ENVIRONMENTAL PRODUCT DECLARATION
as per ISO 14025 and EN 15804

Owner of the Declaration	**Verband der Deutschen Holzwerkstoffindustrie e. V.**
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
Publisher	Institut Bauen und Umwelt e.V. (IBU)
Declaration number	EPD-VHI-20130022-IBE1-EN
Issue date	18.07.2013
Valid to	17.07.2019

Medium-density fibreboard (MDF)
Verband der Deutschen Holzwerkstoffindustrie e. V.

Institut Bauen und Umwelt e.V.

www.bau-umwelt.com / https://epd-online.com

1. General Information

Verband der Deutschen Holzwerkstoffindustrie e. V.	Medium-density fibreboard
Programme holder IBU - Institut Bauen und Umwelt e.V. Panoramastr. 1 D-10178 Berlin	**Owner of the Declaration** Verband der Deutschen Holzwerkstoffindustrie e. V. Ursulum 18 35396 Gießen
Declaration number EPD-VHI-20130022-IBE1-EN	**Declared product / Declared unit** 1m³ medium-density fibreboard
This Declaration is based on the Product Category Rules: Wood based panels, 07-2012 (PCR tested and approved by the independent expert committee)	**Scope:** Approx. 1.8 million m³ MDF were manufactured in Germany in 2009, of which more than 16% was accounted for by members of the association. The contents of this Declaration are based on information provided by members whose production accounted for 290,000 m³, whereby the technology represented here is representative for all members. The owner of the declaration shall be liable for the underlying information and evidence; the IBU shall not be liable with respect to manufacturer information, life cycle assessment data and evidences.
Issue date 18.07.2013	**Verification** The CEN Norm EN 15804 serves as the core PCR Independent verification of the declaration and data according to ISO 14025 ☐ internally ☒ externally
Valid to 17.07.2019	
Prof. Dr.-Ing. Horst J. Bossenmayer (President of Institut Bauen und Umwelt e.V.)	
Dr. Burkhart Lehmann (Chairman of SVA)	Matthias Schulz (Independent tester appointed by SVA)

2. Product

2.1 Product description
Medium-density fibreboard (MDF) represents wooden materials based on wood fibres manufactured in a dry process. Apart from wood fibres, MDF comprises duroplastic binding agents and other additives.

2.2 Application
MDF is used in furniture construction, building construction and civil engineering, and as packaging material.

2.3 Technical Data

General requirements in accordance with EN 622-5:1997 and EN 622-3:2004 (simplified version)

Name	Value	Unit
Bending strength (longitudinal) to EN 310	8 - 28	N/mm²
Bending strength (transverse) to EN 319	0.1 - 0.4	N/mm²
Thickness swelling 24 h to EN 317	7 - 20	%
Bending elasticity module to EN 310	1600 - 2900	N/mm²

2.4 Placing on the market / Application rules
DIN EN 622-3:2004-07, Fibreboard – Specifications – Part 3: Requirements on medium boards; German version EN 622-3:2004
DIN EN 13986:2005-03, Wood-based panels for use in construction – Characteristics, evaluation of conformity and marking; German version EN 13986:2004

2.5 Delivery status
MDF for the companies in VHI are available in the following dimensions:
Length: 200 mm – 6500 mm
Width: 200 mm – 2800 mm
Thickness: 2.5 mm – 64 mm
Special formats in terms of length, width and thickness are available on request.
Classification requirements in accordance with EN 622-3:2004, Tables 2 to 8 (EN 622-3); special qualities available on request.

2.6 Base materials / Ancillary materials
Medium-density fibreboard (MDF) represents wooden materials based on wood fibres manufactured in a dry process. Apart from wood fibres, MDF comprises duroplastic binding agents (urea-formaldehyde binding agents) and other additives.
The wood used is 100% fresh wood. The percentage

shares established for the Environmental Product Declaration comprise:

- wood, primarily coniferous wood: 80.04%
- water: 6.37%
- UF: 12.96%
- paraffin: 0.63%

The product has an average gross density of 737.5 kg/m³.

