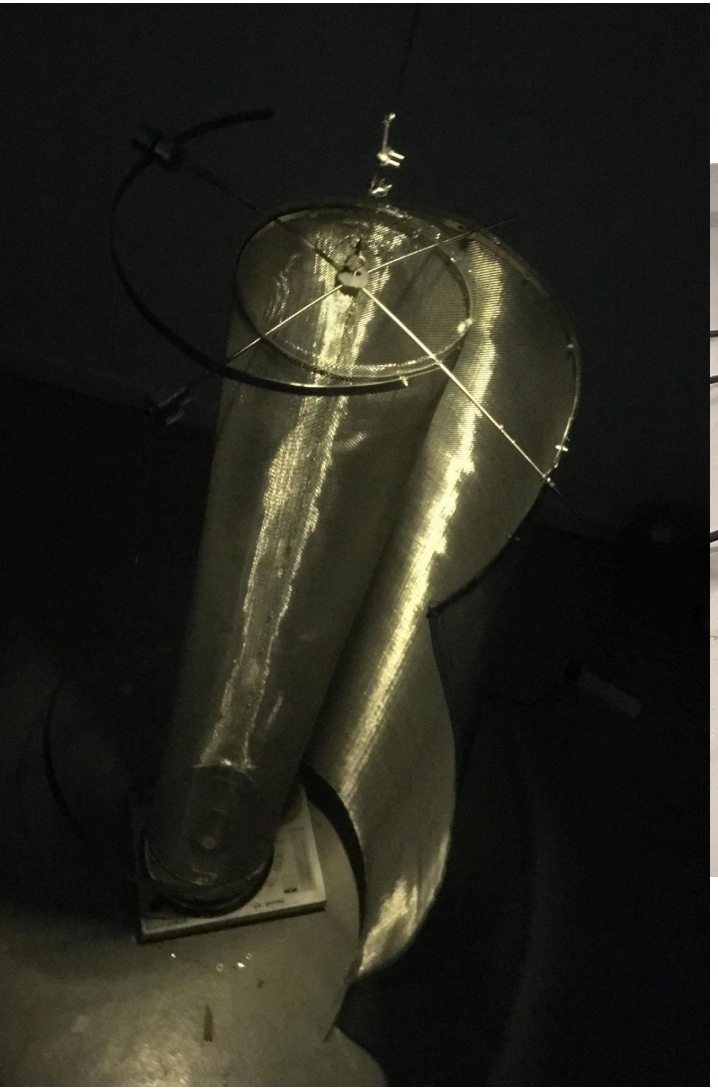
PUBLIC ARTWORK RISK ASSESSMENT:
Evaluation of potential risk to yourself and to other members of the public.

