RECOMMENDED PROTOCOLS FOR SECONDARY SCHOOL WELDER TRAINING PROGRAMS DURING COVID-19 PANDEMIC **UPDATED**

Learning Through the Covid-19 Pandemic

Teaching students in the era of Covid-19 will be a learning experience for school administrators, teachers, and the students themselves. At the beginning of the spread of the disease, many schools closed and went to online learning. The disease was originally called "2019 novel coronavirus" (1) because it was new, and when it was first announced, there was no data or knowledge about this specific disease. Scientists and doctors began to learn and are still learning how we need to live and act with a measure of safety within its boundaries. Many announcements first made were later retracted or changed as knowledge was gained. As students return to classrooms, the newest learning appears to deal with students of all levels (2).

It is hoped that this document will provide adequate guidance for secondary school and CWB Welding Foundation welder training programs, but it should not be used as formal direction from the CWB Group or CWB Welding Foundation on matters related to program safety. Schools and training organizations are encouraged to confirm relevant safety directives with their school boards and relevant government agencies.

At the time of lockdown, some trade schools completed their spring curriculum period via online learning, but that is not a satisfactory method to teach the practical lessons of welding. We need to create methods to teach, learn and work within our new constraints. Learning to weld requires teaching from trained professionals, hands-on learning, and practice. No program can be risk-free, but if the local community viral load is low, and these protocols are followed, the risk to student welder training programs should remain low (18).

Welder Training Within Canada

In looking at existing welder training program formats within Canadian secondary schools, there are schools which provide students with their own personal protective equipment (PPE) and other required equipment (welding jacket, welding helmet, welding gloves, beanie, etc.) for the curriculum period of their secondary school course. Additionally, an individual storage bin for these items is available within their classroom.

At the other end of the program scale, we have as many as 24 -25 students per class and 3 or 4 classes per quarter, for a total of 75 – 100 students per curriculum period with each student welding approximately 5 - 6 hours per week. Locker space is shared with more than one student to a locker. ***This method will not work safely in the Covid-19 environment in which we find ourselves.*** There must be a separation between students and the sanitizing of training equipment, which is passed from one curriculum period to the next. There must also be isolation of the various personal equipment between classes.

STANDARD PROTOCOLS FOR WELDER TRAINING IN CANADIAN SECONDARY SCHOOLS

Student welder training programs should be provided with appropriate room for welding booths, classroom student desk space, and applied learning; these spaces should all provide the required distances specified in social distancing standards. The number of students welding at any given time during the welder training course is determined by the number of welding booths available (only one student per welding booth). Standard welder training booths are typically isolated by walls, curtains, and welding tables, with ventilation systems removing welding fume and providing make up air. This is an isolated space and meets the Government of Canada recommendations of: (23) ***"Risk mitigation measures that are more protective involve separating people from each other or shared surfaces through physical distancing and physical barriers"***. Students are expected to maintain social distancing within shared classroom space, currently described as 2 metres of spacing.

Welding program students have their own personal protective equipment (PPE) and other required equipment (welding jacket, welding helmet, welding gloves, beanie, etc.) for the curriculum period of their secondary school course. ***An individual storage bin for these items should be available within their classroom.*** Footwear should meet jurisdictional requirements for the shop environment.

Fabric coveralls and/or fabric welding jackets certified to ISO 11611 – 2015 Class 1 (5) may replace leather jackets. For programs where leather jackets have limited availability and are shared, each student should have individual fire retardant (FR) coveralls; this will provide not only an FR clothing outer layer but also a barrier to reduce the spread of Covid-19 disease when leathers are shared. Fire retardant clothing should be washed only according to manufacturers' instructions

and be stored in the student's individual storage bin between class sessions.

If the FR coveralls, FR jackets, beanies, or other cloth items are shared from one class curriculum period to another individual in the next class curriculum period, the coveralls, fabric jackets, beanies, or other cloth items should be laundered per manufacturers' instructions. ***Welders' protective clothing should not be shared class to class within the same curriculum period, and they should not be shared until proper laundering procedures have been followed*** (16).

