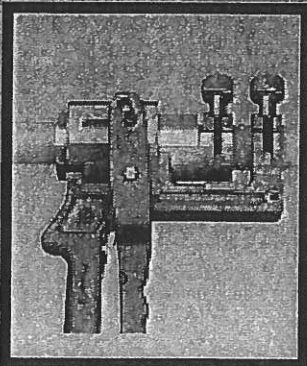
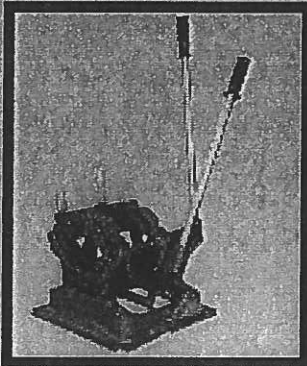
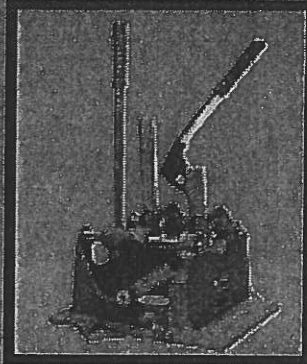
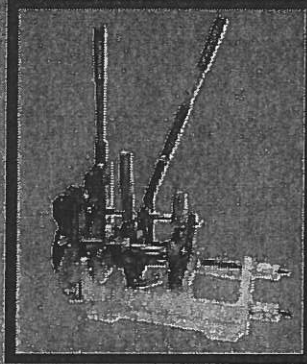


# Manual Butt Fusion Machine Procedure



## Manual Butt Fusion Machine Procedure

The principle of heat fusion is to heat two surfaces to a designated temperature, and then fuse them together by application of force. This pressure causes flow of the melted materials, which causes mixing and thus fusion. When the polyethylene material is heated, the molecular structure is transformed from a crystalline state into an amorphous condition. When fusion pressure is applied, the molecules from each polyethylene part mix. As the joint cools, the molecules return to their crystalline form, the original interfaces are gone, and the two pipes become one homogeneous unit.

The principle operations include:

Clamping	The pipe pieces held axially to allow all subsequent operations to take place.
Facing	The pipe ends must be faced to establish clean, parallel mating surfaces perpendicular to the centerline of the pipes.
Alignment	The pipe ends must be aligned with each other to minimize mismatch or high-low of the pipe wall.
Heating	A melt pattern that penetrates into the pipe must be formed around both pipe ends.
Joining	The melt patterns must be joined with a specified force. The force must be constant around the interface area.
Holding	The molten joint must be held immobile with a specified force until adequately cooled.

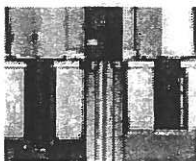
### BUTT FUSION OF PIPES AND COMPONENTS WITH DIFFERENT WALL THICKNESSES

When Butt Fusion is used to join pipes and other components together they must have the same outside diameter and the difference between minimum wall thickness dimensions for the two components being joined should not exceed 26%.

Example: You have a pipe or fitting that has a wall thickness of 1". You can weld that pipe to pipes or fittings that have a wall thickness of 3/4" min. or 1-1/4" max.

Important:

- The pipe line is only as strong as its weakest link.
- The fusion pressure used to join two different wall thicknesses is always that of the thinner.



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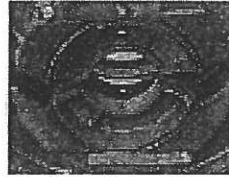


## Manual Butt Fusion Machine Procedure

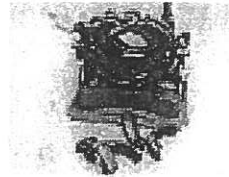
### Install Clamping Inserts

Select and install appropriate clamping inserts for the pipe that is being fused.

**No. 2LC & No. 2CU machines**  
(1/2" CTS - 2" IPS Pipe)  
1-1/2" and smaller inserts are fitted to jaw castings using flat head fasteners.



**No. 14 Pitbull Machines**  
(1" IPS - 4" DIPS Pipe)  
2" Master, 3" & 4" inserts are held in place by spring pins located on upper and lower jaws. 1-1/2" and smaller inserts are fitted to 2" IPS Master inserts using flat head fasteners.



