ENVIRONMENTAL PRODUCT DECLARATION

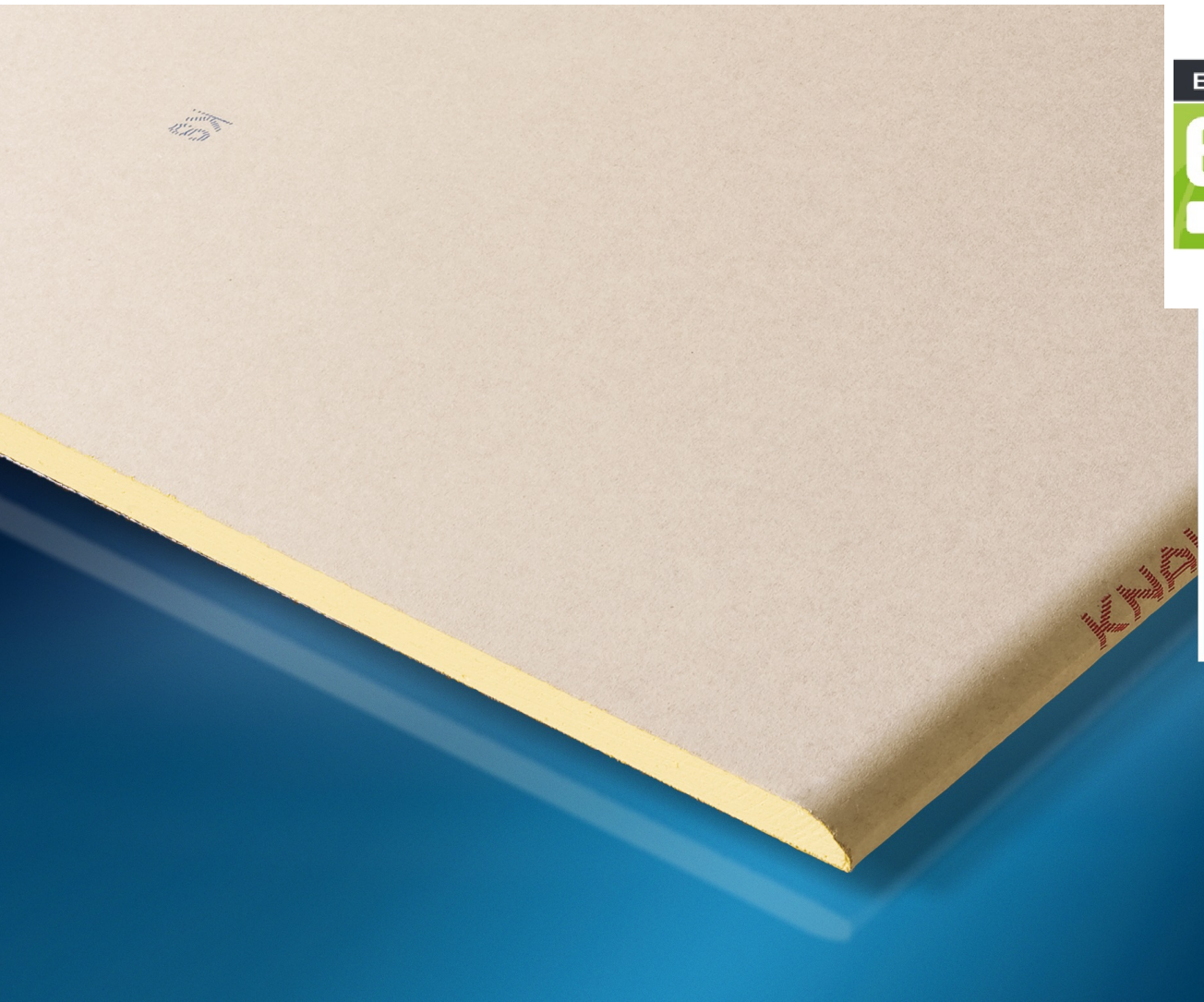
as per *ISO 14025* and *EN 15804+A2*

Owner of the Declaration	Knauf Gips KG
Publisher	Institut Bauen und Umwelt e.V. (IBU)
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
Declaration number	EPD-KNA-20230175-IBA1-EN
Issue date	14.08.2023
Valid to	13.08.2028

Knauf Safeboard GKF

Knauf Gips KG

www.ibu-epd.com | https://epd-online.com



1. General Information

Knauf Gips KG

Programme holder

IBU – Institut Bauen und Umwelt e.V.
Hegelplatz 1
10117 Berlin
Germany

Declaration number

EPD-KNA-20230175-IBA1-EN

This declaration is based on the product category rules:

Plasterboard, 11.07.2023
(PCR checked and approved by the SVR)

Issue date

14.08.2023

Valid to

13.08.2028

Dipl.-Ing. Hans Peters
(Chairman of Institut Bauen und Umwelt e.V.)

Florian Pronold
(Managing Director Institut Bauen und Umwelt e.V.)

Knauf Safeboard GKF

Owner of the declaration

Knauf Gips KG
Am Bahnhof 7
97346 Iphofen
Germany

Declared product / declared unit

Plasterboard Knauf Safeboard Type GKF according to *DIN 18180* respectively DF according to *EN 520*, 1 m², board thickness 12.5 mm, weight of board approx. 17.7 kg/m²

Scope:

This EPD covers 100 % of manufacture of the plasterboard Knauf Safeboard GKF. This plasterboard is manufactured in Germany. The life cycle assessment is based on production data for 2021/22.
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.

The EPD was created according to the specifications of EN 15804+A2. In the following, the standard will be simplified as *EN 15804*.

