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CODE OF PRACTICE

FOR THE **THERMIT**®

QUICK WELDING PROCEDURES

SKV-F- Elite Multiple Use & Single-Use
Crucible Systems



THERMIT AUSTRALIA PTY. LTD.

A member of the Goldschmidt-Thermit-Group

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1. SAFETY FIRST

Before any welding operations are undertaken it is mandatory that all relevant track safety procedures and regulations are observed.

It is also important that the correct, approved safety apparel is worn. Hard hat (if required), Overalls, Orange Safety Vest, Steel Cap Safety Boots, Welding Spats, Heavy Duty Reinforced Palm Insulated Welding Gloves, Ear Muffs, Safety glasses, Full Face Shield with Shade 5 Visor and high impact clear visor attachment for all welding and grinding operations, are all essential items of safety wear.

Special attention should be paid to the following:

1. Store igniters separate from portions and never keep them in pockets of clothes.
2. Protect welding portions, crucibles and moulds against moisture. Never let reacting welding portions or hot reaction products come into contact with water, never use water for fire extinguishing purposes; in case of need cover with dry sand.
3. Observe safety – distances (3m) during the **THERMIT** reaction; specified safety apparel and PPE must be worn for all tasks undertaken.
4. Hot slag pans must always be deposited in a safe position on a dry and none inflammable ground.
5. Make sure that the gas equipment is free from leaks and that the coupling nuts at the preheating torch hand piece are securely tightened. Before the preheating torch is lit first open oxygen valve and then gas valve. When the preheating torch is shut off, first turn off gas valve and then oxygen valve.

In case of flame – Flash-back, which is noted by a high shrill hissing sound, quickly close the oxygen valve and then the gas valve.

6. Specified PPE must be worn during grinding work. Never use grinding equipment without safety guards. Protect surrounds from grinding sparks.
7. All Oxygen and Fuel gas equipment and cylinders should be used, stored and maintained to manufacturer's instructions, including regular safety maintenance checks as specified by the manufacturer and or relevant authorities.
8. **Thermit** welding is a skilled operation and can be a potentially hazardous if not carried out by fully qualified personnel. **Thermit** welding operations should only be undertaken by designated personnel who have attended the appropriate **Thermit** welding course and obtained a valid certificate of competence issued by **Thermit** Australia Pty. Ltd. or an approved training body.
9. The information contained in this Code of Practice is applicable to the SKV-F/E and SKV-F/E Single- Use Crucible welding processes. **Thermit** Australia Pty. Ltd. has a policy of continual development, therefore the information issued in this Code of Practice is for guidance purposes only and is subject to change.

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2. WELDING MATERIALS

The following weld materials are required in sufficient quantities and have to be stored in a secure and dry place:

- THERMIT welding kits or
- Welding portions
- Moulds for respective rail profile
- Underfoot Base Plates (3piece mould system only)
- Luting sand for luting the moulds or alternately
- Luting Putty
- Igniters
- Multiple-Use or Single-Use crucibles
- Crucible thimbles (Multiple-Use Crucibles only)
- Oxygen – as required *
- Propane – as required *
- Refer to manufactures and suppliers handling, storage and usage instructions*

Storage of Portions

Store portions in a secure and dry place and keep them protected against moisture.

On the welding sites, the portions should remain in the containers until use.

Never use welding portions that have become damp or wet, even if they have been dried out.

Igniters

Tubes of igniters should be stored in a locked steel container. Store igniters separate from the welding portions – never store together in the welding portion containers.

The HAZ CHEM notice to be displayed is 1Z.

Moulds

Store moulds in a secure and dry place and keep them protected against moisture at all times.

Luting Sand & Luting Putty

The luting sand must be uniformly moist throughout (6 per cent).

Dry sand may be prepared with water, one day prior to usage.

Alternately for purpose designed moulds luting putty can be supplied, which is conveniently packed in 1.2kg plastic sealed packs in the weld kits or mould units.

3. PREPARING THE RAIL

Ballast under the rail weld site should be removed to obtain adequate working space. After removing the ballast, the rail fastenings are removed for at least 2 sleepers on each side of the joint.

Existing base plates and fastenings in the immediate weld location should be covered with heat protection covers.