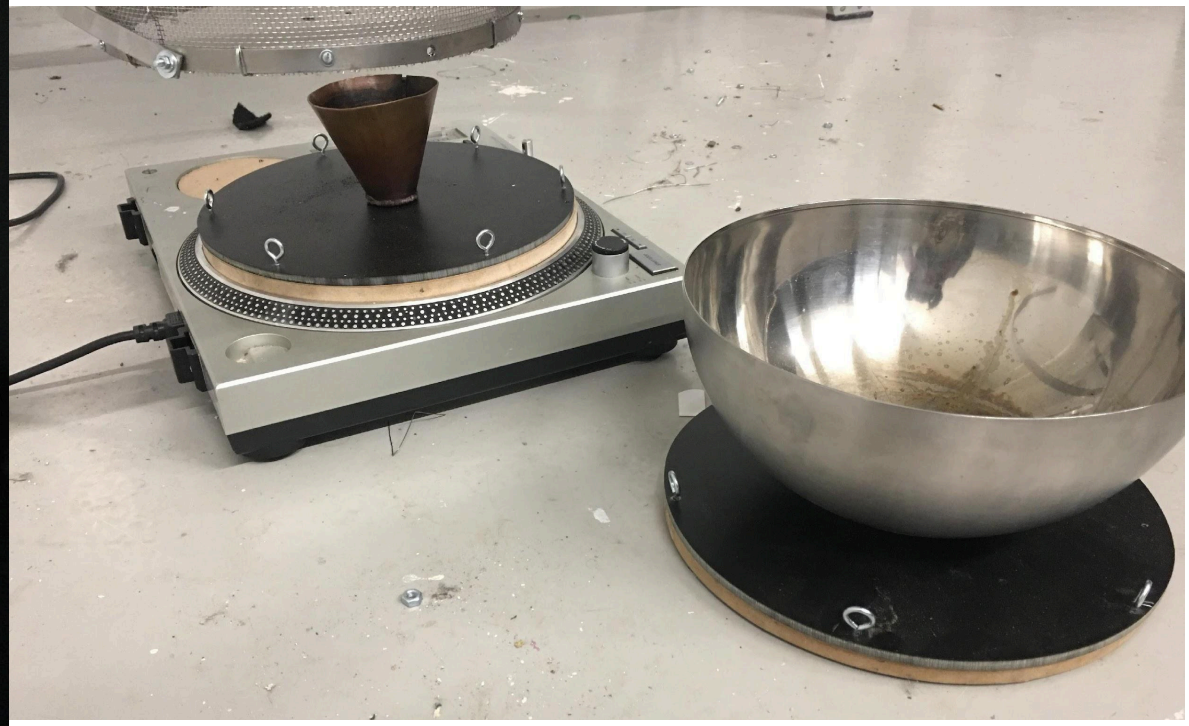
Project Name: *Axis on Fire: device 2*

Description of the project:

Kinetic device components: turntable, biofuel, fire-retardant mica, wire, steel vessel 1, copper vessel 2, swivel, metal rope
Device 2 dimensions: 187 x 110 x 30 cm

The mesh cylinder is suspended from the ceiling on a swivel (a rotating hook). The mesh cylinder's bottom is then connected to the hooks in the spinning platform, shown in the photo 2. When the turntable is set in motion, it causes the mesh cylinder to rotate in sync with it on a swivel. Suspending the mesh cylinder from the ceiling ensures the structure's stability, while also reducing the weight exerted on the floor-spinning motor. The turntable, found in waste and refurbished for the purposes of this project, was PAT-tested.
The kinetic fire sculpture has 2 interchangeable plates with different vessels for the biofuel, both coated with fire-retardant mica – the black material in the photo 2.





