



Field Welding Procedure Loaders and Dozers Previously called LeT-1

Section 03-02

Komatsu has made every effort to make this manual as accurate as possible based on the information available at the time of publication and printing. Continuous improvement and advancement of product design may cause changes to machines, which may not have been included in this publication. Komatsu reserves the right to make changes and improvements at any time. To ensure the most current information, please contact your service center.

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Scope of This Publication

FIELD WELDING PROCEDURES provides instructions for welding structural components on all Komatsu loaders. To avoid personal injury or damage to machine components, it is essential to follow the instructions in this publication.

Safety

This publication contains special instructions that pertain to safety, operation, maintenance, and repair of the machine. Listed below are the signal words and symbols that precede these instructions and their meanings:


DANGER

- The danger label indicates a hazardous situation which, if not avoided, will result in death or serious injury.

WARNING

- The warning label indicates a hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION

- The caution label, used with the safety alert symbol indicates a hazardous situation which, if not avoided, could result in minor or moderate injury (includes the safety alert symbol ).

CAUTION

- The caution label (without safety alert symbol) is used to address practices not related to personal injury – only equipment damage.

NOTICE

The NOTICE graphic is to indicate areas of importance to the reader that are not related to personal injury or machine damage.

Safety, Warnings, and Cautions for Welding Repairs to Komatsu Equipment

WARNING

MULTIPLE HAZARDS

- Multiple hazards exist when working on a machine. Follow all applicable mine and local standards regarding procedures to be used for locking out a machine. Always turn the battery disconnect switch to the off position to isolate the 24VDC circuits and apply a safety lock to prevent the machine from being started while the welder is working and to prevent damage to the electronic controls of the engine. If the battery switch is not present or does not properly operate then disconnect the battery positive (+) and negative (-) battery. Failure to properly lockout a machine starting capability before working on the machine can cause multiple hazards resulting in serious injury or death.

INHALATION HAZARD

- Inhalation hazard exists when steam cleaning or burning paint off areas to be inspected. The cleaning process can be hazardous to personnel performing the cleaning process as well as to personnel in the general area. Inhalation from steam cleaning or from torch burning can occur. Make sure all local safety precautions are followed prior to, during, and after the cleaning process. Wear appropriate personal protective equipment (PPE) to prevent inhalation of fumes. Failure to wear proper PPE can cause inhalation hazards resulting in serious injury.

FIRE HAZARD

- Fire hazard exists when cutting off the ball. The area behind the ball may be filled with grease or other flammable contaminant. Always have a fire extinguisher nearby to put out any fires that result from cutting process. Failure to provide an appropriate fire extinguisher can cause a fire hazard resulting in serious injury or death.

CRUSH HAZARD

- Crush hazards exist if the machine is started or moved while work processes are being performed on the machine. Place bucket flat and level on the ground. Place frame lock in the locked position and lock out the machine's starting capability before performing any work process. Follow all applicable lockout procedures and local rules and regulations for performing work processes. ANYONE performing inspections or service procedures to the machine should be familiar with ALL instructions and procedures contained in the machine's SERVICE MANUAL. Crush hazard could occur if the machine is started or moves while any type of work process is being conducted on the machine, resulting in serious injury or death.
- Crush hazards exist in machine pivot area and area between the tires. Do not enter these areas unless it is verified that the operator has control over the steering and that personnel locking the frame lock have good communication with the operator. Entering the pivot area and area between the tires while the machine is moving or pivoting (articulating) could cause crush hazards resulting in serious injury or death.
- Crush hazards exist if all personnel are not cleared from the bucket and lift arm area before using the hydraulic hoist and bucket hydraulic pressure bleed down valves to relieve pressure from the hoist and bucket circuit. Assembly must be used only when the engine is NOT running. Before using the Manual Bleed Valve Assembly, refer to "HYDRAULIC AND GREASE SYSTEMS", "MANUAL BLEED VALVE ASSEMBLY", in Section 04 of the Service Manual for additional operational and safety information. Operating the manual bleed valve may cause the lift arms and bucket to descend rapidly. All personnel around the bucket and lift arms area shall be removed from the area before operating hydraulic hoist and bucket hydraulic pressure bleed down valves. Using the hydraulic bleed down valves could result in movement of the lift arms and bucket which could cause a crush hazard resulting serious injury or death.
- Crush hazards exist if standing under, working, or placing any body part under hoisted/suspended components. Never stand under hoisted/suspended components. Ensure appropriate lifting devices are used, and blocking is adequate to prevent the component from

unexpectedly moving during transportation. Refer to **SAFETY, WARNINGS, AND CAUTIONS** before attempting to remove the operator's cab. Failure to stay out from under hoisted/suspended components can cause crush hazard resulting in serious injury or death.

- Crush hazard exists when moving the ball. Install lifting eyes with at least 2000 pound (1000 kg) capacity to support the various pieces of the ball as they are removed. The balls are very heavy and if they were to fall they could cause injury or death. This is particularly true of the lift arm balls due to the height. Failure to provide equipment of sufficient strength to hold the weight of the ball can cause crush hazards resulting in serious injury or death.
- Crush hazard exists when using the lifting eye. It is critical to grind through the carburized layer on the surface to ensure proper weld quality on the lifting eye. Failure to grind through the carburized layer can result in a weld that will fail when weight is applied. This could cause the ball to fall resulting in a crush hazard. Failure to grind through the carburized layer can cause crush hazards resulting in serious injury or death.
- Crush hazard exists when using the lifting eye. Preheat is required when welding on a lifting eye in order to assure a quality weld suitable for lifting. Failure to preheat could lead to poor fusion and danger when lifting the ball. This could cause the ball to fall resulting in a crush hazard. Failure to properly preheat can cause crush hazards resulting in serious injury or death.
- Crush hazard exists when cutting the ball loose from the frame. The ball base is heavy and should be properly supported prior to cutting it loose from the frame. If the ball is not properly supported, it can fall and cause a crush hazard. Failure to properly support the ball prior to cutting it from the frame can cause crush hazards resulting in serious injury or death.
- Crush hazard exists when attaching the ball to the frame. The ball base is heavy and should be properly supported as it is attached to the frame. If the ball is not properly supported, it can fall and cause a crush hazard. Failure to properly support the ball when installing it on the frame can cause crush hazards resulting in serious injury or death.
- Crush hazard exists when lifting and removing the ball from the axle. The ball base is heavy and should be properly supported as it is removed from the axle. If the ball is not properly supported, it can fall and cause a crush hazard. Failure to properly support the ball when removing it from the axle can cause crush hazards resulting in serious injury or death.
- Crush hazard exists when lifting and attaching the ball to the axle. The ball base is heavy and should be properly supported as it is attached to the axle. If the ball is not properly supported, it can fall and cause a crush hazard. Failure to properly support the ball when attaching it to the axle can cause crush hazards resulting in serious injury or death.

CRUSH, SHOCK, OR OTHER HAZARDS

- Crush, shock, or other hazards exist if stored energy is not removed or isolated prior to working on the machine. Stored energy (hydraulic, electrical, pneumatic, mechanical, etc.) may be present if not isolated or released prior to working on the machine. Do not work on the machine without removing this stored energy (suspended loads, electrical power, air pressure, etc.). Risk of crushing, shock, or other physical injury exists if stored energy is not removed or isolated prior to working on the machine which could result in serious injury or death.

FALL HAZARDS

- Fall hazard exists when working at heights. Be sure to take appropriate safety precautions when working at heights on the rear and front frames or the lift arms balls. Follow all required statutory regulations for working at height. Wear fall restraint when necessary to prevent falls. Failure to take appropriate safety precautions, including wearing fall restraint when necessary can cause fall hazards resulting in serious injury or death.

FALL AND CRUSH HAZARDS

- Fall hazard or crush hazard exist when working on scaffolding. The scaffolding or work stand must have the capacity to hold 3-4 people and the ball. The scaffold could collapse if it is not built sufficiently to hold the weight. It must also meet all local safety requirements. Failure to provide an appropriate scaffold can cause fall or crush hazards resulting in serious injury or death.

BURN HAZARD

- Burn hazard exists when steam cleaning or burning paint off areas to be inspected. The cleaning process can be hazardous to personnel performing the cleaning process as well as to personnel in the general area. Steam burns or burns from torch burning can occur. Make sure all local safety precautions are followed prior to, during, and after the cleaning process. Wear appropriate personal protective equipment (PPE) to prevent burns. Failure to wear proper PPE can cause burn hazards resulting in serious injury.

BURN AND INHALATION HAZARDS

- Burn and inhalation hazards exist when welding or cutting on the machine. Cutting and welding can produce hot surfaces. Smokey condition can exist if a fire starts. Have qualified fire watch personnel present, and keep a fire extinguisher that meets all statutory regulations nearby during all cutting and welding operations. Failure to provide a qualified fire watch and an appropriate fire extinguisher can cause fire and inhalation hazards resulting in serious injury or death.

EYE INJURY HAZARD

- Eye injury hazard exists when steam cleaning, burning paint, or mechanically (such as wire brush on a grinder) cleaning the areas to be inspected. The cleaning process can be hazardous to personnel performing the cleaning process as well as to personnel in the general area. Make sure all local safety precautions are followed prior to, during, and after the cleaning process. Wear appropriate personal protective equipment (PPE) to eye injuries. Failure to wear proper PPE can cause eye injury hazards resulting in serious injury.

EXPLOSION HAZARDS

- Explosion hazard exists if welding on a tire rim. NEVER, under any circumstances, weld or use a cutting torch on a rim with a tire mounted. The tire must be dismantled prior to welding on the rim. Refer to the section of the Service Manual entitled "TIRE AND RIM MAINTENANCE" for deflation instructions. Failure to dismantle the tire prior to welding on a tire rim can cause an explosion hazard resulting in serious injury or death.

CAUTION

ELECTRICAL DAMAGE

- To ensure that no damage occurs to solid-state components, the welding ground clamp should be as close as possible to the area to be welded. Ground cable must be in close proximity to welding location. Engine must never be used as a grounding point.
- Under NO circumstances should a bearing or movable joint be between the grounding point and the area to be welded. Pin and bushing damage may be caused due to current flowing through an articulation, bushing or bearing joint.
- Isolate ALL DDEC and Cummins ECM components before beginning welding procedures. Damage to components could otherwise result. Welding on the engine or engine mounted components is NEVER recommended.
- Review all engine manufacturer warnings and labels and documentation for procedures for engine isolation prior to welding on Komatsu equipment.
- For machines with an articulating joint, make certain that the ground-strap in the pivot area is left firmly connected because this cable electrically "ties" the two frame sections together.
- If the welding unit is connected to commercial power such as in a shop area, the machine must be isolated from all other contacts to ground other than the welding ground clamp if possible. Machine attachments must not contact any steel wear rails in the floor. If an overhead crane is used to support any part of the machine, a nonconductive sling should be used.
- Do not disconnect the neutral from ground in the master junction box. Machines fitted with the optional ground fault system have this connection at the fault current limiting resistors.

- Remove in-line fuse to AFEX Fire Control System Circuit Monitor panel. Failure to do so may cause the system to actuate and/or damage solid-state components of the system. Replace in-line fuse after completing welding operations.
- Loaders with electric/hydraulic powered rear access ladders - disconnect electrical power to the ladder. Failure to do so could result in serious damage to solid-state components.

COMPONENT COOLING RATE

- The cooling rate is critical. Excessive cooling rates may cause cracks. This must be closely monitored because the frame, lift arms, bucket and other components act as a large heat sink and can dissipate heat very quickly. This is especially critical for repairs in cold climates or repairs being done outside. DO NOT force cool with fans or water.

COMPONENT BORES

- Take care when grinding on the ID of the tube to remove only the cap of the repair weld and nothing else. Do not change the ID of the tube. The dimension is critical to proper ball installation.
- The carburized portion of the ball must not be immersed in liquid nitrogen or damage to the steel may occur. The gray portion in the following diagram is the carburized area. The white area is non-carburized and may be immersed in liquid nitrogen.

COMPONENT HEATING

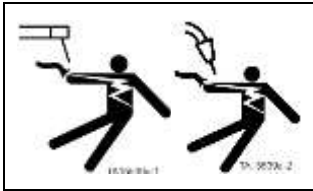
- The tube will be hot. Use gloves to handle the gauge rod when measuring the bore diameter.
- DO NOT apply heat to the carburized neck or spherical portion of the ball base with a torch flame as this will reduce the hardness of the ball and can cause subsurface cracking.

WELDING PROCEDURE

- DO NOT use weave welding to bridge the gap. This will crack and cause further problems.
- Complete passes all the way around are required. Do not weld out one side or top or bottom completely - or warpage of the socket will result.

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General Welding Safety Precautions



ELECTRIC SHOCK can kill.

⚠ DANGER

- Touching live electrical parts can cause fatal shocks or severe burns.
- The electrode and work circuit is electrically live whenever the output is turned on. The input power circuit and welding machine internal circuits are also live when power is on. In semiautomatic or automatic wire welding, the wire, wire reel, drive roll housing, and all metal parts touching the welding wire are electrically live. Incorrectly installed or improperly grounded equipment is a hazard.
- Do not touch live electrical parts.
- Wear dry, hole-free insulating gloves and body protection.
- Insulate yourself from work and ground using dry insulating mats or covers big enough to prevent any physical contact with the work or ground.
- DO NOT use AC output in damp areas, if movement is confined, or if there is a danger of falling.
- Use AC output ONLY if required for the welding process.
- If AC output is required, use remote output control if present on unit.
- Additional safety precautions are required when any of the following electrically hazardous conditions are present:
 - in damp locations or while wearing wet clothing
 - on metal structures such as floors, gratings, or scaffolds
 - when in cramped positions such as sitting, kneeling, or lying
 - when there is a high risk of unavoidable or accidental contact with the workpiece or ground
 - Do not work alone!
- Properly install and ground the welding equipment according to its Owner's Manual and national, state, and local codes.
- Always verify the supply ground – check and be sure that input power cord ground wire is properly connected to ground terminal in disconnect box or that cord plug is connected to a properly grounded receptacle outlet.
- When making input connections, attach proper grounding conductor first – double-check connections.
- Keep cords dry, free of oil and grease, and protected from hot metal and sparks.
- Frequently inspect input power cord for damage or bare wiring – replace cord immediately if damaged – bare wiring can kill.
- Turn off all equipment when not in use.
- Do not use worn, damaged, undersized, or poorly spliced cables.
- Do not drape cables over your body.
- If earth grounding of the workpiece is required, ground it directly with a separate cable.
- Do not touch electrode if you are in contact with the work, ground, or another electrode from a different machine.
- Do not touch electrode holders connected to two welding machines at the same time since double open-circuit voltage will be present.
- Use only well-maintained equipment. Repair or replace damaged parts at once. Maintain unit according to manual. Keep all panels and covers securely in place.
- Wear a safety harness if working above floor level.
- Clamp ground cable with good metal-to-metal contact to workpiece or worktable as near the weld as practical. DO NOT clamp ground cable to where the ground is on the opposite side of a bearing or bushing or ground strap as damage will occur.
- Insulate work clamp when not connected to workpiece to prevent contact with any metal object.
- Do not connect more than one electrode or work cable to any single weld output terminal.

SIGNIFICANT DC VOLTAGE exists in inverter welding power sources AFTER removal of input power.

- Turn Off inverter, disconnect input power, and discharge input capacitors according to instructions in Maintenance Section before touching any parts.



HOT PARTS can burn.

 **DANGER**

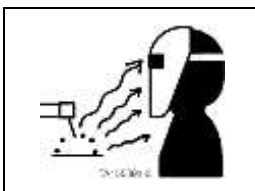
- Do not touch hot parts bare handed.
- To handle hot parts, use proper tools and/or wear heavy, insulated welding gloves and clothing to prevent burns.



FUMES AND GASES can be hazardous.

 **WARNING**

- Welding produces fumes and gases. Breathing these fumes and gases can be hazardous to your health. Keep your head out of the fumes. Do not breathe the fumes.
- If inside, ventilate the area and/or use local forced ventilation at the arc to remove welding fumes and gases.
- If ventilation is poor, wear an approved respirator with air supply.
- Read and understand the Material Safety Data Sheets (MSDSs) and the manufacturer's instructions for metals, consumables, coatings, cleaners, and degreasers.
- Work in a confined space only if it is well ventilated, or while wearing a respirator with air supply. Always have a trained watchperson nearby. Welding fumes and gases can displace air and lower the oxygen level causing injury or death. Be sure the breathing air is safe.
- Do not weld in locations near degreasing, cleaning, or spraying operations. The heat and rays of the arc can react with vapors to form highly toxic and irritating gases.
- Do not weld on coated metals, such as galvanized, lead, or cadmium plated steel, unless the coating is removed from the weld area, the area is well ventilated, and while wearing a respirator with air supply. The coatings and any metals containing these elements can give off toxic fumes if welded.



ARC RAYS can burn eyes and skin.

 **WARNING**

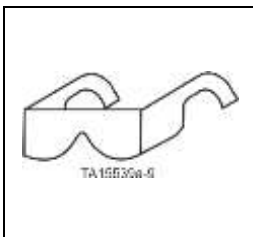
- Arc rays from the welding process produce intense visible and invisible (ultraviolet and infrared) rays that can burn eyes and skin.
- Sparks fly off from the weld that can burn eyes and skin.
- Wear an approved welding helmet fitted with a proper shade of filter lenses to protect your face and eyes from arc rays and sparks when welding or watching.
- Wear approved safety glasses with side shields under your helmet.
- Use protective screens or barriers to protect others from flash, glare and sparks; warn others not to watch the arc.
- Wear protective clothing made from durable, flame-resistant material (leather, heavy cotton, or wool) and foot protection.



WELDING can cause fire or explosion.

⚠ WARNING

- Welding on closed containers, such as tanks, drums, or pipes, can cause them to blow up.
- Sparks can fly off from the welding arc. The flying sparks, hot workpiece, and hot equipment can cause fires and burns.
- Accidental contact of electrode to metal objects can cause sparks, explosion, overheating, or fire.
- Check and be sure the area is safe before doing any welding.
 - Remove all flammables within 35 ft. (10.7 m) of the welding arc.
 - If this is not possible, tightly cover them with approved covers.
 - Do not weld where flying sparks can strike flammable material.
 - Protect yourself and others from flying sparks and hot metal.
 - Be alert that welding sparks and hot materials from welding can easily go through small cracks and openings to adjacent areas.
- Watch for fire, and keep a fire extinguisher nearby.
- Be aware that welding on a ceiling, floor, bulkhead, or partition can cause fire on the hidden side.
- Do not weld on closed containers such as tanks, drums, or pipes, unless they are properly prepared according to AWS F4.1 or local statutory regulations.
- Do not weld where the atmosphere may contain flammable dust, gas, or liquid vapors (such as gasoline).
- Connect work cable to the work as close to the welding area as practical to prevent welding current from traveling long, possibly unknown paths and causing electric shock, sparks, bearing damage and fire hazards.
- Do not use a welder to thaw frozen pipes.
- Remove stick electrode from holder or cut off welding wire at contact tip when not in use.
- Wear oil-free protective garments such as leather gloves, heavy shirt, cuff less trousers, high shoes, and a cap.
- Remove any combustibles, such as butane lighter or matches, from your person before doing any welding.
- After completion of work, inspect area to ensure it is free of sparks, glowing embers, and flames.
- Use only correct fuses or circuit breakers. Do not oversize or bypass them.
- Have a fire watcher and extinguisher nearby.



FLYING METAL or DIRT can injure eyes.

⚠ WARNING

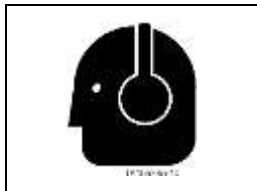
- Welding, chipping, wire brushing, and grinding cause sparks and flying metal. As welds cool, they can throw off slag.
- Wear approved safety glasses with side shields, even under your welding helmet.



BUILDUP OF GAS can injure or kill.

 **WARNING**

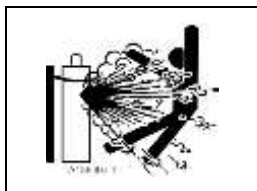
- Shut off shielding gas supply when not in use.
- Always ventilate confined spaces or use approved air-supplied respirator.



NOISE can damage hearing.

 **WARNING**

- Noise from some welding processes or equipment can damage hearing.
- Wear approved ear protection if noise level is high.
- Wear approved ear protection for air arc processes.



CYLINDERS can explode if damaged.

 **WARNING**

- Shielding gas cylinders contain gas under high pressure. If damaged, a cylinder can explode. Since gas cylinders are normally part of the welding process, be sure to treat them carefully.
- Protect compressed gas cylinders from excessive heat, mechanical shocks, physical damage, slag, open flames, sparks, and arcs.
- Install cylinders in an upright position by securing to a stationary support or cylinder rack to prevent falling or tipping.
- Keep cylinders away from any welding or other electrical circuits.
- Never drape a welding torch over a gas cylinder.
- Never allow a welding electrode to touch any cylinder.
- Never weld on a pressurized cylinder – explosion will result.
- Use only correct shielding gas cylinders, regulators, hoses, and fittings designed for the specific application; maintain them and associated parts in good condition.
- Turn face away from valve outlet when opening cylinder valve.
- Keep protective cap in place over valve except when cylinder is in use or connected for use.
- Use the right equipment, correct procedures, and sufficient number of persons to lift and move cylinders.
- Read and follow instructions on compressed gas cylinders, associated equipment, per the manufacturer instructions and all local statutory regulations.



FIRE OR EXPLOSION hazard.

 **WARNING**

- Do not install or place welding equipment on, over, or near combustibles surfaces.
- Do not install welding equipment near flammables.
- Do not overload building wiring when using welding equipment connected to the building wiring. Be sure power supply system is properly sized, rated, and protected to handle the welding equipment.



FALLING EQUIPMENT can injure.

⚠ WARNING

- Use equipment of adequate capacity to lift and support welding equipment and components.
- If using fork lifts to move components or welding equipment be sure that forks are long enough to extend beyond opposite side of unit.
- Keep equipment (cables and cords) away from moving vehicles when working from an aerial location.
- Follow all local statutory guidelines when manually lifting heavy parts or equipment.



FLYING SPARKS can injure.

⚠ WARNING

- Wear a face shield to protect eyes and face when using a grinder.
- Sparks can cause fires — keep flammables away.



MOVING PARTS in welding equipment can injure.

⚠ WARNING

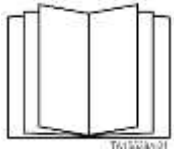
- Keep away from pinch points in welding equipment such as drive rolls.
- Keep away from moving parts in welding equipment such as fans.
- Keep all doors, panels, covers, and guards closed and securely in place in welding equipment.
- Have only qualified persons remove doors, panels, covers, or guards for maintenance and troubleshooting as necessary in welding equipment.
- Reinstall doors, panels, covers, or guards when maintenance is finished and before reconnecting input power to welding equipment.



WELDING WIRE can injure.

⚠ WARNING

- Do not press gun trigger until safe to do so.
- Do not point a wire welding gun toward any part of the body, other people, or any metal.
- Be careful when threading welding wire.



READ INSTRUCTIONS.

WARNING

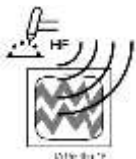
- Read and follow all instructions in the welding procedure related to your repair.
- Read and follow all labels and the Owner's Manual carefully before installing, operating, or servicing the welding equipment. Read the safety information at the beginning of the manual and in each section.
- Perform maintenance and service according to the Owner's Manuals, industry standards, and national, state, and local codes.



EMF Information.

WARNING

- Electric current flowing through any conductor causes localized electric and magnetic fields (EMF). Welding current creates an EMF field around the welding circuit and welding equipment. EMF fields may interfere with some medical implants, e.g. pacemakers. Protective measures for persons wearing medical implants have to be taken. For example, access restrictions for passers-by or individual risk assessment for welders. All welders should use the following procedures in order to minimize exposure to EMF fields from the welding circuit:
 1. Keep cables close together by twisting or taping them, or using a cable cover.
 2. Do not place your body between welding cables. Arrange cables to one side and away from the operator.
 3. Do not coil or drape cables around your body.
 4. Keep head and trunk as far away from the equipment in the welding circuit as possible.
 5. Connect work clamp to workpiece as close to the weld as possible.
 6. Do not work next to, sit or lean on the welding power source.
 7. Do not weld while carrying the welding power source or wire feeder.
- Implanted Medical Device wearers should consult their doctor and the device manufacturer before performing or going near arc welding, spot welding, gouging, plasma arc cutting, or induction heating operations. If cleared by your doctor, then following the above procedures is recommended.



H.F. RADIATION can cause interference.

CAUTION

- High-frequency (H.F.) can interfere with radio navigation, safety services, computers, and communications equipment.
- Have only qualified persons familiar with electronic equipment perform this installation.
- The user is responsible for having a qualified electrician promptly correct any interference problem resulting from the installation.
- If notified by the FCC about interference, stop using the equipment at once.
- Have the installation regularly checked and maintained.
- Keep high-frequency source doors and panels tightly shut, keep spark gaps at correct setting, and use grounding and shielding to minimize the possibility of interference.



ARC WELDING can cause interference.

CAUTION

- Electromagnetic energy can interfere with sensitive electronic equipment such as computers and computer-driven equipment such as robots.
- Be sure all equipment in the welding area is electromagnetically compatible.
- To reduce possible interference, keep weld cables as short as possible, close together, and down low, such as on the floor.
- Locate welding operation 100 meters from any sensitive electronic equipment.
- Be sure this welding machine is installed and grounded according to this manual.
- If interference still occurs, the user must take extra measures such as moving the welding machine, using shielded cables, using line filters, or shielding the work area.



OVERUSE can cause OVERHEATING

CAUTION

- Allow cooling period; follow rated duty cycle for the welding equipment being used.
- Reduce current or reduce duty cycle before starting to weld again.
- Do not block or filter airflow to unit.

WARNING

Explosion hazard exists if welding on a tire rim. **NEVER**, under any circumstances, weld or use a cutting torch on a rim with a tire mounted. The tire must be dismantled prior to welding on the rim. Refer to the section of the Service Manual entitled "TIRE AND RIM MAINTENANCE" for deflation instructions. Failure to dismantle the tire prior to welding on a tire rim can cause an explosion hazard resulting in serious injury or death.

WARNING

Multiple hazards exist when working on a machine. Follow all applicable mine and local standards regarding procedures to be used for locking out a machine. Always turn the battery disconnect switch to the off position to isolate the 24VDC circuits and apply a safety lock to prevent the machine from being started while the welder is working and to prevent damage to the electronic controls of the engine. If the battery switch is not present or does not properly operate then disconnect the battery positive (+) and negative (-) battery. Failure to properly lockout a machine starting capability before working on the machine can cause multiple hazards resulting in serious injury or death.

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CHAPTER 1

General Welding Practices



TA10487-026

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Applicable Welding Standards

- The scope of the procedure contained within this document is governed by AWS D1.1/D14.3 Structural Welding Codes. In the event that this standard is not available, Komatsu recognizes the Australian Standard, AS 1554, as equivalent to AWS D1.1.
- In most cases, AS 1554, Part 4 is the most applicable standard. The manufacturer reserves the right to require weld finishing in accordance with Part 5 of the AS, in lieu of Part 4 finishing requirements. While parts of the machine are welded to AS 1554.4, contact the manufacturer as to whether certain areas may be tested to all requirements of AS 1554.4.

Preheat and Interpass Temperatures

Preheat and interpass temperature controls are crucial elements in making a quality weld.

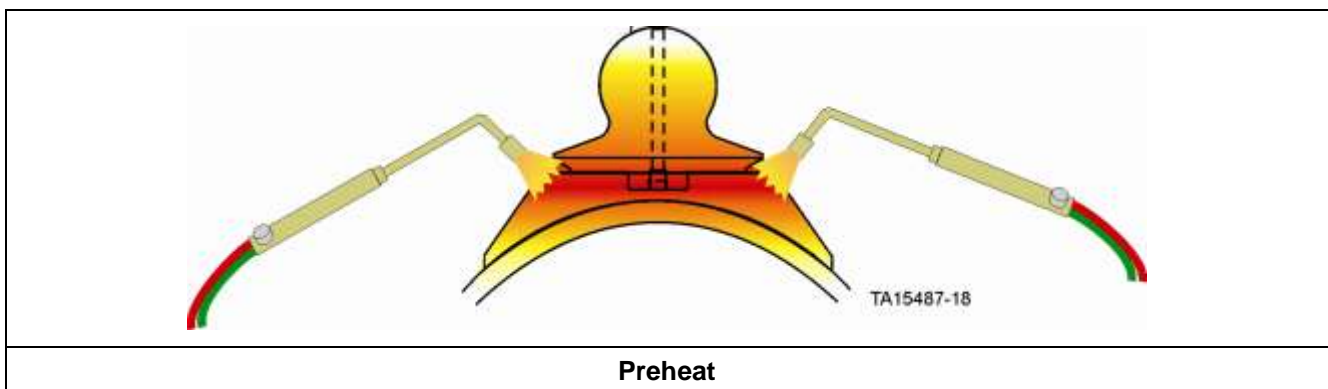
- **Preheat** is defined as the temperature of the base metal in the surrounding area of the starting point of welding immediately before air arc material removal or welding begins.
 - The heat is supplied by an external heat source
- **Interpass** temperature is defined as the temperature of the base material that is created by the welding process.
 - The heat is supplied by the welding process.

