



Earthwool® 1000° Pipe Insulation

Knauf Insulation Earthwool® 1000° Pipe Insulation is a molded, one-piece insulation made from inorganic glass fibers bonded with ECOSE® Technology. It is produced in 3' lengths with or without a factory-applied jacket. ASJ+ is the newest generation all-service jacket composed of aluminum foil, reinforced with a glass scrim bonded to a kraft paper interleaving, with an outer film layer. This jacket leaves no paper exposed, allowing for easier cleaning.

Manson ALLEY-K™ Pipe Insulation is available with or without the standard all service jacket (ASJ).



Performance dashboard

Features & functionality

Excellent resistance to heat loss or gain, saving energy and lowering operating costs

Fast and easy installation reduces labor costs

ASJ+ facing is cleanable with a soapy wet cloth and has a self-sealing lap, which eliminates the need for additional material and tools

UL Environment validated formaldehyde-free

Visit Knauf and Manson for more product information

Earthwool® 1000° Pipe Insulation, ALLEY-K™

Environment & materials

Improved by:

Utilization of recycled glass

Knauf's original bio-based ECOSE® binder technology

Optimized compression packaging

Certification & rating systems:

HPD v2.2, 100ppm; C, S / BM1

UL GREENGUARD Gold certified

UL Validated recycled content

UL Validated formaldehyde-free

Audited, European Certification Board for Mineral Wool Products exoneration process

MasterFormat® 23 07 19

Thermal Insulation Guide Specification

For spec help, contact us or call 317 421 8727

See LCA, interpretation & rating systems



SM Transparency Report (EPD)™

VERIFICATION

3rd-party reviewed



Transparency Report (EPD)

3rd-party verified



Material evaluation

Self-declared



Validity: 2023/05/15 – 2028/05/14

Decl #: KNA – 230515 – 001

LCA

This environmental product declaration (EPD) was externally verified by Harmony Environmental, LLC, according to ISO 21930:2017; UL Part A; UL Part B for Mechanical, Specialty, Thermal and Acoustical Insulation Products; and ISO 14025:2006.

Harmony Environmental, LLC
16362 W. Briarwood Ct.
Olathe, KS 66062
www.harmonyenviro.com
(913) 780-3328



SUMMARY

Reference PCR

UL PCR Part B: Mechanical, Specialty, Thermal, and Acoustic Insulation Product EPD Requirements v1.0, 09/19 - 09/24

Regions; system boundaries

North America; Cradle-to-installation with end of life

Declared unit / expected service life:

1 m of pipe insulation material, including packaging, with an expected service life (ESL) of 75 years; 1 m² of ASJ+ facer; 1 m of SSL; 1 m of butt strip

LCIA methodology: TRACI 2.1

LCA software; LCI database

LCA for Experts v10.7; LCA for Experts 2023

LCA conducted by: Sustainable Minds

Public LCA:

Knauf Earthwool® 1000° Pipe Insulation and Manson ALLEY-K Pipe Insulation

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317 398 4434

Contact us

How we make it greener

Earthwool® 1000° Pipe Insulation ASJ+

[Collapse all](#) [See LCA results by life cycle stage](#)

RAW MATERIALS ACQUISITION



Utilize recycled content

By leveraging recycled content, we reduce the energy required to form glass fibers.

Pursue sequestration potential

Manson and Knauf's bio-based ECOSE Technology is derived from corn. While we don't grow the corn used in our products, the use of corn has a significant carbon sequestration impact on our processes. For instance, the use of corn actually offsets the carbon impact of some of the ancillary facers used on our products.

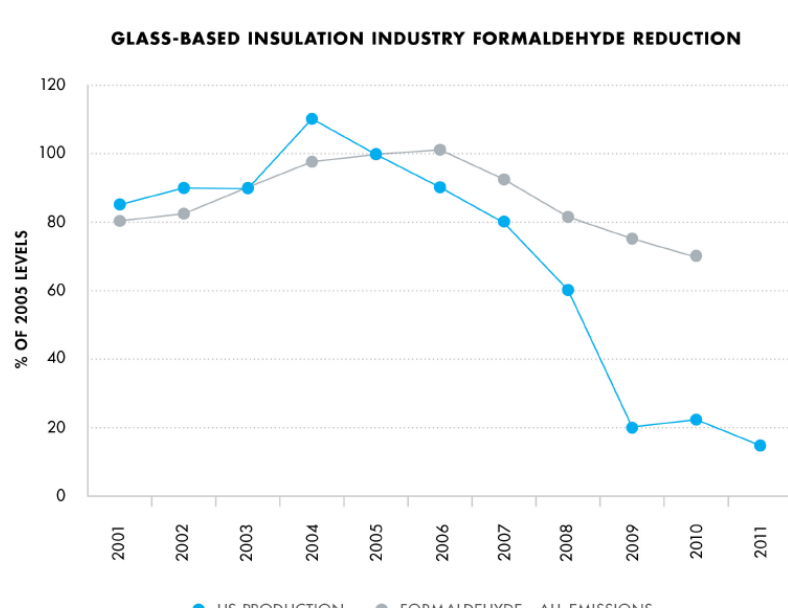
MANUFACTURING

Develop bio-based formaldehyde-free binder

In 2008, Manson and Knauf Insulation launched perhaps the nation's largest formaldehyde-free green chemistry initiative called ECOSE Technology. Offering this into the building materials marketplace quickly transformed the entire fiberglass industry toward bio-based chemistries. Today phenol-formaldehyde (PF) based resins are largely a thing of the past with regard to large volume mineral fiber based insulation products. Manson and Knauf have also launched a new business venture to assist other industries in accessing ECOSE Technology for their processes.

Lead green chemistry efforts

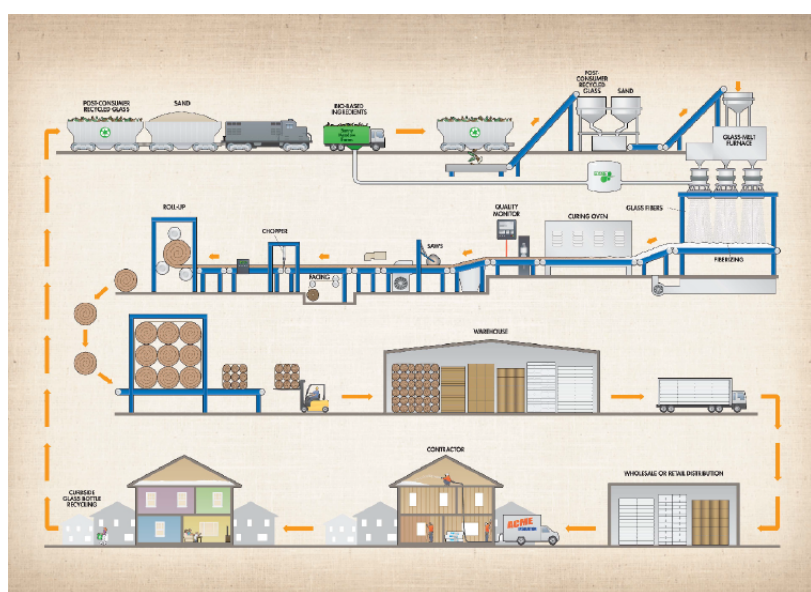
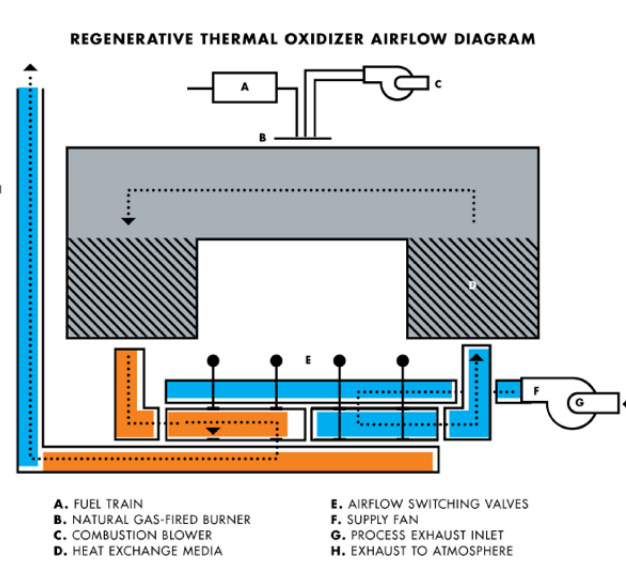
Following the launch of our ECOSE Technology in 2009, we had transformed all of our products and processes to this new technology. Using our bio-based ECOSE Technology has removed phenol and formaldehyde from our stack emissions. By 2012, the entire industry had followed our lead. This initiative not only established Manson and Knauf Insulation in a leadership position, but it had a transformative impact on our industry in general.



