

**NOTICE OF REVIEW**

UNDER SECTION 43A(8) OF THE TOWN AND COUNTRY PLANNING (SCOTLAND) ACT 1997 (AS AMENDED) IN  
RESPECT OF DECISIONS ON LOCAL DEVELOPMENTS

THE TOWN AND COUNTRY PLANNING (SCHEMES OF DELEGATION AND LOCAL REVIEW PROCEDURE)  
(SCOTLAND) REGULATIONS 2008

THE TOWN AND COUNTRY PLANNING (APPEALS) (SCOTLAND) REGULATIONS 2008

**IMPORTANT: Failure to supply all the relevant information could invalidate your notice of review.**

**Use BLOCK CAPITALS if completing in manuscript**

**Applicant(s)**

Name

Address

Postcode

Contact Telephone 1

Contact Telephone 2

Fax No

E-mail\*

**Agent (if any)**

Name

Address

Postcode

Contact Telephone

Contact Telephone 2

Fax No

E-mail\*

Mark this box to confirm all contact should be through  
this representative:

Yes No

\* Do you agree to correspondence regarding your review being sent by e-mail?

Planning authority

Planning authority's application reference number

Site address

Description of proposed development

Date of application  Date of decision (if any)

Note. This notice must be served on the planning authority within three months of the date of the decision notice or from the date of expiry of the period allowed for determining the application.

**Nature of application**

- 1. Application for planning permission (including householder application)
- 2. Application for planning permission in principle
- 3. Further application (including development that has not yet commenced and where a time limit has been imposed; renewal of planning permission; and/or modification, variation or removal of a planning condition)
- 4. Application for approval of matters specified in conditions

**Reasons for seeking review**

- 1. Refusal of application by appointed officer
- 2. Failure by appointed officer to determine the application within the period allowed for determination of the application
- 3. Conditions imposed on consent by appointed officer

**Review procedure**

The Local Review Body will decide on the procedure to be used to determine your review and may at any time during the review process require that further information or representations be made to enable them to determine the review. Further information may be required by one or a combination of procedures, such as: written submissions; the holding of one or more hearing sessions and/or inspecting the land which is the subject of the review case.

Please indicate what procedure (or combination of procedures) you think is most appropriate for the handling of your review. You may tick more than one box if you wish the review to be conducted by a combination of procedures.

- 1. Further written submissions
- 2. One or more hearing sessions
- 3. Site inspection
- 4. Assessment of review documents only, with no further procedure

If you have marked box 1 or 2, please explain here which of the matters (as set out in your statement below) you believe ought to be subject of that procedure, and why you consider further submissions or a hearing are necessary:

**Site inspection**

In the event that the Local Review Body decides to inspect the review site, in your opinion:

- |  | Yes                                 | No                       |
|--|-------------------------------------|--------------------------|
| 1. Can the site be viewed entirely from public land?                                 | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| 2. Is it possible for the site to be accessed safely, and without barriers to entry? | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

If there are reasons why you think the Local Review Body would be unable to undertake an unaccompanied site inspection, please explain here:

No

**Statement**

You must state, in full, why you are seeking a review on your application. Your statement must set out all matters you consider require to be taken into account in determining your review. Note: you may not have a further opportunity to add to your statement of review at a later date. It is therefore essential that you submit with your notice of review, all necessary information and evidence that you rely on and wish the Local Review Body to consider as part of your review.

If the Local Review Body issues a notice requesting further information from any other person or body, you will have a period of 14 days in which to comment on any additional matter which has been raised by that person or body.

State here the reasons for your notice of review and all matters you wish to raise. If necessary, this can be continued or provided in full in a separate document. You may also submit additional documentation with this form.

**FIRST APPLICATION**

1. In earlier conversations with the Environmental Health officer it was clear that from the start he has a bias against wood burning stoves and "possible" nuisances caused wherever the installation was. His original consultation response dated 30/9/15 to object to the proposals was made without any visit to the site.

2. We provided photographic evidence that, until recently when the property was used as a butchers shop, it had an existing chimney in exactly the position of the proposed flue. This was removed when the shop ceased to be used as a butchers.

3. We provided written confirmation from a registered HETAS engineer that the proposed installation complied with: HETAS Approved Document J, Outlets from flues, Section 2.11, Diagram 17. Flue outlet positions for solid fuel appliances.

Other than the above referred to documents, we are not aware of any other technical guidelines for the siting of a stove flue.

**SECOND APPLICATION**

1. To the address the reasons for refusal we proposed the use of an ABCAT flue gas filter which reduces flue emissions.

We believe insufficient consideration was given to the ABCAT technical information provided with the second application. Given the complexity of the information and test data we would have expected some queries or correspondence from the Environmental Health officer being consulted on the application. No queries or correspondence were received.

Have you raised any matters which were not before the appointed officer at the time the determination on your application was made?

Yes  No

If yes, you should explain in the box below, why you are raising new material, why it was not raised with the appointed officer before your application was determined and why you consider it should now be considered in your review.

**List of documents and evidence**

Please provide a list of all supporting documents, materials and evidence which you wish to submit with your notice of review and intend to rely on in support of your review.

These are the documents submitted with the applications:

**FIRST APPLICATION**  
 Location Plan, 13011-E-101, 13011-SITE, 13011-101, 13011-101-A  
 15\_01079\_FUL-AGENT\_SUBMISSION-2731029.jpg  
 15\_01079\_FUL-AGENT\_EMAIL-2731028.pdf

**SECOND APPLICATION**  
 Location Plan, 13011-101-B  
 ABCAT Product Information  
 ABCAT Background and application  
 ABCAT Remains with and without ABCAT  
 ABCAT Residuals of wood burning  
 ABCAT SP test results summary  
 ABCAT test with Wohler SM 500 analyzer

Note. The planning authority will make a copy of the notice of review, the review documents and any notice of the procedure of the review available for inspection at an office of the planning authority until such time as the review is determined. It may also be available on the planning authority website.

**Checklist**

Please mark the appropriate boxes to confirm you have provided all supporting documents and evidence relevant to your review:

- Full completion of all parts of this form
- Statement of your reasons for requiring a review
- All documents, materials and evidence which you intend to rely on (e.g. plans and drawings or other documents) which are now the subject of this review.

Note. Where the review relates to a further application e.g. renewal of planning permission or modification, variation or removal of a planning condition or where it relates to an application for approval of matters specified in conditions, it is advisable to provide the application reference number, approved plans and decision notice from that earlier consent.

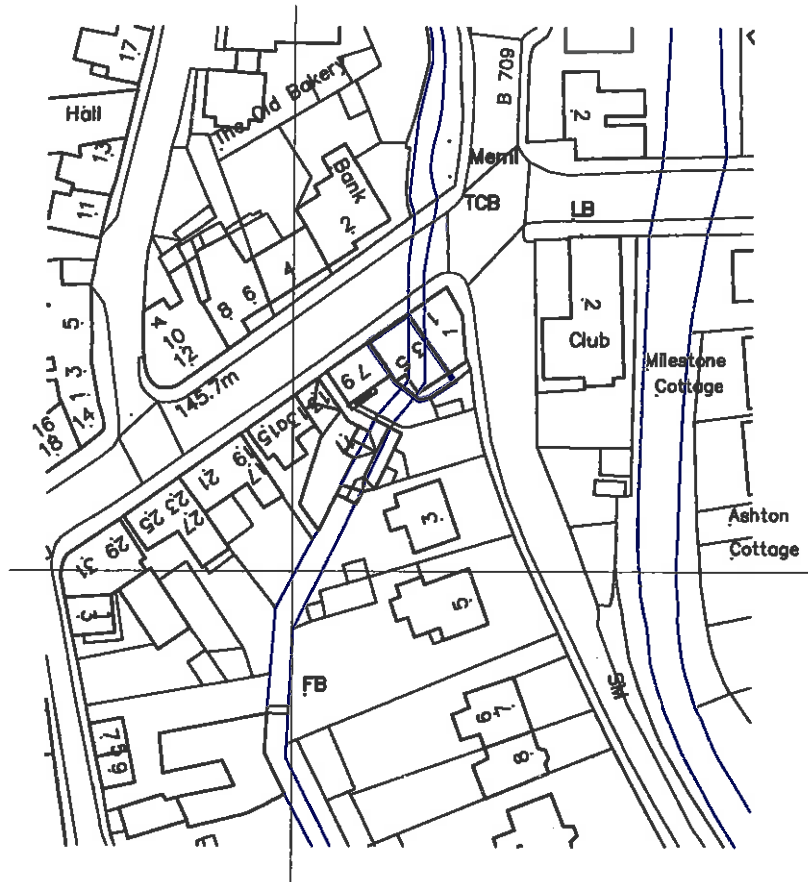
**Declaration**

I the applicant/agent [delete as appropriate] hereby serve notice on the planning authority to review the application as set out on this form and in the supporting documents.

Signed  Date 13/07/17

**The Completed form should be returned to the Head of Corporate Administration, Scottish Borders Council, Council Headquarters, Newtown St. Boswells TD6 0SA.**





project  
**Replacement Windows &  
 Metal Flue at 5 High Street  
 Innerleithen EH44 6HA**

client  
**Mr & Mrs Gordon**

drawing title  
**Location Plan**

drawing number  
**13011-LOC**

scale date  
**1:1250 @A4 Aug 15**



**5 High Street  
 Innerleithen  
 EH446HA**

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## Background and application of the ABCAT flue gas oxidizing catalytic converter for the reduction of flue gas nuisances from wood stoves and -boilers

Firing wood is in various ways a good alternative to heating with fossil fuel. However, wood is chemically a highly complex fuel. Basically it comes down to the fact that the use of wood in woodstoves, even the best and most expensive stoves, is always paired with the emission of odorous substances, soot, particulate matter and many other components. This is where our innovative technique helps out. Most cars on the road have a catalytic converter and/or diesel particulate filter build into their exhaust system to reduce the inevitable emission of carbon monoxide (CO) and particulate matter (mainly soot particles) from their internal combustion engines. Ecolink Solutions now applies the catalytic converter technology to the "exhaust" of wood fired stoves with the ABCAT (AfterBurningCATalist).

