

Sustainable Public Procurement-fiche

Product / service	Version	Date
Wood and gypsum wall panels	Advanced	December 2010

Scope

These criteria apply to wall panels, defined as boards that are used in vertical or angled placement (for example in loft conversions) in a building, where the panel itself is not load bearing and its surface is not the final surface seen in the finished building, i.e. it will be plastered, skimmed, painted, papered etc.

The form has been divided according to two distinct material types, as together these materials represent practically the whole wall panel market:

A - Wood – based boards.

B - Gypsum plasterboards.

The two materials have been dealt with as separate entities as although their use overlaps, the material content does not and neither do many of the standards they must adhere to.

A. Wood panels.

These criteria apply to composite wood panels (non-coated or coated) for indoor use in vertical or angled placement in a building. Products included are plywood boards, oriented strand boards (OSB), chip and particle boards, medium-density fiberboards (MDF), high-density fiberboards (HDF) and solid wood boards.

The criteria do not apply to wood floors / ceilings.

B. Gypsum plasterboard wall panels.

These criteria apply to gypsum plasterboards in vertical or angled placement in a building.

1) Subject matter

Wood / Gypsum panels produced with environmentally friendly materials and processes and produced in a socially responsible way.

1.1. The subject matter in the framework of the organizations policy.

“For <.....> (name of the public authority), the care for the environment and social aspects is important. It is stated in her <strategic policies>, <mission>, <vision>, <procurement policy>, ...”

1.2. “Reserved contracts”

This category of contract is handled separately in Article 19 of Directive 2004/18/EC. This article permits the member states to “reserve” the right to participate in public contract award procedures. It includes contracts awarded to sheltered workshops or awarded in the context of sheltered employment programmes restricted to handicapped persons who cannot conduct professional activities under normal conditions. Paragraph 2 of Article 18a of the Law of 24 December 1993 has already taken a step in this direction by enabling, within the European thresholds, an identical strategy.

2) Exclusion criteria

2.1. Social aspects:

Buyers can take account of social aspects in there procurement. For more information about the different possibilities see:

<http://www.gidsvoorduurzameaankopen.be/en/node/108>

3) Technical capacity

-

4) Market information

-

5) Technical specifications

A. Wood panels.

A1) Wood material sources: sustainable forests (GPP Toolkit, Nature Plus, Blaue Engel, FSC, PEFC, Nordic)

- The final product made of wood, wood fibres or wood particles stemming from forests that are verified as being sustainably managed so as to implement the principles and measures aimed at ensuring sustainable forest management, on condition that these criteria characterize and are relevant for the product.

In Europe, these principles and measures shall at least correspond to those of the Pan-European Operational Level Guidelines for Sustainable Forest Management, as endorsed by the Lisbon Ministerial Conference on the Protection of Forests in Europe (2 to 4 June 1998). Outside Europe they shall at least correspond to the UNCED Forest Principles (Rio de Janeiro, June 1992) and, where applicable, to the criteria or guidelines for sustainable forest management as adopted under the respective international and regional initiatives (ITTO, Montreal Process, Tarapoto Process, UNEP/FAO Dry-Zone Africa Initiative).

Acceptable proof of sustainable harvest for timber may be provided for by means of a tracing system being in place.

Evidence:

The compliance with criteria A1 mentioned above can be proved with the following label:



In case that the tendering company can present this label, any further proof is not necessary. Any other suitable evidence from a recognized body can also be used.

A2) Formaldehyde release (GPP Toolkit, Blaue Engel, Nordic)

- Wood panels that use formaldehyde-containing binding agents shall not exceed the emission limit of the E1 standard for formaldehyde following EN13986⁽¹⁾, 0.13 mg / m³ of air (or 0.1ppm (part per million)). This includes coated boards and pre-coating.

- The bidder must provide appropriate proof that this criterion is met. For example, an independent laboratory test report or any other appropriate proof will also be accepted.

⁽¹⁾ EN 13986: 2004. Wood-based panels for use in construction - Characteristics, evaluation of conformity and marking.

Evidence:

The compliance with all criteria A2 mentioned above can be proved with the following label:



Blaue Engel



Nordic label

In case that the tendering company can present this label, any further proof is not necessary. Any other suitable evidence from a recognized body can also be used.

A3) Formaldehyde content (GPP Toolkit, Nordic)

- The content of free formaldehyde in glues for plywood panels or laminated wood panels may be up to 0.5% weight/weight.

A4) Chemical hazards (GPP Toolkit, Nordic)

- Chemical hazards requirements:
 - o The final product shall not contain chemical products classified as (see also Annex 2 for R-phrases meaning):
 - carcinogenic (R40, R45, R49)
 - mutagenic (R46, R68)
 - harmful or toxic to the reproductive system (R60, R61, R62, R63)
 - toxic (R23, R24, R25, R26, R27, R28)
 - o Regulation (EC) No 1272/2008⁽¹⁾, amending and repealing Directives 67/548/EEC⁽²⁾ and 1999/45/EC⁽³⁾, and amending Regulation (EC) No 1907/2006, gives the following H-phrases which relate to the above R-phrases. The final window product will not release or leach out any substances or preparations that are classified with the listed H-phrases, below under normal usage conditions (see also Annex 3 for translation from Directive 67/548/EEC to Directive 1272/2008/EEC):
 - carcinogenic (Carcinogenic 1A, 1B and 2: H350, H350i, H351)
 - mutagenic and cause heritable genetic damage (Mutagenic 1B and 2: H340 and H341)

- harmful to the reproductive system (Reproductive 1A, 1B and 2: H360F, H360D, H361f, H361d, H360FD, H361fd, H360Fd, and H360Df)
- toxic (Acute Toxicity 1, 2 and 3: H330, H331, H311, H301, H310, H300, Aquatic Chronic 2: H412)

⁽¹⁾ <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32008R1272:EN:NOT>

⁽²⁾ Dangerous Substances Directive: <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31967L0548:en:NOT>

⁽³⁾ Dangerous Preparation Directive: <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31999L0045:en:NOT>

A5) Wood material sources: legality (GPP Toolkit, Nordic, FSC, PEFC)

- Virgin wood material used shall come from legal sources.
The legal origin of timber/wood fibres can be demonstrated with a chain-of-custody tracing system being in place.

