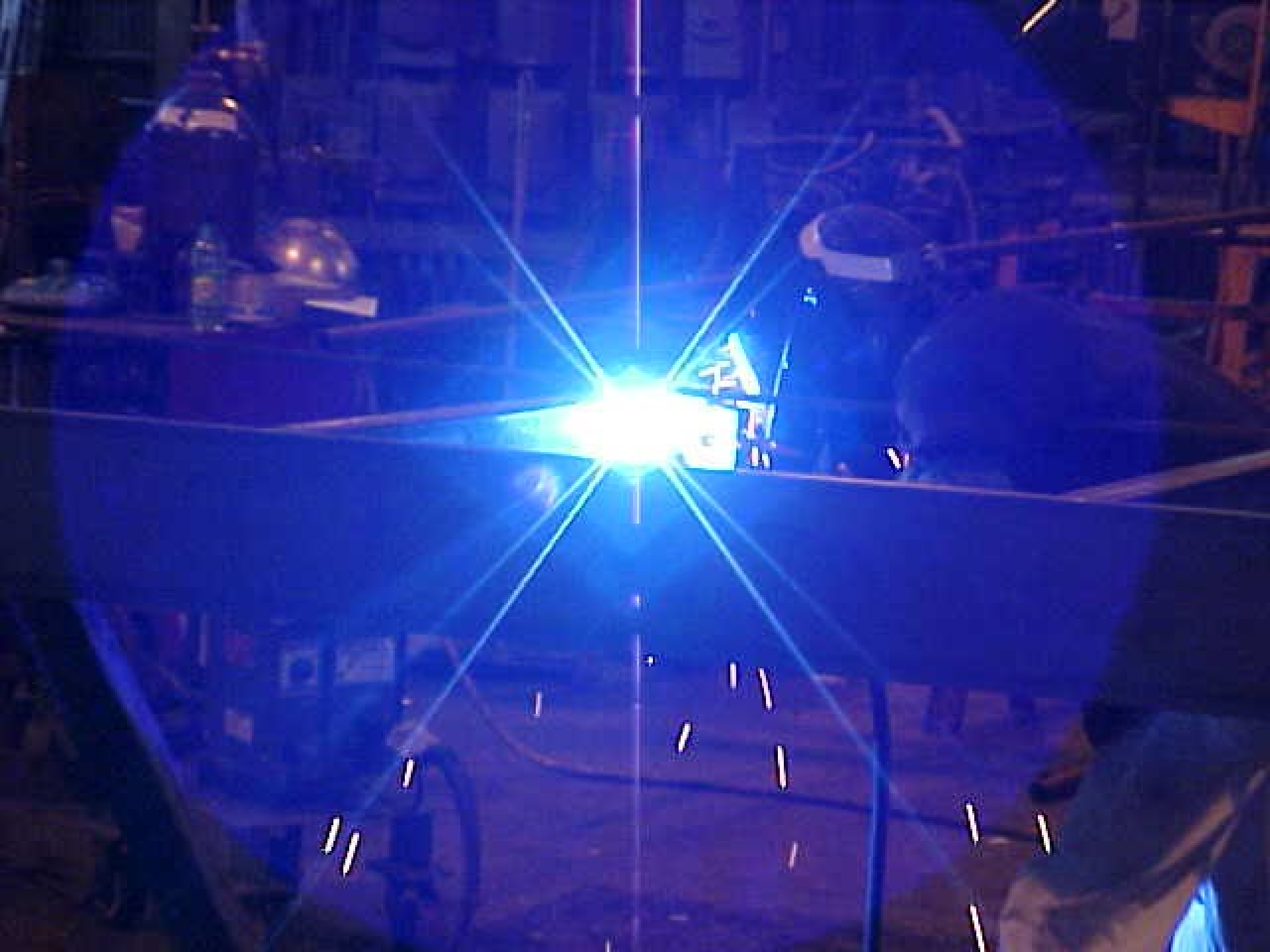
Welding

- *1910 Subpart Q*
- *1926 Subpart J*

Presented by: Steve Davis, GRM

ETTA, OSH Division, (919) 807-2875



Welding

You Must Understand the Types of Welding You May See in General Industry or Construction. What are three types?

1. _____
2. _____
3. _____

Are the Hazards All the Same?

