CONESTOGA
Connect Life and Learning

Electrical Hazard Reduction & other updates to CSA W117.2

CWB Association - Educators Conference

May 30, 2019

Jim Galloway, Conestoga College

Jim Galloway, B.A.Sc.. C.E.T., R.S.E.

- Professor - Conestoga College (Welding Eng. Tech. Programs)
- Welding Program Coordinator
- Metallurgical/Welding – Certified Engineering Technologist
- Inter-Provincial Red Seal (Welder – 456a)
- Member of CSA C232 (CSC26), CSA W117.2, & CSA W48

Previous Industrial Experience:

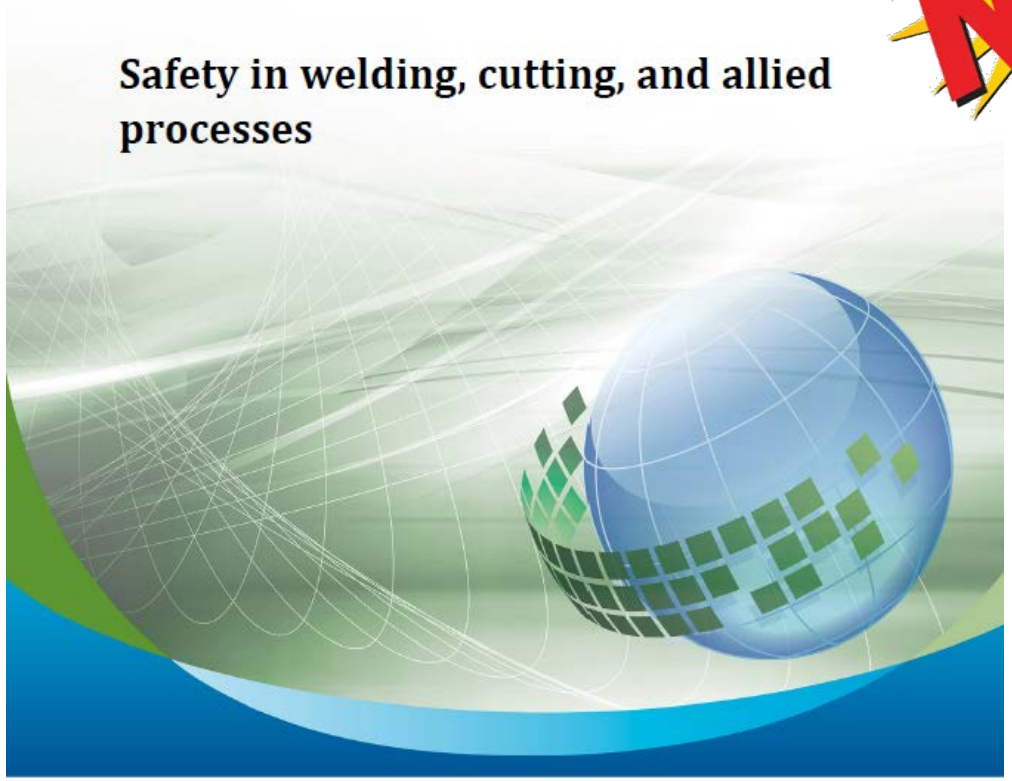
- Ontario Hydro (Bruce Nuclear Construction / Welding R&D Group)
- Director of Welding Technology – National Steel Car
- Manufacturing Manager – Husky Injection Molding Systems

CONESTOGA
Connect Life and Learning

CSA W117.2:19

CSA Group

CSA W117.2:19
National Standard of Canada



Standards Council of Canada
Conseil canadien des normes

CONESTOGA
Connect Life and Learning

About CSA W117.2:19 (…7th Edition)

- The subject is the health & safety of welders and welding operators;
- This is Canada's comprehensive welding safety standard;
- The first edition was published in 1974;
- There are committee members from coast to coast;
- Members include:
  - *welder journey-persons,*
  - *equipment and consumable suppliers,*
  - *fabricators and end-users,*
  - *provincial regulatory authorities,*
  - *and academic experts.*

CSA Group

Standards Council of Canada
Conseil canadien des normes

CONESTOGA
Connect Life and Learning

What's New?

- For one, this protective footwear is no longer acceptable.

(Image Source: Indestructibles – "Steel Toe Bunny Slippers")

CONESTOGA
Connect Life and Learning

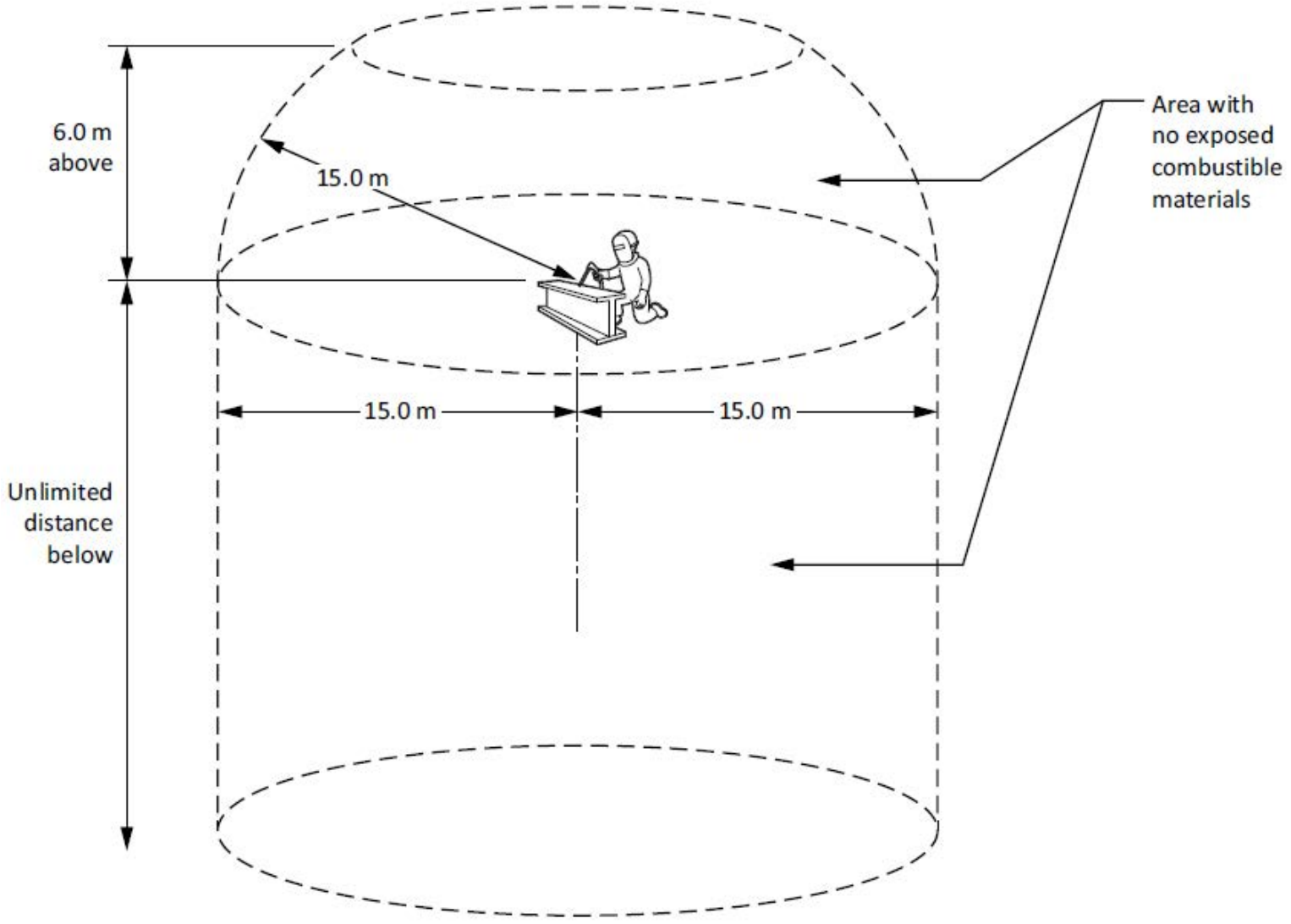
Highlights of Some Key Changes

- Fire safety precautions (*Fire Watch, Site Prep, & Fire Protection*);
- Respiratory protection section updated;
- Clothing requirements (*ref. to ISO 11611:2015*);
- Protective footwear section added;
- Robotic welding section removed (*now references CAN/CSA-Z434*);
- Several new/revised non-compulsory annexes.