Verification

The standard EN 15804 serves as the core PCR
Independent verification of the declaration and data according to ISO 14025:2011
☐ internally ☒ externally

Ms Jane Anderson,
(Independent verifier)

2. Product

2.1 Product description/Product definition

Plasterboard Knauf Safeboard GKF is a lead-free X-ray shielding board for X-ray equipment designed to shield against radiation for enhanced stability and higher fire resistance quality.
For the placing on the market of the product in the European Union/European Free Trade Association (EU/EFTA) (with the exception of Switzerland) Regulation (EU) *No. 305/2011 CPR2011* applies. The product Knauf Safeboard GKF 12.5 mm needs a declaration of performance and the CE-marking harmonized acc. to *EN 520*.

For the application and use the respective national provisions apply.

2.2 Application

Knauf Safeboard GKF are used for room-enclosing constructions of X-ray facilities for radiation shielding regarding the following systems:

- X-Ray shield suspended ceilings
- X-Ray shield partitions
- X-Ray shield furring

2.3 Technical Data

The following technical data in condition on delivery is relevant for the declared product:

Constructional data

Name	Value	Unit
Gross density	≥ 1400	kg/m^3
Flexural breaking load longitudinal according to DIN 18180	≥ 610	N
Flexural breaking load transversal according to DIN 18180	≥ 210	N
Thermal conductivity following EN 12664	0.26	W/(mK)
Water vapour diffusion resistance factor (dry), according to EN ISO 10456	10	-
Water vapour diffusion resistance factor (wet), according to EN ISO 10456	4	-
Shrinkage and expansion air humidity per 1 % change of relative air humidity	0.005 / 0.008	mm/m
Shrinkage and expansion temperature per 1 Kelvin change of temperature	0.013 / 0.02	mm/m

Further information is available in the technical data sheet *K762.de*_ENG Knauf Safeboard GKF under www.knauf.de.

Performance data of the product in accordance with the declaration of performance with respect to its essential characteristics according to *EN 520.*

2.4 Delivery status

Plasterboards Knauf Safeboard GKF according to *DIN 18180* (Type DF according to *EN 520)* are delivered with a board thickness of 12.5 mm as well as a size of 2500 mm x 625 mm with a half-rounded long edge (HRAK) and front cut square edge (SSK).

2.5 Base materials/Ancillary materials

Knauf Safeboard GFK consists of more than 90 % of set gypsum and baryte, covered with a board liner (< 3 %). Furthermore, the plasterboards contain small amounts (< 5 %) of starch, tensides, fibre additives as well as in-organic colour pigments.

The declared products contain substances listed in the candidate list (date: 14.06.2023, *ECHA2023*) exceeding 0.1 percentage by mass: no.

This product contains other CMR substances in categories 1A or 1B (Regulation (EC) No. 1272/2008) which are not on the candidate list, exceeding 0.1 percentage by mass: no

Biocide products were added to this construction product or it has been treated with biocide products (this then concerns a treated product as defined by the (EU) Ordinance on Biocide Products No. 528/2012): no

2.6 Manufacture

The manufacturing process for gypsum boards is shown in Figure 1:

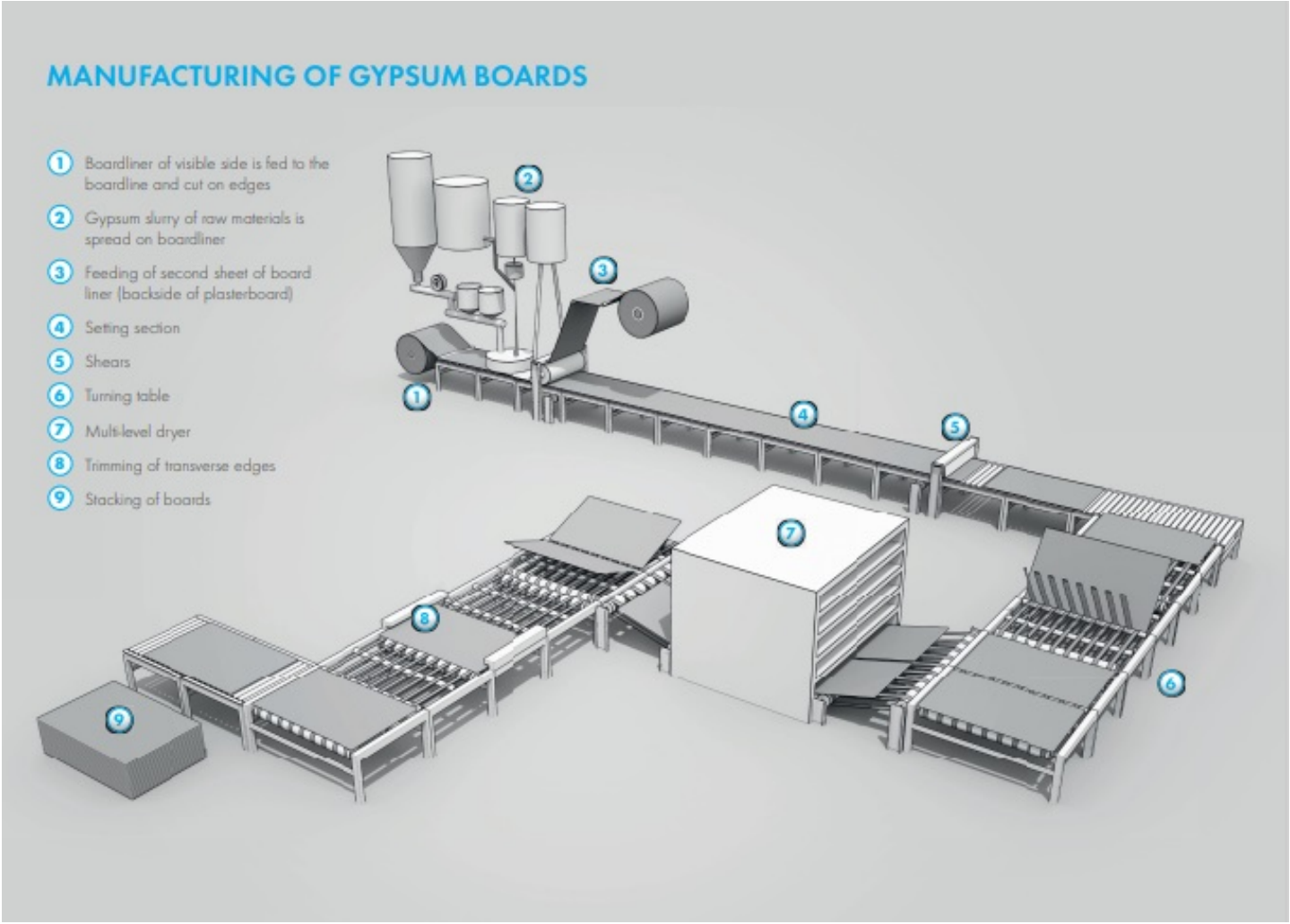


Figure 1: Manufacturing process of gypsum boards

The components of plasterboards Knauf Safeboard GKF are suspended in water and spread on a continuous sheet of board liner (visible face, lower layer). Beforehand, the board liner is cut on the sides for edge shaping. The slurry is covered with a second sheet of board liner (back surface) in the forming station and the edges of the visible face board liner are flipped upwards. On the subsequent board line the gypsum is setting continuously and is dried in a multi-level drier to the permitted residual moisture level. Drying is followed by the cutting of the boards to the desired lengths.

All processes within the company are certified according to *ISO 9001*.

2.7 Environment and health during manufacturing

The production of Knauf Safeboard GKF is subject to the German emission control regulations *BImSchG*. CO_2 emissions are measured due to CO_2 emissions trading. The German manufacturing sites for the production of Knauf Safeboard GKF are certified according to *ISO 50001* as well as certified with the occupational safety standard 'Systematic Safety' from the German Social Accident Insurance Institution for the Raw Materials and Chemical Industry BG RCI.

Gypsum from the flue-gas desulphurization plants of coal-fired power stations is used in addition to natural gypsum. Production waste as well as dust from the filtration units are recycled internally and fed back into the production of plasterboards.

2.8 Product processing/Installation

Storage

Plasterboards Knauf Safeboard GKF should be stored indoors under dust-free and dry conditions in a horizontal position.

Application

During application, dust thresholds are to be observed according to *TRGS 900* and *TRGS 559*. The application and installation should follow the instruction sheets provided under www.knauf.de (e.g., K131, K151, K152, K112) respectively the Knauf brochure *ST02*.de_EN Knauf Safeboard - X-ray Shielding.

Endless filament glass fibres are used in the manufacturing of plasterboards Knauf Safeboard GKF for enhanced fire protection. These fibres do not fan out during application and therefore no fibre dusts according to *TRGS 521* occur.

2.9 Packaging

Plasterboards Knauf Safeboard GKF are stacked on reusable pallets and protected with a PE-film. Pallets are re-used, whereas the PE-film is externally recycled.

2.10 Condition of use

Knauf Safeboard GKF are used for suspended ceilings, partitions and furring for shielding X-rays. They feature high levels of robustness against mechanical impacts and serve increased demands on fire protection. There is no change in the chemical composition during use.

2.11 Environment and health during use

Knauf Safeboard GKF are able to shield effectively against X-rays. The respective values of lead equivalence according to

DIN 6812 are available in the technical data sheet under www.knauf.de.

According to the emission test of Eurofins Product Testing A/S *Eurofins2021*, no hazardous substances are emitted above permissible thresholds during use.

2.12 Reference service life

There was no reference service life determined according to *ISO 15686-1*. However, a reference service life of 50 years can be considered for gypsum plasterboards according to the Guideline for Sustainable Building *BBSR2017*. There are no influences on ageing of plasterboards Knauf Safeboard GKF during use following the established engineering practice.

2.13 Extraordinary effects

Fire

The reaction to fire of plasterboards Knauf Safeboard GKF is classified as follows according to *EN 520* in conjunction with *EN 13501-1*.

Fire safety regulations

Name	Value
Building material class ; fire behaviour class	A2
Smoke gas development ; smoke production	s1
Burning droplets ; flaming droplets/particles	d0

A2 = non-combustible
s1 = no smoke
d0 = no burning fall-off/drop-off

Water

Knauf Safeboard GKF show a small tendency to swell or shrink within changes of climatic conditions. However, a permanent exposure to wet conditions or very high levels of relative humidity may lead to a decrease in strength. An instruction sheet about the restoration of flood damage is available under www.knauf.de *BSDH2013*.

Mechanical destruction

Minor damages on Knauf Safeboard GKF can be mended with suitable gypsum-based filling materials, *e.g.*, Knauf Safeboard Filler. The installation with screws and brackets allows an easy exchange of heavily damaged boards. In this case, the substructure should be examined, too, and replaced if necessary.

2.14 Re-use phase

Re-use

Once plasterboards Knauf Safeboard GKF are installed, they are not suited for re-use in an unchanged way. Prior to collection, plasterboards Knauf Safeboard GKF should be separated from other used building materials and pruned of foreign matter, e.g., metals from the substructure already on site for easier recycling or disposal.

Further use

Residual materials from new plasterboards Knauf Safeboard GKF, e.g., from cut waste at the building site, can be disposed of at a landfill.