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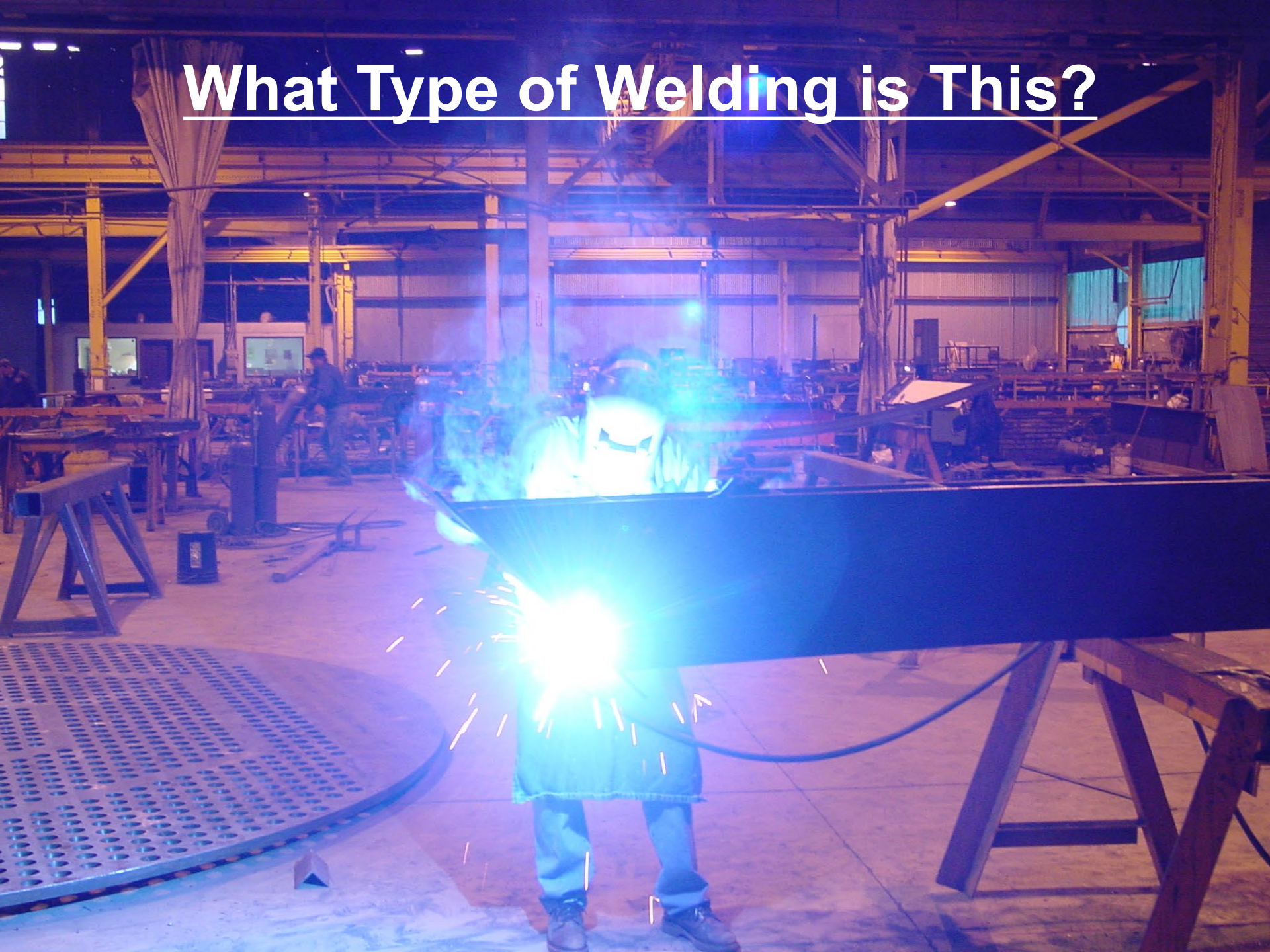
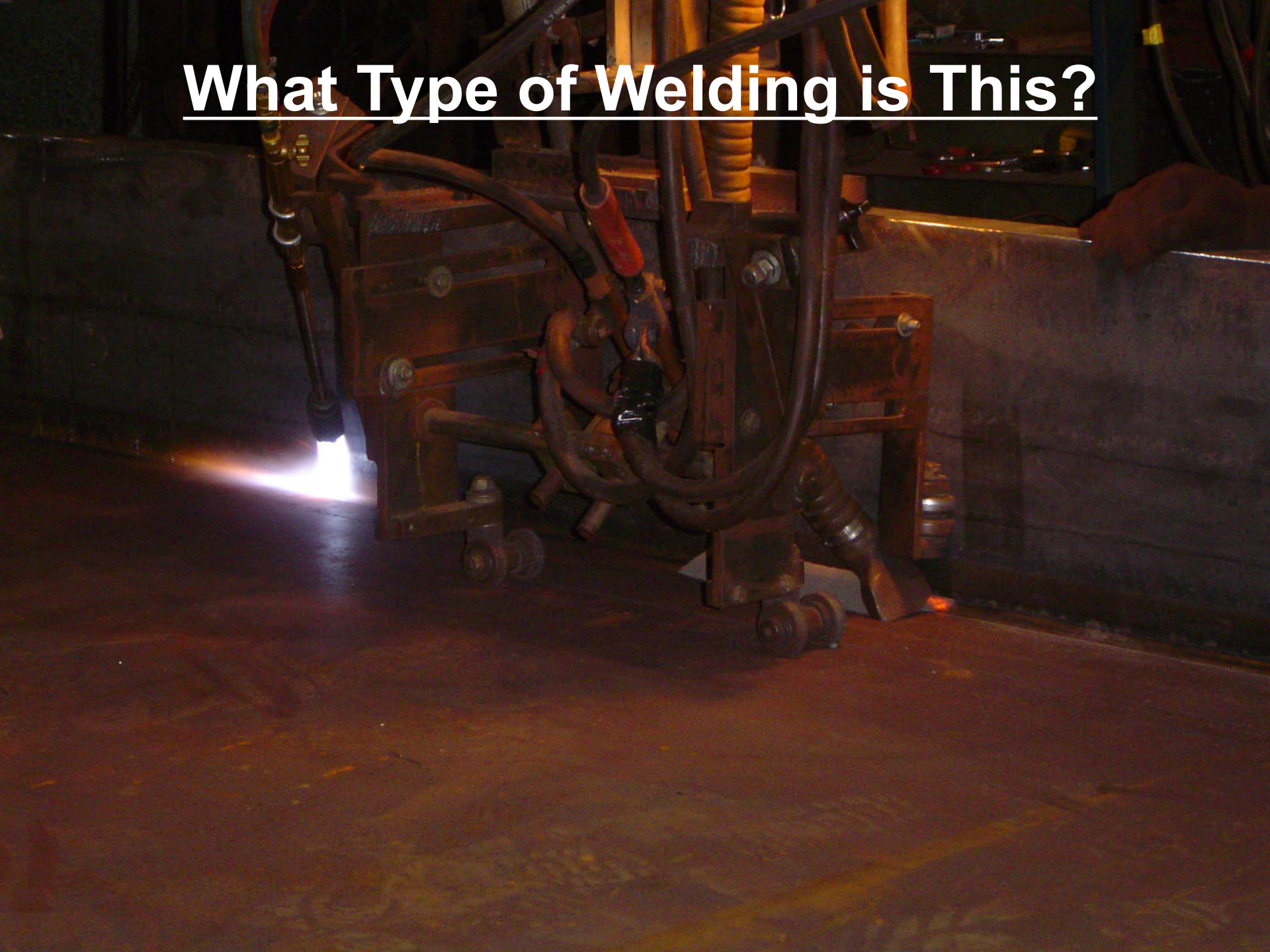
What Type of Welding is This?



What Type of Welding is This?



What Type of Welding/Cutting is This?

What Type of Welding is This?

What Type of Welding is This?

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1910 Subpart Q

- ✓ 1910.251 – Definitions
- ✓ 1910.252 - General Requirements
- ✓ 1910.253 - Oxygen-fuel gas welding & cutting
- ✓ 1910.254 - Arc welding and cutting
- ✓ 1910.255 - Resistance welding

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1926 Subpart J

- ✓ 1926.350 – Gas Welding & Cutting
- ✓ 1926.351 – Arc Welding & Cutting
- ✓ 1926.352 – Fire Prevention
- ✓ 1926.353 – Ventilation & Protection in Welding, Cutting & Heating
- ✓ 1926.354 – Welding, Cutting & Heating in Preserved Coatings

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Incorporated by reference

- ✓ ANSI Standards
- ✓ Compressed Gas Association Standards

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Other Related OSHA Standards

- ✓ 1910.102 - Acetylene
- ✓ 1910.104 - Oxygen
- ✓ 1926.350 - Gas welding and cutting
- ✓ 1926.351 - Arc welding and cutting
- ✓ 1926.352 - Fire prevention
- ✓ 1926.353 - Ventilation and protection in welding, cutting, and heating
- ✓ 1926.354 - Welding, cutting, and heating in way of preservative coatings

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Most Frequently Cited - 2009

- ✓ 1910.253(b)(4)(iii) Oxygen cylinder storage
  1926.350(a)(10) Separation: Distance
- ✓ 1910.253(b)(2)(ii) Cylinder storage – Inside of buildings
- ✓ 1910.252(b)(2)(iii) Protection from rays
  1926.353(d)(1)(iii) Protection from ultraviolent rays
- ✓ 1910.254(d)(9)(iii) Arc welding/cutting – damaged cables
- ✓ 1926.351(b)(2) Maintenance of cables

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Most Frequently Cited - 2009

- ✓ 1910.253(b)(2)(iv) Valve caps
  1926.350(a)(1) Valve protection caps
- ✓ 1926.350(h) Regulators/gauges in working order
- ✓ 1926.352(d) Fire extinguishing equipment in area

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Welding Terminology

Arc welding

• Carbon Arc Welding	CAW
• Gas Metal Arc Welding	GMAW
• Gas Tungsten Arc Welding	GTAW
• Plasma Arc Welding	PAW
• Shielded Metal Arc Welding	SMAW
• Stud Arc Welding	SW
• Submerged Arc Welding	SAW

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Welding Terminology

Oxyfuel Gas Welding

- Oxyacetylene Welding OAW
- Oxyhydrogen Welding OHW
- Pressure Gas Welding PGW

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Welding Terminology

Brazing

• Diffusion Brazing	DFB
• Dip Brazing	DB
• Furnace Brazing	FB
• Induction Brazing	IB
• Infrared Brazing	IRB
• Resistance Brazing	RB
• Torch Brazing	TB

