BREATHE FREELY

Controlling exposures to prevent occupational lung disease in MANUFACTURING

Managing Health Hazards from Welding fumes

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Workplace Health Leadership Group

Northern Ireland

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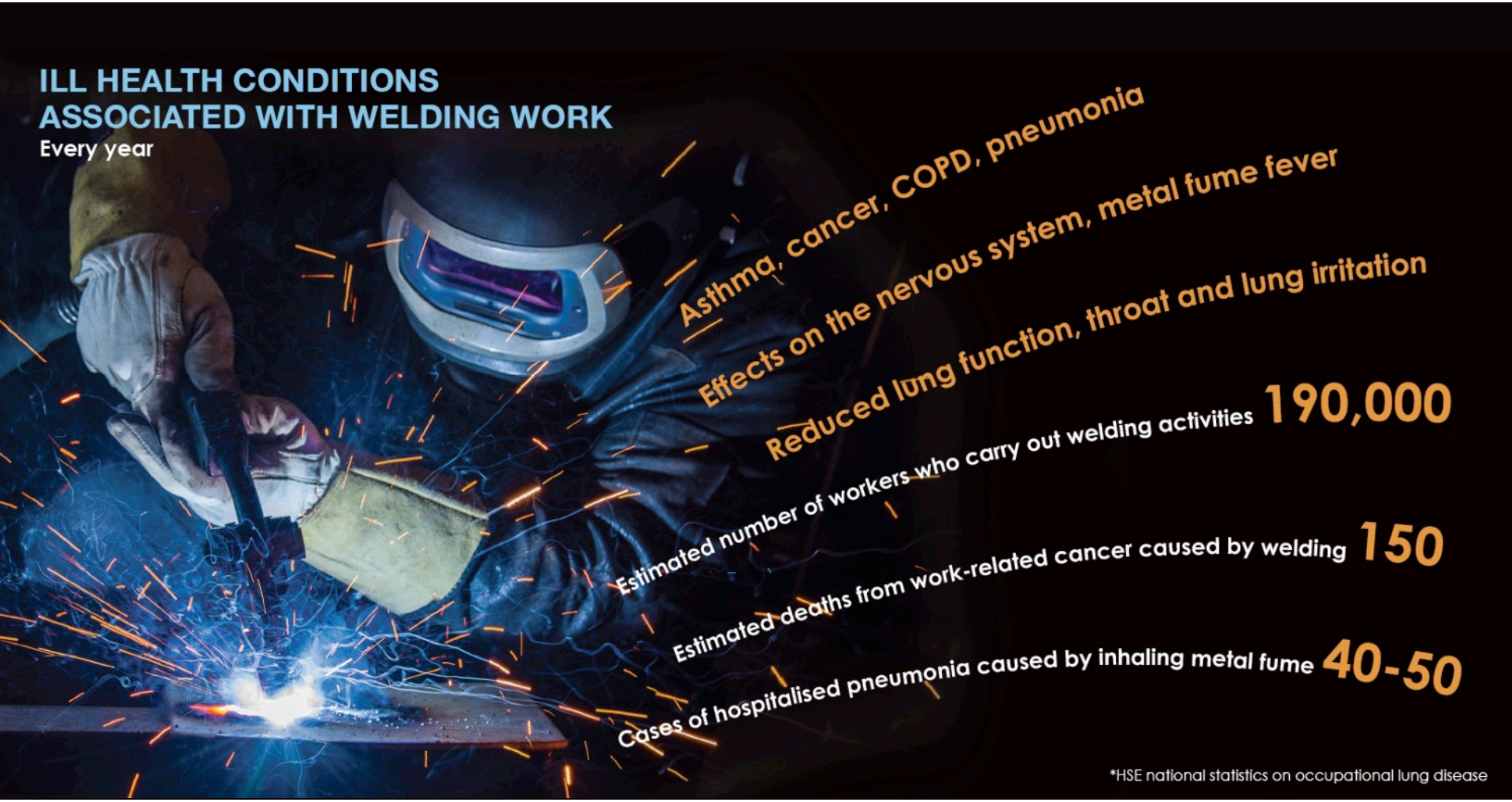

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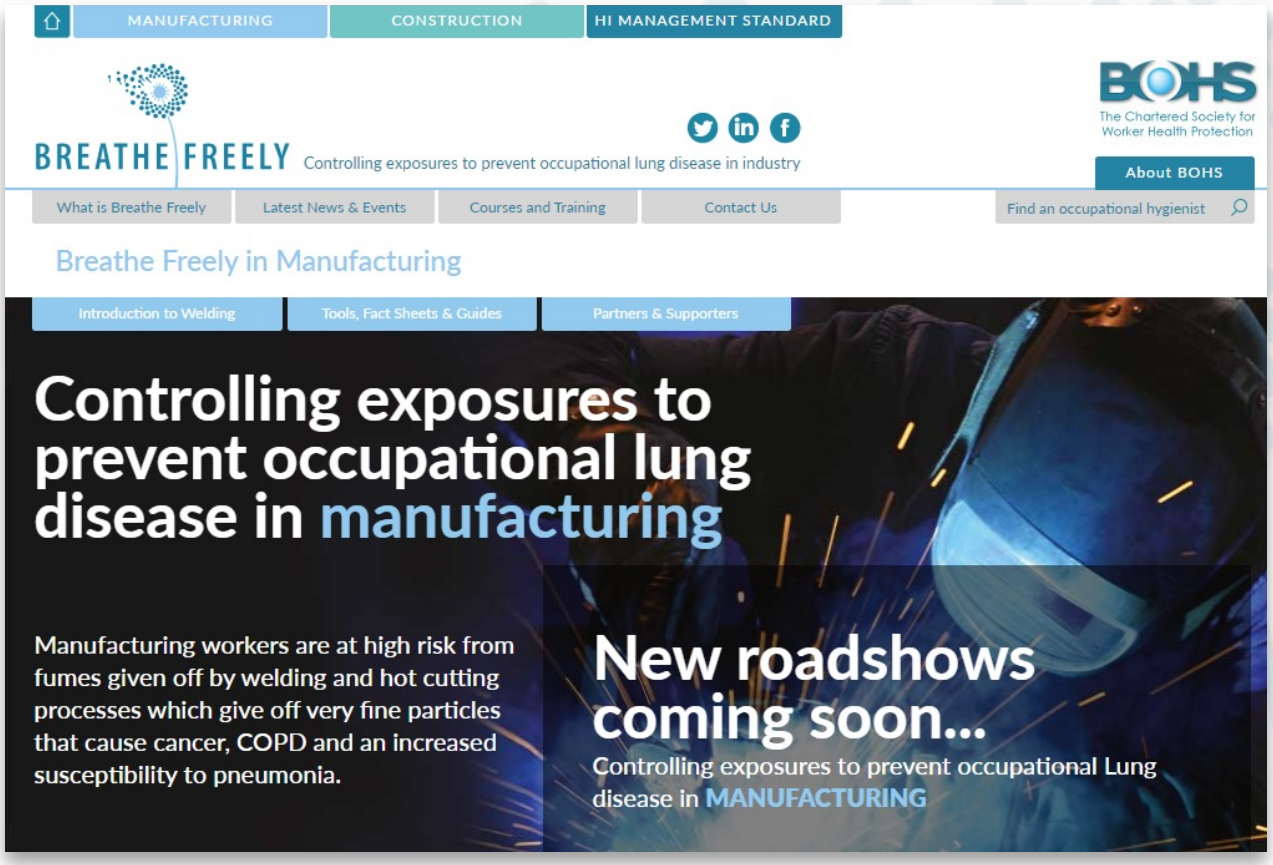

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Information hub

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An introduction to Welding

Why do workers need protecting?