4. RAIL END PREPARATION

In most cases the welding gap is prepared using a rail disc saw. After cutting the rail and measured weld gap ensuring a square cut, the rail ends are carefully ground clean approximately 50mm back along from each rail end, removing dirt, grease, paint and excessive rust. The rail, including underneath the base at the immediate weld joint area, should also be thoroughly cleaned with a wire brush.

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5. USE OF SETTING GAUGE

The Setting Gauge has four main functions and is used for the following:

1. Ensure the correct weld gap is set for the Thermit welding process being carried out.
2. Ensure correct positioning of the Rail Clamp, using the long leg of the setting gauge.
3. Set the correct Preheating Torch tip height, using the short leg of the setting gauge, and finally,
4. To set the correct Crucible pouring height above the moulds, using the setting gauge thickness*
(*Used in conjunction with Multiple-Use Crucible System only)

The weld gap size should be set to the relevant **Weld Data Sheet** for the specified process being carried out, and the weld gap set within a tolerance of ± 1 mm.

Remember weld gaps should always be checked with the correct setting gauge and never guessed.

6. ALIGNMENT AND ELEVATION OF THE RAIL JOINT

After checking the weld gap, the rail ends are aligned using a 1 metre straight edge. The next step is to elevate and align the rail joint. The top surface of the rail is elevated using steel wedges or lifting jacks and an alignment frame. Care must be taken to ensure that the 1 metre straight edge is placed centrally over the weld gap. Hammer home the wedges between the rail and sleeper plates on both sides of the joint until each end of the centrally positioned 1 metre straight edge are 1.5 to 2mm above the running surface. This measurement should always be checked with the recommended taper gauge. Elevation of the running surface is necessary to compensate for shrinkage of rail ends after welding.

The rail foot should then be aligned and any lateral twist taken out before final gauge face alignment is obtained. This operation can be carried out with steel wedges and a 300mm long straight edge.

A final rail joint top running surface and gauge face alignment check should be carried out.

7. THE UNIVERSAL RAIL CLAMP

The universal rail clamp has three main functions.

First, it must hold the mould shoes and sand moulds firmly against the rail.

Secondly it holds the pre-heater support and preheating torch assembly.

Its third function is to hold the crucible and crucible stand assembly, which in turn holds the portion.

Now that the rail is aligned for welding the universal rail clamp must be set correctly using the distance gauge, which is the long leg of the height gauge. Because of the important role it plays it is crucial to secure the rail clamp firmly to the railhead by means of a clamping screw. Make sure the rail clamp is vertical without cant after tightening to the rail.

8. ADJUSTABLE PRE-HEATER SUPPORT

After the rail clamp has been correctly positioned the adjustable pre-heater support is fitted onto it.

The adjustable pre-heater support goes onto the centre short post of the rail clamp, and has backwards, forwards and side ways adjustment so that the correct alignment of the pre-heating torch in relation to the weld gap can be easily obtained. With the pre-heating torch attached set the adjustable pre-heater support into position, and then adjust the preheating torch height so that the short leg of the gap gauge is a neat fit between the top of the rail and the preheating tip. The adjustable pre heater support height is adjusted by means of a locking collar fitted onto the centre post. The preheating torch tip height is set in accordance with the **Weld Data Sheet** for the Thermit welding process being carried out and the rail profile being welded.

9. FITTING OF SAND MOULDS

Sand moulds must be kept in secure and dry storage and protected against moisture at all times. Before fitting the sand moulds check for cracks, damage or moisture contamination, and check that the pouring channels and air vents are clear.

Only sand moulds that fit the rail profile correctly can be used.

Existing base plates and fastenings in the immediate weld joint location should be covered with heat protection covers.

Fitting of 2-Piece Mould System

Before fitting and prior to rubbing in the moulds to the rail profile, check moulds for damage and that pouring channels and air vents are clear. Only moulds which fit the rail profile correctly should be used. Fit the moulds centrally to the weld gap, fit first one half on the outside (field side) of the rail, then fit the second mould half to the inner side (gauge side) ensuring a flush fit top and bottom to the first mould half.