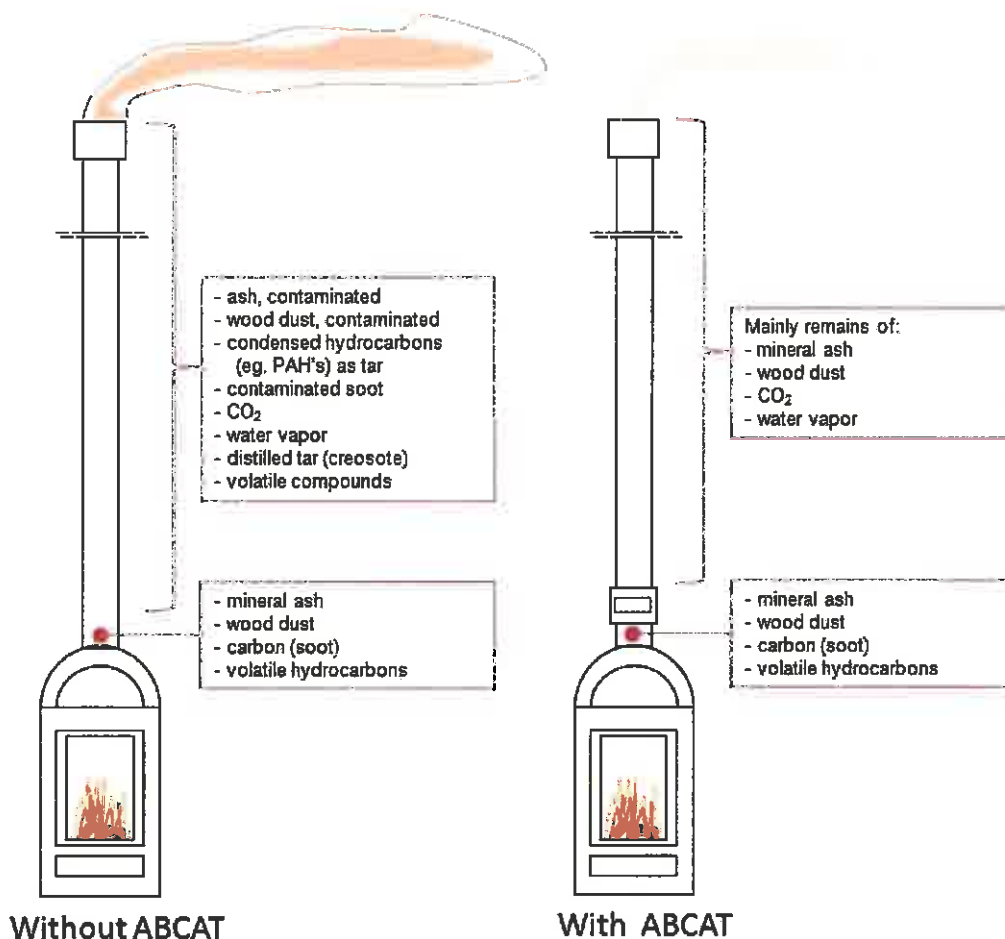
The ABCAT flue gas catalytic converter, which is developed and patented by Ecolink Solutions, looks different from a particulate filter for cars and trucks. There is no real filter of a ceramic catalyst with many small openings. Furthermore, unlike many diesel particulate filters, there is no need for extra fuel injection of special chemicals to keep the ABCAT clean and active. The catalytic converter Ecolink Solutions has developed comprises of a simple construction with a module which fits into the stovepipe in a drawer-like fashion. Subsequently the module can be manually rotated into a full bypass position if necessary. The module contains metals, among which several precious metals. The fumes flow almost undisturbed through the modules and while doing so they are treated by the catalytic converter, which burns harmful compounds through catalytic oxidation. Additionally a significant part of the ash-, wood dust- and soot particles -all are particulate matter- is caught by the ABCAT. In the process of "catalytic afterburning", soot particles and many odorous particulates are also converted into odor- and colorless water vapor and carbon dioxide (CO<sub>2</sub>). The non-combustible parts which stay behind in the module - consisting mostly of mineral ashes and for example iron oxides- need to be removed from the ABCAT regularly by flushing them out with water or by means of vibration (shaking by hand). For this reason the ABCAT can only be installed in a easily accessible location.

The draught in the stovepipe is hardly influenced when installing the ABCAT. The resistance of the ABCAT, also called pressure loss, is approx. 2 Pa (0,02 mbar). The minimal natural draught of a properly constructed, hot chimney easily reaches 20 Pa so that the pressure loss of the ABCAT is easily over-won. The ABCAT has a permanent build-in safety bypass in case the modules provide too much resistance due to a blockage with soot for example. So, when needed, the flue gas can always pass the ABCAT and exit the chimney.

The emission of polluting flue gas is highest during startup of a fire in a cold stove with a cold stovepipe. The particulate filters in cars and trucks only start working optimally when they reach a sufficient temperature. The ABCAT works from start by filtering particulate matter and already at low temperatures carbon monoxide (CO) is converted. Soot- and odorous particles are converted later, starting when the catalytic ABCAT reaches a temperature of approx. 350°C. The ABCAT works best at temperatures between 300°C and 800°C.



The figure below shows a comparison of problematic components which can be present in a stovepipe with and without ABCAT flue gas filter.



The ABCAT does not need electricity or any other connection. When the catalytic converter needs to be replaced after several heating seasons it suffices to renew the ABCAT-module only. The stovepipe can be kept in place.

The ABCAT is available for wood fired stoves and -boilers in the range from 4 kW to 999 kW using square, rectangular or round stovepipes in diameters ranging from 100 to over 300 mm. The layout of the ABCAT can also be adapted to the wishes of the user to mainly convert and reduce odorous substances and/or particulate matter and/or components such as carbon monoxide (CO). The ABCAT can also be applied in a woodstove or -boiler with an heat exchanger when it is built in before the heat exchanger. Applying the ABCAT here generally does require some adaptations to the construction of the stove or boiler however.



The ABCAT is entirely constructed using steel, stainless steel and precious metals. The ABCAT is resistant to temperature shocks and mechanical shocks. It is robust, durable and of course recyclable. The ABCAT is produced in the Netherlands and patented. There is a 2 year warranty on the construction of the ABCAT.



ADVIES & TECHNIEK  
ENERGIE & MILIEU

[www.ecolinksolutions.com](http://www.ecolinksolutions.com)



## Product specifications ABCAT (AfterBurner CATalyst)

Specifications summary ABCAT flue gas filter	
Application	Wood burning stoves
Applied "filter technique"	Full metal palladium catalyst
Operation based on	Catalytic oxidation and mechanical filtration
Treatment/reduction of	Hydrocarbons, CO, particulate matter
Installation	Directly after the stove as first flue gas pipe element
Position of installation	Horizontally, vertically and any position in between
Operational temperature catalyst-module	From 100°C. Optimal >350°C
Maximum operational temperature	800°C
Approved fuel	Untreated wood with max. 20% moisture
Particulate emission reduction (mainly PM2.5)	Up to 95%
PAHC's emission reduction	Up to 90%
CO emission reduction	Up to 65%
HC's emission reduction	Up to 90%
Pressure-loss at 1,5m/s (clean ABCAT)	Bypass 0-1 Pa, operational 2-5 Pa
Material	(Stainless) steel, painted
Warranty	2 years on construction

### General

The ABCAT has been developed to reduce the emission from wood burning stoves' and boilers' chimneys. Most attention has gone into reducing the odor of woodsmoke. The ABCAT is installed directly after the wood burning device by replacing the first stove-pipe element by the ABCAT. The ABCAT contains a precious metal catalyst and is entirely constructed from steel. The ABCAT is generally available for all going stove-pipe diameters and stoves with different capacities. The ABCAT is very robust and operating and maintaining the system is very easy.

### Operation

The filter in the ABCAT consists of a palladium and/or platinum catalytic converter. The catalytic material is fixed in a round module which is placed in the stovepipe like a sort of open valve. Most of the woodsmoke passes through this catalyst. The catalytic converter cracks incompletely burned components like hydrocarbons, which color and odor the woodsmoke. Besides cracking the catalyst also functions as a filter which captures a part of the particulate matter (fly-ash). A catalytic converter needs temperature (approx 300-350°C) and oxygen from the woodsmoke. At this temperature compounds are cracked and burnt without combustion (catalytic oxidation). Therefore the ABCAT needs to be installed directly on or after the wood stove.

The ABCAT is delivered with a bi-metal insert thermometer with a range up to 500 °C and an analogue scale. With this thermometer the temperature of the flue gases can be measured and the state of the ABCAT can be estimated.



Picture 1: ABCAT operational (left) and in by-pass position (right)

### Properties and performance

Shortly after lighting the fire, when the temperature of the ABCAT rises, at first the least stable components of the woodsmoke, like CO, will be cracked. When the ABCAT reaches a temperature of around 350°C and becomes fully active, more stable components will be cracked. These include tar-forming, long-chain hydrocarbon components like PAH's which have a strong odor and can be very harmful to health and environment.

After cracking the components, the separate parts are burned without ignition (flame-less) with oxygen. The oxygen needed comes from the remaining oxygen in the woodsmoke. In an optimal situation – a so called total-oxidation – the ABCAT produces color- and odorless watervapor and carbon-dioxide (CO<sub>2</sub>) as a result of this after-burning. The carbon-dioxide can be absorbed by growing trees and stays in the so called short-CO<sub>2</sub>-cycle without negatively contributing to the greenhouse effect.