Green manufacturing Processes

1. Regenerative thermal oxidizers Manson and Knauf Insulation use regenerative thermal oxidizers (RTO) to capture and recycle much of the energy we used to cure our products. RTO is equipment used for the treatment of exhaust air. Our ovens exhaust into a ceramic heat exchange media to capture and reuse the heat in the exhausted air. Therefore, the amount of energy required to cure our product is reduced substantially.

2. Recycling As you can see below, everything we do starts with recycling. Our plant uses as much as 80% recycled content. While our only option is to landfill our products at end of life, that doesn't stop us from encouraging consumers to recycle other products, particularly glass bottles.



Continuous Improvement

Continuous improvement is key to our sustainable development. Globally, we maintain the following TUV NORD CERT GmbH certifications: ISO 9000, 14000, and 50001. These certifications relate to quality management systems, energy management and environmental management efforts. For more information on our current continuous improvement efforts, please review our global sustainability report.

TRANSPORTATION

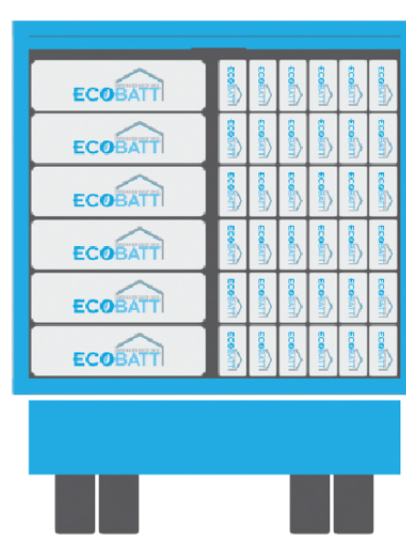


Leverage compression packaging

Glass is a high modulus material, which helps to facilitate compression packaging. We compress our insulation to fit up to five times more product on every truck. This compression means:

- More material can fit on one truck when compared to other insulation materials
- Fewer packages on a job
- Fewer deliveries needed

WE COMPRESS OUR INSULATION TO FIT UP TO **5X** MORE PRODUCT ON EVERY TRUCK.



INSTALLATION AND MAINTENANCE



Be confident in glass fiber's safety

In the past, a label regarding the carcinogenic potential of insulation made from glass fibers was required on all packaging. Following forty years of research, fiberglass has been exonerated entirely. Knauf Insulation fiberglass is comprised of fibers that are biosoluble, meaning that the fibers dissolve in the body in a short period of time and exit the body with normal bodily functions. The scrutiny fiberglass has undergone is now seen as proof of its safety.

Meet and exceed green standards

GREENGUARD certified On the forefront of indoor air quality, Knauf Insulation was the first GREENGUARD certified product in 2002. This achievement led us to understand the impact our formaldehyde-free products could have on the indoor environment. The formaldehyde-free claim is third party validated by UL Environment.

EUCEB tested Glass fiber is perhaps the most widely studied building material available today. All of our processes and formulations are voluntarily third-party audited for compliance with the health and safety exonerated criteria for glass and rock based fiber through the European Certification Board for Mineral Wool Products (EUCEB) exonerated process. This guarantees the formulations are biosoluble and pose no health concerns. Having 35 years of research behind its safety, perhaps no other building material has been as thoroughly evaluated as fiberglass products. We believe a safe product is one that has been thoroughly evaluated.

Green building rating systems

Our products offer a vast array of potential credits for major green building rating systems, including: WELL, LEED v4, International Green Construction Code, Green Guide for Health Care, NAHB Green Building Standard and more.

Visit the [green building rating systems page](#) to see all the credits you can earn using Manson and Knauf Insulation products

Green building rating system credits

Find out all the credits you can earn with Knauf products.

[Learn more](#)

DISPOSAL



Promote Recycling

By taking a comprehensive approach of the benefits of recycling, Manson and Knauf Insulation advocates and promotes local recycling initiatives as well as actively participates in state and local government policy development. In addition, as a member of the North American Insulation Manufacturers Association (NAIMA) and Glass Recycling Coalition (GRC), we encourage regulatory and legislative initiatives that focus on glass recycling infrastructure development to increase the availability of post-consumer recycled glass.



SM Transparency Report (EPD)™

VERIFICATION	LCA
3rd-party reviewed	<input checked="" type="checkbox"/>
Transparency Report (EPD)	
3rd-party verified	<input checked="" type="checkbox"/>
Material evaluation	
Self-declared	<input checked="" type="checkbox"/>

Validity: 2023/05/15 – 2028/05/14
Decl #: KNA – 230515 – 001

This environmental product declaration (EPD) was expertly verified by Harmony Environmental, LLC, according to ISO 21930:2017; UL Part A; UL Part B for Mechanical, Specialty, Thermal and Acoustical Insulation Products; and ISO 14025:2006.

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SUMMARY
Reference PCR
UL PCR Part B: Mechanical, Specialty, Thermal, and Acoustic Insulation Product EPD Requirements v1.0, 09/19 - 09/24

Regions; system boundaries
North America; Cradle-to-installation with end of life

Declared unit / expected service life:
1 m of pipe insulation material, including packaging, with an expected service life (ESL) of 75 years; 1 m² of ASJ+ facer; 1 m of SSL; 1 m of butt strip

LCA methodology: TRACI 2.1

LCA software; LCI database
LCA for Experts v10.7; LCA for Experts 2023

LCA conducted by: Sustainable Minds

Public LCA:
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[Contact us](#)

Earthwool® 1000® (ALLEY-K™) Pipe Insulation with optional ASJ+

Additional EPD content required by:
ULE PCR Part B: Mechanical, Specialty, Thermal, and Acoustic Insulation Product EPD Requirements

Data

Background This product-specific declaration was created by collecting production data from the Shelbyville, IN production location. Secondary data sources include those available in LCA for Experts 2023 databases.

Allocation The allocation methods used were examined according to the updated allocation rules in ISO 21930:2017. Since only facility-level data were available, allocation among the facility's other co-products was necessary to determine the input and output flows associated with the product. Allocation of materials and energy was done on a mass basis for all products except for the ASJ+ facing, SSL, and butt strip which were allocated based on product area, length, or number of pieces. Allocation of transportation was based on weight.