Carefully tighten the swivel arm screws of the universal rail clamp evenly to both sides of the mould shoes, apply firm pressure to ensure a firm fit, but do not over tighten.

Re check the correct fitting of the moulds under the rail foot.

Fitting of 3-Piece Mould System and Underfoot Base Plate

Before fitting Underfoot Base Plates and Sand Moulds check them for damage and that pouring channels and air vents are clear. First fit the Underfoot Base Plate into the Underfoot Base Plate Support Clamp, deposit luting paste (tube type) into grooves provided on each side of the underfoot mould plate. Place the underfoot mould and base plate support underneath the rail foot, lift and position centrally to the weld gap. Once firmly located, tighten the locking screws. To ensure good seal, tap the base plate support clamp lightly on the under side, then retighten the locking screws. Take extra care when locating the base plate onto the rail that the paste does not contact the underfoot of the rail until finally aligned, as paste may stick and have to be reapplied.

Before fitting the moulds, carefully seal the underfoot base plate to the underfoot of the rail with luting sand, ensuring a good firm seal along the both sides. After fitting and sealing of the underfoot-base plate, fit the sand moulds by fitting the first mould half on the outside (field side) of the rail, central to the welding gap. Take second mould half and fit to the inner side (gauge side) ensuring a flush fit top and bottom to the first mould half and underfoot base plate.

Carefully tighten the swivel arm screws of the universal rail clamp evenly on both sides of the mould shoes, apply firm pressure to ensure a firm fit, but do not over tighten. Re check the correct fitting of the moulds to the underfoot base plate.

10. CHECK FIT OF POURING PLUG

The pouring plug is a sand core fitted with a wire positioning loop and designed to be a neat fit in the centre riser aperture of the sand moulds.

After checking the fit the pouring plug is removed. The pouring plug should be kept dry and safe from damage and ready for pre-heating.

11. LUTING (SEALING) UP THE SAND MOULDS

Luting is the name given to the process by which a sealing material is packed between the mould shoes, the sand moulds and the rail.

Thermit luting material, which is a mixture of bentonite and special high quality sand, is supplied with the sand moulds in a pre-mixed dry or pre-packaged ready to use wet condition.

To prepare the dry luting material water is added and then thoroughly mixed until a suitable consistency is obtained. The mixture should be moist but not wet, 6% earth moisture.

A guide to the correct consistency of sand can be obtained by employing a drop test. After thoroughly mixing, a handful of luting sand is compressed and dropped onto a flat surface from a height of approximately 500mm. The correct mix will cause the ball to break open; if the mix is too wet, the ball will splatter.

Before commencing luting operations the luting cards must be fitted. The luting cards are supplied with the Thermit welding consumables and are used to protect the rail head and weld gap. Slide two luting cards along the head of the rail between the sand moulds and the top of the rail head. This placement of the luting cards prevents luting sand from falling into the weld gap during luting operations, which can result in sand inclusion and porosity in the foot area of the weld. Failure to use the supplied luting cards will also cause sand burns and pitting on the rail head. Luting cards are also used to cover the side riser holes of the moulds.

Before commencing luting operations the steel sand tray must be positioned under the prepared weld gap. Commence luting under the rail foot, taking care that the luting sand is pressed firmly on the correct side of the luting groove under the foot of the rail.

Luting then continues on both sides of the moulds towards the head of the rail. Again luting sand must be pressed firmly into the luting strip of the mould shoes. The gap between the rail head and the mould is luted up with the aid of a luting tool or spatula. A layer of luting sand is then pressed firmly onto the outside pouring lips of the mould shoes as well as the rail clamp arm T screws to protect the threads. Alternately for purpose designed moulds luting putty can be supplied, which is conveniently packed in 1.2kg plastic sealed packs in the weld kits or mould units.

The slag pans are then fitted to the lugs on the outside of the mould shoes. Protect the rail head outside of the moulds with a set of large and small rail protecting covers.

12. PREPARATION AND POSITIONING OF THE MULTIPLE-USE CRUCIBLE (MUC)

At the beginning of each day or shift the Multiple-Use crucible to be used is preheated. Before the first weld is made the crucible must be positioned in its stand on firm ballast or ground, and dried with the oxygen LPG preheating torch equipment using a soft soaking flame. The crucible should be preheated for a minimum of 20 minutes for a pre used crucible and a minimum of 30 minutes for a new, unused crucible, and then dried until all evidence of moisture is eliminated. This preheating operation can be undertaken during the weld set up time.