Next to a catalytic function the ABCAT also has a filtering function as a result from its construction. This filters out solid particles from the woodsmoke. This means a part of the fly-ash will also be filtered from the woodsmoke when the ABCAT is still warming up. When the ABCAT reaches its operational temperature, a big part of this filtered fly-ash will be oxidized (burnt). However, a part of this fly-ash can not be burnt and in time will cover the active surface of the catalyst. Therefore the ABCAT needs to be cleaned by shaking or rinsing with water regularly.

Various tests have shown that the ABCAT mainly cracks the smallest particulate fraction, namely PM2.5. This fraction of particulate matter is most problematic for our health since it can get deep into our lungs and penetrate lung tissue.

**Particulate matter:** consists of liquid and solid particles. Liquid particles are very fine dispersed droplets (aerosols) of gaseous components which, as a result of cooling, condensate into a liquid phase. This goes for, for example, hydrocarbons like polycyclic hydrocarbons (PAH's). Solid particles can be made up of wood dust, soot (carbon) and inert mineral inorganic ashes (noncombustible ashes). From the complete combustion of 1kg air dry (20% moisture) beech approx. 10 grams of ashes remain. A part of this ash stays behind in the stove as so called bottom-ash and a part leaves the stove through the chimney as so called fly-ash. During the cooling of woodsmoke as it travels up the chimney, more and more gaseous components – watervapor, benzene, PAH's – condensate and attach to the solid fly-ash particles. Through this process the particles will grow in size as the travel up the chimney and cool down. The longer (or the higher) the chimney or the poorer the insulation thereof, the more the woodsmoke will cool down and the bigger these particles can become. That is, if these particles do not stick to the inner wall of the chimney as tar and in combination with water form the highly acidic creosoot (which is also called tar-distillate). One of the important building blocks of tar are harmful PAH's.

The particulate matter concentration directly above the stove is therefore different from the concentration at the end of the chimney. The concentration of particulate matter at the end of the chimney will be higher. It is also particulate matter that colors the woodsmoke and contributes to its odor. The particulate matter emitted by wood burning appliances mainly consists of non-combusted organic components and to a smaller amount of inert mineral (inorganic) ashes.

The ABCAT treats the woodsmoke directly after the stoves' combustion chamber. Solid, organic components such as soot and components which can further on in the chimney condensate and form particulate matter are cracked and catalytically oxidized close to the source. Inert solid (noncombustible) particles to which gaseous components can stick during condensation are partly filtered by the ABCAT. The ABCAT can, depending on the type and quantity of fuel in the stove and the temperature of the ABCAT, reduce the emission of organic and inorganic components in woodsmoke with up to 90%.

**Odor:** Woodsmoke consists of 70-80 volume% of nitrogen, 10-20% residual oxygen, then a small percentage carbon-dioxide, water-vapor (from the not completely dry wood and as a result of combustion), inert gases, carbon, tar-droplets, ash, sulfurdioxide, nitrogenoxide, etc. De components in woodsmoke that can have a strong smell and can be harmful only account for 1-2% of the woodsmoke-volume. These components belong to the groups listed below. Within these groups, approx. 500 different components can be identified.

- Multiple, mostly polycyclic, hydrocarbons
- Aldehydes, for example ethanol, propanal, formaldehyde and others
- Organic acids including formic acid, acetic, propionic (propanoic) and others
- Condensed aromatics
- Styrene (ethyl benzene)
- Phenol (hydroxybenzene)
- Other compounds: guaiacol, ethyl guaiacol, furfuryl alcohol

Since the ABCAT can catalytically oxidize (burn) a large part of the components mentioned above, the odor of the woodsmoke which can be detected from the top of the chimney onwards is strongly reduced. When the ABCAT functions optimally the odor will be as good as neutralized. There are, however, big differences in properties of different types of wood, stove design, operation of the stove, weather conditions, etc which all have a great influence on the odor of the woodsmoke. To be able to reduce the odor effectively, everything before the ABCAT needs to be in order. The ABCAT is no wonder product which solves all problems without the user paying proper attention to all other important factors of responsible wood burning, which enables the user to burn anything in the stove under poor weather conditions or which solves a wrongful operation of any stove.

#### **Tests and approval**

In the development and testing of the catalytic converter used in the ABCAT, several research institutes have contributed.

Furthermore many companies have played a part in the creation of the ABCAT. The ABCAT should be effective in reducing wood burning-emissions but also has to fulfill strict demands regarding safety and reliability. Much attention has gone into getting the system as air-tight as possible, reducing the pressure loss (flow-resistance), increasing user-friendliness and improving the mechanical and thermal load. For the latter the ABCAT even has to be able to withstand a chimney fire (being exposed to very high temperature) without critical damage to the construction. At this moment Germany is the only European country which has this obligatory strict testing. A system without approval may not be applied.

The pressure loss or flow-resistance of the ABCAT in operation is approx. 2 – 5 Pascal (0,02 – 0,05 mBar) at a flow of 0,5 – 1 m/s. This flow could occur with stoves that are used at full power and with an optimal chimney construction. The minimal draft required for a good combustion (and sufficient supply of oxygen into the stove) is approx. 10 Pa. With this amount the flow-resistance of the ABCAT is easily over won. When in tests the ABCAT was fully blocked to simulate a hypothetical worst-case scenario, the flow resistance was approx. 11 Pa at 0,5 m/s. As mentioned, this is a hypothetical situation, however it is one of the requirements for the German approval to ensure maximum safety. A well designed, warm chimney produces a draft of approx. 20 Pa.

## Versions

The standard ABCAT comes in a chimney-pipe of 250 or 500 mm length. The ABCAT is available for stovepipes with a diameter of Ø150 mm. The segment containing the ABCAT can be integrated in a standard flue gas channel without additional changes.

The pipes are made from 2mm steel and have a decreased diameter on one side to fit into another stovepipe. These pipes can be connected to pipes made from thin blued steel, stainless steel, 2mm steel, etc.

The standard ABCAT is painted with heat resistant, matt-black paint (RAL9005). Alternative colors upon request are black-gloss, anthracite, cast iron or unpainted.

Together with the ABCAT a special analogue flue gas thermometer with a range up to 500°C is supplied.

As an option the ABCAT can also be equipped with an extra, build in soot filter. With this additional filter the effectiveness of the ABCAT as a particulate matter filter will be increased. The additional filter operates as a powerless electromagnetic filter using a principle known as the Seebeck-effect. Soot particles are para-magnetic, which means they can be captured in the created magnetic field where they are oxidized by the ABCAT.

## Installation

To install the ABCAT, the first stovepipe-segment after the stove has to be replaced by the segment containing the ABCAT. The ABCAT segment is reversible and does not have to be installed in a specific position. Furthermore the ABCAT can be installed in any position (horizontal, vertical or anything in between).

The design and use of the stove and the position of the ABCAT have to guarantee that the flames can not reach the ABCAT. Flames can reach very high temperatures and permanently damage the ABCAT's active catalytic surface. When the catalytic converter is exposed to temperatures of over approx. 800°C, the precious metals applied can become unstable or even evaporate. When the included thermometer is placed before or after the ABCAT, the temperature of the ABCAT can be monitored.

The handle and the sealing cap should remain accessible since the ABCAT needs to be removed from the stovepipe regularly to remove the (inert) ashes which have been collected by the ABCAT-module.

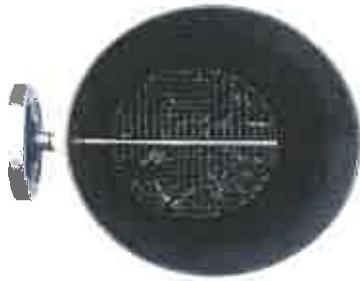


Picture 2: ABCAT in parts

### Operation and maintenance

The ABCAT has a handle on the outside of the stovepipe. By turning this handle the module inside the stovepipe can be rotated into a bypass- or operation position. In bypass-position the woodsmoke can pass the ABCAT without any resistance worth mentioning. This position can be useful when the natural draft in the chimney is low (for example when the stove and chimney are still cold). This position can also be useful when opening the stove to add wood.

Another option is to rotate the ABCAT 360° to remove any ashes that have fallen down the chimney and have landed on top of the ABCAT-module.



*Picture 3: Catalyst in operational position*



*Picture 4: Catalyst in bypass-position*

Ash collects in the ABCAT and needs to be periodically removed since otherwise the effectiveness of the ABCAT will decrease. In order to clean the module, it can be removed from the stovepipe. The module can be shaken, vacuumed or rinsed with water. The ash from the module mainly consists of mineral components like potassium- and sodium-salt and iron- and silicon-oxide (sand) and is harmless to the environment. In case the ABCAT contains black remains of soot, tar or creosote it should not be flushed but instead be collected and treated as normal household waste. Concerning organic components like soot and tar, the ABCAT is self-cleaning. When these components build up in the ABCAT and the operational temperature of 350°C is reached it will also crack and oxidize (after-burn) these components.



*Picture 5: Position of handle before removal for cleaning*



### **Durability**

The warranty on the construction of the ABCAT is 2 years from the date of purchase. The expected lifetime of the catalytic converter with normal and responsible use is many thousands of hours or several wood-burning seasons. Normal and responsible use means that:

- Woods are used that are suitable for burning in a wood stove (untreated wood, preferably of a low-odor-nuisance species). For various aspects of different types of wood we kindly refer to the overview 'Energy from native woods' on our website [www.ecolinksolutions.com](http://www.ecolinksolutions.com)
- Air-dry wood is used with max. 20% moisture. Wood which contains mold also contains spores. This occurs when wood is stored and/or dried using a poor technique. Spores that are released from wood can be very harmful when inhaled. Moldy wood is normally also too wet to be used in a stove
- The ABCAT frequently reaches a temperature of 350°C
- The ABCAT is not exposed to temperatures of over 800°C
- An ABCAT that is still hot is not exposed to water or any other cooling liquid or gas. This could cause so called 'inner-crystal-corrosion' in the catalyst metal leading to a loss of precious metals.
- The ABCAT is not cleaned with any acid, salt or strongly basic liquid. Cleaning can be done in cold or hot water to which optionally dish soap is added. Chlorine or soda containing additives may not be used.