CONESTOGA
Connect Life and Learning

Fire Safety Precautions

- Sparks generated by some hot work processes can fly, roll, bounce, or otherwise travel great distances (e.g., beyond 15 m (50 ft.)).
- Smouldering fires can go unnoticed for many hours before progressing to a full combustion stage



(From CSA W117.2:19)

CONESTOGA
Connect Life and Learning

Respiratory Protection Recommendations

- Powered Air Purifying Respirators;
- Fume extraction guns.

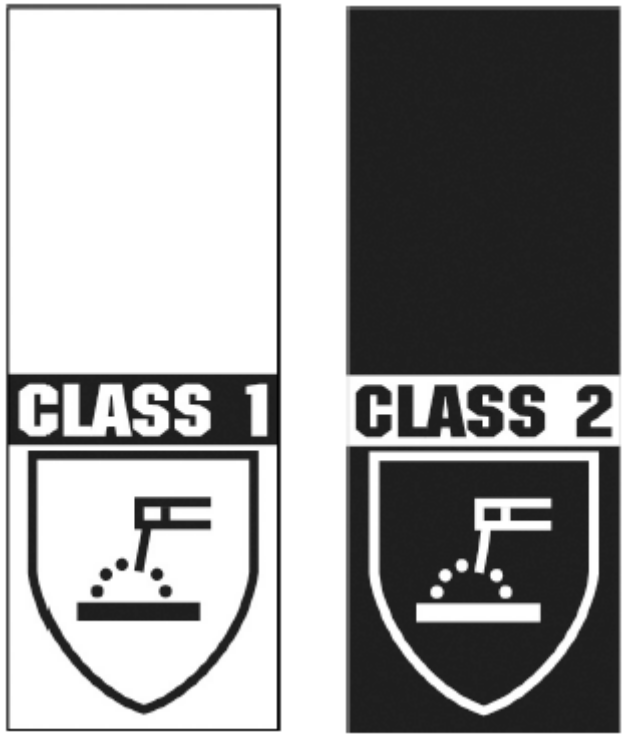
(Image Source: 3M-Speedglass)

(Image Source: RoboVent)

CONESTOGA
Connect Life and Learning

Protective Clothing Recommendations

- Fabric for protective clothing PPE should be listed as either Class 1 for light-duty welding or Class 2 for heavier-duty welding;
- The performance of the fabric should be tested in accordance with ISO 11611;
- A guideline for selection of clothing for each class can be found in the standard.



(From ISO 11611)

CONESTOGA
Connect Life and Learning

Protective Footwear

- CSA Z195:14 (Protective Footwear) with dielectric;
- Minimum 150mm (6”) high & non-flammable shell;
- Trousers to be worn over the boot.

CONESTOGA
Connect Life and Learning

Electrical Hazards – Arc Welding

- Secondary Voltage Hazards
  - ≤ 80V rms
- Primary Voltage Hazards
  - 115-600 VAC mains
  - Auxiliary Output (115-230 VAC)
  - Stray Welding Current Damage

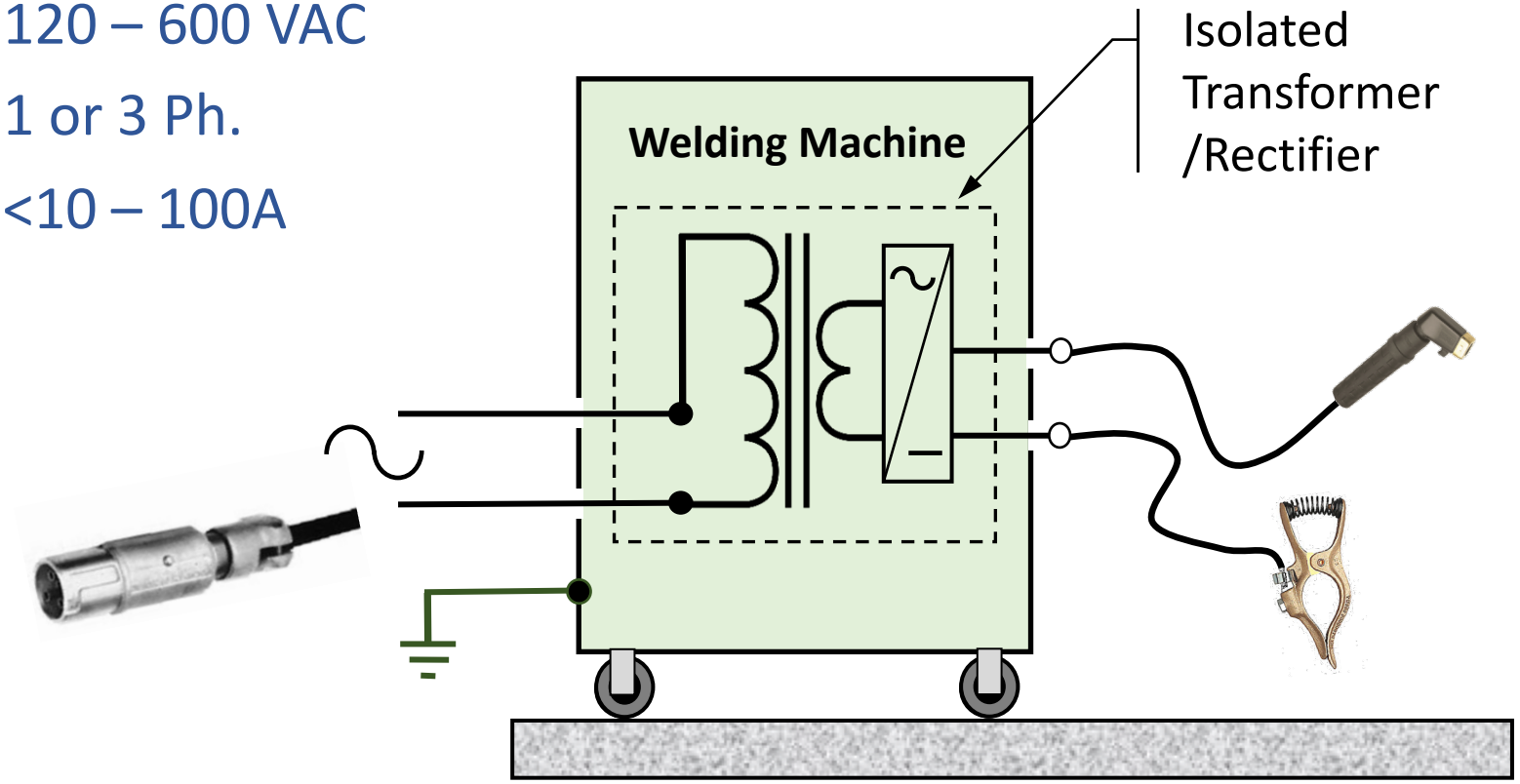
(Image Source: Indestructibles – "Build a Microwave Transformer Homemade Stick/Arc Welder")