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Welding Terminology Slang

- Stick
- MIG
- TIG
- Sub Arc
- Gouging
- Plasma Cutting
- Torch Cutting

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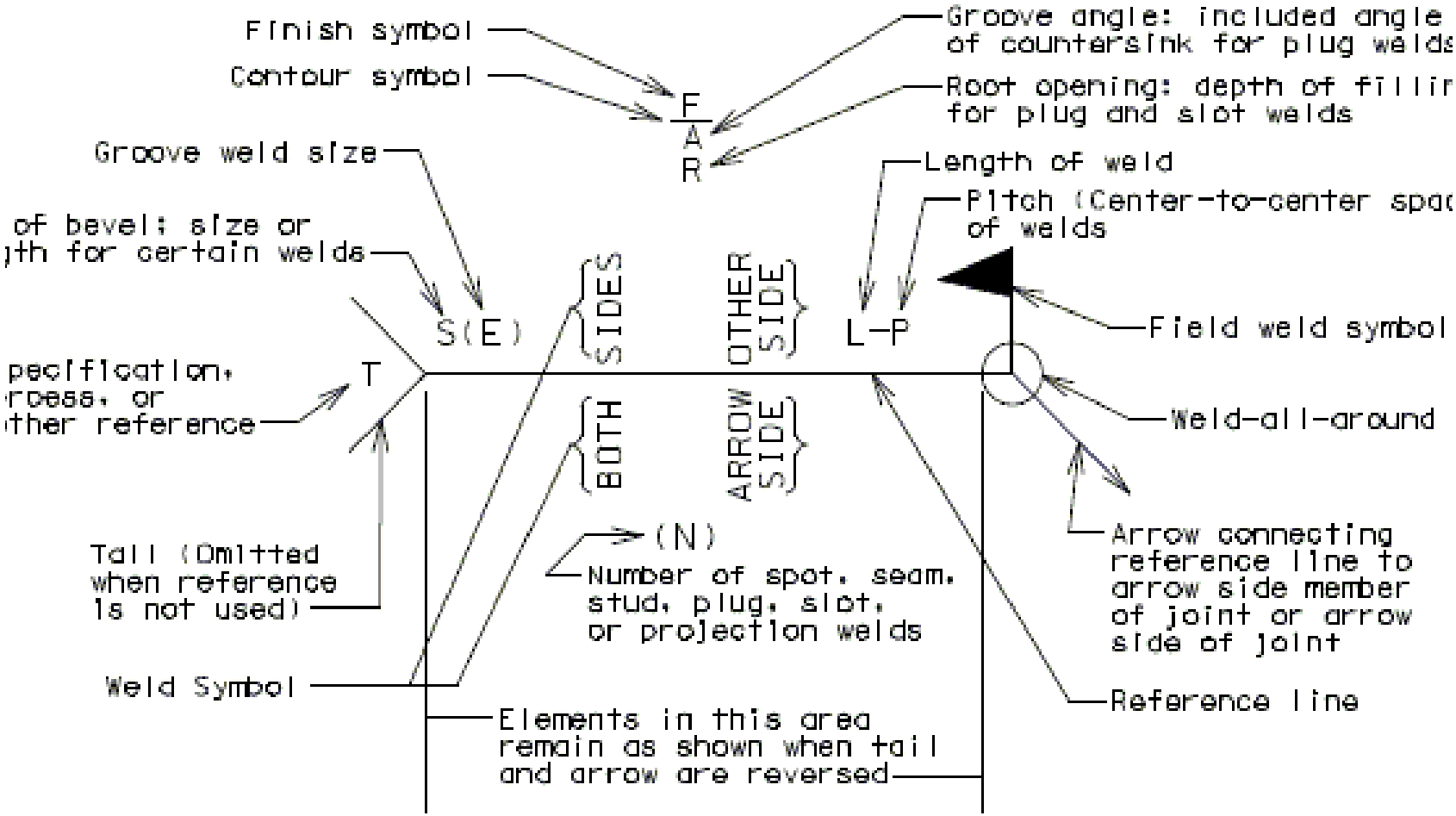
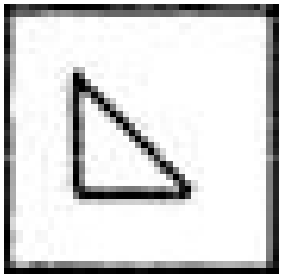
Welding Call Outs

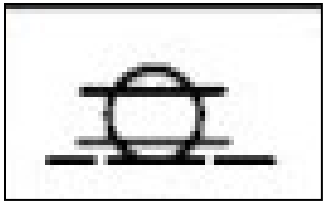


Welding – Types & Typical Symbols

- **FILLET** – Type of weld, approximately triangular cross section joining two surfaces at approximately exact angles to each other.



- **SEAM –** A type of welding, continuous weld made between or upon overlapping metal parts.



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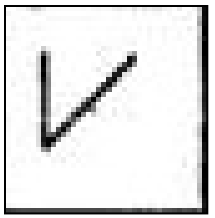
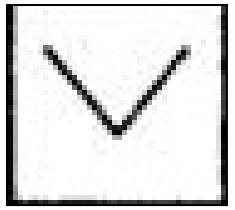
Welding – Types & Typical Symbols

- **BEVEL** – A type of groove weld in which one member has a joint edge beveled from one side



- **V-Groove –** A groove weld in which the joint edge of each member is beveled from the similar side.



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AISC Welding – Best Practices

- Certified Welders (Weld Certs)
- Welding Procedures (WPS)
- Setting up the Welding Machine Properly
- Use of Amp Meter
- Weld Electrode (Rod) Storage in Rod Oven
- Weld Gauges (to visually Inspect the Weld)
- Weld Inspections by Qualified Persons

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AISC Weld Procedures

Williams Erection Company

Page 1 of 2

Welding Procedure Specification

Bu 4a GF NR 212

WPS No. Bu 4a GF NR 212 Date _____ By Philip Torchio Type Manual ☐ Machine ☐

Authorized By P. Torchio Date 5/8/2000 Revision 0 Semi-Auto ☒ Auto ☐

Welding Process(es) FCAW Prequalified ☒

Supporting PQR(s) _____

JOINT

Type Butt

Backing Yes ☒ No ☐ Single Weld ☒ Double Weld ☐

Backing Material A-36

Root Opening as shown Root Face Dimension chisel point

Groove Angle 45 Radius (J-U) _____

Back Gouge Yes ☐ No ☐

Method _____

BASE METALS

Material Spec. ASTM A 572 to GR 50

Type or Grade Cat. B Tble 3.2 to _____

Thickness: Groove (in) 1/8 - unlimited

Fillet ( ) _____ - _____

Diameter (Pipe,) _____ - _____

FILLER METALS

AWS Specification A 5.20-79 E 71 T G

AWS Classification 9 _____

NR 212 Lincoln

SHIELDING

Flux None

Electrode-Flux (Class) NA

Gas NA

Composition _____

Flow Rate _____

Gas Cup Size _____

PREHEAT

Preheat Temp., Min. 32 Deg F

Thickness Up to 3/4" Temperature 32 Deg F

Over 3/4" to 1-1/2" 50 Deg F

Over 1-1/2" to 2-1/2" 150 Deg F

Over 2-1/2" 225 Deg F

Interpass Temp., Min. p.heat spc Max. _____

POSITION

Position of Groove All Fillet All

Vertical Progression: ☒ Up ☐ Down

ELECTRICAL CHARACTERISTICS

Transfer Mode (GMAW):