Certificates of chain of custody for timber/wood fibres certified as FSC, PEFC or any other equivalent means of proof will also be accepted as proof of compliance. If timber/wood fibre stems from a country that has signed a Voluntary Partnership Agreement (VPA) with the EU, the FLEGT license may serve as proof of legality.

Other means of proof that will be accepted includes a relevant and valid CITES certificate or other equivalent and verifiable means such as the application of a "due diligence" system. For the non-certified virgin material bidders shall indicate the types (species), quantities and origins of the timber/wood fibres, together with a declaration of their legality. As such the timber/wood fibres shall be able to be traced throughout the whole production chain from the forest to the product.

Evidence:

The compliance with criteria A3, A4 and A5 mentioned above can be proved with the following label:



Nordic label

For A5 also



FSC label



PEFC label

In case that the tendering company can present this label, any further proof is not necessary. Any other suitable evidence from a recognized body can also be used.

A6) Phenol content (GPP Toolkit, Blaue Engel)

- Composite wood panels including phenol-containing binding agents must not exceed a phenol concentration of $14\mu\text{g}/\text{m}^3$ in the test room, as tested by an independent laboratory.

A7) PMDI content (GPP Toolkit, Blaue Engel)

- Composite wood panels containing PMDI-based binding agents (Polymeric Methylene Diphenyl Diisocyanate) must not emit more than $1\mu\text{g}/\text{m}^3$ (detectable) of the monomer MDI (see Annex 1 for measuring method).

Evidence:

The compliance with criteria A1 mentioned above can be proved with the following label:



Blaue Engel

In case that the tendering company can present this label, any further proof is not necessary. Any other suitable evidence from a recognized body can also be used.

B. Gypsum plasterboard wall panels.

B1) Paper legal or recycled source (GPP Toolkit, FSC, PEFC)

- Paper used in the manufacture of gypsum panels must be either from:
 - o 100% recycled wood/paper, and/or
 - o Paper made of wood, wood fibres or wood particles stemming from legally harvested forests.

Verification a: Provision of appropriate documentation verifying that the paper or wood used is 100% recycled, i.e. from a national or EU certification scheme.

Verification b: The legal origin of timber/wood fibres can be demonstrated with a chain-of-custody tracing system being in place.

Certificates of chain of custody for timber/wood fibres certified as FSC, PEFC or any other equivalent means of proof will also be accepted as proof of compliance. If timber/wood fibre stems from a country that has signed a Voluntary Partnership Agreement (VPA) with the EU, the FLEGT⁽¹⁾ license may serve as proof of legality. Other means of proof that will be accepted includes a relevant and valid CITES⁽²⁾ certificate or other equivalent and verifiable means such as the application of a "due diligence" system. For the non-certified virgin material bidders shall indicate the types (species), quantities and origins of the timber/wood fibres, together with a declaration of their legality. As such the timber/wood fibres shall be able to be traced throughout the whole production chain from the forest to the product.

⁽¹⁾ Forest Law Enforcement, Governance and Trade: range of measures in the EU to tackle illegal logging in the world's forests (see also: <http://www.euflegt.efi.int>).

⁽²⁾ CITES: Convention on International Trade in Endangered Species of Wild Fauna and Flora (see also: <http://www.cites.org>).

Evidence:

The compliance with criteria B1 mentioned above can be proved with the following label:



FSC label



PEFC label

In case that the tendering company can present this label, any further proof is not necessary. Any other suitable evidence from a recognized body can also be used.

B2) Radioactive material (GPP Toolkit, Nordic)

- Where panels contain potentially radioactive material (e.g. from slag products, ash from coal fires, phosphogypsum) it must be demonstrated that the gamma index (my) or the activity index (I1) is less than 1.
Radioactive substances in the panel material are expressed as gamma index/activity index in accordance with:
$$CK/3000 + CRa/300 + CTh/200 < 1.0$$

The radium index must not exceed: $CRa/100 = 1.0$
In the above mentioned formula CK, CRa and CTh signifies respectively the concentration of Potassium-40, Radium-226 and Thorium-232, expressed in bequerel per kilogram (Bq/kg) of the material. 1% Potassium is equivalent to 310 Bq/kg Potassium-40, 1 ppm Uranium is equivalent to 12.3 Bq/kg of Radium-226 and 1 ppm Thorium with 4.0 Bq/kg of Thorium-232.

An independent laboratory testing report will be accepted as appropriate proof.

B3) Chemical hazards (GPP Toolkit, Nordic)

- Chemical hazards requirements:
 - o Gypsum plasterboard shall not contain, as a final product, any chemical product classified as (see also Annex 2 for R-phrases meaning):
 - Carcinogenic (R40, R45, R49)
 - Mutagenic (R46, R68)
 - Harmful or toxic to the reproductive system (R60, R61, R62, R63)
 - Toxic (R23, R24, R25, R26, R27, R28).
 - o Regulation (EC) No 1272/2008⁽¹⁾, amending and repealing Directives 67/548/EEC⁽²⁾ and 1999/45/EC⁽³⁾, and amending Regulation (EC) No 1907/2006, gives the following H-phrases which relate to the above R-phrases. The final product will not release or leach out any substances or preparations that are classified with the listed H-phrases, below under normal usage conditions (see also Annex 3 for translation from Directive 67/548/EEC to Directive 1272/2008/EEC):
 - Carcinogenic (Carcinogenic 1A, 1B and 2: H350, H350i, H351)
 - Mutagenic and cause heritable genetic damage (Mutagenic 1B and 2: H340 and H341)
 - Harmful to the reproductive system (Reproductive 1A, 1B and 2: H360F, H360D, H361f, H361d, H360FD, H361fd, H360Fd, and H360Df)
 - Toxic (Acute Toxicity 1, 2 and 3: H330, H331, H311, H301, H310, H300, Aquatic Chronic 2: H412).