Preheat Temperatures

NOTICE

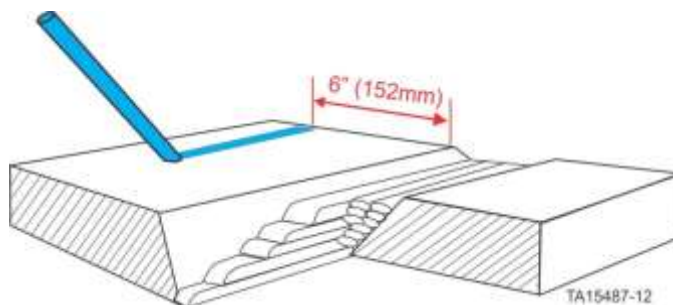
PREHEAT DEFINITION: Preheat is not just the temperature of the base material prior to welding. Whenever the following procedures refer to a “preheat” temperature – this is the temperature of the base material which must be obtained and maintained at the specified distance from the repair:

- obtained prior to air arcing
- obtained prior to welding
- maintained during welding
- maintained after welding



Field Welding Procedures

- Preheat may be applied in various ways. Ceramic heaters, induction heaters or flame heaters. Preheat may be applied using an oxy-fuel torch with a rosebud attachment or with a configuration of burners designed to provide continuous heating to the weld area.
- The minimum preheat temperature shall be maintained at a minimum of 6" (152 mm) in all in all directions from the welding area for Q&T steel repairs (minimum of 9" (228.6 mm) recommended for casting repairs).

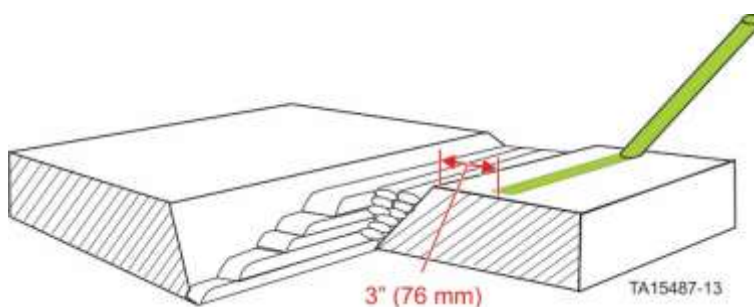


Preheat – measured at 6" (152 mm) in all directions from weld (9" [228.6 mm] on castings)

- Where possible, preheat on opposite side of the area in which welding is being done to ensure that the temperature has soaked through the part. Temperature of the part shall be checked with temperature crayons or other suitable devices.
- Preheat shall be monitored and maintained for the duration of the repair.

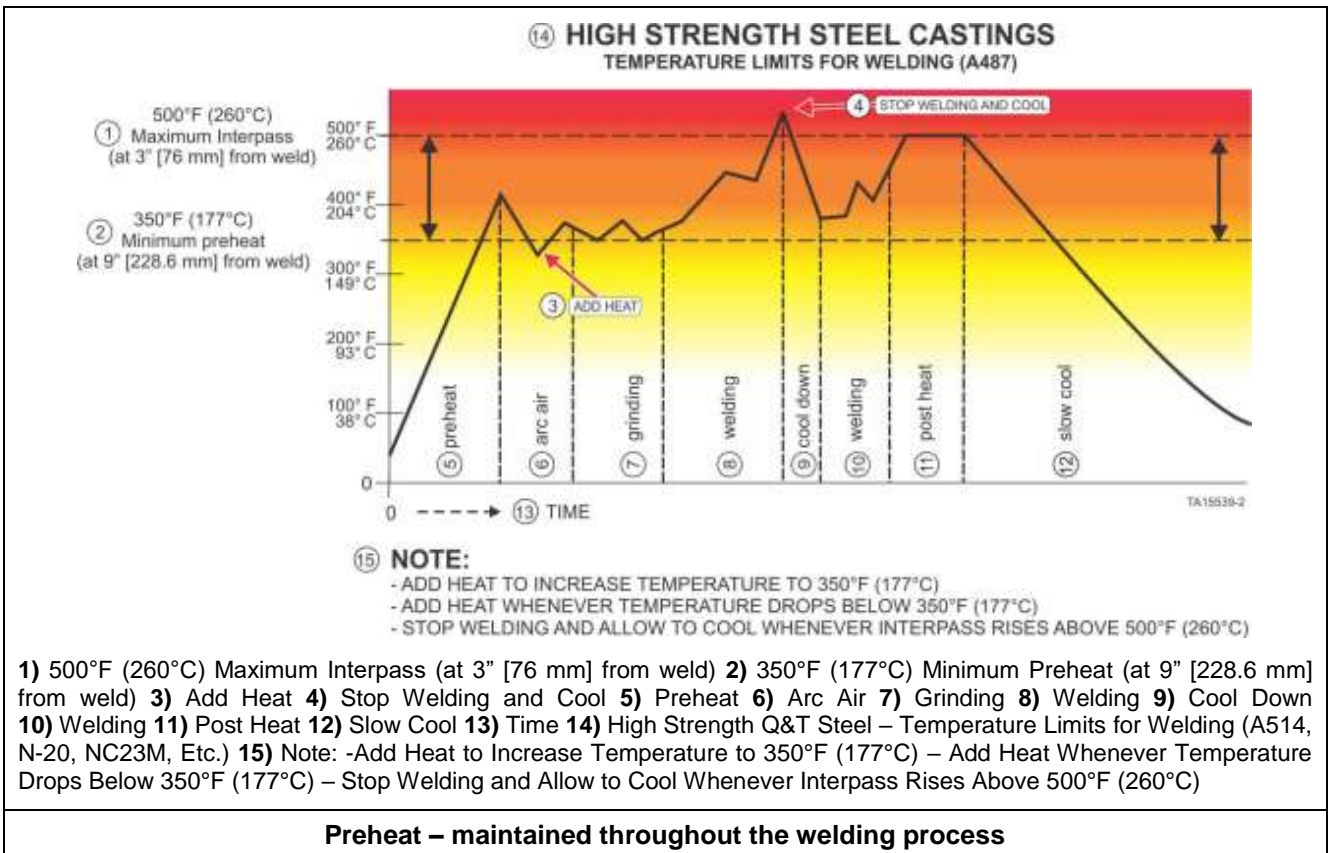
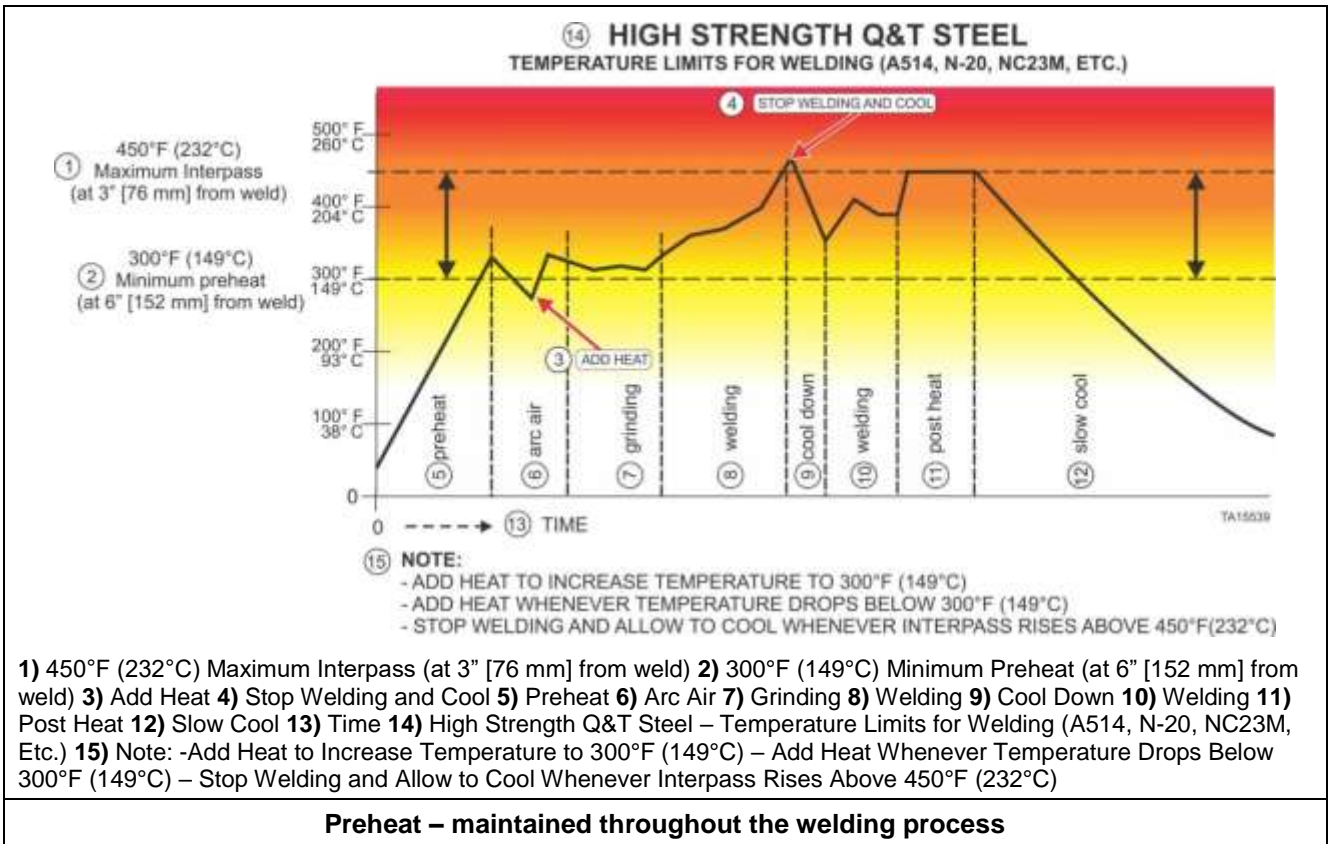
Interpass Temperatures

- Interpass temperature is defined as the temperature of the base material that is created by the welding process. The interpass temperature shall be checked with temperature crayons at 3" (76 mm) away from the weld, between each successive weld pass. If the interpass temperature goes above the maximum specified temperature then the weld process must be stopped until the temperature drops back into the proper range. The start of another weld pass shall not begin until the temperature of the part is below the maximum interpass temperature at 3" (76 mm) from the arc initiation site.



Interpass temperature – measured at 3" (76 mm) in all directions from weld

- The temperature of the base material should:
 - Stay above the preheat temperature
 - Stay below the interpass temperature
- To determine the proper minimum preheat temperature and the maximum interpass temperature, review the information in this document.
- In general the temperature ranges are:
 - 300°F(149°C) to 450°F(232°C) for high strength quenched and tempered plate
 - 350°F(177°C) to 500°F(260°C) for castings



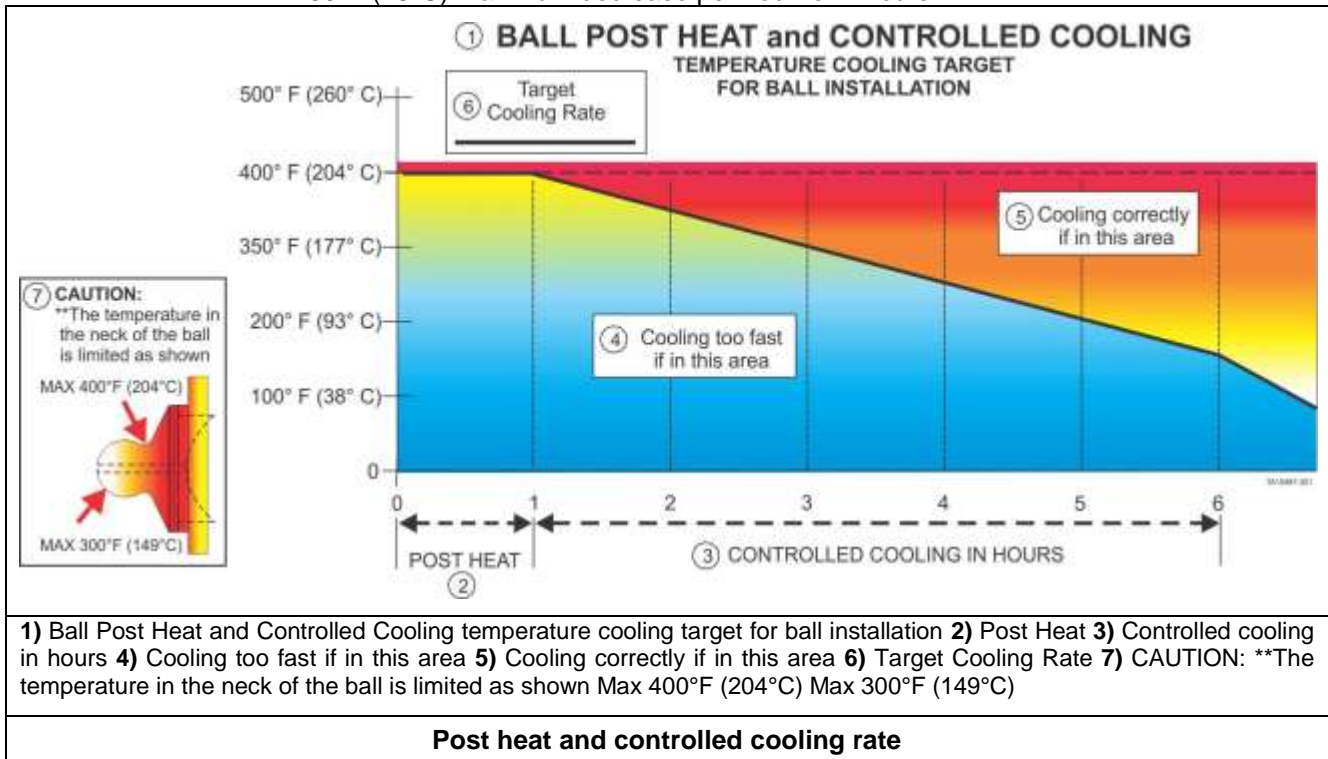
Post-Weld Heating and Slow Cooling

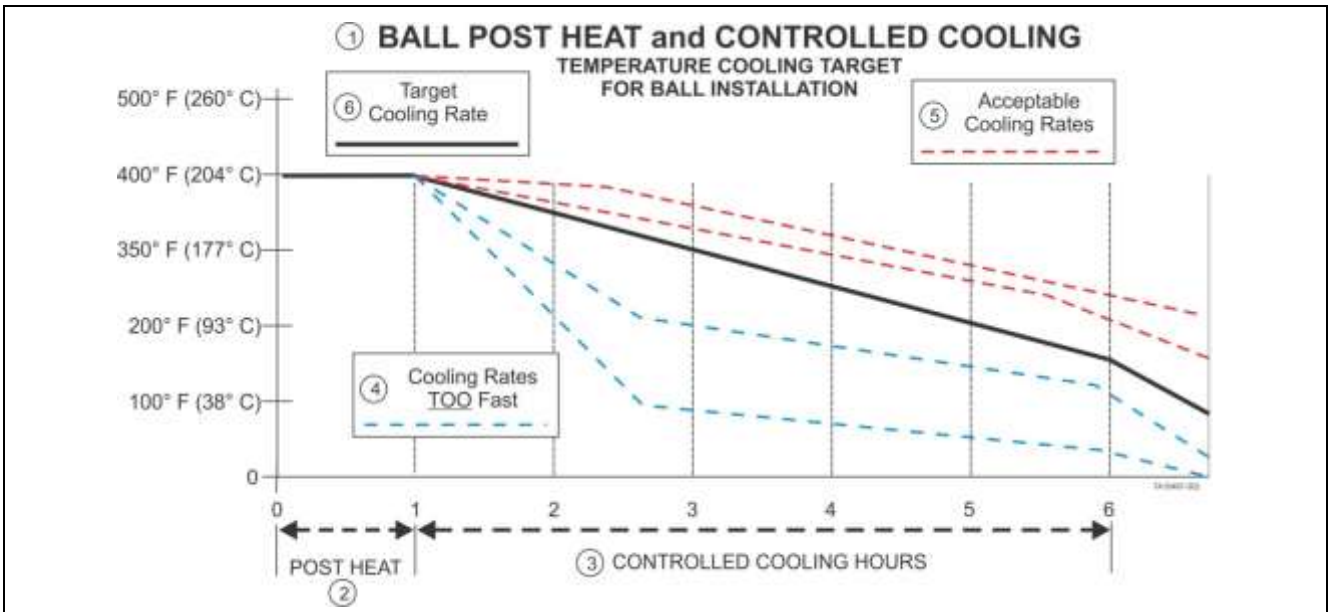
- Upon completion of weld repairs, it is critical that the cooling of the weld area be controlled in all repairs.

CAUTION

DO NOT force the cool of repairs with fans or water or open air. This can cause damage to the weld integrity.

- If Post-Weld Heating has been specified then it is recommended that the specified post heat temperature be maintained for the specified time after completion of repairs to give any trapped hydrogen in the weld metal time to diffuse.
- Each type of repair may specify different times or higher temperatures for post weld heating.
- If details have not specified for a given repair - the following general specifications may be used:
 - Post-Weld Heating will be a minimum of an hour with temperatures held at the maximum interpass temperature.
 1. 450°F (232°C) for high strength quenched and tempered steel
 2. 500°F (260°C) for castings
 3. 400°F (204°C) for balls
 - Slow cooling rate (maximum) will be:
 1. 50°F (28°C) maximum decrease per hour for 4 hours





1) Ball Post Heat and Controlled Cooling temperature cooling target for ball installation 2) Post Heat 3) Controlled Cooling Hours 4) Cooling Rates Too Fast 5) Acceptable Cooling Rates 6) Target Cooling Rate

Examples of acceptable cooling rates

NOTICE

Post-Weld Heating and slow cooling is an integral part of the welding process. This is not something that is done at some later time after the repair has been allowed to cool.

- After the post-heat, heat blankets or other suitable devices should be applied to the weld area to slow the cooling rate of the weld metal.
- Any repair procedure specifying post weld heating will typically have a chart that will give recommended minimum cooling times based on material grade and thickness.
- In the case of thick materials or cold ambient temperatures it may be necessary to apply heat in order to meet the slow cooling specifications.



Post heat and slow cool

Undermatched Welds

The structures used in P&H wheel loaders and dozers are designed in some cases to have under matched welds. Under matched means that the strength of the weld material is by design somewhat lower than the strength of the base material. This has been done by engineering design as permitted by AWS D1.1. Follow the recommendations in the Field Welding Procedures for the welding consumable to be used.

Welding Wire

1. Typical wire sizes used for FCAW welding will be .045" (1.2 mm), .052" (1.4 mm) or 1/16" (1.6 mm) diameter. The most commonly used sizes are .052" (1.4 mm) or 1/16" (1.6 mm).
2. Wire selection for field welding

Material Joint Type	Wire Consumable
Steel to Steel	E7xT- xxxx series
Steel to Casting	E7xT- xxxx series
Casting Repair	E8xT- xxxx series
Socket/Ball Installation	E8xT- xxxx series
Wear Hardware Installation on Bucket	E8xT- xxxx series
Special Repairs	E9xT- xxxx series


Electrodes

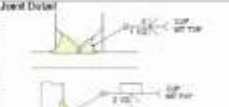
1. Electrodes for SMAW are specified to be low hydrogen in one of the following series (7018, 8018, 9018, etc.), as specified for each type of material and procedure.
2. Typical electrode sizes for SMAW will be 1/8" (3.2 mm) for root passes and 5/32" (4 mm) for the remainder.
3. Storage and handling of low hydrogen electrodes:
 - a. Use new low hydrogen electrodes that are provided in hermetically sealed packages. Do not use old electrodes for structural repairs. Old electrodes are defined as those that were removed from a sealed package more than 1 month earlier and have been kept in an oven.
 - b. Remove only one hour's supply of electrodes at a time. Keep the remainder in a ventilated holding oven at 225° F (107° C).
 - c. Bake previously opened packages of electrodes in a ventilated oven at 500° F (260° C) for two hours before using.
 - d. Electrodes taken from cardboard boxes or a non-airtight container should also be baked at 500° F (260° C) for two hours in a ventilated oven.
 - e. Then the electrodes should be placed immediately in a ventilated holding oven set at 225° F (107° C).
 - f. Any electrode exposed to the air for more than four hours should be re-baked per the instructions above.
4. Electrode selection for field welding.

Material Joint Type	Electrode Consumable
Steel to Steel	7018 series
Steel to Casting	7018 series
Casting Repair	8018 series
Socket/Ball Installation	8018 series
Wear Hardware Installation on Bucket	8018 series
Special Repairs	9018 series

Certified Welders and Approved WPS

- All welding done shall be performed by a certified welder following a developed Welding Procedure Specification (WPS).
- The WPS and welder must be qualified according to AWS D 1.1 Structural Welding Code – Steel, AS 1554, or other governing code as approved by Komatsu.
- The procedures provided in this document have a WPS based on Procedure Qualification Records (PQR's) that were done using Komatsu materials. The use of other consumables may require a new WPS and PQR to certify the local materials and equipment.




Field Welding Procedure		Revision	20-0103
		Revision	3
		WebSite	www.komatsu.com
		Date	1/28/2010
Part description conforms to AWS D 1.1 Structural Welding Code and American Standards AS 1554			
Description Structural Repair Welding Procedure - generic			
Notes See attached with this Welding Procedure			
Welding Process FCAW / SMAW			
Joint		Joint Detail	
Fit	Match or Fit		
Backing	if needed	Material	Mild Steel
Root Opening	1/16" - 1/8" Per Attachment		
Rootface Dimension	1/16" Per Attachment		
Groove Angle	70° ± Per Attachment	Radius	R2
Back Chipping	Yes, if required	Method	ARC-AB
Other			
Base Metals			
Specification	Per Table	Part Table	
Thickness	Per Table	Per Table	
Filler Metals			
AWS designation	A5.18M (E71T) or A5.18 (E71T) or E71T (E71T) or E71T (E71T)	As S.	A5.18M (E71T) or A5.18 (E71T) or E71T (E71T) or E71T (E71T)
Diameter	3/32", 1/8", 5/16", 3/8", 1/2", 5/8", 3/4"		
Shielding Gas Composition		Preheat and Interpass	Preheat and Interpass
Flow Rate	15 - 25 CFH	Shielding Gas	75:20:5
Technique		Preheat	150 - 250 °F
Design of Wave Bead	Shaper	Vertical Progression	Up
Multi-Height Pass per Side	Multiple	Electrical Characteristics	
Flushing	Yes	Current Type	DC-SP
Manipulation	Chipping and or grinding	Current Source	DC-SP
PREHEAT AND INTERPASS TEMPERATURES			
MATERIAL TYPES			
Structural Steel	Carbon	Oil & High strength steel	
Frame Structure	API Spec Torque Tube (150, 150, 225)	Ball	
Bucket	Ligno gas fuel frame (150)	Bucket Lip	
Bucket	Ases (series 133)	Bucket adaptor	
Socket	Socket	Lift arms	
PREHEAT			
Material Thickness	Structural Steel	Carbon and high strength steel	
Distance from weld	0" minimum	0" minimum	
< 1/4"	150°F (65°C)	300°F (150°C)	
1/4" to 1/2"	225°F (110°C)	250°F (125°C)	
1/2" to 3/4"	240°F (115°C)	350°F (175°C)	
3/4" to 1"	270°F (130°C)	350°F (175°C)	
INTERPASS TEMPERATURE			
All thicknesses	500° (260°C) MAXIMUM	450° (230°C) MAXIMUM	
POSTWELD TREATMENT			
450F (232°C) for one hour	See para. VWS (8)	Nil ()	


Weld Pos.	Process	Filler Metal	Shielding Gas	Current Type	AMPS	VOLTS	Weld Speed	Welding Position
All	FCW	E71T (E71T)	75% Ar / 25% He	DC-SP	200-300	22-28	100-300	Flat & Horizontal
All	FCW	E71T (E71T)	75% Ar / 25% He	DC-SP	200-300	22-28	100-300	Flat & Horizontal
All	FCW	E71T (E71T)	75% Ar / 25% He	DC-SP	200-300	22-28	100-300	Flat & Horizontal
All	FCW	E71T (E71T)	75% Ar / 25% He	DC-SP	200-300	22-28	100-300	Flat & Horizontal
All	FCW	E71T (E71T)	75% Ar / 25% He	DC-SP	200-300	22-28	100-300	Flat & Horizontal
All	SMAW	E71T (E71T)	75% Ar / 25% He	DC-SP	200-300	22-28	100-300	Flat & Horizontal
All	SMAW	E71T (E71T)	75% Ar / 25% He	DC-SP	200-300	22-28	100-300	Flat & Horizontal
All	SMAW	E71T (E71T)	75% Ar / 25% He	DC-SP	200-300	22-28	100-300	Flat & Horizontal
All	SMAW	E71T (E71T)	75% Ar / 25% He	DC-SP	200-300	22-28	100-300	Flat & Horizontal

Thickness	Preheat	Interpass
1/16"	150	500
1/8"	150	500
3/16"	150	500
1/4"	150	500
5/16"	225	500
3/8"	225	500
1/2"	240	500
5/8"	240	500
3/4"	270	500
1"	270	500

Material and Type	Welding Position
Steel in shop	1500 max
Steel in field	5000 max
Castings	4000 max
Socket or Ball Attachment	5000 max
Overhead installation on bucket	5000 max



READ TEMPERING PREPASSAGE
The last layer of weld passes must be completed starting from the base material toward the middle of the weld.



BACKING WELD
The groove or fillet weld is 2" deep or larger - it is a weld on the sides of the groove prior to welding the groove joint. Put a single layer or backing layer of weld metal on each side of the weld joint.

SAMPLE WPS

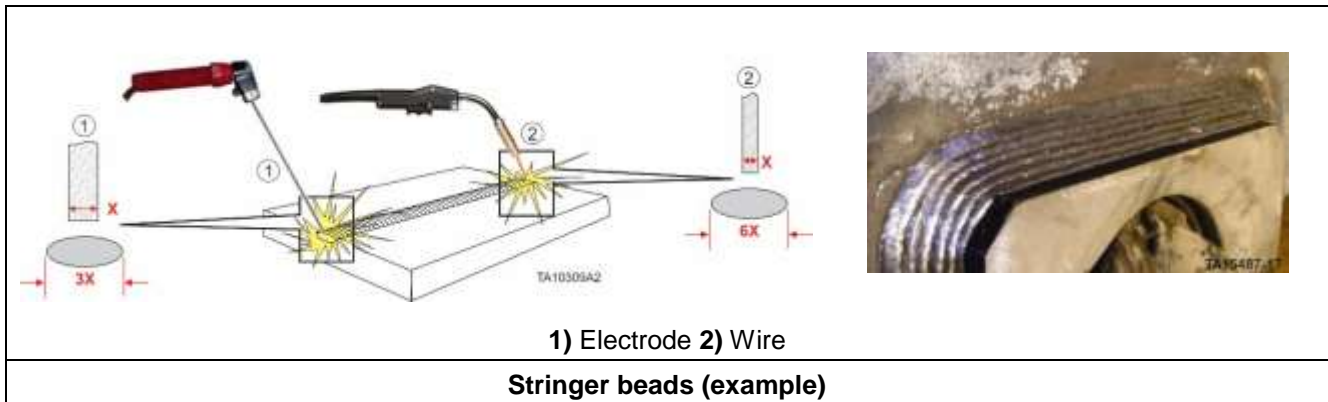
Section 03-02 DOC C-r03
Loaders
2/28/2019

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Welding Techniques

1. Only stringer beads are specified. (Stringer is defined as a weld with minimal side to side movement of the electrode or wire.)