As noted in the hazards section of this document, ***alcohol-based hand sanitizers can not be used in the welding shop***, but handwashing locations must be provided. If sufficient permanent stations are not available, portable handwashing stations must be provided to accommodate the number of students present. These must be supplied with paper towel dispensers (21) ***and located away from welding locations to prevent wastebasket fires.***

To accommodate this protocol, class sizes must be reduced if required to accommodate the welding training shop booth allocation. Classes should be separated into multiple cohorts if necessary, and class schedules compressed or adjusted to allow training booths, welding equipment, PPE, and class sizes to match. Student welder numbers and welder training booth numbers in each class should match.

This is the recommended Standard Protocol for Canadian Welder Training for use by welder training institutions within Canada.

COVID -19 RISKS AND CONTROLS WITH WELDING EQUIPMENT AND PPE

COVID-19 is a respiratory infection, and its spread (6) is primarily (7) through the transmission of breathing droplets and aerosols. This is why all are encouraged to wear masks when in public or when social distance can not be maintained and use controls on our nose and mouth. The other peculiarity of this disease is that it can be spread by carriers who are not sick – asymptomatic spread (8). Transmission may also occur through different forms of contact (7).

Welders Helmet and or Goggles

Welding helmets cover both nose and mouth, collect, and direct breathing and therefore collect the droplets and aerosols, which cause the primary transmission of the virus (7); sharing these devices is not recommended. Welding goggles have similar problems as they, too, collect breathing droplets and aerosols. If shared or passed on at the end of the curriculum period, helmets, goggles and attached headbands will require a very stringent cleaning program that takes personnel and time. Beanie caps must be worn and available on a personal basis to minimize skin or hair contact with the headband. Beanie caps must be laundered or replaced each curriculum period if being passed to the next class.

Helmets and goggles will require a non-alcohol disinfectant that is designed to kill SARS-CoV-2 (Covid19) or a solution of hot water, detergent, and chlorine-based disinfectant process. This cleaning process must be thorough as this will be the weak link in this program – the helmet must be thoroughly cleansed. Sufficient time must be allowed for drying and for the disinfectant odour to dissipate (24) – see the section on Hazards. ***Alcohol-based sanitizers or disinfectants are not permitted for fire safety reasons*** (9). Reports of fires have been made, and the alcohol-fueled flame is almost invisible.

Chlorine Based Bleach Solutions

Diluted household bleach solutions may be used if appropriate for the surface. The USA Center for Disease Control (10) provides this guidance on the use of chlorine bleach.

- Check the label to see if your bleach is intended for disinfection and has an active ingredient of sodium hypochlorite. The concentration of sodium hypochlorite will vary typically between 3% and 6% depending on the manufacturer. Ensure the product is not past its expiration date. Some bleaches, such as those designed for safe use on coloured clothing or for whitening, may not be suitable for disinfection.
- **Mix Ratio** – Always look at the label and follow the guidelines for disinfection of surfaces. All labels may not have this detail, so consult the manufacturer (25). Mix ratio is dependent on the percentage of sodium hypochlorite and can vary greatly among manufacturers (26) (27).
- Unexpired household bleach will be effective against coronaviruses when properly diluted. **Follow the manufacturer's instructions** for application and proper ventilation. ***Never mix household bleach with ammonia or any other***

cleanser. Leave the proper ratio solution on the surface for **at least 1 minute.**

- **Note:** Bleach solutions will be effective for disinfection up to 24 hours only, it must be mixed as required.
- Bleach and other disinfectants are not suitable for consumption or injection under any circumstances. Chlorine bleach or solutions using chlorine bleach should not be used in spray bottles as they are dangerous to eyes, and the aerosols created may be inhaled.

Caution should be used with store-bought sprays, as many contain alcohol. Sprays will not adequately penetrate the crevices and overlaps in welding helmets and goggles. The whole helmet and or goggles must be submerged in the chlorine bleach solution and scrubbed, including the headbands. Solution holding time will be according to product manufacturers' recommendations or as above.