⁽¹⁾ <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32008R1272:EN:NOT>

⁽²⁾ <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31967L0548:en:NOT>

⁽³⁾ <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31999L0045:en:NOT>

Evidence:

The compliance with criteria B2 and B3 mentioned above can be proved with the following label:



Nordic label

In case that the tendering company can present this label, any further proof is not necessary. Any other suitable evidence from a recognized body can also be used.

B4) Recycled gypsum content (GPP Toolkit)

- The gypsum content must be at least 5% recycled gypsum board (by weight, based on an annual average, not including gypsum taken from FGD sites). Where higher percentages are possible these should be selected in preference. Appropriate proof must be provided that this criterion is met. For example, the supply of quality control or production documentation.

B5) Treatment preventing recycling (GPP Toolkit)

- Gypsum plasterboard must not be impregnated, labelled, coated or otherwise treated in a manner which would prevent recycling and / or composting in Europe.

6) Awarding the contract:

	Criteria --- For example ---	Weight
1	Price <i>Calculation (e.g.):</i> Lowest offered price/ stated price x 0,60	e.g. 60%
2	Environmental criteria (The public authority formulates the points it wants to assign to the below mentioned criteria) <i>Calculation (e.g.):</i> Total scored points / maximum number of points x 0,35	e.g. 35%
3	...	e.g. 5 %
4	...	e.g.

In above mentioned table, the weight of the environmental criteria shall be stated by the buyer in function of its particular procurement. Representatives of several sectors federations mention often to not underestimate this weight to give sustainability in the awarding phase a chance at all.

The environmental criteria in the above mentioned table concern the following issues:

A. Wood panels.

A1) Wood treatment

- Wood must after cutting not be treated with pesticides which are classified by WHO (World Health Organization) as type 1A and type 1B⁽¹⁾. This requirement relates to treatment of round timber after cutting. (Blaue Engel, Nature Plus, Nordic)

(1) The WHO recommended classification of pesticides by hazard and guidelines to classification 2000-2002: <http://www.who.int/pcs>.

- Neither wood preservatives (fungicides, insecticides, fire protection agents) nor halogenated organic compounds may be added to composite wood panels and their coatings. (Blaue Engel, Nature Plus)

A2) Advertising (Blaue Engel)

- Advertising messages must not include any statements such as “tested for biological living conditions”, or others belittling the risks in terms of Article 23, para. 4, Directive 67/548/EEC⁽¹⁾ (such as, for example, “non-toxic” or “not detrimental to health”). Product names including words like “bio”, “eco”, “nature” or the like shall not be admissible.

(1) Dangerous Substances Directive <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31967L0548:en:NOT>.

A3) Recycled timber (GPP Toolkit, Nordic)

- The proportion (%) of timber that is recycled or reused timber. The greater this percentage the greater the level of award points offered. Bidders must provide a signed declaration indicating the level of this criterion the products are able to meet. Other appropriate means of proof will also be accepted.

A4) Product composition (Nature Plus)

- Additional points will be awarded if the product is made of at least 85 mass-% from ligno-cellulose based fibres (wood, flax, hemp, straw...) and shavings based upon the dry weight of the product.

A5) Surface treatment: plastics (Nordic)

- Agents for surface treatment include foil, foil adhesive, paper, paint and the like. Halogenated plastics must not be used in surface treatment.

A6) Formaldehyde content (Nordic)

- An alternative free formaldehyde requirement based on the perforator method, in accordance with applicable version of EN-120⁽¹⁾ can be used. The following limit values apply:
 - Single values: ≤ 8 mg formaldehyde/100 g dry product. The requirement must be met by the 95%-quartile of all measurement-values.
 - Half year mean value: ≤ 6.5 mg formaldehyde/100 g dry product.The requirements apply to wood panels with a moisture content of $H = 6.5\%$. If the moisture content of the panels is different from the figure stated above, but falls within the range of 3% to 10%, the analyzed perforator value must be multiplied by a factor F which is derived from the following formula:
Chipboards: $F = -0.133H + 1.86$
MDF: $F = -0.121 H + 1.78$

⁽¹⁾ EN 120: 1992. Wood based panels - Determination of formaldehyde content - Extraction method called the perforator method.

A7) Chemical hazards (Nordic)

- Chemical products classified as allergens when inhaled (R42) in accordance with regulations of classification and labeling of hazardous chemicals in EU's classification system 1999/45/EC⁽¹⁾ (with amendments and corrections) must not be used.

⁽¹⁾ Dangerous Preparation Directive: <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31999L0045:en:NOT>

A8) Surface treatment: plastics (Nordic)

- Agents for surface treatment include foil, foil adhesive, paper, paint and the like. Halogenated plastics must not be used in surface treatment.

B. Gypsum plasterboard wall panels.

B1) Paper sustainable source (GPP Toolkit, FSC, PEFC)

- Additional points will be awarded if paper used in the manufacture of gypsum panels is made from wood, wood fibres or wood particles stemming from forests that are verified as being sustainably managed so as to implement the principles and measures aimed at ensuring sustainable forest management, on condition that these criteria characterize and are relevant for the product.

In Europe, these principles and measures shall at least correspond to those of the Pan-European Operational Level Guidelines for Sustainable Forest Management, as endorsed by the Lisbon Ministerial Conference on the Protection of Forests in Europe (2 to 4 June 1998). Outside Europe they shall at least correspond to the UNCED Forest Principles (Rio de Janeiro, June 1992) and, where applicable, to the criteria or guidelines for sustainable forest management as adopted under the

respective international and regional initiatives (ITTO, Montreal Process, Tarapoto Process, UNEP/FAO Dry-Zone Africa Initiative).

Verification: Acceptable proof of sustainable harvest for timber may be provided for by means of a tracing system being in place. Certificates of chain of custody for the wood fibres certified as FSC, PEFC or any other equivalent means of proof, will also be accepted as proof of compliance.

B2) Paper and cardboard bleaching (Nordic)

- Fibre must not be bleached with any compounds containing chlorine.