CONESTOGA
Connect Life and Learning

Typical Arc Welding Machines

TYPICAL PRIMARY

- 120 – 600 VAC
- 1 or 3 Ph.
- <10 – 100A



TYPICAL SECONDARY

- DC or AC
- <80 V rms (No-Load)
- 10 – 1000A

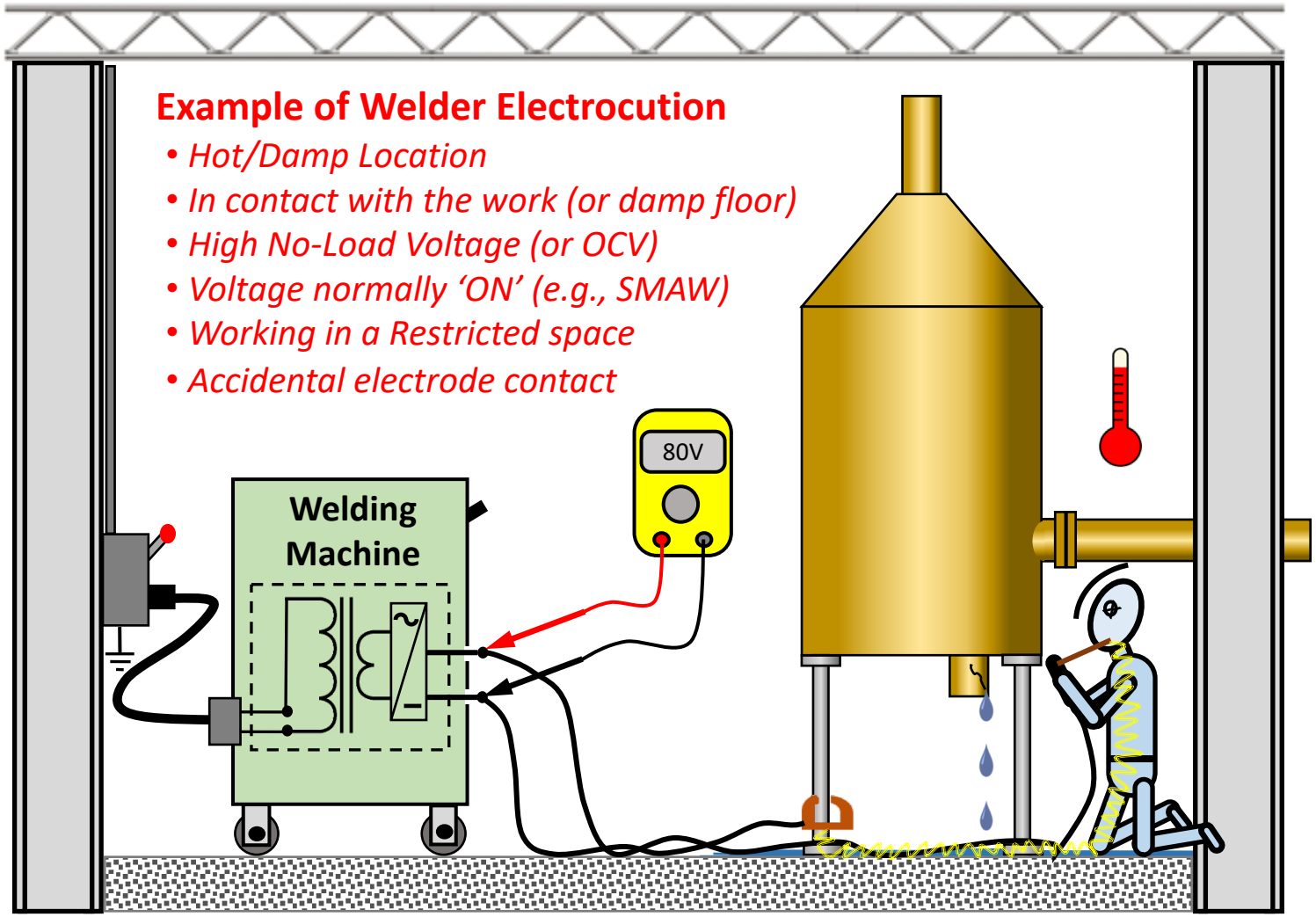
Options:

- *AC 40 – 400 Hz*
- *Pulsed Current*
- *HF Starting*

CONESTOGA
Connect Life and Learning

Secondary Voltage Hazards

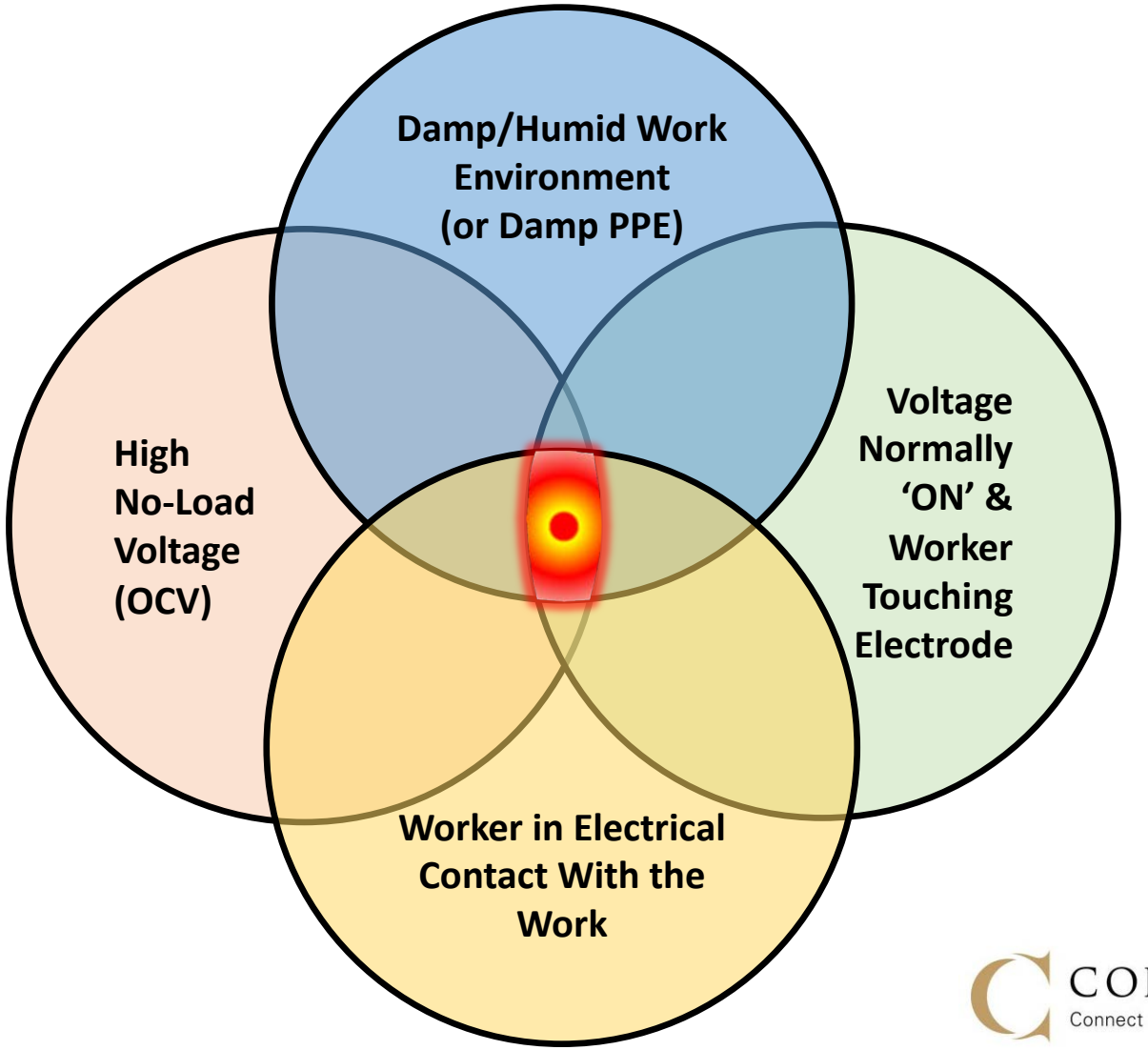
- Many welders have been electrocuted (or shocked) from the secondary voltage hazard;
- CSA W117.2-19 now requires the use of a **Voltage Reduction Device** (VRD) under certain conditions.



CONESTOGA
Connect Life and Learning

Secondary Voltage Reduction Devices

A VRD is required when these four conditions are met:



Higher risk processes:

- *SMAW (stick)*
- *CAC (carbon-arc)*
- *GTAW (tig - without a remote contactor)*

CONESTOGA
Connect Life and Learning

Voltage Reduction Devices

- Voltage Reduction Devices (VRD) are available as either built-in technology or as an accessory device.