### Loading Pipe Into Machine (No. 14 Pitbull Used In the Following Illustrations)

Clean the inside and outside of the pipe ends that are to be fused.

Open the upper jaws and insert pipe in each pair of jaws with applicable inserts installed.

Let the ends of the pipe protrude about 1" past the face of the jaws.

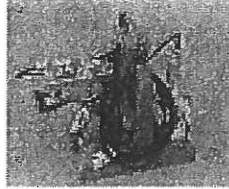
Close upper jaws but do not overtighten.



## Manual Butt Fusion Machine Procedure

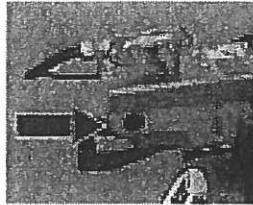
### Electric Facer

The facer is a McElroy Rotating Planer Block Design. The blade holders each contain two cutter blades. The Block rotates on ball bearings and is chain driven (enclosed in lubricant) by a heavy duty electric motor. When operating in a hazardous environment, operate the facer manually.



**▲ DANGER** Electric motors are not explosion proof. Operation of these components in a hazardous environment will result in explosion and death.

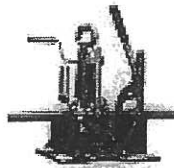
The armature brushes must be removed from the electric motor when manually operating in a hazardous condition. Unscrew the brush covers from both sides of the motor. (Both brushes must be removed). A 7/8" hex shaft allows for manual operation in hazardous conditions.



The facer has a handle that latches into place on a guide bar. The handle must be pulled out to unlatch and remove facer.

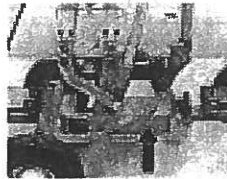
### Manual Facer for No. 2LC and No. 2CU

The manually operated facer has a hand powered crank. Turn the crank counterclockwise for facing.



### Cam Lock

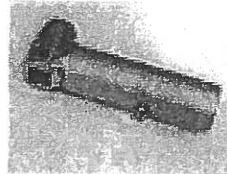
A semi-automatic cam locking system locks the movable jaw during the cooling cycle.



## Manual Butt Fusion Machine Procedure

### Optional Use Of Torque Wrench

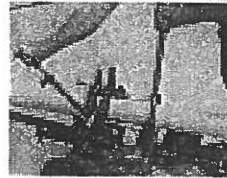
After the heating cycle is completed, remove the heater and quickly apply fusion force with the lever handle. To use a torque wrench with the No. 14 Pitbull, place an adapter in the lever socket.



P/N 410802

The locking cams will assist by holding force during the cooling cycle.

**CAUTION** Failure to follow the proper heating time, pressure and cooling time may result in a bad joint.



Torque Wrench Reading (Ft. Lb.)	No. 2LC Jaw Axial Force (Lb.)	No. 14 Pitbull Jaw Axial Force (Lb.)
10	70	115
20	135	215
30	200	330
40	260	435
50	320	545
60	400	660
70	480	780
80	550	915
90	635	1025
100	690	1140

### Interfacial Pressure (IFP)

Minimum 60 psi  
**Optimum 75 psi**  
 Maximum 90 psi

To determine the amount of force required:  
 $(OD-t) \times t \times 3.1416 \times 75$   
 (IFP) = Force

This value is then read on chart to determine how much torque is needed to apply the force.

## Manual Butt Fusion Machine Procedure

Manual Butt Fusion Machine Procedure

### Cooling Of The Fusion Joint

The fusion joint must be kept under pressure until the joint is cool. This time will vary with pipe size, wall thickness, heater temperature setting and environmental conditions.

There are three acceptable methods that can be used individually or combined.

- 1) Cool to the touch.
- 2) Timing "Guidelines Only" Chart.
- 3) Use pyrometer to measure temperature of the weld bead and compare it to the temperature of the pipe and or fittings being fused. If the temperatures are the same, the cooling requirement has been met.

**Notice:**

Heavier wall thickness pipes require longer cooling times.

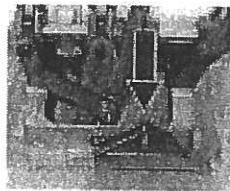
Allow the joint to cool an additional thirty (30) minutes minimum outside of the fusion machine before subjecting the fusion joint to any rough handling or severe bending.