Masks – Covid-19 and Welding Style

Most schools and training centres are now requiring that all students and staff wear a disposable three-ply surgical style mask inside buildings. These masks are not rated for use in welding facilities as breathing protection. These masks will also not minimize the potential virus spread through shared PPE such as welding helmets or face shields. In testing, breathing droplets were found to travel through a mask between about 2.5 inches (6.35 centimeters) and approximately 8 inches (20 cm) from the face (29). Routine cleaning and disinfection protocols of any shared items will not be reduced by the use of these disposable masks.

If disposable masks are worn under welding helmets, they should be of the N95 respirator variety; KN95 are recommended as they are suitable and will not deprive medical workers who require the certified respirator masks. The KN95 respirator masks are a copy of the N95 but are not certified. The KN95's have been reported by welder training shops as providing good results. **These must not have the exhaust valve** (31, 33) as this prevents the mask functioning as a breath containment device which is the intent of a Covid-19 mask. The N95 style of disposable mask has been used by the welding industry for welding cutting and grinding for many years. N95 and KN95 masks are designed as disposable, although cleaning procedures have been developed to reduce consumption in the medical field.

P100 certified half masks are the correct mask for welding use, as these are a particulate filter designed to protect against welding fume inhalation. These also must not have the exhaust (exhale) valve as this prevents the mask functioning as a breath containment device which is the intent of a Covid-19 mask. P100 half masks are designed to be worn under the welding helmet. These do become a personal device for use by one individual only, but they are reusable and do last a long time – in regular use 3M recommends their filter to last 30 days (32). **The P100 without the exhaust valve is the correct mask for the welder to use during the time of Covid-19.**

When disposable face masks are required to be worn in the general welding shop facility to help slow the spread of Covid-19 (35), consideration should be given to also requiring a full-face shield. For example, some facilities require the use of a #5 shade full-face shield for oxy-fuel torch activities (e.g., cutting, welding, or brazing) in-place of the traditional welding goggles. This arrangement provides protection to the eyes and face from infra-red light and protection to the face mask from any sparks or accidental flame contact. A clear full face-shield is often required for other related activities such as grinding so the use of a personal head gear with a #5 tinted shield and an exchangeable clear window is an option.

Note: face-shields and welding helmets are not suitable eye-protection alone and safety glasses conforming to CSA Z94.3 with side-shields must also be worn under this protection.

All disposable masks can cause condensation build-up on safety glasses and goggles due to the direction they force exhalation flow. This can create discomfort and can be a hazard to the welder trainee who is struggling with learning in a new environment. The N95/KN95 are reported to reduce this hazard when they have an adjustable metal nosepiece, although this fit varies from manufacturer to manufacturer and is dependant on each user's facial shape. Fogging may continue to be a problem with any mask which directs breathing exhaust air upwards.

Some welding instructors have raised concerns about the flammability of wearing any of the disposable (or reusable/washable) styles of masks (e.g., three-ply surgical, KN95, or cotton). While all these materials will burn if a flame is directed onto the material, none of them appear to erupt in flames from a minor contact with a hot spark. Tests conducted on samples of a surgical mask, a KN95, and a 100% cotton

Fig. 1: Grinding test on a 3-ply surgical mask (left), a 100% cotton welder's beanie, and a KN95 mask (right). This test was conducted for approximately 2 minutes and no combustion was observed.