Recycling

In principle, gypsum boards can be recycled by standard recycling processes. However, Knauf Safeboard GKF is not suitable for recycling due to the barytes included int the gypsum core.

2.15 Disposal

X-ray shielding boards Knauf Safeboard GKF have to be disposed of in compliance with the following waste codes of the European Waste Catalogue *EWC*:

17 08 02 - gypsum-based construction materials other than those mentioned in 17 08 01
17 09 04 - mixed construction and demolition wastes other than those mentioned in 17 09 01, 17 09 02 and 17 09 03

National disposal guidelines need to be observed. In Germany, plasterboards Knauf Safeboard GKF are to be disposed of at landfills of landfill category 1 or higher according to the regulation of landfills *DepV2021*.

2.16 Further information

Further information about plasterboards Knauf Safeboard GKF, e.g., technical data sheets or material safety data sheets are available at www.knauf.de.

3. LCA: Calculation rules

3.1 Declared Unit

The declared unit is 1 m² of plasterboard Knauf Safeboard GKF with a thickness of 12.5 mm, weight approx. 17.7 kg/m².

Declared Unit

Name	Value	Unit
Declared unit	1	m^2
Conversion factor to 1 kg	0.056	-

Other declared units are allowed if the conversion is shown transparently.

3.2 System boundary

Type of the EPD: cradle to gate - with options, modules C1–C4, and module D (A1–A3 + C+ D, additional modules: A4, A5)

This Environmental Product Declaration according to *EN 15804* contains:

- provision of raw materials and transport to plant, production of boards (A1-A3) including thermal energy for calcination and drying (from natural gas, geographic scope: DE), as well as electricity (residual mix DE)
- transport to building site (A4)
- installation at building site (A5) including the incineration of transport packaging
- disassembly (C1)
- transport to recycling facility or landfill site (C2)
- landfilling at end of life (C4)
- credits in D from incineration of packaging material in A5

The life cycle of Knauf Safeboard GKF is outlined in Figure 2.

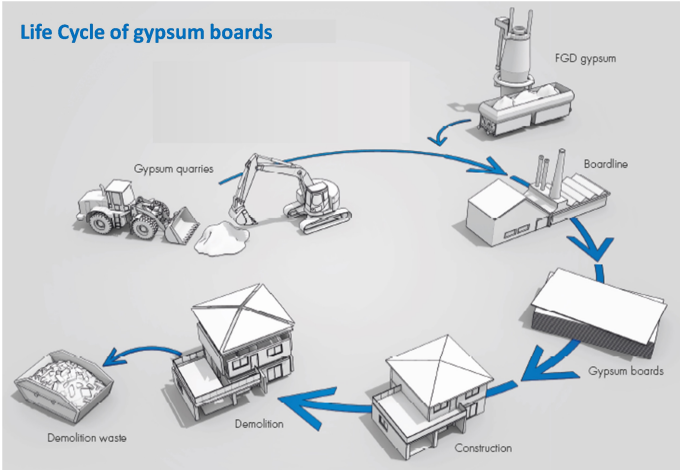


Figure 2: Principal life cycle of gypsum boards

3.3 Estimates and assumptions

For modelling the manufacturing of Knauf Safeboard GKF in plant Iphofen, the residual electricity for Germany has been chosen, whereas processes beyond the plant gate were mainly modelled with the European electricity consumption mix.

Some raw materials and additives were not available in the background database and therefore were either substituted with similar materials or modelled with their own processes. The respectively chosen methods are described in the background report.

Transport to the building site (module A4) as well as transport from the building site to landfill (module C2) is calculated with a standard distance of 100 km. This way, the user of the Environmental Product Declaration can convert the distances of modules A4 and C2 to the specific distance by extrapolation.

3.4 Cut-off criteria

All raw materials for the manufacturing of plasterboards Knauf Safeboard GKF, the required energy, water and the resulting emissions are considered in the life cycle assessment. That way, recipe components with a share even smaller than 1 % are included.
Cut-off rules as required by EN 15804+A2 are respected. The details are given in the background report. The environmental impacts imposed by these cut-offs are considered neglectable. All neglected processes contribute less than 5 % to the total mass or less than 5 % to the total energy consumption.

3.5 Background data

For modelling the LCA the software *LCA for Experts* with data base version 2023.1 from Sphera is used. Data sets for Germany are used for the life cycle inventory as much as possible. This is especially true for the provision of electricity and thermal energy for processes inside the Knauf plant.

3.6 Data quality

The LCA of plasterboards Knauf Safeboard GKF is modelled by using *LCA for Experts*, exclusively. All datasets used have been updated in the last 5 years. For processes and materials, where no direct match is available, data from literature or expert judgements are applied. Only a few materials and processes needed to be cut off due to missing information. Since these cut-off materials and processes are only of small amounts (<< 1 % w/w), the total influence of these neglected inputs is expected to be lower than 5 % of energy usage and mass.

With respect to technological, geographic and time representativeness, the overall data quality is evaluated to be 'satisfactory'.

3.7 Period under review

The modelling of Knauf Safeboard GKF is based on data from production years 2021/2022. Since different plasterboards are manufactured subsequentially, the energy consumption is measured directly during the production of each board type.

3.8 Geographic Representativeness

Land or region, in which the declared product system is manufactured, used or handled at the end of the product´s lifespan: Global

3.9 Allocation

Allocations are avoided in the modelling of production data. There may be allocations in the background data which are are explained in the documentation of the respective datasets.