Individual parts can also be replaced.

De functionality of a used catalyst can be tested by us. In this process the catalyst will be cleaned, the starting temperature of the catalytic oxidation will be determined with a test gas and the reactivity (exothermic reaction) of the catalyst will be monitored. A report will be given in writing or by telephone and the module will be returned.

### The residuals of wood burning; particulate matter, odorous- and gaseous components.

Besides carbon, hydrogen and oxygen wood also contains nitrogen (0,1 to 0,2%), potassium (beech for example approx. 0,2%), sulfur (0,015%), chlorine (0,005%) and trace elements. The majority of the trace elements are metals; arsenic, cadmium, chrome, copper, mercury, lead, and zinc. These metals are taken up from the bottom (ground and groundwater) and stored in the wood. The majority of these so called inorganic components, like potassium and metals, do not burn or evaporate and can be found in the fly ash and the bottom ash.

In the table below, properties and the average composition of several fossil- and renewable fuel are shown.

Fuel	Calorific value MJ/kg (100% Dry matter)	Volatile components in weight%	Ash in weight%	Elements in weight%						
				C	H	O	N	S	Cl	K
<b>FOSSIL</b>										
Natural gas	38 (31,5/m <sup>3</sup> )									
Propane/ butane (LPG)	45,2									
Oil	41,5									
Peat	14,5									
Coal*	31,8	38,8	6,3	79,4	5,1	6,7	1,5	1	<0,2	0,09
Lignite*	31,8	55	7,6	68,4	5,5	15,4	1,8	1,3	?	0,03
<b>BIOGENE</b>										
Willow	18,4**	80,3	2,2	47,1	6,1	43,2	0,54	0,05	0,006	0,26
Spruce fir (pine wood)	18,8	82,9	0,6	49,7	6,3	42,3	0,13	0,02	0,01	0,13
Beech	18,4	84	0,5	47,9	6,2	44,7	0,22	0,02	0,007	0,15
Oak	18,2	80,2	0,4	?	?	?	0,18	?	0,005	?
Wheats traw	17,2	77	5,7	40,9	5,8	40,9	0,48	0,08	0,19	1
Corn straw	17,7	76,8	6,7	45,7	5,3	41,7	0,65	0,12	0,35	?
Hay	17,4	75,4	5,7	45,5	6,1	39,2	1,14	0,16	0,31	1,5
<b>ENERGY-CROPS</b>										
Forage grass	14,5									
Miscanthus	14,5									

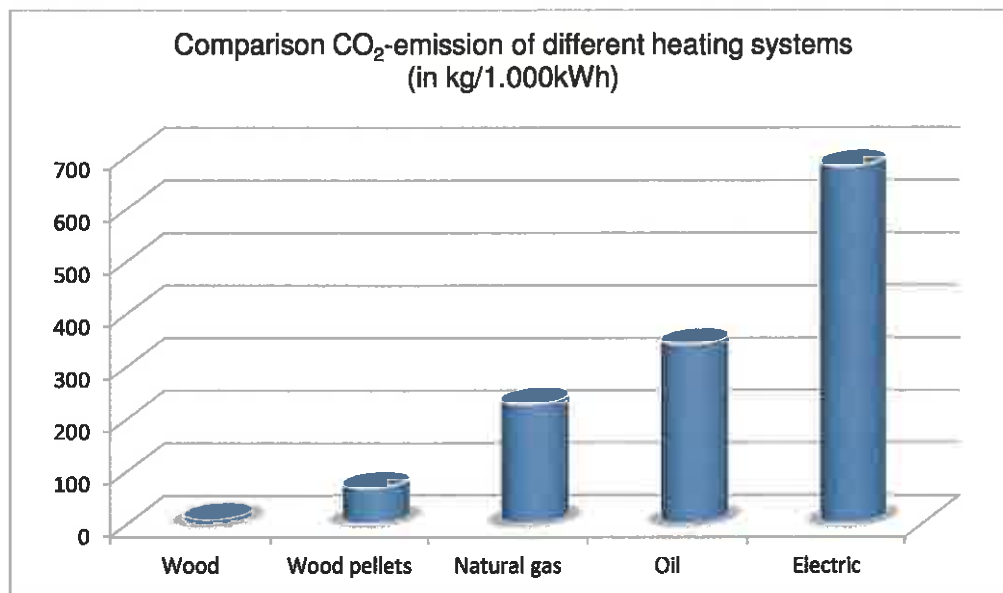
\* Properties strongly depend on location of extraction

\*\* The differences between woods are large in MJ/m<sup>3</sup>

When burning wood residuals are created or released. De emission of these residuals from stovepipes can cause health problems, environmental damage and nuisance. Wood smoke consists for 70 – 80 vol% of nitrogen. Second is 10 – 20 vol% unused oxygen, then several percent carbon dioxide, water vapor (originating from the not 100% dry wood), unburned gasses, carbon, tar droplets, ash, sulfur dioxide, nitrogen oxide, etc.

The emission of the greenhouse gas CO<sub>2</sub> by the burning of wood and wood pellets in heating systems is very favorable compared to other types of heating. In the graph below the CO<sub>2</sub> emission of various forms of heating is compared. The comparison is based on 2006 data and includes for example the harvesting of wood, the possible use of fertilizer, the losses in production (mainly thermal losses in electricity production), etc.

Graph: Comparison CO<sub>2</sub> emission of different heating systems (in kg/1.000kWh)



The CO<sub>2</sub> which is released when burning wood has been absorbed by the growing tree over a period of approx. 10 to 100 years. When burning fossil fuel, CO<sub>2</sub> is released which was stored in fossil layers in the earth by plants and trees over a period of millions of years. This fossil CO<sub>2</sub> is released rapidly and added to the atmosphere and has a negative impact on the earth's thermal management. When burning wood, most CO<sub>2</sub> released into the atmosphere is almost directly consumed by growing trees and is not added to the atmosphere. This is called the short CO<sub>2</sub> cycle since there is a balance in CO<sub>2</sub> release and CO<sub>2</sub> absorption in the short term. When burning fossil fuel on the other hand, the present vegetation on earth is not capable of consuming the overload of fossil CO<sub>2</sub>, which will take millions of years again to be consumed and stored in the form it was released from in the first place.

Still, burning wood is not completely CO<sub>2</sub>-neutral. Because of the use of fossil fuel in the planting of the trees, the harvesting and processing of the wood and the transportation there is a slight addition of fossil CO<sub>2</sub> adding to a total of approx. 9 kg per 1.000 kilowatt-hour (kWh) of thermal wood-energy. The fossil CO<sub>2</sub> addition resulting from the use of fossil fuel in the production and transportation of wood pellets was approx. 68 kg per 1.000 kWh. The reason for this higher amount of CO<sub>2</sub> added is that the process to get from wood to pellets is very energy-consuming. Since wood pellets nowadays are imported from for example Canada to Europe, the emission of fossil CO<sub>2</sub> will possibly be slightly higher.

The flue gas from a wood burning device is composed of, amongst others, the following:

- Fly-ash composed of incombustible, inert dustparticles
- Heavy metals including copper, lead, zinc and cadmium
- Sulfur, chlorine and potassium compounds (SO<sub>2</sub>, HCl, KCl)
- Dioxins and furans
- Nitrogen compounds (NO, NO<sub>2</sub>, HCN, NH<sub>3</sub>, N<sub>2</sub>O)
- Hydrocarbons: Aliphatics, cyclical (mostly benzene) and polycyclical aromatic hydrocarbons (PAH's), formaldehydes, alcohol, ketones, esters and others
- Carbon and soot
- Unburned wood dust
- Oxygen, carbon dioxide (CO<sub>2</sub>), carbon monoxide (CO) and water



Picture: Approx. 5 grams of mineral ash remain after the burn of approx. 500 grams air-dry beech (20% moisture)

The components of wood smoke that can have an intense odor come from the groups below. Within these groups there are approx. 500 different chemical compounds.

- Multiple, mostly polycyclic, hydrocarbons
- Aldehydes, for example ethanol, propanal, formaldehyde and others
- Organic acids including formic acid, acetic, propionic (propanoic) and others
- Condensed aromatics
- Styrene (ethyl benzene)
- Phenol (hydroxybenzene)
- Other compounds: guaiacol, ethyl guaiacol, furfuryl alcohol



Picture: A statue at the entrance of the chimney sweep academy (Schornsteinfegerschule) in Dülmen, Germany

A number of the compounds described above condense in the stovepipe, during the cooling down, on fly-ash consisting of mineral compounds and wood dust. This means that various volatile compounds change into the solid compound tar. Wood dust, mineral ash, soot and tar jointly form the particulate matter which is emitted when burning wood.