CONESTOGA
Connect Life and Learning

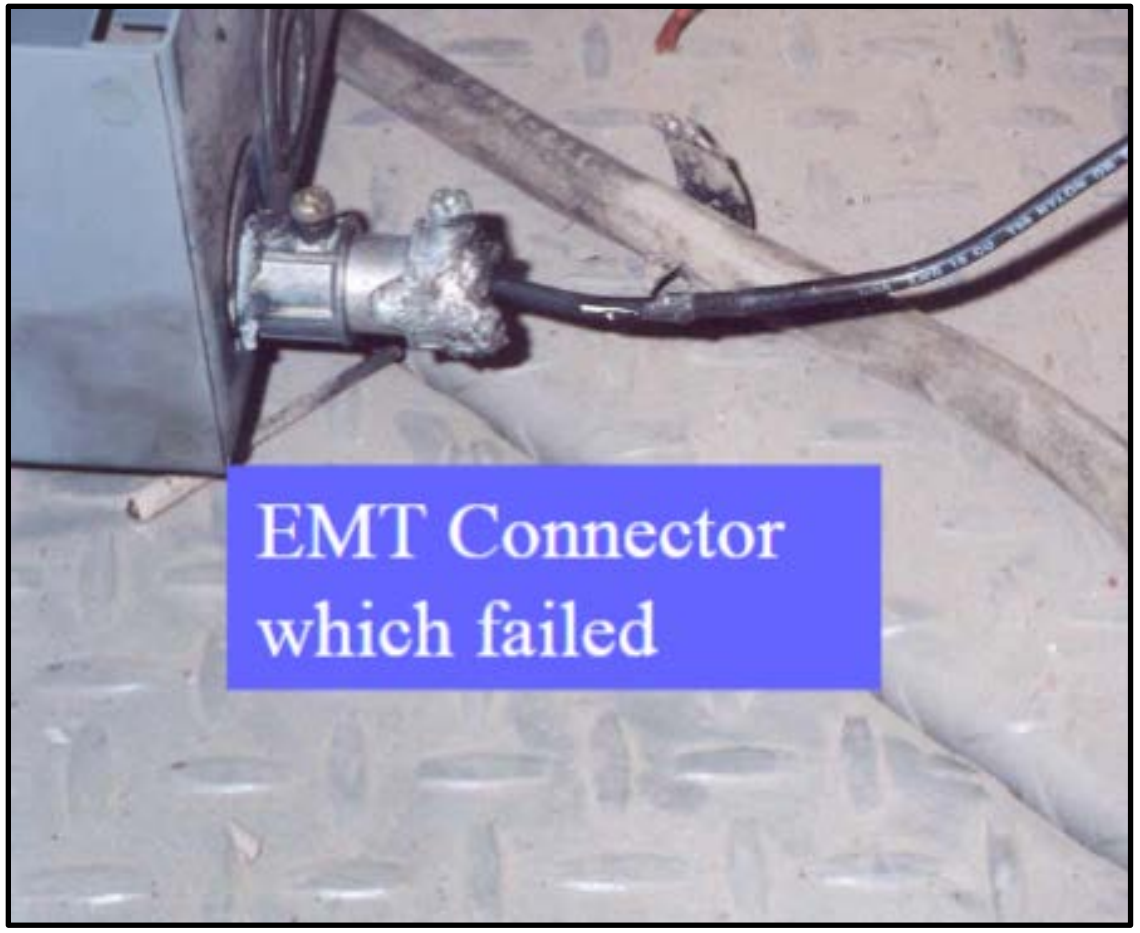
Stray Electrical Current

- Stray current is defined as any flow of electric current through unintended conductors such as buried metallic infrastructure, building structures, electrical grounding or bonding conductors, or other equipment due to electrical system imbalances or improper equipment hook-up;
- The problem of stray current damage was recently studied in a project at Conestoga College.

CONESTOGA
Connect Life and Learning

Stray Welding Current

- A common source of damage in electrical networks occurs due to Stray Welding Current, often in the magnitude of >60 A;
- When subjected to these high-current flows unintended conductors can arc at contact points, overheat, and damage insulation or even start fires.



(Image Source: K. Dokis Electrocution Inquest - Office of the Chief Coroner of Ontario)

CONESTOGA
Connect Life and Learning

Stray Welding Current

Stray electrical currents are known to cause permanent electrical system damage, and this damage can create conditions leading to the injury or death of personnel by electrocution.

Electrical Safety Authority
For Your Safety

FLASH 02-04

Millwright electrocuted while using welding machine

The work lead, often incorrectly referred to as the ground, in this case wasn't properly connected as close to the work area or welding location as required. As a result the stray welding current caused damage to the building's electrical system.

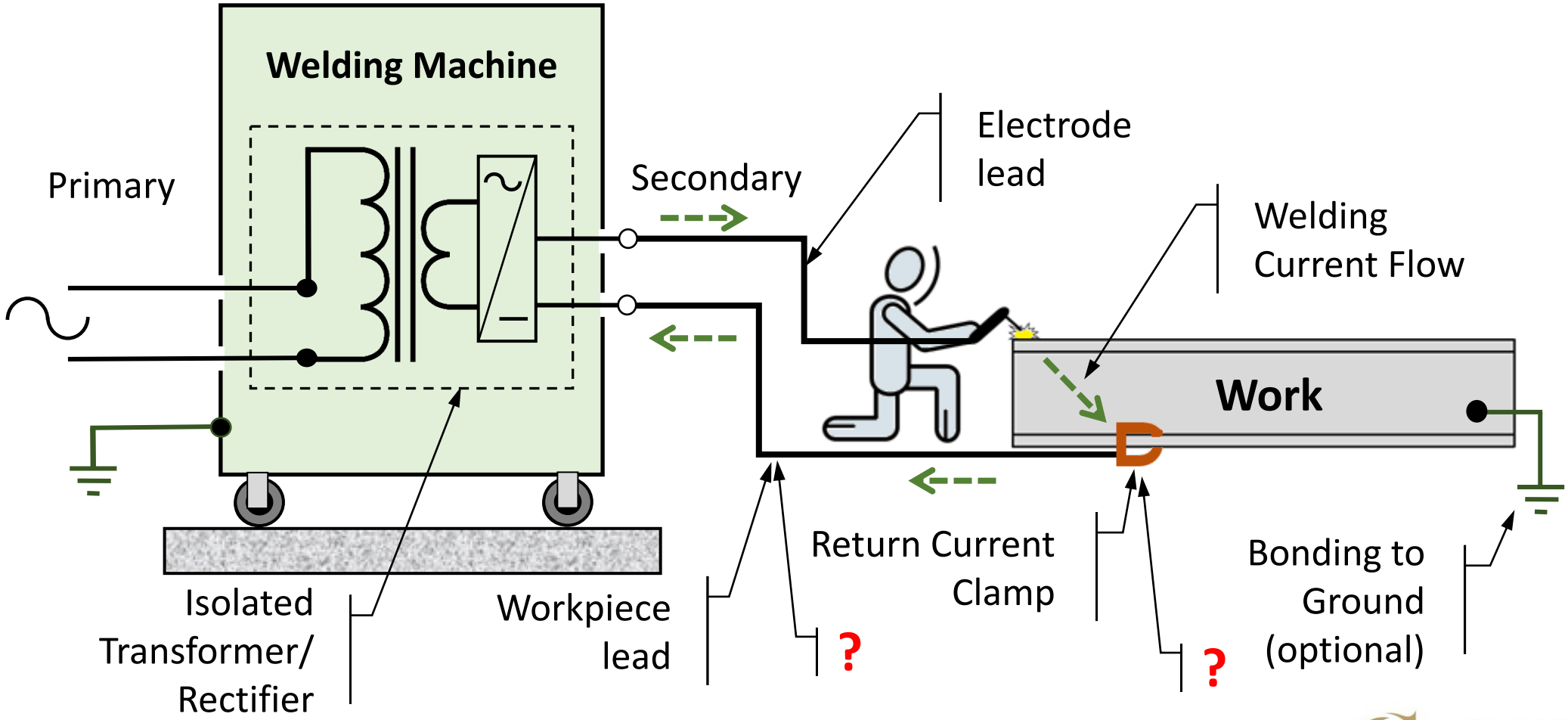
This accident was preventable. Canadian Standards Association, **W 117.2-01 Safety in Welding, Cutting and Allied Processes** suggested the following procedure and set-up;

a) The work lead shall be connected as close as possible to the work area or the location being welded upon to ensure the welding current returns directly to the source through the work lead.
b) The wire of the work lead cable shall be of equal or greater size than that of the electrode cable.
c) All cables shall be free of damage or exposed conductor and shall not be longer than specified by the welder manufacturer.
d) Electrical grounds connected to a building framework or other locations remote from the work area increase the possibility of output current passing through building systems. This passage of current through building systems can cause extensive damage to equipment and electrical circuits if the work lead isn't properly installed.

The work lead, often incorrectly referred to as the ground, in this case wasn't properly connected as close to the work area or welding location as required. As a result the stray welding current caused damage to the building's electrical system.