2.7 Manufacture

Industrial wood and wood chips are used in the production of MDF. The logs are stripped of bark, chopped and boiled along with the wood chips. The boiled wood chips are defibrated under high pressure in a refiner and then glued. The glued fibres are dried and scattered in the corresponding layers for pressing. The compressed boards or stream of boards are cut and formatted. Once the glue has hardened in full, the boards are packed.

2.8 Environment and health during manufacturing

The production conditions do not demand any special health protection measures over and beyond those designated by the authorities for special working areas, e.g. safety vest, safety shoes, dust mask. The MAK values (Germany) are fallen short of at each stage of the production process.

Air: Waste air generated during production is cleaned in accordance with statutory specifications. Emissions fall below the "TA Luft".

Water/Soil: No contamination of water or soil.

Sound protection: All values communicated inside and outside the production facilities are below the standards applicable in Germany. Noise-intensive plant components such as chipping are insulated accordingly by structural measures.

2.9 Product processing/Installation

VHI MDF boards can be sawn, milled, planed, ground and drilled using conventional machinery. Processing recommendations are available in the respective data sheets. Correct structural installation must be ensured. When selecting additional products, please ensure that they do not have a negative influence on the designated environmental compatibility properties of the building products referred to.

During product processing, conventional protective measures (dust mask, gloves, protective clothing, dust extraction etc.) must be observed.

2.10 Packaging

Depending on the manufacturer, VHI MDF boards are supplied in packaging made of solid wood, wood-based materials, cardboard, metal or plastic.

Where re-use is impractical, the materials should be recycled or utilised thermally.

2.11 Condition of use

Composition for the period of use complies with the base material composition in accordance with section 2.6. "Base materials".

Approx. 296 kg of carbon are bound in the product during use. This complies with approx. 1087 kg of carbon dioxide when fully oxidised.

2.12 Environment and health during use

Environmental protection: When the products outlined are used as designated and according to the current state of knowledge, there are no hazards for water, air or soil (see verification).

Health protection: When used normally and in accordance with the designated purpose, no health risks or restrictions are to be anticipated by MDF in line with the current state of knowledge. Emissions can only be established at levels which are harmless.

2.13 Reference service life

Resistance during the condition of use depends on the application classes (EN 622).

2.14 Extraordinary effects

Fire

Min. fire class D in accordance with EN 13501-1
Smoke class s2 – normally smoky
d0 – non-dripping
Change in physical condition (burning dripping/falling material): not possible as the products under review do not liquefy when heated

Water

No ingredients are washed out which could be hazardous to water. VHI MDF boards are not resistant to permanent exposure to water. Damaged areas can however be replaced on site.

Mechanical destruction

In the case of mechanical destruction, sharp edges can arise at points of rupture.

2.15 Re-use phase

Re-use: For the purpose of conversion or termination of the use phase of a building or other products in the case of selective de-construction, VHI MDF boards can be collected separately and re-used for the same or another application provided they are untreated.

Further use: In the event of single-type availability, VHI MDF boards can be prepared and redirected to a manufacturing process for wood-based materials.

Owing to its high heating value and provided that re-use or recycling is impractical, energetic use of MDF is desirable.

2.16 Disposal

Waste wood may not be landfilled in accordance with §9 of the Waste Wood Act (AVV 17 02 01).

2.17 Further information

Further information is available on the VHI (http://www.vhi.de) Web site.

3. LCA: Calculation rules

3.1 Declared Unit

The declared unit under ecological review is the provision of 1m³ medium-density fibreboard with a density of 737.50 kg/m³, a water content of 6.37% and a glue and additives content of 13.59%. The composition complies with the weighted average by production volume.

Declared unit

Name	Value	Unit
Declared unit	1	m^3
Conversion factor to 1 kg	0.001356	-
Ground reference	737.5	kg/m³

3.2 System boundary

The Declaration complies with an EPD "from cradle to plant gate, with options". It includes the production stage, i.e. from provision of the raw materials through to production (cradle to gate, Modules A1 to A3), and parts of the end-of-life stage (Modules C2 to C4). It also contains an analysis of the benefits and loads over and beyond the product's entire life cycle (Module D).