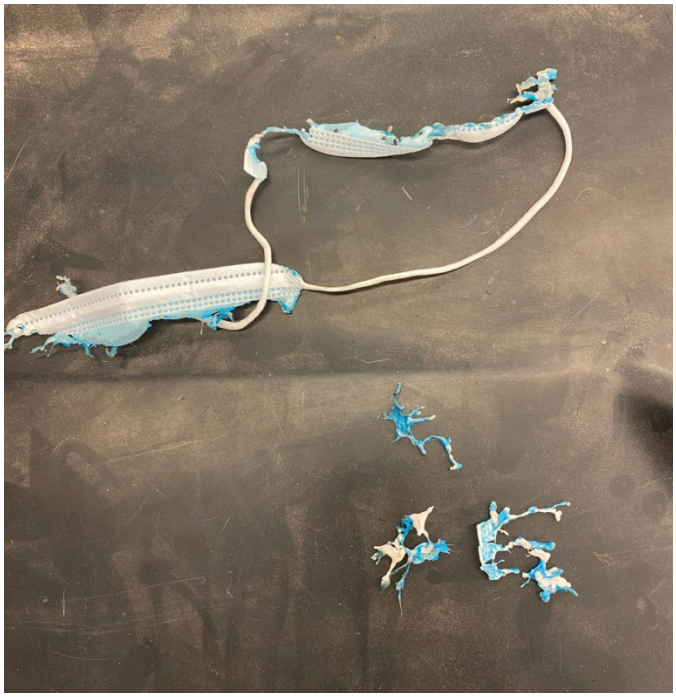

Fig. 3: The photo is of a disposable unrated medical style mask, intentionally ignited. They burn with a flame and drip flames. The mask material burns similar to an acrylic. Caution should be used around an open flame.

Fig. 2: Results from a flame test on a 3-ply surgical mask (left), a 100% cotton welder's beanie, and a KN95 mask (right). The air-propane flame envelope made light contact with each sample.

Welder's beanies woven from 100% cotton have been used by welders for head protection since the beginning of the industry. Welders and fabricators have worn N95/KN95 style (woven polypropylene) masks routinely for many years. However, since these disposable items are being newly introduced into the welding training facilities, care needs to be used with removed or discarded masks around welding facilities. All waste, including disinfectant wipes, disposable masks, and gloves, should be disposed of in a covered waste receptacle to prevent fires and to minimize the spread of any potential virus infections.

welder's 'beanie' demonstrate that all of them can withstand a sustained directed stream from an angle-grinder on steel at approximately 300mm (12 inches) without causing combustion. Similar tests using a directed air-propane flame at the same distance for over one-minute produce no visible effects.

When the materials from the masks listed above are touched by the envelope of an air-propane flame the woven polypropylene masks (surgical and KN95 style) do melt. The 100% cotton welder's 'beanie' however erupted into flame and continued to burn until the fabric was consumed in a quick test. (See Figures 1 & 2.) These results are supported by other investigations (29).

Welders Gloves

Welders gloves can be exchanged, the human skin is an effective barrier against the viral infection. The virus is not absorbed through your hands. Therefore, you do not need another layer of protection on your hands. Extra effort must be made to avoid contact with the face in all operations (12). Thoroughly washing of hands should occur before touching the face, combing hair, etc.

Beanies & Head Coverings

Each student must have their own "beanie" head covering and other restraints as required to control hair and keep hair off the face. This reduces the tendency to touch the face. Like other fabric equipment, this should not be shared or passed on to the next curriculum period class until it is properly laundered.

Leather Welding Jackets and Fire-Retardant Clothing

Most leather welding jackets are made of genuine split cowhide leather and provide outstanding heat resistance. There are no studies specifically on how long SARS-CoV-2 (Covid-19) lives on leather, but some experts think that due to the porous nature of leather and the toxins that leather contains residual to the tanning process, it would not be a suitable virus carrier. ***It needs to be stressed that there are no studies as yet one way or the other, so caution needs to be used.*** Covid-19 guidance from the City of Toronto states that clothing items which have been tried on should be quarantined in a sanitized bin or space for at least 24 hours before returning them to the rack (28).

If it is decided to clean leather equipment, it must only be cleaned following manufacturers' guidelines as it will be destroyed or rapidly deteriorate if mishandled.

As with all shared equipment, extra effort must be made to avoid contact with the face, and the student must be able to wash their hands thoroughly as required and after removing the equipment, whether shared or not (12).

If leather welding chaps are used, apply the same guidelines to chaps and their usage as provided for leather welding jackets.