The crucible must be allowed to cool to near 100 degrees before inserting the automatic tapping thimble and loading the Thermit portion. If necessary the temperature of the inner wall may be measured with the appropriate temperature-indicating crayon.

After the crucible has been sufficiently dried and cooled the crucible and stand assembly are placed on the long post of the rail clamp and clear of the moulds. A check should be made to ensure that the correct crucible pouring height is obtained by adjusting the height of the crucible so that the distance between the base of the crucible and the upper edge of the mould is approximately 25mm.

This adjustment is easily performed using the screw-locking collar on the long post of the rail clamp.

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The crucible is then positioned above the moulds and clearance checked using a gap setting gauge to ensure correct positioning.

The pouring plug is then placed into the top of the moulds and the crucible centered by sighting the pouring plug locating wire loop through the aperture in the base of the crucible.

The crucible stand is fitted with an adjustable arm and locking screw, and by slackening the screw the crucible and stand, as a unit, can be moved to make the required central pouring alignment. The crucible must be vertical and central to the moulds. After adjustments to obtain the correct pouring position have been made the crucible is swung back clear of the moulds.

The crucible is now ready for insertion of the automatic tapping thimble and charging with the Thermit portion. The automatic thimble is removed from its packaging and placed onto the magnetic end of the applicator. The thimble is then inserted into the tapered aperture at the bottom of the crucible. Using the applicator and the palm of the hand the thimble is tapped gently to ensure that it is seated firmly in the base of the crucible. Using undue force to ensure correct seating of the thimble may result in damage and a premature tap. With the thimble applicator still in position the thimble sealing powder is distributed evenly around the thimble cap – the deflector on the applicator will help distribute the sealing powder evenly.

The applicator must be twisted several times before removal to ensure no sealing powder remains on top of the deflector. Remove the applicator carefully and check that no sealing powder has fallen into the thimble cap – if so it must be removed as a delayed tapping time may result.

In addition always ensure that automatic tapping thimbles do not remain in hot crucibles for extended periods, as this can cause premature tapping.

14. PREPARATION AND POSITIONING OF SINGLE-USE CRUCIBLE (SUC)

After carefully removing the single-use crucible container lid and prior to loading, check crucible inner wall is free from damage, also ensure pre installed thimble in base of crucible is clear of obstruction. This may require turning the crucible container upside down to empty out and remove any loose sand particles.

Central placement and positioning of the single-use crucible is done automatically by the alignment lugs on the top of the mould shoes. The pouring height of 25mm is also preset by the crucible container support lugs on the top of the mould shoes.

15. LOADING THE CRUCIBLE

Before charging the crucible with a Thermit portion, each portion bag should be checked to ensure the correct portion has been selected. Thermit portions are supplied in either sealed polythene bags or plastic pails.

They are individually identified by the following information: Rail size and type of portion and process, batch number, date of manufacture, portion number.

Before opening the Thermit portion bag or pail the packaging should be carefully inspected for damage. If damage is noted the portion should not be used.

To ensure thorough mixing open the portion bag or pail and carefully pour the portion powder into a dry clean 20lt bucket, then carefully tip and mix into another dry clean 20lt bucket.

This operation should be carried out a **minimum** of 3 x 3 times into each bucket. Finally, carefully pour the whole contents through the fingers with a sifting action into the crucible, leaving the mixture cone shaped. Cover the crucible with a crucible cap to protect the Thermit portion against moisture.

The welding portion igniter must be on standby.

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16. PREHEATING OPERATIONS

For all preheating and gas cutting operations compact Dual Stage Oxygen regulators, Hi Flow Fuel Gas regulators fitted with 10mm I/D hoses, regulation flash back arrestors at the regulators and non return valves at the hand piece must be used. Manufactures guidelines for operational gas equipment usage should be strictly followed and adhered to. In-line check gauges should be used to set and monitor gas working pressures, ensuring gas working pressures are accurately maintained.