Module A1 analyses the provision of wood from forestry or in the form of ancillary products from the wood industry, the provision of other improved wood products and the provision of glues and other ingredients. Transport of these substances is considered in Module A2. Module A3 comprises the provision of fuels, resources and electricity as well as the production processes on site. Essentially, these involve the preparation, drying, sorting and compression of raw materials.

Module C2 considers transport to the disposing company while Module C3 handles preparation and sorting of waste wood; Module D analyses thermal utilisation and the ensuing benefits in the form of a system extension.

3.3 Estimates and assumptions

As a general rule, all of the material and energy flows for the processes required by production are established on site. The emissions from incineration and other processes on site could only be estimated on the basis of literary references. All other data is based on average values. Detailed information on all estimates and assumptions is documented in (S. Rüter, S. Diederichs: 2012).

3.4 Cut-off criteria

The section of material and energy flows reviewed is based on their use as renewable and non-renewable primary energy per unit process. A decision regarding the flows to be considered was made on the basis of studies available on the analysis of wood products. At least those material and energy flows were assessed which account for 1% of the application of renewable or non-renewable primary energy, whereby the total of flows not considered does not exceed 5% of the indicators referred to. No known material or energy flows were ignored which fell below the limit of 1%.

The inputs and outputs arising from details provided by the company were examined for plausibility.

The expenses associated with provision of the infrastructure (i.e. machinery, buildings etc.) for the entire primary system were not taken into consideration. This is based on the assumption that the expenses associated with building and maintaining the infrastructure do not exceed 1% of the total expenses outlined above. The energetic expenses in the form of heat and electricity required for operating the infrastructure were taken into consideration.

Detailed information on the cut-off criteria is documented in (S. Rüter, S. Diederichs: 2012).

3.5 Background data

All background data was taken from the GaBI Professional data base.

3.6 Data quality

With the exception of forest wood, the background data used for wood materials used for material and energy purposes originates from 2008 to 2010. The power mix originates from 2009 while the provision of forest wood was taken from a 2008 publication which is essentially based on information from 1994 to 1997. All other information was taken from the GaBi Professional Data Base which does not permit any more detailed limitation of quality. As the essential information originates from primary data surveys with a high degree of representativity, the quality of data can be regarded as very good.

3.7 Period under review

Data was surveyed during the period 2009 to 2011, whereby data was always provided for the full calendar year. The data is therefore based on 2008 to 2010. All information is based on averaged data from 12 consecutive months.

3.8 Allocation

The allocations comply with the specifications of the EN 15804:2012 and are explained in detail in (S. Rüter, S. Diederichs: 2012). Essentially, the following system extensions and allocations were carried out.

General

As a general rule, all material-inherent features were allocated in accordance with physical causalities; all other allocations were made on an economic basis. One exception is represented by allocation of the requisite heat combined heat and power which was allocated on the basis of the exergy of electricity and process heat products.

Module A1

- Forestry: Expenses in the forest were allocated to logs and industrial wood on the basis of their prices.
- Wood industry: The expenses required for production of the wood-based ancillary products in the wood materials industry were allocated on the basis of the prices of the respective products and ancillaries.

· The provision of waste wood does not take consideration of expenses incurred during the previous life cycle.

Module A3
Wood-processing industry: Expenses were allocated to primary products and residual materials on the basis of their prices.
With the exception of wood-based materials, the expenses incurred disposal of production waste are based on a system extension. The heat and electricity generated are credited to the system in the form of substitution processes. The credits achieved here account for significantly less than 1% of overall expenses.
All expenses associated with firing were allocated to firing after exergy of these two products in the case of combined generation of heat and power.
The provision of waste wood does not take consideration of expenses incurred during the previous life cycle (as in Module A1).

Module D
The system extension carried out in Module D complies with an energetic recycling scenario for waste wood.

3.9 Comparability
Basically, a comparison or an evaluation of EPD data is only possible if all the data sets to be compared were created according to EN 15804 and the building context, respectively the product-specific characteristics of performance, are taken into account.