Cut-off criteria for the inclusion of mass and energy flows are 1% of renewable primary resource (energy) usage, 1% nonrenewable primary resource (energy) usage, 1% of the total mass input of that unit process, and 5% of environmental impacts. The total of neglected input flows per module does not exceed 5% of energy usage, mass, and environmental impacts. The only exceptions to these criteria are substances with hazardous and toxic properties, which must be listed even when the given process unit is under the cut-off criterion of 1% of the total mass. No known flows are deliberately excluded from this declaration; therefore, these criteria have been met. Biogenic carbon is included in reported results.

Quality Temporal and technological representativeness are considered to be high. Geographical representativeness is considered to be good. All relevant process steps for the product system were considered and modeled. The process chain is considered sufficiently complete with regards to the goal and scope of this study. The product system was checked for mass balance and completeness of the inventory. Capital equipment was excluded as required by the PCR. Otherwise, no data were knowingly omitted. For more information on data quality, see the LCA background report.

LCIA impact factors required by the PCR are global warming, ozone depletion, acidification, eutrophication, smog, and fossil fuel depletion; *These six impact categories are globally deemed mature enough to be included in Type III environmental declarations. Other categories are being developed and defined and LCA should continue making advances in their development. However, the EPD users shall not use additional measures for comparative purposes.*

Relevant technical properties

PROPERTY (UNIT)	TEST	VALUE / PERFORMANCE
Design density of declared unit (size dependent) (kg/m ³)	N/A	50 – 120
Corrosiveness	ASTM C665	Does not accelerate corrosion of steel
Corrosion	ASTM C1617	Pass
Maximum Service Temperature	ASTM C411 + ASTM C447	1000° F (538° C)
Water Vapor Permeance	ASTM E96, Procedure A	0.01 perms or less
Water Vapor Sorption (by weight)	ASTM C1104	Less than 5%
Shrinkage	ASTM C356	Negligible
Mold Growth	ASTM C1338	Pass
Surface Burning Characteristics (flame spread/smoke developed)	ASTM E84, UL 723, CAN/ULC S102	UL/ULC Classified FHC 25/50

Flow diagram

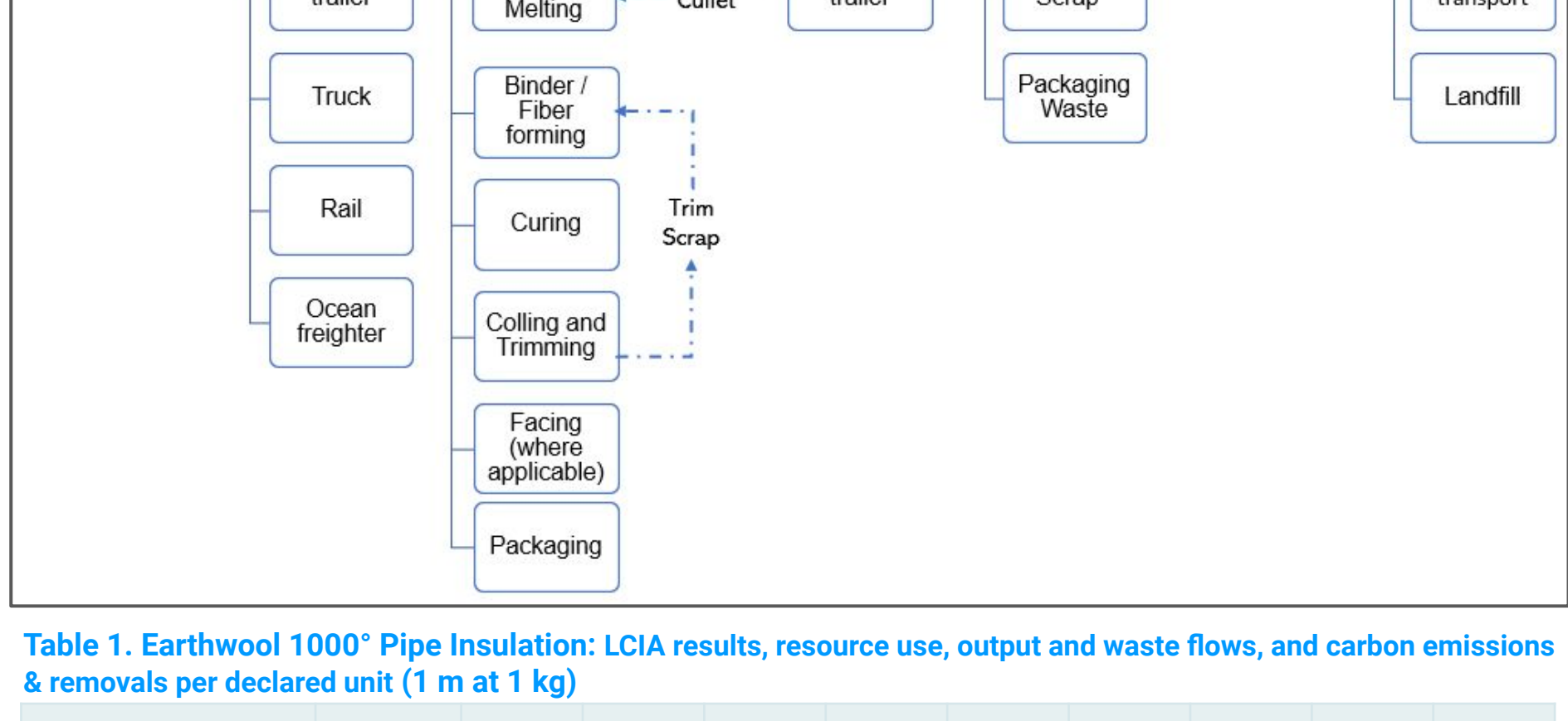


Table 1. Earthwool 1000® Pipe Insulation: LCIA results, resource use, output and waste flows, and carbon emissions & removals per declared unit (1 m at 1 kg)