B3) Surface treatment: plastics (Nordic)

- Agents for surface treatment include foil, foil adhesive, paper, paint and the like. Halogenated plastics must not be used in surface treatment.

B4) Recycled gypsum content (GPP Toolkit, Nordic)

- Additional points will be awarded:
 - o In proportion to the increased percentage of post-consumer recycled gypsum in the purchased plasterboard
 - OR
 - o In proportion to the increased percentage of post consumer recycled gypsum diverted from the manufacturers take back scheme to a composting facility or is used in cement manufacture or equivalent approved diversion method.

B5) Chemical hazards (Nordic)

- Chemical products classified as allergens when inhaled (R42) in accordance with EU's classification system 1999/45/EC⁽¹⁾ (with amendments and corrections) must not be used.

(1) Dangerous Preparattion Directive

(2) <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31999L0045:en:NOT>

B6) Heavy metals in main components (Nordic)

- Main components (>5% weight/weight) in the product may contain the following maximum amounts of heavy metals :
 - o Arsenic 20 mg/kg
 - o Lead 50 mg/kg
 - o Cadmium 1 mg/kg
 - o Mercury 1 mg/kg
 - o Chromium 500 mg/kg

B7) Compounds and additives in chemical products (Nordic)

- Additional points will be awarded if:
 - o Halogenated organic binding agents, halogenated organic flame retardants, polychlorinated biphenyls, alkyl phenols, phthalates, aziridine or polyaziridines as well as pigments and additives based on lead, tin, cadmium, chromium IV and mercury or their compounds are not added to the chemical product.
 - o The content of alkyl phenol etoxylates or other alkylphenol derivatives in the chemical product does not exceed 0.6% weight/weight.
 - o The content of aromatic solvents does not exceed 1% weight/weight.

B8) Environmentally harmful substances in chemical products (Nordic)

The total amount of compounds classified as environmentally harmful by the chemical manufacturer/supplier pursuant to the EU classification system (18th Amendment to Directive 67/548/EEC⁽¹⁾) must be < 0.5 g/kg panel. The requirement is related to the chemical composition of the chemical product at the time of use, i.e. the moment the product is mixed in the panel mixture. The producer shall submit information on total amount of constituent chemical substances in g/kg panel that by the chemical supplier is classified as environmentally harmful.

⁽¹⁾ Dangerous Substances Directive: <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31967L0548:en:NOT>

B9) Surfactants for de-inking of reclaimed fibre (Nordic)

Surfactants used in de-inking reclaimed fibre or upgrading new fibrous pulp must be documented as potentially biodegradable in accordance with OECD-guideline for testing of chemicals, test method no. 301 A-F or 302 A-C⁽¹⁾.

⁽¹⁾ OECD (Organization for Economic Co-operation and Development) Guidelines for the Testing of Chemicals: http://www.oecd.org/document/40/0,3343,en_2649_34377_37051368_1_1_1_1,00.html.

7) Performance clauses:

7.1. Environmental aspects:

A. Wood panels.

a) User information (GPP Toolkit, Nature Plus, Nordic)

- Appropriate and acceptable user information describing the handling, installation procedures, surface treatment applications, recycling and/or disposal methods shall be provided with the product or on the packaging or labels.

b) Covering materials recycling (GPP Toolkit)

- Information on wall panel covering materials, such as paint types, that will not hinder the recycling or diversion of wood based panel boards at end-of-life must be made available. Products holding a relevant Type 1 Ecolabel fulfilling the listed criteria will be deemed to comply.

c) Wood transport, processing and storage (Nature Plus)

- Suitable measures are to be taken during the transport and storage of the timber, wood materials and wood-based products to ensure that there is no severe detrimental change in the moisture content through precipitation, ground-moisture or drying-out.
- The manufacturer must provide the installer/processor with adequate instructions on the dangers of the dust generation characteristics of each type of wood contained within the product and the avoidance of dust production.

B. Gypsum plasterboard wall panels.

a) Recycling information (GPP Toolkit)

- Information on wall panel covering materials, such as paint types, that will not hinder the recycling or diversion of gypsum plasterboard at end-of-life must be made available.

b) User information

- Appropriate and acceptable user information describing the handling, installation procedures, surface treatment applications, recycling and/or disposal methods shall be provided with the product or on the packaging or labels. (GPP Toolkit, Nordic)
- Additional instructions for use shall provide information on: (Nordic)
 - o storage of the panel materials
 - o the technical standards with which the panel complies
 - o recommended maintenance method

c) Packaging (Nordic)

- Packaging requirements:
 - o Relevant national provisions, legislation and/or branch-specific agreements prevailing recycling schemes for products and packaging must be fulfilled in the countries where the products are on sale.
 - o Chlorine-based plastics must not be used in the packaging. The applicant must give information on what materials are used in the transport and sales packaging on the product for which the ecolabel is applied.

7.2. Social aspects:

Buyers can take account of social aspects in their procurement. For more information about the different possibilities see:

<http://www.gidsvoorduurzameaankopen.be/en/node/108>

7.3. Ethical aspects:

“The tenderer undertakes, until the contract has been executed in full, to respect the 8 Basic Conventions of the ILO

By signing his tender, the tenderer undertakes to respect the standards defined in the Basic Conventions of the International Labour Organisation (ILO) and, in particular:

1. The prohibition of forced labour (C29 Forced Labour Convention, 1930, and C105 Abolition of Forced Labour Convention, 1957);
2. The right to freedom of association (C87 Freedom of Association and Protection of the Right to Organise, 1948);
3. The right to organise and collective bargaining (C98 Right to Organise and Collective bargaining, 1949);
4. The prohibition of any discrimination in terms of labour and remuneration (C100 Equal Remuneration, 1951 and C111 Discrimination (Employment and Occupation), 1958);
5. The minimum age for child labour (C138 Minimum Age Convention, 1973), together with the prohibition of the worst forms of child labour (C182 Worst Forms of Child Labour Convention, 1999).

The non-respect of this undertaking may, by virtue of Article 20, §1, 4° of the general specifications annexed to the Royal Decree of 26 September 1996, give rise to the application of the official measures described in § 6 of the same article, including unilateral termination of the contract.”