OK to weld in any position but if welding vertical you must go vertical up

Size _____ Type _____

TECHNIQUE

Stringer or Weave Bead Both

side) Multiple

al na

teral na

ngle na

Contact Tube to Work Distance 1/2 to 1"

Peening none

Interpass Cleaning chip grind or gouge

Procedure is for E 71 T G welding Wire Lincoln NR 212

POSTWELD HEAT TREATMENT PWHT Required ☐

Temp. _____ Time _____

WELDING PROCEDURE

Layer/Pass	Process	Filler Metal Class	Diameter	Cur. Type	Amps or WFS	Volts	Travel Speed	Other Notes
1	FCAW	E 71- T G	.045	DCEN	90-115	15-17	70-90"	1/4>T>5/8
1	FCAW	E 71- T G	.045	DCEN	120-140	17-18	90-100"	1/2>T>3/4
1	FCAW	E 71- T G	5/64	DCEN	150-180	16-19	65-75"	1/2>T>3/4
1	FCAW	E 71- T G	5/64	DCEN	185-225	19-21	80-115"	1/2>T>1"
1	FCAW	E 71- T G	5/64	DCEN	230-275	20-21	80-115"	1/2>T>1"
1	FCAW	E 71- T G	5/64	DCEN	275-325	21-23	110-150"	T>3/4

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Fire Protection

- ✓ Remove fire hazards from the welding area
- ✓ If fire hazards cannot be removed then guards must be used
- ✓ Suitable fire extinguishers must be maintained in a state of readiness

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Fire Watch

- ✓ Required when a major fire hazard exists,
- ✓ Flammable materials within 35 feet
- ✓ Flammable materials more than 35 feet away could easily catch on fire
- ✓ Must continue for at least 30 minutes after welding work is finished

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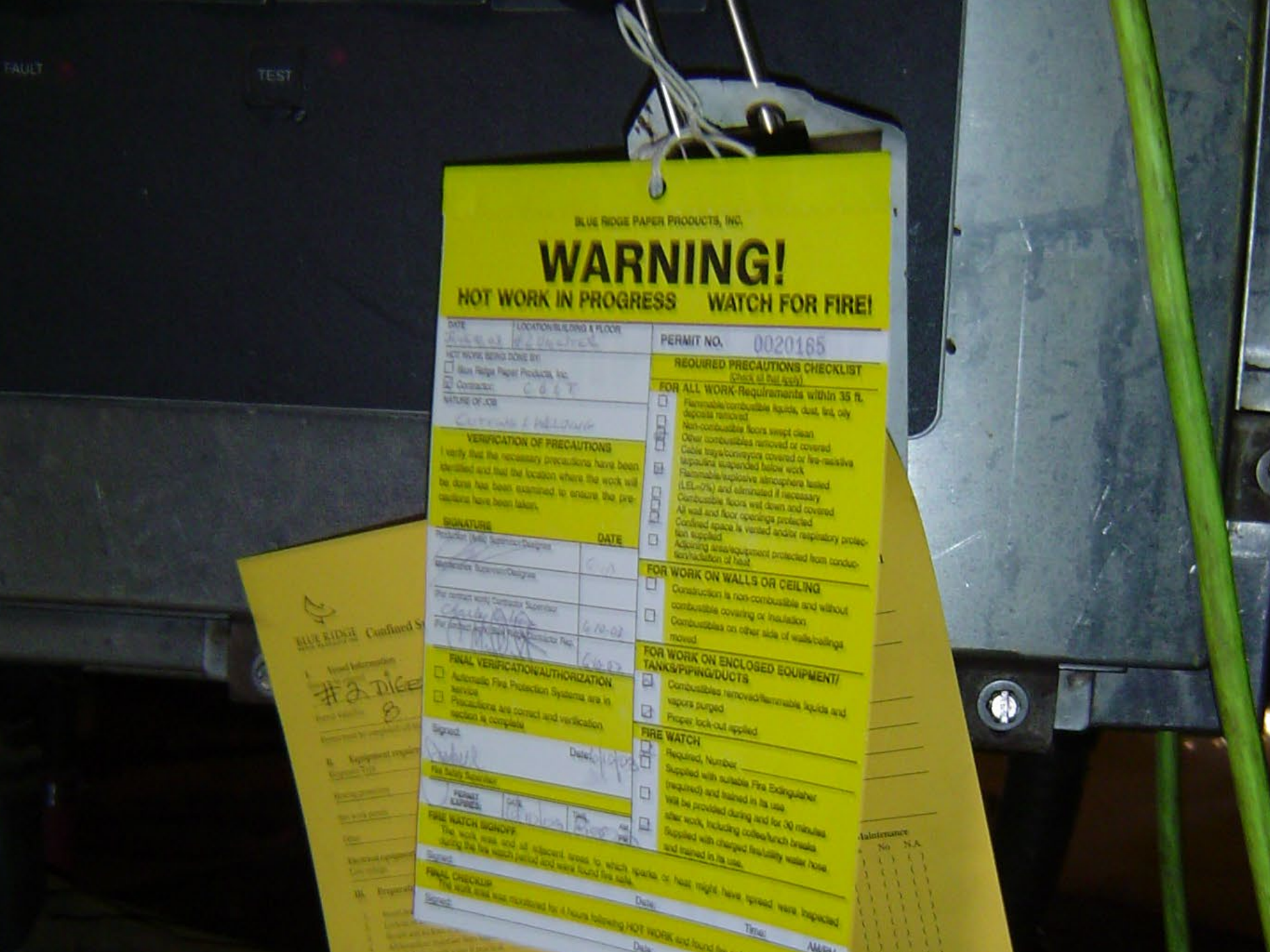
Exercise

- Find in Subpart Q Where it Requires a Fire Watch to Remain in the Welding Area 30 Minutes AFTER the Welding has been Completed.

- ***Answer: 29CFR 1910.252(a)(2)(iii)(B)***


BLUE RIDGE PAPER PRODUCTS, INC.
WARNING!
HOT WORK IN PROGRESS WATCH FOR FIRE!
PERMIT NO. 0020165
REQUIRED PRECAUTIONS CHECKLIST
(Check all that apply)
FOR ALL WORK-Requirements within 35 ft.
FOR WORK ON WALLS OR CEILING
FOR WORK ON ENCLOSED EQUIPMENT/ TANKS/PIPING/DUCTS
FIRE WATCH
VERIFICATION OF PRECAUTIONS
FINAL VERIFICATION/AUTHORIZATION
FIRE WATCH SIGNOFF
FINAL CHECKUP


DIGESTER CAP
BE ON PRIOR
LOAD/COOK SY
BEING TURNED TO

Fire Prevention & Protection

Cutting or welding is not permitted in:

- ✓Areas not authorized by management
- ✓Sprinkled buildings when protection is impaired
- ✓The presence of explosive atmospheres

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Welding & Cutting Containers

- ✓ Cleaned thoroughly of flammable materials such as greases, tars, acids, or
- ✓ Connections to the container must be disconnected or blanked

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Fall & Trip Hazards

- ✓ Welders exposed to falls must be protected by use of guardrails or fall protection equipment
- ✓ Keep welding cable clear of passageways, ladders, and stairways

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Is This What You See in Your Plant?