4. LCA: Scenarios and additional technical information

The scenarios on which the LCA is based are outlined in more detail below.

End of life (C1-C4)
After demolition of the building, it is assumed for waste wood removed from it that it is initially transported across a distance of 20 km to the next user (C2) where it is crushed and sorted (C3). Waste wood is recycled (D) and not disposed of. No expenses are therefore incurred in Module C4.

Name	Value	Unit
Energy recovery , waste wood	737.5	kg

Re-use, recovery and recycling potentials (D), relevant scenario information
The product is recycled in the form of waste wood in the same composition as the declared unit at the end-of-life stage. Thermal recovery in a bio-mass power station with an overall degree of efficiency of 35% and electrical efficiency of 23% is assumed, whereby incineration of 1 tonne wood (atro) (at 18% wood moisture content) generates approx. 1231 kWh electricity and 2313 MJ useful heat. The exported energy substitutes fuels from fossil sources, whereby it is alleged that the thermal energy is generated from natural gas and the substituted electricity complies with the German power mix for 2009.

Name	Value	Unit
Electricity generated (per t atro waste wood)	1231	kWh
Waste heat used (per t atro waste wood)	2313	kWh

5. LCA: Results

DESCRIPTION OF THE SYSTEM BOUNDARY (X = INCLUDED IN LCA; MND = MODULE NOT DECLARED)

PRODUCT STAGE			CONSTRUCTION PROCESS STAGE		USE STAGE							END OF LIFE STAGE				BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARYS
Raw material supply	Transport	Manufacturing	Transport from the gate to the site	Assembly	Use	Maintenance	Repair	Replacement[1)]	Refurbishment[1)]	Operational energy use	Operational water use	De-construction demolition	Transport	Waste processing	Disposal	Reuse-Recovery-Recycling-potential
A1	**A2**	**A3**	**A4**	**A5**	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**C1**	**C2**	**C3**	**C4**	**D**
X	X	X	MND	MND	MND	MND	MNR	MNR	MNR	MND	MND	MND	X	X	X	X

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT: 1m³ MDF

Parameter	Unit	A1	A2	A3	C2	C3	C4	D
GWP	[kg CO_2-Eq.]	-9.07E+2	1.20E+1	2.18E+2	6.52E-1	1.09E+3	0.00E+0	-3.56E+2
ODP	[kg CFC11-Eq.]	9.80E-6	2.39E-8	4.78E-5	1.30E-9	1.19E-6	0.00E+0	-8.10E-5
AP	[kg SO_2-Eq.]	3.24E-1	9.20E-2	6.81E-1	2.80E-3	6.98E-3	0.00E+0	-3.64E-1
EP	[kg $(PO_4)^{3-}$- Eq.]	1.48E-1	2.06E-2	1.30E-1	6.49E-4	5.89E-4	0.00E+0	-3.49E-3
POCP	[kg Ethen Eq.]	3.82E-2	1.08E-2	3.38E-1	3.03E-4	4.64E-4	0.00E+0	-2.44E-2
ADPE	[kg Sb Eq.]	4.69E-5	2.52E-7	2.33E-4	1.38E-8	1.23E-7	0.00E+0	-6.14E-6
ADPF	[MJ]	3.68E+3	1.69E+2	2.57E+3	9.20E+0	4.62E+1	0.00E+0	-3.99E+3

Caption	GWP = Global warming potential; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential of land and water; EP = Eutrophication potential; POCP = Formation potential of tropospheric ozone photochemical oxidants; ADPE = Abiotic depletion potential for non fossil resources; ADPF = Abiotic depletion potential for fossil resources