2. No weave welding is allowed.
3. For multiple pass welds, starts and stops should be staggered for each weld pass.
4. The progression for all passes in vertical welding shall be upward.
5. All starts and stops should occur before or after the corner of a structure.
6. No slug welding will be permitted.
7. Slug welding is defined as introducing a foreign material or metal into a weld joint and welding over it to decrease the amount of time and weld consumable needed to complete the weld joint.
8. Where possible, use run-off tabs. All stops and starts should be on the tabs. Remove all tabs by oxy-fuel cutting or arc gouging, and grind flush.
9. All tack welds should be treated the same as structural welds, with pre-heat and interpass restrictions required.

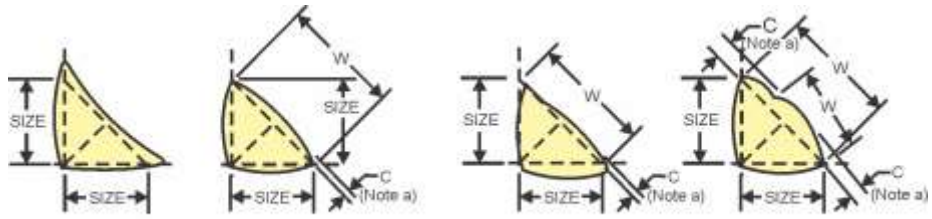
Cleaning Requirement

1. Prior to welding, all loose scale, cutting dross, grease, oil, water, paint, rust, dirt and other contaminants are to be removed at least 2" (50.8 mm) from the edge of the joint.
2. During welding, all individual passes are to be cleaned.
3. No slag welding is allowed.
4. Slag welding is defined as the technique used when welding consecutive weld beads without using appropriate cleaning methods such as chipping, grinding, wire brushing, etc., to remove the slag produced from a previously welded bead. (Intentionally welding over slag).
5. After welding, use appropriate methods to remove slag and spatter from the weld and welded area.
6. Excessive grinding should be avoided, but blend grind all repairs.

Welding Defects

The following discontinuities will cause the weld to be deemed defective and will require for the discontinuity and/or the defective weld to be removed. All field welds should have 100% visual inspection at minimum.

- **Crack** – a fracture of the weld metal and/or the base metal characterized by a sharp tip and high length to width ratio. No cracks allowed.
 - No cracks are permissible.
 - All cracks, even crater cracks in tack welds, shall be removed by grinding or gouging and re-welded.
- **Undercut – Removal of parent material at the toes of the weld.**
 - No undercut greater than 0.010" (0.25 mm) deep.
 - All undercuts deeper than the allowable depth require fill welding or weld toe grinding.
- **Porosity (Pinholes) – any cavity type discontinuity**
 - No more than six (6) holes per 12" (304.8 mm) of length.
 - No individual surface breaking porosity greater than 3/32" (2 mm) allowed.
 - Frequency of surface breaking porosity shall not exceed one in each 4" (101.6 mm) of weld length.
 - Maximum summed total length of the diameters of porosity is 3/32" (2 mm) in any continuous 12" (304.8 mm) length of weld joint.
 - Excessive porosity shall be excavated and re-welded.
- **Overlap (Cold lap) – protrusion of weld metal beyond the weld toe or weld root**
 - No overlap is allowed.
 - Overlaps are to be repaired by grinding and if necessary re-welding to maintain size requirements.
- **Arc Strike –**
 - Arc strikes outside the area of permanent welds should be avoided.
 - Cracks or blemishes cause by arc strikes should be ground to a smooth contour and checked to ensure smoothness.
- **Weld termination –**
 - No crater, undercut or cracks are permissible.
 - All cracks, even crater cracks in tack welds, shall be removed by grinding or gouging and re-welded.
 - All craters shall be filled to the full cross section of the weld.
- **Fillet Weld Surface Irregularity –**
 - No cracks are permissible.
 - No flux between passes.
 - Maximum convexity is to be no more than that listed in the following table.

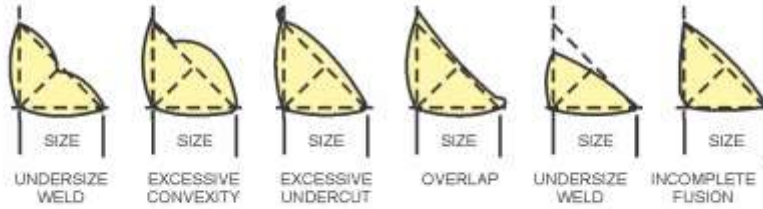


(A) DESIREABLE FILLET WELD PROFILES

(B) ACCEPTABLE FILLET WELD PROFILES

*Convexity, C, of a weld or individual surface bead with dimension W shall not exceed the value of the following table:

WIDTH OF WELD FACE OR INDIVIDUAL SURFACE BEAD, W	MAX CONVEXITY, C
W ≤ 5/16 in (8 mm)	1/16 in (2 mm)
W > 5/16 in (8 mm) TO W < 1 in (25 mm)	1/8 in (3 mm)
W ≥ 1 in (25 mm)	3/16 in (5 mm)



(C) UNACCEPTABLE FILLET WELD PROFILES

TA15487-15

Fillet weld profiles

CHAPTER 2 Generic Structural Repair Welding Procedure

KOMATSU - Loaders and Dozers



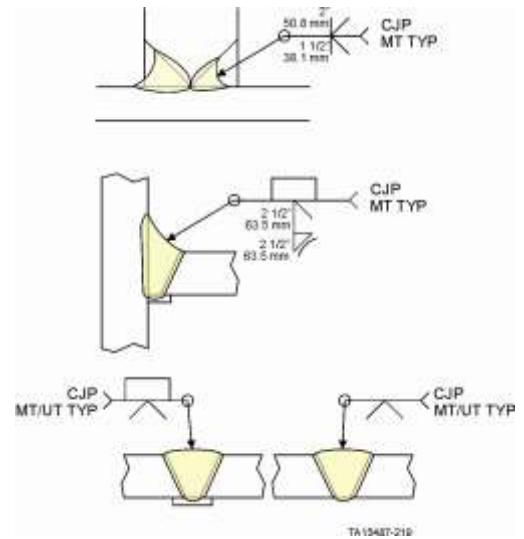
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Procedure	FW-0107
Revision	0
Written by	Joel Armstrong
Date	3/8/2010

Field Welding Procedure				
This document conforms to AWS D1.1/D14.3 Structural Welding Code and Australian Standards AS 1554.4				
Description		Structural Repair Welding Procedure - generic		
Notes		See attachment Field Weld Procedure		
Welding Process		FCAW / SMAW		
Joint				
Type	Groove or Fillet			
Backing	If needed	Material	Mild Steel	
Root Opening	+1/4" / - 1/16" Per Attachment (+6.35 / - 1.6 mm)			
Root face Dimension	+/- 1/16" Per Attachment (+/- 1.6 mm)			
Groove Angle (degrees)	+10/-5 Per Attachment	Radius	N/A	
Back Gouging	Yes, if required	Method	Arc - Air	
Other				
Base Metals				
Specification	Per Table	Per Table		
Thickness	Per Table	Per Table		
Filler Metals				
AWS Specification	A5.20/A5.29	A5.5	A5.1/A5.5	A5.1
AWS Class	E71T-1XX series	E8018C3	E7018	E7016
Diameter	0.045", 0.052", 1/16" (1.2, 1.4, 1.6mm)	1/8", 5/32" (3.2, 4mm)	1/8", 5/32" (3.2,4mm)	3.2 mm
Shielding				
Gas Composition	100% CO2 or Ar/CO2 75/25		Positions Qualified	Flat, Vertical, Horizontal, Vertical
Flow Rate	35 – 45 cfh		Groove	1G, 2G, 3G, 4G
Technique			Fillet	1F, 2F, 3F
Stringer or Weave Bead	Stringer		Vertical Progression	Up
Multi/Single Pass (per side)	Multiple		Electrical Characteristics	
Peening	Yes		FCAW - Current	DCEP
Interpass Cleaning	Chipping and or grinding		SMAW - Current	DCEP
Preheat and Interpass Temperatures			Other	
Material Types				
Structural Steel	Castings		Q&T high strength steel	
Frame structure Bucket Blade	Lift Arm Torque Tube (1150, 1350,1850 Gen2, 2350) Upper part front frame (1350) Axles (some 1350) Sockets		Balls Bucket Lip Bucket adapters Lift arms Bell cranks	
Preheat				
Material Thickness	Structural Steel		Castings and high strength steel	
Distance from weld	6" (152 mm) minimum		6" (152 mm) minimum	
< or = 3/4" (< or = 19 mm)	125° F (52° C)		200° F (93° C)	
>3/4" to 1-1/2" (>19.05 to 38.1 mm)	225° F (107° C)		250° F (121° C)	
>1-1/2" to 2-1/2" (>38.1 to 63.5 mm)	250° F (121° C)		300° F(149° C)	
>2-1/2" (>63.5 mm)	300° F(149° C)		350° F(177° C)	
Interpass Temperature				
All thicknesses	500F (260° C) maximum		450F (232° C) maximum	
Post Heat Treatment				
450F (232° C) for one hour	Required: YES (X) NO ()			

Joint Detail



Welding Parameters

(The FCAW welding parameters were obtained from the qualification of the LINCOLN Ultracore 712A80 used during LTI fabrication on Komatsu welding equipment. These numbers will likely vary depending on the specific welding equipment and consumable used for repairs.)

Weld Pass	Process	Filler Metal	Filler Diameter	Current Type	Amps	Volts	Travel Speed (ipm)	Wire Feed Speed	Welding Position
All	FCAW	E71T-1MJ	1/16"	DCEP	280-340	22-26	8-12	255-300	Flat & Horizontal
All	FCAW	E71T-1MJ	0.052"	DCEP	220-310	22-26	8-12	225-375	Flat & Horizontal
All	FCAW	E71T-1MJ	0.045"	DCEP	210-280	23-25	8-12	275-425	Flat & Horizontal
All	FCAW	E71T-1MJ	1/16"	DCEP	185-225	21-24	7-10	105-130	Vertical
All	FCAW	E71T-1MJ	0.052"	DCEP	195-235	21-24	7-10	200-375	Vertical
All	FCAW	E71T-1MJ	0.045"	DCEP	155-235	21-23	7-10	175-325	Vertical
All	SMAW	E8018C3	5/32"	DCEP	130-220	19-21	N/A	N/A	All
All	SMAW	E8018C3	1/8"	DCEP	90-160	19-21	N/A	N/A	All
All	SMAW	E7018	5/32"	DCEP	130-210	19-21	5-8	N/A	All
All	SMAW	E7018	1/8"	DCEP	90-160	19-21	5-8	N/A	All
Open Root	SMAW	E7016	3.2mm	DCEP or DCEN	90-130			N/A	Flat & Horizontal
Open Root	SMAW	E7016	3.2mm	DCEP or DCEN	80-120			N/A	Vertical

Suggested Air ARC Parameters

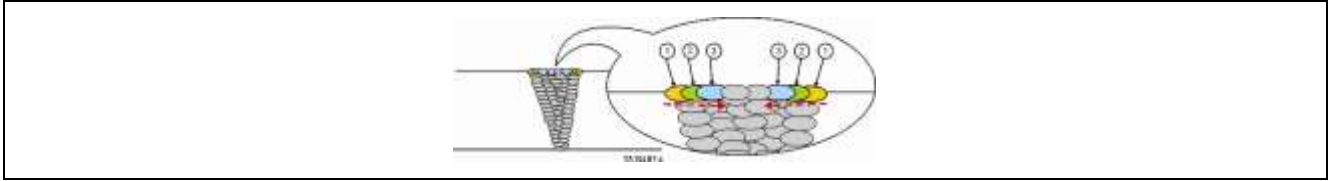
Electrode Diameter		Minimum Amps	Maximum Amps
Inches	Millimeter		
1/8	3.2	60	90
5/32	4.0	90	150
3/16	4.8	200	250
¼	6.4	300	400
5/16	7.9	350	450
3/8	9.5	450	600
½	12.7	800	1000
5/8	15.9	1000	1250
¾	19.1	1250	1600

Proper Electrode Selection for Field Welding

Material joint type	Rod consumable	Wire Consumable
Steel to steel	7018 series	E7xT- xxxx series
Steel to Casting	7018 series	E7xT- xxxx series
Casting Repair	8018 series	E8xT- xxxx series
Socket or Ball installation	8018 series	E8xT- xxxx series
Wear hardware installation on bucket	8018 series	E8xT- xxxx series

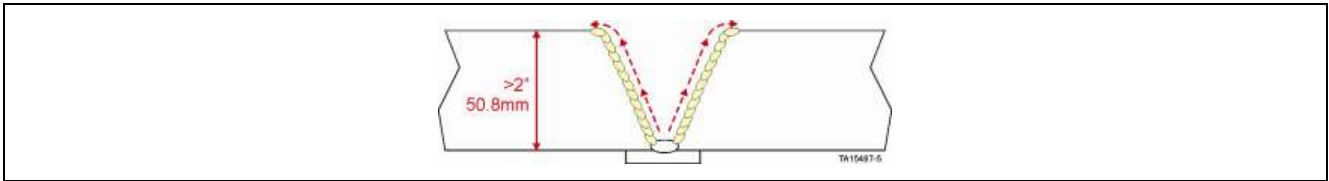
Bead Tempering Finish Passes

The last layer of weld passes must be completed starting from the base material toward the middle of the weld.



Butter Welds

On groove or fillet welds 2" (50.8 mm) deep or larger - butter weld the sides of the groove prior to welding the groove joint. Put a single layer or buttering layer of weld metal on each side of the weld joint.



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Generic Structural Repair Welding Procedure

The following procedure in this document is provided as a generic repair weld procedure for the repair of cracks that may appear in the lift arms, chassis, or other parts of a P&H wheel loader.

Contact Komatsu Product Support for base weld procedures, field welding procedures, specific detailed crack repair procedures, and work instructions.

While this is a crack repair procedure - the welding specifications in this procedure would also apply to the field installation of various components onto the frame, lift arms, or other structural components.

Safety Preparations

WARNING

Crush hazards exist if the machine is started or moved while work processes are being performed on the machine. Place bucket flat and level on the ground. Place frame lock in the locked position and lock out the machine's starting capability before performing any work process. Follow all applicable lockout procedures and local rules and regulations for performing work processes. ANYONE performing inspections or service procedures to the machine should be familiar with ALL instructions and procedures contained in the machine's SERVICE MANUAL. Crush hazard could occur if the machine is started or moves while any type of work process is being conducted on the machine, resulting in serious injury or death.

Machine Shutdown and Lockout

1. Stop the wheel loader on flat level ground.
2. Place bucket flat and on level ground.
3. Move the frame lock to the locked position so that the frame cannot be steered.

WARNING

Crush hazards exist in machine pivot area and area between the tires. Do not enter these areas unless it is verified that the operator has control over the steering and that personnel locking the frame lock have good communication with the operator. Entering the pivot area and area between the tires while the machine is moving or pivoting (articulating) could cause crush hazards resulting in serious injury or death.

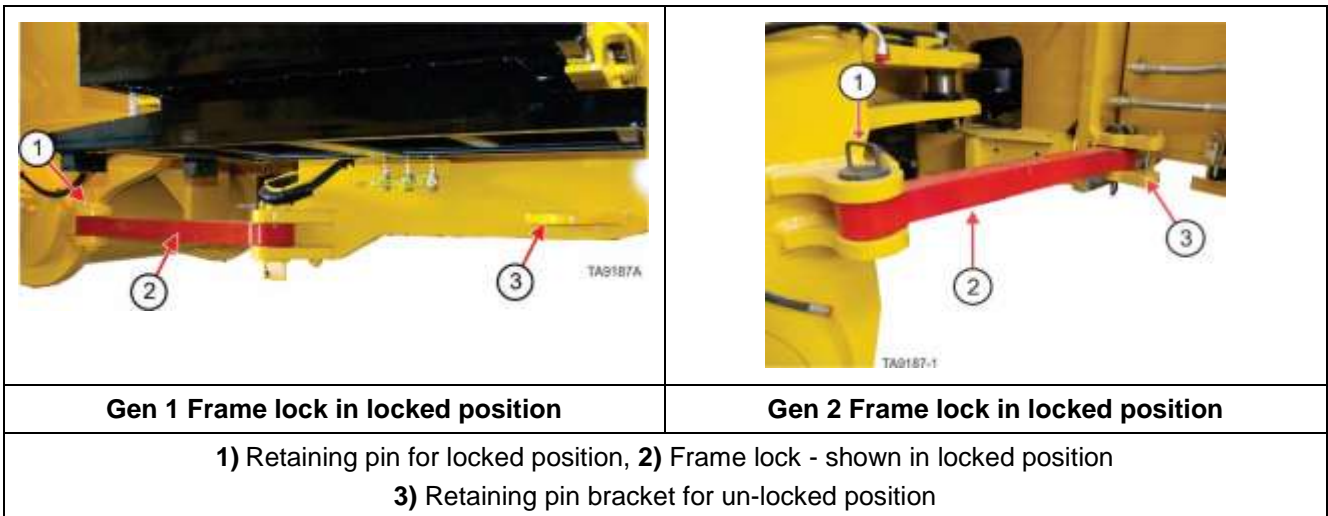


Figure 1. Frame lock in locked position

4. Set the parking brakes.
5. Shut off the engine.
6. Place wheel chocks in front and behind each wheel.
7. Lock out the machine's starting capability before performing any cleaning, inspections, or installation and repair procedure.

WARNING

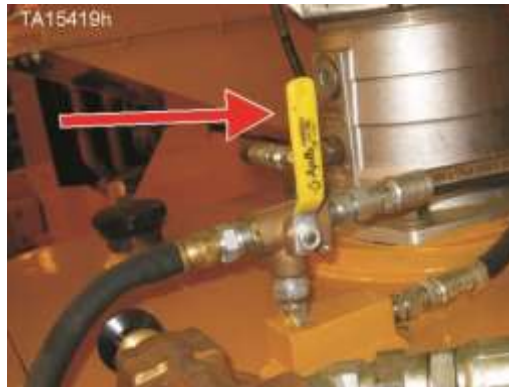
Crush, shock, or other hazards exist if stored energy is not removed or isolated prior to working on the machine. Stored energy (hydraulic, electrical, pneumatic, mechanical, etc.) may be present if not isolated or released prior to working on the machine. Do not work on the machine without removing this stored energy (suspended loads, electrical power, air pressure, etc.). Risk of crushing, shock, or other physical injury exists if stored energy is not removed or isolated prior to working on the machine which could result in serious injury or death.

8. Turn the battery and engine isolation switches to the off position and install locks on the battery isolation switch.



Isolation and Control switches assembly – Battery isolation switch in OFF position with locks in place

9. Release the air from the hydraulic reservoir by using the hydraulic reservoir air valve (ball valve) on top of the reservoir. The supply line from main air system will be blocked and reservoir air will vent out the hose that runs down the outside of the hydraulic reservoir.
10. Turn the handle to the up position as shown.



Hydraulic reservoir air valve handle UP

11. Release the air from the various air storage reservoirs by opening all of the air bleed valves.

Three valves on right side of rear frame under hydraulic reservoir

One valve on right side of front frame near hoist cylinder ball cap

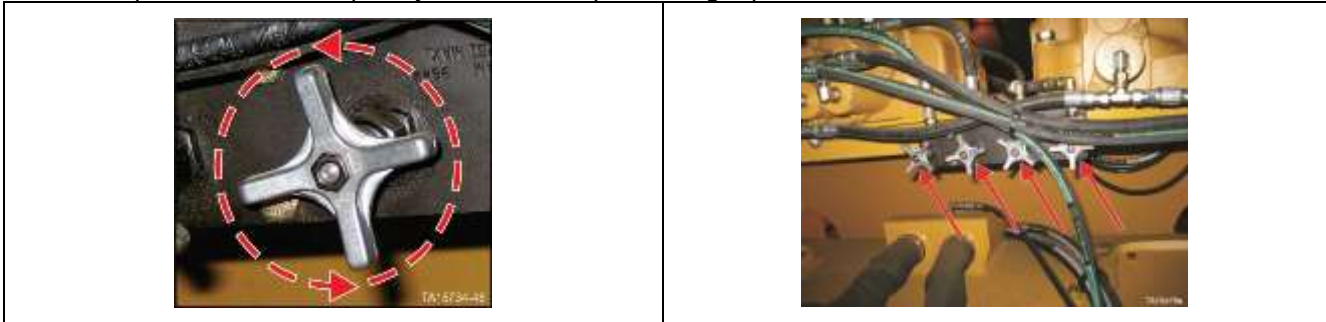


Open air reservoir bleed valves

⚠ WARNING

Crush hazards exist if all personnel are not cleared from the bucket and lift arm area before using the hydraulic hoist and bucket hydraulic pressure bleed down valves to relieve pressure from the hoist and bucket circuit. Assembly must be used only when the engine is NOT running. Before using the Manual Bleed Valve Assembly, refer to “HYDRAULIC AND GREASE SYSTEMS”, “MANUAL BLEED VALVE ASSEMBLY”, in Section 04 of the Service Manual for additional operational and safety information. Operating the manual bleed valve may cause the lift arms and bucket to descend rapidly. All personnel around the bucket and lift arms area shall be removed from the area before operating hydraulic hoist and bucket hydraulic pressure bleed down valves. Using the hydraulic bleed down valves could result in movement of the lift arms and bucket which could cause a crush hazard resulting serious injury or death.

12. Use the hydraulic pressure bleed down valves located in the front frame underneath the Husco valves to bleed any stored pressure in the hoist and bucket cylinders.
13. Turn each valve slowly counterclockwise as shown below and allow the pressure to bleed down.
14. Open the valve completely and leave it open during repairs.



CAUTION

Before performing welding operations on a machine, the fire suppression system circuit monitors panel's in-line fuse must be removed. The fuse is located in the battery box on some machines. Failure to do so may cause the system to actuate and/or damage the solid-state components of the system. Replace the in-line fuse before the machine has been started or after all welding operations have been completed.



Fire suppression in-line fuse located in loader battery box on some machines

WARNING

Fall hazard exists when working at heights. Be sure to take appropriate safety precautions when working at heights on the rear and front frames or the lift arms balls. Follow all required statutory regulations for working at height. Wear fall restraint when necessary to prevent falls. Failure to take appropriate safety precautions, including wearing fall restraint when necessary can cause fall hazards resulting in serious injury or death.

WARNING

Crush hazards exist if standing under, working, or placing any body part under hoisted/suspended components. Never stand under hoisted/suspended components. Ensure appropriate lifting devices are used, and blocking is adequate to prevent the component from unexpectedly moving during transportation. Refer to SAFETY, WARNINGS, AND CAUTIONS before attempting to remove the operator's cab. Failure to stay out from under hoisted/suspended components can cause crush hazard resulting in serious injury or death.

Burn Hazard



Burn and inhalation hazards exist when welding or cutting on the machine. Cutting and welding can produce hot surfaces. Smokey condition can exist if a fire starts. Have qualified fire watch personnel present, and keep a fire extinguisher that meets all statutory regulations nearby during all cutting and welding operations. Failure to provide a qualified fire watch and an appropriate fire extinguisher can cause fire and inhalation hazards resulting in serious injury or death.

Summary

1. Inspection
2. Crack removal
3. Welding procedures
4. Welding wire
5. Welding electrodes
6. Preheat temperature
7. Backup strips
8. Run-on and run-off tabs
9. Root pass
10. Welding types
11. Weld buttering
12. Order of weld finish passes
13. Interpass temperature
14. Grinding procedures
15. Post heat and cool down procedure
16. Final weld inspection

Inspection

1. Steam clean the area to remove all oil, grease, dirt and contamination on weld joints.
2. Clean the area to be welded of all rust, paint, and/or mill scale prior to inspection.
3. Determine the extent of the defect by using Non-Destructive Examinations (NDE) such as Magnetic Particle Inspection (MT) or Dye Penetrant Testing (PT).



Burn hazard exists when steam cleaning or burning paint off areas to be inspected. The cleaning process can be hazardous to personnel performing the cleaning process as well as to personnel in the general area. Steam burns or burns from torch burning can occur. Make sure all local safety precautions are followed prior to, during, and after the cleaning process. Wear appropriate personal protective equipment (PPE) to prevent burns. Failure to wear proper PPE can cause burn hazards resulting in serious injury.

⚠ WARNING

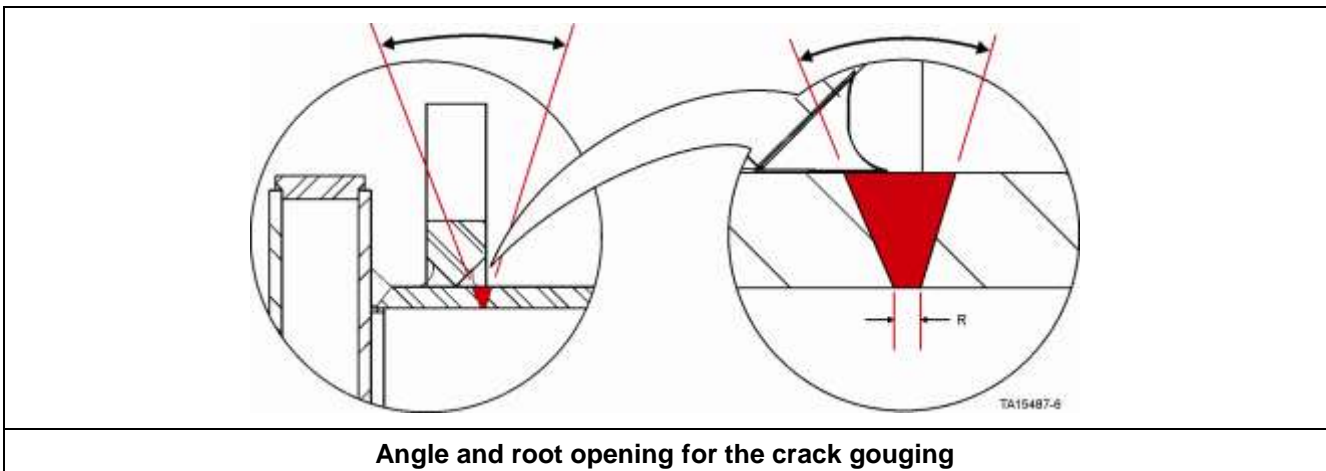
Inhalation hazard exists when steam cleaning or burning paint off areas to be inspected. The cleaning process can be hazardous to personnel performing the cleaning process as well as to personnel in the general area. Inhalation from steam cleaning or from torch burning can occur. Make sure all local safety precautions are followed prior to, during, and after the cleaning process. Wear appropriate personal protective equipment (PPE) to prevent inhalation of fumes. Failure to wear proper PPE can cause inhalation hazards resulting in serious injury.

⚠ WARNING

Eye injury hazard exists when steam cleaning, burning paint, or mechanically (such as wire brush on a grinder) cleaning the areas to be inspected. The cleaning process can be hazardous to personnel performing the cleaning process as well as to personnel in the general area. Make sure all local safety precautions are followed prior to, during, and after the cleaning process. Wear appropriate personal protective equipment (PPE) to eye injuries. Failure to wear proper PPE can cause eye injury hazards resulting in serious injury.