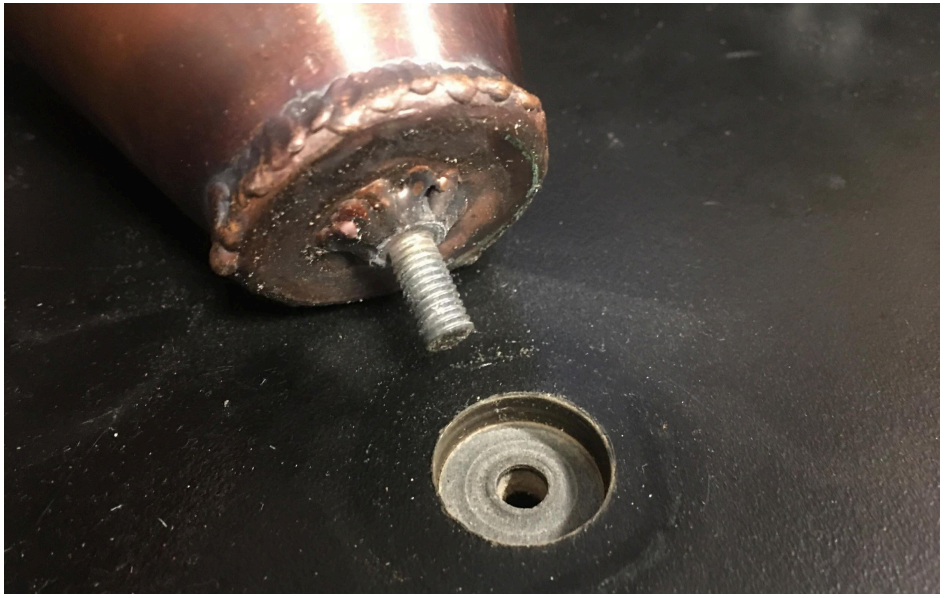
RISK ELIMINATION

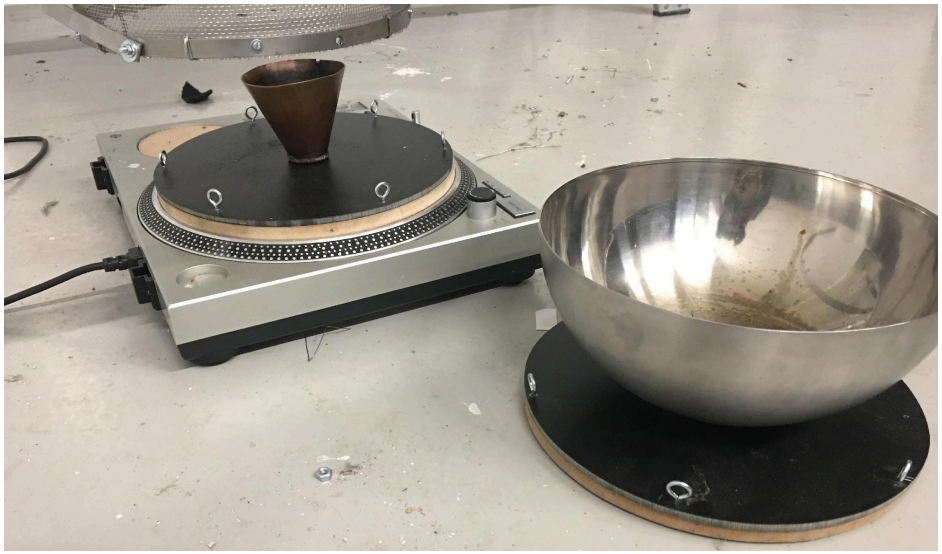
Risk 1: *Overspill*

The vessel with burning ethanol falls over or gets knocked over, and the fuel spills out, causing a fire.

Precaution 1

The steel vessel is welded, and the copper one brazed, to a bolt that goes through 2 layered plates of mica and plywood, and is secured tightly with a nut on the other side. This eliminates the risk of the vessels with fuel destabilizing in any way.

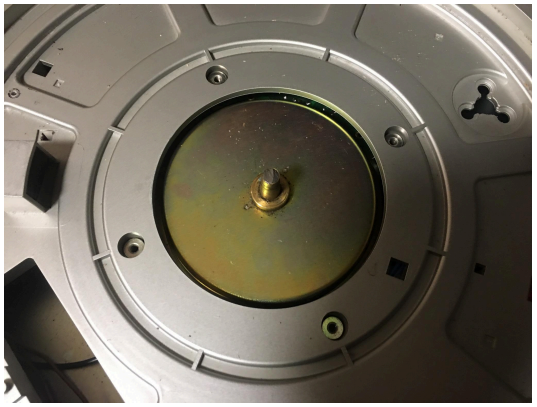




Precaution 2
If drops of ethanol are spilled, the plates of fire-retardant mica (the material used inside circuit boards) will prevent them from igniting.

Risk 2: The heat from the fire vortex travels to the motor of the turntable
Precaution 1

The bolt, welded to the hot fuel vessel, and the nut on it have been ground down to create empty space within the plate (fig. 2) — between the turntable's spinning, protruding end that connects to the motor (fig. 1) and the bolt in the mica and plywood layers — so that heat from the burning fuel does not transfer through the metal to the motor.



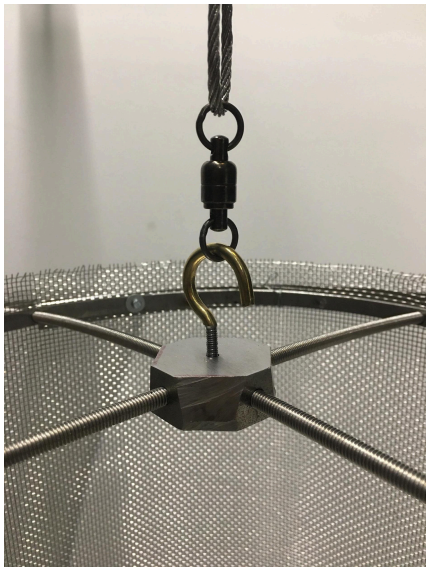
Risk 3: *Collapse*

One of the elements, such as the rope fixing, the swivel, or the hook, fails. Suspended from the ceiling, heavy and spinning, the 1.8m-tall metal mesh cylinder begins to lean and swing, then collapses onto the floor or anyone standing nearby.