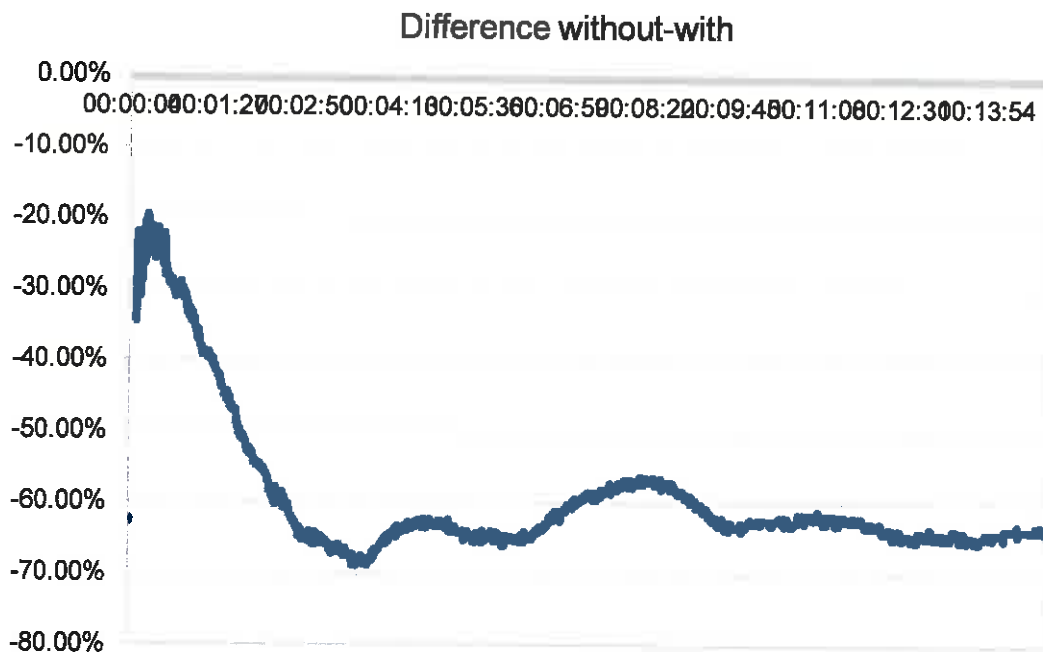
Picture: A quantity of ash (mineral, iron containing ash) which was filtered from the flue gas by the ABCAT modules after the burn of approx. 20 kg air-dry beech. This ash, if not filtered by the ABCAT, would have been emitted into the atmosphere.

Particulate matter as well as many other components of wood smoke are potentially dangerous for the public health and the environment. Odorous components do not have to be harmful but can be the cause for complaints about nuisance. Wood smoke which is perceived as very unpleasant can be an indicator of poor burning conditions and the presence of many harmful components. There is, however, no necessary correlation between the two. An almost complete burn of woods of tropical origin can result in a very strong odor. Since these odors are unfamiliar and exotic to people in the west, they are qualified as unpleasant easily, while there do not necessarily have to be many harmful components in the wood smoke. Complaints often result from the odor and the psychological association with health risk and harmfulness. The emission of particulate matter will, as far as it is not visible as colored smoke or perceived as odor, on the contrary not be the cause for people to complain while particulate matter is certainly a threat to the public health.



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ABCAT test with WÖHLER SM 500 SUSPENDED PARTICULATE ANALYZER



Tijd	AVG without mst(mg/m3)	AVG with mst(mg/m3)	Difference without-with
00:00:01			<b>-59.20% gem red gehele stook</b>
00:00:02			<b>-61.12% gem -1° min</b>
00:00:03			<b>-58.44% gem -1° 2 min</b>
00:00:04			<b>-62.80% gem -1e 3 min</b>
00:00:05			<b>-62.29% gem -1° 5 min</b>
00:00:06			
00:00:07			
00:00:08			
00:00:09			
00:00:10			
00:00:11	294	218	-34.63%
00:00:12	250	205	-22.15%
00:00:13	273	208	-31.25%
00:00:14	245	200	-22.50%
00:00:15	269	205	-31.19%
00:00:16	244	200	-22.00%
00:00:17	261	202	-28.96%
00:00:18	243	199	-21.86%
00:00:19	257	203	-26.60%
00:00:20	241	199	-20.65%
00:00:21	254	202	-25.54%
00:00:22	240	201	-19.60%
00:00:23	253	203	-24.43%
00:00:24	241	199	-20.90%
00:00:25	253	202	-25.00%

Part.Reduction

00:00:26	242	198	-22.18%
00:00:27	252	203	-23.93%
00:00:28	242	199	-21.40%
00:00:29	255	202	-25.78%
00:00:30	244	200	-21.75%
00:00:31	252	202	-24.50%
00:00:32	243	200	-21.50%
00:00:33	253	202	-25.00%
00:00:34	248	200	-23.54%
00:00:35	253	202	-25.25%
00:00:36	246	199	-23.62%
00:00:37	254	200	-26.75%
00:00:38	248	202	-22.32%
00:00:39	256	199	-28.18%
00:00:40	256	202	-26.73%
00:00:41	256	199	-28.39%
00:00:42	257	201	-28.07%
00:00:43	256	198	-29.26%
00:00:44	257	200	-28.50%
00:00:45	257	198	-29.58%
00:00:46	257	200	-28.71%
00:00:47	257	198	-30.02%
00:00:48	259	199	-29.90%
00:00:49	258	197	-31.19%
00:00:50	258	198	-30.30%
00:00:51	259	199	-30.37%
00:00:52	259	198	-31.03%
00:00:53	259	199	-29.90%
00:00:54	259	200	-29.03%
00:00:55	260	198	-31.06%
00:00:56	260	200	-29.97%
00:00:57	260	198	-31.53%
00:00:58	260	199	-30.43%
00:00:59	260	198	-31.28%
00:01:00	265	199	-33.39%
00:01:01	261	197	-32.01%
00:01:02	266	199	-33.89%
00:01:03	262	197	-32.74%
00:01:04	266	198	-34.57%
00:01:05	262	197	-33.22%
00:01:06	267	198	-34.37%
00:01:07	264	196	-34.21%
00:01:08	269	198	-35.83%
00:01:09	266	196	-35.46%
00:01:10	270	197	-37.06%
00:01:11	267	196	-35.74%
00:01:12	271	197	-37.33%
00:01:13	271	196	-38.27%
00:01:14	272	197	-38.05%
00:01:15	272	195	-39.25%
00:01:16	272	196	-38.54%
00:01:17	272	196	-39.01%
00:01:18	273	196	-38.79%
00:01:19	273	197	-38.81%
00:01:20	273	196	-39.52%



## Part.Reduction

00:01:21	273	197	-38.81%
00:01:22	274	195	-40.02%
00:01:23	274	196	-39.54%
00:01:24	274	195	-40.26%
00:01:25	274	196	-39.78%
00:01:26	274	194	-40.98%
00:01:27	274	194	-40.74%
00:01:28	274	193	-41.71%
00:01:29	273	193	-41.70%
00:01:30	273	192	-42.19%
00:01:31	273	192	-41.93%
00:01:32	272	190	-42.91%
00:01:33	272	190	-43.41%
00:01:34	272	189	-43.90%
00:01:35	272	188	-44.16%
00:01:36	272	187	-44.93%
00:01:37	271	187	-44.66%
00:01:38	271	186	-45.70%
00:01:39	270	187	-44.39%
00:01:40	270	185	-45.68%
00:01:41	270	186	-45.15%
00:01:42	270	184	-46.73%
00:01:43	269	184	-46.20%
00:01:44	269	183	-46.99%
00:01:45	269	183	-46.99%
00:01:46	268	182	-47.25%
00:01:47	267	182	-46.97%
00:01:48	270	180	-49.45%
00:01:49	269	180	-48.89%
00:01:50	269	179	-50.28%
00:01:51	268	179	-49.72%
00:01:52	268	178	-50.84%
00:01:53	267	178	-50.28%
00:01:54	267	177	-50.56%
00:01:55	267	176	-51.42%
00:01:56	266	176	-51.14%
00:01:57	266	175	-52.00%
00:01:58	266	174	-52.29%
00:01:59	266	174	-52.88%
00:02:00	265	174	-52.30%
00:02:01	265	173	-53.19%
00:02:02	264	173	-52.61%
00:02:03	264	172	-53.20%
00:02:04	264	171	-53.79%
00:02:05	263	170	-54.40%
00:02:06	263	170	-54.11%
00:02:07	262	169	-54.72%
00:02:08	262	169	-54.72%
00:02:09	262	169	-54.73%
00:02:10	261	169	-54.44%
00:02:11	261	168	-55.06%
00:02:12	261	168	-55.06%
00:02:13	260	167	-55.39%
00:02:14	259	167	-55.09%
00:02:15	259	166	-55.71%

Part.Reduction

00:02:16	259	166	-55.72%
00:02:17	258	165	-56.05%
00:02:18	258	165	-56.36%
00:02:19	260	164	-58.23%
00:02:20	258	164	-57.33%
00:02:21	259	163	-58.90%
00:02:22	258	163	-57.98%
00:02:23	259	162	-59.57%
00:02:24	257	162	-58.33%
00:02:25	259	161	-60.23%
00:02:26	256	162	-57.70%
00:02:27	258	161	-59.94%
00:02:28	256	161	-58.37%
00:02:29	257	161	-59.96%
00:02:30	255	161	-58.40%
00:02:31	256	160	-59.67%
00:02:32	254	160	-58.42%
00:02:33	256	159	-60.69%
00:02:34	254	159	-59.10%
00:02:35	255	159	-60.38%
00:02:36	253	158	-59.79%
00:02:37	254	158	-60.76%
00:02:38	252	157	-60.17%
00:02:39	254	157	-61.46%
00:02:40	253	156	-61.83%
00:02:41	254	157	-61.81%
00:02:42	253	155	-62.55%
00:02:43	253	156	-62.21%
00:02:44	252	155	-62.58%
00:02:45	252	155	-62.58%
00:02:46	252	154	-63.31%
00:02:47	252	154	-63.31%
00:02:48	253	154	-64.64%
00:02:49	251	154	-63.34%
00:02:50	252	153	-64.35%
00:02:51	251	153	-63.73%
00:02:52	252	152	-65.10%
00:02:53	250	152	-64.11%
00:02:54	251	152	-64.80%
00:02:55	249	152	-64.18%
00:02:56	250	151	-64.87%
00:02:57	249	151	-64.57%
00:02:58	249	151	-65.27%
00:02:59	247	151	-63.94%
00:03:00	248	150	-65.33%
00:03:01	246	150	-64.00%
00:03:02	248	149	-65.74%
00:03:03	246	149	-64.40%
00:03:04	247	149	-65.81%
00:03:05	245	149	-64.09%
00:03:06	246	149	-65.13%
00:03:07	244	148	-64.53%
00:03:08	245	148	-65.58%
00:03:09	243	148	-64.56%
00:03:10	244	147	-65.61%