CONESTOGA
Connect Life and Learning

Correct Arc Welding Arrangement



CONESTOGA
Connect Life and Learning

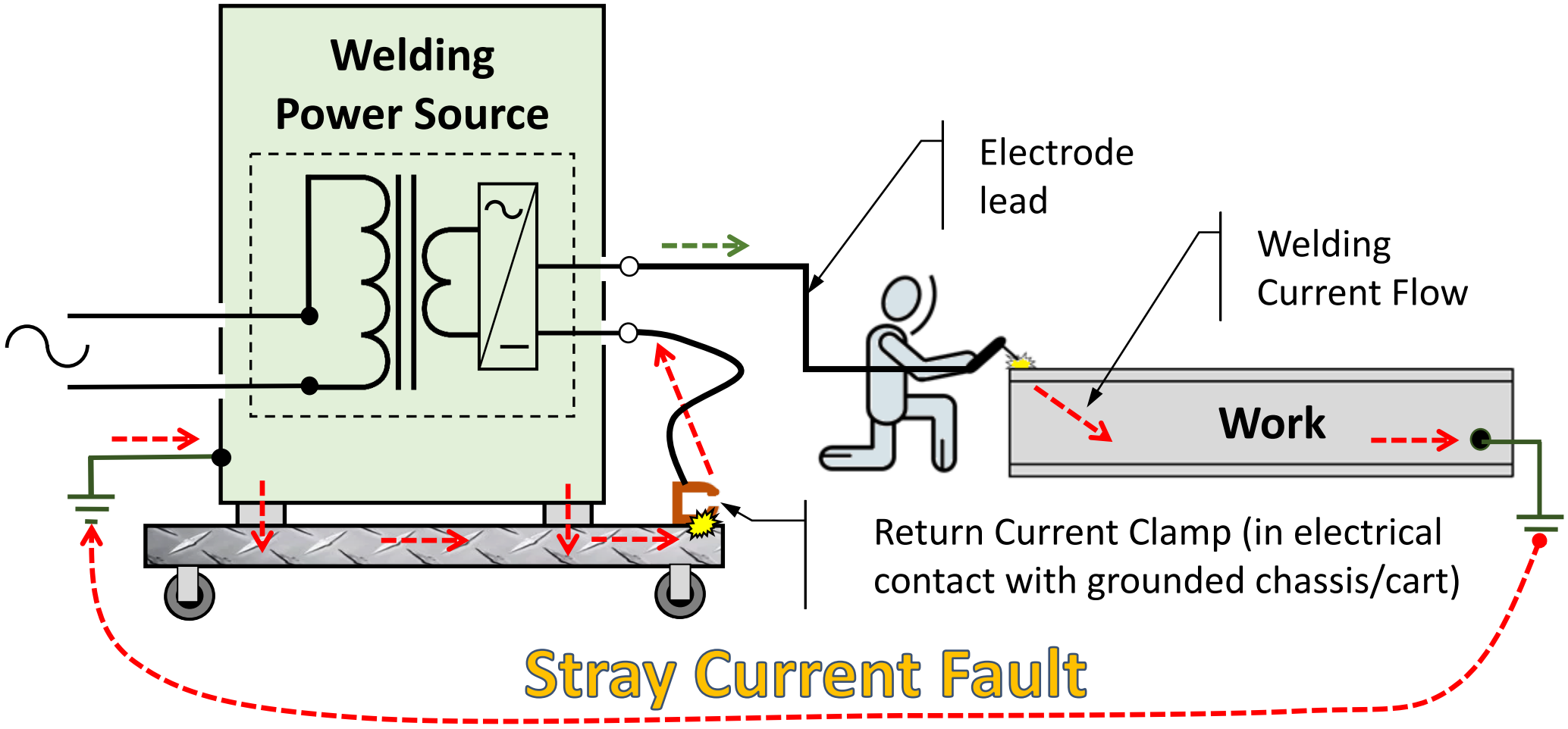
Stray Currents in Arc Welding

Stray Current in welding operations are the result of one of two root causes:

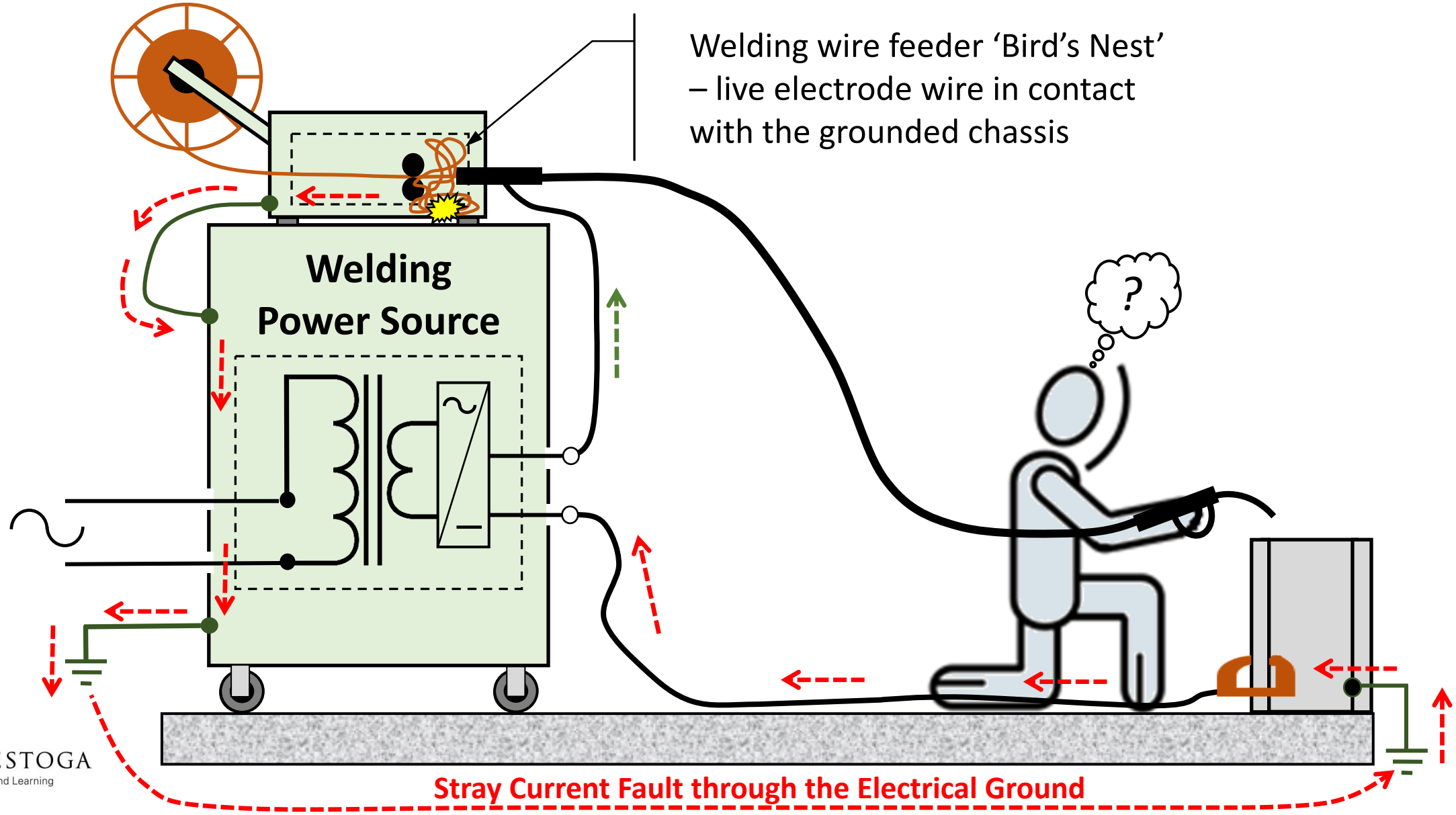
1. Operator Set-up Errors

2. Equipment Malfunction

Stray Current Example: Operator Error



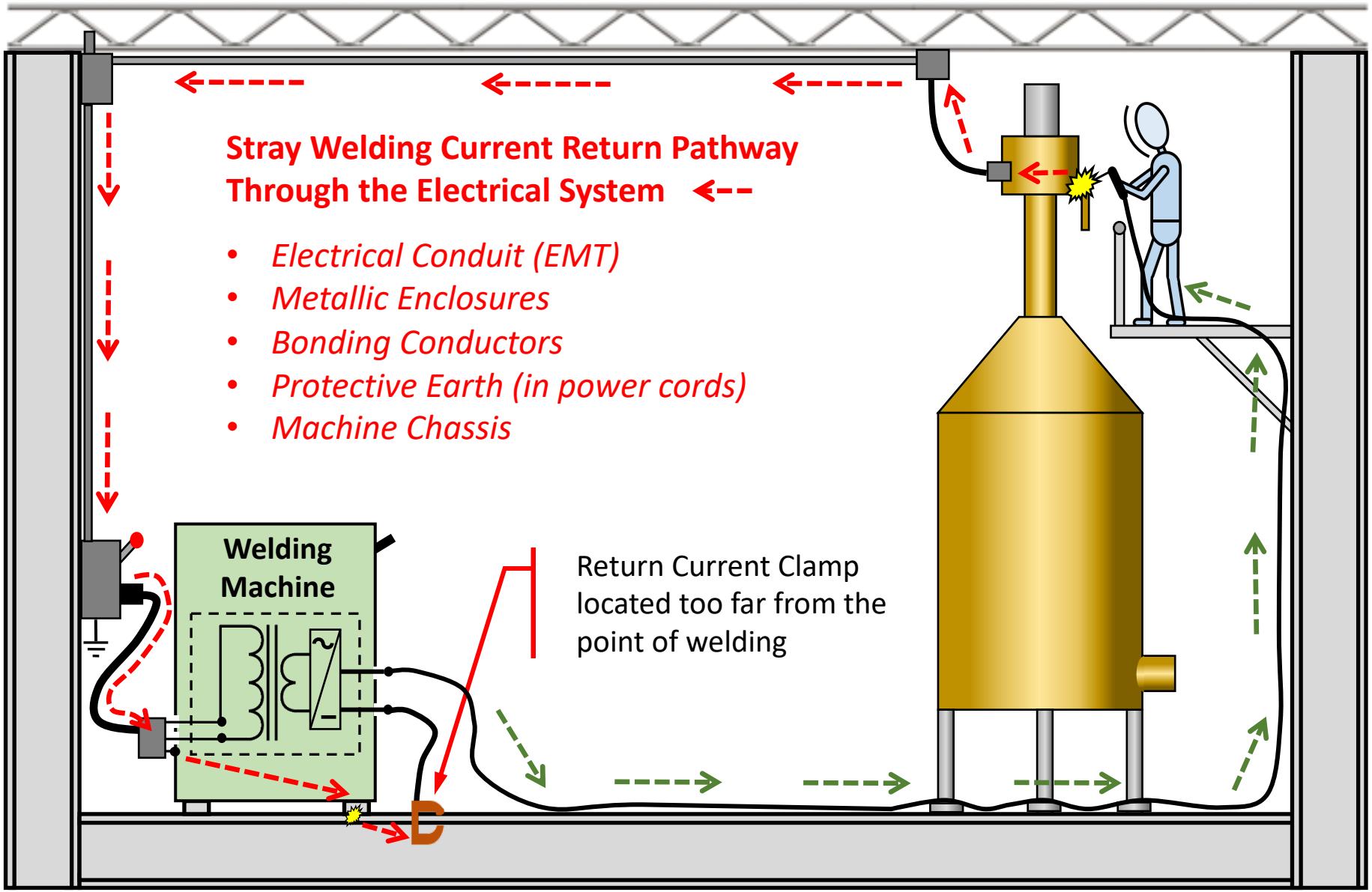
Stray Current Example: Equipment Malfunction



The Problem of Welding Stray Current (Video)

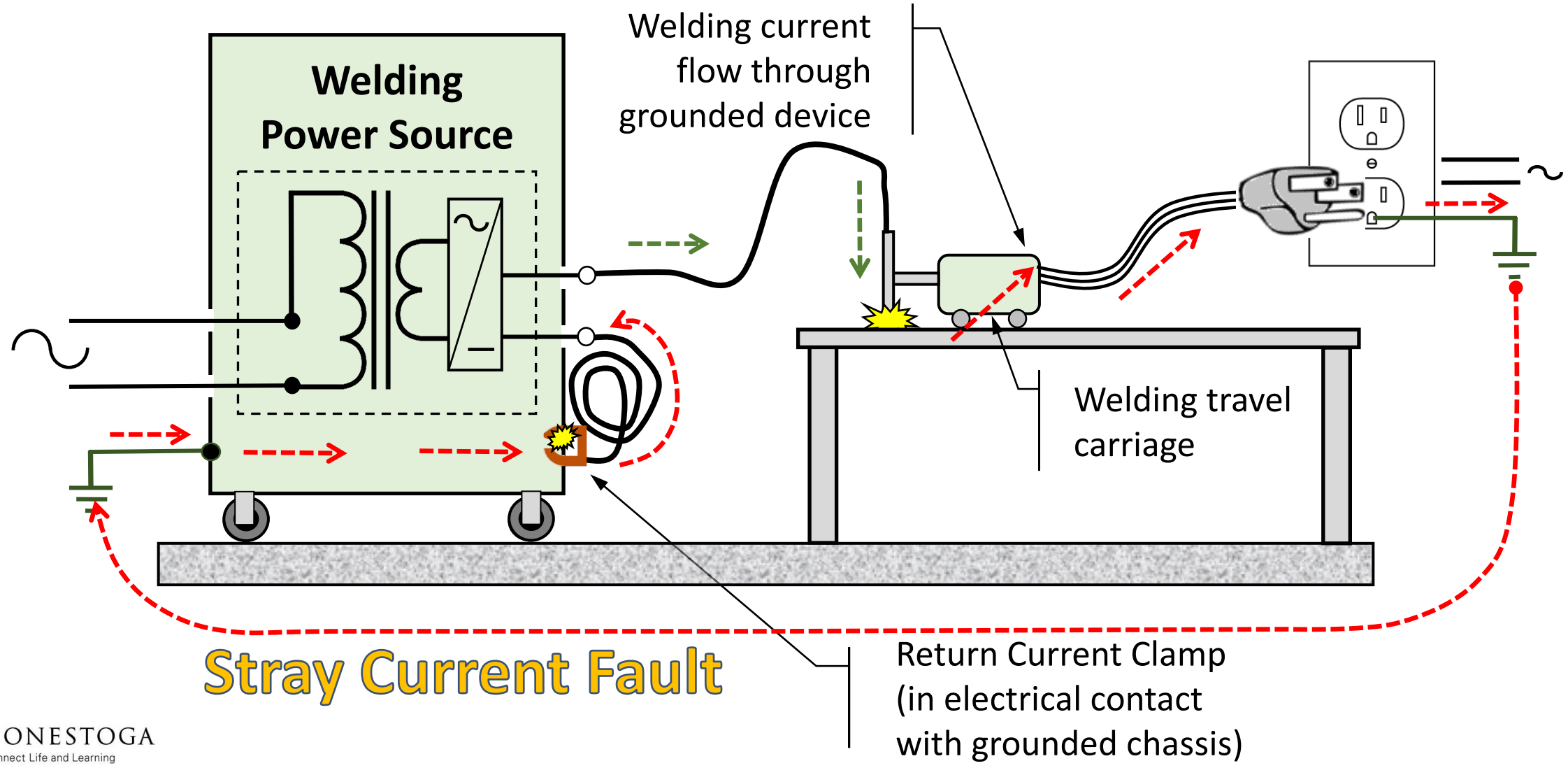
https://www.youtube.com/watch?v=80ehl2nDXUk&t=190s