Welding is one of the most common activities carried out in industry and there are a number of health hazards associated with welding in particular.

Page Includes:
Pdf and Powerpoint downloads.

more>>

Overview Brochure

A concise summary of the health hazards arising form the manufacturing industry and how the Breathe Freely campaign aims to address them

Pdf download.

Welding Guides & Factsheets

Developed by

BSiF · SRP · BOHS The Chartered Society for Worker Health Protection

Monitoring Exposure to Welding Fume

Air monitoring and measurement may be needed where there is a serious risk to health from the inhalation of welding fume and the

likely exposure level of the welders to the fume

NOW LAUNCHED Control Selector tool microsite - online tool & PDFs

Control Selector Tool

This toolkit provides information for managers to better recognise the welding hazards and manage and implement the most appropriate controls through an easy to use online tool.

Click here to visit the microsite

Launch the tool

Want to stay up-to-date with the latest

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Monitoring Exposure to Welding Fume

- **Monitoring**
  means measuring exposure to hazardous substances, to establish if control is adequate.
- **Personal air monitoring**
  measures the concentration of a chemical in the air in a person's breathing zone.
- **Biological monitoring**
  involves analysis of breath, urine or blood samples collected from an employee.

When is air monitoring needed?

Air monitoring and measurement may be needed where there is a serious risk to health from the inhalation of welding fume and the likely exposure level of the welders to the fume is not known, e.g. during the manual metal arc (MMA) welding of stainless steel. Monitoring may also be needed to help confirm that the control measures in use are working correctly, as a deterioration or failure of engineering controls could result in welders being exposed to high levels of fume.

Under the Control of Substances Hazardous to Health (COSHH) system, an initial exploratory exposure monitoring exercise may be needed to reach an accurate judgement about the risk to health. The results will then influence the assessment of how well control measures for the welding fume are working. The investigation will also need to look at other factors that can influence exposure on the day, such as the production rate setting the amount of welding work needed. These things will influence the personal results of the survey for exposure to welding fume.

It is wise to conduct air monitoring when:

- welding coated material, eg galvanised steel
- using metals which have low exposure limits, such as nickel and chromium
- fume is seen in the air coming away from the welding process
- fume is seen which isn't being captured by the existing extraction
- there are concerns about the performance of the existing control measures
- you want to gather information which will help specify further control measures.

When would you carry out biological monitoring?

Biological monitoring can also be used for investigating the extent of exposure following a report of ill health.

Biological monitoring for stainless steel welders should include the measurement of nickel and chromium in a urine sample and this should be undertaken on an annual basis where control has been shown to be good. Samples should be collected at the end of a typical working week.

Biological monitoring can also be used for exposure measurement for other metal fumes, including, for example; cadmium or lead, which should be measured if the metal has been cadmium plated or if lead paint (lead oxide primer) is present. To determine recent exposure to cadmium or lead, a blood sample will be required. The table below sets out the recommended biological monitoring analytical method for various metal types.

Table 2: Types of welding, principal metals involved and recommended biological monitoring

Metal Type	Biological Monitoring is recommended
Mild steel and low alloy steels	Chromium Nickel Manganese (can be present in metal >1%)
Stainless Steel	Chromium Nickel
Nickel alloys	Nickel
Aluminium	Aluminium
Copper	Copper

Please note that other elements will be present depending on the weld and metal types. It would be advisable to check for other possible hazardous fume components that welders may be exposed to.

Practicalities in setting up a biological monitoring programme

Employees cannot be compelled to provide biological monitoring samples without consent. Biological monitoring is a specialist activity. Urine samples are usually collected by either an occupational hygienist (www.bohs.org), or occupational health professional (doctor or nurse) (www.som.org.uk). The samples are then sent to a specialist laboratory (www.hsl.gov.uk) for analysis by post.

Image courtesy of HSL ©

References

- *HSE's COSHH Essentials for Welding, Hot Work and Allied Processes* (WL series)
- *Approved Code of Practice and Guidance: Control of Substances Hazardous to Health* (L5)
- *Monitoring Strategies for Toxic Substances* (HSG173)
- *Health & Safety in Welding and Allied Processes – Sampling of airborne particles and gases in the operators breathing zone.* Part 1: Sampling of airborne particles, BS EN ISO 10882-1. London: British Standards Institution
- *Biological Monitoring in the Workplace* (HSG167)
- *Control of Lead at Work Regulations* (L132)
- *EH40/2005: Workplace Exposure Limits* (WELs)
- *Recommendation from the Scientific Committee for Occupational Exposure Limits for Manganese and Inorganic Manganese Compounds: SCOEL/ SUM/127*

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An introduction to welding: why do workers need protecting?

Welding is one of the most common activities carried out in industry. It is estimated that there are 190,000 workers in the UK who weld, comprising of around 73,000 professional, skilled welders and many other unskilled or semi-skilled welders who carry out welding as part of their job.

There are a number of health hazards associated with welding in particular the following:

Fumes

These are very fine solid particles temporarily suspended in the air.