Eye Protection

- ✓ Helmets or hand shields must be used during all arc welding & cutting operations, excluding submerged arc welding

- ✓ Attendants must also be provided with proper eye protection

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Eye Protection, cont.

- ✓ Goggles or other suitable eye protection must be used during all gas welding operations

- ✓ Spectacles without side shields, with suitable filter lenses are permitted for use during gas welding operations on light work, for torch brazing or for inspection

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Eye Protection, cont.

Welding Operation	Shade No.
Shielded metal-arc welding	10
Gas-shielded arc welding (nonferrous)	11
Gas-shielded arc welding (ferrous)	12
Soldering	2
Torch brazing	3 or 4
Heavy cutting, 6 inches and over	5 or 6

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Protection from Rays

- 1910.252(c)(1)(ii) Screens in General Industry

- 1926.351(e) Shielding. Whenever practicable, all arc welding and cutting operations shall be shielded by noncombustible or flameproof screens which will protect employees and other persons working in the vicinity from the direct rays of the arc.

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Protection from Rays - The Real Story

- Welding Flash Hazard is Within 35 ft. Boundary
- www.twi.uk: 10 meters
- U.S. Army Health & Hygiene
- AWS Table
- Outside of 35 ft. No Significant Hazard Is Present

Arc Welding/Cutting Process	Base Metal	Shielding Gas	Arc Current in Amperes	Distance in m for 1 min	Distance in m for 10 min	Distance in m for 8 h
Shielded Metal Arc (Stick)	Mild steel	None	100–200	3.2	10	71
GMAW	Mild steel	CO_2	90	0.95	3.0	21
			200	2.2	7.0	48
			350	4.0	13	87
	Mild steel	CO_2	175	1.1	3.6	25
			350	2.3	7.3	51
		95% Ar + 5% O_2	150	2.9	9.3	65
			350	6.7	21	150
	Al	Ar	150	3.2	10	70
			300	5.0	16	110
		He	150	1.6	5.0	34
			300	3.2	10	69
GTAW	Mild steel	Ar	50	0.32	1.0	6.9
			150	0.90	2.8	20
			300	1.7	5.5	38
	Mild steel	He	250	3.0	9.5	66
	Al	Ar	50 AC	0.32	1.0	6.9
			150 AC	0.85	2.7	19
			250 AC	1.6	5.0	35
	Al	He	150 AC	0.94	3.0	21
PAW	Mild steel	Ar	200–260	1.5	4.9	34
		85% Ar + 15% H_2	100–275	1.7	5.5	38
		He	100	3.0	9.4	65
PAC (dry)	Mild steel	65% Ar + 35% H_2	400	1.4	4.4	31
			1000	2.4	7.5	52
PAC (H_2O)	Mild steel	N_2	300	3.3	10	72
			750	1.7	5.5	38

(a) These distances are approximate. To convert to feet, multiply the distance in meters by 3.3.
(b) The distances are based upon the worst-case exposure conditions; maximum UVR for exposure angle, arc gap, and electrode diameter.
(c) Invisible actinic UVR poses a potential hazard to cornea (called welder's flash) and skin (much like sunburn) and exposure is cumulative with each exposure over an 8-h workday per 24-h period.
(d) TLVs are published by the ACGIH, Cincinnati, Ohio.
(e) These distances were based upon data from Lyon, T. L. et al, 1976. *Evaluation of the Potential Hazards for Actinic Ultraviolet Radiation Generated by Electric Welding and Cutting Arcs.* U.S. Army Environmental Hygiene Agency.

Exposure Effects

Since the beginning of arc welding, welders have known welding and cutting operations can cause acute effects such as severe "sunburn" (erythema) of the skin and painful "welder's flash" (photokeratitis) of the cornea of the eye. Consequently, early welders empirically selected protective clothing and eyewear for comfortable viewing. Also, the U.S. Army adopted a measure to prevent eye injuries in industrial areas. Ordinary safety glasses were prescribed for all Army personnel, including welders and their helpers. As a by-product of physical injury prevention, the eyewear resulted in a dramatic drop in the incidence of welder's flash. Any stray invisible actinic UVR was also blocked by the transparent lenses.

Exposure Limits

The first actinic UVR exposure guidelines were published by the American Conference of Governmental Industrial Hygienists (ACGIH) in 1972 (Ref. 1). These guidelines were intended to prevent the acute effects of actinic UVR. The International Non-Ionizing Radiation Committee (INIRC) of the International Radiation Protection Association (IRPA) (Ref. 2) proposed similar guidelines in 1985. After considerable review, the International Commission on Non-Ionizing Radiation Protection (ICNIRP) (Ref. 3) revalidated and endorsed those limits. Besides being concerned about acute effects, these standards have also been shown to minimize any adverse effects and pose an extremely small risk for delayed effects.

Instrumentation

By the early 1970s, several instruments were available to measure actinic UVR but many simpler instruments presented significant measurement errors primarily from a flaw called "stray light." The actinic UVR resulting in an acute injury followed a narrow range of wavelengths (from around 200–315 nm) with a varying "action spectrum" (peaking sharply at 270 nm). Producing an instrument with this wavelength response was difficult with known filters at that time. The better instruments were the traditional ultraviolet spectrometers that could manually scan UVR wavelengths, weigh the results against the exposure standard for each wavelength, then sum them for the net result.

Joint Effort

In 1974, a joint effort was planned to determine the optical radiation hazards from electric arc welding and cutting operations. Testing was planned for six processes: gas tungsten arc welding (GTAW), gas metal arc welding (GMAW), flux cored arc welding (FCAW), plasma arc cutting (PAC), plasma arc welding (PAW), and shielded metal arc welding (SMAW). Organizations that provided personnel and equipment for the effort included Union Carbide Corp., the American Welding Society (AWS), Battelle Memorial Institute, National Institute of Occupational Safety and Health (NIOSH), and the U.S. Army Environmental Hygiene Agency (USAEHA, now U.S. Army Center for Health Promotion and Preventive Medicine [USACHPPM]).

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Respirators

- ✓ When proper ventilation cannot be provided a respirator is required
- ✓ SCBA must be provided in IDLH Atmospheres

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WELD SAFELY
AVOID BREATHING OR CONTACT WITH GASES & VAPORS
EXCESSIVE EXPOSURES HAVE BEEN KNOWN TO CAUSE:
-Irritation & damage to skin, eyes, nose, throat & chest
-Metal fume fever
-Chronic heart & lung disease-pulmonary edema
-Asphyxiation in confined spaces
-Carbon monoxide poisoning

Confined Spaces

- ✓ Gas cylinders and welding machines must be left outside of the space
- ✓ Heavy equipment mounted on wheels must be securely blocked to prevent movement
- ✓ The space must be ventilated with clean, breathable air by a mechanical system