Parameter	Unit	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4	Total
LCIA results (per m of pipe insulation material, including packaging, with an expected service life (ESL) of 75 years)										
Ozone depletion	kg CFC-11 eq	9.83E-12	6.56E-17	1.19E-16	MND	0	2.12E-17	0	8.18E-16	9.83E-12
Global warming	kg CO ₂ eq	1.74E+00	2.94E-02	3.25E-02	MND	0	9.51E-03	0	1.66E-02	1.82E+00
Smog	kg O ₃ eq	6.62E-02	5.17E-03	6.00E-04	MND	0	6.48E-04	0	1.61E-03	7.42E-02
Acidification	kg SO ₂ eq	3.76E-03	1.51E-04	7.69E-05	MND	0	2.84E-05	0	8.83E-05	4.10E-03
Eutrophication	kg N eq	5.95E-04	1.29E-05	1.12E-05	MND	0	2.91E-06	0	3.87E-06	6.26E-04
Respiratory effects	kg PM _{2.5} eq	7.06E-04	7.37E-06	2.28E-06	MND	0	1.06E-06	0	6.81E-06	7.24E-04
Additional environmental information										
Carcinogenics	CTUh	87.7%	1.1%	1.5%	MND	0%	0.3%	0%	9.5%	100%
Non-carcinogenics	CTUh	80.9%	1.3%	2.1%	MND	0%	0.4%	0%	15.2%	100%
Ecotoxicity	CTUe	93.4%	3.5%	0.5%	MND	0%	1.1%	0%	1.4%	100%
Fossil fuel depletion	MJ surplus	3.04E+00	5.51E-02	9.23E-03	MND	0	1.78E-02	0	3.35E-02	3.15E+00
Resource use indicators										
Renewable primary energy used as energy carrier (fuel)	MJ, LHV	4.79E+00	1.62E-02	5.67E-03	MND	0	5.24E-03	0	3.12E-02	4.85E+00
Renewable primary resources with energy content used as material	MJ, LHV	3.86E-08	-1.32E-12	7.78E-13	MND	0	-4.27E-13	0	6.22E-12	3.86E-08
Non-renewable primary resources used as an energy carrier (fuel)	MJ, LHV	3.14E+01	4.16E-01	7.20E-02	MND	0	1.35E-01	0	2.66E-01	3.23E+01
Non-renewable primary resources with energy content used as material	MJ, LHV	8.91E-08	1.66E-09	2.32E-10	MND	0	5.36E-10	0	6.64E-10	9.22E-08
Secondary materials	kg	3.82E-01	0.00E+00	0.00E+00	MND	0	0.00E+00	0	0.00E+00	3.82E-01
Renewable secondary fuels	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	MND	0	0.00E+00	0	0.00E+00	0.00E+00
Non-renewable secondary fuels	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	MND	0	0.00E+00	0	0.00E+00	0.00E+00
Recovered energy	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	MND	0	0.00E+00	0	0.00E+00	0.00E+00
Use of net fresh water resources	m ³	1.12E-02	5.63E-05	3.03E-05	MND	0	1.82E-05	0	3.30E-05	1.13E-02
Output flows and waste category indicators										
Hazardous waste disposed	kg	0.00E+00	0.00E+00	0.00E+00	MND	0	0.00E+00	0	0.00E+00	0.00E+00
Non-hazardous waste disposed, conditioned, to final repository	kg	0.00E+00	0.00E+00	2.85E-02	MND	0	0.00E+00	0	7.05E-01	7.33E-01
High-level radioactive waste, conditioned, to final repository	kg	2.02E-06	1.21E-09	6.57E-10	MND	0	3.92E-10	0	3.29E-09	2.02E-06
Intermediate- and low-level radioactive waste, conditioned, to final repository	kg	1.69E-03	1.02E-06	5.75E-07	MND	0	3.30E-07	0	2.95E-06	1.69E-03
Components for re-use	kg	0.00E+00	0.00E+00	0.00E+00	MND	0	0.00E+00	0	0.00E+00	0.00E+00
Materials for recycling	kg	0.00E+00	0.00E+00	8.54E-02	MND	0	0.00E+00	0	0.00E+00	8.54E-02
Materials for energy recovery	kg	0.00E+00	0.00E+00	0.00E+00	MND	0	0.00E+00	0	0.00E+00	0.00E+00
Exported energy	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	MND	0	0.00E+00	0	0.00E+00	0.00E+00
Carbon emissions and removals										
Biogenic carbon removal from product	kg CO ₂	4.22E-03	0.00E+00	0.00E+00	MND	0	0.00E+00	0	0.00E+00	4.22E-03
Biogenic carbon emission from product	kg CO ₂	2.13E-02	0.00E+00	0.00E+00	MND	0	0.00E+00	0	1.37E-03	2.26E-02
Biogenic carbon removal from packaging	kg CO ₂	1.73E-01	0.00E+00	0.00E+00	MND	0	0.00E+00	0	0.00E+00	1.73E-01
Biogenic carbon emission from packaging	kg CO ₂	0.00E+00	0.00E+00	5.52E-03	MND	0	0.00E+00	0	0.00E+00	5.52E-03
Biogenic carbon emission from combustion of waste from renewable sources used in production processes	kg CO ₂	0.00E+00	0.00E+00	8.81E-03	MND	0	0.00E+00	0	0.00E+00	8.81E-03
Calcination carbon emissions	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	MND	0	0.00E+00	0	0.00E+00	0.00E+00
Carbonation carbon removals	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	MND	0	0.00E+00	0	0.00E+00	0.00E+00
Carbon emissions from combustion of waste from non-renewable sources used in production processes	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	MND	0	0.00E+00	0	0.00E+00	0.00E+00

Table 2. ASJ+ facer: LCIA results, resource use, output and waste flows, carbon emissions & removals per declared unit (1 m²)

Parameter	Unit	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4	Total
LCIA results (per m² of ASJ+ facer)										
Ozone depletion	kg CFC-11 eq	1.31E-10	1.02E-17	0	MND	0	4.16E-18	0	1.60E-16	1.31E-10
Global warming	kg CO ₂ eq	3.11E-01	4.58E-03	0	MND	0	1.86E-03	0	3.26E-03	3.21E-01
Smog	kg O ₃ eq	2.02E-02	8.07E-04	0	MND	0	1.27E-04	0	3.16E-04	2.14E-02
Acidification	kg SO ₂ eq	1.47E-03	2.35E-05	0	MND	0	5.56E-06	0	1.73E-05	1.52E-03
Eutrophication	kg N eq	8.93E-05	2.01E-06	0	MND	0	5.70E-07	0	2.77E-05	1.20E-04
Respiratory effects	kg PM _{2.5} eq	1.15E-04	1.15E-06	0	MND	0	2.09E-07	0	1.33E-06	1.17E-04
Additional environmental information										
Carcinogenics	CTUh	94.8%	0.4%	0%	MND	0%	0.2%	0%	4.6%	100%
Non-carcinogenics	CTUh	91.7%	0.3%	0%	MND	0%	0.1%	0%	7.9%	100%
Ecotoxicity	CTUe	96.40%	0.70%	0%	MND	0%	0.30%	0%	2.60%	100%
Fossil fuel depletion	MJ surplus	8.90E-01	8.59E-03	0	MND	0	3.50E-03	0	6.57E-03	9.09E-01
Resource use indicators										
Renewable primary energy used as energy carrier (fuel)	MJ, LHV	3.11E+00	2.53E-03	0	MND	0	1.03E-03	0	6.12E-03	3.12E+00
Renewable primary resources with energy content used as material	MJ, LHV	1.49E-10	-2.06E-13	0	MND	0	-8.37E-14	0	1.22E-12	1.50E-10
Non-renewable primary resources used as an energy carrier (fuel)	MJ, LHV	7.69E+00	6.49E-02	0	MND	0	2.64E-02	0	5.22E-02	7.84E+00
Non-renewable primary resources with energy content used as material	MJ, LHV	3.23E-08	2.59E-10	0	MND	0	1.05E-10	0	1.30E-10	3.28E-08
Secondary materials	kg	0.00E+00	0.00E+00	0	MND	0	0.00E+00	0	0.00E+00	0.00E+00
Renewable secondary fuels	MJ, LHV	0.00E+00	0.00E+00	0	MND	0	0.00E+00	0	0.00E+00	0.00E+00
Non-renewable secondary fuels	MJ, LHV	0.00E+00	0.00E+00	0	MND	0	0.00E+00	0	0.00E+00	0.00E+00
Recovered energy	MJ, LHV	0.00E+00	0.00E+00	0	MND	0	0.00E+00	0	0.00E+00	0.00E+00
Use of net fresh water resources	m ³	3.63E-03	8.78E-06	0	MND	0	3.57E-06	0	6.47E-06	3.65E-03
Output flows and waste category indicators										
Hazardous waste disposed	kg	0.00E+00	0.00E+00	0	MND	0	0.00E+00	0	0.00E+00	0.00E+00
Non-hazardous waste disposed, conditioned, to final repository	kg	0.00E+00	0.00E+00	0	MND	0	0.00E+00	0	1.56E-01	1.56E-01
High-level radioactive waste, conditioned, to final repository	kg	1.89E-07	1.89E-10	0	MND	0	7.69E-11	0	6.46E-10	1.90E-07
Intermediate- and low-level radioactive waste, conditioned, to final repository	kg	2.48E-04	1.59E-07	0	MND	0	6.48E-08	0	5.78E-07	2.49E-04
Components for re-use	kg	0.00E+00	0.00E+00	0	MND	0	0.00E+00	0	0.00E+00	0.00E+00
Materials for recycling	kg	0.00E+00	0.00E+00	0	MND	0	0.00E+00	0	0.00E+00	0.00E+00
Materials for energy recovery	kg	0.00E+00	0.00E+00	0	MND	0	0.00E+00	0	0.00E+00	0.00E+00
Exported energy	MJ, LHV	0.00E+00	0.00E+00	0	MND	0	0.00E+00	0	0.00E+00	0.00E+00
Carbon emissions and removals										
Biogenic carbon removal from product	kg CO ₂	8.52E-02	0.00E+00	0	MND	0	0.00E+00	0	0.00E+00	8.52E-02
Biogenic carbon emission from product	kg CO ₂	0.00E+00	0.00E+00	0	MND	0	0.00E+00	0	2.68E-04	2.68E-04
Biogenic carbon removal from packaging	kg CO ₂	0.00E+00	0.00E+00	0	MND	0	0.00E+00	0	0.00E+00	0.00E+00
Biogenic carbon emission from packaging	kg CO ₂	0.00E+00	0.00E+00	0	MND	0	0.00E+00	0	0.00E+00	0.00E+00
Biogenic carbon emission from combustion of waste from renewable sources used in production processes	kg CO ₂	0.00E+00	0.00E+00	0	MND	0	0.00E+00	0	0.00E+00	0.00E+00
Calcination carbon emissions	kg CO ₂	0.00E+00	0.00E+00	0	MND	0	0.00E+00	0	0.00E+00	0.00E+00
Carbonation carbon removals	kg CO ₂	0.00E+00	0.00E+00	0	MND	0	0.00E+00	0	0.00E+00	0.00E+00
Carbon emissions from combustion of waste from non-renewable sources used in production processes	kg CO ₂	0.00E+00	0.00E+00	0	MND	0	0.00E+00	0	0.00E+00	0.00E+00