Gases

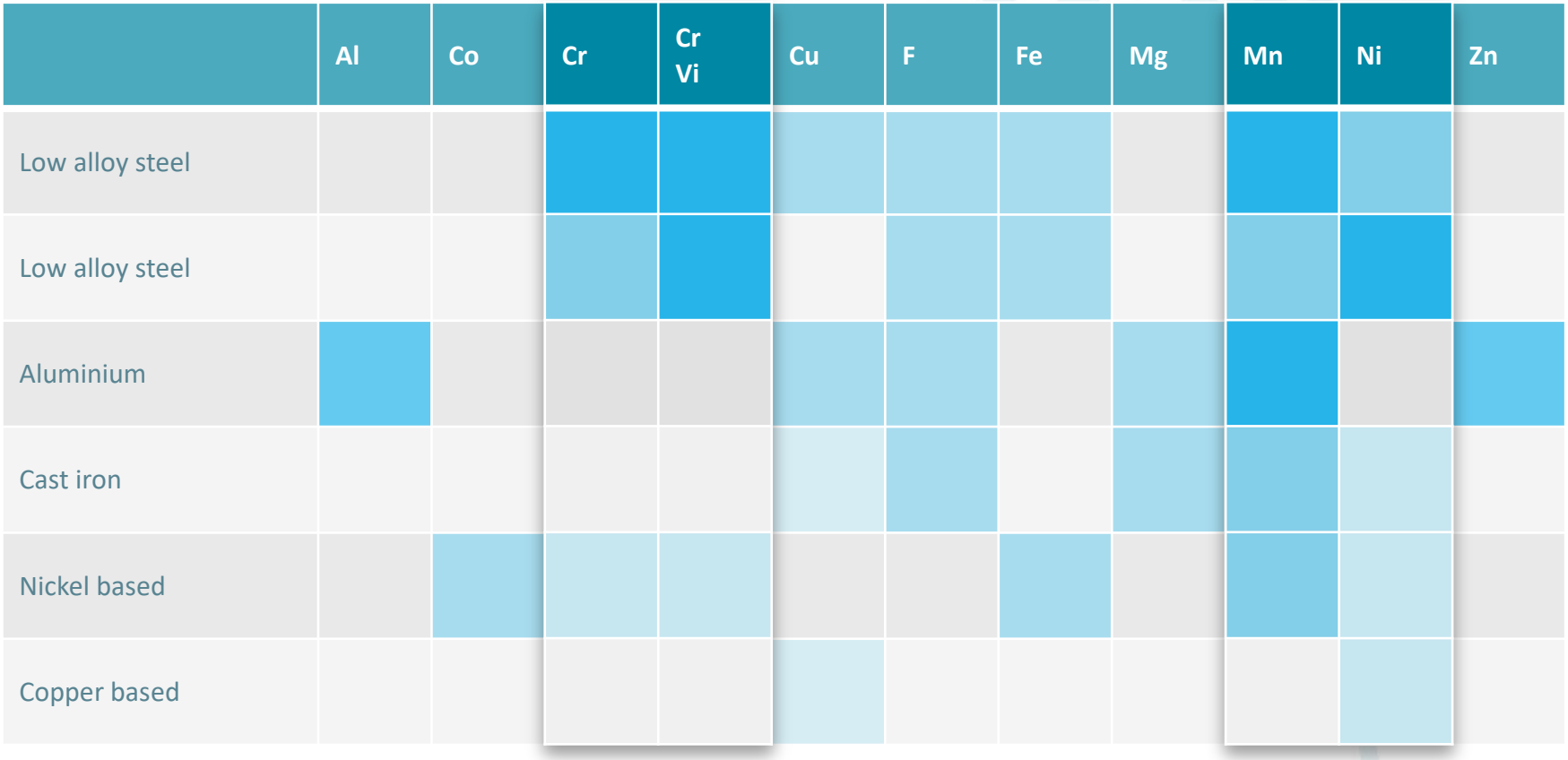
These may include ozone and, in the case of metal inert gas (MIG) and tungsten inert gas (TIG) welding, inert gases that can present a problem when working in confined spaces.

UV radiation from the welding arc

This can affect the eye ("arc eye") and skin and is also responsible for the generation of ozone from atmospheric oxygen.

	Al	Co	Cr	Cr Vi	Cu	F	Fe	Mg	Mn	Ni	Zn
Low alloy steel											
Low alloy steel											
Aluminium											
Cast iron											
Nickel based											
Copper based											

Based on ISO 15011 Health and safety in welding and allied processes



	Al	Co	Cr	Cr Vi	Cu	F	Fe	Mg	Mn	Ni	Zn
Low alloy steel											
Low alloy steel											
Aluminium											
Cast iron											
Nickel based											
Copper based											

Based on ISO 15011 Health and safety in welding and allied processes

Metal	WEL (mg/m^3)	
Chromium II and III	0.5	
Chromium VI	0.05	Carc, sen
Nickel (soluble)	0.1	Sk, Carc (nickel oxides and sulphides)
Nickel (insoluble)	0.5	
Manganese	0.20 inhalable fraction 0.05 respirable fraction	Reduced from 0.50 for all fractions in August 2018

Welding fume reclassification

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Until July 2018

- Specific substances in welding fume classified as human carcinogens
- Only generated if present in the base metal or consumables

July 2018 – International Agency for Research on Cancer (IARC)

- Reclassified all welding fume as a Category 1 ‘Known Human Carcinogen’ for lung cancer

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HSE enforcement expectations

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Consequently HSE issued a safety alert in February 2019

- Control of the cancer risk will require suitable engineering controls for all welding activities indoors e.g. Local Exhaust Ventilation (LEV) (also controls exposure to manganese in mild steel welding fume)
- Where LEV alone does not adequately control exposure, it should be supplemented by adequate and suitable respiratory protective equipment (RPE) to protect against the residual fume
- Appropriate RPE should be provided for welding outdoors (ensure welders are suitably instructed and trained)
- Regardless of duration, HSE will no longer accept any welding undertaken without any suitable exposure control measures in place, as there is no known level of safe exposure
- Risk assessments should be updated accordingly

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HSENI enforcement expectations – Feb '19

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- ✓ Control of the cancer risk will require suitable engineering controls for all welding activities indoors e.g. Local Exhaust Ventilation (LEV) (also controls exposure to manganese in mild steel welding fume)
- ✓ Where LEV alone does not adequately control exposure, it should be supplemented by adequate and suitable respiratory protective equipment (RPE) to protect against the residual fume
- Make sure all engineering controls such as LEV are correctly used, suitably maintained and are subject to thorough examination and test where required
- Make sure suitable controls are provided for all welding activities, irrelevant of duration. This includes welding outdoors
- Ensure the correct selection and use of any RPE