### Timing "Guidelines Only" Chart

Wall Thickness of Pipe being Fused	Cooling Time at 74 ° F
Up to 0.2"	5 minutes
0.2" to 0.4"	5 to 10 minutes
0.4" to 0.6"	10 to 15 minutes
0.6" to 0.8"	15 to 20 minutes

### Remove Pipe and Inspect

After pipe has cooled sufficiently, apply closing force on the lever handle and push the locking cams down into the unlocked position. Unscrew the clamp knobs enough that they can be swiveled outward.



Pull pipe through machine, and prepare for making next fusion. Inspect joint and if it has to be redone, use Trouble Shooting Guides to determine problem and make adjustments before next fusion. (See pages 29 and 30)

## Manual Butt Fusion Machine Procedure

### Butt Fusion Joint Troubleshooting Guide

#### The Inspection Of The Fusion Joint

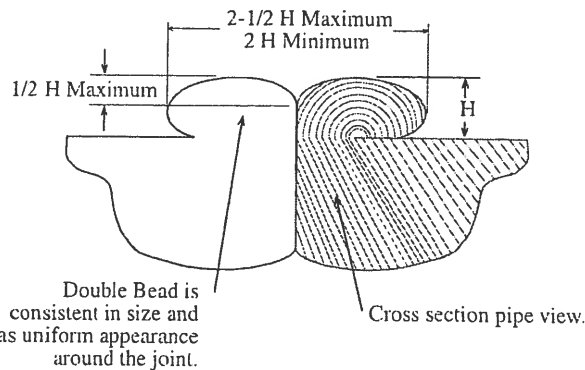
**Golden Rule: If in doubt, cut it out and redo.**

The double bead should be rolled over onto the adjacent surfaces, and be uniformly rounded and consistent in size all around the joint. As illustrated in the Figure below, the double bead width should be 2 to 2-1/2 times its height above the surface, and the v-groove depth between the beads should not be more than half the bead height.

When butt fusing to molded fittings, the fitting side bead may have an irregular appearance. This is acceptable provided the pipe side bead is correct.

It is not necessary for the internal bead to roll over to the inside surface of the pipe.

#### Butt Fusion Bead Proportions



## Manual Butt Fusion Machine Procedure

### Butt Fusion Joint Troubleshooting Guide

Observed Condition	Possible Cause
Excessive double bead width	Overheating; Excessive joining force
Double bead v-groove too deep	Excessive joining force; Insufficient heating; Pressure during heating
Flat top on bead	Excessive joining force; Overheating
Non-uniform bead size around pipe	Misalignment; Defective heating tool; Worn equipment; Incomplete facing
One bead larger than the other	Misalignment; Component slipped in clamp; worn equipment; defective heating tool; incomplete facing
Beads too small	Insufficient heating; Insufficient joining force
Bead not rolled over to surface	Shallow v-groove - Insufficient heating & insufficient joining force; Deep v-groove - Insufficient heating & excessive joining force
Beads too large	Excessive heating time
Squarish outer bead edge	Pressure during heating
Rough, sandpaper-like, bubbly, or pockmarked melt bead surface	Hydrocarbon contamination

Manual Butt Fusion Machine Procedure



## Tips For Success

What can I learn from others before getting started?