3.10 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

Characteristic product properties of biogenic carbon

Information on describing the biogenic carbon content at factory gate

Name	Value	Unit
Biogenic carbon content in product	0.211	kg C
Biogenic carbon content in accompanying packaging	0.043	kg C

Product Stage (A1-A3)

Supply of raw materials
Plasterboards Knauf Safeboard GKF consist of a gypsum core and barytes which is reinforced with mineral fillers and covered with board liner. For its identification the core of Knauf Safeboard GKF is coloured in yellow. The natural gypsum is mainly extracted from open-cast mining in close vicinity to the manufacturing site. Furthermore, gypsum from the flue-gas desulphurization of coal-fired power stations (FGD gypsum) is used as a raw material. Board liner for the covering of gypsum core is produced from recycled waste paper which is certified by FSC and/or PEFC. Additives are added for an easier processing and a fine adjustment of properties of plasterboards Knauf Safeboard GKF. These additives add up to less than 5 % of the overall mass of the product.

Transport of raw materials
Natural gypsum is extracted from mines close to the manufacturing sites of plasterboard Knauf Safeboard GKF. Accordingly, transport distances are short and trucks can be used. FGD gypsum is transported by freight train from coal-fired power plants. The heavy spar is produced predominantly in Germany and also delivered by truck. In parts, baryte can also be delivered from overseas by container ship. Further raw

materials are supplied by truck from manufacturers within Germany or from neighbouring countries.

Manufacturing
Natural gypsum as well as gypsum from the flue-gas desulphurization is calcinated prior to the mixing with other components. FGD gypsum is usually delivered as damp material and, thus, must be dried before calcination. Stucco, mineral fillers and additives are mixed with water and processed as described in section 2.6. The addition of water allows the incorporation of water of crystallization into the molecules of calcium sulphate. By the addition of water, gypsum becomes settled and hardened. Redundant surface water is removed in a multi-level dryer.

Transport to building site (A4)
For transport, a standard distance of 100 km by truck is assumed. This declaration facilitates the extrapolation of the results in A4 to the real distance.

Name	Value	Unit
Litres of fuel (Diesel, density: 0.83 kg/l)	0.0364	l/100km
Transport distance	100	km
Capacity utilisation (including empty runs)	61	%
Gross density of products transported	≥ 1400	kg/m^3

Assembly on building site (A5)
The installation in the building includes the electricity consumption for fastening the Knauf Safeboard GKF. Accessories such as screws or the substructure itself are not part of the LCA in this EPD. The energy consumption for the electrical devices was considered with 0.0018 kWh/m².

The waste material (0.887 kg/m²) from the construction site is transported by truck to a landfill and disposed of. The replacement of this construction waste is considered in A5 as well.

The packaging material, re-usable wooden pallets and PE-film, are incinerated. The credits from this process are reported in Modul D.

Name	Value	Unit
Electricity consumption	0.0018	kWh
Material loss (landfilling)	0.887	kg
Reference service life according to BBSR2017	50	a

Use phase (B1-B7): Excluded since no environmental impacts/benefits are expected.

End of life (C1-C4)
The demolition (C1) of the Knauf Safeboard GKF from the building is considered to be done 100 % manually. It is assumed that the deconstruction would take place without further processing of the waste.

For the transport (C2) from the demolition site to the landfill by truck, a distance of 100 km was assumed in the calculation.

Transport (C2)

Name	Value	Unit
Transport distance	100	km
Capacity utilisation (including empty runs)	61	%

Currently, Knauf Safeboard GKF are not recycled. Therefore, module C3 is declared with 0 impacts.

Disposal (C4) includes the disposal of Knauf Safeboard GKF at an inert landfill.

Disposal (C4)

Name	Value	Unit
Collected separately	17.7	kg
Collected as mixed construction waste	-	kg
Reuse	-	kg
Recycling	-	kg
Energy recovery	-	kg
Landfilling	17.7	kg

Reuse-, recover- and recycling potential (D): Module D contains only credits for exported energy from incineration of packaging material (results only from A5)

5. LCA: Results

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

Product stage			Construction process stage		Use stage							End of life stage				Benefits and loads beyond the system boundaries
Raw material supply	Transport	Manufacturing	Transport from the gate to the site	Assembly	Use	Maintenance	Repair	Replacement	Refurbishment	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	X	X	MND	MND	MNR	MNR	MNR	MND	MND	X	X	X	X	X

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT according to EN 15804+A2: 1 m² Knauf Safeboard GKF 12.5 mm; 17.7 kg/m²

Parameter	Unit	A1-A3	A4	A5	C1	C2	C3	C4	D
GWP-total	kg CO_2 eq	1.36E+00	1.31E-01	3.16E-01	0	1.31E-01	0	1.17E+00	-6.36E-02
GWP-fossil	kg CO_2 eq	2.3E+00	1.3E-01	1.57E-01	0	1.3E-01	0	2.67E-01	-6.29E-02
GWP-biogenic	kg CO_2 eq	-9.42E-01	0	1.59E-01	0	0	0	9.01E-01	-6.06E-04
GWP-luluc	kg CO_2 eq	2.62E-03	1.18E-03	2.72E-04	0	1.18E-03	0	8.29E-04	-6E-06
ODP	kg CFC11 eq	1.43E-11	1.99E-14	7.82E-13	0	1.99E-14	0	6.86E-13	-8.56E-13
AP	mol H^+ eq	4.36E-03	1.64E-04	3.59E-04	0	1.64E-04	0	1.89E-03	-6.64E-05
EP-freshwater	kg P eq	1.67E-05	4.66E-07	9.08E-07	0	4.67E-07	0	5.39E-07	-1.89E-07
EP-marine	kg N eq	1.36E-03	5.69E-05	1.07E-04	0	5.7E-05	0	4.89E-04	-2.37E-05
EP-terrestrial	mol N eq	1.38E-02	6.68E-04	1.15E-03	0	6.69E-04	0	5.38E-03	-2.51E-04
POCP	kg NMVOC eq	3.34E-03	1.41E-04	2.79E-04	0	1.42E-04	0	1.48E-03	-6.13E-05
ADPE	kg Sb eq	1.83E-07	8.49E-09	1.09E-08	0	8.51E-09	0	1.23E-08	-6.03E-09
ADPF	MJ	3.66E+01	1.75E+00	2.25E+00	0	1.75E+00	0	3.55E+00	-9.57E-01
WDP	m^3 world eq deprived	6.74E-02	1.6E-03	2.49E-02	0	1.6E-03	0	2.92E-02	-9.27E-04

