 indoor & outdoor: 8
Tinting systems ²	8
Primers and undercoats	
a. opaque	8
b. with specific blocking/sealing, penetrating/binding properties	6
c. with special adhesion properties	6
Thick decorative coatings	1 m ² per kg of product
Elastomeric outdoor paints	4

Notes:

¹ The spreading rates apply at a hiding power of 98%

² Only base should be tested

This specification is not applicable to varnishes, woodstains, transparent adhesion primers or any other transparent and semi-transparent coatings.

Verification:

The tenders shall provide a test report using the following methods, or their equivalent:

- ISO 6504/1 (Paints and varnishes — determination of hiding power — Part 1: Kubelka-Munk method for white and light-coloured paints)
- ISO 6504/3 (Part 3: determination of contrast ratio (opacity) of light-coloured paints at a fixed spreading rate),
- NF T 30 073 for paints specially designed to give a three-dimensional decorative effect or which are characterised by a very thick coat.

Table 36 Spreading rates for specific paint products

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- ISO 6504/3 (Part 3: determination of contrast ratio (opacity) of light-coloured paints at a fixed spreading rate),
- NF T 30 073 for paints specially designed to give a three-dimensional decorative effect or which are characterised by a very thick coat.

Rationale

A key environmental consideration is the amount of paint used during application. Minimising the amount of paint used, whilst achieving a high quality finish can result in a significant environmental saving. The most appropriate criterion by which this can be monitored is through the paints spreading rate. This criterion belongs to the most important one in the previous and in the current version of the EU Ecolabel for paints and varnishes, approved by the EU Ecolabel Regulatory Committee in November 2013 and adopted in May 2014 (Official Journal EU, 2014/312/EU).

Due to importance of this criterion, the same requirements as in the EU Ecolabel (the old and the new one, i.e. adopted in 2008 and in 2014) are asked for in the GPP **core and comprehensive criteria**. The consultation process did not allow for distinguishing between stricter values for the

comprehensive than for the core ones. However, the high number of licenced products of the old EU Ecolabel criteria (already the ones from 2008) suggests that a sufficient share of the market can comply with this criterion, even if it is required in the core set.

This specification is not applicable to varnishes, woodstains, transparent adhesion primers or any other transparent coatings.

Regarding **verification**, the compliance with the above criterion should be demonstrated through a test report using the following methods, or their equivalent:

- ISO 6504/1 (Paints and varnishes — determination of hiding power — Part 1: Kubelka-Munk method for white and light-coloured paints)
- ISO 6504/3 (Part 3: determination of contrast ratio (opacity) of light-coloured paints at a fixed spreading rate),
- NF T 30 073 for paints specially designed to give a three-dimensional decorative effect or which are characterised by a very thick coat.

Follow-up from stakeholders' consultation

One of stakeholders commented that different values for trim paints could be given. The substantiating rationale was as follows: *"A trim paint can never be formulated above what is called Critical PVC (pigment volume concentration), whereas this is common practice for wall paints. The reason is that trim paints also cover high gloss materials (> 90 GU at 20°). The criterion for trim paints on hiding differ from wall paints, as for wall paints there is a difference in so-called wet- and dry- hiding. The wet hiding criterion is much more challenging from a formulation point of view. A good quality trim paint should be able to give a good wet hiding when a wet layer of 100um (or a dry layer of 40um) provides a Contrast Ratio of 99.5% (for white)".*

Nevertheless, as this issue was not raised during the EU Ecolabel criteria development, no proposal of the threshold and data substantiating it were provided and as the harmonisation of criteria is sought, it is proposed to keep the EU Ecolabel limit. Additionally, another stakeholder proposed to restrict the criterion to indoor products only, indicating that industry does not tests outdoor paints on a usual basis using the above approach. No alternative for testing was however provided, and as this criterion on is considered of high importance and the same requirements are set in the EU Ecolabel, it is proposed to keep them for both – indoor and outdoor products.

Regarding the **verification** process one of the stakeholders provided detailed feedback suggesting other testing methods which should be used. This information was consulted with the CEN TC 139, and it is understood that there is none universal testing method. For instance EN ISO 3233, Paints and varnishes — Determination of percentage volume of non-volatile matter also can be used:

- Part 1: Method using a coated test panel to determine non-volatile matter and to determine dry film density by the Archimedes principle
- Part 2: Method using the determination of non-volatile-matter content in accordance with ISO 3251 and determination of dry film density on coated test panels by the Archimedes principle
- Part 3: Determination by calculation from the non-volatile-matter content determined in accordance with ISO 3251, the density of the coating material and the density of the solvent in the coating material

The three above methods differ depending on how the percentage volume of non-volatile matter and the density of the paint is determined.

According to the information received, the currently proposed method will be revised in the future and maybe then a reference to the new procedure should be done. For the moment it will be kept in the GPP criteria, as also done for the EU Ecolabel.

It shall however be remembered that beside the indicated in the criteria text methods also equivalent methods are allowed and can be used.

5.1.1.2.2 Criterion 2.2 Wet scrub resistance (indoor paints)

Core criteria	Comprehensive criteria
TECHNICAL SPECIFICATIONS	
	<p><i>For applications where cleanability and scrub resistance are required</i></p> <p>2.2 Wet scrub resistance (only indoor paints)</p> <p>Wall paint for which wet scrub resistance is requested in the tender shall achieve Class 1 or 2 in wet scrub resistance according to EN 13300 and EN ISO 11998 or their equivalent. Exempted are matt indoor wall and ceiling paints with white pigment content equal or lower than 25 g/m² of dry film. This requirement only applies to tinting bases (base paints).</p> <p><i>This requirement does not apply to transparent and semi-transparent coatings.</i></p> <p>Verification: The tenderer shall provide a test report according to EN 13300 using the method EN ISO 11998 (Test for cleanability and scrub resistance) or equivalent.</p> <p><i>A core criterion is not proposed, nevertheless, if the procured paint will be used on surfaces which will be intensively cleaned, public procurers are encouraged to use the comprehensive criterion.</i></p>

Rationale

In accordance with the EN 13300¹⁰⁵ wet scrub resistance (WSR) evaluates the resistance of the coating to repeated cleaning. It is determined in accordance with the procedure described in the ISO 11998 standard after a drying period of 28 days at (23±2)°C and (50±5) % relative humidity. WSR is classified according to the loss of thickness of the coat, as follows:

- Class 1 < 5 µm at 200 scrubs,
- Class 2 >5 µm and < 20 µm at 200 scrubs,
- Class 3 >20 µm and < 70 µm at 200 scrubs,
- Class 4 < 70 µm at 40 scrubs,

¹⁰⁵ EN 13300 Paints and varnishes - Water-borne coating materials and coating systems for interior walls and ceilings - Classification.

- Class 5 >70 µm at 40 scrubs.

WSR is considered one of the factors used to determine the durability of a particular paint. Manufacturers state that this is one of the key performance indicators for hard wearing paints (particularly floor and bathroom/kitchen paints). The durability of paint is important in reducing its environmental impact. As is shown within the LCA in the background report¹⁰⁶, any increase in time between repaints, in this case due to an increase in wear resistance, leads to a decrease in the overall lifecycle impact of the paint.

A lengthy debate over the inclusion and scale of this requirement preceded the development of the current criterion for the EU Ecolabel. A key concern was whether tests need to be carried out for all paints or only for those claiming wet scrub resistance. From an environmental perspective, more durable paints would reduce the environmental impact by increasing intervals between repainting which is also related to lower energy consumption/waste production.

However, the proposed universal requirement that all paints must meet this target was opposed because it would exclude most matt wall paints and was seen as unnecessary for some types of paints, e.g. wood and trim paints.

In the EU Ecolabel criteria, after intensive discussions, it was agreed to combine the criterion on white pigment and WSR as follows:

Criterion 1. White pigment and Wet Scrub Resistance (of the EU Ecolabel)

1(a) Minimum requirement for white pigment content:

Indoor wall and ceiling paints for which Class 1 and 2 wet scrub resistance claims are made shall have a white pigment content (white inorganic pigments with a refractive index higher than 1,8) per m² of dry film equal to or lower than that described in Table 1, with 98 % opacity. This requirement only applies to tinting bases (base paints).

Table 37: Relationship between wet scrub resistance and TiO₂ content for indoor paints in EU Ecolabel

Wet scrub resistance	Indoor limit (g/m²)
Class 1	40
Class 2	36

For all other paints, including limed paints, silicate paints, primers, anti-rust paints and facade paints, the white pigment content (white inorganic pigments with a refractive index higher than 1,8) shall not exceed 36g/m² for indoor products and 38g/m² for outdoor products. In the case of paints for both indoor and outdoor use the more stringent limit shall apply.

In case the above mentioned products fall under the exemption indicated in part (b) then the white pigment content (white inorganic pigments with a refractive index higher than 1,8) shall not exceed 25 g/m² of dry film, with 98 % opacity.

1(b) Minimum requirement for Wet Scrub Resistance (for indoor paints only)

All indoor wall and ceiling paints (finishes) shall achieve class 1 or class 2 in wet scrub resistance (WSR) according to EN 13300 and EN ISO 11998. This requirement only applies to tinting bases (base paints).

Exempted from this requirement are indoor wall and ceiling paints with a white pigment content (white inorganic pigments with a refractive index higher than 1,8) that is equal or lower to 25g/m² of dry film, with 98 % opacity.

¹⁰⁶Available online at the project website:

http://susproc.jrc.ec.europa.eu/paints/docs/131021%20Ecolabel%20paints_EUEB%20vote_Technical%20report%20final.pdf.

Only WSR class 1 and 2 ecolabelled paints may claim wet scrub resistance on the label or other marketing documentation.

However, in order to simplify the formulation and facilitate the verification of criteria for public procurers it is considered more appropriate to keep both requirements separately in the core and comprehensive GPP criteria set (as it was also done in the previously valid EU Ecolabel for indoor paints). It is proposed for the **comprehensive criterion** only to align it with the new EU Ecolabel decision from 2014. It would be then required that the wall and ceiling paint finish shall achieve class 1 or 2 in wet scrub resistance according to EN 13300 and tested using EN ISO 11998 or equivalent method. Exempted are matt indoor wall and ceiling paints with white pigment content equal or lower than 25g/m² of dry film. This requirement only applies to tinting bases (base paints). A **core criterion** is not proposed, nevertheless, if the procured paint will be used on surfaces which will be intensively cleaned, public procurers may still wish to use the comprehensive criterion.

Regarding **verification** of compliance with the comprehensive criterion a test report according to EN 13300 using the method EN ISO 11998 (test for cleanability and scrub resistance) or their equivalent shall be provided by the tenderer.

Follow-up from the stakeholders' consultation

Limited feedback was received regarding this criterion. Only one stakeholder asked whether trim and ceiling paints could be exempted from this requirement, as they will not usually be cleaned/scrubbed. Trim paints were not however covered under the previous version of the criteria and no change is needed. Regarding ceiling paints the comment was accepted and if paint is marketed exclusively for painting of ceilings, WSR is not required. A respective amendment was introduced.

Furthermore, one stakeholder asked for addition of class 3 in the criterion. But as explained above the alignment with the EU Ecolabel criteria is sought and the current proposal is kept.

5.1.1.2.3 Criterion 2.3 Weathering resistance (outdoor paints)

Core criteria	Comprehensive criteria
TECHNICAL SPECIFICATIONS	

Masonry, wood and metal paints shall demonstrate resistance to the possible forms of weathering-induced deterioration in Table 38. Masonry paints shall be exposed to artificial test conditions for 1000 hours, wood and metal paints for 500 hours.

This shall be demonstrated according to the recommended test methods, or their equivalent, under artificial weathering conditions. Corrosion resistance for metal paints shall also include blistering.

Table 38 Weathering resistance tests

Weathering induced deterioration	Performance requirement	Recommended test
Decrease of gloss ¹	Less than or equal to 30%	ISO 2813
Flaking	Flake density 2 or less, flake size 2 or less	ISO 4628-5
Cracking	Crack quantity 2 or less, crack size 3 or less	ISO 4628-4
Blistering	Blister density 3 or less, blister size 3 or less.	ISO 4628-2
Corrosion	Rusting equal to or better than Ri2.	ISO 4628-3

Notes:

¹ Not applicable to mid sheen and matt-finishes with an initial gloss value less than 60% at 60° angle of incidence.

Verification:

The tenderer shall provide test results demonstrating performance of the paint according to the requirements in Table 38.

With the exception of corrosion for metal paints the artificial weathering conditions shall reflect the conditions described in ISO 11507 or (for outdoor wood finishes) QUV accelerated weathering apparatus with cyclic exposure with UV(A) radiation and spraying according to EN 927-6 or their equivalent.

For corrosion the relevant atmospheric corrosivity categories in EN ISO 12944-2 and the accompanying procedures specified in EN ISO 12944-6, or equivalent, shall be used. Anti-rust paints for steel substrates shall be tested after 240h salt spray following ISO 9227 or equivalent.

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This shall be demonstrated according to the recommended test methods, or their equivalent, under artificial weathering conditions. Corrosion resistance for metal paints shall also include blistering.

Table 39 Weathering resistance tests

Weathering induced deterioration	Performance requirement	Recommended test
Decrease of gloss ¹	Less than or equal to 30%	ISO 2813
Flaking	Flake density 2 or less, flake size 2 or less	ISO 4628-5
Cracking	Crack quantity 2 or less, crack size 3 or less	ISO 4628-4
Blistering	Blister density 3 or less, blister size 3 or less.	ISO 4628-2
Corrosion	Rusting equal to or better than Ri2.	ISO 4628-3

Notes:

¹ Not applicable to mid sheen and matt-finishes with an initial gloss value less than 60% at 60° angle of incidence.

Verification:

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With the exception of corrosion for metal paints the artificial weathering conditions shall reflect the conditions described in ISO 11507 or (for outdoor wood finishes) QUV accelerated weathering apparatus with cyclic exposure with UV(A) radiation and spraying according to EN 927-6 or or their equivalent.

For corrosion the relevant atmospheric corrosivity categories in EN ISO 12944-2 and the accompanying procedures specified in EN ISO 12944-6, or equivalent, shall be used. Anti-rust paints for steel substrates shall be tested after 240h salt spray following ISO 9227 or equivalent.

Rationale

Exterior surfaces are often exposed to various conditions, which contribute to weathering. Changes in temperatures, exposure to sun and rainfall are the main factors to be mentioned. This exposure can result in change of the general appearance, change of colour/gloss or other effects like: chalking, cracking, blistering, adhesion and flaking (see Table 40 for explanations).

Table 40: Effects of paint weathering process

Blistering	Formation of dome-shaped projections in paints or varnish films resulting from local loss of adhesion and lifting of the film from the underlying surface. It can occur due to surface exposure of paint to strong sunshine. Can be assessed according to ISO 4628-2.
Chalking	Appearance of a loosely adherent fine powder on the surface of a film arising from the degradation of one or more of its constituents. Occurs e.g. due to exposure of UV radiation in sunshine. Can be assessed according ISO 4628-6 or 4628-7.
Cracking	Occurs due to the unequal expansion or contraction of paint coats. It usually happens when the coats of the paint are not allowed to cure/dry completely before the next coat is applied. Can be assessed according to ISO 4628-4.
Flaking	The detachment of pieces of paint from the substrate, caused by a loss of adhesion and elasticity. Can be assessed according to ISO 4628-5.
Rusting	Chemical destruction of the paint film caused by the process corrosion. Can be assessed according to ISO 4628-3.

Source: Based on ISO 4628 series and Glossary of Terms - American Coatings Association¹⁰⁷

In order to evaluate weathering resistance of a paint product '*coatings from paints, varnishes and similar materials are weathered in the laboratory, in order to simulate ageing processes occurring during natural weathering. Artificial weathering of coatings using fluorescent UV lamps and condensation or water spray is carried out in order to produce a certain radiant exposure or mutually agreed total number of operation hours, a given degree of a change in a property or properties. The properties of the exposed coatings are compared with those of unexposed coatings, prepared from the same coating materials under identical conditions, or with coatings whose degradation properties are known. Radiation, temperature and humidity all contribute to the ageing process. Therefore, apparatus specified in this standard simulates all three factors*'.¹⁰⁸

Based on the results of the consultation conducted with industry and all involved stakeholders requirements for weathering resistance were placed for the recently voted EU Ecolabel scheme. Due to the importance of this feature, GPP criteria are aligned with them, for both - core and comprehensive criteria sets. The only difference between these two is that in the **core criteria** masonry paints shall be exposed to artificial test conditions for 1000 hours (i.e. it is aligned with the 2008 EU Ecolabel criteria), while wood and metal paints for 500 hours. In the **comprehensive**

¹⁰⁷Glossary of Terms - American Coatings Association, available online at: <https://www.paint.org/about-our-industry/glossary.html>, accessed April 2014.

¹⁰⁸ISO/FDIS 11507:2006 Paints and varnishes - Exposure of coatings to artificial weathering - Exposure to fluorescent UV lamps and water.

criteria period of 1000 hours applies to all kinds of paints (it is aligned with the 2014 EU Ecolabel criteria). The paints shall demonstrate resistance to the possible forms of weathering-induced deterioration fulfilling the performance requirements indicated in Table 41.

Table 41: Weathering resistance tests

Weathering induced deterioration	Performance requirement	Recommended test
Decrease of gloss ²	Less than or equal to 30% of its initial value	ISO 2813
Chalking	1,5 or better (0,5 or 1,0)	EN ISO 4628-6
Flaking	Flake density 2 or less, flake size 2 or less	ISO 4628-5
Cracking	Crack quantity 2 or less, crack size 3 or less	ISO 4628-4
Blistering	Blister density 3 or less, blister size 3 or less.	ISO 4628-2
Corrosion ³	Rusting equal to or better than Ri2.	ISO 4628-3

Notes:

¹Not applicable to varnishes and bases.

²Not applicable to mid sheen and matt-finishes with an initial gloss value less than 60% at 60° angle of incidence.

³For anti-rust paints.

Regarding **verification** of compliance tests of weathering resistance (as given in Table 41) shall be conducted. A test report using above specified methods (or their equivalent) shall be provided by the tenderer.

The artificial weathering conditions shall reflect the conditions described in ISO 11507 or (for outdoor wood finishes) QUV accelerated weathering apparatus with cyclic exposure with UV(A) radiation and spraying according to EN 927-6 (with the exception of corrosion for metal paints).

For corrosion the relevant atmospheric corrosivity categories in EN ISO 12944-2 and the accompanying procedures specified in EN ISO 12944-6, or equivalent, shall be used. Anti-rust paints for steel substrates shall be tested after 240h salt spray following ISO 9227.

Follow-up from stakeholders' consultation

Tests proposed for verification of the criteria for weathering have been consulted with CEN TC 139 and updated as given in Table 41.

It was clarified that:

- **Artificial weathering** of paints and varnishes is described in EN ISO 16474, *Paints and varnishes – Methods of exposure to laboratory light sources*:
 - Part 1: General guidance
 - Part 2: Xenon-arc lamps
 - Part 3: Fluorescent UV lamps
 ISO 16474-1 to part 3 are replacing EN ISO 11507 (Fluorescent lamps) and EN ISO 11341 (xenon-arc lamps).
- The actual horizontal standards for **colorimetry** are EN ISO/CIE 11664, *Colorimetry*:
 - Part 1: CIE standard colorimetric observers
 - Part 2: CIE standard illuminants
 - Part 3: CIE tristimulus values
 - Part 4: CIE 1976 L*a*b* Colour space
 - Part 5: CIE 1976 L*u*v* Colour space and u', v' uniform chromaticity scale diagram
 - Part 6: CIEDE2000 Colour-difference formula

- The actual vertical standards for colour measurement are [ISO 18314](#), *Analytical colorimetry*:
 - *Part 1: Practical colour measurement*
 - *Part 2: Saunderson correction, solutions of the Kubelka-Munk equation, tinting strength, hiding power*
 - *Part 3: Special indices*
- [ISO 7724-1 to -3](#) are withdrawn.
- [EN ISO 2813](#) on gloss measurement and all parts of [EN ISO 4628](#) are still valid.

Appropriate amendments were introduced. Additionally, the requirement regarding colour change was removed from the above criterion, as the testing proposed seems unsuitable and no better alternative has been agreed so far.