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**M McELROY**

Tips for Success

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## Tips for Success

Tips for Success

-  Use Personal Safety Equipment. Always wear a hard hat and protective boots. Gloves protect hands from heater burns and sharp blades on the facer. Protective Eye Glasses are also a good idea.
-  Make sure all equipment is in good working order and power cords are free of cuts with grounding blade on receptacle in tack.
-  Position fusion equipment on level ground whenever possible.
-  If the fusion equipment has wheels, set the wheel lock or block them.
-  Position pipe support stands on either side of the fusion equipment approximately 20' from ends of the fusion equipment. Adjust stands so that pipes are level to reduce drag.
-  When working with McElroy Self-Contained fusion units excluding the T-500 and T-900, make sure to open the facer valve prior to starting the unit and keep it open until started. Close valve once unit is running. This will save the battery and keep you from burning up the starter.
-  Plug heater in on self-contained fusion units only after unit has been started and warmed up. Unplug heater before turning fusion unit off. This will keep you from having heater element and circuitry problems with your heater.
-  Load loose pipe joints into movable side of the fusion equipment and pull joints already fused through non-movable side.
-  Check your pipe before you fuse it. Look for deep scratches, cuts and gouges. Use the 10 percent rule: Any imperfection affecting more than 10 percent of the pipe wall being worked with should not be used.
-  When rough cutting pipe, use a pipe wrap to mark the pipe with a reference line, this will aid you in making a square and even cut. In general, tooling that works with wood works well with HDPE pipe. For cutting pipe, skill saws and chain saws work well. When using chain saws, the cut ends MUST be cleaned with isopropyl alcohol to remove BAR Oil Splash or any other contaminants. For cutting holes in pipe, drills with hole saws and reciprocating saws work well.
-  When making fusions that involve pipe to fittings, special care should be taken. The necking down or toe in at the pipe ends, which is normal, needs to be completely removed in the facing process. This is seen primarily in working with the larger pipe diameters.
-  Do not abuse the facer when facing pipes by using too much pressure.
-  When pulling pipe through the fusion equipment, elevate pipe in the machine using the pipe lifts so the fusion bead clears all obstructions as it is pulled through.













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## Tips for Success (Continued)

-  If a fusion weld does not come out exactly as you like or you question the quality of the fusion weld, then cut it out and re-fuse. Always remember - **IF IN DOUBT, CUT IT OUT** and redo.
-  Fusion beads can be removed by means of external and internal bead removers without effecting the integrity of the fusion joint.
-  In inclement weather and especially in windy conditions, the fusion operation should be shielded to avoid precipitation or blowing snow and excessive heat loss from wind chill. Capping ends of pipe that are being fused aides heater from being chilled as fusion joint is being made.
-  The joint area and its parts that are being fused must be completely dry. No liquid of any kind running through the pipe or fittings is permissible.
-  When fusion is done in cold weather, **DO NOT INCREASE HEATING TOOL SURFACE TEMPERATURE.**
-  Do not try to shorten cooling times of fusions by applying wet cloths, water or the like.
-  When removing pipe from the fusing unit and pulling into place, use proper lifting slings and pulling heads in good condition. Chains and rope can slip and cause injury/damage to personnel and pipe.
-  When working with coiled pipe 2" - 6", a McElroy LineTamer™ should be used to straighten and reround coiled pipe to meet or exceed ASTM D-2513 Quality Requirements.
-  Squeeze tools can be used on HDPE Pipe to stop flow in a pipeline while a tie in or repair is made. Follow manufacturer's squeeze-off tool instructions.
-  A common obstacle when working with HDPE pipe in the field is understanding the thermal expansion and contraction.  
Rule of thumb - 1.4"/ 100' / 10°F.

Butt Fusion Joining Rates	
Pipe Sizes IPS/DIPS	Approx. Fusions per 8-10 Hr. Day
3/4" - 3"	30 - 60
4" - 8"	24 - 48
10" - 18"	12 - 24
20" - 24"	10 - 16
26" - 34"	8 - 12
36" - 48"	6 - 10
51.5" - 63"	4 - 8

**Important:**  
Fusions per day are dependent upon pipe wall thickness, equipment to move and handle pipe, manpower, site conditions and weather. Use lower number for estimation and planning.

Tips for Success

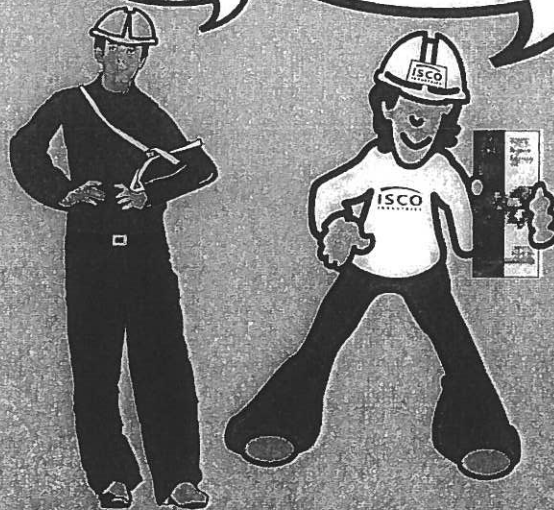


# Fusion Equipment Safety Information



How was I  
suppose to  
know?