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; WDP = Water (user) deprivation potential)

RESULTS OF THE LCA - INDICATORS TO DESCRIBE RESOURCE USE according to EN 15804+A2: 1 m² Knauf Safeboard GKF 12.5 mm; 17.7 kg/m²

Parameter	Unit	A1-A3	A4	A5	C1	C2	C3	C4	D
PERE	MJ	2.17E+00	1.28E-01	2.14E+00	0	1.28E-01	0	5.81E-01	-4.16E-01
PERM	MJ	8.4E+00	0	-1.55E+00	0	0	0	0	0
PERT	MJ	1.06E+01	1.28E-01	5.9E-01	0	1.28E-01	0	5.81E-01	-4.16E-01
PENRE	MJ	3.63E+01	1.76E+00	2.46E+00	0	1.76E+00	0	3.56E+00	-9.57E-01
PENRM	MJ	3.77E-01	0	-2.1E-01	0	0	0	0	0
PENRT	MJ	3.67E+01	1.76E+00	2.25E+00	0	1.76E+00	0	3.56E+00	-9.57E-01
SM	kg	3.98E-01	0	0	0	0	0	0	0
RSF	MJ	0	0	0	0	0	0	0	0
NRSF	MJ	0	0	0	0	0	0	0	0
FW	m^3	1.3E-02	1.42E-04	1.18E-03	0	1.42E-04	0	8.96E-04	-1.47E-04

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 – WASTE CATEGORIES AND OUTPUT FLOWS according to EN 15804+A2: 1 m² Knauf Safeboard GKF 12.5 mm; 17.7 kg/m²

Parameter	Unit	A1-A3	A4	A5	C1	C2	C3	C4	D
HWD	kg	2.98E-09	9E-12	1.54E-10	0	9.01E-12	0	7.66E-11	-5.27E-12
NHWD	kg	5.21E-01	2.71E-04	9.21E-01	0	2.72E-04	0	1.78E+01	-5.43E-04
RWD	kg	9.8E-04	3.43E-06	5.58E-05	0	3.43E-06	0	4E-05	-4.31E-05
CRU	kg	0	0	0	0	0	0	0	0
MFR	kg	0	0	0	0	0	0	0	0
MER	kg	0	0	0	0	0	0	0	0
EEE	MJ	0	0	2.58E-01	0	0	0	0	0
EET	MJ	0	0	4.65E-01	0	0	0	0	0

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; EET = Exported thermal energy

RESULTS OF THE LCA – additional impact categories according to EN 15804+A2-optional: 1 m² Knauf Safeboard GKF 12.5 mm; 17.7 kg/m²

Parameter	Unit	A1-A3	A4	A5	C1	C2	C3	C4	D
PM	Disease incidence	2.21E-07	1.2E-09	1.26E-08	0	1.2E-09	0	2.33E-08	-5.38E-10
IR	kBq U235 eq	1E-01	5.03E-04	6.01E-03	0	5.04E-04	0	4.54E-03	-4.56E-03
ETP-fw	CTUe	1.1E+01	1.24E+00	8.02E-01	0	1.24E+00	0	1.94E+00	-1.87E-01
HTP-c	CTUh	5.45E-10	2.53E-11	4.69E-11	0	2.53E-11	0	2.99E-10	-1.25E-11
HTP-nc	CTUh	3.75E-08	1.35E-09	3.79E-09	0	1.35E-09	0	3.28E-08	-3.37E-10
SQP	SQP	3.6E+01	7.25E-01	1.93E+00	0	7.26E-01	0	8.96E-01	-2.89E-01

PM = Potential incidence of disease due to PM emissions; IR = Potential Human exposure efficiency relative to U235; ETP-fw = Potential comparative Toxic Unit for ecosystems; HTP-c = Potential comparative Toxic Unit for humans (cancerogenic); HTP-nc = Potential comparative Toxic Unit for humans (not cancerogenic); SQP = Potential soil quality index

Disclaimer 1 – for the indicator “Potential Human exposure efficiency relative to U235”. This impact category deals mainly with the eventual impact of low-dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure or radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, radon and from some construction materials is also not measured by this indicator.

Disclaimer 2 – for the indicators “abiotic depletion potential for non-fossil resources”, “abiotic depletion potential for fossil resources”, “water (user) deprivation potential, deprivation-weighted water consumption”, “potential comparative toxic unit for ecosystems”, “potential comparative toxic unit for humans – cancerogenic”, “Potential comparative toxic unit for humans - not cancerogenic”, “potential soil quality index”. The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high as there is limited experience with the indicator.

6. LCA: Interpretation

In general, the highest environmental impacts of Knauf Safeboard GKF result from the product stage A1-A3. Exceptions are Global Warming Potential – total GWP-t, non-hazardous waste disposed NHWD, and Human toxicity - non-cancer effects HTP-nc. For those indicators, module C4 and the disposal of the boards at inert landfill lead to the highest overall contributions.