RESULTS OF THE LCA - RESOURCE USE: 1m³ MDF

Parameter	Unit	A1	A2	A3	C2	C3	C4	D
PERE	[MJ]	4.30E+1	2.23E-1	2.83E+3	1.22E-2	4.70E+0	0.00E+0	-4.32E+2
PERM	[MJ]	1.14E+4	0.00E+0	5.55E+1	0.00E+0	0.00E+0	0.00E+0	0.00E+0
PERT	[MJ]	1.14E+4	2.23E-1	2.89E+3	1.22E-2	4.70E+0	0.00E+0	-4.32E+2
PENRE	[MJ]	3.02E+3	1.69E+2	4.24E+3	9.25E+0	8.78E+1	0.00E+0	-1.19E+4
PENRM	[MJ]	1.00E+3	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
PENRT	[MJ]	4.02E+3	1.69E+2	4.24E+3	9.25E+0	8.78E+1	0.00E+0	-1.19E+4
SM	[kg]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
RSF	[MJ]	0.00E+0	0.00E+0	3.32E+3	0.00E+0	0.00E+0	0.00E+0	6.40E+3
NRSF	[MJ]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
FW	[m³]	1.71E+3	3.18E+0	2.51E+3	1.73E-1	4.99E+1	0.00E+0	3.31E+3

Caption	PERE = Use of renewable primary energy excluding renewable primary energy resources used as raw materials; PERM = Use of renewable primary energy resources used as raw materials; PERT = Total use of renewable primary energy resources; PENRE = Use of non renewable primary energy excluding non renewable primary energy resources used as raw materials; PENRM = Use of non renewable primary energy resources used as raw materials; PENRT = Total use of non renewable primary energy resources; SM = Use of secondary material; RSF = Use of renewable secondary fuels; NRSF = Use of non renewable secondary fuels; FW = Use of net fresh water

RESULTS OF THE LCA – OUTPUT FLOWS AND WASTE CATEGORIES: 1m³ MDF

Parameter	Unit	A1	A2	A3	C2	C3	C4	D
HWD	[kg]	4.21E-1	0.00E+0	1.11E-1	0.00E+0	0.00E+0	0.00E+0	1.45E+0
NHWD	[kg]	1.78E-3	0.00E+0	1.29E-2	0.00E+0	0.00E+0	0.00E+0	4.40E-5
RWD	[kg]	1.17E-1	2.98E-4	5.96E-1	1.63E-5	1.49E-2	0.00E+0	-1.01E+0
CRU	[kg]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
MFR	[kg]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
MER	[kg]	0.00E+0	0.00E+0	2.88E+0	0.00E+0	7.37E+2	0.00E+0	0.00E+0
EEE	[MJ]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
EET	[MJ]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0

Caption	HWD = Hazardous waste disposed; NHWD = Non hazardous waste disposed; RWD = Radioactive waste disposed; CRU = Components for re-use; MFR = Materials for recycling; MER = Materials for energy recovery; EEE = Exported electrical energy; EEE = Exported thermal energy

6. LCA: Interpretation

The interpretation focuses on the production phase (Modules A1 to A3) as it is based on specific data provided by the company.

Global Warming Potential

Of the fossil greenhouse gases analysed in Modules A1 to A3, 48% is accounted for by provision of the raw materials, 3% is attributable to transport and 49% to production. The provision of wood raw materials also covers wide ranges of the processes in the wood industry in which the raw materials are incurred as by-products. The provision of adhesives and additives accounts for 41%, electricity consumption on site is responsible for 34% and the provision of wood raw materials makes up 7%.

Analysis of carbon from bio-mass
A total of approx. 1790 kg CO_2 enter the system in the form of carbon stored in the bio-mass, of which 558 kg CO_2 are emitted within the framework of heat generation on site. The volume of carbon ultimately stored in the product is extracted from the system again when recycled in the form of waste wood.

Acidification Potential
Of the emissions contributing to acidification analysed in Modules A1 to A3, 34% are emitted during the provision of raw materials, 9% within the framework of transporting raw materials and 57% directly or indirectly within the framework of production.
22% of emissions are incurred within the context of provision of additives, 12% is accounted for by the generation of heat and 34% by the generation of power.

Summer Smog Potential
Emissions contributing to near-ground ozone formation are primarily incurred during the phase of wood drying and hardening adhesives, accounting for 61% of the relevant emissions for this indicator.

Eutrification Potential
Of the emissions contributing to eutrification analysed in Modules A1 to A3, 54% are emitted during the provision of raw materials, 7% within the framework of transporting raw materials and 39% directly or indirectly within the framework of production.
45% of emissions are incurred within the context of provision of additives, 11% is accounted for by the generation of heat and 6% by the generation of power.