References

[Information of the public authority that used these clauses in a procurement case]

Annex 1: Phenols content measurement method (also in Annex 1 of Blaue Engel RAL-UZ 76).

Isocyanate measurements shall be taken in a 1m³-test chamber. The conditions set for the testing of wood-based materials relating to loading, air humidity and temperature shall be complied with. Sampling shall be done the day after loading, however, not earlier than 16 h after loading. Inside the test chamber the chipboards shall be arranged in the form of a closed cube with an inner surface of 1m². The cube shall have two drill holes with a diameter of about 10 mm on the opposite corners. One hole shall be used to insert the absorption tube about 10 cm deep into the cube. The other one shall serve as an air inlet. As for the rest, the sampling shall be done in accordance with the method of analysis as specified hereinafter.

1. Fundamentals of the Method

By means of a sampling pump room air is drawn through an absorption tube coated with 1-(2-methoxyphenyl)piperazine (2MP). During the derivatization reaction 2MP and MDI form the corresponding urea derivative which is eluted with methanol. Then, it can be quantitatively determined with the help of high-pressure liquid chromatography (HPLC) in combination with an electrochemical detector. The quantitative evaluation is made on the basis of a calibration using the urea derivative above peak height as reference standard.

The given parameters of the method (linearity, precision, recovery rate, determination limit) have been determined during application of the method using reagents and instruments as described hereinafter. A somewhat different performance (as for example, different but equivalent reagents, separating columns, instruments and different weighed portions) would be possible but if so the method must be adapted correspondingly and, if necessary, reoptimized.

2. Instruments and Chemicals

2.1 Instruments

- High-pressure liquid chromatograph: Hewlett Packard 1090 Series II
- Detector: electrochemical detector BCMA (manufacturer: ERC)
- Separating column: length: 125 mm, ID: 4mm
- Pre-column: length: 4mm, ID: 4 mm
- Column packing: Superspher 60 RP select B (manufacturer: MERCK)
- Particle diameter: 4µm (separating column) or 5µm (pre-column)
- Continuous-flow pump, pump capacity: 1.7 l/min.
- Absorption tubes: Commercial tubes with an OD of 8mm are cut into pieces 8cm long. With the help of a Bunsen burner one end of each tube is narrowed to an opening diameter of 6mm. The tubes are filled with about 0.5g of long-fiber glass wool. 1ml of 2MP reagent is pipetted into each tube (see 2.3).
- Appliance to evaporate under nitrogen flow
- Small test tubes
- Micropipette, 50µl
- Pasteur pipettes
- Small sample bottles with Teflon-coated septum, matching with the HPLC sample dispenser
- Beakers, 50 ml
- Glass filters
- Volumetric flasks 100 ml, 1000 ml
- Analytical balance
- Ultrasonic cleaner
- Usual laboratory equipment

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2.2 Chemicals

- High-purity diphenylmethane-4,4'-diisocyanate (MDI)
- 1-(2-methoxyphenyl)piperazine (2MP), content > 98% (Manufacturer: Aldrich)
- Toluene, anhydrous
- Diethyl ether, analytically pure, stabilized
- HPLC-quality methanol
- Acetic anhydride, analytically pure
- Dichloromethane, analytically pure, anhydrous
- HPLC-quality acetonitrile
- High-purity, HPLC-suited water (e.g. de-ionized with the help of a millipore plant)
- Potassium dihydrogenphosphate, analytically pure
- Sodium chloride
- Long-fiber glass wool

2.3 Absorption Solution

200mg of 1-(2-methoxyphenyl)piperazine are weighed in, accurate to 0.1 mg, on the analytical balance, sprinkled with analytically pure dichloromethane in a volumetric flask (100 ml) and filled with analytically pure dichloromethane up to the mark. As a result, one gets an amine solution about 0.01 molar. 1ml of this solution (10 μ mol) are carefully pipetted into the absorption tube seeing to it that the tube is uniformly moistened. Excess solvent is removed under slight vacuum.

Before use the absorption solution has always been freshly prepared.

2.4 Reference Standard

2.4.1 Description of the MDI-2MD Derivative

1.5 g of 2MP are dissolved in a beaker (50 ml) in 20 ml of anhydrous toluene and added to a suspension of 0.25 g of MDI in 15 ml of anhydrous toluene. After 1 h the precipitated derivative is filtered out. The precipitate is first washed several times with toluene and then, in order to remove the toluene, with diethyl ether. Afterwards the reaction product is dried at 30° C in the vacuum drier to constant weight.

The MDI-2MP-derivative was identified by proton resonance spectroscopy.

1H-NMR-spectrum (270 MHz, DMSO-d6):					
Signal	δ (ppm)	I [H]	m	J	Assignment
a	2.95	8	t	3 _J	- CH2-(piperazine)
b	3.60	8	t	3 _J	- CH2-(piperazine)
c	3.80	6	bs	-	- OMe
d	3.80	2	bs	-	- CH2-(diphenylmethane)
e	7.05-6.80	8	m	-	- 4 vicinal aromatic H
f	7.10	4	d	ortho	1,4-substituted aromatics
g	7.40	4	d	ortho	1,4-substituted aromatics
h	8.50	2	bs	-	- NH- (urea)

For content determination the following tests were made:

Elementary analysis (C,N), proton resonance spectroscopy with internal standard, determination of the volatile portion (toluene) by means of gas chromatography (GC), Karl Fischer titration, test for organic impurities by means of HPLC (UV detector).

A MDI-2MP derivative containing toluene was used for method development. Its content was determined at 92.1 %.

2.4.2 Preparation of the Calibrating Solution

About 10 mg of MDI-2MP derivative are weighed into a volumetric flask (100 ml), accurate to 0.1 mg. About 50ml of methanol is added. Dissolution in an ultrasonic bath. After cooling to room temperature the flask is filled with methanol up to the mark. This stock solution is diluted with methanol at a ratio of 1:500. 50 µl of acetic anhydride are added to 1 ml of this dilution (=calibrating solution).