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Controlling Welding Fume

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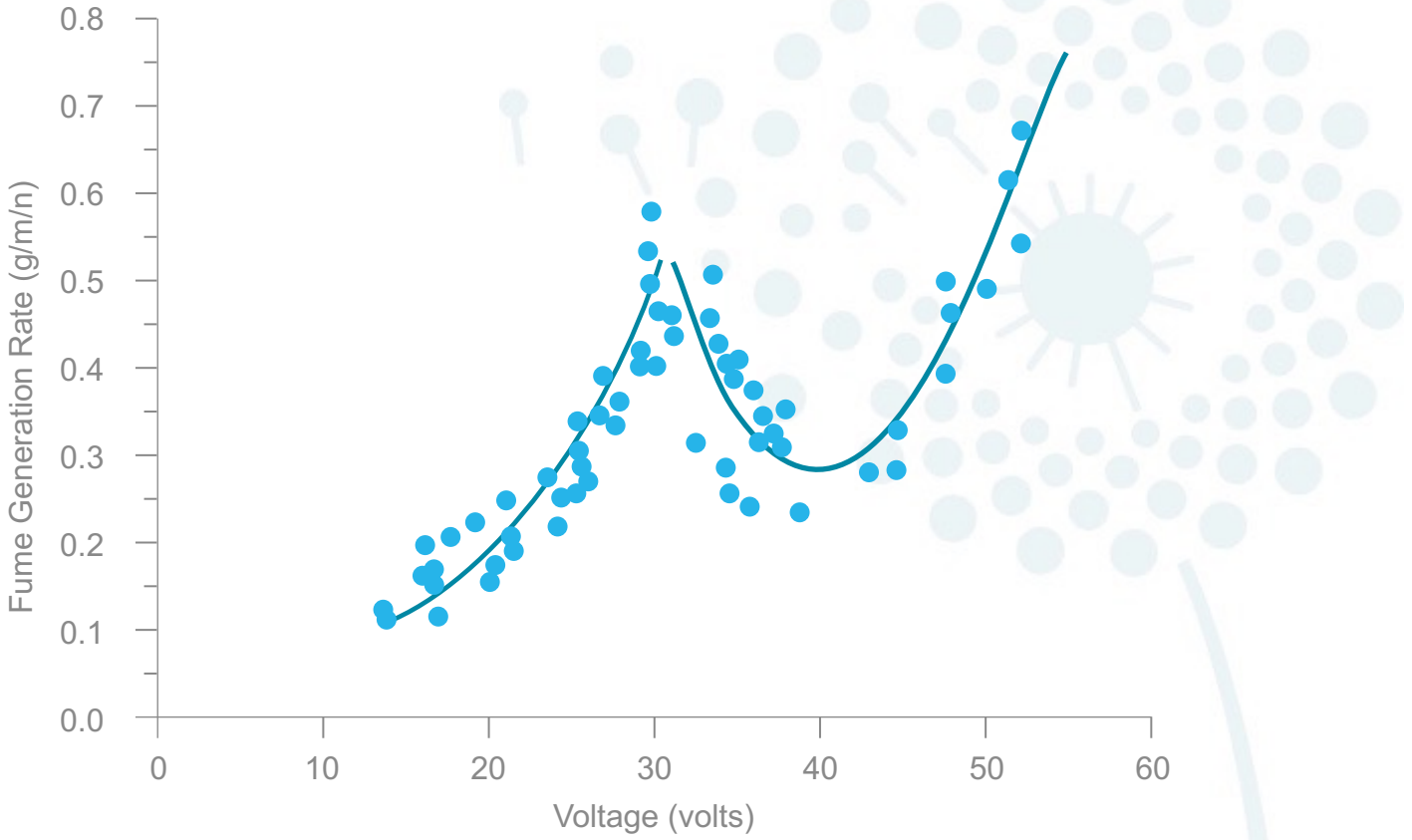

Fig. 2 – Fume generation data reported by Gray, Hewitt and Dare

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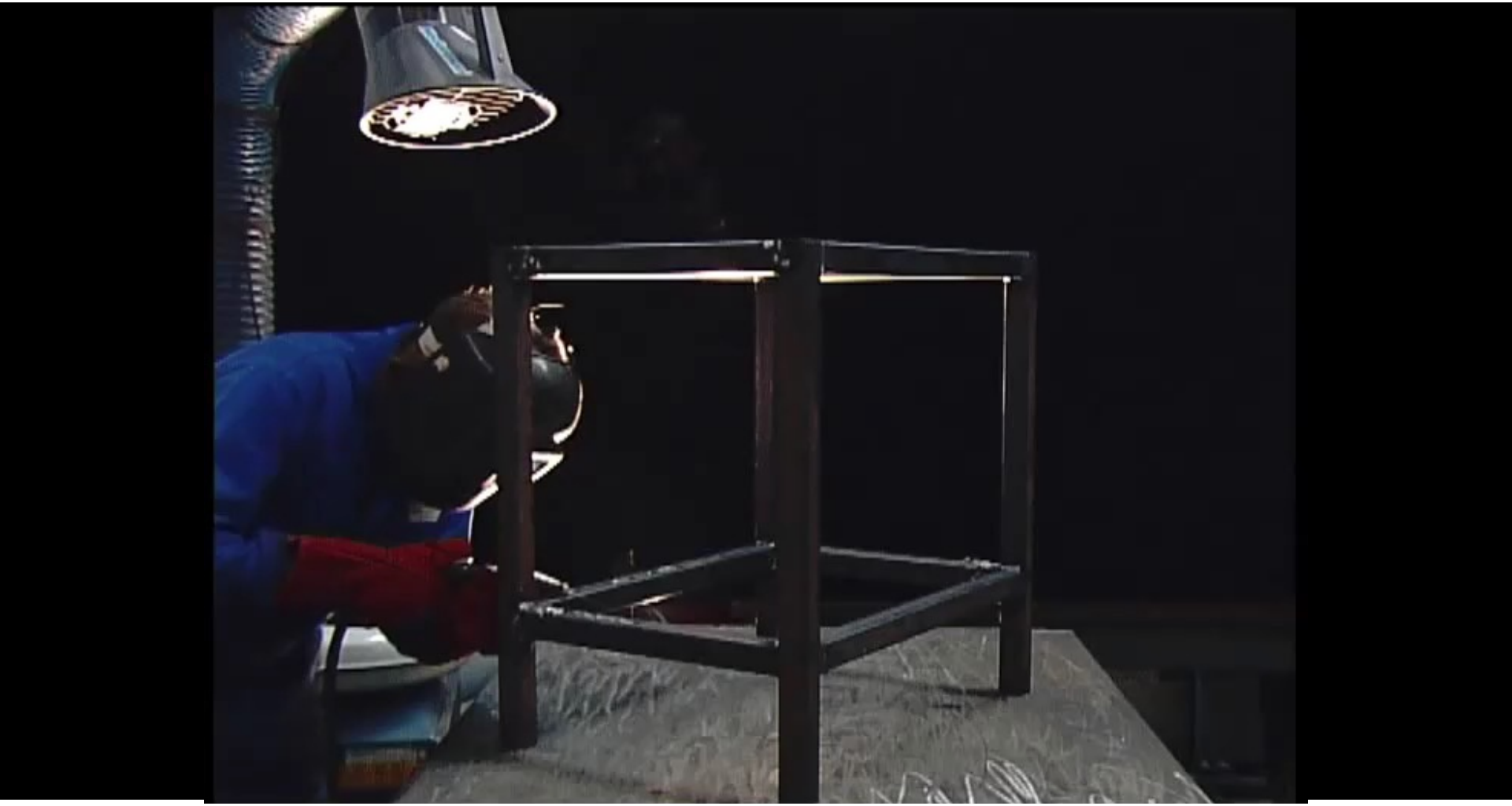