Ozone Depletion Potential
69% of emissions associated with the ozone depletion potential are incurred during the generation of power for the up-stream processes and on site.

Range of results
The individual results for the participating companies differ from the average results in the Environmental Product Declaration. In total, deviations of +20%/-8% (GWP), +34%/-12% (AP) and +21%/-7% (POCP) were measured in relation to the results outlined here.
These deviations are primarily attributable to differences in the fuels and binding agents used as well as the specific electricity consumption levels by the various processes.

Use of primary energy
Renewable energy carriers are primarily used in the form of wood for generating process heat. Of the total 6106 MJ, 3839 MJ are accounted for by the incineration of waste wood.
Non-renewable energy is primarily used for manufacturing adhesives, generating power and in the form of fuels for the transport processes. A total of 7744 MJ of primary energy from non-renewable resources is used.

Depletion of abiotic resources
Resources for material use are primarily deployed in the manufacture of processing tools. Resources used for energy purposes are largely used in the manufacture of adhesives.

Waste
Special waste is largely incurred during the production of adhesives (92%) and operating materials (8%).

7. Requisite evidence

7.1. Formaldehyde

Issuing body: EPH Entwicklungs- und Prüflabor Holztechnologie GmbH, Zellescher Weg 24, 01217 Dresden
Test report: CT-12-10-11-01 dated 11.10.2012
Result: In terms of formaldehyde content, the boards examined comply with the requirements of the DIBt 100 "Directive on the classification and monitoring of wooden panels regarding formaldehyde emissions" and correspond with E1 quality, i.e. the formaldehyde emissions in a standardised test area are less than 0.1 ppm. Accordingly, the requirements of the Chemicals Prohibition Ordinance (ChemVerbotsV) dated 19.7.1996 are fulfilled.

7.2 PCP/Lindane

Issuing body: EPH Entwicklungs- und Prüflabor Holztechnologie GmbH, Zellescher Weg 24, 01217 Dresden
Test report: CT-12-04-23-02 dated 23.04.2012
Result: The fibreboards examined do not contain any PCP or lindane. The MDF boards therefore comply with the limit and reference value of the Chemicals Prohibition Ordinance § 1 (15) for PCP. The MDF boards are not subject to marking concerning their PCP content in accordance with EN 13986.

8. References

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ISO 14025
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EN 15804
EN 15804:2012-04: Sustainability of construction works — Environmental Product Declarations — Core rules for the product category of construction products

S. Rüter, S. Diederichs: 2012 Ökobilanz Basisdaten für Bauprodukte aus Holz (Basic LCA data for wooden building products), Hamburg, Johann Heinrich von Thünen Institut, Institut für Holztechnologie und Holzbiologie, final report

DIN EN 622-3:2004-07, Fibreboard – Specifications – Part 3: Requirements on medium boards; German version EN 622-3:2004

DIN EN 622-5:2010-03, Fibreboard – Specifications – Part 5: Requirements for dry process boards (MDF); German version EN 622-5:2009

DIN EN 13986:2005-03, Wood-based panels for use in construction – Characteristics, evaluation of conformity and marking; German version EN 13986:2004

Product Category Rules for Building Products, Part B: Requirements on the EPD for wood-based materials 2012-10

DIN EN 13501-1: Classification of building products and types by fire performance – Part 1: Classification with the results of tests on fire performance by building products; German version EN 13501-1:2007+A1:2009

Waste Wood Act (AltholzV): Act governing the requirements on utilisation and disposal of waste wood, 2012

GaBi 6, 2013 Software system and data bases for life cycle engineering, Copyright, TM Stuttgart, Echterdingen 1992-2013 GaBi 6 2013B

GaBi 6, Documentation of the GaBi 6 data items in the data base for comprehensive analysis, LBP, University of Stuttgart and PE International, 2013. http://documentation.gabi-software.com/

"TA Luft": Technical Instructions on Air Quality; version dated 24 July 2002 and all VDI guidelines, DIN standards and legal specifications quoted therein

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