A well-sealed stock solution may be kept for several days in the refrigerator. Calibrating solutions must always be freshly prepared.

3. Sampling and Preparation of Samples

3.1 Sampling

With the help of a pump with a stabilized flow of 1.7 l/min 100 l of room air are drawn through a sorption tube.

After sampling 0.2 ml of methylene dichloride is dripped on the sorption tube to make sure that possibly existing MDI particles fully react with the 2MP reagent.

Preparation of Samples

After sampling the sorption tube is eluted with 5 ml of methanol. The eluate collected in a small test tube is blown off with nitrogen to dryness. The residue is taken up in 1 ml of methanol. If necessary, dissolving can be accelerated by means of ultrasonics.

50 µl of acetic anhydride are pipetted and added to the solution. An aliquot of the solution is intermixed and transferred into a small sealed container for the HPLC sample dispenser which is sealed with a PTFE-walled septum.

4. High-pressure Liquid Chromatography

- Working Conditions -

Column	Material:	Steel
	internal diameter:	4 mm
Separating column	length:	125 mm
Pre-column	length:	4 mm
Column packing	Superspher 60 RP select B;	
	4 or 5 µm (separating/pre-column)	
Separating program	isocratic	
Mobile phase	500 ml of acetonitrile	
	300 ml of basic electrolyte solution*	
	with water added to 1l	
	Basic electrolyte solution: 4.5 g of potassium dihydrogenphosphate and 0.195 g of sodium chloride are dissolved with water added to 1l.	
Retention time MDI-2MP about 8.2 min.		
Column oven	40°C	
Detector	electrochemical detector BCMA (manufacturer: ERC)	
Detector adjustment	potential	0.9 V
	range	50 nA
	filter	7.9 s

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	thermostat	35°C
Reference electrode	Ag/AgCl	
Working electrode	glassy carbon	
Injection volume	20µl	

5. Analytical Determination

The samples prepared pursuant to para.3.2 are analysed under the chromatographic conditions given in para.4. The peak of the MDI-2MP derivative is identified on the basis of the retention time.

6. Calibration

The MDI-2MP derivative is quantified by means of an extreme one-point calibration (For confirmation of applicability see para. 8 below: "Assessment of the Method").

Calculation is based on the height determined with the help of the electronic integrator and the weighed portion of the reference standard.

7. Calculation of the Analysis Results

$$X_{MDI} = \frac{h_p * M_{MDI} * W_{MDI-2MP}}{h_K * M_{MDI-2MP} * 500 * 100}$$

$$p_{MDI} = \frac{X_{MDI}}{V_z * \eta}$$

X _{MDI}	MDI mass in the test solution in ng (=adsorbed MDI in ng)
h _p	peak height of MDI-2MP in the test solution in mV
h _K	peak height of MDI-2MP in the calibration solution in mV
M _{MDI}	molar mass of MDI in g/mol
M _{MDI-2MP}	molar mass of MDI-2MP in g/mol
W _{MDI-2MP}	weighed portion of the reference standard/100 ml in ng
500, 100	dilution factors
p _{MDI}	MDI mass in 1m ³ of room air
V _z	sample volume of the gas sample in m ³
n	recovery rate

The validity of these formulas is subject to the observance of the prescribed volumes.

8. Assessment of the Method

8.1 Linearity

Linearity was checked by analysing proper dilutions of the stock solution of the MDI-2MP derivative according to paragraph 4.

MDI-2MP in ng/ml	peak height in mV
20.2	11.16
50.4	18.96
100.7	41.80
201.7	76.10
402.5	164.2
866.7	406.4

Straight calibration line: $hp = B \cdot wMDI-2MP + A$
 Intercept A -0.1132
 Slope B 0.4035
 Correction factor r 0.9998

8.2 Precision

Precision was examined at about the five-fold and twenty-five-fold of the determination limit by carefully wetting six prepared absorption tubes with 1 ml of a MDI solution in anhydrous dichloromethane each. Subsequently, the excess solvent was removed under slight vacuum. In order to imitate sampling 100 l of room air were drawn through the tubes. Afterwards the tubes were prepared according to para. 3.2 and analysed according to para.4.

Measurement No.	MDI-2MP in ng/ml	MDI-2MP in ng/ml
1	102.9	504.7
2	123.0	517.9
3	138.8	517.2
4	132.4	513.2
5	114.7	507.9
6	100.5	--
Average value	118.7	512.2
Standard deviation	15.5	5.8
Relative standard deviation	13.1%	1.1%

8.3 Recovery Rate

The recovery rate was determined according to para. 8.2. The set content was 120.4 ng for the low concentration and 608.0 ng for the high one.

Measurement No. 1	n in %, low conc. 85.5	n in %, high conc. 83.0
2	102.2	85.2
3	115.3	85.1
4	110.0	84.4
5	95.3	83.5
6	83.5	--
Average value	98.6	84.2

In addition, the recovery of the MDI-2MP derivative was examined. For this purpose, 1 ml each of a methanolic MDI-2MP solution (corresponding to 403 ng) was applied to 9 absorption tubes and prepared according to para.8.2.

Measurement No.	n in %
1	96.6
2	89.2
3	88.6
4	91.8
5	84.8
6	94.0

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7	85.0
8	90.3
9	88.4
Average value	89.9

8.4 Determination Limit

The determination limit was fixed according to the signal-to-noise ratio of 3 to 23 ng of MDI-2MP/ml, corresponding to 9 ng of MDI/ml.

Given the above-mentioned sample preparation, calibration and volume of the gas sample of 100 l, this corresponds to 93 ng of MDI/m³ of air.

8.5 Interfering Influences

In order to lower the determination limit one tried to raise the volume of the gas sample to 1000 l. The result was a passivation of the working electrode and a correspondingly steadily decreasing peak height requiring after-calibration after three measurements at the latest. For measurements between two calibrations the content may be calculated approximately on the basis of the average value of the two calibrations.

For the above-mentioned method it will be sufficient to after-calibrate every ten samples.