Laundering of Clothing (16)

Note: Welders' clothing, worn only in the welding environment, should be stored in the student's individual storage bin until the next use. It should not be removed from the classroom. All fabric welders' clothing must be assigned to one individual per curriculum period, then laundered. Clothing must not be exchanged class to class, nor personal items loaned from one student to another.

For clothing, towels, linens, and other items:

- Launder items according to the manufacturer's instructions. Use the warmest appropriate water setting and dry items completely.
- **Wear disposable gloves** when handling dirty laundry from a person who is sick.
- Dirty laundry from a person who is sick can be washed with other people's items.
- **Do not shake** dirty laundry.
- Clean and disinfect clothes hampers according to the guidance above for surfaces.
- Remove gloves, and wash hands right away.

HAZARDS

Alcohol Disinfectants and Hand Sanitizers

DO NOT USE in the welding shop environments or where welding is performed.

It can not be stressed enough that alcohol-based hand sanitizers and disinfectants have no place in the welding shop environment. Isopropyl alcohol is highly flammable and can easily ignite. Vapours may form explosive mixtures with air, travelling to a source of ignition and flashback. It is not the liquid burning – it is the vapours that catch fire. It has been reported to have ignited by static charge, and it burns with a flame that is almost invisible in daylight (11). ***Alcohol-fueled fire on skin or clothing can burn undetected*** until the alcohol is consumed and burning of skin or clothing occurs.

Handwashing locations must be provided. If sufficient permanent stations are not available, portable handwashing stations must be provided to accommodate the number of students present. These must be supplied with paper towel dispensers (21) and located away from welding locations to prevent wastebasket fires.

Chlorine Bleach and Other Disinfectants

Do not use chlorine bleach without mixing to specified concentrations (10); serious injuries have occurred. Personnel need to be trained, and systems regularly audited to ensure correct use. It is imperative that proper procedures are used for the mixing and use of chlorine bleach and other disinfectants. Commonly used Lysol products are not suitable for spray disinfectants on anything but hard surfaces. A recent post by Arc Wear regarding the use of Lysol products (15)

"After our testing to check on the flammability of this product it has come to our attention from NSA's Will Vereen who called the Lysol company, that this is not a recommended use of their spray and the method we used on the bottle is not certified by the EPA to be effective on Corona-virus. ***They are ONLY certified for use on these viruses on hard surfaces, AND it requires sufficient spray to be wet for 10 minutes on those surfaces.*** Additionally, they also do not recommend using the spray, even dry on something next to the face. This is perhaps because the residue contains benzalkonium chloride." Only use disinfectants that are approved to kill SARS-CoV-2 (Covid-19) and in the way directed by the manufacturer or a procedure approved by a reputable organization (10).

The cleaning personnel must use appropriate personal protection to not damage their lungs, skin, and health (24). Rooms need to be ventilated after cleaning with chlorine-containing agents. During audits (22) on industrial and other cleaning products, the most commonly found issue is incorrect use.

Electric Welding Equipment

Do not use any disinfectants, either wipes or sprays, on any electrical equipment as it can seriously damage it. That includes all of the apparatus associated with any form of electrical arc, plasma, or resistance welding equipment. In quoting from the recently published (13) NEMA GD 4-2020 11 COVID 19 Cleaning and Disinfecting Guidance for Electrical Equipment: ***"In some instances, the only approved method for cleaning various types of electrical equipment may be to use a lint-free, dry, clean cloth, which provides mechanical cleaning but not disinfection."*** Other guidance is provided in this document put together, especially for Covid-19 guidance by the National Electrical Manufacturers Association.

Ultra-Violet Light Disinfectant Systems

Ultra-light type C disinfectant systems are being used in some industries with success. In the welding industry, they are problematic as they will not work on clothing, will cause deterioration of plastics and leathers; it is not known whether they would penetrate the multi-layers and crevices in welding helmets and similar apparatus. Also, when used on chrome tanned leather, which includes most if not all welding leathers, (14) Hexavalent Chromium, a carcinogen is produced. **Do not use these systems in welding training facilities.**

DISCUSSIONS AND RECOMMENDATIONS

School boards should operate their student welder training programs within this Standard Protocol. To do that, schools may need to make modifications to the overall school curriculum to compress learning and reduce personnel changes. Sharing personal protective equipment 3 or 4 times a day will not work as proper cleaning will be impossible and likely to fail to occur! ***Welding helmets and goggles are the most likely point of virus transfer*** (19) – these must be thoroughly disinfected by trained personnel and allowed adequate time to dry.