Before igniting the pre-heater first open the oxygen valve, then the propane valve, and then ignite the issuing gases, continuing to open both valves slowly until the oxygen valve is fully open. Then adjust the preheating torch flame giving flame cones of approximately 15-20mm and a neutral flame.

There are three basic flame settings:

the incorrect **oxidizing** flame characterized by blurry distorted cones at the tip and short noisy flame. This type of flame will result in melting during the preheat.

The incorrect **carbonizing** flame is caused by too much fuel gas being used. This flame setting has poor heating properties and results in extended preheating times. The correct **neutral** flame is the only setting that should be used.

After adjusting and setting the neutral flame, position the preheating torch with the adjustable pre-heater support attached onto the rail clamp centre post (ensuring central positioning above the moulds), and secure it by tightening the knurled locking screw.

Take care that the pre-heater torch height is adjusted correctly. Pre-heater flames of approximately 30 to 40 cm long should rise from the riser air vents in the sand moulds. The working pressures on the cylinder gauges must be observed and the preheating torch flame must never be an oxidizing flame. For guidance on the pressures required refer to the relevant **Weld Data Sheet**.

The preheat time, equipment strip down and weld shearing times must be accurately timed with a stopwatch.

The rail ends must be uniformly preheated to a temperature of around 950 to 1000 deg's. C, using the approved shade 5 welding visor or welding goggles during visual inspection.

At the completion of preheating operations, the rail ends should uniformly preheated and a strong bright orange in appearance.

17. FITTING THE POURING PLUG

During the preheat ensure that the pouring plug is dry by heating the plug in the mould side riser flames. After completion of the preheating, and prior to ignition of the Thermit portion, remove the preheating torch from the moulds and position the dry pouring plug in the space between the mould halves using a pair of fire tongs.

18. IGNITION OF THE THERMIT PORTION

Prior to ignition the sealing of the sand moulds must again be checked within 2 minutes of completion of the preheat. The crucible cap is removed and the ignition tape is inserted into the top of the Thermit portion mound leaving one third of the length exposed. The crucible cap is then refitted.

On completion of preheating the pre-heater is removed and the mould plug is fitted. The crucible is centrally located over the moulds and the ignition tape is lit with the preheating torch through the top of the crucible cap.

It is important that the Thermit reaction is only observed through the approved safety shade 5 welding visor or welding goggles. Be sure to observe the correct minimum safety distance of 3 meters during the Thermit reaction and pour.

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19. TAPPING THE CRUCIBLE

When the Thermit reaction is complete the thimble automatically releases the charge at the correct moment. On completion of the pour the crucible is carefully swung away to the side of the moulds.

20. REMOVAL OF EQUIPMENT

Approximately one minute after the completion of the pour the slag pans are removed using the small crow bars, and placed in a safe dry location. Emptying the slag pans must only take place after the slag has solidified. It is extremely dangerous to allow hot slag pans or their contents to come into contact with water.

Multiple-Use Crucible removal

After two more minutes the MU crucible stand assembly and rail protection covers are carefully removed.

The mould clamping T screws on the rail clamp are now released. Once released the universal rail clamp and mould shoes are carefully removed. This should be done no earlier than four and half minutes after the completion of the pour. After the specified waiting time has elapsed the top section of the sand moulds is **carefully** removed.

Care should be taken to ensure that the weld metal has completely solidified before final removal of the sand mould residue. For equipment removal times refer to the **Weld Data Sheet**

Single-Use Crucible removal

Approximately one minute after the completion of the pour the slag pans are removed using the small crow bars, and placed in a safe dry location. Emptying the slag pans must only take place after the slag has solidified. It is extremely dangerous to allow hot slag pans or their contents to come into contact with water.

After two more minutes the SU crucible is carefully removed from the top of the moulds by way of the crucible wire loop handle and provided SU crucible lifting bar. The rail protection covers are then also removed.

The mould clamping T screws on the rail clamp are now released. Once released the universal rail clamp and mould protectors are carefully removed. This should be done no earlier than four and half minutes after the completion of the pour. After the specified waiting time has elapsed the top section of the sand moulds is **carefully** removed.

Care should be taken to ensure that the weld metal has completely solidified before final removal of the sand mould residue.