In modules A1-A3, major contributions result from the provision of raw materials by at least 31 % to the overall life cycle impacts of the product. Exceptions are Non-hazardous waste disposed NHWD (< 1 %), Potential soil quality index SQP (approx. 28 %), and Global Warming Potential land use and land use change GWP-luluc (approx. 16 %).

The non-hazardous waste disposed NHWD, is dominated by the disposal C4 by almost 92 %. This was expected since there is no recycling at end of life but a complete landfilling. The high contribution of C4 to GWP-t results from the emission of biogenic carbon incorporated in the plasterboard. Landfilling in C4 contributes also considerably to the impact categories Water deprivation potential WDP (20 %), Eutrophication – freshwater EP-fw (24 %), Eutrophication – marine EP-m (25 %), Eutrophication – terrestrial (28 %), Acidification potential AP (27 %), and Human toxicity - cancer effects HTP-c (32 %).

Transports in A4 and in C2 cause only minor contributions to the overall life cycle impacts, due to assumed distances of 100 km in both modules. Exceptions are Ecotoxicity, freshwater ETP-fw (approx. 8 %) and the Global Warming Potential land use and land use change GWP-luluc (approx. 20 %).

Some small credits given in module D result from the incineration and recycling of packaging only. The disassembled product is landfilled after disassembly.

7. Requisite evidence

7.1 Leaching (sulphates and heavy metals)

Plasterboards Knauf Safeboard GKF show a leaching behaviour typical for gypsum based building products /Dre2006/. Thus, sulphates are leached in the saturation region (complexometric titration according to /DIN 38404-5:1985/). That is why disposal is only allowed in landfills from landfill category 1 in Germany /DepV2009/.
Heavy metal concentrations were verified (by ICPOES according to /ISO 11885:2007/) significantly below the assignment criteria according to landfill category 1 complying with /DepV2009/.

Plasterboards Knauf Safeboard GKF are classified in water hazard class 1 (slightly water-hazardous) *AwSV*.

7.2 Radioactivity

According to *Geh2012* and *RP 112* dose values and radon concentrations of gypsum-based building products are below 0.3 mSv/a. Thus, they can be used without restrictions.

7.3 VOC emissions

According to emission test from Eurofins Product Testing A/S, no hazardous substances are emitted above permissible thresholds during use */Eurofins2021/*.

Test after 3 days (limit value)

Name	Value	Unit
TVOC	≤ 10	mg/m³
Total carcinogens	< 0.01	mg/m³

Test after 28 days (limit value)

Name	Value	Unit
TVOC	≤ 1.0	mg/m³
TSVOC	≤ 0.1	mg/m³
R-value (dimensionless)	≤ 1	-
Sum of VOC without NIK/LCI	≤ 0.1	mg/m³
Formaldehyde	≤ 0.1	mg/m³
Total carcinogens	≤ 0.001	mg/m³

VOC emission tests showed that Knauf Safeboard GKF significantly undercuts the required thresholds.

8. References

Standards

DIN 6812
DIN 6812:2013-06, Medical X-ray equipment up to 300 kV - Rules of construction for structural radiation protection

DIN 18180
DIN 18180:2014-09, Gypsum plasterboards - Types and requirements

DIN 38404-5
DIN 38404-5: 1984, German standard methods for the examination of water, waste water and sludge; physical and physico-chemical parameters (group C); determination of the pH-value (C 5)

EN 520
EN 520:2009-12, Gypsum plasterboards - Definitions, requirements and test methods

EN 12664
DIN EN 12664: Thermal Performance of Building Materials and Products - Determination of Thermal Resistance by Means of Guarded Hot Plate and Heat Flow Meter Methods - Dry and Moist Products with Medium and Low Thermal

EN 13501-1
Fire classification of construction products and building elements – Part 1: Classification using data from reaction to fire tests; German version EN 13501-1:2018

EN 15804
EN 15804:2012+A2:2019+AC:2021, Sustainability of construction works — Environmental Product Declarations — Core rules for the product category of construction products.

ISO 9001
DIN EN ISO 9001:2015-09; Quality management system – Requirements

ISO 10456
EN ISO 10456-1:2010-05: Building materials and products - Hygrothermal properties – Tabulated design values and procedures for determining declared and design thermal values - Technical Corrigendum 1 (ISO 10456:2007/Cor 1:2009)

ISO 11885
EN ISO 11885:2009, Water quality – Determination of selected elements by inductively coupled plasma optical emission spectrometry (ICP-OES)

ISO 14025
EN ISO 14025:2011, Environmental labels and declarations — Type III environmental declarations — Principles and procedures.

ISO 15686-1
ISO 15686-1:2011: Buildings and constructed assets -- Service life planning -- Part 1: General principles and framework

ISO 45001
ISO 45001:2018, Occupational health and safety management systems – Requirements with guidance for use

ISO 50001
EN ISO 50001:2018, Energy management systems – Requirements with guidance for use

Further References

AwSV
Verordnung über Anlagen zum Umgang mit wassergefährdenden Stoffen 1,2 (AwSV) 18.04.2017 vom Bundesministerium der Justiz

BBSR2017
Service life of building components for life cycle analyses acc. to the Sustainable Building Assessment System (BNB) -- Nutzungsdauer von Bauteilen für Lebens-zyklusanalysen nach Bewertungssystem Nachhaltiges Bauen (BNB) 2017-02-24 vom Bundesinstitut für Bau-, Stadt-, Raumforschung (BBSR)

BDSH2013
Bauschäden durch Hochwasser – Tipps für die Sanierung (Flood damage - tips for recovery), instruction sheet, Knauf Gips KG (editor), Iphofen, 2013, www.knauf.de