5.1.1.2.4 Criterion 2.4 Resistance of paint against fungi and algae (only outdoor paints)

Core criteria	Comprehensive criteria																		
TECHNICAL SPECIFICATIONS																			
<p><i>For applications where fungal and algal resistance of the film are required</i></p> <p>Exterior masonry and wood paints shall meet the requirements in Table 42. Only base paints shall be required to meet the criterion.</p> <p>Table 42 Fungal and algal resistance</p> <table border="1"> <thead> <tr> <th>Application</th> <th>Fungal resistance</th> <th>Algal resistance</th> </tr> </thead> <tbody> <tr> <td>Masonry</td> <td>Class 1 or lower</td> <td>Class 1 or lower</td> </tr> <tr> <td>Wood</td> <td>Class 0</td> <td>Class 0</td> </tr> </tbody> </table> <p>Verification: The tenderer shall provide test results demonstrating compliance according to the test methods EN 15457 and/or EN 15458, or their equivalent. For coatings containing encapsulated dry-film biocides altered conditioning protocols shall also be accepted. Manufacturers shall provide information about any variation in conditioning along with test results of the EN 15457 and/or 15458 standards.</p>	Application	Fungal resistance	Algal resistance	Masonry	Class 1 or lower	Class 1 or lower	Wood	Class 0	Class 0	<p><i>For applications where fungal and algal resistance of the film are required</i></p> <p>Exterior masonry and wood paints shall meet the requirements in Table 43. Only base paints shall be required to meet the criterion</p> <p>Table 43 Fungal and algal resistance</p> <table border="1"> <thead> <tr> <th>Application</th> <th>Fungal resistance</th> <th>Algal resistance</th> </tr> </thead> <tbody> <tr> <td>Masonry</td> <td>Class 1 or lower</td> <td>Class 1 or lower</td> </tr> <tr> <td>Wood</td> <td>Class 0</td> <td>Class 0</td> </tr> </tbody> </table> <p>Verification: The tenderer shall provide test results demonstrating compliance according to the test methods EN 15457 and/or EN 15458, or their equivalent. For coatings containing encapsulated dry-film biocides altered conditioning protocols shall also be accepted. Manufacturers shall provide information about any variation in conditioning along with test results of the EN 15457 and/or 15458 standards.</p>	Application	Fungal resistance	Algal resistance	Masonry	Class 1 or lower	Class 1 or lower	Wood	Class 0	Class 0
Application	Fungal resistance	Algal resistance																	
Masonry	Class 1 or lower	Class 1 or lower																	
Wood	Class 0	Class 0																	
Application	Fungal resistance	Algal resistance																	
Masonry	Class 1 or lower	Class 1 or lower																	
Wood	Class 0	Class 0																	

Rationale

Microorganisms can grow in liquid paints prior to and after the application. Manufacturers, in order to prevent this growth use biocides. Some of them are in-can preservatives, which are used in order to prevent the growth of microorganisms during storage of the product. Other are added to the paint to protect the applied paint (the so called film preservatives). And finally, biocides contained in

the product can also have a function of imparting antimicrobial activity to the coating (producing an antimicrobial coating).¹⁰⁹

Dry conditions do not favour the growth of microorganisms, while wet (at least periodically) surfaces constitute good environment for their development. Without proper protection, coatings quality can deteriorate. The growth of microorganisms, like e.g. algae or fungi, on the external walls of buildings can result in discoloration of the painted surface and its physico-chemical deterioration; microorganisms can penetrate the surface damaging it, making it more permeable. Further, the development under the film can cause loss of adhesion of the coating. Algal growth on painted wood is a sign that the underlying wood is rotting.¹¹⁰

Setting a requirement regarding fungal and algal resistance of the film is considered important for outdoor paints, for example, wood paints, in order to ensure the quality and durability of the painted surfaces. Along the consultation process, it was requested for all outdoor coatings that claim fungal and algal resistance that specific testing of fungal and algal resistance is performed. The same formulation of the criterion (aligned with the EU Ecolabel criteria) is proposed as **core and comprehensive**.

Regarding **verification**, the compliance shall be verified by testing in accordance with test methods described in EN 15457 and/or EN 15458, or their equivalent.

Follow-up from stakeholders' consultation

Following stakeholder's remarks the criteria are now aligned with the EU Ecolabel ones.

One stakeholder commented also that the test method used for fungal and algae resistance have very low correlation to the real life performance of the products and that many modern formulations with encapsulated biocides might not fulfil the criteria. In the recent years research has been conducted regarding the release of biocides from the paint film and comparison between free and encapsulated biocides^{111,112,113} showing significant reduction of the release of the biocides from the film to the environment when the encapsulation technology is applied.

In the stakeholders feedback provided and further consultation conducted with industry concerns were raised that the modern encapsulated biocides would mostly probably not pass the proposed tests, which were developed for conventional, free biocides. The following explanation was provided by the association: *"The crucial point is that for truly encapsulated dry-film biocides a longer preconditioning time of the dried coating prior to testing usually may be required. This is in order to allow the migration of actives out of the capsule and thus making them bioavailable at the coating's surface before inoculating it with fungal and algal organisms"*.

Point 7.3 of the 15457 Conditioning of the test samples states that

Condition the test sample in a horizontal position for at least 5 days at (23 ± 2) °C and (50 ± 5) % relative humidity, in accordance with EN 23270.

NOTE The conditioning time might vary according to the coating material and end use corresponding to information given by the manufacturer.

109 Introduction to the Microbiology of Coatings, PRA Coatings Technology Centre, available online at: http://www.pra-world.com/technical_services/laboratory/microbiology/introduction, accessed April 2014.

110 Gaylarde P. M., Gaylarde C. C., Algae and cyanobacteria on painted surfaces in Southern Brazil, Rev. Microbiol. vol.30 n.3 São Paulo July/Sept. 1999.

111 Breuer K., Mayer F., Scherer K., Schwerd R., Sedlbauer K., Wirkstoffauswaschung aus hydrophoben Fassadenbeschichtungen: verkapselte versus unverkapselte Biozidsysteme, Bauphysik 34 (2012), Heft 1.

112 Burkhardt, M, Dietschweiler, C, Campiche, S, Junghans, M, Schifferli, A, Baumberger, D, Kienle, C, Vermeirssen, E, Werner, I (2013): Ecotoxicological Assessment of Immersion Samples from Façade Render. Report for the Swiss Federal Office for the Environment FOEN, Bern, p. 34.

113 Schoknecht U., On the face of it – Leaching of actives from façades – current knowledge and actions European Coatings JOURNAL 03, 2014, p. 18.

Industry provided a proposal that a phrase is added in the criteria which would state that altered conditioning protocols which might be necessary for coatings containing encapsulated dry-film biocides shall also be accepted. Manufacturers shall provide information about any variation in conditioning as outlined in § 8 g) along with test results of the EN 15457 and 15458 standards. A respective statement is added in the revised proposal in order to ensure that state-of-the-art-biocides are accepted in GPP compliant products.

5.1.1.2.5 Criterion 2.5 Abrasion resistance of floor paints (indoor and outdoor paints)

Core criteria	Comprehensive criteria
TECHNICAL SPECIFICATIONS	
<p>Floor coatings and floor paints shall demonstrate an abrasion resistance not exceeding 70 mg weight loss after 1000 test cycles with a 1000 g load and a CS10 wheel according to EN ISO 7784-2.</p> <p>Verification: The tenderer shall provide test results carried out according to EN ISO 7784-2 or equivalent.</p>	<p>Floor coatings and floor paints shall demonstrate an abrasion resistance not exceeding 70 mg weight loss after 1000 test cycles with a 1000 g load and a CS10 wheel according to EN ISO 7784-2.</p> <p>Verification: The tenderer shall provide test results carried out according to EN ISO 7784-2 or equivalent.</p>

Rationale

Abrasion resistance can be defined as the ability of a material to withstand mechanical activity (like rubbing, scraping or erosion), which progressively removes the material from the surface. This is a very important feature of the coating from the point of view of maintaining material's original appearance and structure. The better the abrasion resistance, the less frequent the need to repaint the surface and thus, the lower the overall environmental impact of the paint in a life cycle perspective. Due to this reason, it is proposed to set **core and comprehensive** criteria in this area. Consultation process resulted in the following formulation (aligned with the EU Ecolabel criteria): Floor coatings and floor paints shall demonstrate an abrasion resistance not exceeding 70 mg weight loss after 1000 test cycles with a 1000 g load and a CS10 wheel according to EN ISO 7784-2.¹¹⁴

Regarding **verification**, the tenderer shall provide a test results carried out according to EN ISO 7784-2¹¹⁵ or equivalent.

5.1.2 AWARD CRITERIA FOR PAINTS AND VARNISHES

According to the Communication 2008(400) "Public procurement for a better environment":

"Some of the GPP criteria may also be formulated as environmental award criteria, to stimulate additional environmental performance without being mandatory and therefore without foreclosing the market for products not reaching the proposed level of performance. Award criteria, if given a significant weighting, may however give an important signal to the market place".

114 ISO 7784-2 Paints and varnishes - Determination of resistance to abrasion - Part 2: Rotating abrasive rubber wheel method.

115 Paints and varnishes - Determination of resistance to abrasion - Part 2: Rotating abrasive rubber wheel method.

Contracting authorities have to indicate in the contract notice and tender documents how many additional points will be awarded for each award criterion. Environmental award criteria should, altogether, account for at least 10 to 15 % of the total points available. Where the award criterion is formulated in terms of "better performance as compared to the minimum requirements included in the technical specifications", points will be awarded in proportion to the improved performance.

5.1.2.1 Criterion 1 Content of Semi Volatile Organic Compounds

Core criteria	Comprehensive criteria																												
AWARD CRITERIA																													
-	<p>Points shall be awarded if the tenderer is able to supply paint with a SVOC content equal to less than the limits given in Table 44.</p> <p>The content of SVOCs shall be determined for the ready to use product and shall include any recommended additions prior to application such as colourants and/or thinners.</p> <p>Where verification by testing is selected by the Contracting Authority tenderers shall be provided with the markers and test modifications described in Annex 4 (of the criteria document).</p> <p>Table 44 SVOC content limits</p> <table border="1"> <thead> <tr> <th>Product description (with subcategory denotation according to Directive 2004/CE/42)</th> <th>SVOC limits (g/l including water)</th> </tr> </thead> <tbody> <tr> <td>a. Interior matt walls and ceilings (Gloss <25@60°)</td> <td>30¹/40²</td> </tr> <tr> <td>b. Interior glossy walls and ceilings (Gloss >25@60°)</td> <td>30¹/40²</td> </tr> <tr> <td>c. Exterior walls of mineral substrate</td> <td>40</td> </tr> <tr> <td>d. Interior/Exterior trim and cladding paints for wood and metal</td> <td>50¹/60²</td> </tr> <tr> <td>e. Interior trim varnishes and woodstains, including opaque woodstains</td> <td>30</td> </tr> <tr> <td>e. Exterior trim varnishes and woodstains, including opaque woodstains</td> <td>60</td> </tr> <tr> <td>f. Interior and Exterior minimal build woodstains</td> <td>30¹/40²</td> </tr> <tr> <td>g. Primers</td> <td>30¹/40²</td> </tr> <tr> <td>h. Binding primers</td> <td>30¹/40²</td> </tr> <tr> <td>i. One-pack performance coatings</td> <td>50¹/60²</td> </tr> <tr> <td>j. Two-pack reactive performance coatings for specific end use such as floors</td> <td>50¹/60²</td> </tr> <tr> <td>Decorative effect coatings</td> <td>50¹/60²</td> </tr> <tr> <td>Anti-rust paints</td> <td>60</td> </tr> </tbody> </table> <p>Notes: 1 Indoor white paints and varnishes 2 Indoor tinted paints / outdoor paints and varnishes</p> <p>Verification: The tenderer shall provide a test report according to ISO 11890-2 or equivalent, with modifications according to the requirements in</p>	Product description (with subcategory denotation according to Directive 2004/CE/42)	SVOC limits (g/l including water)	a. Interior matt walls and ceilings (Gloss <25@60°)	30 ¹ /40 ²	b. Interior glossy walls and ceilings (Gloss >25@60°)	30 ¹ /40 ²	c. Exterior walls of mineral substrate	40	d. Interior/Exterior trim and cladding paints for wood and metal	50 ¹ /60 ²	e. Interior trim varnishes and woodstains, including opaque woodstains	30	e. Exterior trim varnishes and woodstains, including opaque woodstains	60	f. Interior and Exterior minimal build woodstains	30 ¹ /40 ²	g. Primers	30 ¹ /40 ²	h. Binding primers	30 ¹ /40 ²	i. One-pack performance coatings	50 ¹ /60 ²	j. Two-pack reactive performance coatings for specific end use such as floors	50 ¹ /60 ²	Decorative effect coatings	50 ¹ /60 ²	Anti-rust paints	60
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Anti-rust paints	60																												

Rationale

The World Health Organisation has defined semi volatile organic compounds (SVOCs) as organic compounds with boiling points ranging from 240 °C to 400 °C.¹¹⁶ For the purpose of the EU Ecolabel criteria SVOCs were further defined as all organic compounds which are eluting in a capillary column with a retention range between n-Pentadecane (C₁₅H₃₂) to n-Docosane (C₂₂H₄₆)n- for non-polar systems and diethyl adipate (C₁₀H₁₈O₄) to methyl palmitate (C₁₇H₃₄O₂) for polar systems.

The decline in use of VOCs has led to an increase in the use of SVOC's. Construction and building products are a major source of SVOCs and the Construction Products Directive¹¹⁷ has an optional criterion that SVOCs need to be avoided within the sector.^{118,119} The major issue is that SVOC's can redistribute themselves from one surface, such as paints, onto other surfaces, from which they can be inhaled and ingested.¹²⁰

Presence of semi volatile organic compounds (SVOC) in the indoor environment gained in the recent time special interest due to the rising health concerns related to those compounds. Some of them, e.g. polycyclic organic hydrocarbons (PAHs), are known to be carcinogenic. Other may contribute to asthma, allergies, and other bronchial irritations. Possible exposure routes to SVOCs are skin contact with surfaces, aerosol deposition on skin and respiratory intake.¹²¹

It is therefore proposed to set a **comprehensive award criterion** to support purchase by public authorities of products with lower SVOC content. This criterion is aligned with the EU Ecolabel criterion. SVOCs are also addressed in the Blue Angel criteria for paints.

Regarding **verification** it is proposed to request only a test report because this provides a simpler form of verification for procurers as opposed to calculations which would be more complicated and require expertise to verify, but are also permitted in the EU Ecolabel.

Follow-up from the stakeholders' consultation

Following the stakeholders comments, similarly like for the VOC emissions a possibility to provide the calculation should be given in order to align the criteria with the EU Ecolabel criteria. It was stated that if testing at external institutes was required, that would very much increased the costs for the paint suppliers.

The thresholds proposed are aligned with the requirement set in the EU Ecolabel criteria. Some industry stakeholders agreed with them while others considered them too restrictive; however no supportive technical information was provided and the current values are proposed to be kept.

116WHO, World Health Organization. 1997. Environmental Health Criteria 192, International programme on chemical safety. Geneva. 81 p. ISBN 9241571926.

117Council Directive 89/106/EEC of 21 December 1988 on the approximation of laws, regulations and administrative provisions of the Member States relating to construction products, OJ L 40, 11/02/1989, p. 12.

118Scutaru A. M., Keirsbulck M., Tirikkonen T., Sperk C., Funch L. W., Horn W., Maupetit F., Saarela K., Kephelopoulous S., Sateri J., Crump D., Witterseh T., Daeumling Ch., European Collaborative Action. Urban air, indoor environment and human exposure, Report No 27; Harmonisation framework for indoor material labelling schemes in the EU, 2010.

119CEN/TC 351 Construction products: Assessment of the release of dangerous substances.

120de Oliveira Fernandes E., Jantunen M., Carrer P., Seppänen O., Harrison P., Kephelopoulous S., EnVIE; Coordination Action on Indoor air Quality and Health Effects, Final Report, 2010, available online at: <http://cordis.europa.eu/documents/documentlibrary/126459681.ENG.pdf>, accessed May 2014.

121Järnström H., Vares S., Airaksinen M., Semi volatile organic compounds and flame retardants, Occurrence in indoor environments and risk assessment for indoor exposure, VTT RESEARCH NOTES 2486, available online at: <http://www.vtt.fi/inf/pdf/tiedotteet/2009/T2486.pdf>; accessed May 2014.

5.1.2.2 Criterion 2 Indoor Air Quality: Indoor paints

Core criteria	Comprehensive criteria																																					
AWARD CRITERIA																																						
<p>Points shall be awarded to products with emissions lower than the limits indicated in Table 45.</p> <p>Table 45 Indoor paint hazardous emissions to air limits</p> <table border="1"> <thead> <tr> <th rowspan="2">Product</th> <th colspan="2">Emissions limits (µg/m³)</th> </tr> <tr> <th>3 days</th> <th>28 days</th> </tr> </thead> <tbody> <tr> <td>TVOC's¹</td> <td>10,000</td> <td>2,000</td> </tr> <tr> <td>Formaldehyde</td> <td>-</td> <td>120</td> </tr> </tbody> </table> <p>¹Total Volatile Organic Compounds</p> <p>Verification: The tenderer shall verify that one or more of the selected technical improvements have been met based on analytical testing according to EN 16402 or equivalent.</p>	Product	Emissions limits (µg/m ³)		3 days	28 days	TVOC's ¹	10,000	2,000	Formaldehyde	-	120	<p>Points shall be awarded to products with content or emissions lower than the limits indicated in Table 46.</p> <p>Table 46 Indoor paint hazardous emissions to air limits</p> <table border="1"> <thead> <tr> <th rowspan="2">Product</th> <th rowspan="2">Concentration limit (ppm)</th> <th colspan="2">Emissions limits (µg/m³)</th> </tr> <tr> <th>3 days</th> <th>28 days</th> </tr> </thead> <tbody> <tr> <td>TVOC's</td> <td></td> <td>10,000</td> <td>1,500</td> </tr> <tr> <td>Formaldehyde</td> <td></td> <td>-</td> <td>60</td> </tr> <tr> <td>Isothiazolinones - sum total</td> <td>500</td> <td></td> <td></td> </tr> <tr> <td>MIT²</td> <td>200</td> <td></td> <td></td> </tr> <tr> <td>CIT/MIT³</td> <td>15</td> <td></td> <td></td> </tr> </tbody> </table> <p>¹Total Volatile Organic Compounds ²Methylisothiazolinone ³5-chloro-2-methyl-4-isothiazolin-3-one (CIT) / 2- methyl-4-isothiazolin-3-one (MIT) in a ratio of 3:1</p> <p>Verification: The tenderer shall verify that one or more of the selected technical improvements have been met based on analytical testing according to EN 16402 or equivalent for TVOCs and formaldehyde. For verification of isothiazolinones content Safety Data Sheets shall be provided.</p>	Product	Concentration limit (ppm)	Emissions limits (µg/m ³)		3 days	28 days	TVOC's		10,000	1,500	Formaldehyde		-	60	Isothiazolinones - sum total	500			MIT ²	200			CIT/MIT ³	15		
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CIT/MIT ³	15																																					

Rationale

As mentioned in the section regarding indoor air quality in the environmental evaluation chapter (see chapter 4.1.3) already in the studies conducted in the 1980's¹²² contamination of indoor air by most commonly encountered VOC's was several times higher indoor than in the outside air, regardless of the environment (whether rural or industrial). The quality of indoor air is important especially for the human health (VOCs can contribute to health concerns, like asthma, allergies, and bronchial irritations) but also well-being (at home and in the work place).

¹²² EPA's Office of Research and Development's, 'Total Exposure Assessment Methodology (TEAM) Study', Volumes I through IV, 1985.

New legislation, in particular regulations in France and Germany pushes paints manufacturers toward testing of indoor air quality (IAQ). This issue is also important from the perspective of buildings certification with regards to emissions into the internal environment. An IAQ criterion is currently proposed for the EU GPP criteria for office buildings and includes requirements for paints and varnishes. A range of certification schemes also exists for building materials and products, including schemes in Scandinavia, Germany, Austria, France and the USA, which combine substance specific lowest concentration of interest LCIs with TVOCs¹²³ and SVOCs requirements.