Please read the  
Safety Section  
first.



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## Fusion Equipment Safety Information

### Safety Alerts


This hazard alert sign  appears in this manual. When you see this sign, carefully read what it says. YOUR SAFETY IS AT STAKE.

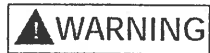



You will see the hazard alert sign with these words: DANGER, WARNING, and CAUTION.

 **DANGER** Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.



 **WARNING** Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.



 **CAUTION** Indicates a hazardous situation which, if not avoided, may result in minor or moderate injury.



In this manual you should look for two other words: NOTICE and IMPORTANT.

#### NOTICE:

Can keep you from doing something that might damage the machine or someone's property. It may also be used to alert against unsafe practices.

#### IMPORTANT:

Can help you do a better job or make your job easier in some way.

### Read And Understand

Do not operate fusion equipment until you have carefully read, and understand the "Safety" and "Operation" sections of this manual, and all other equipment manuals that will be used with it.



Your safety and the safety of others depends upon care and judgement in the operation of this equipment.

Follow all applicable federal, state, local, and industry specific regulations.

## Fusion Equipment Safety Information

ISCO Industries, LLC cannot anticipate every possible circumstance that may involve a potential hazard. The warnings in this manual and on the machine are therefore not all inclusive. You must satisfy yourself that a procedure, tool, work method, or operating technique is safe for you and others. You should also ensure that the machine will not be damaged or made unsafe by the method of operation or maintenance you choose.

### General Safety

Safety is important. Report anything unusual that you notice during set up or operation.

**Listen** for thumps, bumps, rattles, squeals, air leaks, or unusual sounds.

**Smell** odors like burning insulation, hot metal, burning rubber, hot oil, or natural gas.

**Sense** any changes in the way the equipment operates.

**See** problems with wiring and cables, hydraulic connections, or other equipment.

**Report** anything you see, feel, smell, or hear that is different from what you expect, or that you think may be unsafe.



### Wear Safety Equipment

Wear a hard hat, safety shoes, safety glasses, and other applicable personal protection equipment.

Remove jewelry and rings, and do not wear loose-fitting clothing or long hair that could catch on controls or moving machinery.

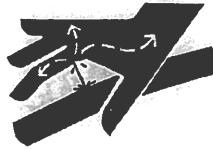


## Fusion Equipment Safety Information

### Units With Hydraulics

Although the hydraulic pressures in the machine are low compared to some hydraulically operated equipment, it is important to remember that a sudden hydraulic leak can cause serious injury or even be fatal if the pressure is high enough.

**▲ WARNING** Escaping fluid under pressure can penetrate the skin causing serious injury. Keep hands and body away from pinholes which eject fluid under pressure. Use a piece of cardboard or paper to search for leaks. If any fluid is injected into the skin, it must be immediately removed by a doctor familiar with this type of injury.



### NOTICE:

Wear safety glasses, and keep face clear of area when bleeding air from hydraulic system to avoid spraying into eyes.

### Heaters Are Not Explosion Proof

**▲ DANGER** Heaters are not explosion proof. Operation of a heater in a hazardous environment without necessary safety precautions will result in explosion and death. When operating in a hazardous environment, heater should be brought up to temperature in a safe environment, then unplugged before entering the hazardous atmosphere for fusion.



## Fusion Equipment Safety Information

### Electric Motors Are Not Explosion Proof

**▲ DANGER** Electric Motors are not explosion proof. Operation of these components in a hazardous environment without necessary safety precautions will result in explosion or death. When operating in a hazardous environment, keep pump motor and chassis in a safe area by using hydraulic extension hoses.



### Electrical Safety

**▲ WARNING** Always ensure power cords are properly grounded. It is important to remember that when you are working in a wet environment with electrical devices, proper ground connections help to minimize the chances of an electric shock.



Frequently inspect electrical cords and unit for damage. Damaged components need to be replaced and service performed by a qualified electrician. Do not carry electrical devices by the cord.

#### NOTICE:

Always connect units to the proper power source as listed on the unit, or in the owner's manual. On units with two power cords, plug each cord into separate power circuits. Do not plug into both outlets of one duplex receptacle.