BG RCI
Occupational health and safety management: Systematic Safety, editor: The German Social Accident Insurance Institution for the Raw Materials and Chemical Industry, Heidelberg, 2021-12-01

BImSchG
Act on the Prevention of Harmful Effects on the Environment Caused by Air Pollution, Noise, Vibration and Similar Phenomena (Federal Immission Control Act - BImSchG), Publication 2013-05-2017 (BGBI. I p. 1274), last amended 2015-08-31 (BGBI. I p. 1474)

DepV
Verordnung über Deponien und Langzeitlager (Deponieverordnung – DepV), German landfill ordinance, last amended and supplemented: 2021-07-09

Dre2006
H. Drexler, Test report no. 1080556 AU-23572, Dorfner Analysenzentrum und Anlagenplanungsgesellschaft mbH, Hirschau, 11.01.2006 (originator: Bundesverband Gips e. V., Dr. H.-J. Kersten, Berlin)

ECHA
European Chemicals Agency (ECHA), Candidate List of Substances of Very High Concern for Authorisation (published

in accordance with Article 59(10) of the REACH Regulation), http://echa.europa.eu/de/candidate-list-table, Revision: 2023-06-14

Eurofins2021
VOC Emission Test Report for Knauf Safeboard GKF 12.5 mm by the institute 'Eurofins Product Testing A/S in Galten-Denmark; 2021-02-23

European Waste Code
Guidance on classification of waste according to EWC-Stat categories, Supplement to the Manual for the Implementation of the Regulation (EC) No 2150/2002 on Waste Statistics, COMMISSION OF THE EUROPEAN COMMUNITIES/EUROSTAT, v2, December 2010

Geh2012
K. Gehrcke, B. Hoffmann, U. Schkade, V. Schmidt, K. Wichterey: Natürliche Radioaktivität in Baumaterialien und die daraus resultierende Strahlenexposition, Report BfS-SW-14/12, Bundesamt für Strahlenschutz (editor), http://nbn-resolving.de/urn:nbn:de:0221-201210099810, Salzgitter, 2012

Gips-DB
Gips-Datenbuch, editor: Bundesverband Gips e. V. (German association of gypsum manufacturers), Berlin, 2013

IBU 2022
Institut Bauen und Umwelt e.V.: General Instructions for the EPD programme of Institut Bauen und Umwelt e.V., Version 2.1, Berlin: Institut Bauen und Umwelt e.V., 2022; www.ibu-epd.com

IBU PCR Part A
Institut Bauen und Umwelt e.V.: Product Category Rules for Building-Related Products and Services Part A: Calculation Rules for the Life Cycle Assessment and Requirements on the Project Report according to EN 15804+A2:2019, v1.1.2, 2021-09-02

IBU PCR Part B "Plasterboards"
Institut Bauen und Umwelt e.V.: PCR Guidance-Texts for Building-Related Products and Services Part B: Requirements on the EPD for Plasterboard, v5, 2023-07-11

LCA for Experts (GaBi)
LCA for Experts (v10.7.0.183): Software-System and Databases for Life Cycle Engineering, Sphera Solutions GmbH, Leinfelden- Echterdingen, Germany, 2023 (database version 2023.1)

Regulation (EU) No 305/2011
Regulation (EU) No 305/2011 for construction products (CPR), Regulation (EU) No 305/2011 of the European Parliament and of the Council of 9 March 2011 laying down harmonized conditions for the marketing of construction products

Regulation (EC) No 528/2012
REGULATION (EU) No 528/2012 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 22 May 2012 concerning the making available on the market and use of biocidal products

Regulation (EC) No. 1272/2008
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

RP112
Radiation Protection 112: Radiological protection principles concerning the natural radioactivity of building materials, European Commission, Luxembourg, 2000

TRGS 521
Technical Rules for Hazardous Substances TRGS 521: Demolition, reconstruction and maintenance work with biopersistent mineral wools, Edition: February 2008, Federal Institute for Occupational Safety and Health (editor)

TRGS 559
Technical Rules for Hazardous Substances TRGS 559: Mineral Dust, Edition: February 2010, Federal Institute for Occupational Safety and Health (editor), last amended and supplemented: GMBl 2011

TRGS 900
Technical Rules for Hazardous Substances TRGS 900: Occupational Exposure Limits, Edition: January 2006, Federal Institute for Occupational Safety and Health (editor), last amended and supplemented: GMBl 201

Technical brochures Knauf
Downloadable under www.knauf.de

K11
K11.de_ENG; Knauf X-ray Shielding Ceiling Systems, technical document 2022-09

K13
K13.de_ENG; Knauf X-ray Shielding Partitions, technical document 2022-09

K15
K15.de_ENG; Knauf X-ray Shielding Furring, technical document 2022-09

K762
K762.de_ENG; Knauf Safeboard GKF; technical data sheet 2022-06

ST02
ST02.de_ENG; Knauf Safeboard – X-ray Shielding, technical brochure 2017-07

Publisher

Institut Bauen und Umwelt e.V.
Hegelplatz 1
10117 Berlin
Germany

+49 (0)30 3087748- 0
info@ibu-epd.com
www.ibu-epd.com

Programme holder

Institut Bauen und Umwelt e.V.
Hegelplatz 1
10117 Berlin
Germany

+49 (0)30 3087748- 0
info@ibu-epd.com
www.ibu-epd.com

Author of the Life Cycle Assessment

Knauf Gips KG
Am Bahnhof 7
97346 Iphofen
Germany

0049 9001 31-1000 *
knauf-direkt@knauf.de
www.knauf.de

Owner of the Declaration

Knauf Gips KG
Am Bahnhof 7
97346 Iphofen
Germany

0049 9001 31-1000 *
knauf-direkt@knauf.de
www.knauf.de