Recognising the importance of this area it is proposed to set an **award criterion** in both –**core and comprehensive** criteria sets for greener public procurement. Limit values in the core criteria are aligned with selected emission values from B class of the French scheme¹²⁴, while the values for comprehensive criteria correspond to the A class.

The **verification** of the compliance with this requirement shall be conducted through analytical testing according to EN 16402¹²⁵ or equivalent.

Follow-up from the stakeholders' consultation

Some stakeholders welcomed the introduction of this new criterion and proposed even to have it as a core one, while others had some additional queries or mentioned that VOC and SVOC are already restricted in the criteria. The criteria on SVOC and IAQ are however an award criterion, not technical specifications, and thus it is considered appropriate to keep both to give more flexibility to the applicants. The proposed IAQ thresholds are based on the French system but also correspond to the work of the JRC towards a harmonised European level.

For testing it was proposed to define the air ventilation rate as being 0.5 m³/(m²h) and that the limit values of the award criterion are connected to this (for example the limit values of formaldehyde emission testing of new ecolabel criteria were established under air ventilation 1.0 as per EN717 chamber method-RAL UZ 102. If air ventilation was 0.5 then the limit values should be doubled for formaldehyde emission criterion).The loading factor shall be paint specific, i.e. 1.0 for wall paints, 0.12 for trim and cladding paints.

Additionally, it was requested to include requirements on sensitizing preservatives – isothiazolinones. As this point comes late in the process it is proposed to align the comprehensive GPP criteria with the current EU Ecolabel requirement (see above proposed).

5.1.2.3 Criterion 3 Distribution and take-back

Core criteria	Comprehensive criteria
AWARD CRITERIA	
Points shall be awarded to tenderers that use paint supply systems that minimises packaging waste.	Points shall be awarded to tenderers that use paint supply systems that minimises packaging waste.
Tenderers shall submit an estimate of the	Tenderers shall submit an estimate of the

123 TVOC = total volatile organic compounds

124 EUROFINs, *French Regulations on VOC emissions from construction products*, available online at: <http://www.eurofins.com/voc-france.aspx>.

125EN 16402 - Paints and varnishes - Assessment of emissions of substances from coatings into indoor air - Sampling, conditioning and testing.

<p>weight and type of packaging that will be used as the function of the volume of paint delivered for the contract. Reusable systems shall be given the maximum amount of points.</p> <p>Verification:</p> <p>The systems to be used for storage and delivery of the paint shall be described and calculations provided for the estimate of the weight of packaging per volume of paint.</p>	<p>weight and type of packaging that will be used as the function of the volume of paint delivered for the contract. Reusable systems shall be given the maximum amount of points. Packaging waste together with residual paint shall be taken back for re-use, recycling or safe disposal.</p> <p>Verification:</p> <p>The systems to be used for storage and delivery of the paint shall be described and calculations provided for the estimate of the weight of packaging per volume of paint.</p> <p>The take-back system and end-markets for residual road marking and packaging waste shall be described.</p>
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Rationale

As indicated in section 4.1.2.2.4, unused paint has a significant environmental impact. Therefore any decrease in the amount of unused paint, reduces the environmental impact of the paint and paint industry. There are various methods which can be used to achieve this:

- Through sale of more appropriate quantities of paint (e.g. using different sized tins or bespoke dosing systems, correctly conveying the amount of paint required to prevent over-ordering, etc.).
- Through appropriate reuse (where possible).
- Through take-back schemes (usually run by the charitable sector).

Beside the paint itself, also reduction in packaging of the paint shall be strived for.

A WRAP study from 2011 analysed alternative supply chain approaches for paints in the UK.¹²⁶The study concluded that the concept of distributing paint in bulk is not a new one – for more than 10 years some companies use it already, but these systems are not wide spread yet. In general, the manufacturer provides the product in bulk to the point of sale, where is it dispensed to customer-tailored sizes of packaging. Beside the bulk delivery, the authors identified practices of dispensing into refillable packaging (which is however suitable more for frequent purchasers). The results of the WRAP study showed that bulk distribution can be both environmentally and economically beneficial. The reduction in packaging waste, when using the bulk distribution, can contribute to significant greenhouse gases emissions reduction (95% of saving in embedded carbon impacts) and financial saving of around 30%. There are, however, some important factors which need to be taken into account:

- Appropriate storage conditions,
- Frequent use (due to difficulties in maintaining of rheology for some types of paints),
- Ensuring the appropriate pressure in the bulk container (a pump may be needed to decent the product in an efficient way).

In order to minimise environmental impacts related to unused paint and packaging it is proposed to require that points are awarded for the tenderers that will minimise packaging waste per volume of paint supplied. It is envisaged that the best performance will be using a system of tailored delivery

¹²⁶ Lee P., Willis P, WRAP, Paint and woodcare products – distribution and delivery – A review of alternative supply chain approaches within UK paint and woodcare markets, Final Report, 2011.

(to minimise waste) and bulk refillable systems for large contracts (**core and comprehensive criteria**).

In the **comprehensive criteria set** it is proposed that in addition residual paint shall be taken back for re-use, recycling or safe disposal. Examples of such practices can be found in the WRAP study.¹²⁶In addition, packaging waste shall also be taken back for reuse, recycling or safe disposal to further minimise environmental impacts related to its use.

Regarding **verification** in order to enable a procurer to make a comparison between tenders an estimate of the packaging in proportion to volume of paint supplied together with a description of the system to be used for storage and delivery of the paint shall be provided. Additionally in the **comprehensive criteria set** the take-back system and end-markets for residual road marking and packaging waste shall be described.

Follow-up from the stakeholders' consultation

It was mentioned in the feedback provided by one stakeholder that packaging take-back can be expensive. This comment is accepted and this is the reason why this criterion is proposed as a comprehensive award criterion (not a technical specification) with the aim to promote the most ambitious applicants.

5.1.2.4 Criterion -Titanium dioxide production – **CRITERION WITHDRAWN**

Core criteria	Comprehensive criteria									
AWARD CRITERIA										
	<p>If the product contains more than 3.0% w/w of titanium dioxide then points shall be awarded in proportion to the reduction in energy used in its production and the recovery of co-products compared to the EU IPPC Reference document on Best Available Techniques' recommendations (see Table 47):</p> <p>Table 47 Titanium dioxide energy and co-product requirements</p> <table border="1"> <thead> <tr> <th>Process</th> <th>EU BREF BAT energy benchmark</th> <th>Recovery and sale of co-products</th> </tr> </thead> <tbody> <tr> <td>Chloride</td> <td>25 GJ/tonnes of TiO₂</td> <td>- Iron from ore refining (if synthetic ore is used). - Ferrous chloride from pigment production.</td> </tr> <tr> <td>Sulphate</td> <td>41 GJ/tonnes of TiO₂</td> <td>- Iron from ore refining (if synthetic ore is used). - Iron sulphate (copperas) from feedstock processing</td> </tr> </tbody> </table> <p>Verification: The tenderer shall submit supporting documentation showing compliance by the titanium dioxide producer for the raw material used in the paint product, to include 12 months data indicating the respective energy performance.</p>	Process	EU BREF BAT energy benchmark	Recovery and sale of co-products	Chloride	25 GJ/tonnes of TiO ₂	- Iron from ore refining (if synthetic ore is used). - Ferrous chloride from pigment production.	Sulphate	41 GJ/tonnes of TiO ₂	- Iron from ore refining (if synthetic ore is used). - Iron sulphate (copperas) from feedstock processing
Process	EU BREF BAT energy benchmark	Recovery and sale of co-products								
Chloride	25 GJ/tonnes of TiO ₂	- Iron from ore refining (if synthetic ore is used). - Ferrous chloride from pigment production.								
Sulphate	41 GJ/tonnes of TiO ₂	- Iron from ore refining (if synthetic ore is used). - Iron sulphate (copperas) from feedstock processing								

Rationale

Titanium Dioxide (TiO₂) is the most important pigment in the paint industry. It can be produced using two chemical processes: the sulphate or the chloride process. The chloride process produces TiO₂ through a reaction of titanium ores with chlorine gas. The sulphate process produces TiO₂ by reacting titanium ores with sulphuric acid. 70% of the European production is from the sulphate process and 30% from the chloride process. Waste arising from its production cover solid waste, strong acid waste, weak acid waste, neutralised waste, treatment waste and dust.¹²⁷

Existing Community legislation on waste from TiO₂ industry aims to prevent and progressively reduce pollution caused by waste from TiO₂ industry with a view to eliminate such pollution. It also seeks to harmonise laws on waste from TiO₂ industry in order to avoid distortion of competition within the internal market. Three directives were addressing disposal (Council Directive 78/176/EEC¹²⁸), monitoring and surveillance (Council Directive 82/883/EEC¹²⁹) and programs for the reduction of pollution (Council Directive 92/112/EEC¹³⁰) from TiO₂ production. **At present these have been replaced by the Directive 2010/75/EU on industrial emissions (integrated pollution prevention and control).**¹³¹

As shown in the environmental assessment section (chapter 4.1) reduction in the use of pigment in paints, and particularly TiO₂, is desired as it is a significant contributor to the paint's environmental impact. The EU Ecolabel includes a criterion that addresses waste and emissions from both the chloride and sulphate production processes. Having reviewed further the LCA evidence base for the main impacts associated with TiO₂ it was considered meaningful to explore the criteria which instead focuses on energy use and recovery and use of co-products. This is because one of the main environmental impacts related to the energy use in the finishing step in the TiO₂ production process but there is a trade-off in relation to the type of the ore use in the two main production processes. Based on the evidence in the BREF Reference Document on Best Available Techniques¹³² this trade-off could be mitigated by the recovery and sale of co-products from preparation of the ore.

127 For more detail see DH Environment webpage: <http://ec.europa.eu/environment/waste/titanium.htm>.

128 Council Directive 78/176/EEC of 20 February 1978 on waste from the titanium dioxide industry, OJ L 054, 25.02.1978, p.19.

129 Council Directive 82/883/EEC of 3 December 1982 on procedures for the surveillance and monitoring of environments concerned by waste from the titanium dioxide industry, OJ L 378, 31.12.1982, p. 1.

130 Council Directive 92/112/EEC of 15 December 1992 on procedures for harmonizing the programmes for the reduction and eventual elimination of pollution caused by waste from the titanium dioxide industry, OJ L 409, 31.12.1992, p. 11.

131 Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control) (Recast), L 334, 17.12.2010, p. 17.

132 Integrated Pollution Prevention and Control Reference Document on Best Available Techniques for the Manufacture of Large Volume Inorganic Chemicals - Solids and Others industry, August 2007, available online at: http://eippcb.jrc.ec.europa.eu/reference/BREF/lvic-s_bref_0907.pdf, accessed April 2014.

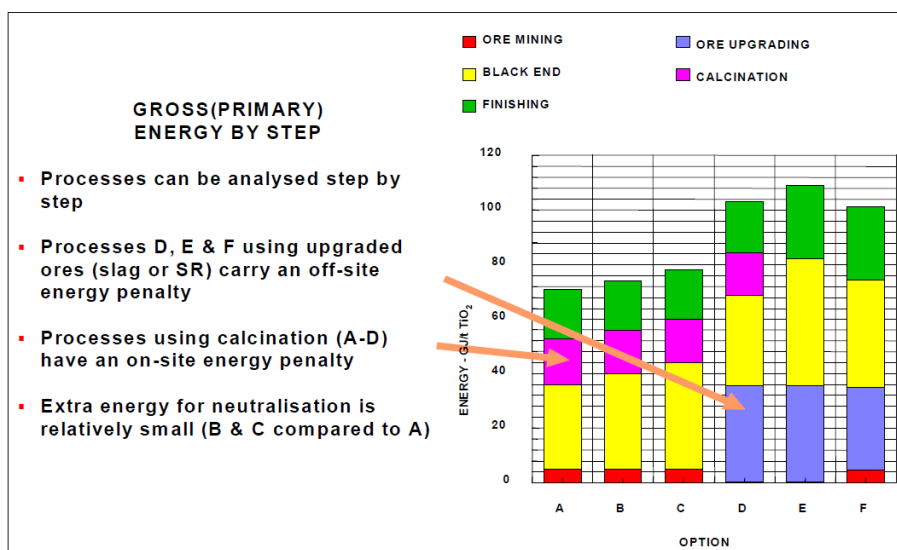


Figure 11: Comparison of primary energy used for different titanium dioxide production options

Source: Integrated Pollution Prevention and Control Reference Document on Best Available Techniques for the Manufacture of Large Volume Inorganic Chemicals - Solids and Others industry, 2007

Therefore, an **award comprehensive criterion** was proposed initially to be set in the GPP criteria set. It was required that for products containing more than 3.0% of TiO₂ points shall be awarded in proportion to the reduction in energy used in its production and the recovery of co-products compared to the 'EU IPPC Reference document on Best Available Techniques' recommendations.

Regarding **verification** to prove the compliance with the requirement the tenderer shall submit supporting documentation by the titanium dioxide producer for the raw material used in the paint product, to include 12 months data indicating the respective energy performance.

Table 48: Titanium dioxide energy and co-product requirements

Process	EU BREF BAT energy benchmark	Recovery and sale of co-products
Chloride	25 GJ/tonnes of TiO ₂	<ul style="list-style-type: none"> - Iron from ore refining (if synthetic ore is used). - Ferrous chloride from pigment production.
Sulphate	41 GJ/tonnes of TiO ₂	<ul style="list-style-type: none"> - Iron from ore refining (if synthetic ore is used). - Iron sulphate (copperas) from feedstock processing

Regarding **verification** to prove the compliance with the requirement the tenderer shall be asked to submit supporting documentation by the titanium dioxide producer for the raw material used in the paint product, to include 12 months data indicating the respective energy performance.

Follow-up from the stakeholders' consultation

Industrial association provided the feedback on the criterion, which, although recognised meaningfulness of addressing this environmental aspect did not agree with the first criteria formulation stating among others that "BREF mentions that there is no single 'best' option for TiO₂ production and that the long term availability of a local market for low value co-products was an

important factor. (...) The amount of energy used by the TiO₂ producer depends on the feedstock purchased and the waste treatment option chosen. If a higher grade feedstock is used then the energy requirement for the TiO₂ producer is less because the energy has already been used by the feedstock supplier to upgrade the feedstock. The overall energy usage is similar but the quantity of energy used by the TiO₂ supplier to the paint industry varies significantly but with no linear relationship to the overall environmental impact of the product" (...) An energy criteria would penalise sites using lower grade feedstock and acid recycling".

A second proposal was prepared and consulted with industry, which differentiated further between energy consumption requirements for sulphate process depending whether sulphuric acid neutralisation or sulphuric acid re-concentration was conducted (see Table 50).

Table 49 Overall energy efficiency in titanium dioxide production

Process	EU BREF BAT energy benchmark
Chloride	25 GJ/t of TiO ₂ pigment
Sulphate	29 GJ/t of TiO ₂ pigment in the process with sulphuric acid neutralisation
	41 GJ/t of TiO ₂ pigment in the process with sulphuric acid re-concentration

This proposal also did not find support from the industry side. The following feedback was provided: "The problem is there is no proportional link to environmental performance because so much of the life cycle depends on the energy consumed in producing the feedstock (titaniferous ores) that the TiO₂ producers purchase. Indeed this is evident from the wide range of figures reported in the BREF. We have no control of the energy consumed in mining, extraction and concentration activities of our suppliers and nor can we choose the type of feedstock we purchase (slag, ilmenite, rutile) beyond the specific design capabilities of the individual production plants. Limited choice within a specific ore type might be possible but energy data may be limited and since this is by far the largest variable cost for production, producers will typically be tied into multi-year purchase contracts so in practice we have no control.

Regarding recovery and re-use of co-products we would obviously support initiatives that encourage the recovery and use of co-products (which provide benefits in potential avoidance of waste, material conversation and possible energy benefits if the overall use profile is considered) but each plant is so individual in terms of what co-products can be produced (process type, feedstock, treatment technology, availability of local markets) that setting requirements on recovery and sale could indeed create barriers".

In the light of the above feedback in this criteria proposal the requirement is withdrawn. Nevertheless, for the future revision further investigation of feasibility of setting a criterion on titanium dioxide energy consumption and co-product generation/use should be conducted.

5.1.3 CONTRACT PERFORMANCE CLAUSES FOR PAINTS AND VARNISHES

Contract performance clauses are used to lay down the framework how a contract shall be carried out. For instance, in contract performance clauses the authority may specify the way the goods are to be supplied, how the service is performed, how the disposal of used products or packaging shall be managed or can specify training of contractor staff required. In the contract clauses

environmental considerations at the performance stage can be addressed.¹³³ In this section of the criteria the following requirements are addressed:

- Technical advice and site inspections,
- Distribution and take-back.

5.1.3.1 Criterion 1 Technical advice and site inspections

Core criteria	Comprehensive criteria
CONTRACT PERFORMANCE CLAUSES	
<p>The tenderer shall provide technical advice and site works instructions to the Contracting Authority or their contractors. This shall include the following:</p> <ul style="list-style-type: none"> • Method statements and guidance on substrate preparation, • Method statements and guidance on paint preparation, including estimates for application per m², • Optimal conditions for storage and application of the product, • Risk mitigation measures to minimise environmental pollution. <p>Technical advice shall also be made available to the site-operatives of the Contracting Authority or their contractors either in the form of on-site visits or a technical hotline.</p> <p>Verification: The tenderer shall provide documentation which contains the listed information and shall obtain confirmation in writing from site-operatives that the on-site technical support or a technical hotline has been provided.</p>	<p>The tenderer shall provide technical advice and site works instructions to the Contracting Authority or their contractors. This shall include the following:</p> <ul style="list-style-type: none"> • Method statements and guidance on substrate preparation, • Method statements and guidance on paint preparation, including estimates for application per m², • Optimal conditions for storage and application of the product, • Risk mitigation measures to minimise environmental pollution. <p>Technical advice shall also be made available to the site-operatives of the Contracting Authority or their contractors either in the form of on-site visits or a technical hotline.</p> <p>Verification: The tenderer shall provide documentation which contains the listed information and shall obtain confirmation in writing from site-operatives that the on-site technical support or a technical hotline has been provided.</p>

Rationale

It is considered important that the GPP criteria for the purchase of paints with a reduced environmental impact address technical advice and on-site inspections aspects (in both **core and comprehensive** criteria sets). These will be supportive to ensure appropriate storage and application of the product, which in consequence assure that, among others, the product is not wasted and its application fulfils high quality standards. Furthermore, in order to prevent environmental pollution, the tenderer shall advise the contractor how to mitigate potential risks through indicating risk mitigation measures.

¹³³ Buying green! A handbook on environmental public procurement, available online at: http://ec.europa.eu/environment/gpp/pdf/buying_green_handbook_en.pdf, accessed May 2014.

An example of a site-work advice and instructions prepared by Akzo Nobel was reviewed.¹³⁴ This example highlighted what information the paint suppliers may provide to the contractor or the site services they may provide. Based on this the following areas were identified:

- Method statements and guidance on substrate preparation and on paint preparation,
- Ambient conditions for storage and application of the product,
- Risk mitigation measures to minimise environmental pollution,
- Site-visits or a technical advice by technician to support the work.

It is therefore proposed that the **core and comprehensive criteria** consist of a number of areas of technical advice together with the availability of site-visits by technicians or a technical hotline from the paint manufacturer.

Regarding **verification** to prove the compliance with this criterion the tenderer shall provide documentation which contains the above listed information and shall obtain confirmation in writing from site-operatives that the on-site technical support or a technical hotline has been provided.

5.2 ROAD MARKINGS

The key environmental impacts associated with road markings are related to their use phase rather than to their production. As presented in the LCA review section (see chapter 4.2), durability of the road markings system under traffic wear is most decisive for the overall impact on the environment. In general, solvent based paints have a higher environmental impact than water based paints or thermo spray plastics or reactive 2-component cold spray plastics, while binder, glass beads and TiO₂ manufacture have an important environmental impact in the production stage. Additives have a wide range of health and environmental implications. Among the main substance related concerns are:

- Volatile Organic Components,
- Heavy metals: Pb, As, Sb (e.g. in glass beads),
- Pigments: Pb-chromates,
- Chlorinated or phtalate based plasticizers.¹³⁵

Follow-up along the stakeholder's consultation

Environmental criteria in existing procurement practices

Along the consultation process procurers from different MS were contacted in order to better understand the way the procurement of road markings is conducted and the environmental aspects addressed in the existing tenders. An analysis of several calls, provided kindly by the procurers, was performed. In general, it can be said that only in very few MS environmental criteria are added into calls for tenders¹³⁶.