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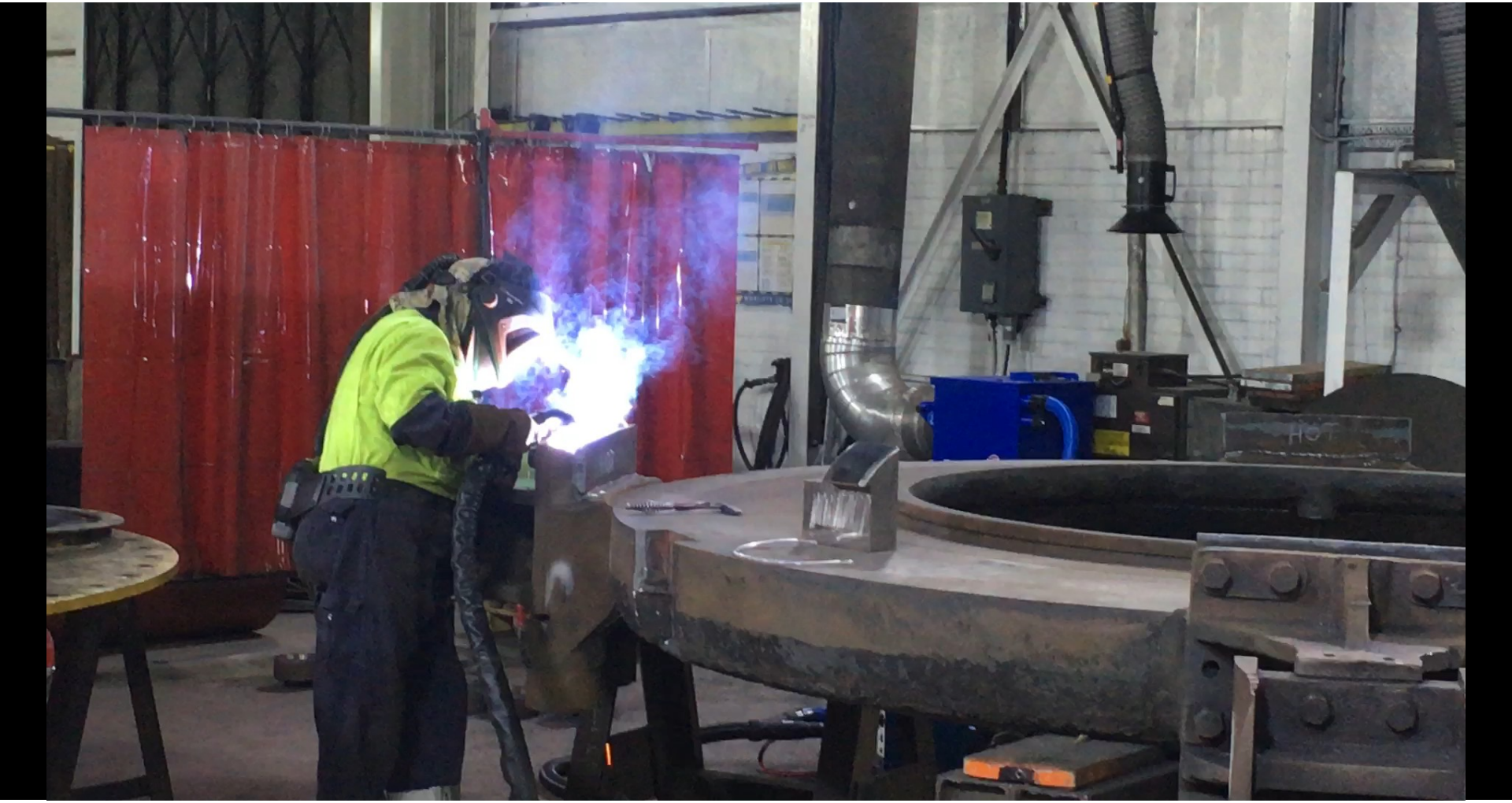

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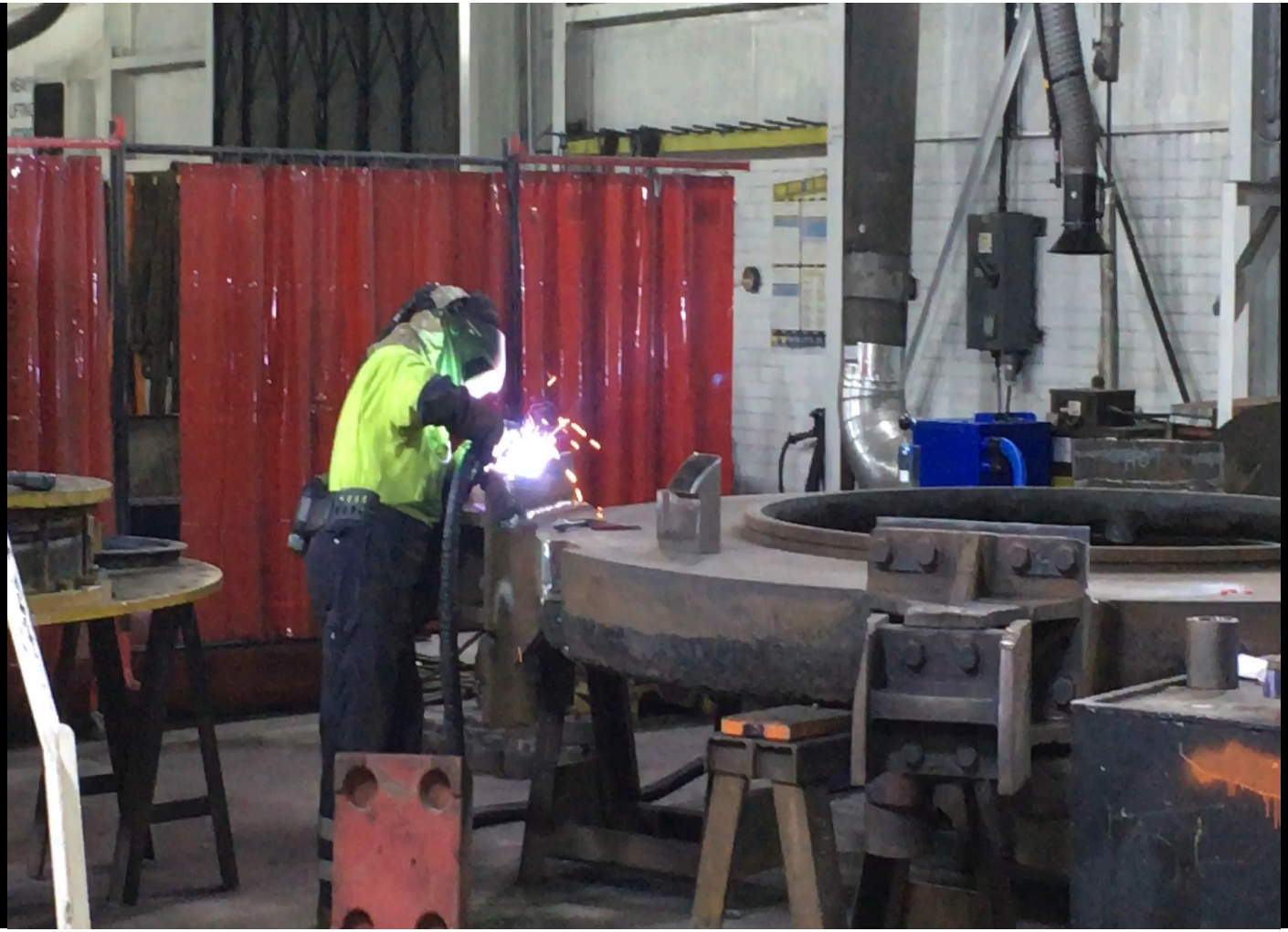