Crack Removal

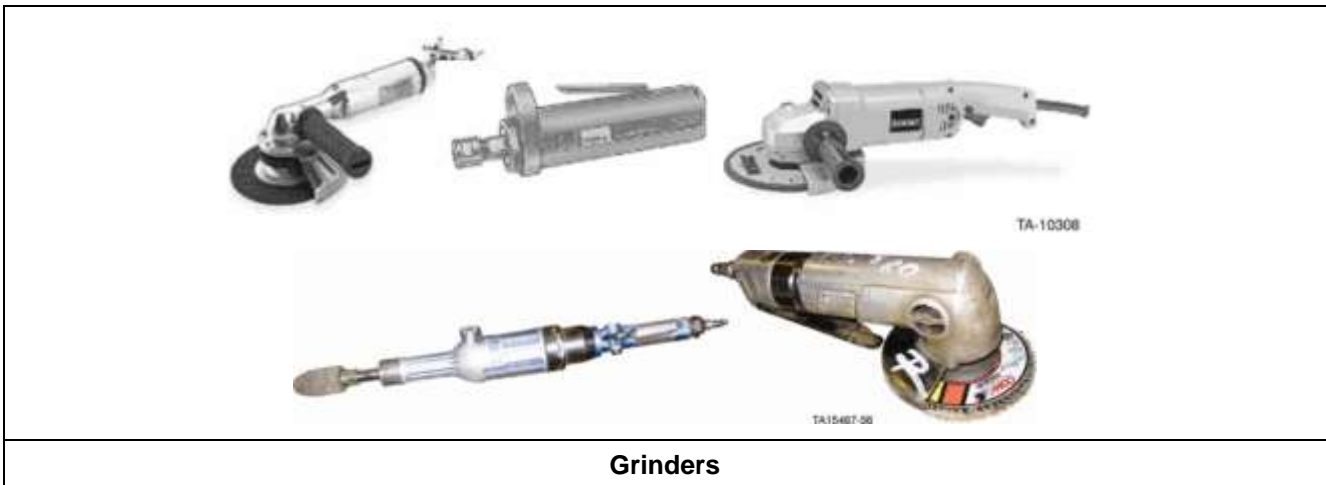
1. Before any cutting or air carbon arc gouging is performed, ensure the area is dry.
2. Preheat the area at least 6" (152 mm) around the crack to at least 250° F (121° C).
3. Use air carbon gouging to remove the crack.
4. Test the area after arc air has been completed, with magnetic particle (MT), to ensure that the entire crack has been removed. (Dye Penetrant cannot be used as the joint will have to be cooled and this should not be done.)
5. Continue to air carbon arc gouge until the crack has been removed.
6. The area removed should be between 30 and 45 degrees beveled as shown in Figure "Angle and root opening for the crack gouging".



7. If the crack penetrates through the plate - the width of the gap at the bottom of the gouging should be as close as possible to the widths listed in the following table for a backing strip or for open root repair:

Welding Process	Groove Angle	Root Opening
Stick/ Flux Core wire with backing strip	30°	10 mm (≈3/8")
	45°	6 mm (≈1/4")
7016 stick with open root	30° - 45°	4 mm (≈1/8")

8. Grind the entire gouged area (100%) so that the steel is free of any slag and carbon deposits. Shiny steel material should be visible in all parts. This can be done with either air powered or electric powered grinders as shown in following illustration.



9. Test the area with magnetic particle (MT) after grinding has been completed, to ensure the entire crack has been removed. (Dye Penetrant cannot be used, as the joint will have to be cooled, and this should not be done.)

Welding Procedures

The welding consumable can be either flux cored wire or stick electrodes meeting the requirements listed:

Welding Wire

1. Typical wire sizes used for FCAW welding will be .045" (1.2 mm), .052" (1.4 mm) or 1/16" (1.6 mm) diameter. The most commonly used sizes are .052" (1.4 mm) or 1/16" (1.6 mm).
2. Wire selection for field welding.

Material Joint Type	Wire Consumable
Steel to Steel	E7xT- xxxx series
Steel to Casting	E7xT- xxxx series
Casting Repair	E8xT- xxxx series
Socket/Ball Installation	E8xT- xxxx series
Wear Hardware Installation on Bucket	E8xT- xxxx series
Special Repairs	E9xT- xxxx series

Electrodes

1. Electrodes for SMAW are specified to be low hydrogen in one of the following series (7018, 8018, 9018, etc.) as specified for each type of material and procedure.
2. Typical electrode sizes for SMAW will be 1/8" (3.2 mm) for root passes and 5/32" (4 mm) for the remainder.
3. Storage and handling of low hydrogen electrodes:
 - a. Use new low hydrogen electrodes that are provided in hermetically sealed packages. Do not use old electrodes for structural repairs. Old electrodes are defined as those that were removed from a sealed package more than 1 month earlier – even if they have been kept in an oven.
 - b. Remove only one hour's supply of electrodes at a time. Keep the remainder in a ventilated holding oven at 225° F (107° C).
 - c. Bake previously opened packages of electrodes in a ventilated oven at 500° F (260° C) for two hours before using.
 - d. Electrodes taken from cardboard boxes or a non-airtight container should also be baked at 500° F (260° C) for two hours in a ventilated oven.
 - e. Then the electrodes should be placed immediately in a ventilated holding oven set at 225° F (107° C).
 - f. Any electrode exposed to the air for more than four hours should be re-baked per the instructions above.
4. Electrode selection for field welding

Material Joint Type	Electrode Consumable
Steel to Steel	7018 series
Steel to Casting	7018 series
Casting Repair	8018 series
Socket/Ball Installation	8018 series
Wear Hardware Installation on Bucket	8018 series
Special Repairs	9018 series

Preheat Temperature

1. Preheat the area to be welded, with a heat blanket or torch, to a temperature corresponding to the values found in the following preheat table.

NOTICE

Whenever possible, the preheat should be applied from the opposite side of the plate or joint, away from the repair, to ensure the temperature fully penetrates the plate or casting. The preheat temperature should be checked on the same side as the repair.

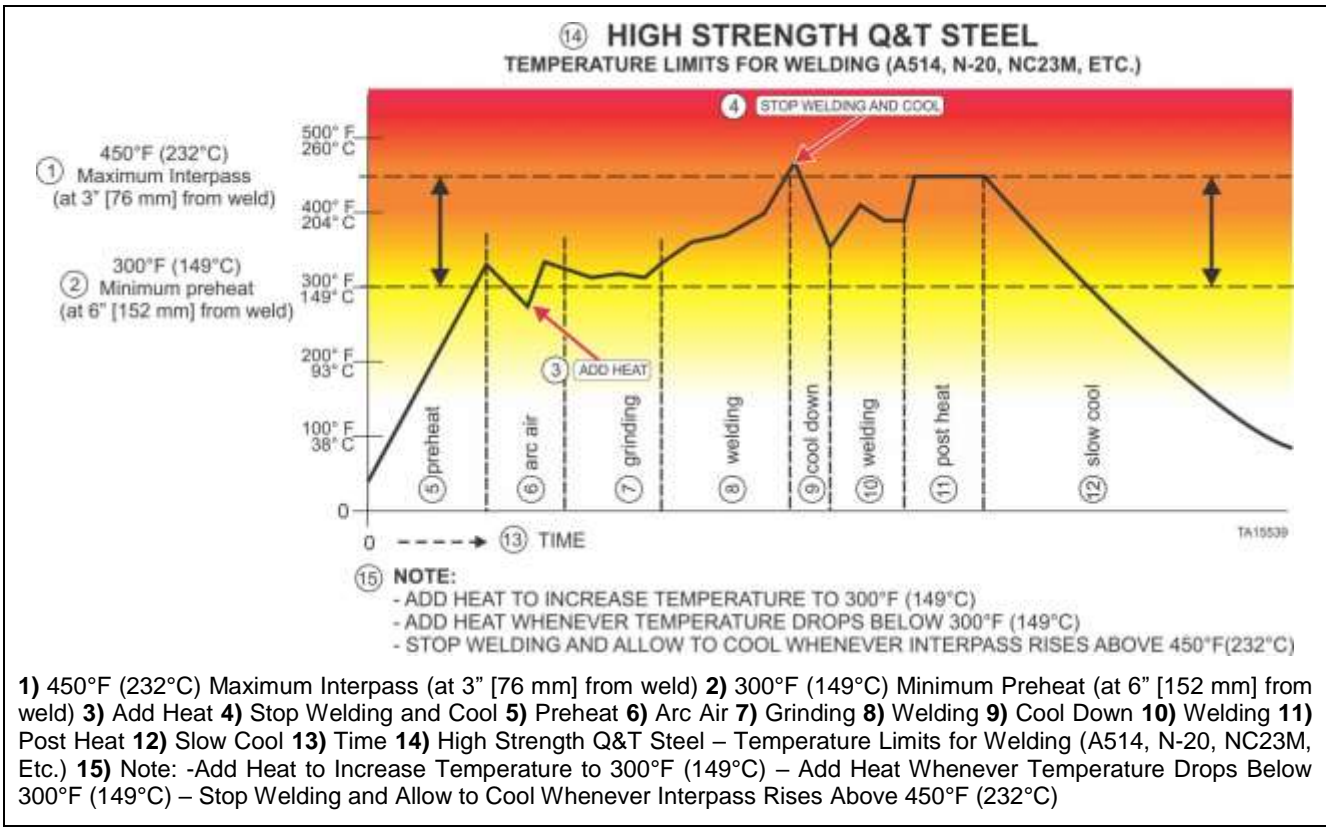
Material Types

Structural Steel	Castings	Q&T High Strength Steel
Frame structure	Lift Arm Torque Tube (1150, 1350, 1850 Gen2, 2350)	Balls
Bucket	Upper part front frame (1350)	Bucket Lip
Blade	Axles (some 1350)	Bucket adapters
	Sockets	Lift arms

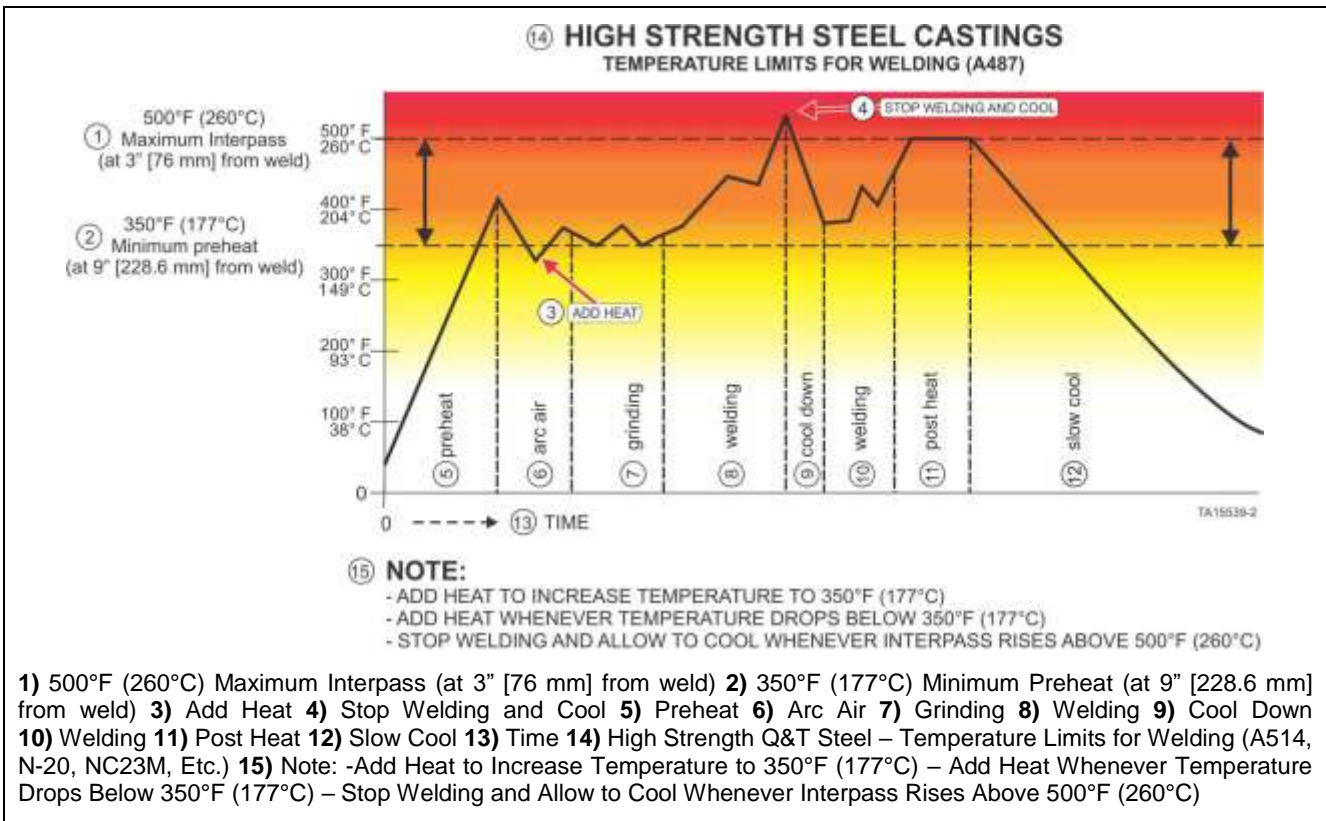
Preheat		
Material Thickness	Structural Steel	Castings and high strength steel
Distance from weld	6" (152 mm) minimum	9" (228.6 mm) minimum
< or = 3/4" (< or = 19 mm)	125° F (52° C)	200° F (93° C)
>3/4" to 1-1/2" (>19.05 to 38.1 mm)	225° F (107° C)	250° F (121° C)
>1-1/2" to 2-1/2" (>38.1 to 63.5 mm)	250° F (121° C)	300° F (149° C)
>2-1/2" (>63.5 mm)	300° F (149° C)	350° F (177° C)

NOTICE

In most cases of field repairs it is recommended to preheat the repair to the numbers listed for material thicker than >2-1/2" (>63.5 mm). This will allow for the variances in material thickness found in typical structures. This will not damage the thinner materials and will make the generic repair process easier to remember.

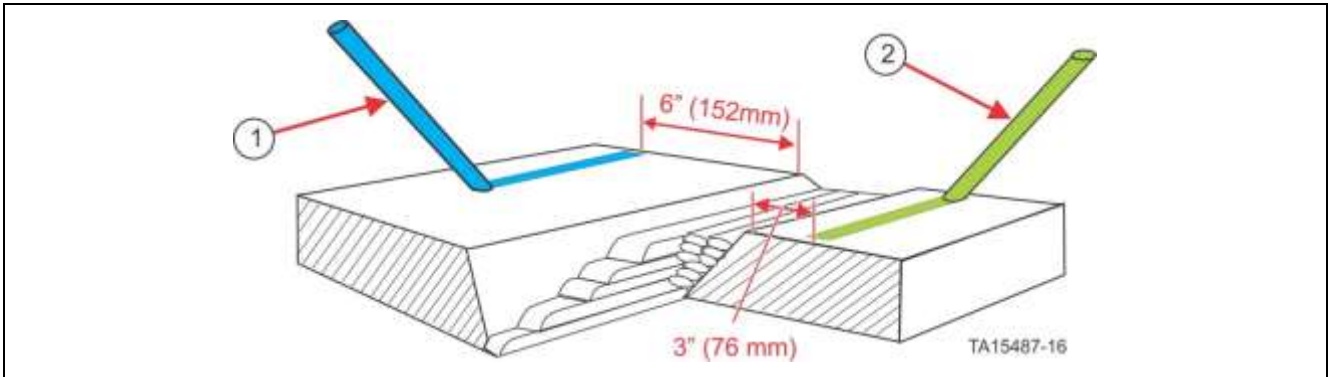


Preheat – maintained throughout the welding process



Preheat – maintained throughout the welding process

1. Preheat distance of 6" (152 mm) (9" [228.6 mm] minimum for castings) must be maintained for the duration of the repair and must be checked using heat crayons (heat sticks) or a contact temperature device, prior to initiating each pass.



Angle and root opening for the crack gouging

1. **Preheat** temperature stick (crayon)
2. **Interpass** temperature stick (crayon)

NOTICE

Heat sticks (crayons) or contact temperature devices are the recommended primary method of monitoring preheat and interpass temperature.

Infrared non-contact devices are not recommended as the primary temperature measuring device for preheat and interpass temperatures because they have accuracy problems on smooth shiny metal materials or in smoky/dusty areas.



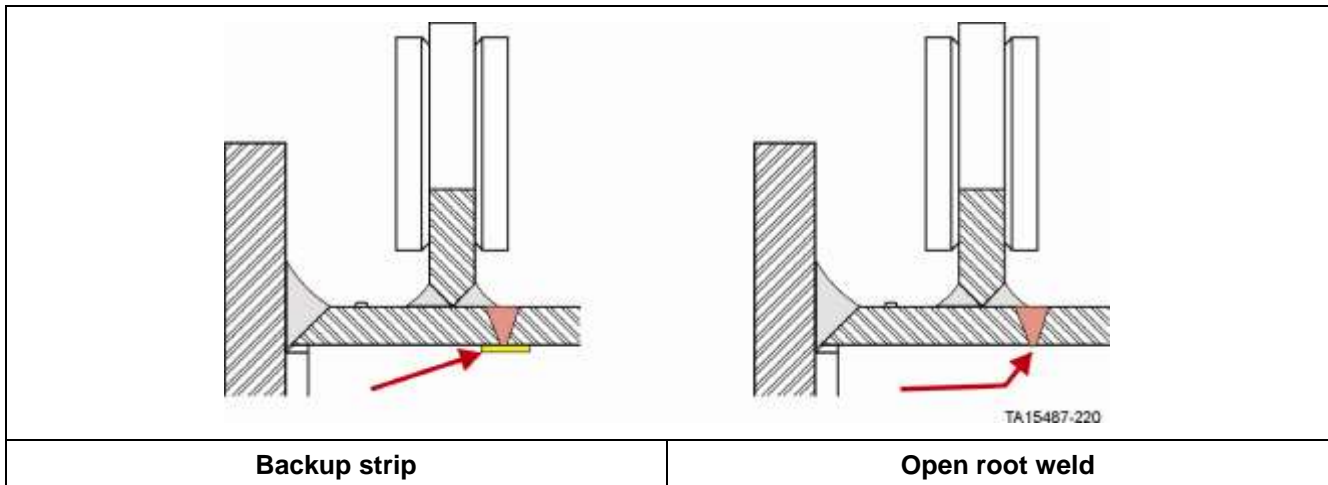
Temperature crayon/stick

2. A preheat temperature log must be maintained and updated at least once every hour during the repair.
 - a. Monitor the preheat temperature in various locations 6" (152 mm) away from the weld.
 - b. Following is a typical format for a temperature log. This is shown as a sample – a full page version is included in the Appendix of this document.

Preheat Temperature Log Sheet (sample layout)			
Job Description		Date	
Welder	Time	Temp	Initial
	0		
	1 hour		
	2 hour		
	3 hour		
	4 hour		
	5 hour		
	6 hour		
	7 hour		

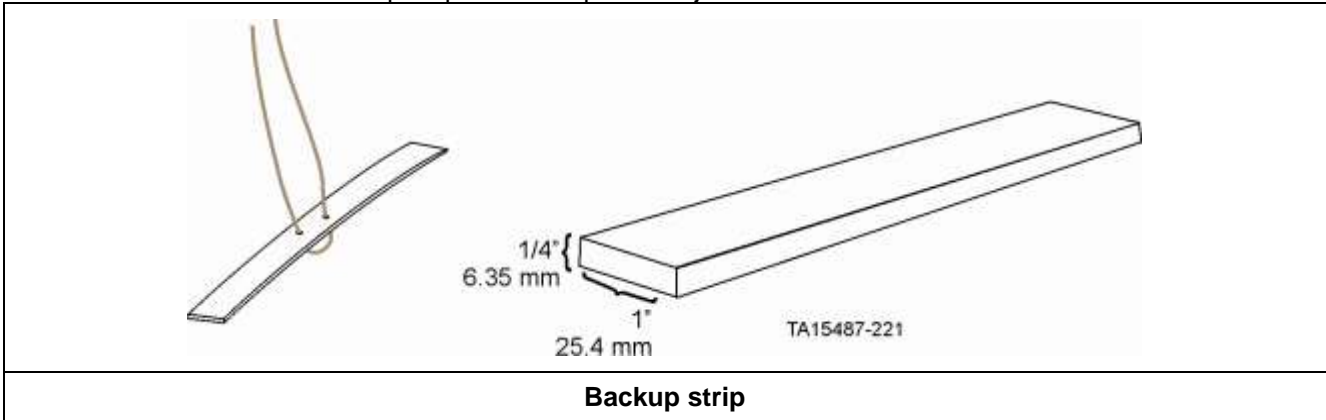
Backup Strip

If the groove penetrates fully through the part being repaired – the groove weld can be started by one of two methods: Open root pass (no backing) or with backing strip.

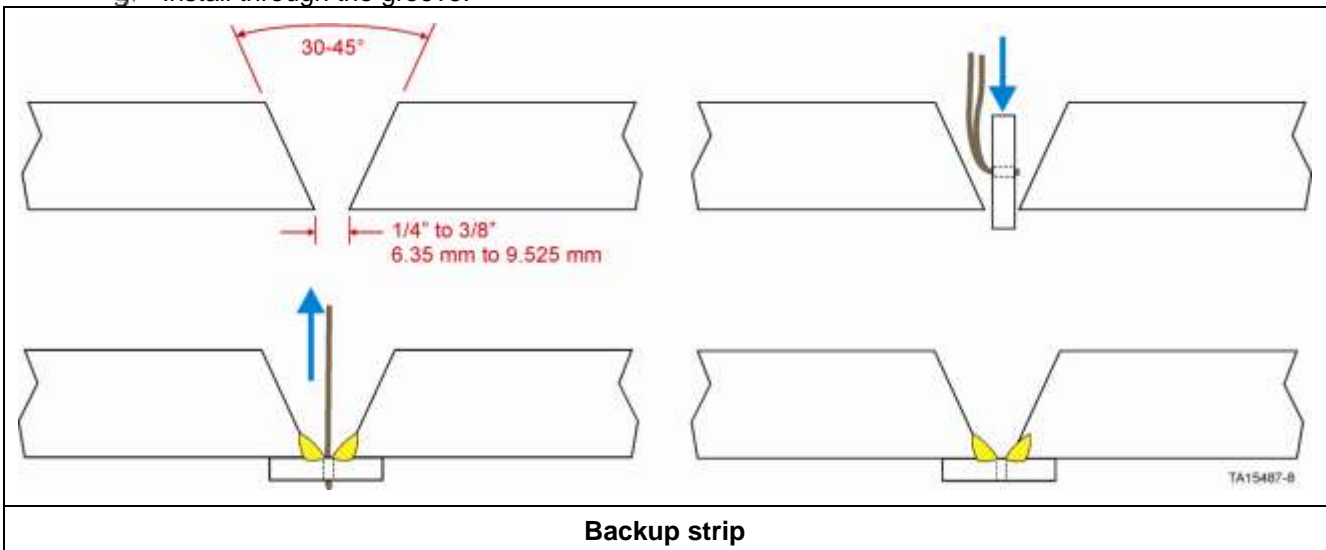


1. If an open root repair method is selected:
 - a. Use 7016 rod.
 - b. Kobe LB-52U 3.25 mm is an example of 7016 rod.
 - c. Details for use of this rod to make the open root weld are covered at:
 - <http://www.kobelco.co.jp/english/welding/files/c-sp9-10.pdf>
2. If a backup strip method is selected:
 - a. Use a backup strip made from minimum 1/4" X 1" (6.35 mm X 25.4 mm) mild steel.

- b. The backup strip must be slightly longer than the length of the crack (the part that has penetrated through the plate) should be slightly longer than the crack.
- c. If the crack is longer than 12" (305 mm) then the backup strip should be segments of no more than 12" (305 mm) in length.
- d. Conform the backup strip to the shape of the joint.



- e. If there is no way to access the repair from the side - Drill two holes 1/2" - 1" (12.7 mm - 25.4 mm) apart in the middle of the backup strip.
- f. Feed a piece of welding wire through holes.
- g. Install through the groove.



- h. Put the backup plate inside repair.
- i. Pull it up to the inside of the weld with the wire.
- j. Hold in place and tack in place.
- k. Remove the wire.

Run-On and Run-Off Tabs

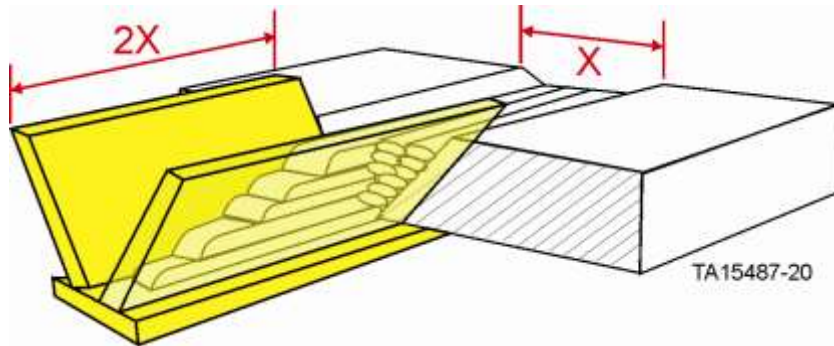
To produce sound, flush welds on many welded joint geometries, run-on and run-off tabs (also known as tabs, weld tabs, extension plates and extension bars) projecting from the finished member are required to permit starting and stopping the groove and fillet welds beyond the edge of the base material. The run-off tabs will minimize the possibility of high stress concentrations and resulting base metal or weld metal cracking. AWS D1.1:2008 Section 5.31 should be followed.

Run-off tabs are tacked onto the ends of the base material to allow the welder to start or extinguish the arc without forming a crater on the base material. Run-on and run-off tabs should be used for all butt welds, groove welds and fillet welds that will have a flat flush surface at the edge of the base material,



RUN-OFF Tabs

The run-off tab consists of scrap pieces of base metal formed to give the same groove or fillet shape as the weld area. The run-off tabs should have a length that is at least 2 times the width of the weld.

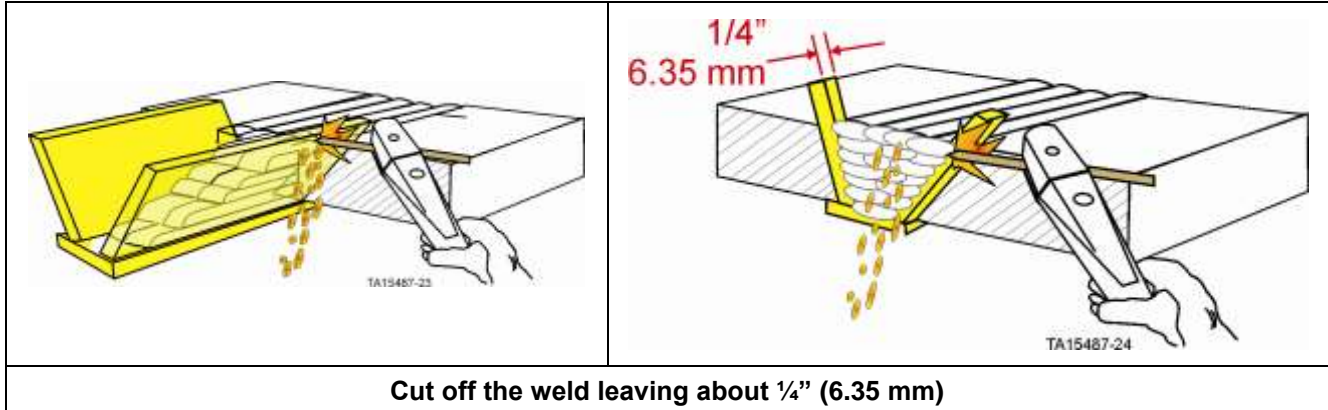


RUN-OFF Tabs

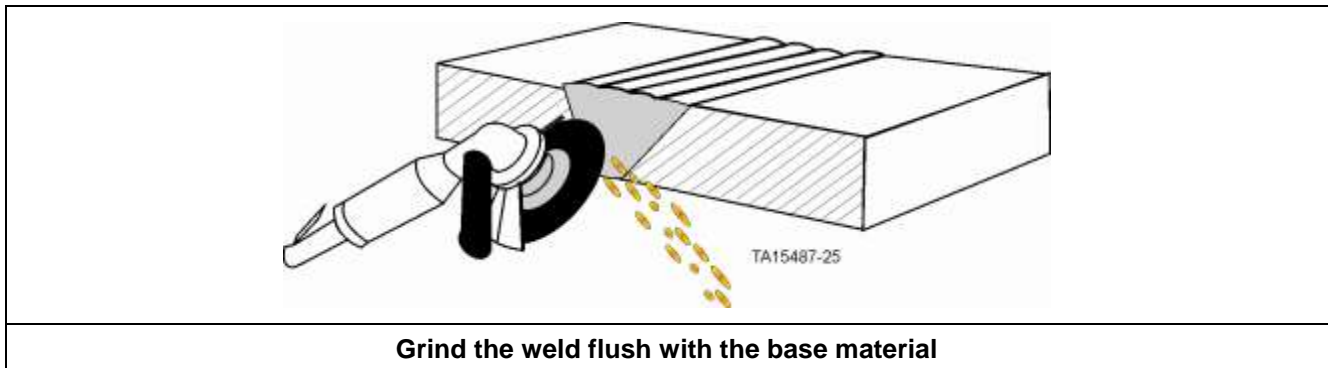
The weld should extend into the run-on run-off tabs by a distance at least equal to that of the thickness of the parent material and the joint should be completely filled.