For instance in the city of Vienna only solvent-free cold plastic road markings are used. Additionally, the following environmental requirements must be met:

- content of lead chromate shall not exceed 0.25%,
- content of xylene shall be lower than 0,005%,

134 ICI Paints, AkzoNobel, Site Work Instructions v5, 2012, available online at: http://dulux.trade-decorating.co.uk/web/pdf/guides/site_work_instructions.pdf.

135Nuyttens R., 3M Europe, Advanced Technology for Traffic Signs & Road Markings, 2008, available online at: http://www.irfnet.ch/files-upload/news-gallery/green_public_procurement/12.NUYTTENS_3M.pdf, accessed May 2014.

136 Personal communication with the procurers.

-
- materials should be nearly free of benzene, toluene and organochloride compounds.

A Norwegian procurer provided information that road marking materials they use shall not contain:

- heavy metals,
- carcinogenic substances or other compounds that will make the material classifiable as “Very toxic” or “Toxic”,
- above 2% by weight of VOC (Volatile Organic Compounds).

For glass beads that are to be used in road marking materials or for drop-on, any arsenic content shall not exceed 200 mg/kg.

The procurer indicated that their best environmental contributions are their strategies for road marking, namely:

- they analysed during six years annual cost and best practice at different roads and traffic intervals, to choose the right method water-based paint/spray/extruded thermoplastic,
- they decided that longitudinal road marking shall be laid in a milled strip in the asphalt course (6 mm high). This prevents the road marking from wear of traffic and snow-clearing machines. In this case the lifetime of road marking has increased by 50 – 150 %.

This kind of strategy would be of importance for countries with cold climate and heavy snowfalls during winter period.

Belgian authority informed that the only environmental requirement used in their tenders refers to using low-VOCs products in some communes.

No environmental criteria are added to tenders in Greece and Portugal, according to the information received.

Beside the public tenders, also existing labelling schemes were looked at:

NF Environment French Ecolabel for road markings¹³⁷ sets the following requirements:

- Substances classified as carcinogenic, mutagenic or toxic for reproduction, very toxic, toxic or subject to sentences R51, R52 or R53 shall be excluded.
- Preservatives used in the product composition may contain substances classified as dangerous for the environment, toxic or very toxic for human health within the limit of 0.1% of the total composition of the product.
- Arsenic-based compounds, cadmium, chromium VI, mercury or lead shall not be used. Ingredients may however contain impurities or traces of heavy metals from raw materials, within the regulatory limits according to Directive 67/548/EC and its amendments.
- The following glycol ethers (CAS number in brackets): EGME (109-86-4), EGEE (110-80-5) EGMEA (110-49-6) EGEEA (111-15-9) EGDME (110-71-4) DEGEE (111-90-0) DEGDME (111-96-6) TEGME (112-35-6) TEGDME (112-49-6) and EGBE (111-76-2) shall not be used.
- The product shall be not labelled as explosive (E) oxidising (O) extremely flammable (F +), highly flammable (F), Flammable (R10), very toxic (T +), toxic (T), harmful (Xn), corrosive (C) irritant (Xi) and dangerous for the environment (N) according to Directive 67/548 / EEC and Directive 99/45 / EEC and their adaptations.
- There are requirements regarding total losses during manufacturing and product packaging, as well as the treatment of production waste.
- White pigment content shall not exceed:

137 For more information please see: NF Environnement – Produits de signalisation horizontale, available online at: <http://www.ecolabels.fr/fr/recherche-avancee/categorie-de-produits-ou-services-certifies/produits-a-usage-professionnel/nf-environnement-produits-de-signalisation-horizontale>.

- 200 g/m² of dry film for painting,
- 400 g/m² of dry film for a coating or a preformed type,
- Information on emissions from titanium dioxide production shall be provided.
- VOC content should be less than or equal to 80 g/kg (excluding water).
- Aromatic hydrocarbon content should be less than 0.5% by weight in the formulation.

Brazilian Ecolabel for roadmarking systems¹³⁸; includes the following requirements:

- Environmental criteria for the product cover performance characteristics (night time visibility, daytime visibility, coefficient of resistance, erosion).
- The following heavy metals or their compounds should not be used as ingredients of the product or pigment whether as a substance or as part of any preparation used:
 - Cadmium
 - Lead
 - Chromium VI
 - Mercury
 - Arsenic
 - Barium (excluding barium sulfate)
 - Selenium
 - Antimony

It is accepted that ingredients may contain traces of these metals up to a maximum of 0.01% (w/w) from impurities of raw materials.

- Solvents containing halogenated or aromatic hydrocarbons in its formulation shall not be used.
- The content of VOCs in the final product shall be less than or equal to 150 g/kg according to ASTM D2369-10.
- There are also criteria for packaging, distribution, criteria applicable to the process.
- Program for optimization of energy and water consumption, including reduction goals as appropriate.
- Waste management program.

One of the issues raised by the procurers along the consultation process was related to the **inclusion of conservation works** into the criteria. For instance it could be prescribed that the durability must be x years and that at the end of this period a certain maximum level of damage is allowed (in special cases additional minor maintenance is permitted). It was also proposed that the requirements could address more the terms of durability, visibility, etc.

The performance is defined through the following parameters: retro-reflexion (sometimes also under wet conditions), day luminance, roughness and colour. And these are also the main specifications which are controlled in reference to the performance of the road marking.

This is however not easy to set unique performance requirements, as it there are various aspects which needs to be taken into account while setting the requirements; for instance the location and type (is it a highway or a small village street), the climatic conditions (wet/dry), the traffic intensity and other. It is up to the procurer to specify the intended application. The GPP criteria shall promote use of more environmentally friendly products or techniques available on the market. It should allow comparison of offers, and assigning most points to the best offers in the environmental evaluation part of the tendering process.

Road markings are a safety product, thus their performance cannot be compromised due to their formulation. There are however various trade-offs between different aspects. Let's take for instance

¹³⁸ For more information please see Road Marking Systems – PE-167.0A, 2011, available online at: <http://www.abnt.org.br/>.

the intention to minimise TiO₂ content and expanding the durability of the marking. This makes this criteria development a challenging task. Therefore, in the revised draft, several of the criteria have been proposed as award criteria. This will allow for granting point to these tenders which offer better environmental performance for specific (and specified by the procurer) application, without setting absolute requirements.

It is recognised that industry and regulators are still working on establishing a common framework for the evaluation of road markings at the European market (developments in the framework of CPD and CE marking and harmonisation of standards for performance testing). Beside this, industry is working on promoting minimum performance requirements for existing applied markings. All these developments shall be taken into account in the future revision of these criteria.

5.2.1 TECHNICAL SPECIFICATIONS FOR ROAD MARKINGS

5.2.1.1 Criterion 1 Road marking formulation

5.2.1.1.1 Content of Volatile Organic Compounds (VOC's)

Core criteria	Comprehensive criteria
TECHNICAL SPECIFICATIONS	
<p>(i) The maximum content of VOCs shall not exceed a limit of 150 g/l. The content of VOCs shall be determined for the ready to use product and shall include any recommended additions prior to application. Solvents which have negligible contribution to smog formation may be excluded from VOC calculation (see Appendix 5 of the criteria document). Exceptionally, when procurers determine that there are local specificities (locations where very low or very high temperatures may occur) which prevent the use of low VOC road markings, the total content of VOC shall not exceed 395 g/l.</p> <p>(ii) The following compounds shall not be used:</p> <ul style="list-style-type: none"> – Chlorinated solvents, such as methylene chloride or chloroalkanes, – Aromatic solvents, such as benzene, ethyl benzene, toluene, or xylene, – Ethylene-based glycol ethers or their acetates. <p>Verification: The tenderer shall provide results of calculation based on the ingredients and raw materials or a test report according to ISO 11890-2 or equivalent supported by necessary calculations. In addition, a declaration that the specifically excluded solvents are not used, shall be provided.</p>	<p>(i) The maximum content of VOCs shall not exceed a limit of 100 g/l. The content of VOCs shall be determined for the ready to use product and shall include any recommended additions prior to application. Solvents which have negligible contribution to smog formation may be excluded from VOC calculation (see Appendix 5 of the criteria document). Exceptionally, when procurers determine that there are local specificities (locations where very low or very high temperatures may occur) which prevent the use of low VOC road markings, the total content of VOC shall not exceed 395 g/l.</p> <p>(ii) The following compounds shall not be used:</p> <ul style="list-style-type: none"> – Chlorinated solvents, such as methylene chloride or chloroalkanes, – Aromatic solvents, such as benzene, ethyl benzene, toluene, or xylene, – Ethylene-based glycol ethers or their acetates. <p>Verification: The tenderer shall provide results of calculation based on the ingredients and raw materials or a test report according to ISO 11890-2 or equivalent supported by necessary calculations. In addition, a declaration that the specifically excluded solvents are not used, shall be provided.</p>

Rationale

As explained in the section 5.1.1.1.2 use of volatile organic compounds in paint products was identified as an important environmental aspect, hot spot in the LCA of paints. Many VOCs have short- and long-term adverse health and environmental effects.

In general the four different road marking systems used show different characteristics of VOC emissions. Table 50 below describes in general terms solvent content and related VOC emissions of the various road markings types:

Table 50: Solvent content and related VOC emissions of road marking systems

Paint Systems		Cold plastic Systems	Thermoplastic Systems
solvent-based	water-based		
medium to high solvent content	low solvent content	medium solvent content (reacting during polymerisation)	no solvent content
medium to high VOC emission	low VOC emission	low VOC emissions	no VOC emission

Source: Ökopol, 2009¹³⁹

According to the information collected in the framework of a study completed for the European Commission in 2009 by the Ökopol consultancy¹³⁹ on the assessment and review of Directive 2004/42/EC¹⁴⁰ VOC reduction potential was estimated, among others for road markings. It was recognised in the study that across Europe the main road marking systems vary. For instance in Sweden, the most commonly used systems are thermoplastics and to lower extent dispersion paints. In Germany mainly cold plastics and thermoplastics are used, especially on federal roads. At the community level – road marking paints are used more frequently. In France and some Eastern European countries like Poland, Hungary, Slovenia and Czech Republic paint systems are mainly used. In Spain – cold plastic and thermoplastics, similarly in Italy and Portugal. In Austria solvent-based paints are predominantly used.

In 2010 additional study was conducted by Ökopol and IER University of Stuttgart¹⁴¹ specifically on road markings to evaluate the option of limiting the VOC solvent content in road markings to 60 g/l. The authors compared the existing national VOC limits in MS for public procurement limitation on VOC content:

- In Germany and Austria for solvent-based paints the max VOC content in public tenders was 25% (weight),
- In Netherlands – 28%,
- In Sweden and Finland – the VOC content was restricted to 2%.

139 Ökopol GmbH, Assessment and Review of Directive 2004/42/EC, Final Report, 2009, available online at: http://ec.europa.eu/environment/air/pollutants/pdf/paints_report.pdf, accessed May 2014.

140 Directive 2004/42/CE of the European Parliament and of the Council of 21 April 2004 on the limitation of emissions of volatile organic compounds due to the use of organic solvents in certain paints and varnishes and vehicle refinishing products and amending Directive 1999/13/EC, OJ L 143, 30.4.2004, p. 87.

141 Ökopol and IER University of Stuttgart for Dow and Gaveco, Review of the Directive 2004/42/EC – Report on the potential scope extension of the directive covering road markings, 2011, available online at: http://www.geveko-markings.com/fileadmin/Brochures/VOC_Impact_assessment_of_road_markings_environmental_impact.pdf, accessed May 2014.

It should be added that, taking into account the product densities a limit of 25% (weight) corresponds to 375-575 g/l, 10% - to 150-230 g/l and 2% - to 40-100 g/l.

Outside Europe VOC limit values were found for Canada and USA. In USA, the threshold of 150 g/l or even 100 g/l for some regions was established. For Canada – 150 g/l for the period between May and September and 450 g/l for the rest of the year.¹⁴¹

In accordance with the estimations made for the review of the 2004/42/EC Directive if all solvent-based road markings are substituted by water-borne products, VOC emissions from road markings could be reduced by approximately 80% in comparison with the state-of-art of the analysed situation. According to the results obtained from the impact assessment in the second study, the potential to reduce VOC emissions from road markings in the EU 27 by the year 2020 amounts approximately 40 kilotons, assuming a mean content of VOC in road markings to be 30 g/l.

Price levels (solvent-based set as 1) and expected life times of various road marking systems, as given in the above mentioned study, are presented in Table 51.

Table 51: Cost structure and expected life time of road marking systems

Road marking system	Cost index	Expected functional life time (years)
Solvent-based paint	1	1-2
Water-based paint	1.1-1.3	1-2
Thermoplastic	4.2-4.5	3-5
Cold plastic	4.3-4.6	3-5
Cold spray plastic*	2.1-2.4	2-3

*The costs include drop-on glass beads

According to the values provided in the study¹⁴¹ in 2006 for EU 12 only 12% of the paint systems produced constituted water-based road marking paint systems. Currently, a mean content of VOC emission from solvent-based paint was approximately 400 g/l (about 25 weight-%).

Following the rationale regarding VOC emissions presented for paints (chapter 5.1.1.1.2) and the stakeholders' feedback received along the consultation process it is proposed to require that tenderers offer also road marking paints with reduced amount of VOCs in the formulation.

During the consultation process diverse feedback was received from stakeholders on the potential limit values for VOCs in road markings. One industrial stakeholder proposed to set the maximum VOC content in the product at the level used in point NF Environnement 331 criteria (i.e. the voluntary certification mark issued by AFNOR – the French certification body and the only national Ecolabel for road marking products in Europe). NF mark requires that VOC content in road markings must be less than or equal to 80 g/kg in the product (excluding water). This would equate to the use a water-based paint products or structural plastic systems.

However, further investigation suggest that there is still a demand for solvent-based paints but this can now be formulated with a lower VOC content. Evidence from a Brazilian standard¹⁴² as well industries response to VOC content, restrictions by the US EPA¹⁴³ and Environment Canada¹⁴⁴ suggest that a threshold of 150 g/l may better reflect a low VOC solvent-based paint. It should be however taken into account that in the US and Canada the calculation of VOC content certain

142 ABNT, *Ecolabel for roadmarking systems*, February 2012 revision, Brazil.

143 Responsible Purchasing Network, *Green purchasing best practices: Traffic paint*, 30th September 2013, USA.

144 Environment Canada, *Performance of Waterborne, Low Temperature, Low VOC Traffic Paint*, May 2010.

compounds are exempted due to their low potential to smog formation.¹⁴⁵ Pricing in the US suggests that this type of product can be obtained for the same price as conventional solvent-based paint.

For European countries where very high summer temperatures or very low winter temperatures are a constraint (i.e. in order to ensure that the product application and drying process proceeds properly the VOC content must be higher) the threshold of 395 g/l (which corresponds to the above mentioned 25% weight) was proposed.

This constraint was highlighted by a number of stakeholders who expressed their disapproval of strict limitations of VOC content in road markings. They explained that: *'especially important in countries of Mediterranean climate, where the solar radiation and the pavement temperature make necessary a high performance of these products so they can resist a reasonable period of time in good conditions. Water-borne coatings and thermoplastics (hot coating) show a thermoplastic behaviour: when the temperature increases will soften and increase its plasticity. In countries of Mediterranean climate, the high temperatures reached in summer make these products deteriorate much, especially its daytime visibility and duration. Therefore, using solvent-borne coatings and multi-component plastics (cold coating) is essential'*.

Further, they stated that: *'A general restriction of VOC content for all types of road marking paints it is not a reasonable approach because it is not feasible to substitute directly the high VOC types (solvent-borne) by the low VOC types (water-borne)'*.

They also pointed out that due to technological advancements two different types of solvent-based formulations exist: the first of them using solvents that result in the product being classified as harmful and eventually also as dangerous for the environment and another type, which are much less dangerous that do not make the product to be classified neither as harmful or dangerous for the environment. Therefore, the stakeholders propose a new approach linked to consideration of the nature of the solvents used in the formulations. They ask to set a different VOC limit value for those solvent-born paints formulated with solvents not classified as harmful or dangerous for the environment.

Recommendations from the US on purchasing of solvent-based road markings suggest the restriction on the following types of solvents, in addition to the limitation of the VOC content to 150 g/l required at the federal level:

- Chlorinated solvents (such as methylene chloride or chloroalkanes);
- Aromatic solvents (such as benzene, ethyl benzene, toluene, or xylene);
- Ethylene-based glycol ethers or their acetates.

Regarding **verification** in order to prove the compliance with the above requirements, the tenderer shall provide a test report according to ISO 11890-2¹⁴⁶ or equivalent.

Follow-up from stakeholders' consultation

In general, many stakeholders supported moving away from solvent-born paints. Although it was again mentioned that in some MS, where the climatic conditions are more extreme (e.g. in the south of Europe) solvent-based road markings are still commonly used. In those regions keeping the limit at 395 g/l, as proposed in the last draft, seemed feasible. Only one stakeholder proposed increasing the threshold to 410 g/l. It was said that it is, however, not possible to precisely define lower and upper temperature and this would need to be evaluated by the procuring authority.

Contradicting information was provided on this issue of climatic difference and possible conditions of use of water- and solvent-based products. On the one hand it was stated that water-based products cannot be applied in winter conditions due to *"their high sensitivity to humidity and low*

¹⁴⁵ See below in this section for more explanation.

¹⁴⁶ ISO 11890-2 - Paints and varnishes -- Determination of volatile organic compound (VOC) content -- Part 2: Gas-chromatographic method.

temperatures, and as they are more plastic". In particular for concrete surface solvent-based products allow creating a strong bond in the temperatures experienced in countries like Denmark. Water-based paints would not give the bond strength required on a concrete surface. Also in in countries of Mediterranean climate, due to *"the solar radiation and the pavement temperature it is necessary that a high performance products which can resist a reasonable period of time in good conditions"* are used. It was claimed that water-borne paints could not provide such good performance in these conditions.

Other stakeholders provided opposite information, stating that *"water-borne paints are successfully used for road-marking in Mediterranean countries including Spain and Italy"*. Water-borne paints producer provided information that according to the results of their tests *"water-borne paints exhibit longer retention of night visibility and similar retention of day visibility when compared to solvent-borne acrylic traffic paint"*. It was emphasized that the application temperatures recommended for solvent-borne paints, as well as thermoplastics and cold plastics is typically between 5 and 45 degrees, while the relative humidity below 75% or 80%. For water-borne paints the recommended temperature is between 10 and 45 degrees and relative humidity identical to the one of other kinds of road markings. The producer mentioned that there are specific technologies available to extend the window of application of water-borne paints in particular at high humidity.

The limit of 150 g/l (proposed for core criteria) can only be met by water-borne paints, cold plastic or thermoplastic. It is not technically achievable with existing solvent-borne paints. In the United States and Canada, where much lower limits are set, certain VOC which are considered to have negligible contribution to ground-level smog formation are excluded from the calculation. For instance acetone is excluded (for the complete list see below). The same approach was supported by some of the stakeholders and could be applied in the GPP criteria. It was quoted that if the exempt solvents were included in the calculation in the US the total VOC content would be around 400 g/l, however in this way use of environmentally harmful solvents can be limited, which is considered reasonable.

The US Federal Code of Regulations Title 40 Protection of Environment CFR 51.100(s) defines Volatile organic compounds and exempt compounds:

(s) "Volatile organic compounds (VOC)" means any compound of carbon, excluding carbon monoxide, carbon dioxide, carbonic acid, metallic carbides or carbonates, and ammonium carbonate, which participates in atmospheric photochemical reactions.