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Welding Fume Control Selector Tool

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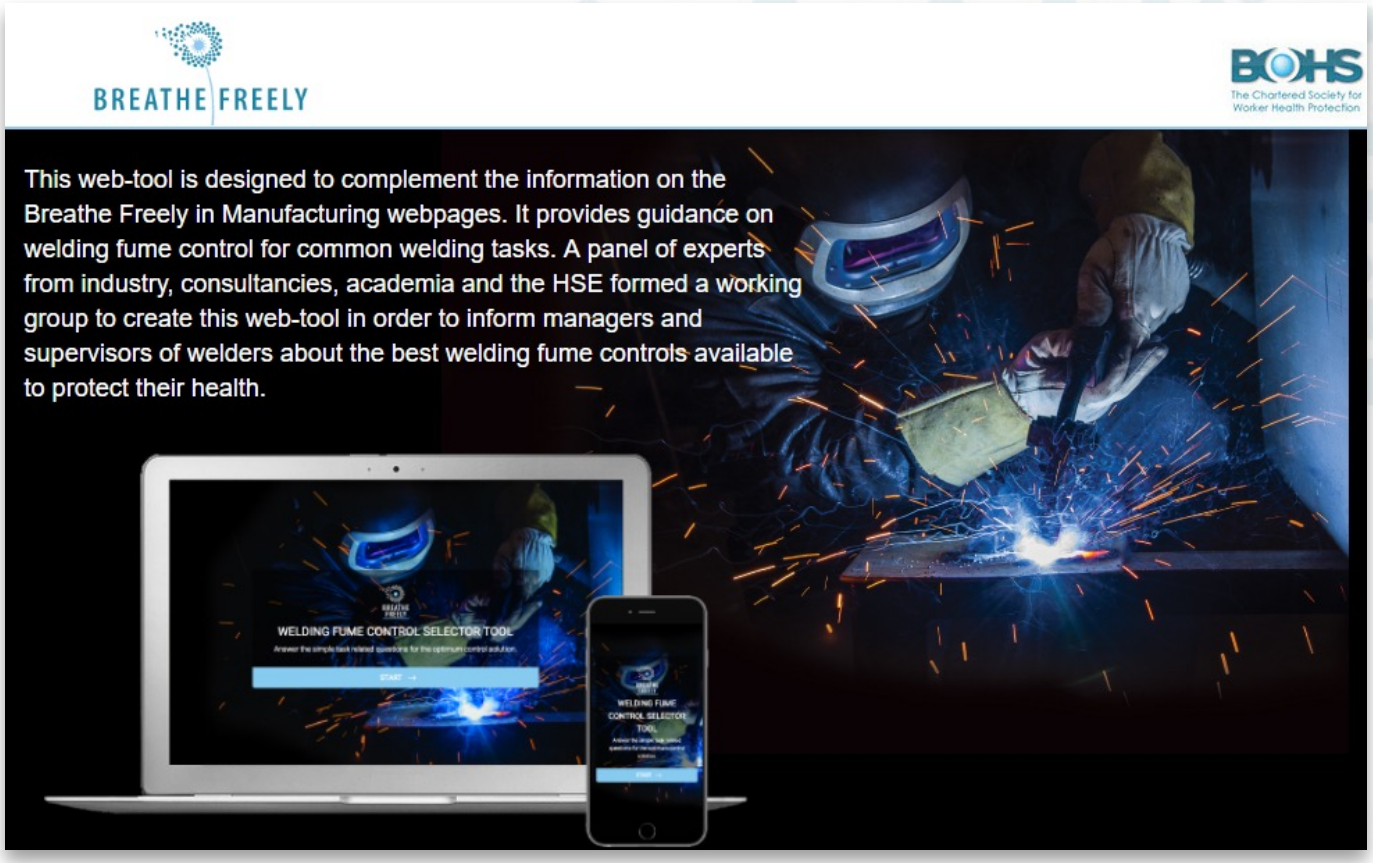

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Meet the team of volunteers

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Overall effectiveness rating

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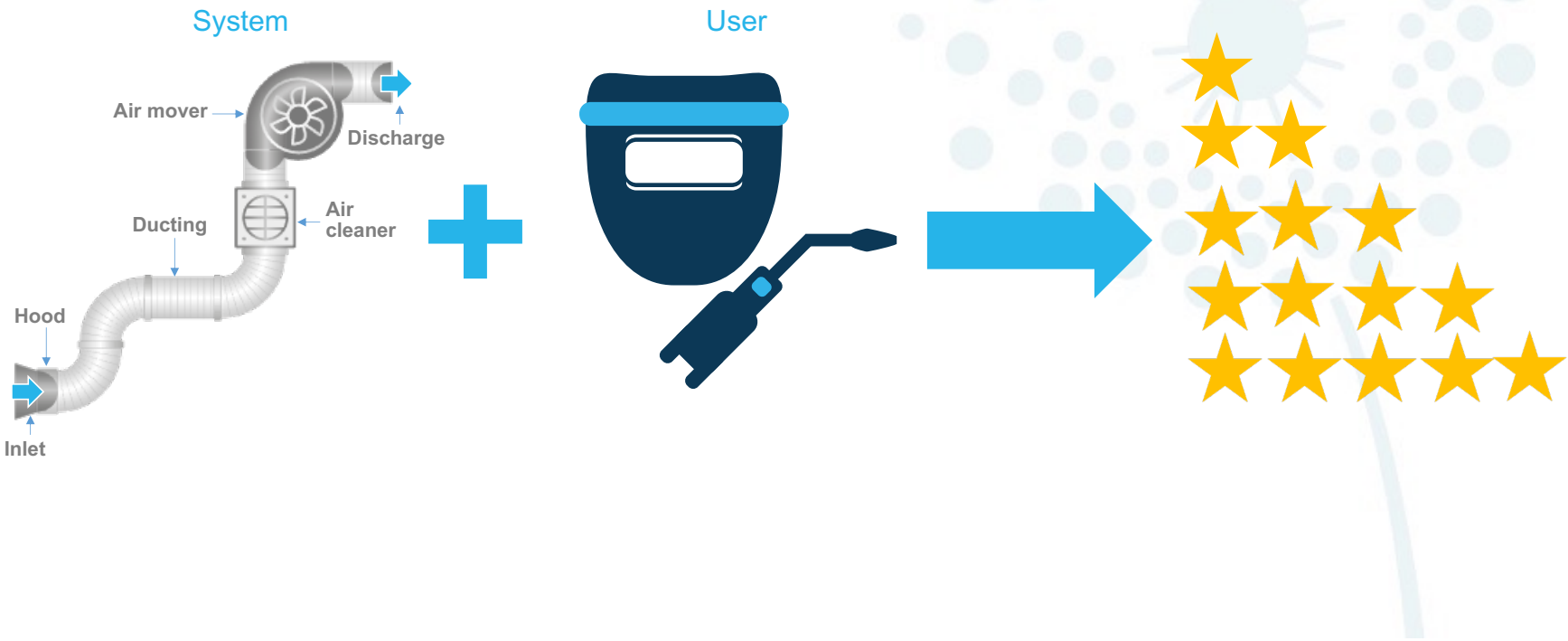