Precaution 1

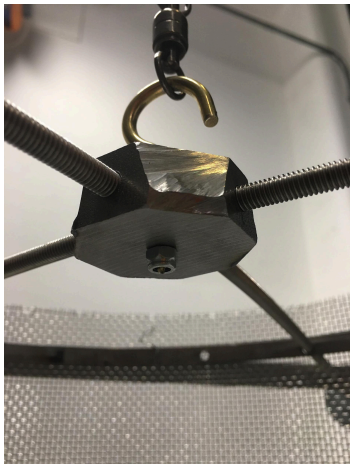
The metal mesh cylinder is suspended with a metal rope using 2 metal rope clamps on each loop, tightened with a wrench — 4 in total.

Precaution 2
The suspended cylinder's weight is appr. 40 kg
The swivel's breaking point is 124 kg:



Precaution 3

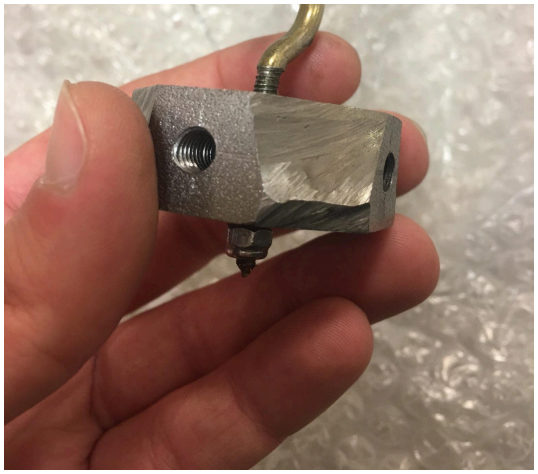
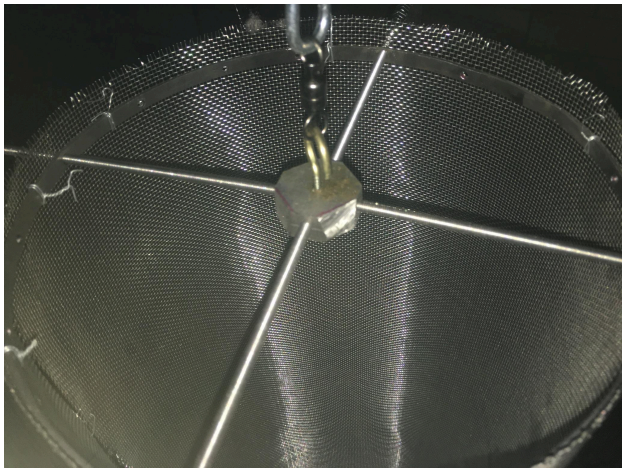
The hook was threaded for extra grip and security, and is held on with a nut.




Risk 4: *Unscrews*
As a result of vibration during the sculpture's rotation, one or more of the 4 steel threaded rods can unscrew, causing the structure to break and collapse.

Precaution 1
https://www.nord-lock.com/insights/bolting-tips/2015/the-experts-thread-engagement-in-a-tapped-hole/ :"the minimum recommended thread engagement to make a strong connection for a component with a tapped hole is approximately 1 times the nominal diameter in steel."

The rods used are M6, meaning the min. thread engagement must be 6 mm.
Each of the 4 threads inside the central metal blob piece (fig.1) was made by hand in the metal workshop and is 8 mm deep.