#### NOTICE:

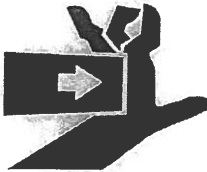
Disconnect the machine from the power source before attempting any maintenance or adjustment.



## Fusion Equipment Safety Information

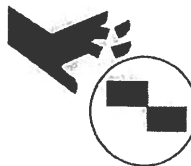
### Crush Points

**⚠WARNING** Hydraulically operated jaws are operated under pressure. Anything caught in the jaws will be crushed. Keep fingers, feet, arms, legs, and head out of the jaw area. Always check pipe alignment with a pencil or similar object.



### Facer Blades Are Sharp

**⚠WARNING** Facer blades are sharp and can cut. Never attempt to remove shavings while the facer is running, or is in the facing position between the jaws. Use care when operating the facer, and handling the unit.



#### NOTICE:

Disconnect power from the facer, and remove the facer blades before attempting any maintenance or adjustment.

### Heater Is Hot

**⚠CAUTION** The heater is hot and will burn clothing and skin. Keep the heater in its insulated heater stand or sling blanket when not in use, and use care when heating the pipe.



#### NOTICE:

Use only a clean non-synthetic cloth such as a cotton cloth to clean the heater plates.

### Fusion Procedures

**⚠CAUTION** Follow the procedures carefully, and adhere to all specified parameters. Failure to follow procedures could result in a bad weld. Always follow the proper fusion procedures.



## Fusion Equipment Safety Information

### Units With Gas Engines

**⚠WARNING** Handle fuel with care. Fuel is highly flammable. Do not refuel the machine while smoking or near open flames or sparks. Always stop the engine before refueling machine. Fill fuel tank outdoors. Help prevent fires by keeping machine clean of accumulated trash, grease, debris, and facer shavings. Always clean up spilled fuel.



**⚠WARNING** Breathing exhaust gases can cause sickness or death. Always operate machine outdoors in an area with adequate ventilation.



### Units With Batteries

**⚠CAUTION** Sulfuric acid in battery electrolyte is poisonous. It is strong enough to burn skin, eat holes in clothing, and cause blindness if splashed into eyes. Avoid contact with eyes, skin, and clothing. Exploding gases from battery could cause blindness or serious injury. Keep sparks, flames, and cigarettes away.



### Have Tires Properly Serviced

**⚠WARNING** Failure to follow proper procedures when mounting a tire on a wheel or rim can produce an explosion which may result in serious injury or death. Have tires mounted by someone that is experienced, and has the equipment to perform the job safely.



## Fusion Equipment Safety Information

### Periodically Check Temperature

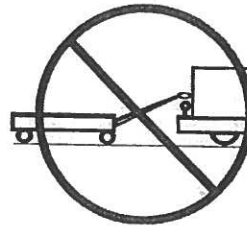
**NOTICE:**

Incorrect heating temperature can result in bad fusion joints. Check heater plate surface temperature periodically with a pyrometer, and make necessary adjustments. The thermometer on heaters indicates internal temperature, and should be used as a reference only.



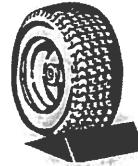
### Do Not Tow Fusion Machine At Speeds Greater Than 5 MPH

**WARNING** The chassis is not designed for over-road towing. Towing at speeds greater than five miles per hour can result in machine damage as well as injury. Always transport the machine by flat bed truck or similar means, and make sure that unit is properly secured.



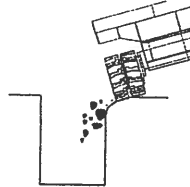
### Positioning Fusion Machine

Place fusion machine on as level ground as possible, and set the brake on the rear wheel. If it is necessary to operate machine on unlevel grade, chock the wheels and block the unit to make it as stable as possible.



### Keep Machine Away From Edge Of Ditch

**WARNING** Heavy equipment too close to a ditch can cause the walls of the ditch to cave-in. Keep the machine far enough away from the edge of the ditch to prevent injury to personnel and equipment from a cave-in.

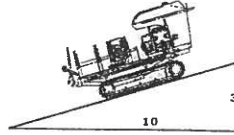


## Fusion Equipment Safety Information

### Operating TracStar Fusion Machines

Place fusion machine on as level ground as possible.