The peak shape of excess 2MP will be considerably improved by adding acetic anhydride.

Equal concentrations of acetic anhydride in all test and calibration solutions are essential for the reproducibility of the retention times.

9. Discussion

The present method is based on publications by Warwick [1] and Seifert [2]. For the lower trace range the only possible alternative method would be HPLC with fluorescence detection [3].

10. Literature

1. C.J. Warwick, D.A. Bagon, C.J. Purnell, Analyst 106 (1981) 676.
2. F. Schmidtke, B. Seifert, Fresenius J. Anal. Chem. 336 (1990) 647.
3. C. Sango, E. Zimerson, J. Liquid Chromatogr. 3 (1980) 1106.

Annex 2: R-phrases.

R-phrases are mentioned on product labels and in product safety datasheets. It can be a useful tool for verification-procedures.

<u>R1:</u>	Explosive when dry.
<u>R2:</u>	Risk of explosion by shock, friction, fire or other sources of ignition.
<u>R3:</u>	Extreme risk of explosion by shock, friction, fire or other sources of ignition.
<u>R4:</u>	Forms very sensitive explosive metallic compounds.
<u>R5:</u>	Heating may cause an explosion.
<u>R6:</u>	Explosive with or without contact with air.
<u>R7:</u>	May cause fire.
<u>R8:</u>	Contact with combustible material may cause fire.
<u>R9:</u>	Explosive when mixed with combustible material.
<u>R10:</u>	Flammable
<u>R11:</u>	Highly flammable
<u>R12:</u>	Extremely flammable
<u>R13 (obsolete):</u>	<i>Extremely flammable liquid gas (This R-phrase is no longer designated by the version of the GefStoffV published on 26.10.93.)</i>
<u>R14:</u>	Reacts violently with water.
<u>R15:</u>	Contact with water liberates extremely flammable gases.
<i>Merck R15.1</i>	<i>Contact with acid liberates extremely flammable gases.</i>
<u>R16:</u>	Explosive when mixed with oxidizing substances.
<u>R17:</u>	Spontaneously flammable in air.
<u>R18:</u>	In use, may form flammable/explosive vapour-air mixture.
<u>R19:</u>	May form explosive peroxides.
<u>R20:</u>	Harmful by inhalation.
<u>R21:</u>	Harmful in contact with skin.
<u>R22:</u>	Harmful if swallowed.
<u>R23:</u>	Toxic by inhalation.
<i>Riedel-de Haen R23K:</i>	<i>Also toxic by inhalation.</i>
<u>R24:</u>	Toxic in contact with skin.
<i>Riedel-de Haen R24K:</i>	<i>Also toxic in contact with skin.</i>
<u>R25:</u>	Toxic if swallowed.
<i>Riedel-de Haen R25K:</i>	<i>Also toxic if swallowed.</i>
<u>R26:</u>	Very toxic by inhalation.
<i>Riedel-de Haen R26K:</i>	<i>Also very toxic by inhalation.</i>
<u>R27:</u>	Very toxic in contact with skin
<i>Riedel-de Haen R27A:</i>	<i>Very toxic in contact with eyes.</i>
<i>Riedel-de Haen R27K:</i>	<i>Also very toxic in contact with skin.</i>
<i>Riedel-de Haen R27AK:</i>	<i>Also very toxic in contact with eyes.</i>
<u>R28:</u>	Very toxic if swallowed.
<i>Riedel-de Haen R28K:</i>	<i>Also very toxic if swallowed.</i>
<u>R29:</u>	Contact with water liberates toxic gas.
<u>R30:</u>	Can become highly flammable in use.
<u>R31:</u>	Contact with acids liberates toxic gas.
<i>Merck R31.1</i>	<i>Contact with alkalis liberates toxic gas.</i>
<u>R32:</u>	Contact with acids liberates very toxic gas.
<u>R33:</u>	Danger of cumulative effects.
<u>R34:</u>	Causes burns.
<u>R35:</u>	Causes severe burns.
<u>R36:</u>	Irritating to eyes.

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Riedel-de Haen R36A: Lacrimating

- R37: Irritating to respiratory system.
- R38: Irritating to skin.
- R39: Danger of very serious irreversible effects.
- R40: Possible risk of cancer.
CAUTION: Until 2001 this R-phrase was used for possible mutagenic or teratogenic risks as well. These risks are now labelled with R68!
- R41: Risk of serious damage to eyes.
- R42: May cause sensitization by inhalation.
- R43: May cause sensitization by skin contact.
- R44: Risk of explosion if heated under confinement.
- R45: May cause cancer.
- R46: May cause heritable genetic damage.
- R47(*obsolete*): *May cause deformities.*
(This R-phrase is no longer designated by the version of the GefStoffV published on 26.10.93.)
- R48: Danger of serious damage to health by prolonged exposure.
- R49: May cause cancer by inhalation.
- R50: Very toxic to aquatic organisms.
- R51: Toxic to aquatic organisms.
- R52: Harmful to aquatic organisms.
- R53: May cause long-term adverse effects in the aquatic environment.
- R54: Toxic to flora.
- R55: Toxic to fauna.
- R56: Toxic to soil organisms.
- R57: Toxic to bees.
- R58: May cause long-term adverse effects in the environment.
- R59: Dangerous for the ozone layer.
- R60: May impair fertility.
- R61: May cause harm to the unborn child.
- R62: Possible risk of impaired fertility.
- R63: Possible risk of harm to the unborn child.
- R64: May cause harm to breastfed babies.
- R65: Harmful: may cause lung damage if swallowed.
- R66: Repeated exposure may cause skin dryness or cracking.
- R67: Vapours may cause drowsiness and dizziness.
- R68: Possible risks of irreversible effects.

Annex 3: Translation between classification in accordance with Directive 67/548/EEC and Directive 1272/2008/EEC.