Removal of Run-Off Tabs

Gouge off the run-on and/or run-off tab and weld leaving minimum $\frac{1}{4}$ " (6.35 mm) of weld material.



Grind the remaining material flush with the bases of the weld dressed flush, with the dressing marks parallel to the direction of loading.



Inspection after Removal of the Tabs

1. 100% visual inspection of the welds per AWS D14.4 CLASS III criteria.
2. MT/PT – Magnetic Particle or Dye Penetrant inspection of the weld per AWS D14.4 CLASS III criteria.

Root Pass

1. Weld the root pass bead for the complete length of the bottom of the crack area.
2. Remove the slag from the root pass with an air scaler or air chisel.



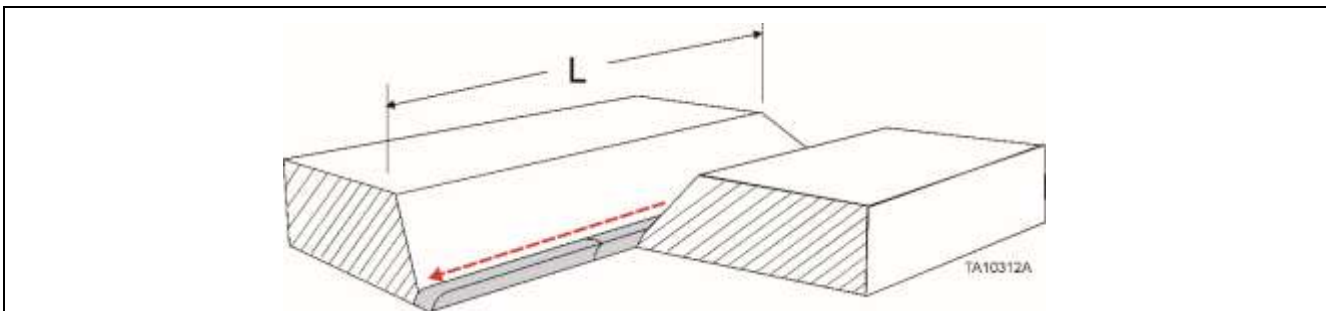
Needle scaler kit, scalars

3. Peen each bead, except for the root and cap passes, with the needle scaler or chipper to reduce stress concentrations.
4. To ensure that the root pass has no cracks, visually check the root pass weld. Use dye penetrant or magnetic particle if a crack is suspected. If cracks are found, the root should be gouged out, edges ground smooth with a grinder and re-welded.

NOTICE

If there are problems with cracks in the root pass using the 7018 electrode, then raise the preheat by 50° F (28° C) and repeat the root pass. If there are still problems then it is permissible to use either 6013 or 6011 electrodes to make the root pass.

5. Continue the bead for a full pass the length of the weld prior to beginning a second pass. Refer to illustration "FULL PASS WELD".

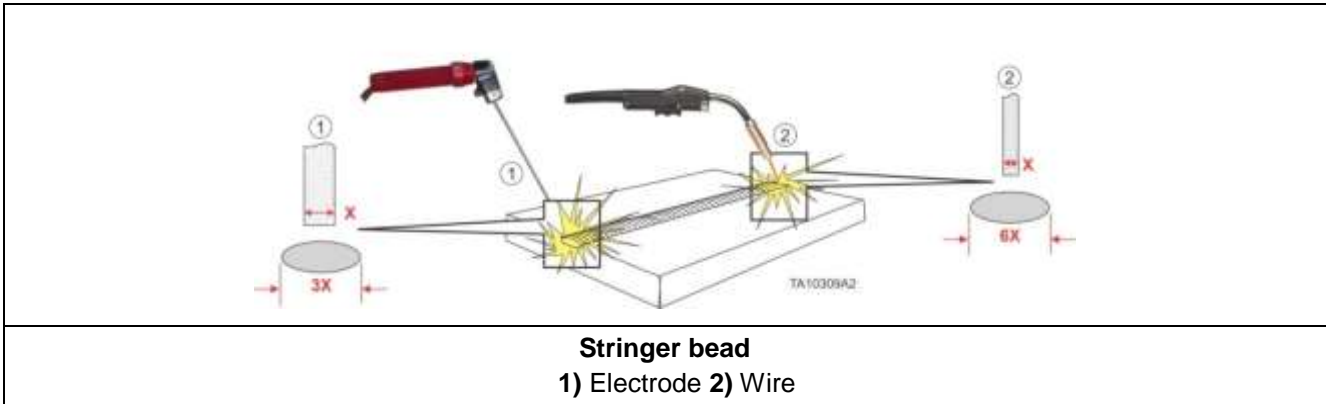


Full pass weld

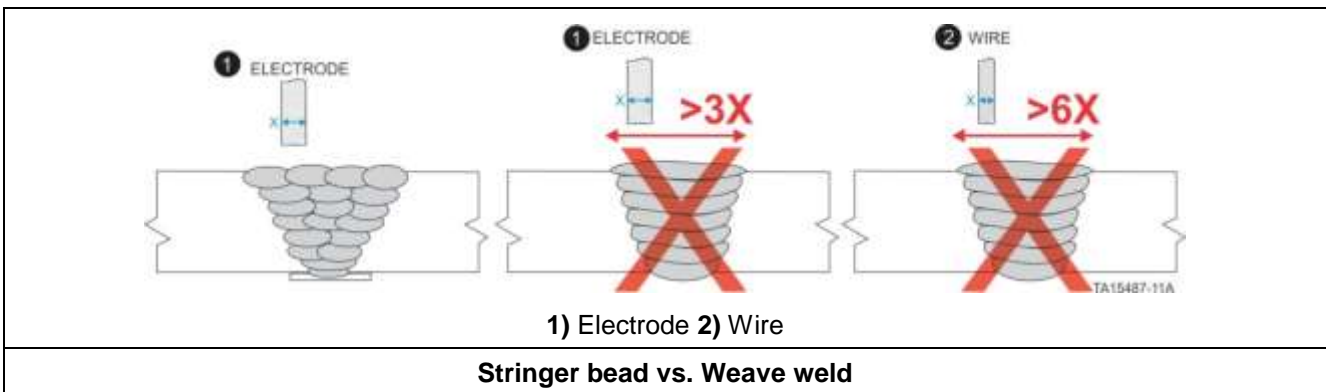
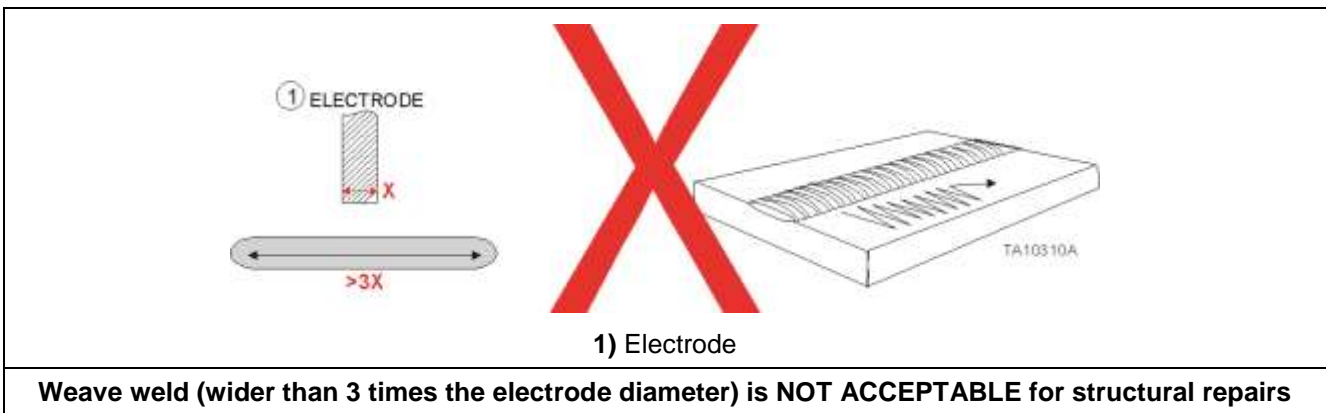
Each pass must be completed for the full length (l) of the repair area prior to starting the next pass.

Welding Types

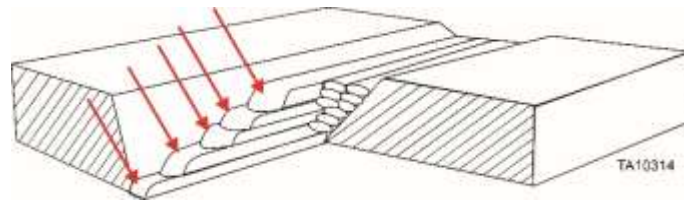
1. Use stringer beads when welding. The bead width must be no wider than 3 times the diameter of the consumable.



2. **NO** weave welds are permitted.



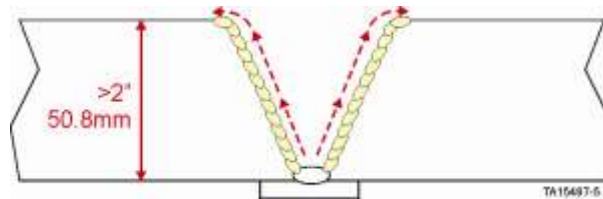
3. Starts and stops on each pass should each be in different locations from the previous passes.



Weld starts and stops

Weld Buttering

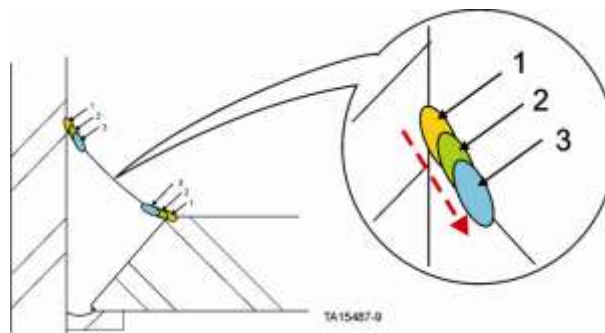
1. On any groove or fillet weld deeper than 2" (50.8 mm) - butter weld the sides of the groove prior to welding the groove joint. Put a single layer or buttering layer of weld metal on each side of the weld joint. This does two things:
 - a. Buttering as shown, puts weld metal on the joint when there is no restraint on it. The weld metal merely has to fuse to the base material.
 - b. The subsequent passes will temper the preceding butter passes and eliminate the hardened heat affected zone.
2. This layer will be approximately 3/32" - 1/8" (2.4 mm - 3.175 mm) thick and should be a stringer bead.
3. These buttering passes should extend up over the top edge of the joint and onto the surface of the plate for approximately 1/4 inch (6.35 mm) on each side of the joint.



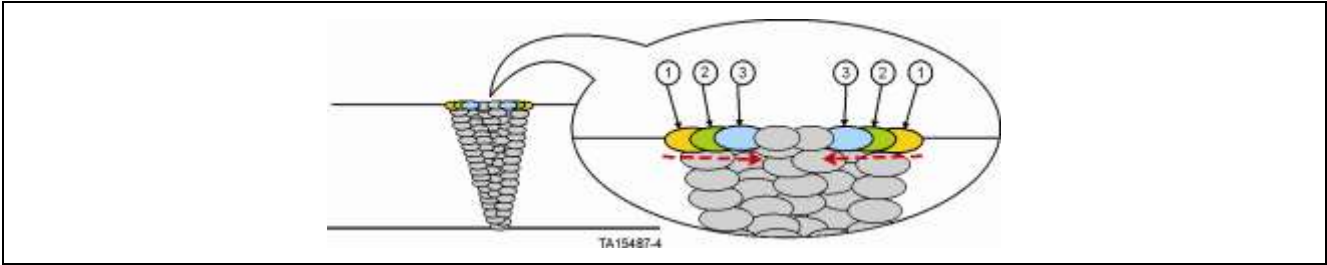
Butter welds

Order of Weld Finish Passes

1. The edges of the final passes on all repair welds should be made in the following sequence in order to minimize the HAZ (heat affected zone).
 - a. Weld Pass 1 at the edge of the weld with the parent material.
 - b. Weld Pass 2 with a 50% overlap over pass 1.
 - c. Weld Pass 3 with a 50% overlap over pass 2.
 - d. The final welds should always be near the middle of the weld away from the parent metal.



Final bead passes – begin at edge of parent metal and work back toward center of weld

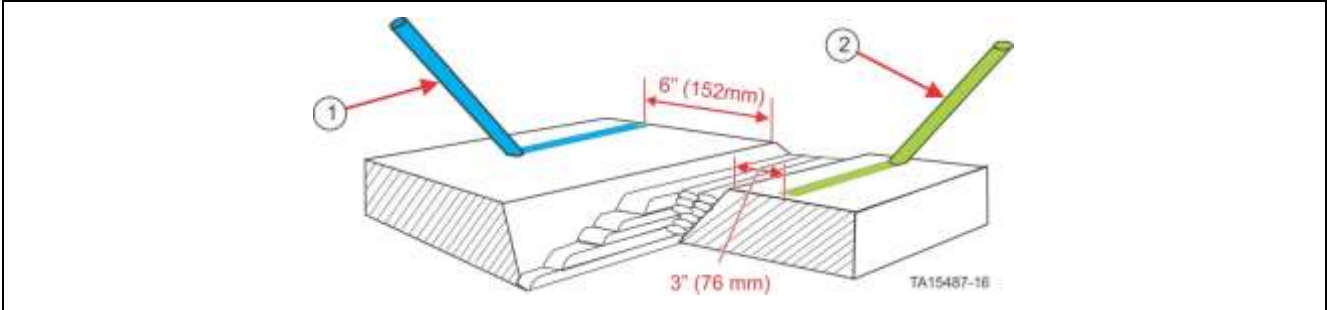


Final bead passes – begin at edge of parent metal and work back toward center of weld

Interpass Temperature

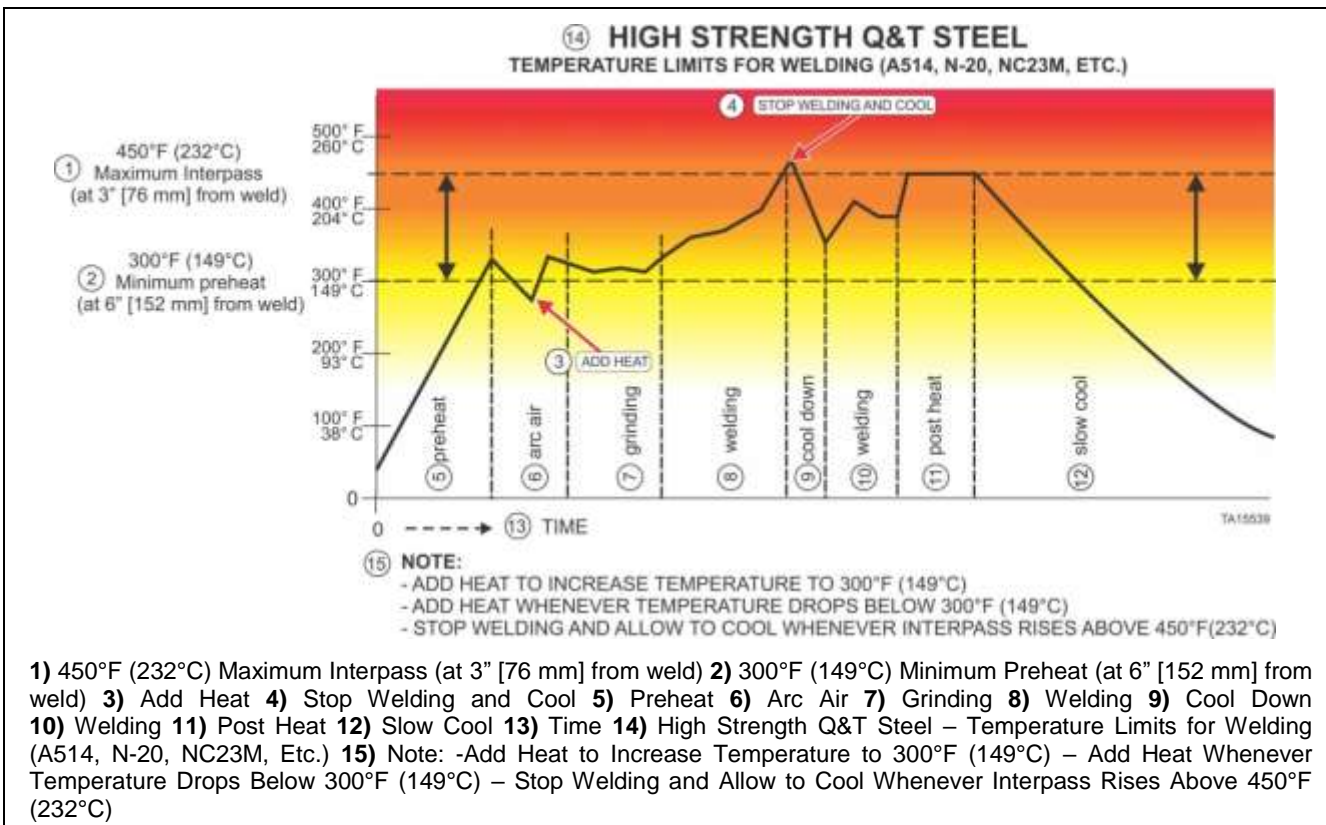
1. Before every weld pass - monitor the interpass temperature 3" (76 mm) away from the active weld.

Interpass Temperature	
Structural Steel	Castings and High Strength Steel
500F (260° C) maximum	450F (232° C) maximum

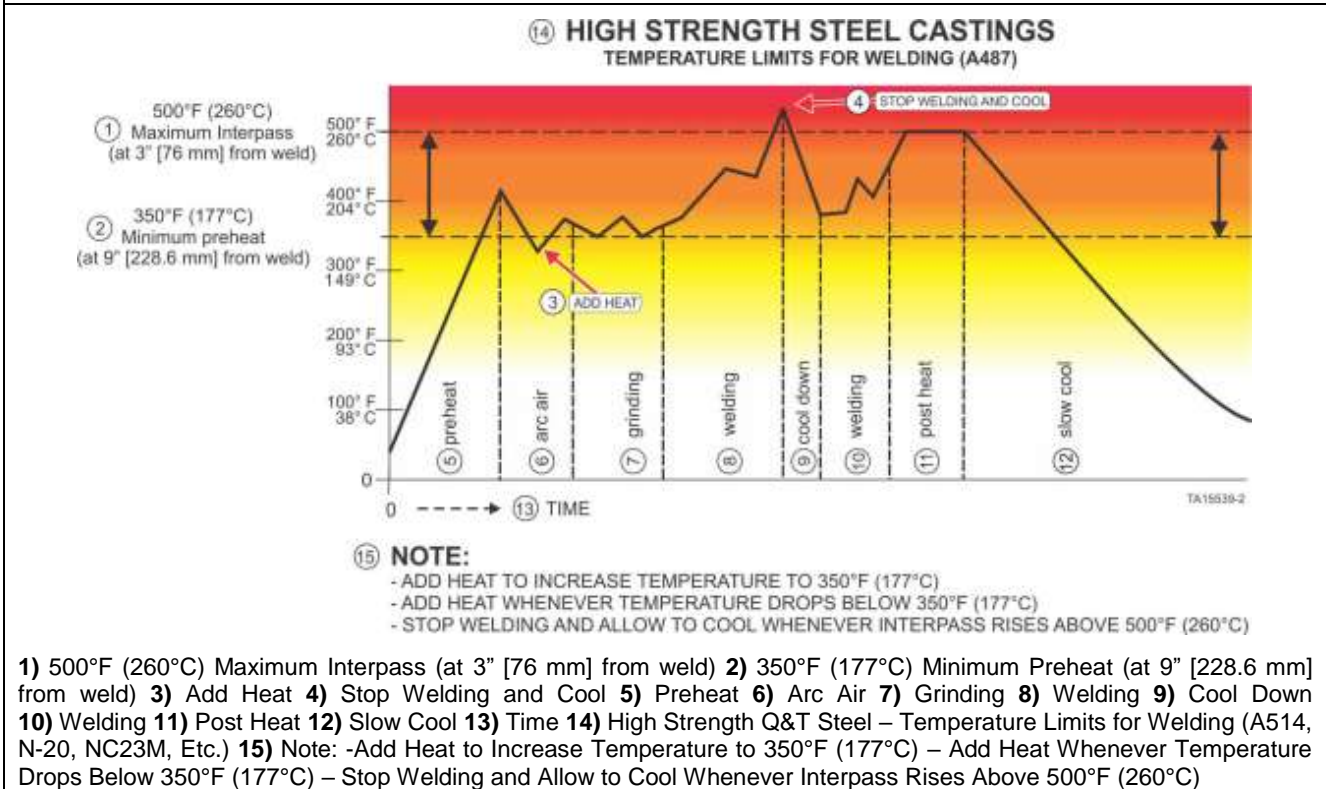


Interpass temperature
 1) Preheat temperature, 2) Interpass temperature

2. If the temperature goes over this maximum level then the welding process should be stopped until the temperature drops back under this level.



Interpass temperature – maintained throughout the welding process



Interpass temperature – maintained throughout the welding process

3. An interpass temperature log should be maintained and updated every hour during the repair. Following is a typical format for a temperature log.

Following is a sample – a full size log is included in the appendix.

Interpass Temperature Log Sheet (sample layout)			
Job Description		Date	
Welder	Time	Temp	Initial
	0		
	1 hour		
	2 hour		
	3 hour		
	4 hour		
	5 hour		
	6 hour		
	7 hour		

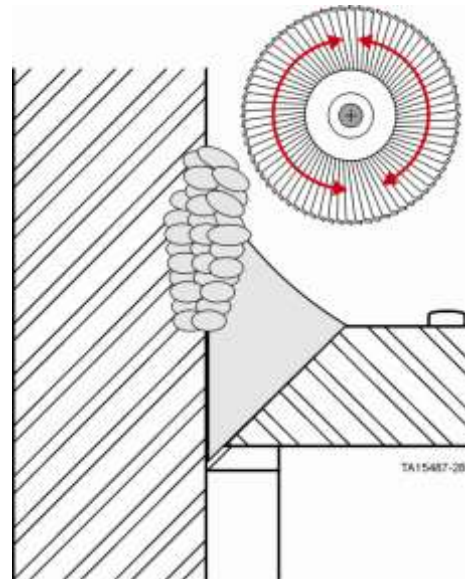
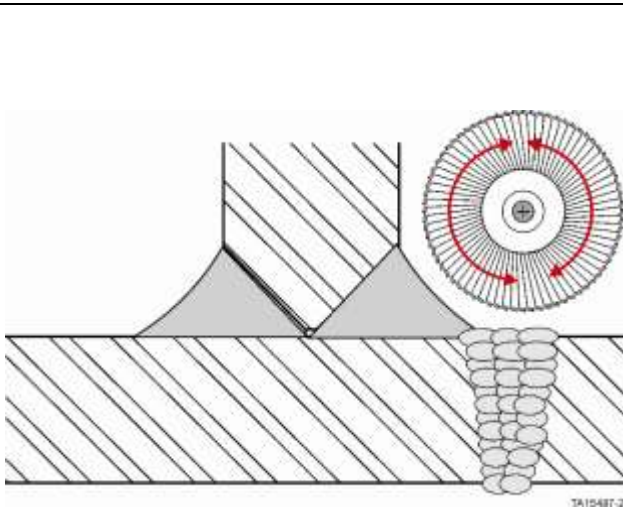
Grinding Procedures

1. All repair welds should be blend grinded to have a smooth transition into the base materials.
2. The typical blend radius is recommended to be about 2" (50.8 mm) – which is what would be achieved by using a standard 4" (101.6 mm) or 4.5" (114.3 mm) grinding wheel.

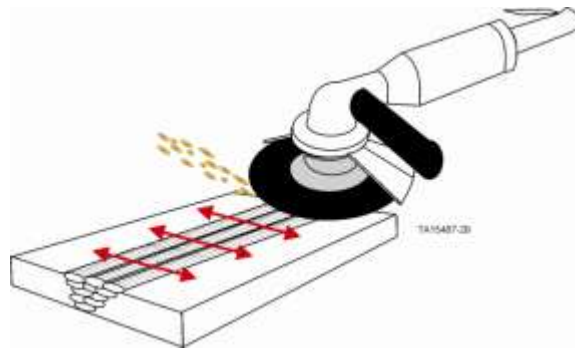


Typical air grinder with flapper type wheel

3. No undercut is allowed.
4. Grind feed marks should not be visible when the grinding is finished. If necessary, polish with an emery wheel or disk.
5. All grinding marks and polish marks should be across the weld.



Grind Direction



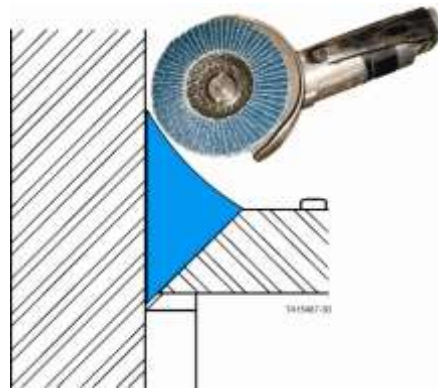
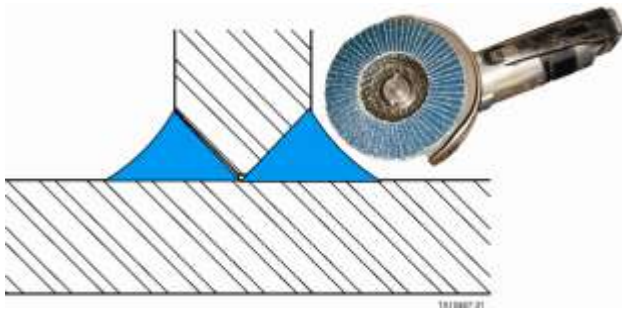
Grind direction



Typical grinders

6. Grind with combination of stones and disks

- a. Metal grinding disk.
- b. Metal grinding flapper disks.
- c. Stones.



Blend grinding

Post Heat and Cool Down Procedure

1. This will normally be required and specified on any multi-pass repair.
2. No undercut at edge of the final weld is permitted. Small undercuts can be blend ground during the next steps. Large undercuts must be corrected by weld repair.
3. Increase the temperatures in the area within 6" (152 mm) (all directions) of the weld repair to 450°F (232°C).
4. Once the temperature is in this range – maintain the temperature for at least 1 hour.

NOTICE

One hour is a general time used for most repairs. However, some specific weld repairs may have the post heat and cool down times lowered or increased depending on the type of repair.

5. After the time has been completed - cover the weld area with thermal blankets and allow weld to slowly cool to ambient. Monitor the temperature decrease rate.
 - a. Maximum rate of temperature decrease is 50° F/hour (28° C/hour) for the first two hours.
 - b. Maximum rate of temperature decrease after that is 100° F/hour (56° C/hour) until down to ambient temperature.
6. If thermal blankets are not available or the temperature is very cold – monitor the temperature and control the cool down rate with external heat sources.

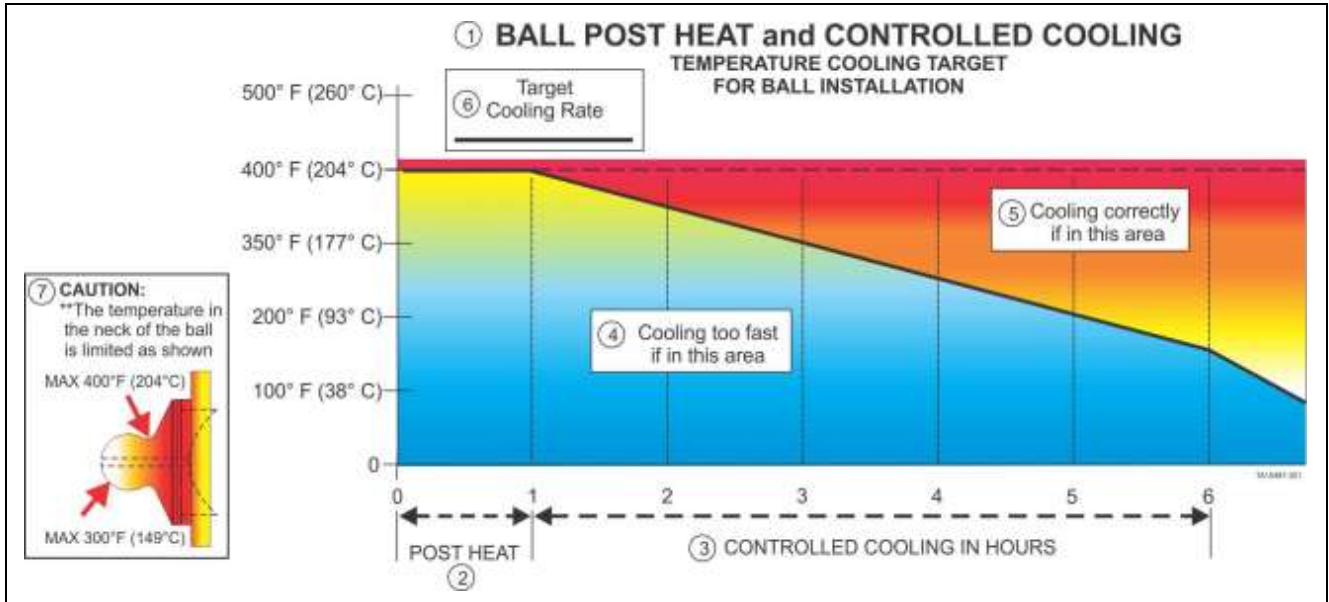
CAUTION

The cooling rate is critical. Excessive cooling rates may cause cracks. This must be closely monitored because the frame, lift arms, bucket and other components act as a large heat sink and can dissipate heat very quickly. This is especially critical for repairs in cold climates or repairs being done outside. DO NOT force cool with fans or water.