Table 3. Self-sealing lap (SSL): LCIA results, resource use, output and waste flows, carbon emissions & removals per declared unit (1m)

Parameter	Unit	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4	Total
LCIA results (per m of SSL)										
Ozone depletion	kg CFC-11 eq	3.47E-16	2.02E-19	0	MND	0	8.22E-20	0	3.17E-18	3.51E-16
Global warming	kg CO ₂ eq	9.02E-03	9.04E-05	0	MND	0	3.68E-05	0	6.44E-05	9.21E-03
Smog	kg O ₃ eq	2.41E-04	1.59E-05	0	MND	0	2.51E-06	0	6.23E-06	2.65E-04
Acidification	kg SO ₂ eq	1.10E-05	4.64E-07	0	MND	0	1.10E-07	0	3.42E-07	1.19E-05
Eutrophication	kg N eq	1.02E-06	3.98E-08	0	MND	0	1.13E-08	0	5.47E-07	1.62E-06
Respiratory effects	kg PM _{2.5} eq	4.81E-07	2.27E-08							

Table 5. Pipe insulation thicknesses for various iron and copper pipe sizes and their associated scaling factors

Iron pipe size (in)	Copper pipe size (in)	Nominal pipe insulation thickness (in)	Actual pipe insulation thickness (in)	Actual pipe insulation thickness (cm)	Scaling factor		
					INS	ASJ	BUT
1/2	7/8	1/2	4.85E-01	1.23E+00	5.01E-02	4.49E-02	5.05E-02
	5/8	1/2	4.95E-01	1.26E+00	4.20E-02	3.93E-02	4.42E-02
3/4	1 1/8	1/2	4.95E-01	1.26E+00	6.02E-02	5.11E-02	5.75E-02
1	1 3/8	1/2	4.75E-01	1.21E+00	6.55E-02	5.60E-02	6.30E-02
1 1/4	1 5/8	1/2	5.15E-01	1.31E+00	7.70E-02	6.43E-02	7.23E-02
1 1/2		1/2	4.65E-01	1.18E+00	7.56E-02	6.79E-02	7.63E-02
2		1/2	4.60E-01	1.17E+00	9.21E-02	8.09E-02	9.10E-02
	2 1/8	1/2	4.85E-01	1.23E+00	8.12E-02	7.47E-02	8.41E-02
2 1/2		1/2	4.65E-01	1.18E+00	1.01E-01	9.29E-02	1.05E-01
	2 5/8	1/2	4.85E-01	1.23E+00	9.63E-02	8.65E-02	9.74E-02
3		1/2	4.60E-01	1.17E+00	1.16E-01	1.06E-01	1.20E-01
	3 1/8	1/2	4.85E-01	1.23E+00	1.02E-01	9.84E-02	1.11E-01
3 1/2		1/2	4.70E-01	1.19E+00	1.22E-01	1.18E-01	1.33E-01
	3 5/8	1/2	4.85E-01	1.23E+00	1.16E-01	1.10E-01	1.24E-01
4		1/2	5.00E-01	1.27E+00	1.45E-01	1.31E-01	1.48E-01
	4 1/8	1/2	4.85E-01	1.23E+00	1.24E-01	1.22E-01	1.37E-01
4 1/2		1/2	5.10E-01	1.30E+00	1.55E-01	1.44E-01	1.62E-01
5		1/2	4.75E-01	1.21E+00	1.60E-01	1.57E-01	1.76E-01
	5 1/8	1/2	4.85E-01	1.23E+00	1.51E-01	1.46E-01	1.64E-01
6		1/2	4.45E-01	1.13E+00	1.75E-01	1.80E-01	2.03E-01
	6 1/8	1/2	4.65E-01	1.18E+00	1.70E-01	1.69E-01	1.90E-01
7		1/2	4.50E-01	1.14E+00	1.73E-01	2.04E-01	2.30E-01
8		1/2	4.35E-01	1.10E+00	1.88E-01	2.28E-01	2.56E-01
9		1/2	4.90E-01	1.24E+00	2.35E-01	2.53E-01	2.85E-01
10		1/2	4.30E-01	1.09E+00	2.28E-01	2.78E-01	3.13E-01
1 1/2	7/8	1	9.45E+00	2.40E+00	9.70E-02	6.67E-02	7.50E-02
	5/8	1	1.08E+00	2.73E+00	1.03E-01	6.67E-02	7.50E-02
3/4	1 1/8	1	8.25E-01	2.10E+00	9.00E-02	6.67E-02	7.50E-02
1	1 3/8	1	1.02E+00	2.58E+00	1.35E-01	8.16E-02	9.18E-02
1 1/4	1 5/8	1	8.80E-01	2.24E+00	1.24E-01	8.16E-02	9.18E-02
1 1/2		1	1.01E+00	2.55E+00	1.62E-01	9.34E-02	1.05E-01
2		1	9.75E-01	2.48E+00	1.68E-01	1.05E-01	1.18E-01
	2 1/8	1	8.80E-01	2.24E+00	1.34E-01	9.34E-02	1.05E-01
2 1/2		1	9.75E-01	2.48E+00	1.92E-01	1.17E-01	1.32E-01
	2 5/8	1	8.80E-01	2.24E+00	1.55E-01	1.05E-01	1.18E-01
3		1	9.65E-01	2.45E+00	2.17E-01	1.30E-01	1.47E-01
	3 1/8	1	8.80E-01	2.24E+00	1.77E-01	1.17E-01	1.32E-01
3 1/2		1	1.26E+00	3.19E+00	3.30E-01	1.55E-01	1.75E-01
	3 5/8	1	1.01E-01	2.31E+00	2.07E-01	1.30E-01	1.47E-01
4		1	1.01E+00	2.55E+00	2.77E-01	1.55E-01	1.75E-01
	4 1/8	1	1.19E+00	3.02E+00	3.17E-01	1.55E-01	1.75E-01
4 1/2		1	1.26E+00	3.19E+00	3.92E-01	1.79E-01	2.01E-01
5		1	9.50E-01	2.41E+00	3.11E-01	1.79E-01	2.01E-01
	5 1/8	1	1.19E+00	3.02E+00	3.56E-01	1.79E-01	2.01E-01
6		1	9.20E-01	2.34E+00	3.30E-01	2.03E-01	2.28E-01
	6 1/8	1	1.17E+00	2.97E+00	4.06E-01	2.03E-01	2.28E-01
7		1	9.20E-01	2.34E+00	3.73E-01	2.26E-01	2.55E-01
8		1	9.70E-01	2.46E+00	4.42E-01	2.53E-01	2.85E-01
9		1	9.90E-01	2.51E+00	4.97E-01	2.77E-01	3.1E-01
10		1	9.05E-01	2.30E+00	5.00E-01	3.00E-01	3.38E-01
11		1	1.05E+00	2.65E+00	6.32E-01	3.30E-01	3.71E-01
12		1	1.04E+00	2.63E+00	6.75E-01	3.54E-01	3.98E-01
14		1	9.10E-01	2.31E+00	6.42E-01	3.77E-01	4.24E-01
15		1	9.10E-01	2.31E+00	6.84E-01	4.01E-01	4.51E-01
16		1	9.10E-01	2.31E+00	7.27E-01	4.24E-01	4.77E-01
17		1	9.10E-01	2.31E+00	7.69E-01	4.48E-01	5.04E-01
18		1	9.10E-01	2.31E+00	8.12E-01	4.72E-01	5.31E-01
19		1	9.10E-01	2.31E+00	8.55E-01	4.95E-01	5.57E-01
20		1	9.10E-01	2.31E+00	8.97E-01	5.19E-01	5.84E-01