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The Selector Tool criteria

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It is an online tool to help you make the right choice of welding fume control.

It asks the following key questions:

- What type of welding or cutting is it?
- What type of metal is it?
- What size is the workpiece?
- How long will the welding take (arc time)?

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Optimum control solution

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The Selector Tool provides advice on the best available control solution for the task criteria selected by the user

It also provides links to other suitable alternative fume control solutions, as it is recognised that for one-off jobs it may not always be possible to have the optimum control solution available

With every fume control solution there are limitations to its use and its ability to adequately capture fume and these are addressed on each control sheet

Simple not simplistic

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Control sheet example

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Welding Selector Tool — Control Sheet

Fume Extraction:
Local Exhaust Ventilation (LEV)

Flexible Extraction Arm

Flexible Extraction Arm at a glance

Effectiveness rating

Appropriate workpiece size

✓ Small (up to 1.0m x 0.5m) ✓ Medium (up to 2.0m x 1.0m)

✗ Large (up to 2.0m x 4.0m) ✗ Extra large (> 2.0m x 4.0m)

Purchase price and other costs

Supply and installation	£1500 + VAT for single arm mobile unit For multi-hood systems the cost will depend on the specific design
Other costs	Thorough examination and test every 14 months – cost will depend on number of systems to be tested

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Welding Selector Tool — Control Sheet
Flexible Extraction Arm

Flexible Extraction Arm

These systems have a round or oval inlet on the end of a flexible arm which can be moved over the welding position.

The purpose of the system is to draw the welding fume into the capture hood. To achieve this, the capture hood needs to be positioned as close as possible to the source of the welding fume. The careful positioning and repositioning of the capture hood is essential to maintain the optimal effectiveness of these types of systems.

The system is particularly suitable for welding smaller or medium scaled objects, where there are not too many welding points. When the extraction hood needs to be moved frequently, effective control may not be achieved.

When positioned correctly, they can be used without compromising weld integrity or shielding gas. Ideally, the capture velocity (a measurement of the air velocity at the point where the fume is released) would be 0.5 m/s.

The extracted air should be vented outdoors. Where this is not possible, suitable filters should be fitted to units, which recirculate the filtered air back into the workplace.

An airflow indicator should be fitted so that the welder can check there is sufficient airflow through the system.

Top tips
How to use the LEV effectively

Ensure the LEV visibly captures all the fume, so it doesn't pass through the worker's breathing zone.

Also make sure the welding is within the capture zone of the hood at all times. To achieve this:

- The hood normally needs to be positioned at a distance of 1 to 2 hood diameters from the welding point.
- Place the capture hood above the welding point to ensure an upward movement of the fume.
- Never position the welder between the capture hood and the welding point.
- As the welder changes position, the hood will need to be repositioned to ensure efficient capture of fume.

Fixed arm system

Standard Wheeled Mobile LEV

Portable Fume Extraction System

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Management advice sheets

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In addition to the Control Sheets, there are management sheets available via links in the text of the control sheet which provide appropriate advice on the following topics:

- General Ventilation
- Design of LEV
- LEV Installation, Commissioning, Maintenance and Testing
- Measurement of Welding Fume Exposure
- Health Surveillance
- Information , Instruction and Training for Welders

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Where is it?

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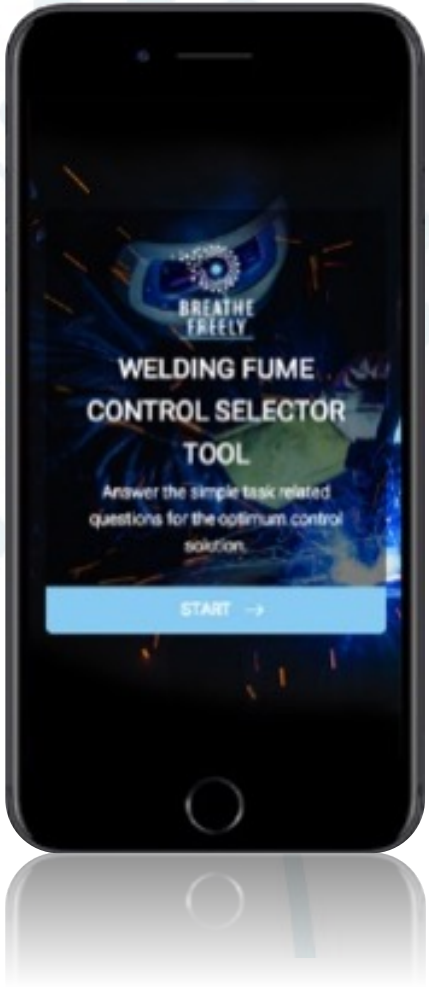
You can use your mobile phone to access the tool

No need to download

www.breathefreely.org.uk/wst/



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What next?

Re-energise campaign

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Must be sustainable for BOHS, and not rely on roadshows

- Update Welding control selector tool (wider involvement)
- Redesign web site to draw in more traffic (overall website plan)
- International involvement; Australia and New Zealand

Use multi-channel communications and marketing

Ultimately to reduce risk of Occupational Lung Disease

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What can YOU do?