(1) This includes any such organic compound other than the following, which have been determined to have negligible photochemical reactivity:

- methane;
- ethane;
- methylene chloride (dichloromethane);
- 1,1,1-trichloroethane (methyl chloroform);
- 1,1,2-trichloro-1,2,2-trifluoroethane (CFC-113);
- trichlorofluoromethane (CFC-11);
- dichlorodifluoromethane (CFC-12);
- chlorodifluoromethane (HCFC-22);
- trifluoromethane (HFC-23);
- 1,2-dichloro 1,1,2,2-tetrafluoroethane (CFC-114);
- chloropentafluoroethane (CFC-115);
- 1,1,1-trifluoro 2,2-dichloroethane (HCFC-123);
- 1,1,1,2-tetrafluoroethane (HFC-134a);
- 1,1-dichloro 1-fluoroethane (HCFC-141b);
- 1-chloro 1,1-difluoroethane (HCFC-142b);
- 2-chloro-1,1,1,2-tetrafluoroethane (HCFC-124);
- pentafluoroethane (HFC-125);

- 1,1,2,2-tetrafluoroethane (HFC-134);
- 1,1,1-trifluoroethane (HFC-143a);
- 1,1-difluoroethane (HFC-152a);
- parachlorobenzotrifluoride (PCBTF);
- cyclic,
- branched, or linear completely methylated siloxanes;
- acetone;
- perchloroethylene (tetrachloroethylene);
- 3,3-dichloro-1,1,1,2,2-pentafluoropropane (HCFC-225ca);
- 1,3-dichloro-1,1,2,2,3-pentafluoropropane (HCFC-225cb);
- 1,1,1,2,3,4,4,5,5-decafluoropentane (HFC 43-10mee);
- difluoromethane (HFC-32);
- ethylfluoride (HFC-161);
- 1,1,1,3,3,3-hexafluoropropane (HFC-236fa);
- 1,1,2,2,3-pentafluoropropane (HFC-245ca);
- 1,1,2,3,3-pentafluoropropane (HFC-245ea);
- 1,1,1,2,3-pentafluoropropane (HFC-245eb);
- 1,1,1,3,3-pentafluoropropane (HFC-245fa);
- 1,1,1,2,3,3-hexafluoropropane (HFC-236ea);
- 1,1,1,3,3-pentafluorobutane (HFC-365mfc);
- chlorofluoromethane (HCFC-31);
- 1 chloro-1-fluoroethane (HCFC-151a);
- 1,2-dichloro-1,1,2-trifluoroethane (HCFC-123a);
- 1,1,1,2,2,3,3,4,4-nonafluoro-4-methoxy-butane (C₄F₉OCH₃ or HFE-7100);
- 2-(difluoromethoxymethyl)-1,1,1,2,3,3,3-heptafluoropropane ((CF₃)₂CF₂OCH₃);
- 1-ethoxy-1,1,2,2,3,3,4,4,4-nonafluorobutane (C₄F₉OC₂H₅ or HFE-7200);
- 2-(ethoxydifluoromethyl)-1,1,1,2,3,3,3-heptafluoropropane ((CF₃)₂CF₂OC₂H₅);
- methyl acetate; 1,1,1,2,2,3,3-heptafluoro-3-methoxy-propane (n-C₃F₇OCH₃, HFE-7000);
- 3-ethoxy- 1,1,1,2,3,4,4,5,5,6,6,6-dodecafluoro-2-(trifluoromethyl) hexane (HFE-7500);
- 1,1,1,2,3,3,3-heptafluoropropane (HFC 227ea);
- methyl formate (HCOOCH₃);
- 1,1,1,2,2,3,4,5,5,5-decafluoro-3-methoxy-4-trifluoromethyl-pentane (HFE-7300);
- propylene carbonate;
- dimethyl carbonate;
- *trans*-1,3,3,3-tetrafluoropropene;
- HCF₂OCF₂H (HFE-134);
- HCF₂OCF₂OCF₂H (HFE-236cal2);
- HCF₂OCF₂CF₂OCF₂H (HFE-338pcc13);
- HCF₂OCF₂OCF₂CF₂OCF₂H (H-Galden 1040x or H-Galden ZT 130 (or 150 or 180));
- *trans* 1-chloro-3,3,3-trifluoroprop-1-ene;
- 2,3,3,3-tetrafluoropropene;
- 2-amino-2-methyl-1-propanol;
- and perfluorocarbon compounds which fall into these classes:
 - Cyclic, branched, or linear, completely fluorinated alkanes;
 - Cyclic, branched, or linear, completely fluorinated ethers with no unsaturations;
 - Cyclic, branched, or linear, completely fluorinated tertiary amines with no unsaturations; and
 - Sulfur containing perfluorocarbons with no unsaturations and with sulfur bonds only to carbon and fluorine.

Solvents which are among the compounds listed above can be excluded from the calculation of the VOC of the road marking product in the current proposal.

In the current proposal, in order to accommodate the needs of MS or regions, when procurers determine that there are local specificities impeding the use of low VOC road markings, it is proposed that the VOC content shall not exceed 395 g/l

Beside this requirement, a possibility to introduce additional restriction on chlorinated and aromatic solvents, as well as ethylene-based glycol ethers or their acetates found stakeholders' support. They are state-of-the-art in some European MS like Germany or Switzerland and this requirement is kept in the new proposal.

One stakeholder indicated that for thermoplastic products, which are melt processed at about 200°C with considerable evaporation, instead of VOC SVOC may need to be considered. In the area of SVOC not much experience exists so far. In the area of decorative paints and varnishes for instance the EU Ecolabel requires also SVOC testing or calculation. In the case of road markings it is proposed to take into consideration this issue in the future revision, when more information is available.

It is finally proposed that, with exception of call for tenders, when procurers determine that there are local specificities (locations where very low or very high temperatures may occur) which prevent the use of low VOC products (where the total content of VOC, as mentioned above, shall not exceed 395 g/l) the following limits shall apply: 150 g/l in **core criteria** and 100 g/l in **comprehensive criteria**. Solvents which have negligible contribution to smog formation may be excluded from VOC calculation (if listed above). Additionally, the following compounds shall not be used:

- Chlorinated solvents, such as methylene chloride or chloroalkanes,
- Aromatic solvents, such as benzene, ethyl benzene, toluene, or xylene,
- Ethylene-based glycol ethers or their acetates.

Regarding VOC **verification** it was mentioned that for reactive systems testing shall be conducted according to EC 2004/42¹⁴⁷, which defines ASTM 2369 as the appropriate test method for VOC content measurement on reactive systems. This directive does not cover directly road markings. The verification of the criterion indicates possibility to provide a calculation or a test results according to ISO 11890-2 or equivalent, which allows also for the use of ASTM 2369 where appropriate.

5.2.1.1.2 Criterion 1.2 Product hazard labelling

Core criteria	Comprehensive criteria
TECHNICAL SPECIFICATIONS	
<p>The final product shall not be classified and labelled as being acutely toxic, a specific target organ toxicant, carcinogenic, mutagenic or toxic for reproduction, hazardous to the environment, in accordance with Regulation (EC) No 1272/2008 (CLP Regulation), as indicated in Table 52.</p> <p>Table 52 Final product classification</p>	<p>The final product shall not be classified and labelled as being acutely toxic, a specific target organ toxicant, carcinogenic, mutagenic or toxic for reproduction, hazardous to the environment, in accordance with Regulation (EC) No 1272/2008 (CLP Regulation), as indicated in Table 53.</p> <p>Table 53 Final product classification</p>

¹⁴⁷ See Article 3 and Annex III of the Directive 2004/42/CE on the limitation of emissions of volatile organic compounds due to the use of organic solvents in certain paints and varnishes and vehicle refinishing products and amending Directive 1999/13/EC.

Acute toxicity	Acute Tox. 1 Acute Tox. 2 Acute Tox. 3	Acute toxicity	Acute Tox. 1 Acute Tox. 2 Acute Tox. 3
Specific target organ toxicity – repeated exposure Specific target organ toxicity – single exposure	STOT RE 1 or 2 STOT SE 1, 2 or 3	Specific target organ toxicity – repeated exposure Specific target organ toxicity – single exposure	STOT RE 1 or 2 STOT SE 1, 2 or 3
Carcinogenicity	Carc. 1A Carc. 1B Carc. 2	Carcinogenicity	Carc. 1A Carc. 1B Carc. 2
Germ cell mutagenicity	Muta. 1A Muta. 1B Muta. 2	Germ cell mutagenicity	Muta. 1A Muta. 1B Muta. 2
Reproductive toxicity	Repr. 1A Repr. 1B Repr. 2	Reproductive toxicity	Repr. 1A Repr. 1B Repr. 2
Hazardous to the aquatic environment	Aquatic Acute 1	Hazardous to the aquatic environment	Aquatic Acute 1
	Aquatic Chronic 1 or 2		Aquatic Chronic 1 or 2 Aquatic Chronic 3
<p>or shall not carry a precautionary statements required for products with these classifications. The corresponding packaging labels are provided for reference in Annex 2.</p> <p>Verification: Tenderers shall provide appropriate documentation confirming that the products to be supplied are not classified and/or do not require labelling with the listed hazards. The documentation can include calculations of mixture classification carried out in accordance with the rules provided in the CLP Regulation and/or Safety Data Sheets.</p>		<p>or shall not carry a precautionary statements required for products with these classifications. The corresponding packaging labels are provided for reference in Annex 2.</p> <p>Verification: Tenderers shall provide appropriate documentation confirming that the products to be supplied are not classified and/or do not require labelling with the listed hazards. The documentation can include calculations of mixture classification carried out in accordance with the rules provided in the CLP Regulation and/or Safety Data Sheets.</p>	
		<p>Respiratory sensitization</p> <p>Resp. Sens. 1, 1A or 1B</p>	
		<p>Skin sensitization</p> <p>Skin Sens. 1, 1A or 1B</p>	

Rationale

Due to the use conditions of road markings and various factors influencing their performance along the product life cycle (e.g. climatic conditions, aging processes) various undesired substances may be released from the road marking. These compounds can be then washed off during rainfall to the surrounding environment. In this sense hazardous ingredients contained in road markings may contribute e.g. to environmental hazard for neighbouring land used for agricultural purposes.¹⁴⁸

As mentioned in the rationale for the same criterion for paints (see section 5.1.1.1.3), similarly to road marking products the formulations are complex consisting of high number of various compounds. Depending on the type of a road marking the formulation differs. A typical specification for white marking system consists of minimum 18% (weight) of binder, 10% of rutile (TiO₂) and

148 Pal S. K., Wallis S. G. and Arthur S., Assessment of heavy metals emission from traffic on road surfaces, Cent. Eur. J. Chem. 9(2), 2011, pp. 314-319.

minimum 48 % of glass beads. In the case of yellow markings instead of rutile 4% of yellow pigment of lead chromate (with a minimum of 50 % of lead) could be used. A binder could be maleic modified rosin ester and other plasticisers.¹⁴⁹

Glass beads are fixed into the road marking that is sprayed onto the road surface. They are dropped into the wet paint, are enveloped by the paint (up to above the halfway point of the bead). Glass beads made of clear soda lime glass are composed approximately as follows: 70-74% SiO₂, 12-15% Na₂O, 8-10% CaO, 3.5-4.5 % MgO, 0.3-0.8 % K₂O, 0.0-0.2% Al₂O₃ and 0.08-0.1% Fe₂O₃.¹⁴⁹ In glass beads obtained from recycled material additionally certain amounts of impurities can be found, among them some metals, which are undesired pollutants, hazardous for the environment and human health.

In order to set a preventive measure to ensure that environmental and human health hazards have been taken into account in the product formulation it is proposed to require in both **core and comprehensive criteria** sets that products cannot be classified as hazardous to human health or the environment (in accordance with Regulation (EC) No 1272/2008 of the European Parliament and of the Council (the 'CLP Regulation') or Council Directive 67/548/EC (the 'DSD Directive')); i.e. they cannot be classified or labelled as:

- Acutely toxic,
- A specific target organ toxicant,
- Carcinogenic, mutagenic or toxic for reproduction,
- Hazardous to the environment (H400, H410, H411).

Additionally, in the **comprehensive** set of criteria one additional requirement is set: the requirement regarding classification or labelling as hazardous for the environment is set stricter to cover not only the classification:

- H400 Very toxic to aquatic life,
- H410 Very toxic to aquatic life with long lasting effects,
- H411 Toxic to aquatic life with long lasting effects,

but also:

- H412 Harmful to aquatic life with long lasting effects.

Regarding **verification** of compliance with the criterion tenderers shall provide calculations verifying that the products to be supplied do not require classification or labelling with the listed hazards carried out in accordance with the rules provided in the CLP Regulation or alternatively (prior to 1st June 2015) in the DSD Directive.

Follow-up from stakeholders' consultation

The final classification refers to the road marking product as provided for purchase. Following the request from the stakeholders, beside the calculation of the final classification also provision of material safety data sheets (where the information on the classification of the mixture is given in section 2.1) was included in the verification of the requirement.

149 Diagnostic tool for source apportionment of heavy metals around roads, Fry, C., Jarvis, K.E. and Parry, S.J., UK Environment Agency, 2008, available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/291000/scho0508bocyc-e-e.pdf, accessed May 2014.

5.2.1.1.3 Criterion 1.3 Hazardous ingredients

Core criteria	Comprehensive criteria														
TECHNICAL SPECIFICATIONS															
<p>The product shall not contain the following substances at or greater than the concentration limits in Table 54.</p> <p>Table 54 Paint hazardous ingredient requirements</p> <table border="1"> <thead> <tr> <th>Ingredient</th> <th>Concentration limit</th> </tr> </thead> <tbody> <tr> <td>Phthalates: <i>Di(2-ethylhexyl)-phthalate (DEHP, 117-81-7)</i> <i>Butylbenzylphthalate (BBP, 85-68-7)</i> <i>Dibutylphthalate (DBP, 84-74-2)</i> <i>Di-iso-butylphthalate (DIBP, 84-69-5)</i> <i>Di-C6-8-branchedalkylphthalates (DIHP, 71888-89-6)</i> <i>Di-C7-11-branchedalkylphthalates (DHNUP 685,15-42-4)</i> <i>Di-n-hexylphthalate (DHP, 84-75-3)</i> <i>Di-(2-methoxyethyl)-phthalate (DMEP 117-82-8)</i></td> <td>0.01% per phthalate</td> </tr> <tr> <td>Metals: <i>Cadmium, lead, chromium VI, mercury, arsenic, selenium</i></td> <td>0.01% per metal</td> </tr> </tbody> </table> <p>Verification: The tenderer shall verify the concentration limits established in the criterion for metals by providing test reports using the ISO 3856 series or equivalent. To verify the content of other ingredients Safety Data Sheets shall be provided.</p>	Ingredient	Concentration limit	Phthalates: <i>Di(2-ethylhexyl)-phthalate (DEHP, 117-81-7)</i> <i>Butylbenzylphthalate (BBP, 85-68-7)</i> <i>Dibutylphthalate (DBP, 84-74-2)</i> <i>Di-iso-butylphthalate (DIBP, 84-69-5)</i> <i>Di-C6-8-branchedalkylphthalates (DIHP, 71888-89-6)</i> <i>Di-C7-11-branchedalkylphthalates (DHNUP 685,15-42-4)</i> <i>Di-n-hexylphthalate (DHP, 84-75-3)</i> <i>Di-(2-methoxyethyl)-phthalate (DMEP 117-82-8)</i>	0.01% per phthalate	Metals: <i>Cadmium, lead, chromium VI, mercury, arsenic, selenium</i>	0.01% per metal	<p>The product shall not contain the following substances at or greater than the concentration limits in Table 55.</p> <p>Table 55 Paint hazardous ingredient requirements</p> <table border="1"> <thead> <tr> <th>Ingredient</th> <th>Concentration limit</th> </tr> </thead> <tbody> <tr> <td>Dry film preservatives: <i>Preservatives shall be non-bioaccumulative and any associated risk mitigation measures shall be implemented.</i></td> <td>Log Kow ≤ 3.2 or Bioconcentration Factor (BCF) ≤ 100</td> </tr> <tr> <td>Phthalates: <i>Di(2-ethylhexyl)-phthalate (DEHP, 117-81-7)</i> <i>Butylbenzylphthalate (BBP, 85-68-7)</i> <i>Dibutylphthalate (DBP, 84-74-2)</i> <i>Di-iso-butylphthalate (DIBP, 84-69-5)</i> <i>Di-C6-8-branchedalkylphthalates (DIHP, 71888-89-6)</i> <i>Di-C7-11-branchedalkylphthalates (DHNUP 685,15-42-4)</i> <i>Di-n-hexylphthalate (DHP, 84-75-3)</i> <i>Di-(2-methoxyethyl)-phthalate (DMEP 117-82-8)</i></td> <td>0.01% per phthalate</td> </tr> <tr> <td>Metals: <i>Cadmium, lead, chromium VI, mercury, arsenic, selenium</i></td> <td>0.01% per metal</td> </tr> </tbody> </table> <p>Verification: The tenderer shall verify the concentration limits established in the criterion for metals by providing test reports using the ISO 3856 series or equivalent. To verify the content of other ingredients Safety Data Sheets shall be provided.</p>	Ingredient	Concentration limit	Dry film preservatives: <i>Preservatives shall be non-bioaccumulative and any associated risk mitigation measures shall be implemented.</i>	Log Kow ≤ 3.2 or Bioconcentration Factor (BCF) ≤ 100	Phthalates: <i>Di(2-ethylhexyl)-phthalate (DEHP, 117-81-7)</i> <i>Butylbenzylphthalate (BBP, 85-68-7)</i> <i>Dibutylphthalate (DBP, 84-74-2)</i> <i>Di-iso-butylphthalate (DIBP, 84-69-5)</i> <i>Di-C6-8-branchedalkylphthalates (DIHP, 71888-89-6)</i> <i>Di-C7-11-branchedalkylphthalates (DHNUP 685,15-42-4)</i> <i>Di-n-hexylphthalate (DHP, 84-75-3)</i> <i>Di-(2-methoxyethyl)-phthalate (DMEP 117-82-8)</i>	0.01% per phthalate	Metals: <i>Cadmium, lead, chromium VI, mercury, arsenic, selenium</i>	0.01% per metal
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Rationale

As presented in the rationale for respective criterion established for paint products (see section 5.1.1.1.4) paint and roadmarking products contain a wide range of various compounds, many of which have hazardous properties and can have harmful effects to human health and the

environment. It is thus proposed to set restrictions on use of certain compounds or function substance groups of particular relevance. Reducing the potential for the leaching of hazardous substances from road surfaces to the surrounding environment or from the removal of road markings is of high importance.¹⁴³

In the **core criteria** for road marking the following restrictions are proposed: maximum concentration limit of 0.01% per compound for the following phthalates: DEHP, BBP, DBP, DIBP, DIHP, DHNUP, DHP and DMEP (see Table 56 below) and metals: cadmium, lead, chromium VI, mercury, arsenic, selenium (see Table 57). These include a number of substances identified under Art. 59 of REACH as substances of very high concern, for example lead chromate which was used as a yellow pigment.

Table 56: Phthalates proposed to be restricted in GPP road markings

Name	CAS number	Acronym
Di(2-ethylhexyl)-phthalate	117-81-7	DEHP
Butylbenzylphthalate	85-68-7	BBP
Dibutylphthalate	84-74-2	DBP
Di-iso-butylphthalate	84-69-5	DIBP
Di-C6-8-branched alkylphthalates	71888-89-6	DIHP
Di-C7-11-branched alkylphthalates	68515-42-4	DHNUP
Di-n-hexylphthalate	84-75-3	DHP
Di-(2-methoxyethyl)-phthalate	117-82-8	DMEP

Table 57: Metals proposed to be restricted in GPP road markings

Name	Concentration limit
Cadmium Lead Chromium VI Mercury Arsenic Selenium.	0.01% per metal

The same restriction applies also in the **comprehensive criteria** set. In addition it is asked that **preservatives** used shall not be bioaccumulative and any associated risk mitigation measures shall be implemented. These restrictions are based on the results of the work conducted in the framework of the EU Ecolabel criteria development; nevertheless are simplified to allow more practical verification to be applied by the public authorities.

Regarding **verification** to prove compliance with the criterion ingredients concentrations meeting the limits for specific substances established in the criterion shall be checked using Safety Data Sheets obtained from raw material suppliers. Of the substance groups chosen for restrictions metals have a test method which can be specified to provide high level of assurance to procurers.