** Post Heat and Cool Down Log		
Time	Target Temperature	Actual Temperature
Post heat:		
1 hour*	450° F (232° C)	
Cool Down: (minimum times listed)		
30 min	425° F (218° C)	
1 hour	400° F (204° C)	
2 hour	350° F (177° C)	
3 hour	250° F (121° C)	
4 hour	150° F (66° C)	

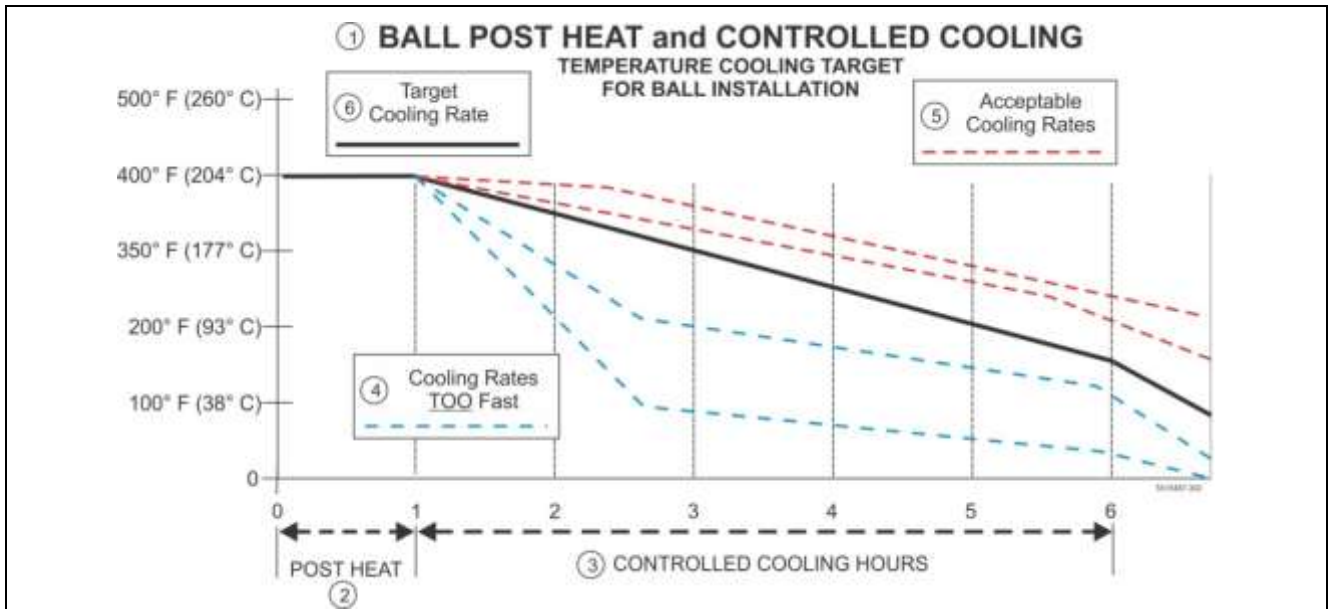
** A full size copy of this log is included in the appendix of this document.

Examples: Temperature Cooling Target



1) Ball Post Heat and Controlled Cooling temperature cooling target for ball installation 2) Post Heat 3) Controlled Cooling in Hours 4) Cooling too fast if in this area 5) Cooling correctly if in this area 6) Target Cooling Rate 7) CAUTION: **The temperature in the neck of the ball is limited as shown Max 400°F (204°C) Max 300°F (149°C)

Post heat and controlled cooling rate



1) Ball Post Heat and Controlled Cooling temperature cooling target for ball installation 2) Post Heat 3) Controlled Cooling Hours 4) Cooling Rates Too Fast 5) Acceptable Cooling Rates 6) Target Cooling Rate

Examples of acceptable cooling rates

NOTICE

If the repairs have only been 0.5" (13 mm) or less pad welds, added to correct the profile, then the post heat time can be reduced to 30 minutes. There should still be a slow cool down.

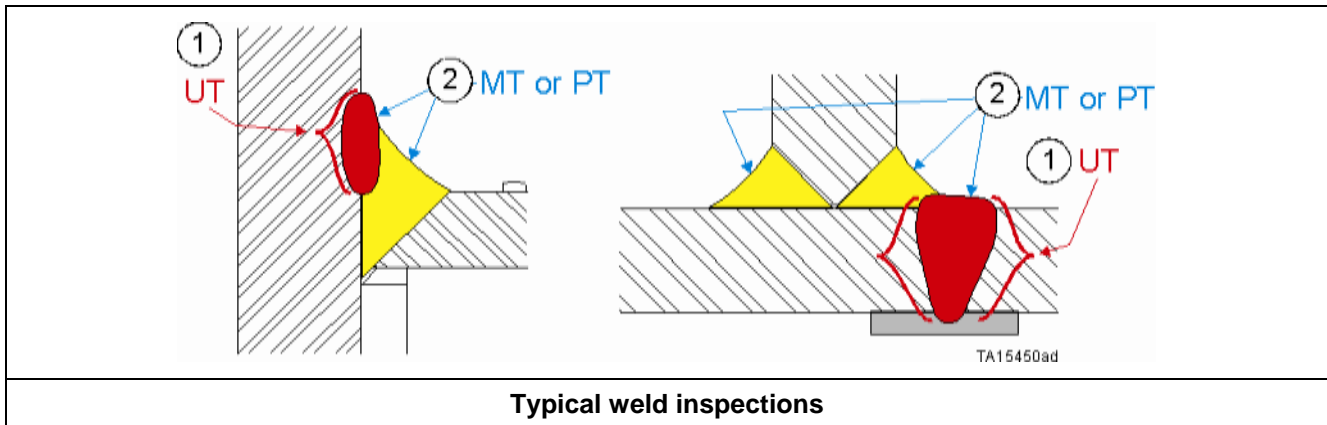
Final Weld Inspection

48 hours (minimum) after the welds have been completed and cooled they should be inspected as follows:

NOTICE

The machine can be operated during the 48 hour time period.

1. 100% visual inspection of all replacement welds per AWS D14.4 CLASS III criteria.
2. MT/PT – Magnetic Particle or Dye Penetrant inspection of all replacement welds per AWS D14.4 CLASS III criteria.
3. UT – Ultrasonic testing of the weld is required for the crack repairs in the torque tube in the area noted in the drawing –per AWS D14.4 criteria.
4. All cracks and discontinuities should be repaired per previous procedures.



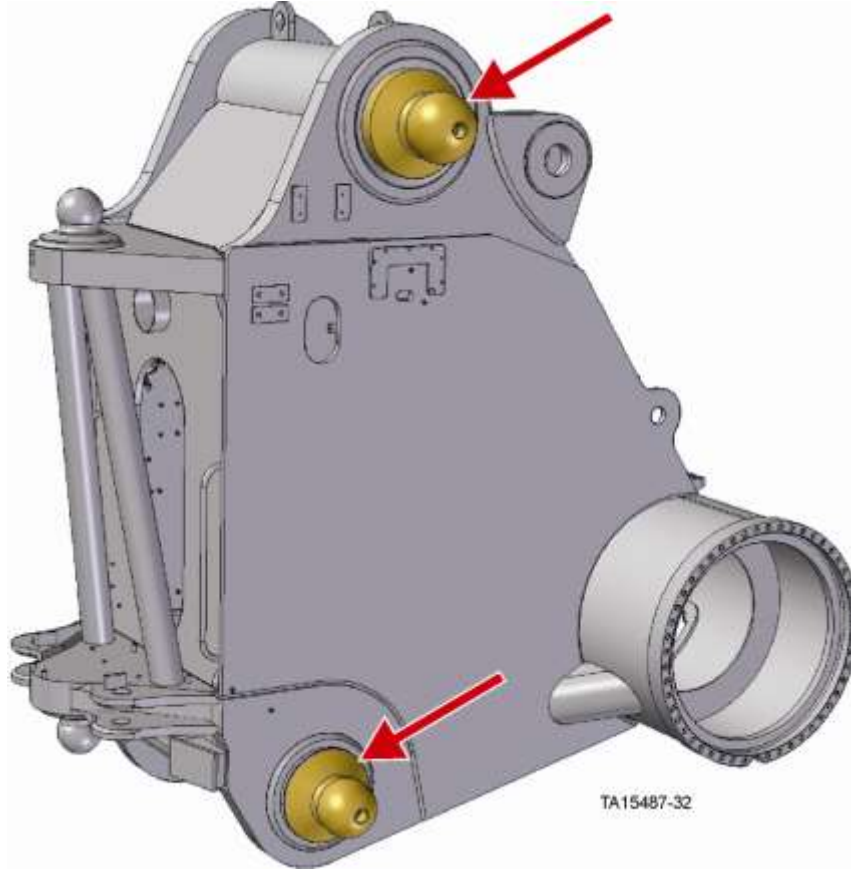
NOTICE

Re-Commissioning after Component Replacements

- Replaced or repaired Components on a loader that require greasing from the auto lube system, require specific assembly and maintenance instructions. These requirements are outlined in the Re-Commissioning Replacement Document. This must be done to assure proper functions of the components
- The operations outlined in the document should be done after all welding and inspection procedures have been completed.
- Following is the Re-Commissioning Replacement Document and a copy is also included in the Appendix of this document.

CHAPTER 3

Hoist Cylinder Ball and Lift Arm Ball Field Replacement Procedures

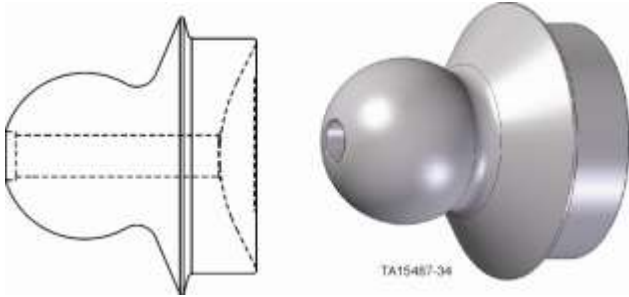
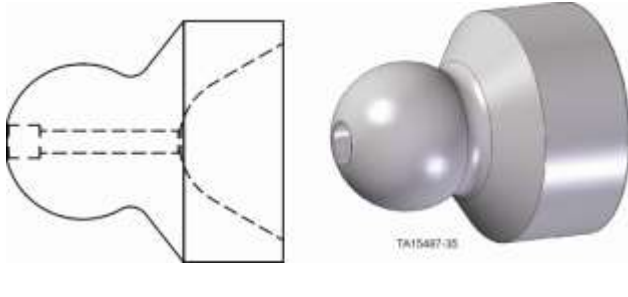


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Hoist Cylinder Ball and Lift Arm Ball Field Replacement Procedures

The design for the hoist and lift arm balls requires a high interference fit between the ball and tube. It is important that the procedures for removal and installation are followed or damage to frame and or new ball can result. The following is a short summary of how the ball, tube, and ear are assembled.

The processes for replacing the hoist cylinder ball and lift arm ball on 50 series loaders are similar. However, because of the differing ball configurations between machine models, two procedures exist for replacing the lift arm ball or the lower hoist cylinder ball. Review the matrix below and determine which procedure should be used before beginning replacement.

Type A ball:		Type B ball:	
			
Ball base with flange		Ball base without flange	
Machine model	Hoist cylinder ball	Lift arm ball	
L-950	Use Procedure "A"	Use Procedure "A"	
L-1150			
L-1350			
L-1400			
L-1800			
L-1850	Use Procedure "B"	Use Procedure "B"	
L-2350			

Safety Preparations



Crush hazards exist if the machine is started or moved while work processes are being performed on the machine. Place bucket flat and level on the ground. Place frame lock in the locked position and lock out the machine's starting capability before performing any work process. Follow all applicable lockout procedures and local rules and regulations for performing work processes. ANYONE performing inspections or service procedures to the machine should be familiar with ALL instructions

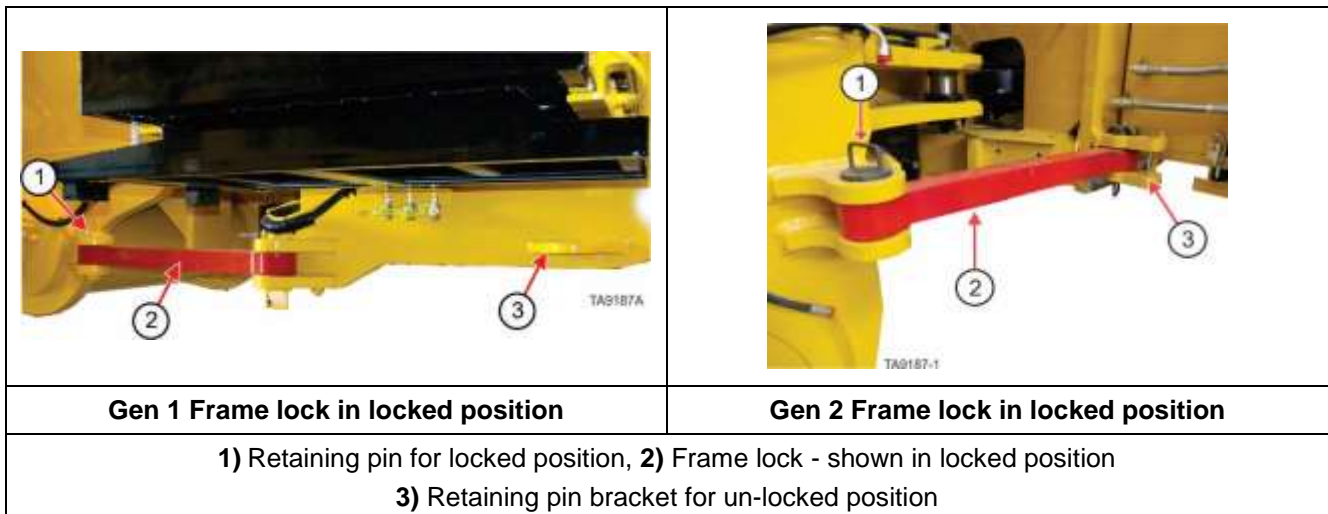
and procedures contained in the machine's **SERVICE MANUAL**. Crush hazard could occur if the machine is started or moves while any type of work process is being conducted on the machine, resulting in serious injury or death.

Machine Shutdown and Lockout

1. Stop the wheel loader on flat level ground.
2. Place bucket flat and on level ground.
3. Move the frame lock to the locked position so that the frame cannot be steered.

⚠ **WARNING**

Crush hazards exist in machine pivot area and area between the tires. Do not enter these areas unless it is verified that the operator has control over the steering and that personnel locking the frame lock have good communication with the operator. Entering the pivot area and area between the tires while the machine is moving or pivoting (articulating) could cause crush hazards resulting in serious injury or death.



Frame lock in locked position

4. Set the parking brakes.
5. Shut off the engine.
6. Place wheel chocks in front and behind each wheel.
7. Lock out the machine's starting capability before performing any cleaning, inspections, or installation and repair procedure.

⚠ **WARNING**

Crush, shock, or other hazards exist if stored energy is not removed or isolated prior to working on the machine. Stored energy (hydraulic, electrical, pneumatic, mechanical, etc.) may be present if not isolated or released prior to working on the machine. Do not work on the machine without removing this stored energy (suspended loads, electrical power, air pressure, etc.). Risk of crushing, shock, or

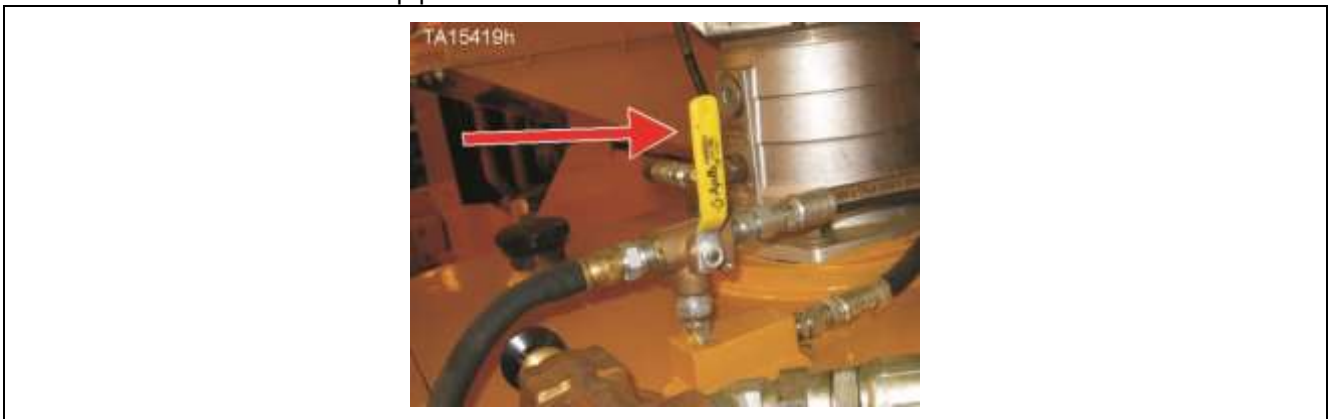
other physical injury exists if stored energy is not removed or isolated prior to working on the machine which could result in serious injury or death.

8. Turn the battery and engine isolation switches to the off position and install locks on the battery isolation switch.



Isolation and Control switches assembly – Battery isolation switch in OFF position with locks in place

9. Release the air from the hydraulic reservoir by using the hydraulic reservoir air valve (ball valve) on top of the reservoir. The supply line from main air system will be blocked and reservoir air will vent out the hose that runs down the outside of the hydraulic reservoir.
10. Turn the handle to the up position as shown.



Hydraulic reservoir air valve handle UP

11. Release the air from the various air storage reservoirs by opening all of the air bleed valves.

Three valves on right side of rear frame under hydraulic reservoir
One valve on right side of front frame near hoist cylinder ball cap



Figure 2. Open air reservoir bleed valves

⚠ WARNING

Crush hazards exist if all personnel are not cleared from the bucket and lift arm area before using the hydraulic hoist and bucket hydraulic pressure bleed down valves to relieve pressure from the hoist and bucket circuit. Assembly must be used only when the engine is NOT running. Before using the Manual Bleed Valve Assembly, refer to “HYDRAULIC AND GREASE SYSTEMS”, “MANUAL BLEED VALVE ASSEMBLY”, in Section 04 of the Service Manual for additional operational and safety information. Operating the manual bleed valve may cause the lift arms and bucket to descend rapidly. All personnel around the bucket and lift arms area shall be removed from the area before operating hydraulic hoist and bucket hydraulic pressure bleed down valves. Using the hydraulic bleed down valves could result in movement of the lift arms and bucket which could cause a crush hazard resulting serious injury or death.

12. Use the hydraulic pressure bleed down valves located in the front frame underneath the Husco valves to bleed any stored pressure in the hoist and bucket cylinders.
13. Turn each valve slowly counterclockwise as shown below and allow the pressure to bleed down.
14. Open the valve completely and leave it open during repairs.



CAUTION

Before performing welding operations on a machine, the fire suppression system circuit monitors panel’s in-line fuse must be removed. The fuse is located in the battery box on some machines. Failure to do so may cause the system to actuate and/or damage the solid-state components of the system. Replace the in-line fuse before the machine has been started or after all welding operations have been completed.



Fire suppression in-line fuse located in loader battery box on some machines

WARNING

Fall hazard exists when working at heights. Be sure to take appropriate safety precautions when working at heights on the rear and front frames or the lift arms balls. Follow all required statutory regulations for working at height. Wear fall restraint when necessary to prevent falls. Failure to take appropriate safety precautions, including wearing fall restraint when necessary can cause fall hazards resulting in serious injury or death.

WARNING

Crush hazards exist if standing under, working, or placing any body part under hoisted/suspended components. Never stand under hoisted/suspended components. Ensure appropriate lifting devices are used, and blocking is adequate to prevent the component from unexpectedly moving during transportation. Refer to SAFETY, WARNINGS, AND CAUTIONS before attempting to remove the operator's cab. Failure to stay out from under hoisted/suspended components can cause crush hazard resulting in serious injury or death.

Burn Hazard

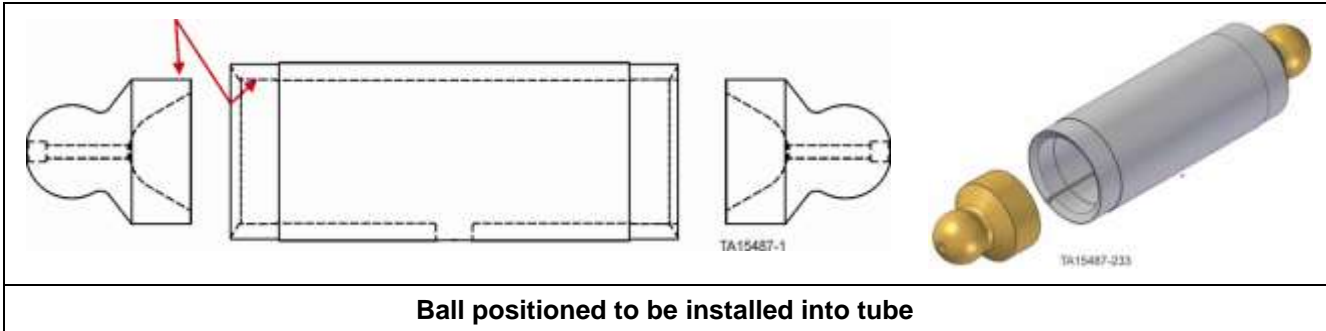
WARNING

Burn and inhalation hazards exist when welding or cutting on the machine. Cutting and welding can produce hot surfaces. Smokey condition can exist if a fire starts. Have qualified fire watch personnel present, and keep a fire extinguisher that meets all statutory regulations nearby during all cutting and welding operations. Failure to provide a qualified fire watch and an appropriate fire extinguisher can cause fire and inhalation hazards resulting in serious injury or death.

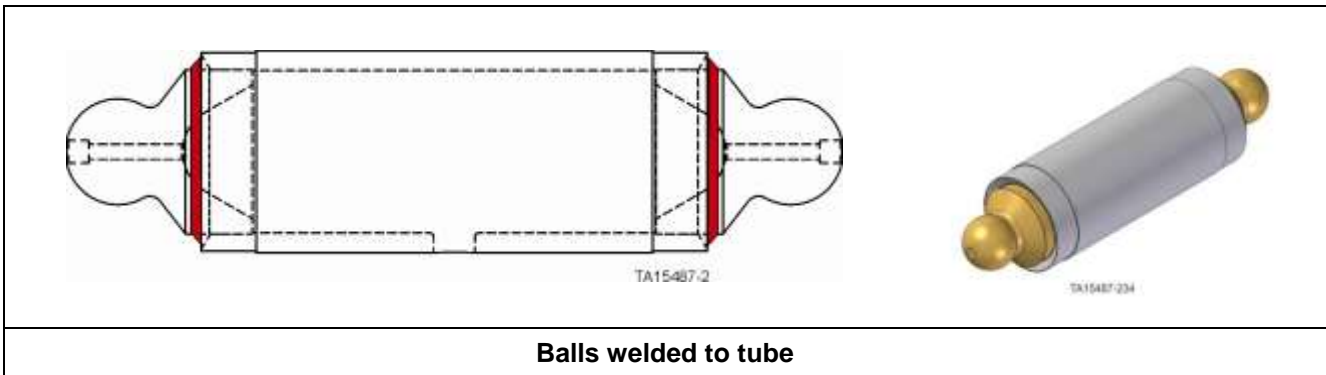
Ball and Tube Structure Assembly Process

(This applies to lift arm balls and hoist cylinder balls.)

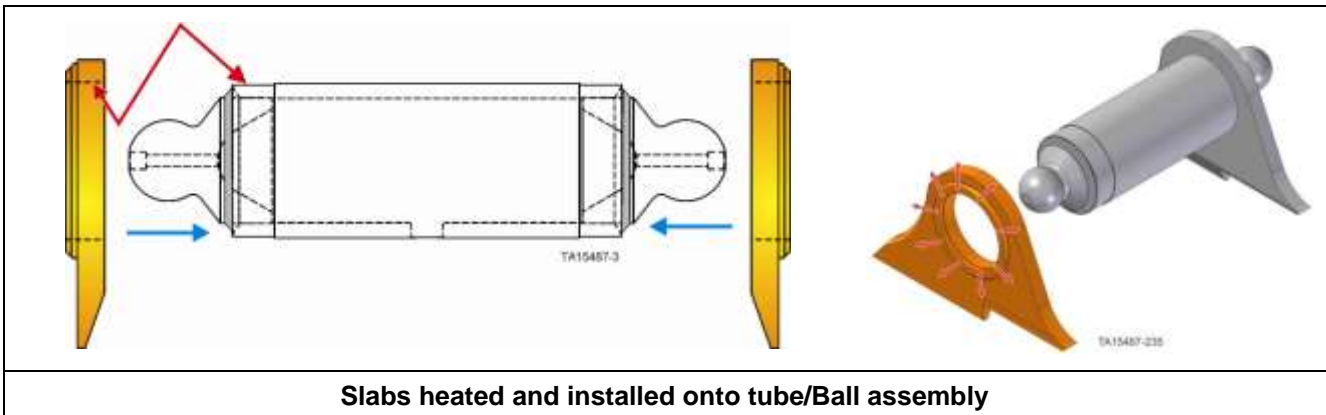
1. The balls are installed into the tube.
2. The fit is close to 0.000" and minimal heating of the tube is required.



3. The balls are welded to the tube.



4. The bore in the thick slab and boss is approximately 0.020" (0.508 mm) smaller than the OD of the tube.
5. The slabs and boss are heated to expand the bore.
6. The slabs and boss are placed onto the tube, positioned, and allowed to cool.



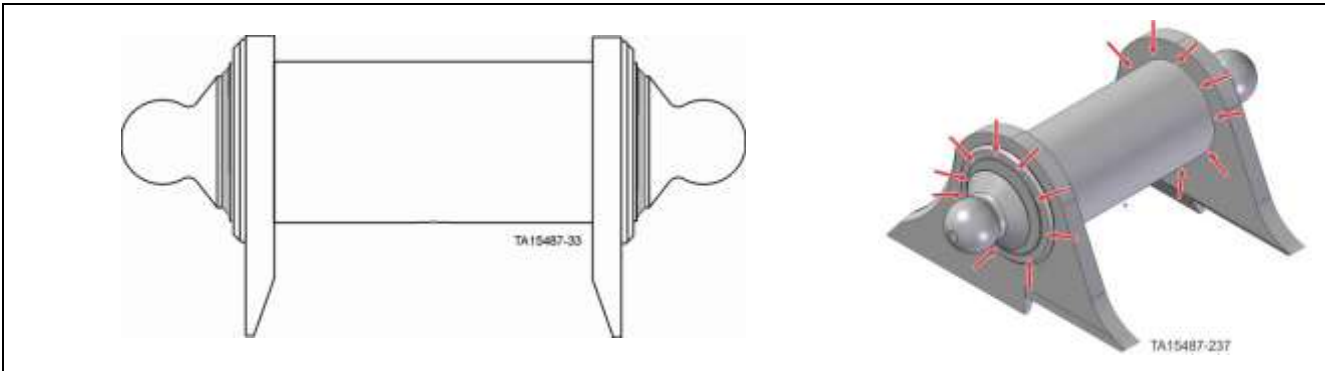
7. The slabs cool and compress the tube and ball.