The Canadian government has an online document: (3) Risk mitigation tool for child and youth settings operating during the COVID-19 pandemic, which provides some guidance for assessing the risk in delivering school-based instruction and should be consulted.

COVID-19 guidance for schools Kindergarten to Grade 12 (4) is a related document which school administrators should also be familiar with.

Humans, by instinct, are social beings, and this virus creates a need for us to do just the opposite – to leave space between us – this is difficult for all but especially tough on our youth. We ask our welder training students to use special consideration and to understand that not only are their own lives at risk but also, siblings, parents, grandparents, and others they associate with. If the students only outing was to the school classroom, Covid-19 spread would be easier to control within the student body.

Shop Ventilation – Fume Removal

Shop ventilation systems (20) must be qualified to reduce welding fume elements to the levels required for the workplace, as identified by the authority having jurisdiction. If welder trainees wear a respirator, then additional jurisdictional requirements must be met in fitting and cleaning of respirators.

The shop ventilation system that is utilized to remove welding fume adequately could have a side benefit as there is information available which describes ventilation systems (17) role in reducing SARSCoV-2 (Covid-19) spread (34).

Social Distancing, Avoiding Facial Contact and Viral Spread

SARS-CoV-2 (Covid-19) is transmitted mainly, person to person and is highly contagious through droplet and aerosol transfer from breathing. **Social distancing (maintaining at least 2 metres),** the wearing of masks, sneezing into your arm, and repetitive washing of our hands is the best prevention.

Handwashing locations must be provided. If sufficient permanent stations are not available, portable handwashing stations must be provided to accommodate the number of students present. *These must be supplied with paper towel dispensers (21) and located away from welding locations to prevent wastebasket fires.*

Wearing of masks can never be an excuse for less social distance, less hand washing, or not staying at home when one feels sick. All measures that minimize the source of the hazard are preferred over personal protection. For example, breathing is a relatively small hazard, but talking is a bigger hazard, screaming even bigger, and sneezing/coughing the biggest.

The most common reason for touching one's face is to move your hair; welding students need to use hairbands, hairstyles and whatever restraint is necessary to keep hair up and out of the way, both to prevent to remain safe.

This level of prevention must continue within our shop environments if we are to successfully educate this generation of welders throughout this pandemic. W

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Acknowledgements

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CHANGES/UPDATES EFFECTIVE 06/10/2020

Coveralls changed to: For programs where leather jackets have limited availability and are shared, each student should have individual fire retardant (FR) (5) coveralls
Masks – Covid-19 and Welding Style - complete section added
Chlorine Based Bleach Solutions – section heading added and references on how to determine mix ratios added
Welders gloves - requirement for disposable liners removed - reference link updated

References added and updated

(12) COVID-19: Use of Disposable Gloves in Non-Health Care Workplaces
(23) Risk mitigation measures that are more protective involve separating people from each other or shared surfaces through physical distancing and physical barriers.
(24) CDC Facts about Chlorine
(29) Flammability of Respirators and other Head and Facial Personal Protective Equipment
(30) Visualization shows exactly how face masks stop COVID-19 transmission
(31) Can a Respirator with an Exhaust Valve be Used as a Source Control?
(33) Non-medical masks and face coverings: About Limitations
(34) CDC Scientific Brief: SARS-CoV-2 and Potential Airborne Transmission
(35) Interested in the effectiveness of plain old masks, hit the CDC link, this is a history lesson from 2 hairdressers who had Covid-19 while they worked, they wore masks as did their 139 clients - no trans mission. https://www.cdc.gov/mmwr/volumes/69/wr/mm6928e2.htm-?s_ci-d=mm6928e2_w

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