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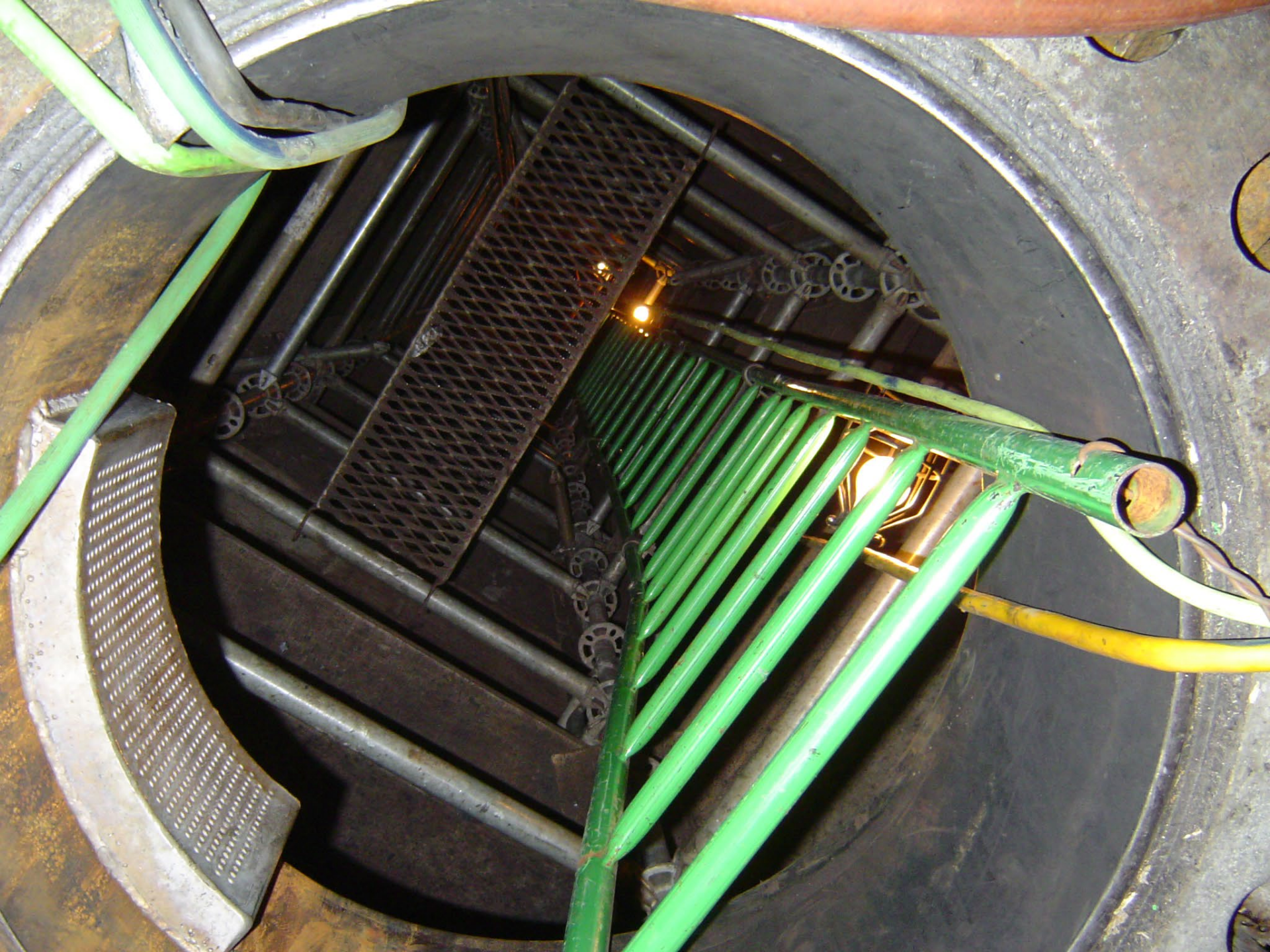

Confined Spaces

- ✓ Means of emergency retrieval must be provided
- ✓ An attendant with a pre-planned rescue procedure must be located outside the space
- ✓ The attendant must be trained in the hazards of confined spaces

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Confined Spaces

When arc welding is suspended for any substantial period of time:

- ✓ Electrodes must be removed from the holders
- ✓ Holders must be located so that accidental contact cannot occur
- ✓ The machine must be disconnected from the power source

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Confined spaces

When the torch will not to be used for a substantial period of time:

- ✓ Valves must be closed & gas supply positively shut off at some point outside the confined area
- ✓ Where practicable, the torch and hose must also be removed from the confined space

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Oxygen-fuel gas welding

- ✓ Acetylene cannot be used at a pressure in excess of 15 psig or 30 psia
- ✓ The use of liquid acetylene is prohibited
- ✓ Only approved apparatus may be used

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Oxygen-fuel gas welding

- ✓ Portable cylinders used for the storage and shipment of compressed gases must be constructed in accordance with the regulations of the U.S. Department of Transportation, 49 CFR Parts 171-179.

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- Acetylene Cylinders are filled with Calcium Silicate

Oxygen-fuel gas welding

- ✓ Cylinders must be legibly marked to identifying their contents
- ✓ Markings must not be easily removed
- ✓ Whenever practical, the marking must be located on the shoulder of the cylinder

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OXYGEN, COMPRESSED
UN 1072
OXYGEN
2


ACETYLENE
UN1001
FLAMMABLE GAS
DT30
Labelmaster, Chicago, IL
DANGER! Flammable Gas. May Form Explosive Mixtures With Air.
KEEP AWAY FROM HEAT, FLAME AND SPARKS

Cylinder Storage

- ✓ Cylinders stored in buildings must be in a well-protected, well-ventilated, dry location
- ✓ Stored away from heat sources
- ✓ 20 feet from highly combustible materials
- ✓ Stored in assigned places away from elevators, stairs, or gangways.

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Cylinder Storage

- ✓ Storage space must be located where cylinders will not be damaged or tampered with
- ✓ Cylinders must not be kept in unventilated enclosures
- ✓ Empty cylinders must have their valves closed

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Cylinder Storage

- ✓ Oxygen and acetylene cylinders in storage must be separated by 20 feet or a 1/2 hour fire wall
- ✓ The cap must be in place except when cylinders are in use or connected for use