Sub structure assembly with hot slab in place

8. When the slab has cooled there will be about a 0.020" (0.508 mm) compressive interference fit with the tube.

9. The slabs are NOT welded to the tube. They are only held in place by the interference fit.

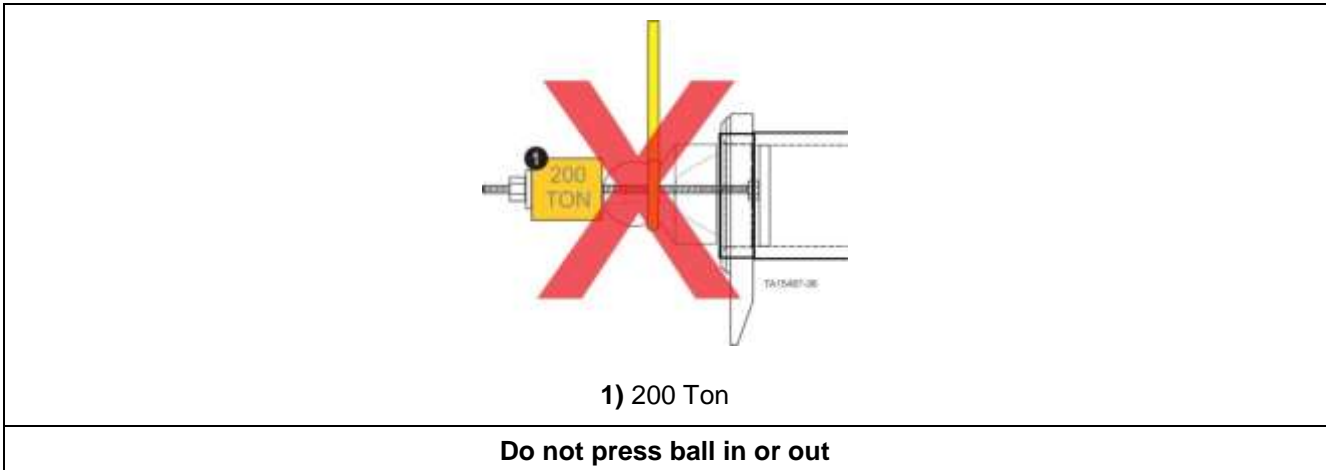


Sub structure assembly

Because of the high interference fit imposed by the slabs - special procedures are required to remove the existing ball and install a new ball.

DO NOT Press a Ball IN or OUT

The ball should not be pushed into place or removed with a press. It would take well over 200 tons to press a ball out or to press a ball in. This will damage the ball and tube surfaces. (A ball that is only stuck in about 1" (25 mm) can require 200 tons and special tooling to remove)



WARNING

Crush and struck-by hazards exist if attempting to use a press to install or remove a ball. **DO NOT** attempt to use a press to install or remove a lift arm or hoist cylinder ball. Equipment failure is possible. Because of the high interference fit, the forces required are very high and this is a safety hazard. Failure to use the proper equipment can cause crush or struck-by hazards resulting in serious injury or death.

CAUTION

DO NOT attempt to use a press to install or remove a lift arm or hoist cylinder ball. Because of the high interference fit, the forces required are very high and this is a safety hazard. It will likely damage the mating surfaces of the ball and tube.

To remove and install the lift arm and hoist cylinder balls:

- The old ball has to be cut out, in pieces, to be removed.
- The new ball must be cooled with liquid nitrogen (**not** dry ice or CO₂). The frame must be heated for installation.

NOTICE

Re-Commissioning after Campaign Ball Replacement

- After each ball has been replaced or repaired and all the welding/inspection procedures have been completed- specific assembly and maintenance items outlined in the Re-Commissioning Replacement Document must be done to assure proper function of the ball joints.
- Re-Commissioning Replacement Document is included in the Appendix of the Field Welding Procedure document.

CHAPTER 3A

Procedure for “Type A” Ball (Ball Base with Flange)

Hoist Cylinder Ball and Lift Arm Ball -



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Procedure	FW-0108
Revision	0
Written by	Joel Armstrong
Date	3/8/2010

Field Welding Procedure

This document conforms to AWS D1.1/D14.3 Structural Welding Code and Australian Standards AS 1554.4

Description	Installation of Hoist Cylinder Ball and Lift Arm Ball
Notes	See attachment
Welding Process	FCAW / SMAW

Joint				Joint Detail	
Type	Groove or Fillet				
Backing	If needed	Material	Mild Steel		
Root Opening	+1/4 / - 1/16" Per Attachment (+6.35 / - 1.6 mm)				
Root face Dimension	+/- 1/16" Per Attachment (+/- 1.6 mm)				
Groove Angle (degrees)	+10/-5 Per Attachment	Radius	N/A		
Back Gouging	Yes, if required	Method	Arc - Air		
Other					

Base Metals			
Specification	ASTM A829 Grade 8620 Normalized	A151 4820H	3316 per SAE J1249 or ASTM A508 Grade 4N
Thickness	2.5" (63.5 mm)	9-12" (228-305 mm)	14" (355.6 mm)
	Tube	Balls	Balls

Filler Metals		
AWS Specification	A5.20/A5.29	A5.1, A5.5
AWS Class	E71T-12MJH4 E81T1-NiMJH4	E7018-H4, E8018C3
Diameter	0.045", 0.052", 1/16" (1.2, 1.4, 1.6 mm)	1/8", 5/32" (3.2, 4mm)

Shielding		Positions Qualified	Flat, Vertical, Horizontal
Gas Composition	100% CO2 or Ar/CO2 75/25	Groove	1G, 2G, 3G, 4G
Flow Rate	35 – 45 cfh	Fillet	1F, 2F, 3F
Technique		Vertical Progression	Up

Technique		Electrical Characteristics	
Stringer or Weave Bead	Stringer	FCAW - Current	DCEP
Multi/Single Pass (per side)	Multiple	SMAW - Current	DCEP
Peening	Yes	Other	
Interpass Cleaning	Chipping and or grinding		

Preheat and Interpass Temperatures

Material Types		
Structural Steel	Castings	Q&T High Strength Steel
Frame structure Bucket Blade	Lift Arm Torque Tube (1150, 1350, 1850 Gen2, 2350) Upper part front frame (1350) Axles (some 1350) Sockets	Balls Bucket Lip Bucket adapters Lift arms Bell cranks

Preheat		
Material Thickness	Structural Steel	Castings and high strength steel
Distance from weld	6" (152 mm) minimum	6" (152 mm) minimum
< or = 3/4" (< or = 19 mm)	125° F (52° C)	200° F (93° C)
>3/4" to 1-1/2" (>19.05 to 38.1 mm)	225° F (107° C)	250° F (121° C)
>1-1/2" to 2-1/2" (>38.1 to 63.5 mm)	250° F (121° C)	300° F (149° C)
>2-1/2" (>63.5 mm)	300° F (149° C)	350° F (177° C)

Interpass Temperature		
All thicknesses	500° F (260° C) maximum	450° F (232° C) maximum

Post Heat Treatment	
400° F (204° C) for one hour	Required: YES (X) NO ()

Welding Parameters

(The FCAW welding parameters were obtained from the qualification of the LINCOLN Ultracore 712A80 used during Komatsu fabrication on Komatsu welding equipment. These numbers will likely vary depending on the specific welding equipment and consumable used for repairs.)

Weld Pass	Process	Filler Metal	Filler Diameter	Current Type	Amps	Volts	Travel Speed (ipm)	Wire Feed Speed	Welding Position
All	FCAW	E71T-1MJ	1/16"	DCEP	280-340	22-26	8-12	255-300	Flat & Horizontal
All	FCAW	E71T-1MJ	0.052"	DCEP	220-310	22-26	8-12	225-375	Flat & Horizontal
All	FCAW	E71T-1MJ	0.045"	DCEP	210-280	23-25	8-12	275-425	Flat & Horizontal
All	FCAW	E71T-1MJ	1/16"	DCEP	185-225	21-24	7-10	105-130	Vertical
All	FCAW	E71T-1MJ	0.052"	DCEP	195-235	21-24	7-10	200-375	Vertical
All	FCAW	E71T-1MJ	0.045"	DCEP	155-235	21-23	7-10	175-325	Vertical
All	SMAW	E7018	5/32"	DCEP	130-210	19-21	5-8	N/A	All
All	SMAW	E7018	1/8"	DCEP	90-160	19-21	5-8	N/A	All
All	SMAW	E8018C3	5/32"	DCEP	130-220	19-21	N/A	N/A	All
All	SMAW	E8018C3	1/8"	DCEP	90-160	19-21	N/A	N/A	All

Suggested Air Arc Parameters

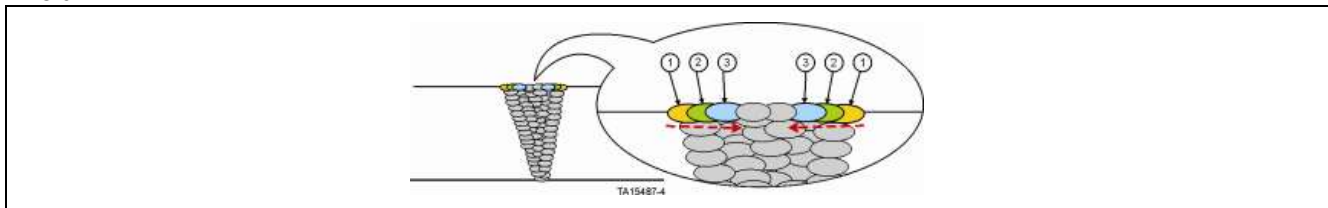
Electrode Diameter		Minimum Amps	Maximum Amps
Inches	Millimeter		
1/8	3.2	60	90
5/32	4.0	90	150
3/16	4.8	200	250
¼	6.4	300	400
5/16	7.9	350	450
3/8	9.5	450	600
½	12.7	800	1000
5/8	15.9	1000	1250
¾	19.1	1250	1600

Proper Electrode Selection for Field Welding

Material joint type	Rod consumable	Wire Consumable
Steel to steel	7018 series	E7xT- xxxx series
Steel to Casting	7018 series	E7xT- xxxx series
Casting Repair	8018 series	E8xT- xxxx series
Socket or Ball installation	8018 series	E8xT- xxxx series
Wear hardware installation on bucket	8018 series	E8xT- xxxx series

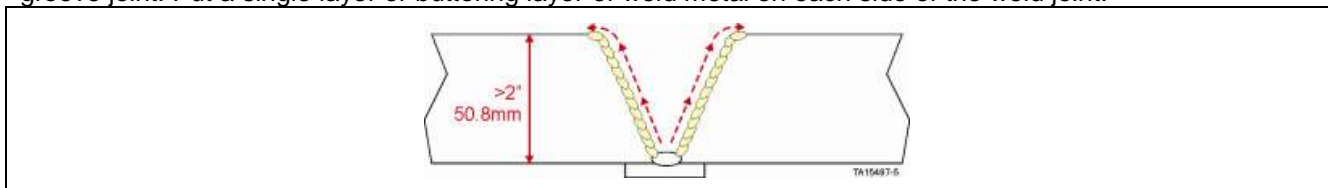
Bead Tempering Finish Passes

The last layer of weld passes must be completed starting from the base material toward the middle of the weld.



Butter Welds

On groove or fillet welds 2" (50.8 mm) deep or larger - butter weld the sides of the groove prior to welding the groove joint. Put a single layer or buttering layer of weld metal on each side of the weld joint.



Procedure “A” (These Balls Have a Flange on the Base)

Safety Preparations

WARNING

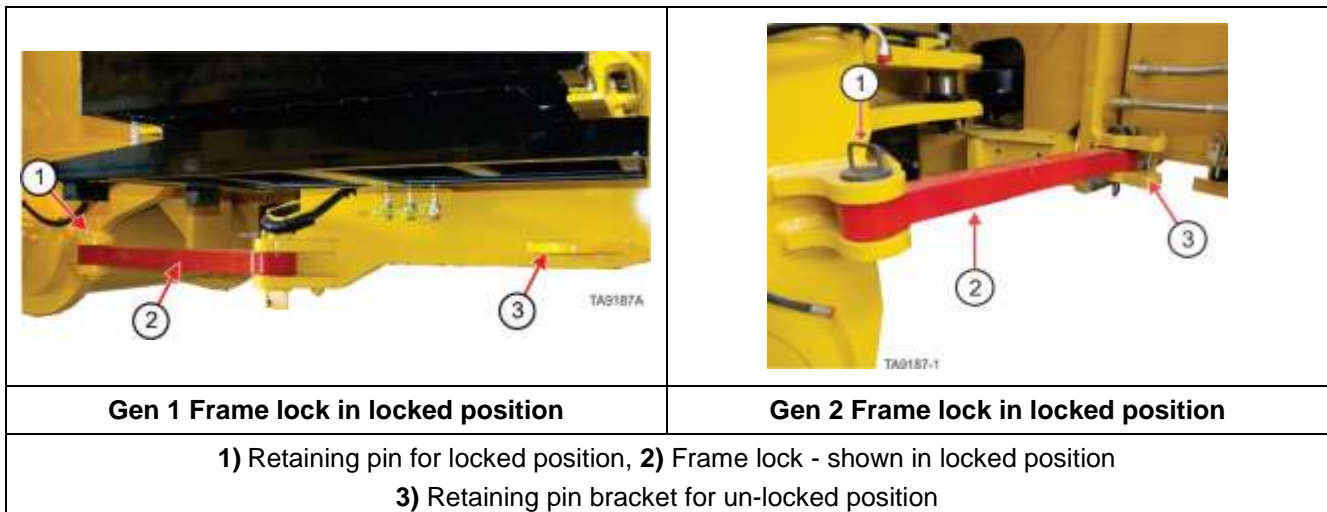
Crush hazards exist if the machine is started or moved while work processes are being performed on the machine. Place bucket flat and level on the ground. Place frame lock in the locked position and lock out the machine’s starting capability before performing any work process. Follow all applicable lockout procedures and local rules and regulations for performing work processes. ANYONE performing inspections or service procedures to the machine should be familiar with ALL instructions and procedures contained in the machine’s SERVICE MANUAL. Crush hazard could occur if the machine is started or moves while any type of work process is being conducted on the machine, resulting in serious injury or death.

Machine Shutdown and Lockout

1. Stop the wheel loader on flat level ground.
2. Place bucket flat and on level ground.
3. Move the frame lock to the locked position so that the frame cannot be steered.

WARNING

Crush hazards exist in machine pivot area and area between the tires. Do not enter these areas unless it is verified that the operator has control over the steering and that personnel locking the frame lock have good communication with the operator. Entering the pivot area and area between the tires while the machine is moving or pivoting (articulating) could cause crush hazards resulting in serious injury or death.



4. Set the parking brakes.
5. Shut off the engine.
6. Place wheel chocks in front and behind each wheel.
7. Lock out the machine’s starting capability before performing any cleaning, inspections, or installation and repair procedure.

WARNING

Crush, shock, or other hazards exist if stored energy is not removed or isolated prior to working on the machine. Stored energy (hydraulic, electrical, pneumatic, mechanical, etc.) may be present if not isolated or released prior to working on the machine. Do not work on the machine without removing this stored energy (suspended loads, electrical power, air pressure, etc.). Risk of crushing, shock, or other physical injury exists if stored energy is not removed or isolated prior to working on the machine which could result in serious injury or death.

8. Turn the battery and engine isolation switches to the off position and install locks on the battery isolation switch.



Isolation and Control switches assembly – Battery isolation switch in OFF position with locks in place

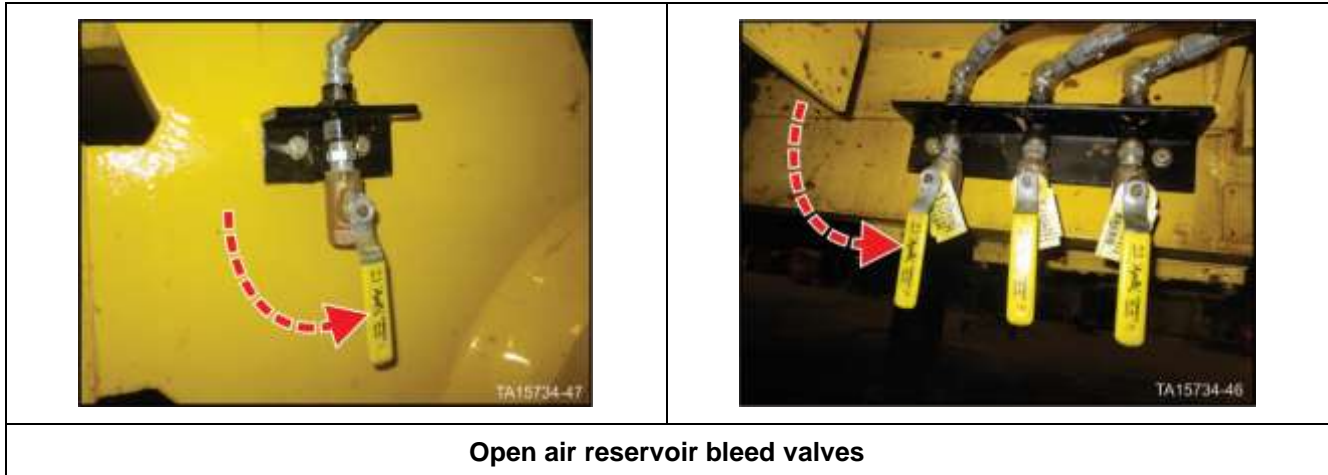
9. Release the air from the hydraulic reservoir by using the hydraulic reservoir air valve (ball valve) on top of the reservoir. The supply line from main air system will be blocked and reservoir air will vent out the hose that runs down the outside of the hydraulic reservoir.
10. Turn the handle to the up position as shown.



Hydraulic reservoir air valve handle UP

- Release the air from the various air storage reservoirs by opening all of the air bleed valves.

Generation 1	Generation 2
Three valves on left side of rear frame under electrical cabinet	Three valves on right side of rear frame under hydraulic reservoir
One valve on left side of front frame near frame lock and hoist cylinder ball cap	One valve on right side of front frame near hoist cylinder ball cap



⚠ WARNING

Crush hazards exist if all personnel are not cleared from the bucket and lift arm area before using the hydraulic hoist and bucket hydraulic pressure bleed down valves to relieve pressure from the hoist and bucket circuit. Assembly must be used only when the engine is NOT running. Before using the Manual Bleed Valve Assembly, refer to “HYDRAULIC AND GREASE SYSTEMS”, “MANUAL BLEED VALVE ASSEMBLY”, in Section 04 of the Service Manual for additional operational and safety information. Operating the manual bleed valve may cause the lift arms and bucket to descend rapidly. All personnel around the bucket and lift arms area shall be removed from the area before operating hydraulic hoist and bucket hydraulic pressure bleed down valves. Using the hydraulic bleed down valves could result in movement of the lift arms and bucket which could cause a crush hazard resulting serious injury or death.

- Use the hydraulic pressure bleed down valves located in the front frame underneath the Husco valves to bleed any stored pressure in the hoist and bucket cylinders.
- Turn each valve slowly counterclockwise as shown below and allow the pressure to bleed down.
- Open the valve completely and leave it open during repairs.



CAUTION

Before performing welding operations on a machine, the fire suppression system circuit monitors panel's in-line fuse must be removed. The fuse is located in the battery box on some machines. Failure to do so may cause the system to actuate and/or damage the solid-state components of the system. Replace the in-line fuse before the machine has been started or after all welding operations have been completed.



Fire suppression in-line fuse located in loader battery box on some machines

⚠ WARNING

Fall hazard exists when working at heights. Be sure to take appropriate safety precautions when working at heights on the rear and front frames or the lift arms balls. Follow all required statutory regulations for working at height. Wear fall restraint when necessary to prevent falls. Failure to take appropriate safety precautions, including wearing fall restraint when necessary can cause fall hazards resulting in serious injury or death.

⚠ WARNING

Crush hazards exist if standing under, working, or placing any body part under hoisted/suspended components. Never stand under hoisted/suspended components. Ensure appropriate lifting devices are used, and blocking is adequate to prevent the component from unexpectedly moving during transportation. Refer to SAFETY, WARNINGS, AND CAUTIONS before attempting to remove the operator's cab. Failure to stay out from under hoisted/suspended components can cause crush hazard resulting in serious injury or death.

Burn Hazard

⚠ WARNING

Burn and inhalation hazards exist when welding or cutting on the machine. Cutting and welding can produce hot surfaces. Smokey condition can exist if a fire starts. Have qualified fire watch personnel present, and keep a fire extinguisher that meets all statutory regulations nearby during all cutting and welding operations. Failure to provide a qualified fire watch and an appropriate fire extinguisher can cause fire and inhalation hazards resulting in serious injury or death.

Summary

1. Lift arms will have to be removed to replace a lift arm ball.
2. Hoist cylinder will have to be removed to replace a hoist cylinder ball.
3. Welding Consumables:
 - 1) Crack repair in base material: E7018 electrode or E71T-12MJH4 wire.
 - 2) Ball installation: E-8018C3 electrode or E81T1-Ni1MJDH4 wire.

NOTICE

The factory will consider approving other wire types depending on the specifications of the wire. For example: Komatsu uses Lincoln Ultracore E71T-1MJ along with gas that is 75% Ar/25% CO2 for installation of the balls. This combination of gas and wire gives a tensile strength of 83,000 psi (572 MPa) which meets the specifications for E80XX wire.

4. Slab preheat for air arc: 250° F (121° C) for 6" (152 mm) from weld in all directions.
5. Ball Freezing: 30-40 minutes in liquid nitrogen.
6. Frame/tube heating to 300° F (149° C) for ball installation.
7. Gauge the hole to ensure clearance prior to ball installation.
8. Slab preheat for welding: 300° F (149° C) for 6" (152 mm) from weld in all directions.
9. Interpass temperature maximum 450° F (232° C).
10. Stringer beads with each pass all around.
11. Post heat and slow cool.
12. Wait 48 hours and UT (ultrasonic testing) and MT or PT weld area (magnetic particle or dye penetrant).
13. Re-Commissioning after Campaign Ball Replacement.

Preparation/Ball Removal

1. Prepare suitable protection to protect the personnel and loader from cold, wind, dust, etc.
2. If changing the hoist cylinder ball - remove the catwalk for the lift arm ball to allow access for the cable from the overhead crane. Install appropriate scaffolding equipment or stands and safety precautions for work at height.

WARNING

Fall hazard or crush hazard exist when working on scaffolding. The scaffolding or work stand must have the capacity to hold 3-4 people and the ball. The scaffold could collapse if it is not built sufficiently to hold the weight. It must also meet all local safety requirements. Failure to provide an appropriate scaffold can cause fall or crush hazards resulting in serious injury or death.



Provide protection

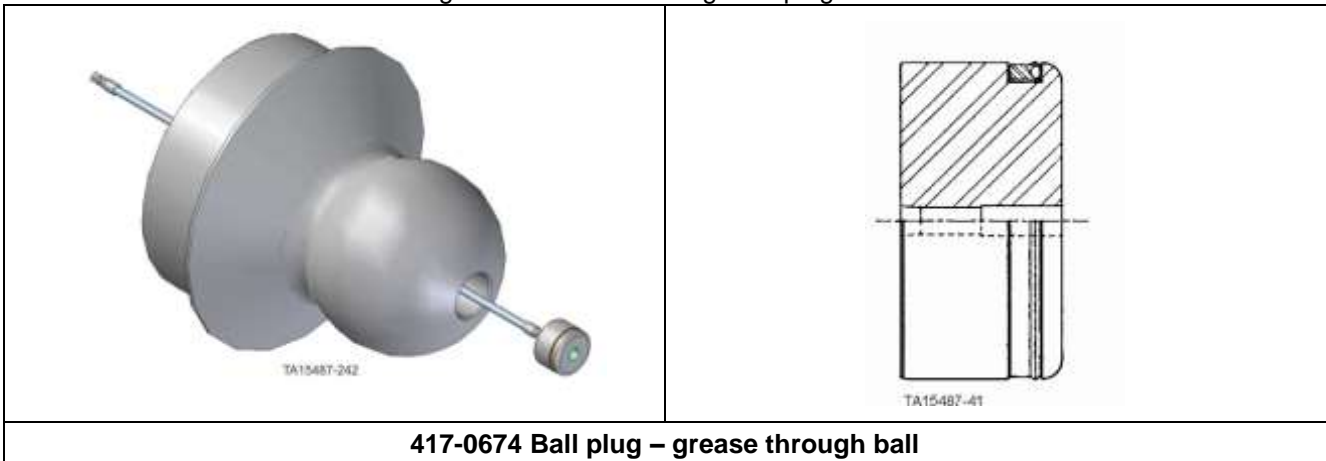
3. Remove the grease plug in the center hole. If you are unable to remove this plug then it is recommended to have a new plug available as the plug is typically damaged during ball removal.

4. This plug could be one of several types:

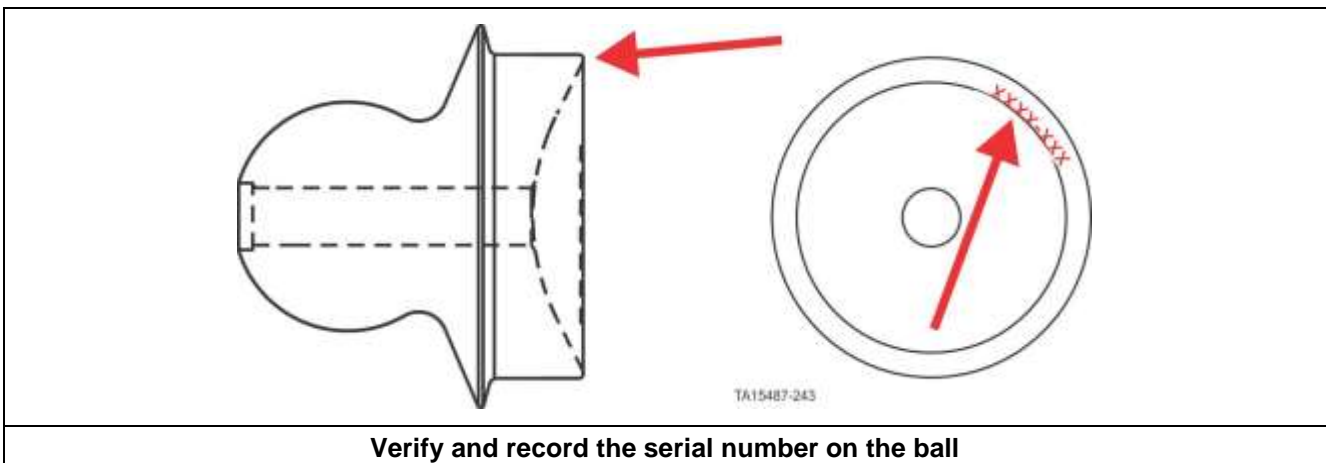
- a. The Type A hoist cylinder ball on L-950, L-1150 and L-1350 used either a 407-8325 or 426-7874 plug and the ball was greased through the cap.



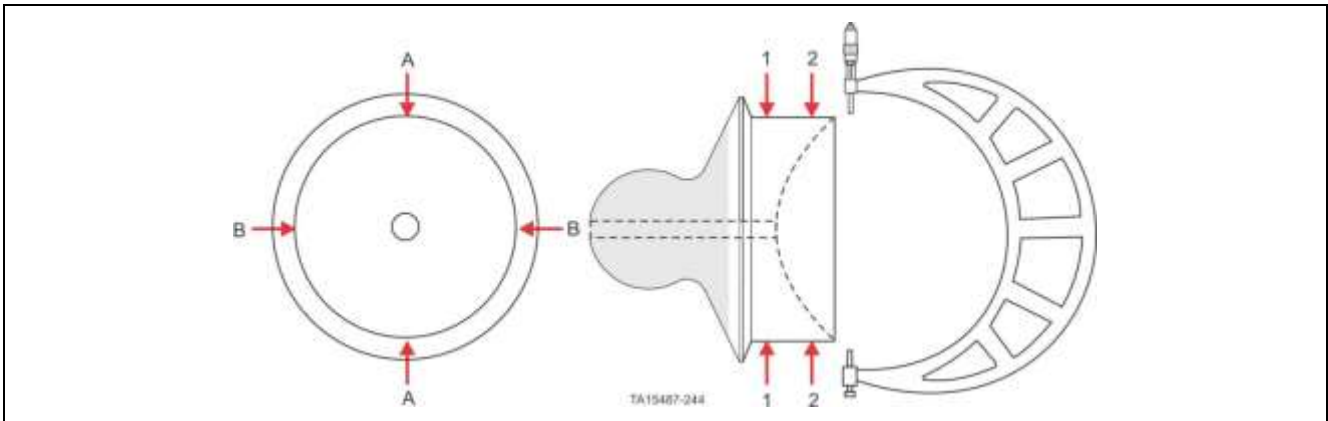
- b. The Type A hoist cylinder ball on the L-1850 and all of the Type A lift arm balls have a plug with a hole in the middle and the grease comes in through the plug.