<http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:353:0001:1355:EN:PDF>

Classification under Directive 67/ 548/EEC	Physical state of the substance when rele-vant	Classification under 1272/2008/EEC		Note
		Hazard Class-and-Category	Hazard statement	
E; R2		No direct translation possible.		
E; R3		No direct translation possible.		
O; R7		Org. Perox. CD	H242	
		Org. Perox. EF	H242	
O; R8	gas	Ox. Gas 1	H270	
O; R8	liquid, solid	No direct translation possible.		
O; R9	liquid	Ox. Liq. 1	H271	
O; R9	solid	Ox. Sol. 1	H271	
R10	liquid	No direct translation possible.		
		Correct translation of R10, liquid is: <ul style="list-style-type: none"> Flam. Liq. 1, H224 if flashpoint < 23 °C and initial boiling point ≤ 35 °C Flam. Liq. 2, H225 if flashpoint < 23 °C and initial boiling point > 35 °C Flam. Liq. 3, H226 if flashpoint ≥ 23 °C 		
F; R11	liquid	No direct translation possible.		
		Correct translation of F; R11, liquid is: <ul style="list-style-type: none"> Flam. Liq. 1, H224 if initial boiling point ≤ 35 °C Flam. Liq. 2, H225 if initial boiling point > 35 °C 		
F; R11	solid	No direct translation possible.		
F+; R12	gas	No direct translation possible.		
		Correct translation of F+; R12, gaseous results either in Flam. Gas 1, H220 or Flam. Gas 2, H221.		
F+; R12	liquid	Flam. Liq. 1	H224	
F+; R12	liquid	Self-react. CD	H242	
		Self-react. EF	H242	
		Self-react. G	none	
F; R15		No translation possible.		
F; R17	liquid	Pyr. Liq. 1	H250	

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F; R17	solid	Pyr. Sol. 1	H250	
Xn; R20	gas	Acute Tox. 4	H332	(1)
Xn; R20	vapours	Acute Tox. 4	H332	(1)
Xn; R20	dust/mist	Acute Tox. 4	H332	
Xn; R21		Acute Tox. 4	H312	(1)
Xn; R22		Acute Tox. 4	H302	(1)
T;R23	gas	Acute Tox. 3	H331	(1)
T;R23	vapour	Acute Tox. 2	H330	
T;R23	dust/mist	Acute Tox. 3	H331	(1)
T;R24		Acute Tox. 3	H311	(1)
T;R25		Acute Tox. 3	H301	(1)
T+; R26	gas	Acute Tox. 2	H330	(1)
T+; R26	vapour	Acute Tox. 1	H330	
T+; R26	dust/mist	Acute Tox. 2	H330	(1)
T+; R27		Acute Tox. 1	H310	
T+; R28		Acute Tox. 2	H300	(1)
R33		STOT RE 2	H373	(3)
C; R34		Skin Corr. 1B	H314	(2)
C; R35		Skin Corr. 1A	H314	
Xi; R36		Eye Irrit. 2	H319	
Xi; R37		STOT SE 3	H335	
Xi; R38		Skin Irrit. 2	H315	
T;R39/23		STOT SE 1	H370	(3)
T;R39/24		STOT SE 1	H370	(3)
T;R39/25		STOT SE 1	H370	(3)
T+; R39/26		STOT SE 1	H370	(3)
T+; R39/27		STOT SE 1	H370	(3)
T+; R39/28		STOT SE 1	H370	(3)
Xi; R41		Eye Dam. 1	H318	
R42		Resp. Sens. 1	H334	
R43		Skin Sens. 1	H317	
Xn; R48/20		STOT RE 2	H373	(3)
Xn; R48/21		STOT RE 2	H373	(3)

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Xn; R48/22		STOT RE 2	H373	(3)
T;R48/23		STOT RE 1	H372	(3)
T;R48/24		STOT RE 1	H372	(3)
T;R48/25		STOT RE 1	H372	(3)
R64		Lact.	H362	
Xn; R65		Asp. Tox. 1	H304	
R67		STOT SE 3	H336	
Xn; R68/20		STOT SE 2	H371	(3)
Xn; R68/21		STOT SE 2	H371	(3)
Xn; R68/22		STOT SE 2	H371	(3)
Carc. Cat. 1; R45		Carc. 1A	H350	
Carc. Cat. 2; R45		Carc. 1B	H350	
Carc. Cat. 1; R49		Carc. 1A	H350i	
Carc. Cat. 2; R49		Carc. 1B	H350i	
Carc. Cat. 3; R40		Carc. 2	H351	
Muta. Cat. 2; R46		Muta. 1B	H340	
Muta. Cat. 3; R68		Muta. 2	H341	
Repr. Cat. 1; R60		Repr. 1A	H360F	(4)
Repr. Cat. 2; R60		Repr. 1B	H360F	(4)
Repr. Cat. 1; R61		Repr. 1A	H360D	(4)
Repr. Cat. 2; R61		Repr. 1B	H360D	(4)
Repr. Cat. 3; R62		Repr. 2	H361f	(4)
Repr. Cat. 3; R63		Repr. 2	H361d	(4)
Repr. Cat. 1; R60-61		Repr. 1A	H360FD	
Repr. Cat. 1; R60 Repr. Cat. 2; R61		Repr. 1A	H360FD	
Repr. Cat. 2; R60 Repr. Cat. 1; R61		Repr. 1A	H360FD	
Repr. Cat. 2; R60-61		Repr. 1B	H360FD	
Repr. Cat. 3; R62-63		Repr. 2	H361fd	
Repr. Cat. 1; R60 Repr. Cat. 3; R63		Repr. 1A	H360Fd	
Repr. Cat. 2; R60 Repr. Cat. 3; R63		Repr. 1B	H360Fd	
Repr. Cat. 1; R61 Repr. Cat. 3; R62		Repr. 1A	H360Df	

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Repr. Cat. 2; R61 Repr. Cat. 3; R62		Repr. 1B	H360Df	
N; R50		Aquatic. Acute 1	H400	
N; R50-53		Aquatic Acute 1 Aquatic Chronic 1	H400 H410	
N; R51-53		Aquatic Chronic 2	H411	
R52-53		Aquatic Chronic 3	H412	
R53		Aquatic Chronic 4	H413	
N; R59		Ozone	EUH059	