## Part.Reduction

00:03:11	242	147	-64.63%
00:03:12	243	147	-65.31%
00:03:13	242	146	-65.03%
00:03:14	242	146	-65.75%
00:03:15	241	146	-65.10%
00:03:16	242	146	-65.79%
00:03:17	240	145	-65.52%
00:03:18	241	145	-66.21%
00:03:19	241	145	-66.59%
00:03:20	240	145	-65.90%
00:03:21	240	144	-67.05%
00:03:22	240	144	-65.94%
00:03:23	239	143	-66.74%
00:03:24	239	144	-66.01%
00:03:25	239	143	-66.40%
00:03:26	238	143	-66.05%
00:03:27	238	143	-66.82%
00:03:28	238	143	-65.70%
00:03:29	238	142	-66.86%
00:03:30	237	142	-66.51%
00:03:31	237	142	-66.90%
00:03:32	237	142	-66.55%
00:03:33	236	141	-67.38%
00:03:34	236	142	-66.24%
00:03:35	236	141	-67.42%
00:03:36	235	141	-67.06%
00:03:37	235	141	-67.06%
00:03:38	235	140	-67.10%
00:03:39	234	140	-67.54%
00:03:40	234	140	-67.14%
00:03:41	235	139	-68.66%
00:03:42	233	139	-67.22%
00:03:43	234	139	-68.35%
00:03:44	233	139	-68.03%
00:03:45	234	138	-68.80%
00:03:46	233	138	-68.07%
00:03:47	234	139	-68.39%
00:03:48	232	138	-67.71%
00:03:49	233	138	-68.07%
00:03:50	231	138	-67.39%
00:03:51	232	138	-68.12%
00:03:52	232	137	-68.57%
00:03:53	231	138	-67.80%
00:03:54	231	137	-68.61%
00:03:55	231	137	-68.25%
00:03:56	231	137	-68.66%
00:03:57	230	137	-67.88%
00:03:58	230	137	-67.93%
00:03:59	229	137	-67.56%
00:04:00	229	136	-67.97%
00:04:01	228	137	-66.83%
00:04:02	228	136	-67.65%
00:04:03	228	137	-66.46%
00:04:04	227	136	-66.95%
00:04:05	227	136	-66.54%

Part.Reduction

00:04:06	226	135	-66.63%
00:04:07	226	136	-66.22%
00:04:08	225	135	-65.89%
00:04:09	225	135	-65.89%
00:04:10	224	135	-65.52%
00:04:11	224	135	-65.15%
00:04:12	223	135	-65.59%
00:04:13	223	135	-64.81%
00:04:14	222	134	-65.67%
00:04:15	222	135	-64.44%
00:04:16	222	134	-65.30%
00:04:17	221	134	-64.55%
00:04:18	220	134	-64.18%
00:04:19	220	134	-64.18%
00:04:20	220	134	-64.21%
00:04:21	219	134	-63.84%
00:04:22	219	134	-63.84%
00:04:23	218	133	-63.50%
00:04:24	219	133	-64.66%
00:04:25	217	133	-63.16%
00:04:26	218	133	-63.91%
00:04:27	218	133	-63.94%
00:04:28	217	132	-63.98%
00:04:29	217	132	-64.02%
00:04:30	216	132	-63.22%
00:04:31	216	132	-63.26%
00:04:32	215	132	-63.29%
00:04:33	215	131	-63.71%
00:04:34	214	131	-62.94%
00:04:35	214	131	-63.78%
00:04:36	213	131	-62.60%
00:04:37	213	131	-63.01%
00:04:38	213	130	-63.43%
00:04:39	213	130	-63.46%
00:04:40	212	130	-62.66%
00:04:41	212	130	-63.11%
00:04:42	211	130	-62.72%
00:04:43	211	129	-63.14%
00:04:44	211	129	-63.18%
00:04:45	210	129	-62.37%
00:04:46	210	129	-62.40%
00:04:47	209	128	-62.86%
00:04:48	209	128	-62.47%
00:04:49	209	128	-63.28%
00:04:50	208	128	-62.92%
00:04:51	208	128	-62.11%
00:04:52	208	128	-62.53%
00:04:53	208	127	-63.39%
00:04:54	207	127	-62.57%
00:04:55	207	127	-62.60%
00:04:56	206	127	-62.63%
00:04:57	206	127	-62.24%
00:04:58	206	126	-62.66%
00:04:59	206	126	-63.10%
00:05:00	206	126	-63.10%

Part.Reduction

00:05:01	205	125	-63.16%
00:05:02	205	126	-63.13%
00:05:03	204	125	-62.77%
00:05:04	204	125	-63.20%
00:05:05	203	125	-62.40%
00:05:06	203	124	-63.27%
00:05:07	202	124	-62.47%
00:05:08	203	125	-62.83%
00:05:09	202	124	-62.50%
00:05:10	202	124	-62.90%
00:05:11	201	123	-62.97%
00:05:12	202	123	-63.38%
00:05:13	201	123	-62.57%
00:05:14	201	123	-63.01%
00:05:15	200	123	-62.20%
00:05:16	201	122	-63.90%
00:05:17	200	122	-63.49%
00:05:18	200	122	-63.52%
00:05:19	200	122	-63.97%
00:05:20	199	122	-63.11%
00:05:21	199	122	-63.15%
00:05:22	199	121	-64.05%
00:05:23	198	121	-63.64%
00:05:24	198	121	-64.09%
00:05:25	198	120	-64.13%
00:05:26	198	120	-64.13%
00:05:27	197	120	-64.17%
00:05:28	197	120	-64.21%
00:05:29	196	120	-63.79%
00:05:30	197	119	-65.13%
00:05:31	196	119	-64.71%
00:05:32	196	119	-64.29%
00:05:33	195	119	-63.87%
00:05:34	195	119	-64.33%
00:05:35	195	118	-64.79%
00:05:36	195	118	-64.83%
00:05:37	194	118	-64.41%
00:05:38	194	118	-64.41%
00:05:39	195	118	-65.30%
00:05:40	194	117	-65.38%
00:05:41	194	117	-65.38%
00:05:42	193	117	-64.06%
00:05:43	193	117	-64.53%
00:05:44	192	117	-64.57%
00:05:45	193	117	-64.53%
00:05:46	192	117	-64.14%
00:05:47	192	116	-65.52%
00:05:48	191	117	-63.71%
00:05:49	192	116	-65.09%
00:05:50	191	116	-64.66%
00:05:51	191	116	-65.13%
00:05:52	190	116	-64.27%
00:05:53	191	116	-64.70%
00:05:54	190	115	-64.31%
00:05:55	190	115	-64.74%

## Part.Reduction

00:05:56	189	115	-63.87%
00:05:57	190	115	-64.78%
00:05:58	189	115	-63.91%
00:05:59	189	114	-65.31%
00:06:00	189	115	-64.39%
00:06:01	189	114	-64.87%
00:06:02	188	114	-63.99%
00:06:03	188	114	-64.91%
00:06:04	188	114	-64.47%
00:06:05	188	114	-65.40%
00:06:06	188	114	-64.47%
00:06:07	188	113	-65.88%
00:06:08	187	113	-65.00%
00:06:09	188	113	-65.93%
00:06:10	187	113	-64.56%
00:06:11	187	113	-65.04%
00:06:12	187	113	-64.56%
00:06:13	186	113	-65.09%
00:06:14	186	113	-64.64%
00:06:15	186	112	-65.13%
00:06:16	186	112	-65.13%
00:06:17	185	112	-64.69%
00:06:18	185	112	-65.18%
00:06:19	185	112	-64.73%
00:06:20	185	112	-65.22%
00:06:21	185	112	-65.22%
00:06:22	184	112	-64.78%
00:06:23	184	111	-65.27%
00:06:24	184	111	-65.27%
00:06:25	183	111	-64.37%
00:06:26	184	111	-64.82%
00:06:27	183	111	-64.86%
00:06:28	183	111	-65.36%
00:06:29	182	111	-63.96%
00:06:30	183	111	-64.91%
00:06:31	182	110	-64.50%
00:06:32	182	110	-64.95%
00:06:33	182	110	-64.50%
00:06:34	182	110	-64.50%
00:06:35	181	110	-64.55%
00:06:36	182	110	-65.00%
00:06:37	181	110	-64.09%
00:06:38	181	110	-64.55%
00:06:39	180	110	-64.13%
00:06:40	180	110	-63.64%
00:06:41	180	110	-64.13%
00:06:42	180	110	-64.13%
00:06:43	179	110	-63.22%
00:06:44	180	110	-63.68%
00:06:45	179	109	-63.26%
00:06:46	179	109	-63.72%
00:06:47	179	109	-63.26%
00:06:48	179	109	-63.26%
00:06:49	178	109	-62.80%
00:06:50	179	109	-63.26%