Stray Current Example #3: Operator Error

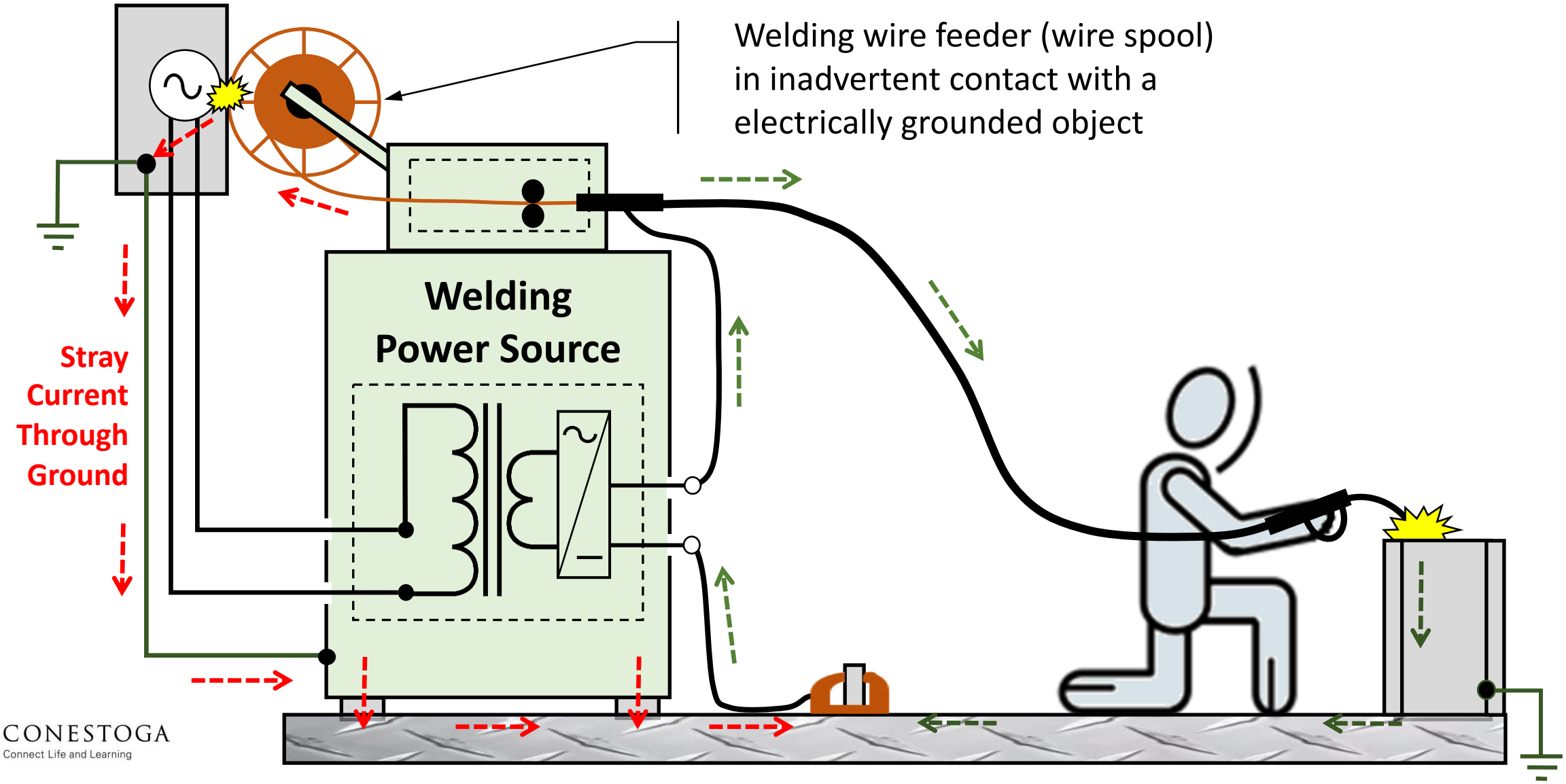


CONESTOGA
Connect Life and Learning

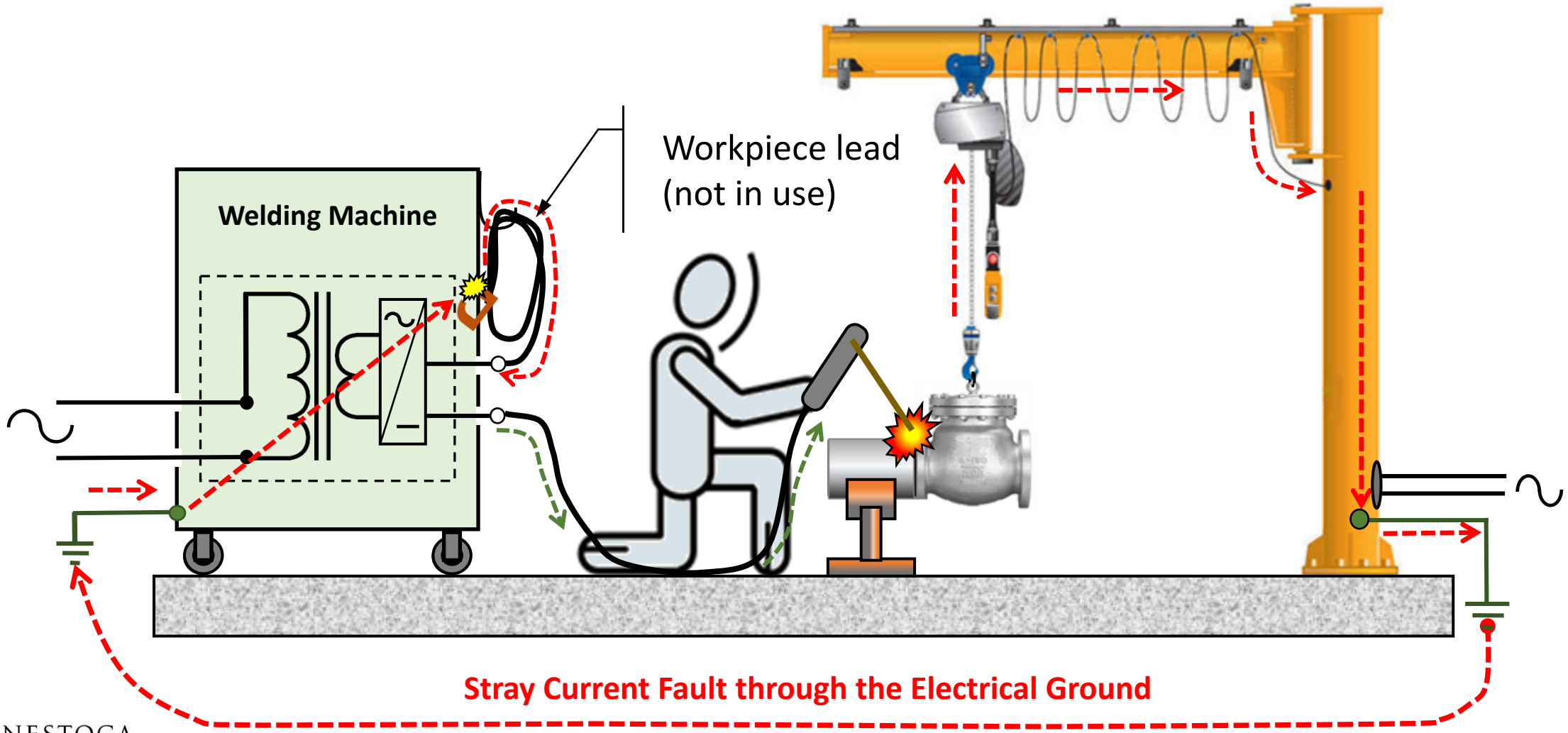
Stray Current Example #4: Set-up Error



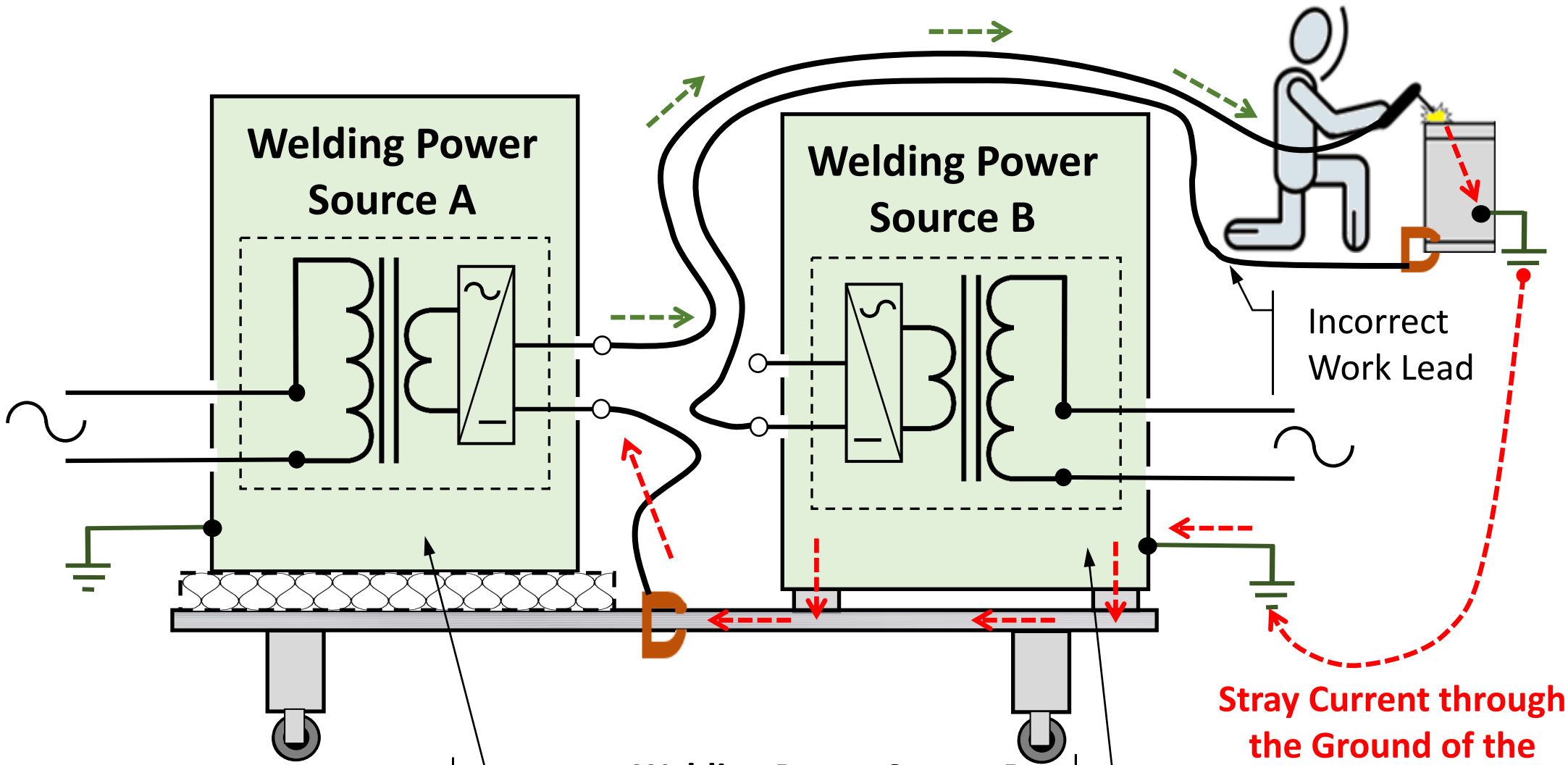
Stray Current Example #5: Inadvertent Contact