5.2.1.2 Criterion 2 Content of hazardous ingredients in broadcast material

Core criteria	Comprehensive criteria
TECHNICAL SPECIFICATIONS	
<p>The glass beads used as broadcast material within the road marking shall not contain arsenic, antimony and lead at individual concentrations exceeding 200 ppm.</p> <p>Verification: The tenderer shall provide a test report verifying the concentrations of the specified substances present in the glass beads according to EN 1423 or equivalent.</p>	<p>The glass beads used as broadcast material within the road marking shall not contain arsenic, antimony and lead at individual concentrations exceeding 150 ppm.</p> <p>Verification: The tenderer shall provide a test report verifying the concentrations of the specified substances present in the glass beads according to EN 1423 or equivalent.</p>

Rationale

For the purpose of this criterion set broadcast material refers specifically to glass beads added to road markings. In accordance with EN 1423¹⁵⁰ glass beads are defined as 'transparent spherical glass particles, used to provide night visibility for the road markings by retroreflecting the incident headlight beams of a vehicle towards the driver'.¹⁵¹ These have been specifically included as criteria set as they were identified as environmental hot-spot in the LCAs studies review.

The below given standards apply for road markings broadcast material (glass beads):

- EN 1424 Road marking materials –Pre-mix glass beads,
- EN 1423 Road marking materials – Drop on materials – glass beads, anti-skid aggregates and mixture of the two.

Road markings are mentioned among potential input sources of contamination to road surface with some metals, like arsenic, antimony, cadmium or lead. These metals have negative influence on human health and the environment. For instance arsenic can contribute among others to loss of hair, damage of liver, gastroenteritis or cancer etc.¹⁵² Similarly, antimony, cadmium and lead exposure have serious human health and environmental impacts (see also section 4.1.2.2.3). Road markings originating from recycled glass may contain some amounts of these metals. Due to the fact that they are applied directly on roads and due to the vehicles passage as well as potential influence of UV radiation, temperature, rainfalls, aging process etc. these substances may be released from the road marking.

Metals on the road surface (which originate mainly from the transport but also the road materials) are bound to the road dust and other particulates. Precipitation either makes them dissolve or be washed off with the dust and be released directly to the environment; either via the soil or the aquatic one, depending among other on the chemical nature of metals, soil particles and the present pH value. Soil bound metals stay in the soil, while soluble ones can be transported and are more readily available to plants and animals.¹⁵³

150 EN 1423: Road marking materials - Drop on materials - Glass beads, antiskid aggregates and mixtures of the two.

151 'Note: This product is defined by five characteristics: refractive index, maximum weighted percentage of defective glass beads, granulometry, content of dangerous substances and resistance to chemicals. In addition, surface treatment with its intended use need to be declared by manufacturer (if any)'.

152 Arsenic and Arsenic Compounds, Ullmann's Encyclopedia of Industrial Chemistry, Sabina C. Grund, Hanusch K. and Wolf H. U., published online 2008.

153 Northern Virginia Soil and Water Conservation District, Heavy Metal Pollution, available online at: www.fairfaxcounty.gov/nvswcd/newsletter/heavymetal.htm, accessed May 2014.

Glass beads and transparent anti-skid aggregates in glass are produced mainly from recycled glass (of domestic and industrial origin). Due to the fact that in the past metals like arsenic (As), antimony (Sb) and lead (Pb) were used to manufacture glass (as colouring and refining agents), control of the content of those hazardous is of high importance. According to information received along the consultation process, better furnace technologies allowed glass manufacturers to eliminate these toxic additives in production processes. Nevertheless, as glass beads in their intended use are spread into the environment, the presence of these substances needs to be controlled.¹⁵⁰ Also due to the fact that glass beads are partially imported from other countries outside of the EU, where such technologies might not be available.

In accordance with EN 1423 standard each element (As, Pb, Sb) shall be separately classified into one of the following two classes:

- Class 0: no value requested,
- Class 1: ≤ 200 ppm (mg/kg).

Recommendations made by the US Responsible Purchasing Network make a similar recommendation based on Class 1 and US EPA test methods.¹⁴³

In order to prevent emissions of toxic metals from road marking products to the environment, it is considered important to limit the allowed content of these substances in glass bead produced from recycled glass. For the purpose of the GPP criteria it is proposed to require that the glass beads used as broadcast material within the road marking shall not contain arsenic, antimony or lead at individual concentrations exceeding 200 ppm, as it is specified in the EN 1423 standard, in **core and comprehensive** criteria sets.

Regarding **verification** of compliance with the criteria a test report verifying the concentrations of the specified substances present in the glass beads according to EN 1423¹⁵⁴ or equivalent shall be provided by the tenderer.

Follow-up from stakeholders' consultation

The previously given limit values were not found too strict. Additional literature research revealed that Australia and New Zealand recommend a maximum of 50 ppm for As, Sb, and Pb, and 10 ppm as a maximum for Cd, Hg, and Cr¹⁵⁵. This is significantly lower than the values required in the EN 1423. Sandhu et al (2013)¹⁵⁶ analysed glass beads coming from Europe, Australia and New Zealand. They noticed that average concentrations of selected metals ranges from: 103 to 683 mg/kg for As, 62 to 187 mg/kg for Sb, 23 to 179 mg/kg for Pb.

Due to lack of comprehensive information on the usual contents of heavy metals in glass beads in Europe, and especially taking into account that recycled glass should be promoted, setting such strict values seems pre-mature. It is considered however reasonable to lower the previously proposed values in the **comprehensive criteria** to 150 ppm to stimulate using the beads with lower content of these harmful substances. This proposal is still consulted with beads industry association, who will provide additional information.

Regarding the **verification**, one stakeholder proposed also declaration from the glass beads supplier and not only test report should be accepted. However, as the proposal refers to a test that is anyway necessary for the CE marking it was considered to keep the test in the verification part of the requirement.

154EN 1423 - Road marking materials. Drop on materials. Glass beads, antiskid aggregates and mixtures of the two.

155 DR 06734 Amendment 1 to AS/NZS 2009:2006 - Glass beads for pavement marking materials.

156 Sandhu N.K., Axe L., Jahan K., Ramanujachary K.V. and Coolahan K., Environmental Impact of Metal and Metalloid Leaching from Highway Marking Glass Beads, Environ. Science & Technology, 2013, 47 (9), pp 4383–4391.

5.2.1.3 Criterion 3 Quality and durability of road marking system – Minimum abrasion resistance

Core criteria	Comprehensive criteria
TECHNICAL SPECIFICATIONS	
<p>The tenderer shall demonstrate that the road marking maintains the minimum performance requirements specified by the procurer in the call for tender for night time visibility, day time visibility, skid resistance and erosion after at least 500,000 wheel passages.</p> <p>Verification: The tenderer shall provide a test report or the approval of a national test facility demonstrating compliance of the road marking system under the conditions appropriate to the contract and according to EN 1824, EN 13197 or equivalent. To ensure comparability the test to be used by all tenderers shall be specified by the procurer.</p>	<p>The tenderer shall demonstrate that the road marking maintains the minimum performance requirements specified by the procurer in the call for tender for night time visibility, day time visibility, skid resistance and erosion after at least 2,000,000 wheel passages.</p> <p>Verification: The tenderer shall provide a test report or the approval of a national test facility demonstrating compliance of the road marking system under the conditions appropriate to the contract and according to EN 1824, EN 13197 or equivalent. To ensure comparability the test to be used by all tenderers shall be specified by the procurer.</p>

Rationale

The functional life of a road marking is defined in EN 1436 standard¹⁵⁷ as a period during which the road marking fulfils all the performance requirements of the classes initially specified by the road authority. The durability of road markings is understood as maintenance of main functions. It plays a key role in the evaluation on the environmental performance of road marking. The more durable the road marking, the less often repainting/refreshing needs to be conducted and the lower all related environmental impacts (related to manufacture of the road marking, its supply, application, etc.).

In order to measure the durability road tests or wear simulator tests are conducted. In a trial the material applied on to a road surface is exposed to certain number of wheel passages in combination with weather and climate conditions. In a wear simulator test, the material applied on to a test plate is also exposed to wheel passages. Finally, also laboratory tests are undertaken under pre-selected testing conditions.

The three types of methods used in various Member States to evaluate certain aspects of durability of the road marking materials are described in the following voluntary European standards:

- laboratory tests in EN 1790¹⁵⁸ and EN 1871¹⁵⁹,
- wear simulator in EN 13197¹⁶⁰,
- road trials in EN 1824¹⁶¹.

157 EN 1436 - Road marking materials - Road marking performance for road users

158 EN 1790 - Road marking materials. Preformed road markings.

159 EN 1871- Road marking materials. Physical properties.

160 EN 13197 - Road marking materials - Wear simulator Turntable.

161 EN 1824: Road marking materials - Road trials.

Performance characteristics of road markings are defined by EN 1436. Road markings shall meet the minimum requirements to ensure a good level of safety and functionality at day and night, even on wet roads (see Table 58).

Table 58: Minimum characteristics for road markings

Characteristics	Conditions	Specification
Night-time visibility* (mcd/m ² .lx)	Dry	≥100 (White) ≥80 (Yellow)
	Wet	≥ 25
Day-time visibility* (mcd/m ² .lx)	Coefficient under diffuse lighting luminescence	≥100 (Asphalt) ≥130 (Concrete)
Skid resistance **	--- x ---	≥ 45

* Not specified for road markings having other colour than white or yellow for which only skid resistance and erosion shall be tested.

** Skid resistance test cannot be performed on road markings with textured surface (for instance structured road markings) thus no skid resistance shall be specified for such road markings.

In accordance with the EN 1824 the performance classes (roll-over classes) for permanent road marking are as follows:

Table 59: Roll-over classes for road markings

Roll-over class	Number of wheel passages
P0	≤ 50 000
P1	Between 50 000 and 60 000
P2	100 000 ± 20 %
P3	200 000 ± 20 %
P4	500 000 ± 20 %
P5	1 000 000 ± 20 %
P5.5	1 500 000 ± 10 %
P6	2 000 000 ± 10 %

Source: EN 1824

While in accordance with the EN 13197 they are as follows:

Table 60: Traffic classes for road markings

Traffic classes	Number of wheel passages
P0	≤ 50 000
P1	50.000 (optional)
P2	100 000
P3	200 000 ± 20 %
P4	500 000
P5	1 000 000

P6	2 000 000
P7	4 000 000

According to information received from the industry stakeholders, testing with EN 1824 are widely used in many European countries (including France, Belgium, Austria, Czech Republic, Slovakia, Poland, Croatia, Hungary the Netherlands and the UK). EN 13197 is used e.g. in Germany and Spain. Laboratory tests are mainly used in Denmark, Sweden, Finland and Greece. Elsewhere in Europe there are no fixed testing standards. It is understood that CEN TC 226 works currently on harmonisation of standards.

It was proposed by stakeholders that systems reaching class 4 or higher shall be considered as durable, high quality marking. It was indicated that testing in accordance with EN 1824 or EN 13197 could be accepted. However, the difficulty of comparing results from different test standards and the variations in requirements across Europe described above make setting a criteria challenging.

In another detailed comment provided it was proposed that wear characteristics, respectively durability of the road marking system shall be tested by wear simulation test according to EN 13197 using test plates with smooth to medium roughness equal to maximum $0,70 \pm 0,10$ (RG0 to maximum RG2). The performance features shall be maintained after 500 000 for the **core criteria** and 2 000 000 wheel passages for the **comprehensive criteria**, which should promote even more environmentally favourable products. Field test results obtained according to EN 1824 meeting above characteristics shall also deem to comply with the corresponding requirement.

Regarding **verification** of compliance with the criterion the tenderer shall provide a test report or the approval of a national test facility demonstrating compliance of the road marking system under the conditions appropriate to the contract and according to EN 1824, EN 13197 or equivalent. Due to the issue of comparability of results a tenderer should choose one testing procedure for the verification. In the case of countries with requirements based on laboratory tests or which have not yet fixed the features it is proposed that the procedure should be as a minimum EN 13197.

Follow-up from stakeholders' consultation

The stakeholders mentioned that both field test (EN 1824) and wear simulator (EN 13197) provide tools to evaluate different aspects of durability. It was stated that from the point of view of reproducibility, cost and time line perspective EN 13197 should be specified as the standard and EN1824 certification shall be accepted wherever available.

There is no correlation between field testing (EN 1824) and wear simulator testing (EN 13197) results, which makes setting absolute value impossible, while accepting still the two testing methods. And that even on the same field test results are not very consistent when comparing the same material applied at a different spots.

Wear simulator testing according to EN 13197 provides well controlled test conditions; nevertheless, its disadvantage is that, it simulates the wear by a certain tires, shear and load characteristic only. It is accepted in many European countries¹⁶². Its costs range from 2000 Euro for P5 type I systems to 3500 Euro for P7 type II. The results can be obtained within a few months.

In comparison, cost for field tests are significantly higher (above 10000 Euro per system) and the duration of the test is also much longer (years). An example from France was provided. France uses field certification according to EN 1824 on national highway N2. New road marking systems can be

¹⁶² According to information received – in Estonia, Lithuania, Latvia, Luxemburg, Greece, Hungary, Bulgaria, Croatia, Slovenia, Serb and parts of Italy.

applied in beginning of June. The applied system performance is observed over a period of up to one year with up to one million wheel passages on the system (P5 certification). Counting in the administrative procedure it takes minimum two years to obtain a P5 certificate.

Stakeholders highlighted, that it should also be taken into account that the actual application conditions (like temperature, humidity, pavement conditions, equipment and other factors) have impact on the functional life of a road marking. Beside this, obviously, the actual traffic wear, location, topography and climatic condition also play a role. For instance, in countries with colder climate snow plow and/or de-icing agents during harsh winters considerably impact the system performance and obtain consistent results from different years (certification periods) is very difficult. The same refers to results obtained from test filed located at sea side, where a heavy sand load influences the road marking lifetime and the results differ from those obtained in locations without sand flow.

As road markings are covered by the Construction Products Directive and should have CE marking a common testing methods should be agreed for the European market. This is however not the case at present and works are ongoing. For the time being both test methods shall be allowed and the procurer shall specify the standard which should be used for a particular call for tender, depending on the methods applied in the given MS or region.

To certain extent there were split views regarding the minimum class required in both core and comprehensive criteria. Some stakeholders supported the minimum class P4 for core criteria, while one proposed to set the level at P5 performance class. Similarly, there was some support regarding the P6 performance class for comprehensive criteria, with one voice stated that specifying class P6 without specifying further parameters is not ambitious enough. There are better performing systems available on the market and industry would be discouraged from increasing R&D efforts to develop even better solutions. It should be however remembered that the GPP criteria stimulate and promote use of products which are more environmentally friendly but are also available at the market.

One additional comment was received regarding the minimum performance characteristics, which according to the association, shall be amended as presented in their position paper: "Marking the way towards a safer future - An ERF Position Paper on how Road Markings can make our road safer future"¹⁶³. Various research projects have been and are being conducted at present in the area of road marking functionality and safety on roads. In particular the following areas are addressed through various projects conducted by industry and research or testing institutes.

- durability of the applied marking,
- visibility and retro-reflectivity, in particular wet night retro-reflectivity,
- relation between the drivers age, the visibility of the marking and the safety on roads in a broad sense (reaction speed).

In the paper of ERF the results of various studies regarding state of the existing road markings, public spending on markings, needed minimum performance factors and their dependence on the e.g. age of the driver are analysed. ERF states that the analysis of the state of road markings in various Member States shown that the serious deterioration of the quality of markings on Europe's road network can be observed. This contributes to decrease of safety on roads. The association proposes establishing *a comprehensive policy for the maintenance of road markings and the establishment of a minimum intervention policy which can guarantee that markings do not fall under a specific performance*. According to the proposal of ERF the *performance should not be*

163 European Road Federation, Marking the way towards a safer future: An ERF Position Paper on how Road Markings can make our road safer, available online at: http://www.irfnet.eu/images/ERF_Paper_on_Road_Markings_Released.pdf.

allowed to drop below 150 mcd/lux/m² (R3) in dry weather conditions and 35 mcd/lux/m² (RW2) in wet and rainy conditions.

In criteria set is proposed that performance features shall be maintained at least after 500 000 for the **core criteria** and 2 000 000 wheel passages for the **comprehensive criteria**. It shall be up to the procurer to specify, depending on their specific needs (e.g. the road type, location, linked climatic conditions and traffic intensity) the minimum performance characteristics, which will be different for different public orders. The proposal of ERF could be an aid in this p.

5.2.2 AWARD CRITERIA FOR ROAD MARKING PAINTS

5.2.2.1 Criterion 1 Road marking formulation - White pigment (titanium dioxide) content

Core criteria	Comprehensive criteria
TECHNICAL SPECIFICATIONS	
<p><i>For call for tenders where specific quality and durability requirements are set:</i></p> <p>Points shall be awarded to the bidder with a product showing a lower white pigment content than:</p> <ul style="list-style-type: none"> – for systems applied at <0.5 kg/m²: <14 % TiO₂, – for systems applied at >0.5 kg/m²: <10 % TiO₂. <p>Verification: The tenderer shall provide documentation for the formulation, supported by test results, showing the content of white pigment.</p>	<p><i>For call for tenders where specific quality and durability requirements are set:</i></p> <p>Points shall be awarded to the bidder with a product showing a lower white pigment content than:</p> <ul style="list-style-type: none"> – for systems applied at <0.5 kg/m²: <10 % TiO₂, – for systems applied at >0.5 kg/m²: <8 % TiO₂. <p>Verification: The tenderer shall provide documentation for the formulation, supported by test results, showing the content of white pigment.</p>

Rationale

As explained in the section 4.1.1 white pigment content is one of the key environmental aspects for paints and similarly for road markings. It must be nevertheless also mentioned that the content of titanium dioxide is linked to the performance and durability of the road marking, which is of utmost importance for the overall environmental performance of the road marking system. TiO₂ is also partially responsible for providing retro-reflection of a car's headlight at night. Therefore, as informed by manufacturers, the content of TiO₂ needs to be higher in road markings than in decorative paints. In accordance with data provided, in paint road marking systems its content can be around 20%, while for thermoplastic and cold plastics around 10%.

In order to ensure reduced use of white pigment on the one hand and the durability of the product whilst on the other hand, some stakeholders proposed to associate the GPP criterion on maximum white pigment content with either the durability classes or the projected lifespan of the marking in years. Class P5 was considered by the industry as indicating high durability of the marking.

There are two main standards used in Member States to define the performance classes of road markings: EN 1824, which is based road trials and EN 13197 which is based on simulated trials. This is discussed in more detail under the criterion related to abrasion resistance of road marking.

The consultation process did not result in an agreed version of this criterion. It has been highlighted that because different testing standards are used across the EU (road trial vs simulated trial conditions) the results will not be comparable. The road trials are also dependant on various conditions, traffic load, and climatic conditions. In various MS one or another method is used, in some there is no agreed procedure. Additional complexity arises from the fact that in some Member States, for example Germany, there are in force legal requirements establishing a minimum thickness of the road marking layer, understood to approximate to 0.5 kg/m² of road paint, which will also directly influence the content of TiO₂.

In the interim the following proposal was put forward by industry stakeholders for the **core and comprehensive criteria**: White pigment content shall be equal to or lower than the limits given in Table 61:

Table 61: Requirement on white pigment content in road markings

Performance class	Core criteria TiO ₂ limit (g/m ²)	Comprehensive criteria TiO ₂ limit (g/m ²)
P5	200	70
P6	400	150

This proposal was linked to performance classes for the number of wheel passages during testing, with the data presented relating to P5 and P6. This is largely understood to be based on results from testing in France but would still be subject to variability depending on the road marking product and the test method. An alternative approach would be to normalise for comparability the TiO₂ limit to be achieved based on either the projected lifespan of the road marking or, with reference to performance classes, the number of wheel passages. Table 62 shows that in order to minimise the life cycle usage of TiO₂, both projected lifespan and TiO₂ usage by surface unit (which depends on TiO₂ content in the road-marking material and on applied weights per surface unit) should be considered in combination.