## Part.Reduction

00:06:51	178	109	-62.84%
00:06:52	178	109	-62.80%
00:06:53	177	109	-61.89%
00:06:54	177	109	-62.39%
00:06:55	177	109	-62.39%
00:06:56	177	109	-62.39%
00:06:57	176	109	-61.47%
00:06:58	177	109	-61.93%
00:06:59	176	109	-61.01%
00:07:00	176	109	-61.96%
00:07:01	176	109	-61.50%
00:07:02	176	108	-62.00%
00:07:03	175	109	-61.04%
00:07:04	176	108	-62.50%
00:07:05	175	108	-61.08%
00:07:06	175	108	-61.08%
00:07:07	175	108	-61.08%
00:07:08	174	108	-60.62%
00:07:09	175	108	-61.08%
00:07:10	174	108	-60.62%
00:07:11	174	108	-60.15%
00:07:12	173	108	-60.19%
00:07:13	174	108	-60.65%
00:07:14	173	108	-60.19%
00:07:15	173	108	-60.68%
00:07:16	173	108	-59.72%
00:07:17	172	108	-59.75%
00:07:18	172	108	-59.29%
00:07:19	172	107	-60.25%
00:07:20	172	107	-59.78%
00:07:21	172	107	-59.78%
00:07:22	171	107	-59.32%
00:07:23	172	107	-59.78%
00:07:24	171	107	-59.32%
00:07:25	171	107	-59.32%
00:07:26	170	107	-58.88%
00:07:27	171	107	-59.35%
00:07:28	170	107	-58.88%
00:07:29	170	107	-58.88%
00:07:30	170	107	-58.41%
00:07:31	170	107	-58.41%
00:07:32	170	107	-58.41%
00:07:33	170	107	-58.91%
00:07:34	169	107	-58.44%
00:07:35	169	106	-59.43%
00:07:36	169	107	-58.44%
00:07:37	169	106	-59.43%
00:07:38	169	106	-58.46%
00:07:39	169	106	-59.43%
00:07:40	168	106	-58.49%
00:07:41	169	106	-58.96%
00:07:42	168	106	-58.99%
00:07:43	168	106	-58.99%
00:07:44	168	106	-58.02%
00:07:45	168	106	-58.52%



## Part.Reduction

00:07:46	168	106	-58.52%
00:07:47	168	106	-58.52%
00:07:48	167	106	-58.04%
00:07:49	167	106	-58.04%
00:07:50	167	106	-58.04%
00:07:51	167	106	-58.04%
00:07:52	167	106	-57.08%
00:07:53	167	105	-58.54%
00:07:54	167	106	-57.57%
00:07:55	167	106	-57.57%
00:07:56	166	105	-57.59%
00:07:57	167	105	-58.07%
00:07:58	166	105	-57.59%
00:07:59	166	105	-58.10%
00:08:00	166	105	-57.12%
00:08:01	166	105	-57.62%
00:08:02	166	105	-57.62%
00:08:03	165	105	-57.14%
00:08:04	166	105	-57.62%
00:08:05	165	105	-57.14%
00:08:06	165	105	-56.67%
00:08:07	165	105	-56.67%
00:08:08	165	105	-57.17%
00:08:09	165	104	-57.67%
00:08:10	164	105	-56.69%
00:08:11	164	104	-56.71%
00:08:12	164	105	-56.69%
00:08:13	164	104	-56.71%
00:08:14	164	104	-57.69%
00:08:15	163	104	-56.73%
00:08:16	163	104	-57.23%
00:08:17	163	104	-57.23%
00:08:18	163	104	-57.23%
00:08:19	163	104	-56.75%
00:08:20	163	104	-56.75%
00:08:21	162	104	-56.27%
00:08:22	163	103	-57.26%
00:08:23	162	103	-56.29%
00:08:24	162	103	-57.28%
00:08:25	161	103	-56.31%
00:08:26	161	103	-56.31%
00:08:27	161	103	-56.31%
00:08:28	161	103	-56.82%
00:08:29	161	102	-56.84%
00:08:30	161	102	-56.84%
00:08:31	160	102	-56.86%
00:08:32	160	102	-56.86%
00:08:33	160	102	-56.37%
00:08:34	160	102	-56.37%
00:08:35	160	102	-56.89%
00:08:36	160	101	-57.40%
00:08:37	159	101	-56.91%
00:08:38	159	101	-56.91%
00:08:39	159	101	-56.93%
00:08:40	159	101	-56.91%

## Part.Reduction

00:08:41	158	101	-56.44%
00:08:42	159	100	-57.97%
00:08:43	158	100	-56.98%
00:08:44	158	100	-56.98%
00:08:45	158	100	-57.50%
00:08:46	158	100	-56.98%
00:08:47	158	100	-57.50%
00:08:48	157	100	-57.53%
00:08:49	157	100	-57.02%
00:08:50	157	99	-58.05%
00:08:51	157	99	-58.08%
00:08:52	156	99	-57.05%
00:08:53	156	99	-57.58%
00:08:54	156	99	-57.58%
00:08:55	156	99	-58.11%
00:08:56	156	98	-58.14%
00:08:57	155	98	-58.16%
00:08:58	156	98	-58.67%
00:08:59	155	98	-58.70%
00:09:00	155	98	-58.19%
00:09:01	155	98	-58.19%
00:09:02	154	97	-58.22%
00:09:03	154	97	-58.76%
00:09:04	154	97	-58.76%
00:09:05	154	97	-59.31%
00:09:06	154	97	-58.79%
00:09:07	154	97	-58.79%
00:09:08	153	96	-58.82%
00:09:09	154	96	-59.90%
00:09:10	153	96	-58.85%
00:09:11	153	96	-59.41%
00:09:12	153	96	-59.41%
00:09:13	153	96	-59.41%
00:09:14	152	95	-59.44%
00:09:15	152	95	-60.56%
00:09:16	152	95	-60.00%
00:09:17	152	95	-60.00%
00:09:18	152	95	-60.04%
00:09:19	152	95	-60.04%
00:09:20	152	95	-60.04%
00:09:21	152	94	-60.60%
00:09:22	152	94	-61.17%
00:09:23	152	94	-61.17%
00:09:24	151	94	-61.21%
00:09:25	151	94	-61.21%
00:09:26	151	94	-60.68%
00:09:27	151	93	-61.79%
00:09:28	151	93	-61.25%
00:09:29	151	93	-61.25%
00:09:30	151	93	-62.41%
00:09:31	151	93	-61.83%
00:09:32	151	93	-62.41%
00:09:33	150	93	-61.87%
00:09:34	150	93	-61.87%
00:09:35	150	92	-62.45%

## Part.Reduction

00:09:36	150	92	-63.04%
00:09:37	150	92	-63.04%
00:09:38	150	92	-63.04%
00:09:39	150	92	-62.50%
00:09:40	149	92	-61.96%
00:09:41	150	92	-62.50%
00:09:42	149	92	-62.55%
00:09:43	150	91	-63.69%
00:09:44	149	91	-63.14%
00:09:45	149	91	-63.14%
00:09:46	149	91	-62.59%
00:09:47	149	91	-63.74%
00:09:48	149	91	-62.59%
00:09:49	148	91	-62.64%
00:09:50	149	91	-63.19%
00:09:51	148	91	-63.24%
00:09:52	148	91	-63.24%
00:09:53	148	91	-63.24%
00:09:54	148	91	-63.24%
00:09:55	148	91	-63.24%
00:09:56	148	91	-63.24%
00:09:57	148	90	-63.28%
00:09:58	147	90	-62.73%
00:09:59	148	90	-63.89%
00:10:00	147	90	-62.73%
00:10:01	147	90	-63.33%
00:10:02	147	90	-62.78%
00:10:03	147	90	-63.33%
00:10:04	147	90	-62.78%
00:10:05	147	90	-62.78%
00:10:06	147	90	-62.78%
00:10:07	146	90	-62.22%
00:10:08	146	90	-62.22%
00:10:09	146	90	-62.83%
00:10:10	146	90	-62.83%
00:10:11	146	90	-62.83%
00:10:12	146	90	-62.83%
00:10:13	146	90	-62.83%
00:10:14	146	90	-62.27%
00:10:15	146	90	-62.83%
00:10:16	146	90	-62.27%
00:10:17	146	89	-62.87%
00:10:18	146	90	-62.27%
00:10:19	145	89	-62.31%
00:10:20	145	89	-62.31%
00:10:21	145	89	-62.31%
00:10:22	145	89	-62.36%
00:10:23	145	89	-62.36%
00:10:24	145	89	-62.36%
00:10:25	145	89	-62.36%
00:10:26	145	89	-62.36%
00:10:27	145	89	-62.97%
00:10:28	145	89	-62.97%
00:10:29	145	89	-62.97%
00:10:30	144	89	-62.41%

## Part.Reduction

00:10:31	144	89	-62.41%
00:10:32	144	89	-62.41%
00:10:33	144	89	-62.41%
00:10:34	144	89	-62.41%
00:10:35	144	89	-62.41%
00:10:36	144	89	-61.84%
00:10:37	144	88	-62.45%
00:10:38	144	88	-62.45%
00:10:39	144	88	-62.45%
00:10:40	144	88	-63.07%
00:10:41	143	88	-61.89%
00:10:42	143	88	-62.50%
00:10:43	143	88	-61.93%
00:10:44	143	88	-62.50%
00:10:45	143	88	-62.55%
00:10:46	143	88	-63.12%
00:10:47	143	87	-63.17%
00:10:48	143	87	-63.17%
00:10:49	142	87	-62.60%
00:10:50	142	87	-62.60%
00:10:51	142	87	-62.60%
00:10:52	142	87	-62.60%
00:10:53	142	87	-62.60%
00:10:54	141	87	-61.45%
00:10:55	141	87	-61.45%
00:10:56	141	87	-61.45%
00:10:57	141	87	-61.45%
00:10:58	141	87	-62.07%
00:10:59	141	87	-62.12%
00:11:00	141	87	-62.69%
00:11:01	140	87	-61.54%
00:11:02	141	87	-62.12%
00:11:03	140	87	-61.54%
00:11:04	140	87	-61.54%
00:11:05	140	87	-61.54%
00:11:06	140	87	-61.54%
00:11:07	140	87	-61.54%
00:11:08	140	86	-62.16%
00:11:09	140	86	-61.58%
00:11:10	140	86	-62.16%
00:11:11	140	86	-61.58%
00:11:12	140	86	-61.58%
00:11:13	139	86	-61.00%
00:11:14	140	86	-61.58%
00:11:15	140	86	-62.21%
00:11:16	139	86	-61.63%
00:11:17	140	86	-61.58%
00:11:18	140	86	-62.84%
00:11:19	139	86	-61.63%
00:11:20	140	86	-62.84%
00:11:21	140	86	-62.84%
00:11:22	139	86	-61.67%
00:11:23	139	86	-62.26%
00:11:24	139	86	-61.67%
00:11:25	139	86	-61.67%