21		1	9.10E-01	2.31E+00	9.40E-01	5.43E-01	6.10E-01
22		1	9.10E-01	2.31E+00	9.82E-01	5.66E-01	6.37E-01
23		1	9.10E-01	2.31E+00	1.03E+00	5.90E-01	6.64E-01
24		1	9.10E-01	2.31E+00	1.07E+00	6.14E-01	6.90E-01
25		1	9.10E-01	2.31E+00	1.11E+00	6.37E-01	7.17E-01
26		1	9.10E-01	2.31E+00	1.15E+00	6.61E-01	7.43E-01
27		1	9.10E-01	2.31E+00	1.20E+00	6.85E-01	7.70E-01
28		1	9.10E-01	2.31E+00	1.24E+00	7.08E-01	7.97E-01
29		1	9.10E-01	2.31E+00	1.28E+00	7.32E-01	8.23E-01
30		1	9.10E-01	2.31E+00	1.32E+00	7.56E-01	8.50E-01
1/2	7/8	1 1/2	1.51E+00	3.84E+00	1.70E-01	9.34E-02	1.05E-01
	5/8	1 1/2	1.39E+00	3.53E+00	1.42E-01	8.16E-02	9.18E-02
3/4	1 1/8	1 1/2	1.39E+00	3.53E+00	1.76E-01	9.34E-02	1.05E-01
1	1 3/8	1 1/2	1.52E+00	3.85E+00	2.20E-01	1.05E-01	1.18E-01
1 1/4	1 5/8	1 1/2	1.63E+00	4.14E+00	2.68E-01	1.17E-01	1.32E-01
1 1/2		1 1/2	1.51E+00	3.82E+00	2.57E-01	1.17E-01	1.32E-01
2		1 1/2	1.51E+00	3.82E+00	2.98E-01	1.30E-01	1.47E-01
	2 1/8	1 1/2	1.38E+00	3.51E+00	2.44E-01	1.17E-01	1.32E-01
2 1/2		1 1/2	1.79E+00	4.53E+00	4.22E-01	1.55E-01	1.75E-01
	2 5/8	1 1/2	1.41E+00	3.58E+00	2.71E-01	1.30E-01	1.47E-01
3		1 1/2	1.50E+00	3.80E+00	3.56E-01	1.55E-01	1.75E-01
	3 1/8	1 1/2	1.69E+00	4.29E+00	3.86E-01	1.55E-01	1.75E-01
3 1/2		1 1/2	1.76E+00	4.46E+00	4.78E-01	1.79E-01	2.01E-01
	3 5/8	1 1/2	1.44E+00	3.66E+00	3.08E-01	1.55E-01	1.75E-01
4		1 1/2	1.51E+00	3.82E+00	3.80E-01	1.79E-01	2.01E-01
	4 1/8	1 1/2	1.69E+00	4.29E+00	4.14E-01	1.79E-01	2.01E-01
4 1/2		1 1/2	1.76E+00	4.46E+00	4.98E-01	2.03E-01	2.28E-01
5		1 1/2	1.45E+00	3.68E+00	4.30E-01	2.03E-01	2.28E-01
	5 1/8	1 1/2	1.69E+00	4.29E+00	4.84E-01	2.03E-01	2.28E-01
6		1 1/2	1.42E+00	3.61E+00	4.82E-01	2.26E-01	2.55E-01
	6 1/8	1 1/2	1.67E+00	4.24E+00	5.50E-01	2.26E-01	2.55E-01
7		1 1/2	1.49E+00	3.77E+00	5.70E-01	2.53E-01	2.85E-01
8		1 1/2	1.47E+00	3.73E+00	6.27E-01	2.77E-01	3.1E-01
9		1 1/2	1.49E+00	3.78E+00	6.96E-01	3.00E-01	3.38E-01
10		1 1/2	1.53E+00	3.89E+00	7.92E-01	3.30E-01	3.71E-01
11		1 1/2	1.55E+00	3.92E+00	8.63E-01	3.54E-01	3.98E-01
12		1 1/2	1.54E+00	3.90E+00	9.22E-01	3.77E-01	4.24E-01
14		1 1/2	1.41E+00	3.58E+00	9.13E-01	4.01E-01	4.51E-01
15		1 1/2	1.41E+00	3.58E+00	9.72E-01	4.24E-01	4.77E-01
16		1 1/2	1.41E+00	3.58E+00	1.03E+00	4.48E-01	5.04E-01
17		1 1/2	1.41E+00	3.58E+00	1.09E+00	4.72E-01	5.31E-01
18		1 1/2	1.41E+00	3.58E+00	1.15E+00	4.95E-01	5.57E-01
19		1 1/2	1.41E+00	3.58E+00	1.21E+00	5.19E-01	5.84E-01
20		1 1/2	1.41E+00	3.58E+00	1.27E+00	5.43E-01	6.10E-01
21		1 1/2	1.41E+00	3.58E+00	1.32E+00	5.66E-01	6.37E-01
22		1 1/2	1.41E+00	3.58E+00	1.38E+00	5.90E-01	6.64E-01
23		1 1/2	1.41E+00	3.58E+00	1.44E+00	6.14E-01	6.90E-01
24		1 1/2	1.41E+00	3.58E+00	1.50E+00	6.37E-01	7.17E-01
25		1 1/2	1.41E+00	3.58E+00	1.56E+00	6.61E-01	7.43E-01
26		1 1/2	1.41E+00	3.58E+00	1.62E+00	6.85E-01	7.70E-01
27		1 1/2	1.41E+00	3.58E+00	1.68E+00	7.08E-01	7.97E-01
28		1 1/2	1.41E+00	3.58E+00	1.74E+00	7.32E-01	8.23E-01
29		1 1/2	1.41E+00	3.58E+00	1.79E+00	7.56E-01	8.50E-01
30		1 1/2	1.41E+00	3.58E+00	1.85E+00	7.79E-01	8.76E-01
1/2	7/8	2	2.01E+00	5.11E+00	2.77E-01	1.17E-01	1.32E-01
	5/8	2	1.92E+00	4.86E+00	2.32E-01	1.06E-01	1.20E-01
3/4	1 1/8	2	1.89E+00	4.80E+00	2.71E-01	1.17E-01	1.32E-01
1	1 3/8	2	2.05E+00	5.19E+00	3.32E-01	1.30E-01	1.47E-01
1 1/4	1 5/8	2	1.91E+00	4.85E+00	3.22E-01	1.30E-01	1.47E-01
1 1/2		2	2.32E+00	5.88E+00	4.62E-01	1.55E-01	1.75E-01
2		2	2.04E+00	5.17E+00	4.33E-01	1.55E-01	1.75E-01
	2 1/8	2	2.19E+00	5.56E+00	4.49E-01	1.55E-01	1.75E-01
2 1/2		2	2.29E+00	5.80E+00	5.66E-01	1.79E-01	2.01E-01
	2 5/8	2	1.94E+00	4.93E+00	4.21E-01	1.55E-01	1.75E-01
3		2	2.00E+00	5.07E+00	5.21E-01	1.79E-01	2.01E-01
	3 1/8	2	2.19E+00	5.56E+00	5.52E-01	1.79E-01	2.01E-01
3 1/2		2	2.26E+00	5.73E+00	5.93E-01	2.03E-01	2.28E-01
	3 5/8	2	1.94E+00	4.93E+00	4.55E-01	1.79E-01	2.01E-01
4		2	2.01E+00	5.09E+00	5.48E-01	2.03E-01	2.28E-01
	4 1/8	2	2.19E+00	5.56E+00	5.82E-01	2.03E-01	2.28E-01
4 1/2		2	2.26E+00	5.73E+00	6.87E-01	2.26E-01	2.55E-01
5		2	1.95E+00	4.95E+00	6.19E-01	2.26E-01	2.55E-01
	5 1/8	2	2.19E+00	5.56E+00	6.73E-01	2.26E-01	2.55E-01
6		2	1.99E+00	5.04E+00	7.21E-01	2.53E-01	2.85E-01
	6 1/8	2	2.24E+00	5.68E+00	7.88E-01	2.53E-01	2.85E-01
7		2	1.99E+00	5.04E+00	8.03E-01	2.77E-01</	