Table 62: Comparison of TiO₂ content for different Road Marking systems

Road marking system	Edge Durability (Years)	Center Durability (Years)	Application Paint Quantity (Kg)/m ²	TiO ₂ g/kg	TiO ₂ g/m ²	TiO ₂ g/m ² /year
1a. Waterborne Paint standard fast drying	2.0	1.0	0.45	97.10	43.70	21.56
1b. Waterborne Paint High Efficiency	2.0	1.0	0.45	60.00	27.00	13.32
1c. Waterborne Paint High Durability	3.0	2.0	0.6	115.80	69.48	21.62
2a Solvent-borne Paint (Alkyd)	2.0	1.0	0.6	100.00	60.00	29.61
2b.Solvent-borne Paint (Acrylic)	2.0	1.0	0.6	100.00	60.00	29.61
3a. Thermoplastic Package (Cat. I)	3.0	2.0	3.0	70.00	210.00	65.34
3b. Thermoplastic Package (Cat. II)	4.0	3.0	4.0	70.00	280.00	65.03

4a. Cold Plastic (Cat. I)	3.0	2.0	1.0	100.00	100.00	31.12
4b. Cold Plastic (Cat. II)	3.0	2.0	2.0	65.00	130.00	40.45

Source: Dow (2014) based on Life Cycle Assessment Road Marking Technologies Eco-Profile. Final Report Nov. 2012. Dr. H. Kheradmand, LCT, LSA & SD Expert, DCM

An approach based on the projected life span could be specified based on a warranty period, if required by the procurer, whilst an alternative approach could be based on the performance class to be met. For example, thermoplastic markings would require white pigment to be applied up to 280g/m² which, based on a projected lifespan of 3-4 years, would equate to 70-93g/m²/year or, based on a minimum P4 performance class, 0.56 µg/m²/wheel passage. A proposed threshold based on wheel passages is proposed in Table 63, assuming a linear correlation between TiO₂ content and abrasion resistance.

Table 63: Requirement on white pigment content in road marking

Performance class	Core criteria TiO₂ limit (g/m²/10³wheelpassages)	Comprehensive criteria TiO₂ (g/m²/10³wheelpassages)
P4 – P6	0.2	0.07

Regarding **verification** the tenderer shall provide documentation for the road marking formulation, supported by analysis results showing that the content of white pigments is compliant with this criterion. If the link to performance classes is retained then the procurer will need to specify that all the bidders use the same test method to ensure comparability of bids. For those countries where there is a requirement on minimum thickness of road marking layer an award criterion was proposed based on white pigment content.

Follow-up from stakeholders' consultation

One stakeholder expressed doubts regarding the values used for calculation in Table 62, considering them too low. However, no technical information, which could allow verification of the information provided by DOW was presented.

Another stakeholder checked the values versus their own products and confirmed that the proposed values were fine for core criteria and quite demanding for the comprehensive ones for P5 performance class. German expert stated that Type II systems existing in his MS would not comply with the requirements of the comprehensive criterion.

It was stated that only for very thin layers of about 0.20 mm or lower a higher TiO₂ (>10 wt%) is needed to archive adequate hiding power and there may be certain dependants between the content of TiO₂ and durability. This refers however only to Type I and not to Type II systems.

In general, the stakeholder recognised that TiO₂ is an environmental hotspot. But again it was emphasized that it is essential for the durability of the product and its performance in terms of safety. The implications of setting an absolute max concentration on the performance would require more thorough investigation, which exceeds the scope of the current project.

Additional difficulty is linked to the fact that still no harmonised standards for testing of road markings performance exist in Europe. Thus the given in Table 63 performance classes should be fine for the EN 1824, while for instance in Germany, where EN 13197 is used and, according to information provided, P7 is the most common class.

It was stated that the currently drafted criteria (core and comprehensive) are based on the assumption that there is a direct correlation between durability of the road marking and TiO₂ content and that such a correlation does not exist in general. This is however not the intention of

the criteria to base on the correlation but to award manufacturers, who manage formulate a better product, i.e. offering the same performance (tested either with EN 1824 or EN 13197) but with lower amount of TiO₂. This can be done through choice of the formulation ingredients, e.g. higher quality TiO₂, choice of binders, etc.

Some stakeholders proposed to refer to the French scheme – NF331 - NF Environnement

- Horizontal road marking products¹⁶⁴, which states that the products shall have a content in white mineral pigments TiO₂ less than or equal to:

- 200 g/m² of dry film for paint,
- 400 g/m² of dry film for plastic or for preformed marking.

However, discussion with the NF representatives was conducted; however the reasoning for setting these thresholds was unavailable.

Alternative proposals were also provided from a MS, where there are requirements on the minimum film thickness:

1) Two criteria on white pigment content depending on lasting could be set:

- normal lasting (solvent borne or water borne) coatings: 0,2 g/m²*10³ wheel passages,
- long lasting coatings (multicomponent plastics (cold coating): 0,8 g/m²*10³ wheel passages.

2) Or maximum content based on thickness, instead of surface: 0,2 g/m²*10³ wheel passages • mm thickness could be proposed.

Nevertheless; to evaluate all the above proposals, data is missing on the content of the pigment and corresponding performance.

One more proposal was provided in order to accommodate both, thin and thick layer systems. It is formulated as follows:

- Core criteria:

Systems applied at <1 kg/m²: <14wt% TiO₂

Systems applied at >=1 kg/m²: <10wt% TiO₂

- Comprehensive criteria:

Systems applied at <1 kg/m²: <10wt% TiO₂

Systems applied at >=1 kg/m²: <8wt% TiO₂

It is proposed to consult it with the stakeholders in the current consultation round. It would allow for setting some minimum requirement levels.

It is now understood better how the real durability or life span of a road marking depends on the specified functionality. And that there is a substantial difference depending if there is or not a requirement on the night-time visibility (retro-reflectivity), and (even more challenging) if there is a requirement on wet night retro-reflectivity. These will influence the choice of the system by the procurer and to certain extent also the content of TiO₂. *'To obtain night-time visibility of a road marking, respectively retro-reflectivity both a minimum content of TiO₂ and a minimum presence and a minimum size of retro-reflecting glass beads at the surface of the road marking material is required, whereby glass bead dimension requires a minimum thickness of the road marking material to anchor the beads in the pigmented material.'*

164 More information available online at: NF331 - NF Environnement - Horizontal road marking products, <http://www.marque-nf.com/en/nf-for-professional/which-nf-certification-should-i-choose/>.

Beside the quality of TiO₂ and the colour of the fillers in the formulation which influence the performance parameters of the road marking, also factors like the 'road texture and the characteristics of the pavement influence the minimum thickness required to obtain Type I retro-reflective character (usually 0.25-0.4 mm required) and Type II spray applied road markings (respectively about 0.4 to 0.7 mm for)'.

It is thus understood that at the current state of knowledge it is challenging to propose minimum thresholds for the different systems and applications in the EU linking them with performance factors.

It is proposed to consult the proposal provided along the consultation process, which differentiates thin and thick applications. Points shall be awarded to the bidder who offers products showing a lower white pigment content than:

Core criteria	Comprehensive criteria
<ul style="list-style-type: none"> – for systems applied at <0.5 kg/m²: <14 % TiO₂, – for systems applied at >0.5 kg/m²: <10 % TiO₂. 	<ul style="list-style-type: none"> – for systems applied at <0.5 kg/m²: <10 % TiO₂, – for systems applied at >0.5 kg/m²: <8 % TiO₂.

As **Verification** appropriate documentation for the paint formulation, supported by test results, showing the content of white pigment shall be provided.

5.2.2.2 Criterion 2 Broadcast material

As mentioned before, glass beads in road markings are used to achieve retroreflection. They are partially embedded on the surface of the marking binder material. There are two principle kinds of glass beads: 1) used as intermix for thermoplastic marking or 2) drop-on beads.¹⁶⁵

Two important field properties of beads are the amount and dispersion across a line and the depth of embedment of the beads. They are influenced by: bead drop rate, speed of the striping truck, temperature, and viscosity of the binder material, etc. During the manufacturing process the following features of beads (chemical and physical), which have a significant influence on the retroreflection of light, can be controlled: bead size, refractive index, clarity and roundness.¹⁶⁵

Regarding size, it shall be mentioned that bigger beads have slightly higher retro-reflectivity under dry conditions (but no on refractive index). In wet conditions, the film of water that covers the marking causes that the light scatters before it can enter the bead. Therefore, large beads are more effective when roads are slightly wet. They protrude through the water film better than smaller beads. But this is also dependant on the thickness of the film (the thicker the film the larger beads more lose their effectiveness).

'The refractive index (RI) is a function of the chemical makeup of the beads, which is determined by the raw material used to make the bead. The higher the refractive index, the more light is retroreflected'.¹⁶⁵ Higher refractive indices are achieved by beads made from virgin glass than from recycled glass. But these beads are normally more expensive. Transparency and roundness are also important. Transparency ensures that the light passes through the bead and it is not partially blocked by the material. While rounded surface 'causes the light ray to bend downward to a point below where the bead is embedded in the paint. Light striking the back of the embedded portion of the bead is reflected back to the path of entry'.¹⁶⁵

¹⁶⁵ Lopez, C. A., Online Manual: Pavement Marking Handbook, 2004, available online at: http://onlinemanuals.txdot.gov/txdotmanuals/pmh/glass_beads.htm, accessed May 2014.

5.2.2.2.1 Criterion 2.1 Quantity of broadcast material required – CRITERION WITHDRAWN

Initial rationale

As indicated in the LCA of road markings, glass beads contributes to the main environmental impacts of road markings, it is proposed to establish an **comprehensive award criterion**, which should address manufacturers offering products with lower amount of broadcast materials in their product, ensuring at the same time equal quality with regard to night time visibility and retro-reflectivity. As the performance is crucial, testing of the retro-reflectivity feature is very important. It should be added that an inadequate distribution rate of beads would lead to insufficient retro-reflectivity, while too excessive amount of glass beads 'would render the reflected light being shadowed by the excessive glass beads'.¹⁶⁶ It is proposed that points should be awarded in inverse proportion to the quantity of broadcast material required per m² of roadmarking to provide the same specified grade of night time visibility and retro-reflectivity in wet conditions.

Regarding **verification** of compliance with the criteria the tenderer shall provide a bill of materials in response to the ITT¹⁶⁷ specifications for the road marking contract, to include a calculation of the broadcast material quantity per m².

Follow-up from stakeholders' consultation

Stakeholders stated that it is not possible to specify minimum quantity of glass beads due to the fact that there are too many types of road marking systems with different characteristics and the optimal quantity ratio for glass beads will depend on the system chosen by the procurer and the intended application and location. The amount and the size of glass beads are linked with the applied film thickness.

Additionally, the European association of producers of glass beads Euroadbead stated that industry is aware of their impact on climate change. Possibilities of reducing CO₂ emission and improving energy efficiency were analysed in a Product Carbon Footprint (PCF) study of glass beads for road marking applications. The report of this study is available¹⁶⁸. *The study showed us that it is possible to quantify the efforts made by the European glass bead industry to limit their environmental impact.* It would however require conducting a Product Carbon Footprint (PCF). Such an approach is not considered for practical. The studies on PCF of different competing products need to be consistent and with comparable outcomes which lead that rules on PCF category rules may be necessary. Moreover, even if this is resolved it will be a challenge to verify these declarations in a cost effective way.

It is thus decided to withdraw this criterion as an award criterion.

5.2.2.2.2 Criterion 2 Broadcast material – Recycled glass content

Core criteria	Comprehensive criteria
AWARD CRITERIA	
	<i>For purchase of road marking containing broadcast material to fulfil specified grade</i>

166 Guidance notes on the application of thermoplastic materials for road markings, Highways Department, Research & Development Division, Hong Kong, 2010, available online at:

http://www.hyd.gov.hk/en/publications_and_publicity/publications/technical_document/guidance_notes/pdf/GN036.pdf .

167 ITT = Invitation to Tender

168 For details see <http://www.euroadbead.eu/wp-content/uploads/2014/03/PCF-Report-2014.pdf>.

	<p><i>of night time visibility and retro-reflectivity in wet conditions set in the call for tender:</i></p> <p>Points shall be awarded when post-consumer recycled glass content of the glass beads used as broadcast material exceeds 15%.</p> <p>The specified grade of night time visibility and retro-reflectivity in wet conditions set in the call for tender shall be met.</p> <p>Verification:</p> <p>The tenderer shall provide declaration from the glass bead manufacturer indicating the recycled glass content per kg of broadcast material. This shall be third party certified as part of ISO 9001 or an equivalent national or international scheme for verifying traceability of recycled content.</p>
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Rationale

Glass beads can be made from virgin or recycled glass. Due to the fact that glass manufacturing is a highly energy consuming process, use of recycled materials conserves energy and resources, and allows additionally reduction of pollution related to raw materials extraction and energy production and consumption.¹⁶⁹ Recycled glass for beads can originate from both – manufacturing and postconsumer waste. Collected glass is sorted and crushed to customized sizes, depending on its intended application method and the type of road marking it will be used with. It is understood that the flat glass is the main source of feedstock. Application of glass beads in road markings created a market for material recovery and allowed avoiding necessity of disposal of waste glass.¹⁷⁰

In accordance with the information provided along the consultation process by the stakeholders, there are two classes of glass beads used as drop-on materials. They are of different size and they provide different functionality, which at the same time require different levels of quality which is reflected in the glass feedstock:

It is proposed to support the use of recycled glass in road markings and to set a **comprehensive award criterion** which addresses the content of recycled glass. Additional points shall be awarded to the tenderer who offers products with recycled glass beads (the points shall be given in proportion to the recycled glass content of the glass beads used as broadcast material).

Regarding **verification** of compliance of the tendered product with the criteria recycled glass content for the bead specification per kg of product shall be certified by the glass bead manufacturer and provided by the tenderer. In the absence of a specific traceability standard for recycled glass content it is proposed that verification of production management as part of ISO 9001 could be used as a starting point or alternatively a national or international scheme that are specific to recycled glass production.

169 Kankan-Dwumfour E., Recycled glass bead production in selected towns in Ashanti, Industrial Art Ceramics, 2009.

170 Utilization of Recycled Materials in Illinois Highway Construction – Glass Beads, US Department of Transportation, Federal Highway Administration, 2001, available online at: <http://www.fhwa.dot.gov/pavement/recycling/recbead.cfm>, accessed May 2014.

Follow-up from stakeholders' consultation

Explanatory information was provided regarding the use of beads by the industry association. It was explained that *Type I and Type II performance cannot be directly correlated to a bead size or to a chemical composition. The wet reflectivity performance relates only to the applied system (bead size, road marking material, film thickness, structure etc.) and not to the single road marking components.* It was suggested that referring to Type I and Type II beads is confusing and should be avoided. Respective text was amended in the text.

Due to the fact that another criterion on glass beads is withdrawn, and knowing that glass beads contribute to environmental impacts along road markings life cycle, it is proposed to award points for higher use of post-consumer recycled glass. As minimum, in order to be given award points, the content of recycled glass in glass beads should amount 15%. Input on this value will be received from the beads association still and it may be revised.

5.2.2.2.3 Criterion 3 Distribution and take-back

Core criteria	Comprehensive criteria
CONTRACT PERFORMANCE CLAUSES	
<p>Points shall be awarded to tenderers that use road marking supply systems that minimises packaging waste.</p> <p>Tenderers shall submit an estimate of the weight and type of packaging that will be used as the function of the volume of road marking delivered for the contract.</p> <p>Maximum amount of points shall be given for reusable systems in place.</p> <p>Verification:</p> <p>The systems to be used for storage and delivery of the road marking shall be described and calculations provided for the estimate of the weight of packaging per volume of road marking.</p>	<p>Points shall be awarded to tenderers that use road marking supply systems that minimises packaging and road marking waste.</p> <p>Tenderers shall submit an estimate of the weight and type of packaging that will be used as the function of the volume of road marking delivered for the contract.</p> <p>Maximum amount of points shall be given for reusable systems in place.</p> <p>Packaging waste together with residual road marking shall be taken back for re-use, recycling or safe disposal.</p> <p>Verification:</p> <p>The systems to be used for storage and delivery of the road marking shall be described and calculations provided for the estimate of the weight of packaging per volume of road marking.</p> <p>The take-back system and end-markets for residual road marking and packaging waste shall be described.</p>

The same requirements as for paints are proposed regarding distribution and take-back schemes for road marking and its packaging (see Section 5.1.2.3). This refers also to verification process.

Follow-up from stakeholders' consultation:

Stakeholders commented that this kind of product is applied by professional sector only and therefore the efficiency of usage is pretty high if compared with consumer products like decorative paints. It was described that bulk containers are used for delivery and storage of the road marking

material and that also small containers are taken back for recycling. Thus it seems that this requirement shall be feasible to comply with.

5.2.3 CONTRACT PERFORMANCE CLAUSES FOR ROAD MARKING PAINTS

5.2.3.1 Criterion 1 Technical support and site inspections

Core criteria	Comprehensive criteria
CONTRACT PERFORMANCE CLAUSES	
<p>The tenderer shall provide technical advice and site works instructions to the Contracting Authority or their contractors. This shall include the following:</p> <ul style="list-style-type: none"> • Method statements and guidance on substrate preparation, • Method statements and guidance on paint preparation, including estimates for application per m², • Optimal conditions for storage and application of the product, including support in selecting and using application equipment, • Risk mitigation measures to minimise environmental pollution, • Advice on appropriate disposal of unused paint. <p>Site visits and training by technicians from the paint manufacturer shall also be available upon request for larger works by the Contracting Authority or their contractors.</p> <p>Verification: The tenderer shall provide documentation which contains the listed information. Written feedback from the operatives applying the road marking product shall confirm satisfactory provision of technical advice and site support shall be provided.</p>	<p>The tenderer shall provide technical advice and site works instructions to the Contracting Authority or their contractors. This shall include the following:</p> <ul style="list-style-type: none"> • Method statements and guidance on substrate preparation, • Method statements and guidance on paint preparation, including estimates for application per m², • Optimal conditions for storage and application of the product, including support in selecting and using application equipment, • Risk mitigation measures to minimise environmental pollution, • Advice on appropriate disposal of unused paint. <p>Site visits and training by technicians from the paint manufacturer shall also be available upon request for larger works by the Contracting Authority or their contractors.</p> <p>Verification: The tenderer shall provide documentation which contains the listed information. Written feedback from the operatives applying the road marking product shall confirm satisfactory provision of technical advice and site support shall be provided.</p>

Rationale

As explained in a respective requirement for paints, in order to ensure appropriate application of the road marking product and that the appropriate amount of the product is purchased (i.e. the product is not wasted) it is considered important to address technical advice and site inspections aspects in the frame of GPP criteria. This advice shall cover the following:

- Method statements and guidance on substrate preparation and paint preparation,
- Optimal conditions for storage and application of the product,

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- Risk mitigation measures to minimise environmental pollution,

It is proposed that the tenderer shall additionally provide estimates for the amount of road marking required in different applications per m². This will aid more accurate estimation of the amount of product needed for the specific work the public authority intends to contract.

In addition, it is proposed that upon request for larger works site visits by technicians from the manufacturer shall also be available to ensure proper application of the product and its subsequent appropriate performance along the life cycle. Given that the application of road markings requires specialist equipment it is considered that training should also be provided in order to optimise a product's application.

Regarding **verification** of compliance the tenderer shall provide documentation which contains requested information. Written feedback from the operatives applying the road marking product shall confirm satisfactory provision of technical advice and site support.

DRAFT - WORK IN PROGRESS

5.3 PAINTS AND ROAD MARKINGS WORK CONTRACTS

In the last section of this report aspects and requirements related to paints and road marking contracts are presented. These can include one-off works contracts; call down contracts from a framework as well as cyclical, long-term painting services. These contracts provide an opportunity to focus not just on the product but on how efficiently it is used and the overall durability of the painted or marked surfaces. This is in line with the background technical analysis which highlighted the importance of extending the life-span of the product.

A major example for paints and varnishes would be the cyclical painting of municipal housing and buildings, inclusive of window frames, facades and metal balustrades, as well as interior decoration and street furniture (lamps, benches, etc.). For road marking this could include maintenance contracts with national highways authorities as well as local municipalities.