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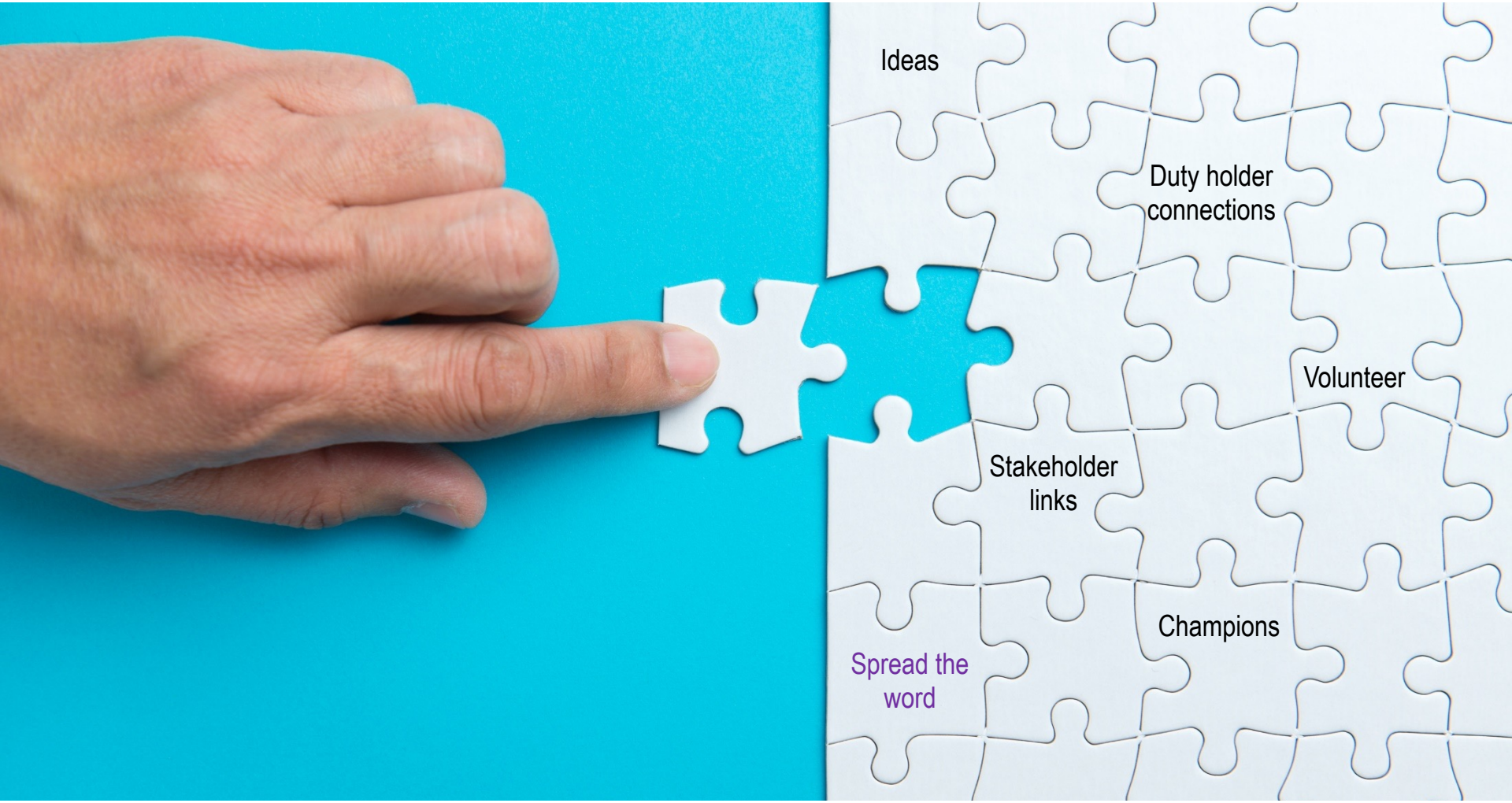

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Practical implementation – global company

CONTEXT

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c. 2,000 MIG welders

c. 100 welding robots

Estimated annual usage

- Approx. 4,000 Tonnes of welding wire (10,000 miles)

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CONTROL

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Patchwork of controls globally

- Extracted full enclosures
- Local Exhaust Ventilation (LEV)
- On-torch extraction (LEV)
- General ventilation
- RPE

Outside UK – awareness lower and hence controls less effective

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MANGANESE LIMIT – IN PRACTICE

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Manganese challenging for MIG on mild steel

- 1-2% manganese in welding rod, but 10 – 15% in the fume

Varied controls meant sometimes relied on RPE, so we did some analysis

- Of 21 personal exposure measurements (outside RPE)
- 18 (86%) exceeded new Mn WEL (previously just 10%)
- Without RPE our welders would have been over-exposed

Some of the non-welders such as supervisors were also approaching the new Mn WEL

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PROJECT OBJECTIVES

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Gained Exec level commitment to action and sponsorship

Control exposures to welding fumes/gases (Hierarchy)

- Reduce manganese in welding fume
- Consider alternate joining techniques/automation/reduced welding
- Provide effective Local Exhaust Ventilation (LEV)
- Supplement with good general ventilation
- Consistently apply RPE where needed
- Ensure effective maintenance and inspection (LEV and RPE)
- Deliver additional training for welders

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ACTIVITIES – ON-TORCH SYSTEMS

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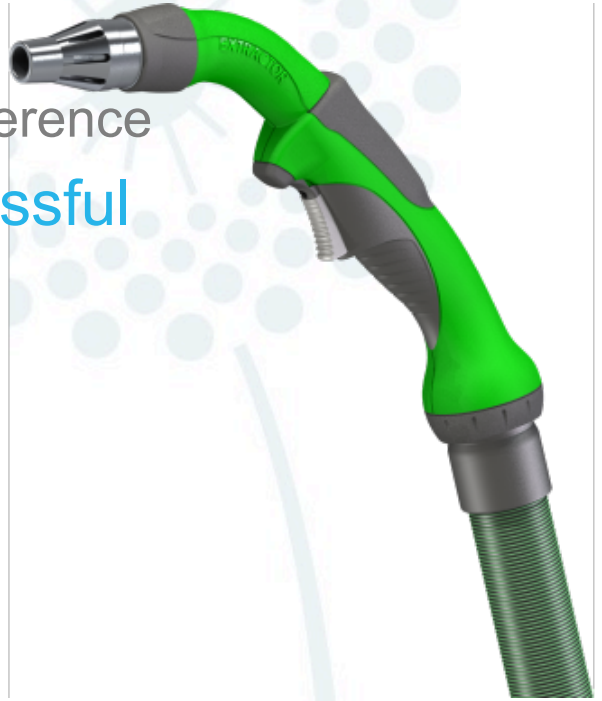
On-torch extraction trials to test new generation of weld sets

- Group Manufacturing Engineering led
- Five suppliers in trial
- Effectiveness varied, selected system ~70%
- Tested efficiency, ergonomics, weight, heat, preference

Pilot across one business (90 sets) successful

- Ironing out last wrinkles when Covid arrived



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Thank you

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Join us and be part of the solution!

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