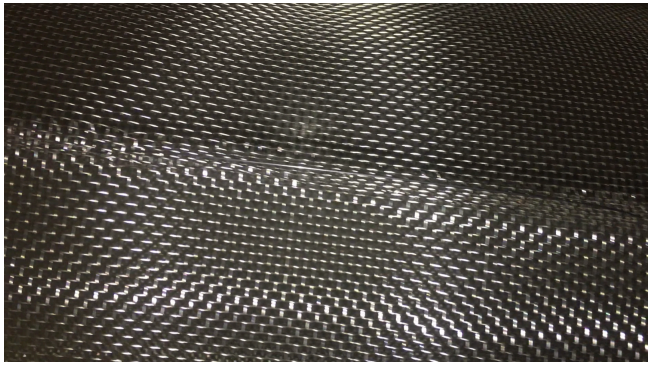
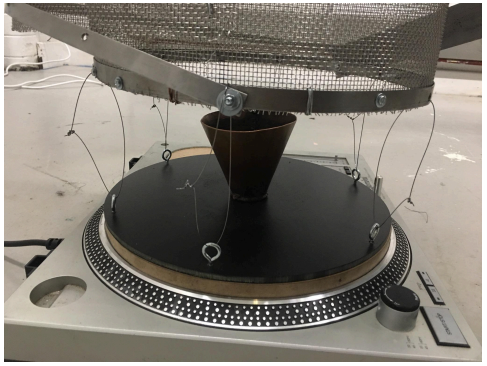



Precaution 2
It can't unscrew because of the heavy weight pulling the rods down, keeping them in a fixed position.

Risk 5
The swivel wears out and weakens, causing a disruption in spinning and leading to the destabilization of the mesh cylinder.
Precaution 1
The swivel is lubricated with a specific oil every time before the sculpture is set to spin, whether for testing or showcasing.
Precaution 2
The swivel is regularly replaced with a new one.

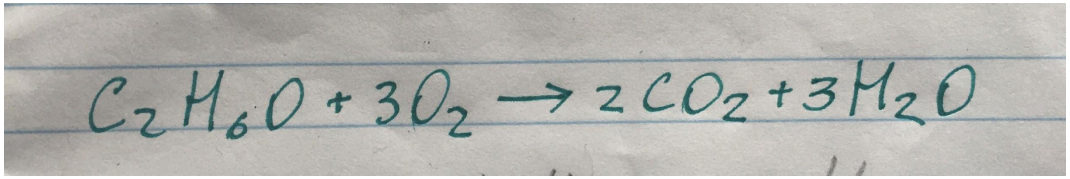
Risk 6: Vibration
During spinning, vibration causes the wire holding the elements together to stretch and deform slightly, leading to the gradual destabilization of the structure.

Precaution 1: Piano Wire
The cylinder is swirled and held together by woven piano wire, which, unlike common metal wire, has a low degree of malleability and strongly holds its shape once formed with pliers. Piano wire is also used to tie the cylinder to the spinning plate through the six eyelets.

BIOFUEL

The kinetic sculpture uses ethanol as the biofuel.
Ethanol burning formula:



As you can see, it burns completely and cleanly into carbon dioxide and water. (you can find the same formula at https://edu.rsc.org/experiments/combustion-of-ethanol/1773.article)

Ethanol is a type of biofuel. An ethanol fireplace is a popular alternative to wood-burning fireplaces on the market, because it doesn't require a chimney, since it burns completely cleanly. Ethanol is often sold as 'bioethanol', which is chemically identical to regular ethanol, but the name is used to emphasize its inherent eco-friendly properties and safety for human health.

Risk 7
The conclusion of this scientific article states the importance of being aware of ethanol vapour's high flammability.

Risk 7.0
A spark or open flame in the space where the sculpture is being lit may ignite the traveling vapour.

Precaution 1

The key fact is that the burning ethanol vapour is fully contained within the cylinder. Once it combusts, it turns into carbon dioxide and water—neither of which are flammable gases. Why the vapour is contained:

1. Due to the spinning motion, the ignited vapours forming the fire pillar remain compressed within the central axis and travel only upward. By the time the gases rise beyond the cylinder, they have already turned into water and CO_2.
2. According to the same scientific article: *"*It is well known in the safety community that flames cannot travel through small openings*"* (Section 4.3: *Possible Technical Barriers*). The metal mesh of the cylinder, with 1–2 mm openings, prevents the spread of vapour ignition beyond the enclosure.