5.3.1 SELECTION CRITERIA

5.3.1.1 Criterion 1 Competencies of the tenderer

Core criteria	Comprehensive criteria
SELECTION CRITERIA	
<p>The tenderer shall demonstrate professional competencies in the following areas, as relevant to the nature of the contract being let:</p> <ul style="list-style-type: none"> • Method statements for the efficient use of paint on-site, including the preparation of estimates and the use of specialist equipment; • Method statements for the preparation of substrates and paint formulations prior to application (including, where appropriate, safety procedures for removal of paints or road markings which may have been made with lead pigment and are considered hazardous; or high pressure removal of road markings); • The application of environmentally improved products, including those with reduced VOC content; • The application of durable and high specification finishes, with reference to relevant EN standards or their equivalent; • Policies and supporting management systems to minimise paint or road markings waste, maximise the re-use or recycling of residual paint or road marking and to ensure their safe disposal and safe disposal of other 	<p>The tenderer shall demonstrate professional competencies in the following areas, as relevant to the nature of the contract being let:</p> <ul style="list-style-type: none"> • Method statements for the efficient use of paint on-site, including the preparation of estimates and the use of specialist equipment; • Method statements for the preparation of substrates and paint formulations prior to application (including, where appropriate, safety procedures for removal of paints or road markings which may have been made with lead pigment and are considered hazardous; or high pressure removal of road markings); • The application of environmentally improved products, including those with reduced VOC content; • The application of durable and high specification finishes, with reference to relevant EN standards or their equivalent; • Policies and supporting management systems to minimise paint or road marking waste, maximise the re-use or recycling of residual paint or road marking and to ensure their safe disposal and safe disposal of other

chemicals such as paint stripping agents.	chemicals such as paint stripping agents.
Verification: The tenderer shall provide supporting documentation including method statements, product specifications used on previous contracts and policies relating to residual and waste paint or road markings handling. Performance data from previous work contracts shall be provided where available.	Verification: The tenderer shall provide supporting documentation including method statements, product specifications used on previous contracts and policies relating to residual and waste paint or road markings handling. Performance data from previous work contracts shall be provided where available.

Rationale

Selection criteria are related to the capacity of bidders to perform the contract.¹⁷¹ In order to be selected for the painting service the tenderer needs to demonstrate a range of professional competencies in the areas relevant to the nature of the contract. For the purpose of this GPP criteria it is considered that the most important competencies encompass:

- Method statements for the efficient use of paint on-site, including the preparation of estimates and the use of specialist equipment;
- Method statements for the preparation of substrates and paint formulations prior to application (including, where appropriate, safety procedures for removal of paints which in the past have been made with lead pigment and are considered hazardous; or high pressure removal of road markings);
- The application of environmentally improved products, including those with reduced VOC content;
- The application of durable and high specification finishes, with reference to relevant EN standards or their equivalent;
- Policies and supporting management systems to minimise paint waste, maximise the re-use or recycling of residual paint and to ensure safe disposal of waste paint and other chemicals such as paint stripping agents.

The same requirements apply to both, **core and comprehensive criteria sets**.

Regarding **verification** of compliance the tenderer shall provide supporting documentation including method statements, product specifications used on previous contracts and policies relating to residual and waste paint handling. In addition, it is asked that the performance data from previous work contracts shall be provided where available.

5.3.1.2 Criterion 2 Use of paints or road markings meeting the EU GPP criteria

Core criteria	Comprehensive criteria
SELECTION CRITERIA	
The tenderer shall use paints or road marking products that comply with the EU Green Public Procurement requirements as specified:	The tenderer shall use paints or road marking products that comply with the EU Green Public Procurement requirements as specified:

¹⁷¹ European Commission 'Buying Green Handbook', 2011, available at: http://ec.europa.eu/environment/gpp/buying_handbook_en.htm.

<ul style="list-style-type: none"> – For paints: Technical specifications for core criteria of EU GPP Section 3.1 Paints and varnishes <p>or</p> <ul style="list-style-type: none"> – For road markings: Technical specifications for core criteria of EU GPP Section 3.2 Road markings <p>Verification: The tenderer shall provide supporting documentation that the products used meet the criteria as specified in the verification part of the EU GPP criteria.</p>	<ul style="list-style-type: none"> – For paints: Technical specifications for comprehensive criteria of EU GPP Section 3.1 Paints and varnishes <p>or</p> <ul style="list-style-type: none"> – For road markings: Technical specifications for comprehensive criteria of EU GPP Section 3.2 Road markings <p>Verification: The tenderer shall provide supporting documentation that the products used meet the criteria as specified in the verification part of the EU GPP criteria.</p>
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This criterion was newly introduced just in order to ensure that the criteria for environmentally preferable products and for work contracts are used simultaneously by the procurers who intend to purchase "a service and a product in one tender".

5.3.2 TECHNICAL SPECIFICATIONS FOR PAINTS AND ROAD MARKINGS WORK CONTRACTS

5.3.2.1 Criterion 1 Management of residual paint or road marking

Core criteria	Comprehensive criteria
TECHNICAL SPECIFICATIONS	
<p>Paint or road marking waste shall be no more than 5% of the amount used during the duration of the contract.</p> <p>The tenderer shall submit a waste management plan for paint or road marking arising from the preparation of the substrate and application of new paint or road marking. The plan shall include:</p> <ul style="list-style-type: none"> • An assessment for the potential hazardous content of paint or road marking that has been stripped from substrates and, if a risk is identified, a method statement for mitigating the risk by safe handling and disposal. • A method statement shall be provided for on-site practices in the cleaning of painting equipment and the storage of residual paint or road marking for safe disposal as hazardous waste. 	<p>Paint or road marking waste shall be no more than 1.5% of the amount used during the duration of the contract.</p> <p>The tenderer shall submit a waste management plan for paint or road marking arising from the preparation of the substrate and application of new paint or road marking. The plan shall include:</p> <ul style="list-style-type: none"> • An assessment for the potential hazardous content of paint or road marking that has been stripped from substrates and, if a risk is identified, a method statement for mitigating the risk by safe handling and disposal. • A method statement shall be provided for on-site practices in the cleaning of painting equipment and the storage of residual paint or road marking for safe disposal as hazardous waste.

<p>Verification: The tenderer shall provide calculation of the amount of unused paint (expressed in percentage of the purchased paint) together with a documented waste management plan which shall include method statements for safe paint or road marking stripping, equipment cleaning and residual paint handling and disposal.</p> <p><i>Monitoring of paint or road marking waste arising shall be addressed as a contract performance clause.</i></p>	<p>Verification: The tenderer shall provide calculation of the amount of unused paint (expressed in percentage of the purchased paint) together with a documented waste management plan which shall include method statements for safe paint or road marking stripping, equipment cleaning and residual paint handling and disposal.</p> <p><i>Monitoring of paint or road marking waste arising shall be addressed as a contract performance clause.</i></p>
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Rationale

As indicated in section 4.1 on LCA of paints, unused paint is one of the environmental issues of concern. It can be considered hazardous waste and its amount should be kept as low as possible. In the current proposal it is required that paint or road marking waste shall be no more than 5% in **core criteria** and 1.5% in **comprehensive criteria** of the amount used during the duration of the contract.

In general, there lacks data about the shares of paint and road marking products left unused after completing the application process and wasted. The study conducted by WRAP¹⁷² highlighted the problem of unused paint in the UK. In the domestic sphere, around 25% of all paint goes unused, whereas in trade sector it is 1.5%. The later value was chosen as a target for the comprehensive criteria, while, due to lack of additional thresholds, 5% is proposed for the consideration and feedback from stakeholders. Monitoring of the amount of paint or road marking waste is addressed in the framework of contract clauses.

Further, it is considered important that a tenderer has or establishes a waste management plan for waste paint or road marking arising from the preparation of the substrate and application of new paint or road marking. This plan shall ensure safe handling, storage and disposal of the paint. In addition, indications regarding appropriate practices for cleaning of paint equipment are of importance. The plan proposed for **core and comprehensive criteria** shall include:

- A assessment for the potential hazardous content of paint or road marking that has been stripped from substrates and a method statement for its safe handling and disposal. This is being highlighted also by the US EPA as a potential issue where, for example, older paints may contain metals like lead and cadmium require stripping. It may also be the case for road markings that pigment such as lead chromate (now a substance of very high concern) may have been used.
- A method statement shall be provided for on-site practices in the cleaning of painting equipment and the storage of residual paint or road marking for safe disposal as hazardous waste. The on-site system for washing the water-based paints from the equipment in order to prevent the residues from paint washing entering the drainage system could be an effective example of one of such practices.

Regarding **verification** of compliance with the criterion the tenderer shall provide a documented waste management plan including method statements for safe paint or road marking stripping,

¹⁷²Lee P., Willis P, WRAP, Paint and woodcare products – distribution and delivery – A review of alternative supply chain approaches within UK paint and woodcare markets, Final Report, 2011.

equipment cleaning and residual paint handling and disposal. Monitoring of paint or road marking waste arising shall be addressed as a contract clause.

Follow-up from the stakeholders' consultation

Industry stakeholders suggested that considering the very minor amount of road marking paint which may remain for disposal in this specific sector, they suggest not to implement criteria on road marking waste management. This is mainly due to the big documentation effort which typically small application enterprises would need to do to prove the compliance, with little added value to the environment. This is however considered a good environmental practice and should be an added value not only for public contracts but for the general normal practices of the company. The verification documentation needed for this criterion should not constitute excessive effort.

5.3.3 AWARD CRITERIA FOR PAINTS AND ROAD MARKINGS WORK CONTRACTS

5.3.3.1 Criterion 1 Efficiency of application and durability

5.3.3.1.1 Criterion 1.1 Provision of warranties

Core criteria	Comprehensive criteria
AWARD CRITERIA	
<p>Points shall be awarded according to the length of the warranty offered for performance of the painted surfaces.</p> <p>Verification: The tenderer shall provide a copy of the warranty terms and conditions and the security put in place to maintain the warranty commitment. The basis for the assumption of warranty length shall be provided. Assumptions relating to preparation of the substrate and paint or road marking specifications to be used shall be outlined.</p>	<p>Points shall be awarded according to the length of the warranty offered for performance of the painted surfaces.</p> <p>Verification: The tenderer shall provide a copy of the warranty terms and conditions and the security put in place to maintain the warranty commitment. The basis for the assumption of warranty length shall be provided. Assumptions relating to preparation of the substrate and paint or road marking specifications to be used shall be outlined.</p>

Rationale

As explained in the environmental analysis section, use phase of a paint or a road marking, i.e. its quality and durability, are among the most crucial aspects determining its environmental performance, beside the amount of paint used. In this respect, the time between repaints is very important.

Products with good performance characteristics not only will be used in lower amount but also afterwards the painted surface will require less frequent repainting. As a consequence, looking from the life cycle perspective, smaller amount of a paint or a road marking used results in a lower environmental impact related to its production, release of air pollutants during application and the treatment of waste.

As decreasing the frequency between repaints has a significant effect on reducing the overall environmental impact of the paint or the road marking it is proposed to establish an **award criterion (core and comprehensive)** in the area of extended warranty. Points shall be awarded to

tenderers offering longer than the warranty required by the contract and according to the length of the projected performance and life-span of the painted surfaces. Stakeholder feedback suggested that this is a common practice in some countries in relation to road markings.

Regarding **verification** of compliance with the requirements the tenderer shall provide a copy of the warranty terms and conditions and the security put in place to maintain the warranty commitment. The basis for the assumption of warranty length shall be provided. Assumptions relating to preparation of the substrate and paint or road marking specifications to be used shall be outlined.

5.3.3.1.2 Criterion 1.2 Long-term painting contracts

Core criteria	Comprehensive criteria
AWARD CRITERIA	
	<p>Points shall be awarded according to the identified potential for savings in the amount of paint or road marking used during a planned paint contract that may require several renewals of the paint or marking.</p> <p>The potential for savings in the use of paint during the contract period, as well as related savings in related overheads such as access, stopping up of highways (in the case of road markings) shall be calculated on the basis of the planned program and the assumptions provided.</p> <p>Verification:</p> <p>The tenderer shall provide a document setting out the estimated quantities of paint required during the contracted program as well as the potential for savings on paint or road marking. The equivalent financial savings, including saving on associated overheads, shall also be estimated.</p>

Rationale

In addition to the above criterion, a second **comprehensive award criterion** is proposed for long-term painting contracts which cover also repainting service. It is understood from examples from public sector housing maintenance contracts in the UK that overall costs can be reduced over the life-span of the contract by selecting more durable products and by more frequent preventative works to prevent deterioration of a painted surface or material. Where a contract is over longer period of time, 5 years or more, then there will be an inherent incentive for the contractor to choose paint and road marking products that are more durable.

Less frequent repaints would have the potential to contribute to environmental savings mentioned for the previous criterion, but also result in savings in related overheads such as access, stopping up of highways and lower danger due to works conducted on roads (the last two in the case of road markings). Therefore it is proposed that points shall be awarded according to the potential for savings in paint or road marking use for planned, cyclical repainting by providing supplementary

maintenance and remedial services for painted surfaces. Such long-term contract could cover maintenance service (on an agreed time-basis), cleaning of dirty surfaces and repairing damaged ones. The tenderers shall provide estimation of savings for overheads such as access, stopping up of highways (in the case of road markings). The basis for the assumptions used shall also be provided.

Regarding **verification** of compliance with the requirements the tenderer shall provide a document setting out the estimated quantities of paint required during the contracted program as well as the potential for savings on paint or road marking. The equivalent financial savings, including saving on associated overheads, shall also be estimated.

5.3.3.2 Criterion 2 Management of residual paint

5.3.3.2.1 Criterion 2.1 Paint re-use and recycling

Core criteria	Comprehensive criteria
AWARD CRITERIA	
	<p>Points shall be awarded reflecting a commitment to re-use or recycle residual paint or road marking product. The tenderer shall submit a management plan setting out how residual paint arising from works will be:</p> <ol style="list-style-type: none"> 1. Re-used on the same or other contracts, and/or 2. Arrangements to ensure it is re-used or recycled externally. <p>Re-use or recycling routes could include re-use projects or the manufacturing of new paint or road marking using residual product as a base. A monitoring system will be used to account for residual paint arisings.</p> <p>Verification: The tenderer shall provide a documented management plan which shall include method statements for handling and storage of residual paint for re-use by the contractor, as well as arrangements for re-use or recycling of paint by third parties. The monitoring system shall record the quantities of waste paint or road marking arisings and their subsequent use.</p>

Rationale

A **comprehensive award criterion** is proposed for the area of management of residual paint. As shown in the environmental evaluation section the end of life of paint is a problematic area. Reduction of the amount of paint or road marking which is disposed shall be strived, as it contributes to decrease of the overall environmental impact. Re-use and recycling of unused paints

are sustainable though still not widely used practices which could be used to achieve this goal. Therefore, in order to promote tenderers who are committed to re-use or recycle of residual product it is proposed to set a comprehensive award criterion on paint or road marking re-use and recycling. Re-use or recycling routes could include re-use projects or the manufacturing of new product using residual paint or road marking as a base. The tenderer shall submit a management plan setting out how residual paint arising from works will be:

- Re-used on the same or other contracts, and/or
- Arrangements to ensure it is re-used or recycled externally.

Regarding **verification** of compliance with the requirements of this criterion the tenderer shall provide a documented management plan which shall include method statements for handling and storage of residual paint for re-use by the contractor, as well as arrangements for re-use or recycling of paint by third parties. The monitoring system shall record the quantities of waste paint or road marking arisings and their subsequent use.

5.3.4 CONTRACT PERFORMANCE CLAUSES FOR PAINTS AND ROAD MARKINGS WORK CONTRACTS

5.3.4.1 Criterion 1 Management of paint or road marking usage and application

Core criteria	Comprehensive criteria
CONTRACT PERFORMANCE CLAUSES	
<p>The contractor shall record and evidence:</p> <ul style="list-style-type: none"> • The quantity of paint or road marking purchased, • The actual paint or road marking quantities used in fulfilling the contract specifications. <p>The contractor shall also provide records for residual paint or road marking arisings, including tracking where it has been:</p> <ul style="list-style-type: none"> • Re-used by the contractor, • Sent for external re-use and/or recycling, • Safely disposed of. <p>The contractor shall also provide records – in case old paint or road marking layer needed to be removed from the substrate that it has been:</p> <ul style="list-style-type: none"> • Handled safely • Disposed of safely for treatment as hazardous waste <p>Verification: The contractor shall provide reports at agreed intervals during the contract duration.</p>	<p>The contractor shall record and evidence:</p> <ul style="list-style-type: none"> • The quantity of paint or road marking purchased, • The actual paint or road marking quantities used in fulfilling the contract specifications. <p>The contractor shall also provide records for residual paint or road marking arisings, including tracking where it has been:</p> <ul style="list-style-type: none"> • Re-used by the contractor, • Sent for external re-use and/or recycling, • Safely disposed of. <p>The contractor shall also provide records – in case old paint or road marking layer needed to be removed from the substrate that it has been:</p> <ul style="list-style-type: none"> • Handled safely • Disposed of safely for treatment as hazardous waste <p>Verification: The contractor shall provide reports at agreed intervals during the contract duration.</p>

Rationale

Contract performance clauses are used by public procurers to specify how a contract is to be carried out. They are related to performance of the contract, i.e. the tasks which are necessary for the production and the provision of the goods, services or works purchased. The compliance with the requirements specified in the contractual clauses is monitored along the period of carrying out of the contract.¹⁷³ For the GPP criteria set for the paints and road markings work contracts several issues are considered as of high relevance to the performance of the contract, taking into account the previously mentioned aspects of highest relevance for the environmental performance of the service to be provided. Among them the most important include: the quantity of product purchased by the contractor to fulfil the work contract, the estimates regarding the need for repainting and the amount of actual product used by the contractor and the treatment of the paint or roadmarking that was removed from the substrate before the painting service was conducted. Additionally, it is considered essential that the contractor provides records on the residual paint amount and, when applicable, on the waste management practice applied to it; i.e. whether (and what share of it) was:

- Re-used by the contractor,
- Sent for external re-use/recycling,
- Safely disposed of.







Further, in case the former old paint or road marking is removed from the substrate, proper handling and channelling it to the respective stream of hazardous waste is required.

Regarding **verification** of compliance with the criteria the contractor shall provide reports on the records on the residual paint amount and, when applicable, on the waste management practice and the treatment of removed old paint or road markings at agreed intervals along the contract duration.

¹⁷³ European Commission 'Buying Green Handbook', 2011, available at: http://ec.europa.eu/environment/gpp/buying_handbook_en.htm.

6 ANNEXES










Annex 1. Hazard labels that shall be avoided

Old classification and label (DSD)			Hazard classes and categories ¹⁷⁴	New classification and label ¹⁷⁵		
Very toxic	R28 R27 R26		Acute toxicity, categories 1, 2 - Oral - Dermal - Inhalation	H300 H310 H330	Danger	
Toxic	R25 R24 R23		Acute toxicity, category 3 - Oral - Dermal - Inhalation	H301 H311 H331		
Toxic	R46 R45, R49 R60, R61 R39 R48		Germ cell mutagenicity, categories 1A, 1B Carcinogenicity, categories 1A, 1B Reproductive toxicity, categories 1A, 1B STOT ¹⁷⁶ , single exposure, category 1 STOT ¹⁷⁶ , repeated exposure, category 1	H340 H350 H360 H370 H372	Danger	
Harmful	R42		Respiratory sensitization, category 1	H334		

¹⁷⁴ According to Annex I of CLP Regulation 1272/2008 for all hazard categories with Globally Harmonized System of Classification and Labelling of Chemicals (GHS) pictograms

¹⁷⁵ According to Annex V of CLP Regulation 1272/2008

¹⁷⁶ STOT = Specific Target Organ Toxicity

	R68 R40 R62, R63 R68 R48		Germ cell mutagenicity, categories 2A, 2B Carcinogenicity, categories 2A, 2B Reproductive toxicity, categories 2A, 2B STOT ¹⁷⁶ single exposure, category 2 STOT ¹⁷⁶ , repeated exposure, category 2	H341 H351 H361 H371 H373	Warning	
	R22 R21 R20		Acute toxicity, category 4 - Oral - Dermal - Inhalation	H302 H312 H332	Warning	
Irritant	R43 R37		Skin sensitization, category 1 STOT ¹⁷⁶ , single exposure, category 3 – Respiratory tract irritation	H317 H335	Warning	
Dangerous for the environment	R50 R50/53		Hazardous to the aquatic environment, acute, category 1 Hazardous to the aquatic environment, chronic, category 1	H400 H410	Warning	
	R51/53		Hazardous to the aquatic environment, chronic, category 2	H411		
	R52/53 R53	No symbol	Hazardous to the aquatic environment, chronic, category 3 Hazardous to the aquatic environment, chronic, category 4	H412 H413	-----	No pictogram