For the 3-piece mould system the underfoot - base plate support clamp should only be released and removed on completion of shearing operations.

For equipment removal times refer to the **Weld Data Sheet**

21. TRIMMING THE WELD

A Hot Work Crate" must be place in the established Hot Work Area and used to store **all** waste materials prior to removal from the work site.

A hot set and wire brush should be used to clean away sand and sand mould residue prior to weld trimming operations. Removal of the excess weld metal on the head of the rail is carried out by trimming with a Thermit hydraulic weld shear. The risers must not be bent back either before or after trimming the rail head. Leave the risers on the rail foot. Remove them only using a hammer by tapping them in towards the rail web when completely cold.

22. REMOVING THE STEEL ALIGNMENT WEDGES & FRAMES

Approximately 15 to 20 minutes after trimming the weld remove the steel alignment wedges or alignment frame and jacks from under the rail. Ensure sleepers are correctly spaced and that ballast has been returned to the cribs and sleeper rings. Also ensure that adjacent sleepers are properly packed and rail correctly fastened.

23. GRINDING THE WELD

Under normal traffic conditions all welds must be ground on the day they are installed, using the specially designed rail profile grinder. Welds should not be finished ground until they have cooled to the rail temperature. If the minimum cooling time is not observed the weld will develop a hollow upon cooling. If a post weld heat treatment is to be applied it will be performed after preliminary grinding and before final grinding. See point 24 below.

Before beginning the final grind, make sure that the locking wheel is in the “locked” position so that the stone does not move. To ensure that a good straight surface without hollows is achieved, use a 1 metre straight edge frequently during preliminary grinding. Both the gauge face and running surface must be ground flush.

On completion of final grinding operations the welded rail should be checked for correct surface straightness and proper alignment. The final measurements must comply with the relevant Track Authorities Specification.

Finally, remove all excess sand and cast weld residue from the weld reinforcement area with the use of a blunt chisel or similar tool.

24. POST WELD HEAT TREATMENT

This process involves re-heating the weld metal using a special burner and takes place once the weld had been preliminary ground. The burner is coupled to the oxygen and propane gas cylinders using the required safety valves, regulators, flash-back arrestors and pressure gauges. The oxygen and propane pressure must then be set in accordance with the relevant **Weld Data Sheet**. The burner is then positioned in the universal mounting clamp and the height above the rail is fixed. The burner is then ignited and placed above the rail for a period specified in the Weld Data Sheet. After this time, the burner is removed and an insulating muffle is placed on the rail for the length of time specified in the **Weld Data Sheet**. Once the muffle is removed, the weld can be allowed to cool normally. Final grinding can take place once the weld is cool.

25. PERMANENT WAY FINISH

Any necessary work to be completed on the permanent way must be completed before leaving the work site. This may include such things as replacing ballast under welds, lifting and tamping sleepers, replacement or tightening of fastenings or any other necessary work.

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26. SAFETY DEPENDS ON YOU

When Thermit welds are carried out safety regulations of the welding authorities must be observed and special attention paid to the following:

Igniters stored separately from portions, and never kept in pockets or clothes. Welding portions, crucibles and moulds must be protected against moisture. Never let reacting portions or hot reaction products come into contact with water.

Never use water for fire extinguishing purposes – cover with dry sand.

Observe work safety distances at **all times** during the Thermit reaction and pour.

Remember, safety clothing and equipment must be used and worn at all times when carrying out welding, trimming and grinding operations.

Hot slag pans must always be deposited in a safe position on dry and not flammable ground.

Ensure that Oxygen and Fuel Gas Equipment maintenance checks are carried out.

Prior to use make sure the gas equipment is free from leaks and that the coupling nut of the pre-heater is tightened.

Before the pre-heater is lit first open the oxygen valve and then the gas valve. When turning off the pre-heater first turn off the gas valve and then the oxygen valve. In case of a flame flashback which is noted by a sure hissing sound quickly close the oxygen valve and then the gas valve

Safety clear high impact visors must be worn during all grinding work.

Never use grinding equipment without safety guards. Protect surrounds from grinding sparks.

People are important, health and safety is everyone's responsibility
Remember Always Work Safe

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