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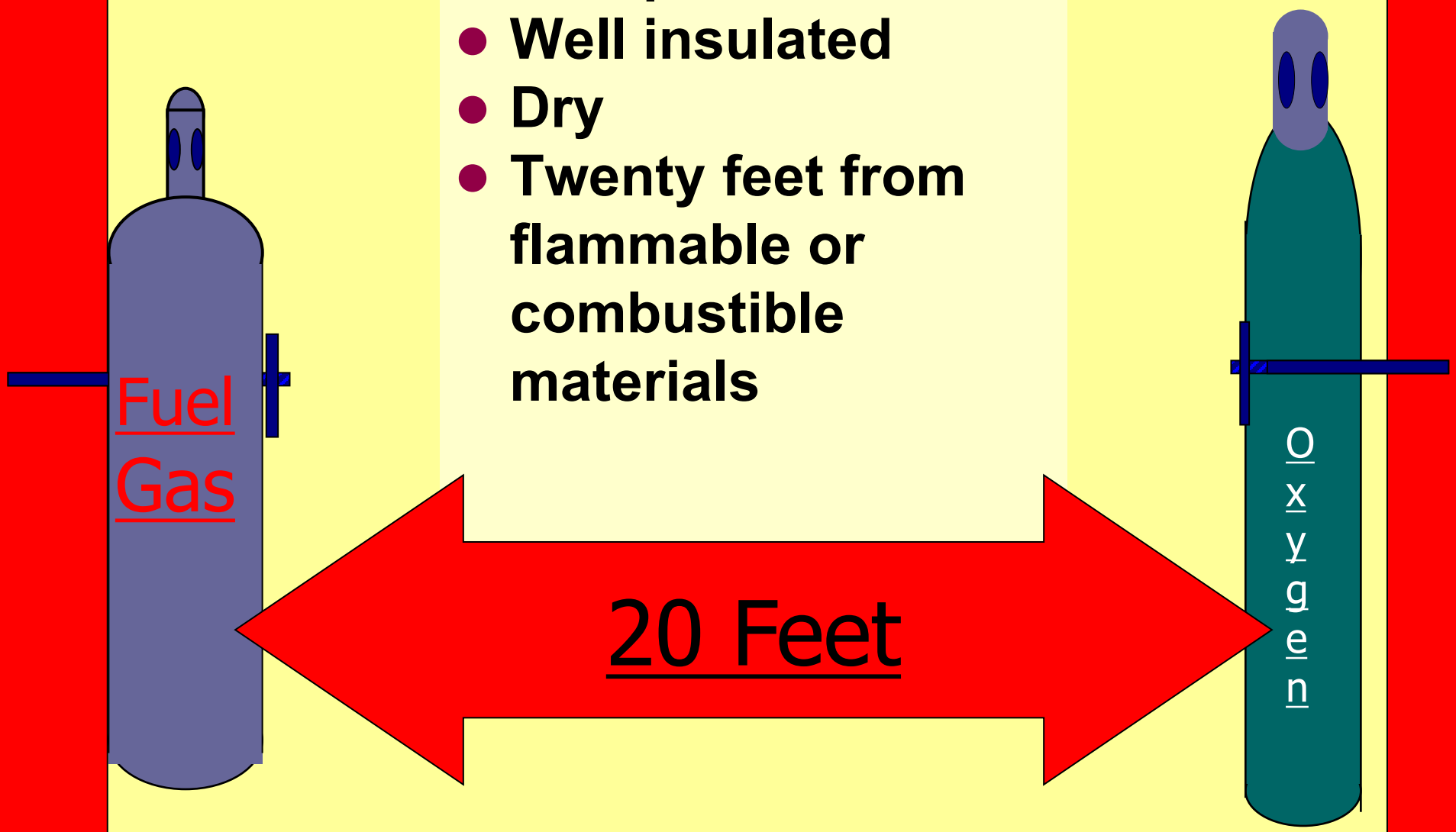
Indoor Cylinder Storage

- **Well protected**
- **Well insulated**
- **Dry**
- **Twenty feet from flammable or combustible materials**



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Cylinder Storage

- ✓ Cylinders in storage must be limited to a total gas capacity of 2,000 cubic feet or 300 pounds of liquefied petroleum gas
- ✓ Storage in excess of 2,000 cubic feet or 300 pounds must be in a separate room or kept outside
- ✓ Storage rooms or compartments must have no open flames and be well ventilated

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FULL CYLINDERS


Is This Correct Storage of an Oxygen Cylinder?

Oxygen-fuel gas welding

- ✓ Cylinders, valves, couplings, regulators, hose, and apparatus must be kept free from oily or greasy substances.

- ✓ Oxygen cylinders or apparatus must not be handled with oily hands or gloves.

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Transporting Cylinders

- ✓ When transporting cylinders by a crane, a cradle or suitable platform must be used
- ✓ Slings or electric magnets must not be used
- ✓ Valve-protection caps must always be in place
- ✓ Regulators must be removed
- ✓ Caps must not be used for lifting

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Transporting & Moving Cylinders

- ✓ Valve protection caps must be in place and secured.
- ✓ Hoist cylinders by cradle or pallet…not by choker, magnet or valve cap.
- ✓ Cylinders must be secured on truck, cart, or other device while in use & upright at all times.

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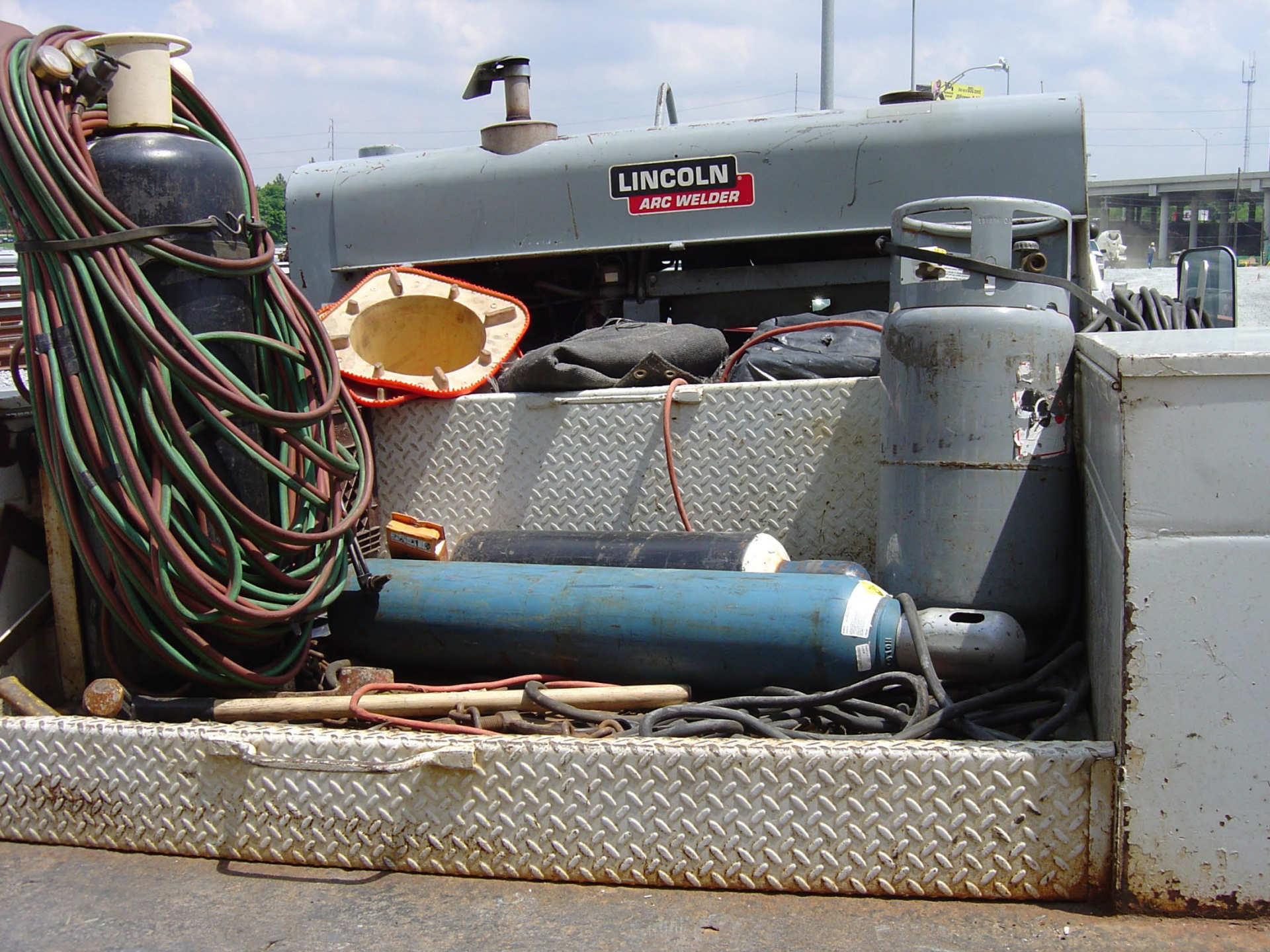
LINCOLN
ARC WELDER

Oxygen-fuel gas welding

- ✓ Cylinder valves must be closed when work is finished
- ✓ Valves of empty cylinders must be closed

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Oxygen-fuel gas welding

- ✓ Cylinders must be kept away from welding operations so sparks or flames will not reach them, or shields must be used