If it is necessary to operate machine on unlevel grade, make sure that the ground is stable. Some unstable conditions maybe ice, snow, mud, and loose gravel.



**⚠WARNING** For operation safety, never operate machine on a grade steeper than 30%. (A 3 foot elevation change in 10 feet.)

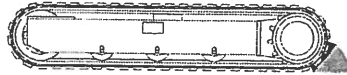
### Do Not Attempt to Tow A TracStar Fusion Machine

**⚠CAUTION** The machine is not designed for towing. Attempting to tow the machine can result in machine damage. Always transport the machine by flat bed truck or similar means, and make sure that unit is properly secured.



### Positioning Fusion Machine

Place fusion machine on as level ground as possible. If it is necessary to operate machine on unlevel grade, chock the tracks and block the unit to make it as stable as possible.



### Hearing Protection Required For TracStar 412 and TracStar 618.

When operating machine for more than four hours per day, wear hearing protection.



## Fusion Equipment Safety Information

### Safety Precautions For Guarding Against Static Electricity And Gaseous Ignition

**▲ DANGER** Polyethylene plastic pipe does not readily conduct electricity. A static electricity charge can buildup on inside and outside surfaces and stay on the pipe surface until some grounding device, such as a tool or a person comes close enough for the static electricity to discharge to the grounding device.



**▲ WARNING** Discharging one part of the pipe surface will not affect other charged areas because static electricity does not flow readily from one area to another. Polyethylene pipe cannot be discharged by attaching grounding wires to the pipe.

Heaters, electric facers and electric power tools are NOT explosion proof. Static electricity discharge can ignite a flammable gas or combustible dust atmosphere.

A static electricity discharge to a person, a tool, or a grounded object close to the pipe surface can cause an electric shock or a spark that can ignite a flammable gas or combustible dust atmosphere causing fire or explosion.

In gas utility applications, static electricity can be a potential safety hazard. Where a flammable gas-air mixture may be encountered and static charges may be present, such as when repairing a leak, squeezing-off an open pipe, purging, making a connection, etc., arc preventing safety precautions are necessary. Observe all procedures for static electricity safety and control, including procedures for discharging static electricity and requirements for personal protection.

Take steps to discharge static electricity from the surface of the polyethylene gas pipe. Such steps include wetting the entire exposed pipe surface with a conductive anti-static liquid or a dilute soap and water solution, then covering or wrapping the entire wetted, exposed pipe surface with grounded wet burlap, conductive poly film, or wet tape conductor. The external covering should be kept wet by occasional re-wetting with anti-static solution. The covering or tape should be suitably grounded such as to a metal pin driven into the ground.

Steps that discharge the outer surface do not discharge the inner surface of the pipe. Squeeze-off purging, venting, cutting, etc., can still result in a static electricity discharge. When appropriate, ground tools and remove all potential sources of ignition.

## Fusion Equipment Safety Information

### Safety Precautions For Guarding Against Static Electricity And Gaseous Ignition (Continued)

#### Key items:

**Do not** put a butt fusion machine chassis in a hazardous environment. Set the chassis up out of harms way and use extension hoses to operate upper works in hazardous area.

**Do not** use a butt fusion machine with an electric facer in a gaseous environment. Use a machine equipped with a hydraulic facer or convert the electric facer to a manual by removing the brushes and turning facer manually.

When making butt fusions, saddle fusions and socket fusions in a hazardous environment, set the generator up out of harms way and have the heater plugged into it there. Set the heater temperature at the maximum allowed for the application. Use 450° F for butt fusion and 510° F for saddle fusion and socket fusion. These are surface temperatures. The high side temperatures are used to compensate for the drop in temperature experienced when heater is unplugged from the power source to make fusion in hazardous area. Unplug heater prior to using in a hazardous environment.

**Do not** drill hole first prior to making a saddle fusion.

When prepping the main pipe for a saddle fusion, **do not** use an electric grinding tool. Prepare main pipe manually by use of 50-60 grit utility cloth.

**Do not** use an electric drill for punching hole through after saddle fusion has been made.

Use your senses and good judgment: Listen, Smell, Feel, See and Report any unsafe situations you see or see coming to your onsite contact, if corrective action is not taken in your opinion, **Do not** enter into the situation.

Fusion Hotline 1-800-345-ISCO ext. 4790

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