14		4	3.91E+00	9.93E+00	2.94E+00	5.19E-01	5.84E-01
15		4	3.91E+00	9.93E+00	3.10E+00	5.43E-01	6.10E-01
16		4	3.91E+00	9.93E+00	3.26E+00	5.66E-01	6.37E-01
17		4	3.91E+00	9.93E+00	3.43E+00	5.90E-01	6.64E-01
18		4	3.91E+00	9.93E+00	3.59E+00	6.14E-01	6.90E-01
19		4	3.91E+00	9.93E+00	3.75E+00	6.37E-01	7.17E-01
20		4	3.91E+00	9.93E+00	3.92E+00	6.61E-01	7.43E-01
21		4	3.91E+00	9.93E+00	4.08E+00	6.85E-01	7.70E-01
22		4	3.91E+00	9.93E+00	4.24E+00	7.08E-01	7.97E-01
23		4	3.91E+00	9.93E+00	4.40E+00	7.32E-01	8.23E-01
24		4	3.91E+00	9.93E+00	4.57E+00	7.56E-01	8.50E-01
25		4	3.91E+00	9.93E+00	4.73E+00	7.79E-01	8.76E-01
26		4	3.91E+00	9.93E+00	4.89E+00	8.03E-01	9.03E-01
27		4	3.91E+00	9.93E+00	5.06E+00	8.26E-01	9.30E-01
28		4	3.91E+00	9.93E+00	5.22E+00	8.50E-01	9.56E-01
2		4 1/2	4.63E+00	1.17E+01	1.37E+00	2.78E-01	3.13E-01
	2 1/8	4 1/2	4.78E+00	1.21E+01	1.39E+00	2.78E-01	3.13E-01
2 1/2		4 1/2	4.38E+00	1.11E+01	1.34E+00	2.78E-01	3.13E-01
	2 5/8	4 1/2	4.53E+00	1.15E+01	1.36E+00	2.78E-01	3.13E-01
3		4 1/2	4.56E+00	1.16E+01	1.55E+00	3.00E-01	3.38E-01
	3 1/8	4 1/2	4.26E+00	1.08E+01	1.32E+00	2.77E-01	3.11E-01
3 1/2		4 1/2	4.32E+00	1.10E+01	1.51E+00	3.00E-01	3.38E-01
	3 5/8	4 1/2	4.51E+00	1.14E+01	1.54E+00	3.00E-01	3.38E-01
4		4 1/2	4.70E+00	1.19E+01	1.81E+00	3.30E-01	3.71E-01
	4 1/8	4 1/2	4.26E+00	1.08E+01	1.50E+00	3.00E-01	3.38E-01
4 1/2		4 1/2	4.45E+00	1.13E+01	1.76E+00	3.30E-01	3.71E-01
5		4 1/2	4.64E+00	1.18E+01	1.99E+00	3.54E-01	3.98E-01
	5 1/8	4 1/2	4.38E+00	1.11E+01	1.75E+00	3.30E-01	3.71E-01
6		4 1/2	4.61E+00	1.17E+01	2.18E+00	3.77E-01	4.24E-01
	6 1/8	4 1/2	4.36E+00	1.11E+01	1.92E+00	3.54E-01	3.98E-01
7		4 1/2	4.61E+00	1.17E+01	2.37E+00	4.01E-01	4.51E-01
8		4 1/2	4.60E+00	1.17E+01	2.56E+00	4.24E-01	4.77E-01
9		4 1/2	4.62E+00	1.17E+01	2.76E+00	4.48E-01	5.04E-01
10		4 1/2	4.55E+00	1.15E+01	2.92E+00	4.72E-01	5.31E-01
11		4 1/2	4.55E+00	1.15E+01	3.11E+00	4.95E-01	5.57E-01
12		4 1/2	4.54E+00	1.15E+01	3.29E+00	5.19E-01	5.84E-01
14		4 1/2	4.41E+00	1.12E+01	3.41E+00	5.43E-01	6.10E-01
15		4 1/2	4.41E+00	1.12E+01	3.59E+00	5.66E-01	6.37E-01
16		4 1/2	4.41E+00	1.12E+01	3.77E+00	5.90E-01	6.64E-01
17		4 1/2	4.41E+00	1.12E+01	3.96E+00	6.14E-01	6.90E-01
18		4 1/2	4.41E+00	1.12E+01	4.14E+00	6.37E-01	7.17E-01
19		4 1/2	4.41E+00	1.12E+01	4.32E+00	6.61E-01	7.43E-01
20		4 1/2	4.41E+00	1.12E+01	4.51E+00	6.85E-01	7.70E-01
21		4 1/2	4.41E+00	1.12E+01	4.69E+00	7.08E-01	7.97E-01
22		4 1/2	4.41E+00	1.12E+01	4.88E+00	7.32E-01	8.23E-01
23		4 1/2	4.41E+00	1.12E+01	5.06E+00	7.56E-01	8.50E-01
24		4 1/2	4.41E+00	1.12E+01	5.24E+00	7.79E-01	8.76E-01
25		4 1/2	4.41E+00	1.12E+01	5.43E+00	8.03E-01	9.03E-01
26		4 1/2	4.41E+00	1.12E+01	5.61E+00	8.26E-01	9.30E-01
27		4 1/2	4.41E+00	1.12E+01	5.79E+00	8.50E-01	9.56E-01
2		5	5.10E+00	1.30E+01	1.61E+00	3.00E-01	3.38E-01
	2 1/8	5	5.26E+00	1.33E+01	1.63E+00	3.00E-01	3.38E-01
2 1/2		5	5.48E+00	1.39E+01	1.93E+00	3.30E-01	3.71E-01
	2 5/8	5	5.03E+00	1.28E+01	1.62E+00	3.01E-01	3.39E-01
3		5	5.19E+00	1.32E+01	1.89E+00	3.30E-01	3.71E-01
	3 1/8	5	5.38E+00	1.37E+01	1.92E+00	3.30E-01	3.71E-01