Part.Reduction

00:11:26	139	86	-61.67%
00:11:27	139	86	-61.67%
00:11:28	139	85	-62.30%
00:11:29	139	86	-61.67%
00:11:30	139	85	-62.94%
00:11:31	139	85	-62.94%
00:11:32	138	85	-62.35%
00:11:33	139	85	-62.94%
00:11:34	138	85	-61.76%
00:11:35	138	85	-61.76%
00:11:36	138	85	-61.76%
00:11:37	138	85	-61.76%
00:11:38	138	85	-61.76%
00:11:39	138	85	-61.76%
00:11:40	138	85	-62.40%
00:11:41	138	85	-62.40%
00:11:42	138	85	-62.40%
00:11:43	137	84	-62.45%
00:11:44	137	84	-62.45%
00:11:45	137	84	-62.45%
00:11:46	137	84	-61.86%
00:11:47	137	84	-62.50%
00:11:48	137	84	-61.86%
00:11:49	137	84	-62.50%
00:11:50	137	84	-62.50%
00:11:51	137	84	-62.50%
00:11:52	136	84	-61.90%
00:11:53	136	84	-61.90%
00:11:54	136	84	-61.90%
00:11:55	136	84	-61.95%
00:11:56	136	84	-61.95%
00:11:57	136	83	-62.60%
00:11:58	136	83	-62.60%
00:11:59	136	83	-63.25%
00:12:00	136	83	-63.25%
00:12:01	136	83	-63.25%
00:12:02	135	83	-62.65%
00:12:03	135	83	-62.65%
00:12:04	135	83	-62.65%
00:12:05	135	83	-63.31%
00:12:06	135	83	-62.70%
00:12:07	135	83	-63.31%
00:12:08	135	82	-63.36%
00:12:09	135	82	-63.36%
00:12:10	135	82	-63.36%
00:12:11	135	82	-63.36%
00:12:12	135	82	-63.36%
00:12:13	134	82	-62.75%
00:12:14	134	82	-62.75%
00:12:15	134	82	-63.41%
00:12:16	134	82	-64.08%
00:12:17	134	82	-64.08%
00:12:18	134	82	-63.47%
00:12:19	134	82	-64.08%
00:12:20	134	82	-63.47%

## Part.Reduction

00:12:21	133	81	-63.52%
00:12:22	133	81	-63.52%
00:12:23	133	81	-63.52%
00:12:24	133	81	-63.52%
00:12:25	133	81	-63.52%
00:12:26	133	81	-64.88%
00:12:27	133	81	-64.88%
00:12:28	133	81	-64.88%
00:12:29	133	81	-64.26%
00:12:30	132	81	-63.64%
00:12:31	132	81	-63.64%
00:12:32	132	81	-63.64%
00:12:33	132	81	-63.64%
00:12:34	132	80	-65.00%
00:12:35	132	80	-65.00%
00:12:36	132	80	-65.00%
00:12:37	132	80	-64.38%
00:12:38	132	80	-64.38%
00:12:39	132	80	-64.38%
00:12:40	131	80	-64.44%
00:12:41	131	80	-64.44%
00:12:42	131	80	-64.44%
00:12:43	131	80	-64.44%
00:12:44	131	79	-65.13%
00:12:45	131	79	-64.50%
00:12:46	131	79	-64.50%
00:12:47	131	79	-64.50%
00:12:48	131	79	-65.19%
00:12:49	130	79	-64.56%
00:12:50	131	79	-65.19%
00:12:51	130	79	-63.92%
00:12:52	130	79	-63.92%
00:12:53	130	79	-63.92%
00:12:54	130	79	-64.62%
00:12:55	130	79	-64.62%
00:12:56	129	79	-63.98%
00:12:57	129	78	-64.68%
00:12:58	129	78	-64.68%
00:12:59	129	78	-64.68%
00:13:00	129	78	-64.68%
00:13:01	129	78	-64.04%
00:13:02	128	78	-63.40%
00:13:03	128	78	-63.40%
00:13:04	128	78	-64.10%
00:13:05	128	78	-64.81%
00:13:06	128	78	-64.81%
00:13:07	128	78	-64.81%
00:13:08	128	78	-64.81%
00:13:09	128	78	-64.81%
00:13:10	128	78	-64.16%
00:13:11	128	78	-64.16%
00:13:12	128	78	-64.16%
00:13:13	127	77	-64.22%
00:13:14	127	77	-64.22%
00:13:15	127	77	-64.94%

Part.Reduction

00:13:16	127	77	-64.94%
00:13:17	127	77	-64.29%
00:13:18	127	77	-64.29%
00:13:19	127	77	-65.00%
00:13:20	127	77	-65.00%
00:13:21	127	77	-65.00%
00:13:22	127	77	-65.00%
00:13:23	126	77	-64.35%
00:13:24	126	77	-63.70%
00:13:25	126	77	-63.70%
00:13:26	126	77	-63.70%
00:13:27	126	77	-63.70%
00:13:28	126	77	-63.70%
00:13:29	126	76	-64.41%
00:13:30	126	76	-64.41%
00:13:31	126	76	-65.13%
00:13:32	125	76	-65.20%
00:13:33	125	76	-63.82%
00:13:34	125	76	-65.20%
00:13:35	125	76	-63.82%
00:13:36	125	76	-64.54%
00:13:37	125	76	-64.54%
00:13:38	125	75	-65.27%
00:13:39	125	76	-64.54%
00:13:40	124	75	-64.60%
00:13:41	124	75	-64.60%
00:13:42	124	75	-64.60%
00:13:43	124	75	-64.60%
00:13:44	124	75	-64.60%
00:13:45	124	75	-65.33%
00:13:46	124	75	-64.67%
00:13:47	124	75	-65.33%
00:13:48	124	75	-65.40%
00:13:49	124	75	-65.40%
00:13:50	124	75	-65.40%
00:13:51	123	75	-64.73%
00:13:52	123	75	-64.73%
00:13:53	123	75	-64.73%
00:13:54	123	75	-64.73%
00:13:55	123	75	-64.73%
00:13:56	123	75	-64.06%
00:13:57	123	75	-64.06%
00:13:58	123	75	-64.06%
00:13:59	123	75	-64.06%
00:14:00	123	74	-64.80%
00:14:01	122	74	-64.13%
00:14:02	122	74	-64.13%
00:14:03	122	74	-64.86%
00:14:04	122	74	-64.13%
00:14:05	122	74	-64.13%
00:14:06	122	74	-64.19%
00:14:07	122	74	-64.19%
00:14:08	122	74	-64.19%
00:14:09	122	74	-64.19%
00:14:10	122	74	-64.19%

Part.Reduction

00:14:11	122	74	-64.19%
00:14:12	122	74	-64.19%
00:14:13	122	74	-64.19%
00:14:14	122	74	-64.93%
00:14:15	121	74	-63.51%
00:14:16	121	74	-63.57%
00:14:17	121	74	-63.57%
00:14:18	121	74	-63.57%
00:14:19	121	74	-63.57%
00:14:20	121	74	-63.57%
00:14:21	121	74	-63.57%
00:14:22	121	74	-63.57%
00:14:23	121	74	-63.57%
00:14:24	121	74	-63.57%
00:14:25	121	74	-63.57%
00:14:26	121	74	-63.57%
00:14:27	120	74	-62.90%
00:14:28	121	73	-64.32%
00:14:29	120	73	-63.64%
00:14:30	120	73	-63.70%
00:14:31	120	73	-63.64%
00:14:32	120	73	-63.70%
00:14:33	120	73	-63.70%
00:14:34	120	73	-63.70%
00:14:35	120	73	-63.70%
00:14:36	120	73	-63.70%
00:14:37	120	73	-63.70%
00:14:38	120	73	-63.70%
00:14:39	120	73	-63.70%
00:14:40	120	73	-63.70%
00:14:41	120	73	-63.70%
00:14:42	120	73	-63.70%
00:14:43	119	73	-63.76%
00:14:44	119	73	-63.76%
00:14:45	119	73	-63.76%
00:14:46	119	73	-63.07%
00:14:47	119	73	-63.76%
00:14:48	119	73	-63.07%
00:14:49	119	73	-63.07%
00:14:50	119	73	-63.07%
00:14:51	119	73	-63.07%
00:14:52	119	73	-63.07%
00:14:53	119	72	-63.82%
00:14:54	119	72	-63.82%
00:14:55	119	72	-63.82%
00:14:56	119	72	-63.82%
00:14:57	119	72	-64.58%
00:14:58	119	72	-63.82%
00:14:59	119	72	-64.58%
00:15:00	119	72	-64.58%
00:15:01	119	72	-64.58%





single storey building
  1½ storey building
  2½ storey building

project  
**Stove installation at  
 5 High Street  
 Innerleithen EH44 6HA**

client  
**Mr & Mrs Gordon**

drawing title  
**Site Plan**

drawing number  
**13011-SITE**

scale                      date  
**1:200                      @A4                      Jan 16**



**5 High Street  
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 EH446HA**

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