- ✓ Cylinders must not be placed where they might become part of an electric circuit

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Oxygen-fuel gas welding

- ✓ Cylinders must be kept away from radiators, piping systems, layout tables, etc., that may be used for grounding electric circuits such as for arc welding machines
- ✓ Tapping an electrode against a cylinder to strike an arc is prohibited
- ✓ Cylinders must never be used as rollers or supports

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Oxygen-fuel gas welding

- ✓ Before connecting the regulator, the valve must be opened slightly for an instant and then closed
- ✓ Always stand to one side of the outlet when opening the cylinder valve
- ✓ Equipment must be installed and used in a manner approved by the manufacturer

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Protective Equipment, Hose & Regulators

Pressure relief devices:

- ✓ Service piping systems must be protected by pressure relief devices set to function at not more than the design pressure of the systems and discharging upwards to a safe location

Oxygen-fuel Gas Welding
Piping Protective Equipment

- ✓ Fuel-gas and oxygen piping systems must incorporate protective equipment
- ✓ Prevents backflow of oxygen into the fuel-gas supply system
- ✓ Prevents passage of a flash back into the fuel-gas supply system

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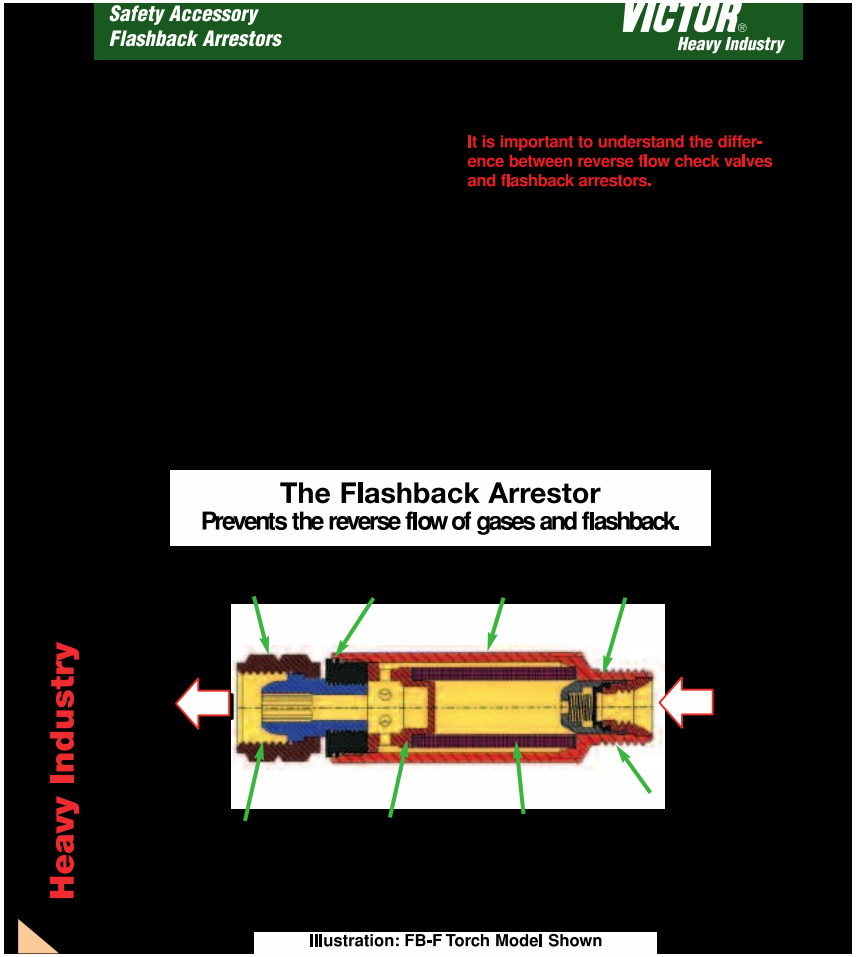
Flash Arrestors -The Real Story

- Flash Back Occurs at the Torch Head
- Flash Arrestors Should be Installed at the Torch Head
- Many New Torch Heads, (victor) have flash arrestors built in
- Mfg. State – Installation of another set of flash arrestors not recommended



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USE NO OIL
LISTED COMPRESSED GAS
MODEL NO. 25- 15C
REGULATOR
HARRIS CALORIFIC CO
GAINESVILLE, GEORGIA
BOC GASES

Oxygen-fuel gas welding

- ✓ Hose for oxy-fuel gas service must comply with the Specification for Rubber Welding Hose, 1958, Compressed Gas Association and Rubber Manufacturers Association

- ✓ When parallel lengths of oxygen and acetylene hose are taped together, not more than 4 inches out of 12 may be covered by tape

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Oxygen-fuel gas welding

- ✓ Hose connections must comply with the Standard Hose Connection Specifications, 1957, Compressed Gas Association
- ✓ Hose connections must be securely fastened to withstand twice the pressure to which they are normally subjected
- ✓ Hose showing leaks, burns, or other defects must be repaired or replaced

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Pressure-Reducing Regulators

- ✓ Pressure-reducing regulators must be used only for the gas and pressures for which they are intended.

- ✓ Regulators and gauges may only be repairer by skilled mechanics who have been trained to do so.

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Pressure-Reducing Regulators

- ✓ Gages on oxygen regulators must be marked "USE NO OIL“
- ✓ Connections on regulators must be inspected for leaks before use

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Arc Welding & Cutting

- ✓ Workers designated to operate arc welding equipment must be properly instructed and qualified

- ✓ Control apparatus must be enclosed except for the operating wheels, levers, or handles

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Arc Welding & Cutting

- ✓ Terminals for welding leads must be protected from accidental contact by personnel or metal objects

- ✓ Electrode holders must be placed so that they cannot make contact with persons or other objects

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Good welding hood but
inadequate skin protection

Arc Welding & Cutting

- ✓ Cables with splices within 10 feet of the holder must not be used

- ✓ The welder should not coil or loop welding electrode cable around parts of his body

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LN-25
LINCOLN ELECTRIC
LINCOLN
ARC WELDER
Miller

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Miller
Trailblazer 250G
'87 4 29

Resistance Welding – Safety Controls

- ✓ Installation
- ✓ Thermal protection
- ✓ Personnel
- ✓ Guarding
- ✓ Spot and seam welding machines
- ✓ Voltage
- ✓ Capacitor welding
- ✓ Interlocks
- ✓ Guarding
- ✓ Shields
- ✓ Foot switches
- ✓ Stop buttons
- ✓ Safety pins
- ✓ Grounding

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Test

- What is the minimum storage distance between Oxygen and Acetylene Cylinders?
- Answer – 20 Ft. or ½ Hour Fire Wall 5 Ft. High
- What is the danger of oil on a Oxygen Cylinder Gauge?
- Answer - Fire or Explosion Danger
- How Long is a Fire Watch Required to Monitor the Work Area After the Welding Has Ended? Why?
- Answer - 30 Minutes, Metal Retains Heat!

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Test

- You Can Spice a Welding Lead within 5 ft of the Electrode Holder? True or False?
- False – No closer than 10 Ft.
- The Welder's Helper Must Wear the Same Eye Protection as the Welder? True of False?
- Yes

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What Can Happen When you DO IT WRONG!

Thank You For Attending!

Final Questions?

1-800-NC-LABOR

(1-800-625-2267)

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Handouts

Place all handouts at the end of this presentation

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