3 1/2		5	4.95E+00	1.26E+01	1.86E+00	3.30E-01	3.71E-01
	3 5/8	5	5.13E+00	1.30E+01	1.88E+00	3.30E-01	3.71E-01
4		5	5.20E+00	1.32E+01	2.11E+00	3.54E-01	3.98E-01
	4 1/8	5	4.88E+00	1.24E+01	1.84E+00	3.30E-01	3.71E-01
4 1/2		5	4.95E+00	1.26E+01	2.06E+00	3.54E-01	3.98E-01
5		5	5.14E+00	1.31E+01	2.31E+00	3.77E-01	4.24E-01
	5 1/8	5	5.38E+00	1.37E+01	2.37E+00	3.77E-01	4.24E-01
6		5	5.11E+00	1.30E+01	2.52E+00	4.01E-01	4.51E-01
	6 1/8	5	5.36E+00	1.36E+01	2.59E+00	4.01E-01	4.51E-01
7		5	5.11E+00	1.30E+01	2.73E+00	4.24E-01	4.77E-01
8		5	5.10E+00	1.29E+01	2.94E+00	4.48E-01	5.04E-01
9		5	5.12E+00	1.30E+01	3.16E+00	4.72E-01	5.31E-01
10		5	5.03E+00	1.28E+01	3.34E+00	4.95E-01	5.57E-01
11		5	5.05E+00	1.28E+01	3.55E+00	5.19E-01	5.84E-01
12		5	5.04E+00	1.28E+01	3.76E+00	5.43E-01	6.10E-01
14		5	4.91E+00	1.25E+01	3.89E+00	5.66E-01	6.37E-01
15		5	4.91E+00	1.25E+01	4.10E+00	5.90E-01	6.64E-01
16		5	4.91E+00	1.25E+01	4.30E+00	6.14E-01	6.90E-01
17		5	4.91E+00	1.25E+01	4.51E+00	6.37E-01	7.17E-01
18		5	4.91E+00	1.25E+01	4.71E+00	6.61E-01	7.43E-01
19		5	4.91E+00	1.25E+01	4.92E+00	6.85E-01	7.70E-01
20		5	4.91E+00	1.25E+01	5.12E+00	7.08E-01	7.97E-01
21		5	4.91E+00	1.25E+01	5.33E+00	7.32E-01	8.23E-01
22		5	4.91E+00	1.25E+01	5.53E+00	7.56E-01	8.50E-01
23		5	4.91E+00	1.25E+01	5.74E+00	7.79E-01	8.76E-01
24		5	4.91E+00	1.25E+01	5.94E+00	8.03E-01	9.03E-01
25		5	4.91E+00	1.25E+01	6.14E+00	8.26E-01	9.30E-01
26		5	4.91E+00	1.25E+01	6.35E+00	8.50E-01	9.56E-01
2		6	5.73E+00	1.45E+01	1.96E+00	3.30E-01	3.71E-01
2 1/2		6	6.48E+00	1.64E+01	2.56E+00	3.77E-01	4.24E-01
	2 5/8	6	6.13E+00	1.56E+01	2.25E+00	3.54E-01	3.98E-01
3		6	6.19E+00	1.57E+01	2.52E+00	3.77E-01	4.24E-01
	3 1/8	6	6.38E+00	1.62E+01	2.54E+00	3.77E-01	4.24E-01
3 1/2		6	5.95E+00	1.51E+01	2.48E+00	3.77E-01	4.24E-01
	3 5/8	6	6.13E+00	1.56E+01	2.51E+00	3.77E-01	4.24E-01
4		6	6.20E+00	1.57E+01	2.78E+00	4.01E-01	4.51E-01
	4 1/8	6	6.38E+00	1.62E+01	2.81E+00	4.01E-01	4.51E-01
4 1/2		6	5.95E+00	1.51E+01	2.73E+00	4.01E-01	4.51E-01
5		6	6.14E+00	1.56E+01	3.02E+00	4.24E-01	4.77E-01
	5 1/8	6	6.38E+00	1.62E+01	3.08E+00	4.24E-01	4.77E-01
6		6	6.11E+00	1.55E+01	3.27E+00	4.48E-01	5.04E-01
	6 1/8	6	6.36E+00	1.62E+01	3.34E+00	4.48E-01	5.04E-01
7		6	6.11E+00	1.55E+01	3.52E+00	4.72E-01	5.31E-01
8		6	6.10E+00	1.55E+01	3.77E+00	4.95E-01	5.57E-01
9		6	6.12E+00	1.55E+01	4.03E+00	5.19E-01	5.84E-01
10		6	6.03E+00	1.53E+01	4.25E+00	5.43E-01	6.10E-01
11		6	6.05E+00	1.54E+01	4.51E+00	5.66E-01	6.37E-01
12		6	6.04E+00	1.53E+01	4.76E+00	5.90E-01	6.64E-01
14		6	5.91E+00	1.50E+01	4.93E+00	6.14E-01	6.90E-01
15		6	5.91E+00	1.50E+01	5.18E+00	6.37E-01	7.17E-01
16		6	5.91E+00	1.50E+01	5.43E+00	6.61E-01	7.43E-01
17		6	5.91E+00	1.50E+01	5.67E+00	6.85E-01	7.70E-01
18		6	5.91E+00	1.50E+01	5.92E+00	7.08E-01	7.97E-01
19		6	5.91E+00	1.50E+01	6.16E+00	7.32E-01	8.23E-01
20		6	5.91E+00	1.50E+01	6.41E+00	7.56E-01	8.50E-01
21		6	5.91E+00	1.50E+01	6.66E+00	7.79E-01	8.76E-01
22		6	5.91E+00	1.50E+01	6.90E+00	8.03E-01	9.03E-01
23		6	5.91E+00	1.50E+01	7.15E+00	8.26E-01	9.30E-01
24		6	5.91E+00	1.50E+01	7.40E+00	8.50E-01	9.56E-01