Stray Current Example #6: Lifting Equipment

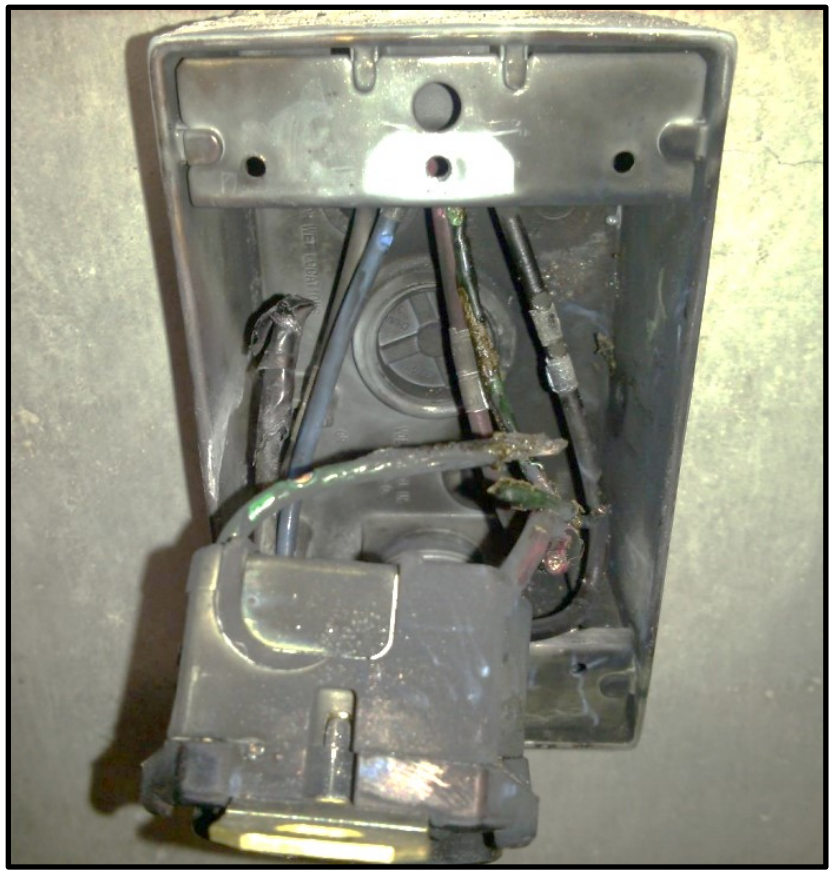


Stray Current Example #7: Two-Machine Scenario



CONESTOGA
Connect Life and Learning

Stray Welding Current Electrical System Damage



(Image courtesy V. Bolsterli – Fleming College)

(Image Source: K. Dokis Electrocution Inquest - Office of the Chief Coroner of Ontario)

CONESTOGA
Connect Life and Learning

Stray Welding Current Electrical System Damage

The welder was electrocuted by 348 VAC when he touched this plug/receptacle

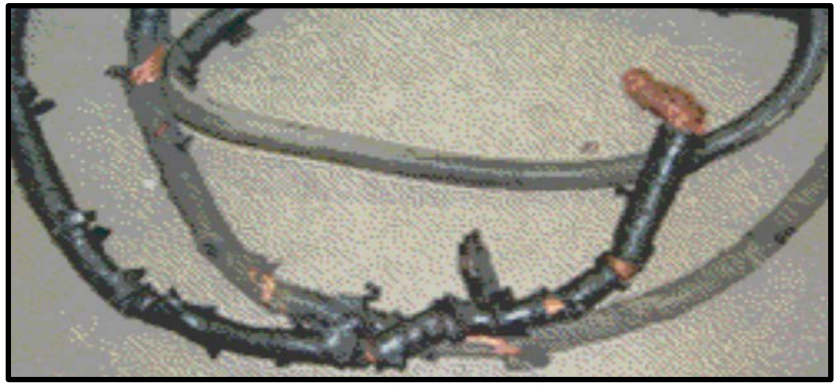
(Image Source: K. Dokis Electrocution Inquest - Office of the Chief Coroner of Ontario)

Stray Welding Current Cord Damage (Video)

https://www.youtube.com/watch?v=kIVH5V9ntrY

What Can Be Done?

- Welders should always follow the rules in standards such as CSA W117.2-19;
- Welding equipment and secondary cables/connectors should always be checked and in good condition;
- Welding machines and ancillary equipment such as wire-feeders should never fail;
- Engineering controls?



CONESTOGA
Connect Life and Learning

Stray Current Interrupter Device (Video)

https://www.youtube.com/watch?v=t9SXEAGLBCs

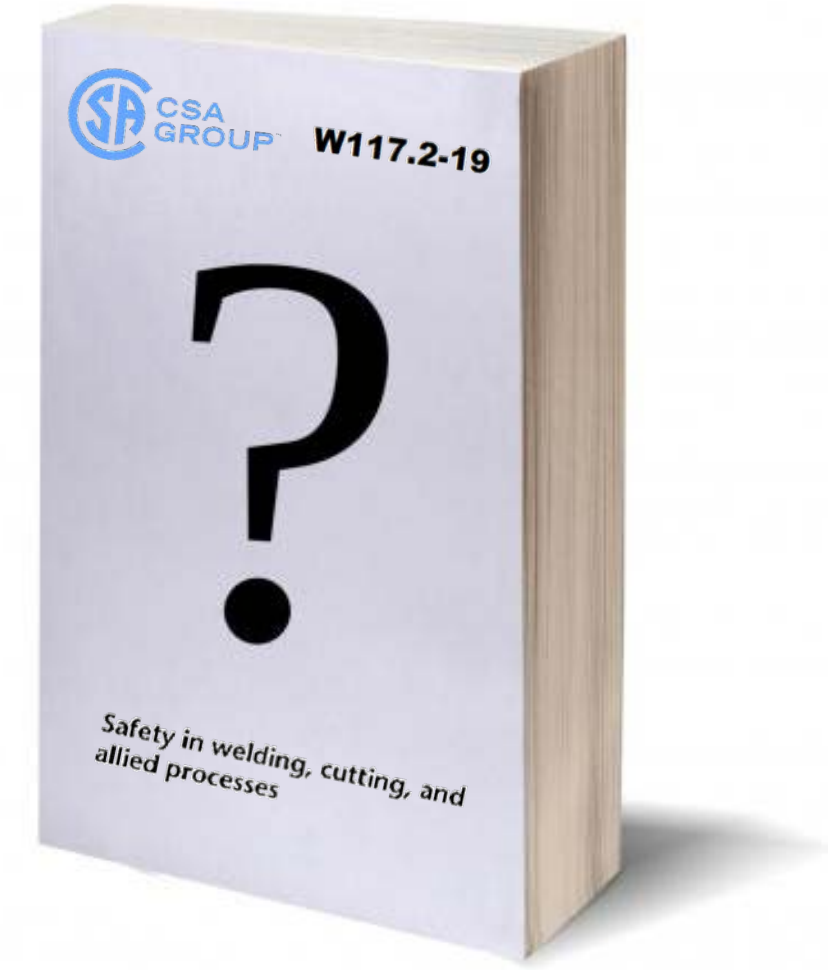
CONESTOGA
Connect Life and Learning

Summary

- The new 2019 edition of CSA W117.2 has recently been published;
- We can learn from accidents, incidents, and evolving technology to improve the safety and working conditions in our industry;
- There are numerous updates as the standard has evolved over time;
- There are significant developments in electrical safety for welding applications.

CONESTOGA
Connect Life and Learning

New Edition: CSA W117.2-19



CONESTOGA
Connect Life and Learning