Risk 7.1
"Lighting up the ethanol again can ignite the leftover fume cloud, leading to a burn…"

Precaution 1
When the ethanol in the kinetic fire sculpture runs out, it is ensured that no small flame remains before refilling with new ethanol. This prevents vapours from the new, open bottle from being ignited by a lingering flame.

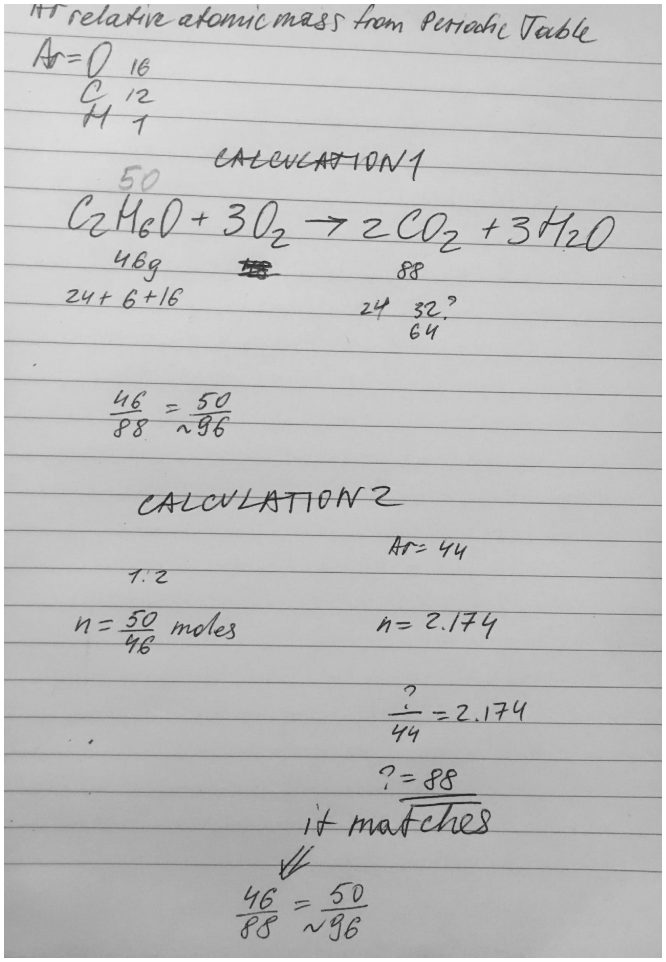
Risk 8
Despite all the above-mentioned built-in precautions, the burning liquid somehow manages to spill into the powered turntable, causing an electrical fire.
Precaution 1
Lighting the sculpture is always accompanied by having a specific type of fire extinguisher at hand:
https://www.screwfix.com/p/firechief-fap1-dry-powder-fire-extinguisher-1kg/339fy

The product specification reads: 'Suitable for flammable liquids, gases… electrical equipment.' It would extinguish both the burning ethanol and an electrical fire.

CO2 OUTPUT

Risk 9
"As the concentration CO_2 in air rises it can cause headaches, dizziness, confusion and loss of consciousness".(https://www.hse.gov.uk/carboncapture/carbondioxide.htm**)**

Precaution 1
The amount of CO_2 produced by igniting the sculpture is negligible and nowhere near sufficient to cause the symptoms mentioned above.
I've measured that 1 activation of the kinetic sculpture uses max. 50 ml of ethanol, which creates a vertical vortex of fire lasting appr. 4 minutes. While 50ml may seem like a small amount, the key point is that the fire pillar is quite literally air on fire — stretched out into a shape of a pillar by the spinning motion and the vertical mesh cylinder. This design maximises visual impact while minimising fuel consumption.
We can calculate the mass of CO_2 produced by the sculpture, knowing that the amount of ethanol used is 50 ml:



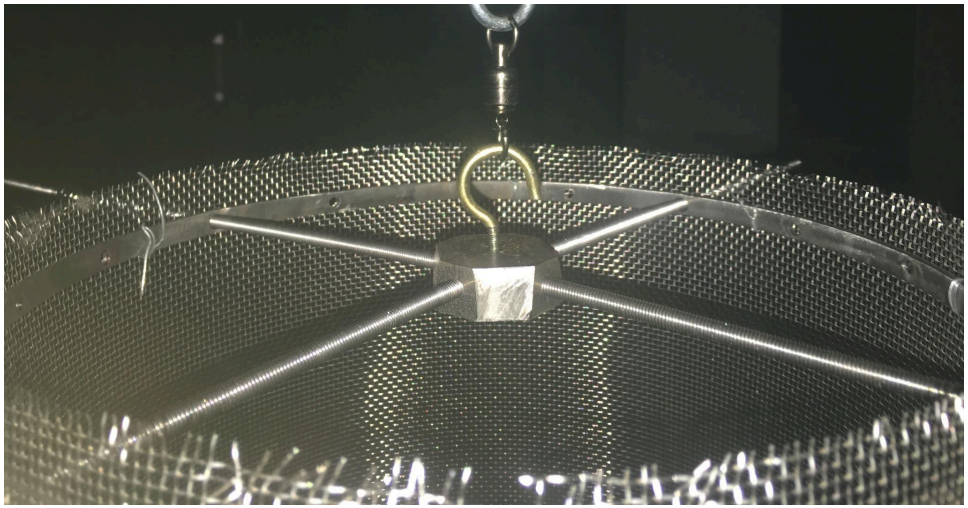
96g of CO2 is produced by 1 activation of the kinetic fire sculpture.

An average human produces 1kg of CO2 per day.(https://www.sciencefocus.com/planet-earth/how-much-does-human-breathing-contribute-to-climate-change).

If we take 1000g and divide it by 24, we get appr. 42g, which is the amount of CO_2 a single human produces per hour. 96/42 = 2.285 hours, or 2 hours 17 minutes

The amount of CO_2 produced by the fire sculpture is equivalent to the amount of CO_2 an average person produces by breathing over 2 hours 17 minutes. The amount of CO_2 produced by the work is nowhere near sufficient to pose a risk to the viewer's health.

Risk 11
When the sculpture is lit up, the fire burns off the coating on the metal parts, producing toxic fumes.
Precaution 1
The central metal element and the threaded rods are made of raw steel with no coating.



Precaution 2
In places where the reflective metal is made more matte for artistic effect, heat-resistant spray paint is used.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To Whom It May Concern

Public Liability & Professional Indemnity Insurance

Members of Scottish Artists Union

This is to confirm that we act as insurance intermediary for the above named and have arranged Public and Products Liability and Professional Indemnity Insurance for all members that are domiciled within the United Kingdom, The Channel Islands and the Isle of Man. Details of the policy are summarised below:

Policyholder:	Individual registered members for the time being of the Scottish Artists Union
Business Description:	Preparation, lecturing, teaching, public display and sale of fine art and applied art including participation in exhibitions, open studio events, displays involving live non-static physical performance, work undertaken in community settings, socially engaged practice and participatory art.
Insurer:	Covea Insurance plc
Policy Number:	ENTCL/00242
Period of Insurance:	1st April 2023 to 31st March 2024, both dates inclusive

Public Liability Insurance

Limit of Indemnity:	£5,000,000
Indemnity to Principal:	Included
Height Limit:	10 metres
Use of Heat:	Included subject to Heat Application Warranty
Territorial Limits:	Worldwide
Jurisdiction:	Worldwide

Products Liability Insurance

Limit of Indemnity:	£5,000,000
Indemnity to Principal:	Included
Territorial Limits:	Worldwide
Jurisdiction:	Worldwide

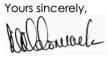
Professional Indemnity Insurance

Limit of Indemnity:	£5,000,000
Indemnity to Principal:	Included
Territorial Limits:	Worldwide
Jurisdiction:	Worldwide excluding USA & Canada

Please note that this letter does not constitute proof of membership and in some circumstances entitlement to cover may cease before the expiry date shown. Confirmation of the present position can be obtained by request by contacting the Scottish Artists Union

If you have any questions, please do not hesitate to contact the undersigned.

Yours sincerely,



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