5. Verify and record the serial number on the ball.



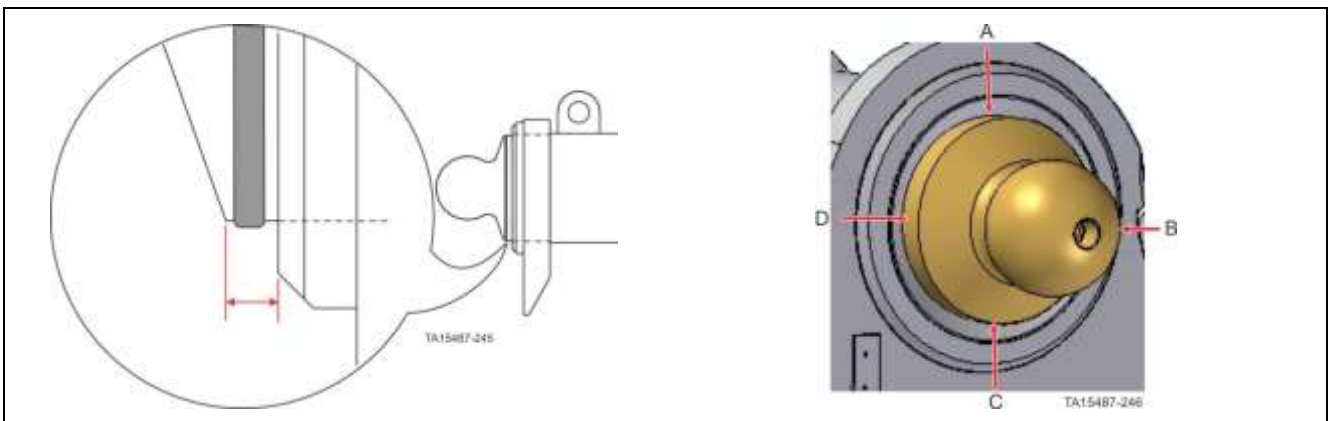
6. Verify the diameter of the shoulder on the ball



Measure diameter of the shoulder on the ball

A1	A2	B1	B2
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7. Before removing the damaged ball, locating dimensions must be established so that the new ball can be located properly and quickly when initially installed. The locating dimensions are taken from the shoulder of the ball base, across the weld joint, to the face of the side plate ring. Make three or four measurements around the ball.



Position reference measurement

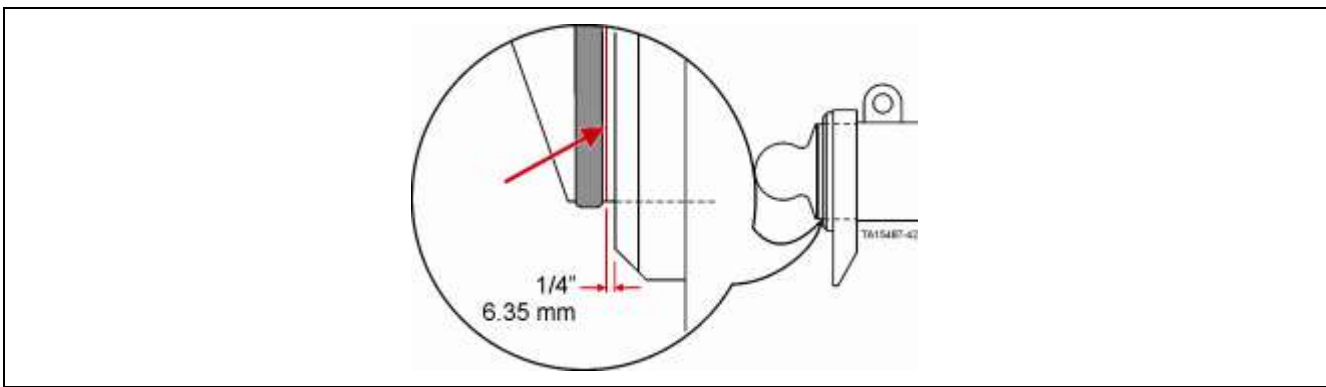
A	B	C	D
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8. The shoulder of the ball base may have its corners beveled, as shown. Make sure the locating dimension is taken from the original shoulder corner and not from the beveled corner. This can be accomplished by laying a straight edge on the ball base and measuring out from the side plate ring to the straight edge.



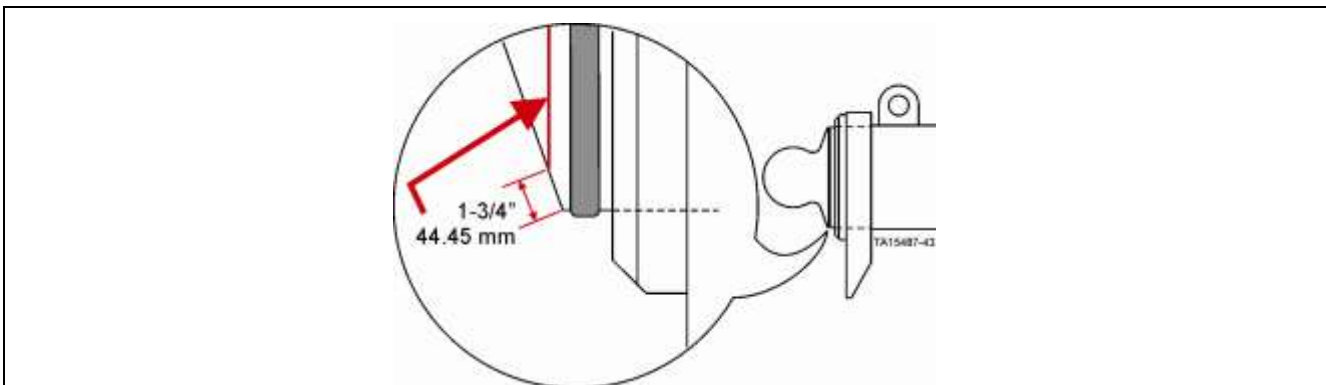
Position measurement

9. Write the reference dimensions on the side of the frame where it will be easy to read when installing the new ball. Do not write in the areas near the tube that will be heated.
10. Scribe a mark around the weld joint $\frac{1}{4}$ " (6.35 mm) out from the side plate ring. This scribe mark is to be used when cutting off the ball base.



Position measurement

11. Scribe a mark around the base of the ball $1\frac{3}{4}$ " (44.45 mm) in from the outer diameter of the ball base. This scribe mark is to be used when cutting off the ball base.



Cut measurement

⚠ WARNING

Crush hazard exists when moving the ball. Install lifting eyes with at least 2000 pound (1000 kg) capacity to support the various pieces of the ball as they are removed. The balls are very heavy and if they were to fall they could cause injury or death. This is particularly true of the lift arm balls due to the height. Failure to provide equipment of sufficient strength to hold the weight of the ball can cause crush hazards resulting in serious injury or death.

412-4128	430 lb. (195 kg)	9" ball
416-8403	629 lb. (285 kg)	9" ball

12. Lifting eyes of at least 2000 lb. (1000 kg) capacity should be installed on the heavy pieces prior to removal so they cannot fall and cause injury.
13. Grind a flat area on the ball in the area where the lifting eye is to be attached.

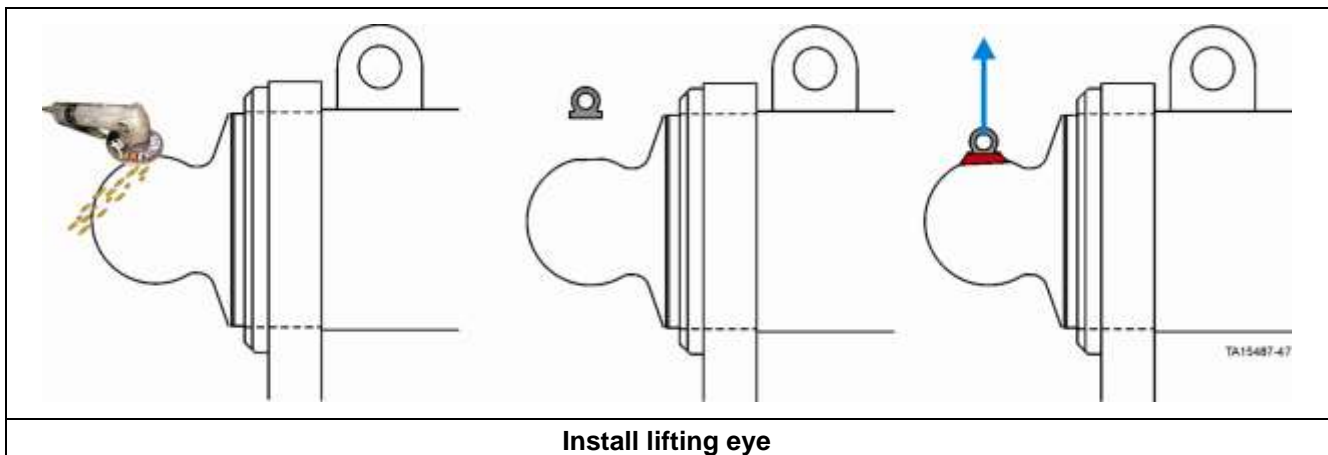
⚠ WARNING

Crush hazard exists when using the lifting eye. It is critical to grind through the carburized layer on the surface to ensure proper weld quality on the lifting eye. Failure to grind through the carburized layer can result in a weld that will fail when weight is applied. This could cause the ball to fall resulting in a crush hazard. Failure to grind through the carburized layer can cause crush hazards resulting in serious injury or death.

14. Grind at least .150" (4 mm) deep to get below the carburized surface of the ball.
15. Preheat to 300° F (149° C) and weld the lifting eye in place.

⚠ WARNING

Crush hazard exists when using the lifting eye. Preheat is required when welding on a lifting eye in order to assure a quality weld suitable for lifting. Failure to preheat could lead to poor fusion and danger when lifting the ball. This could cause the ball to fall resulting in a crush hazard. Failure to properly preheat can cause crush hazards resulting in serious injury or death.



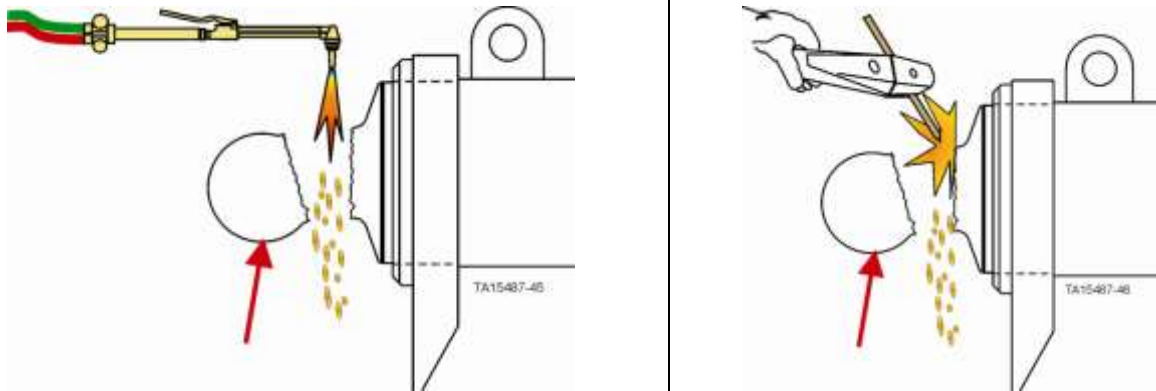
16. Use air-arc or oxy-fuel cutting process to cut the ball off at the neck.

⚠ WARNING

Fire hazard exists when cutting off the ball. The area behind the ball may be filled with grease or other flammable contaminant. Always have a fire extinguisher nearby to put out any fires that result from cutting process. Failure to provide an appropriate fire extinguisher can cause a fire hazard resulting in serious injury or death.

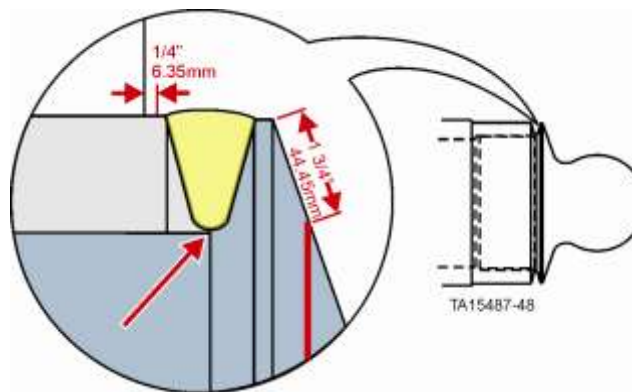


Grease in tube



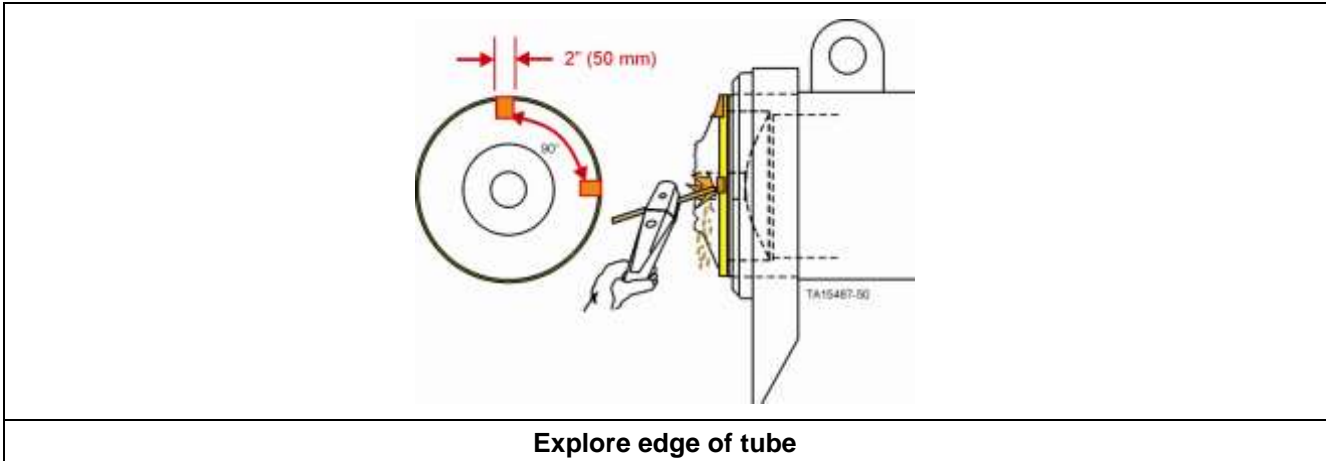
Cut neck of ball

17. The following shows detail of the reference dimensions as related to the end of the tube.

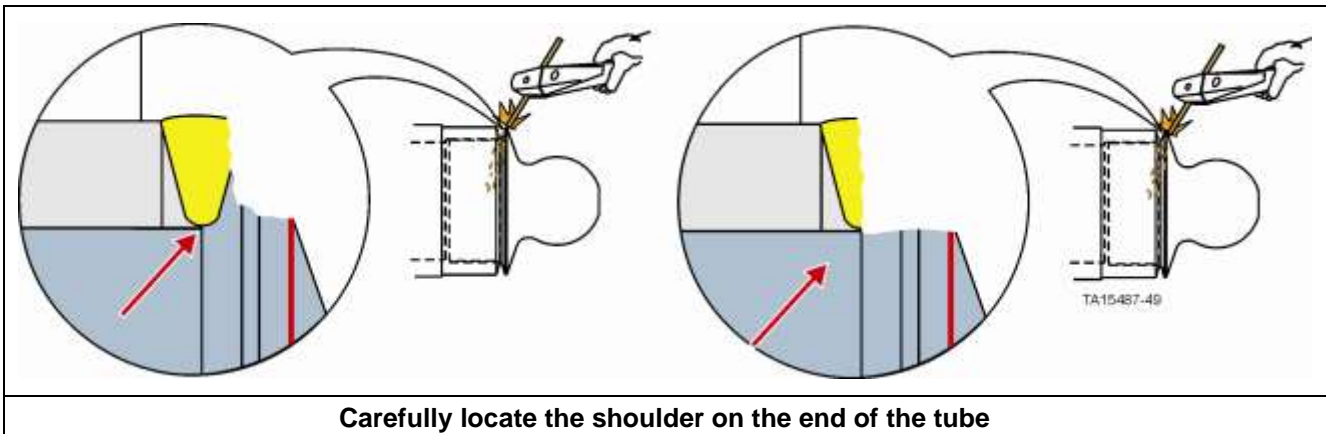


Reference measurements and shoulder on end of tube

18. Use air-arc to explore the edge of the tube in two areas 90° apart near top of ball. 2" (50.8 mm) wide.



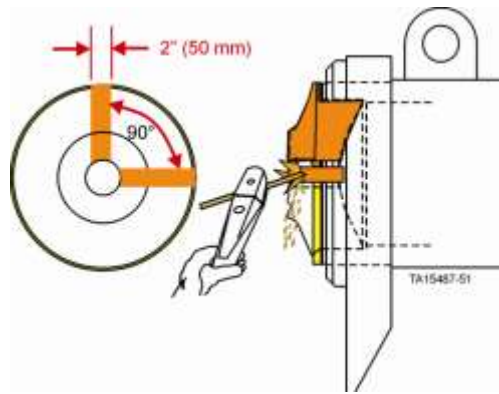
19. Carefully locate the tube ball interface shoulder. The intersection of the 1-3/4" (44.45 mm) scribe marks and the middle of the weld is used to locate the approximate root of the weld joint.



NOTICE

This interface may or may not be present depending on how the tube was prepared during the ball installation and how hot the root pass was installed. In particular, a previously replaced ball may have lost the shoulder depending on the ball removal and installation processes used.

20. Continue with the air-arc cuts through the ball at 90° from each other as shown. Be careful not to cut into the tube. -These cuts should be about 2" (50.8 mm) wide.

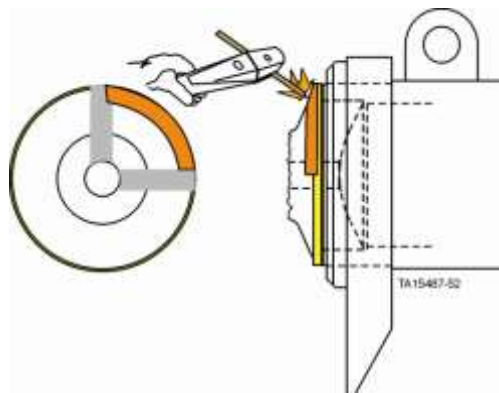


Two cuts at 90°

NOTICE

It is possible to remove a ball base in two pieces with a single cut across the ball base. However, this process is not shown in this document as the pieces are hard to remove and are very heavy and hazardous.

21. Cut away the material between and around the ball and in between the 90° cuts. Take care not to damage the shoulder if present.



Cut around the edge exposing the shoulder

WARNING

Crush hazard exists when moving the ball. Install lifting eyes with at least 2000 pound (1000 kg) capacity to support the various pieces of the ball as they are removed. The balls are very heavy and if they were to fall they could cause injury or death. This is particularly true of the lift arm balls due to the height. Failure to provide equipment of sufficient strength to hold the weight of the ball can cause crush hazards resulting in serious injury or death.

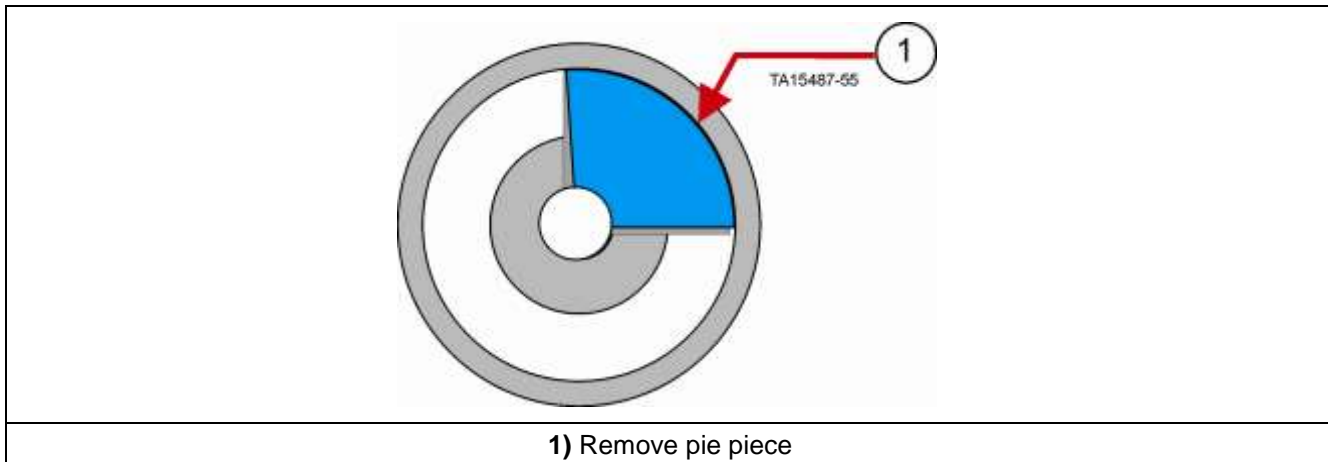
WARNING

Crush hazard exists when using the lifting eye. It is critical to grind through the carburized layer on the surface to ensure proper weld quality on the lifting eye. Failure to grind through the carburized layer can result in a weld that will fail when weight is applied. This could cause the ball to fall resulting in a crush hazard. Failure to grind through the carburized layer can cause crush hazards resulting in serious injury or death.

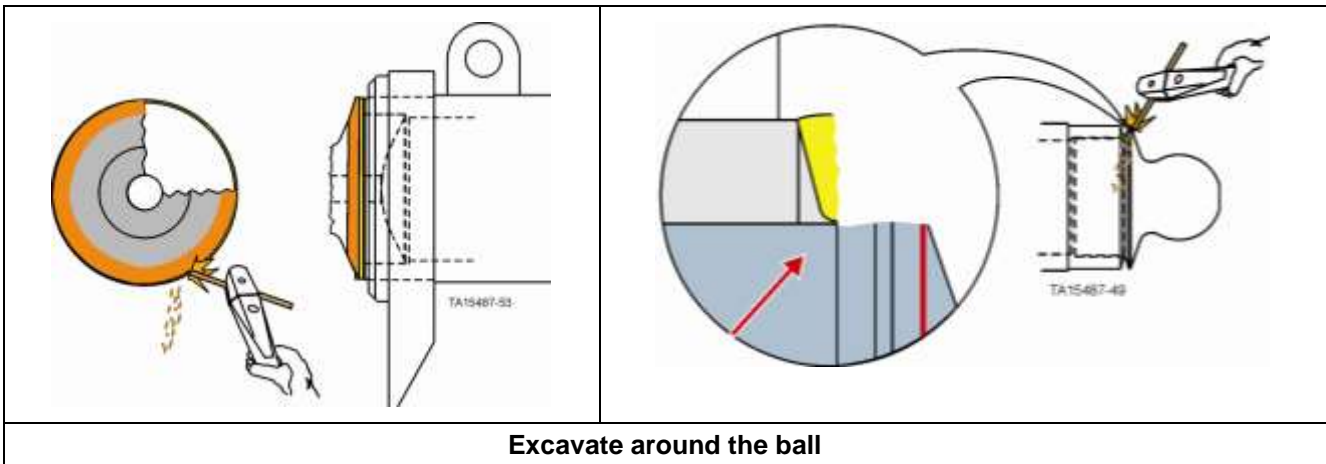
WARNING

Crush hazard exists when using the lifting eye. Preheat is required when welding on a lifting eye in order to assure a quality weld suitable for lifting. Failure to preheat could lead to poor fusion and danger when lifting the ball. This could cause the ball to fall resulting in a crush hazard. Failure to properly preheat can cause crush hazards resulting in serious injury or death.

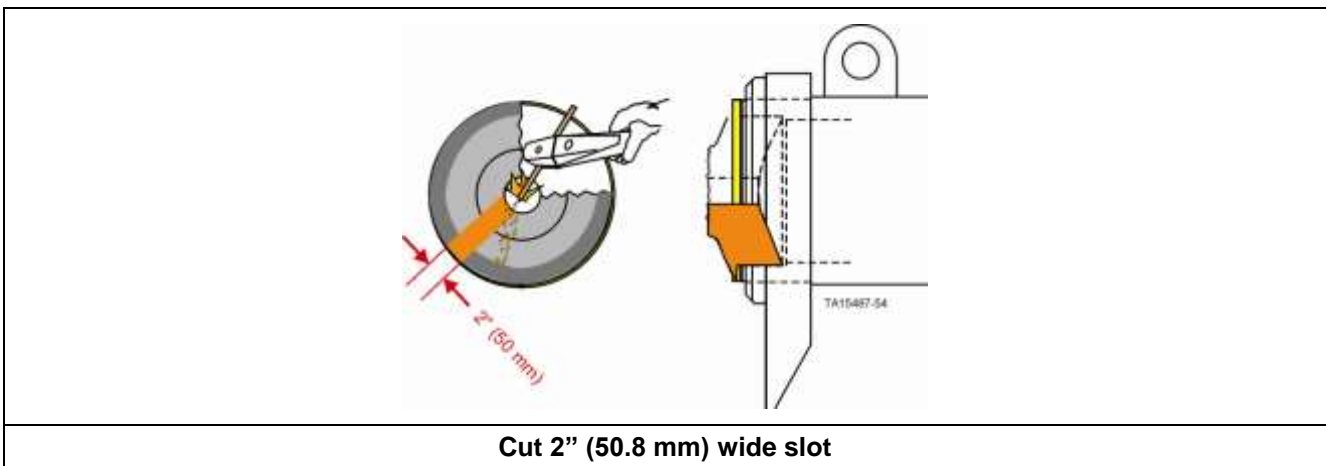
22. Remove the pie shaped section of the ball base.



23. Excavate around the ball. Remove material down to the shoulder.



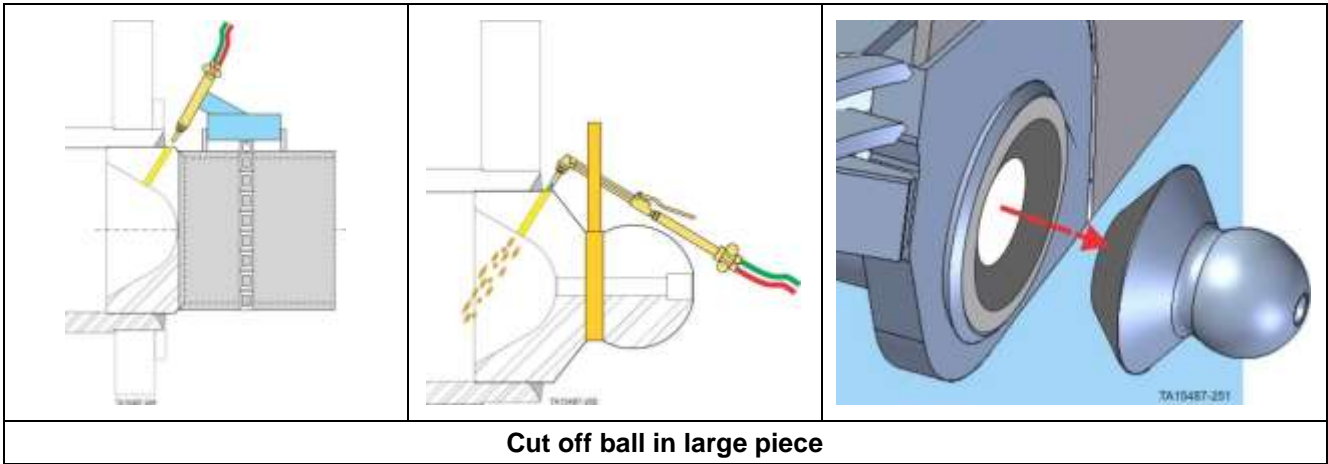
24. Make a 2" (50.8 mm) cut across remaining ball. Do not damage the tube.



25. Remove the remaining sections of the ball.

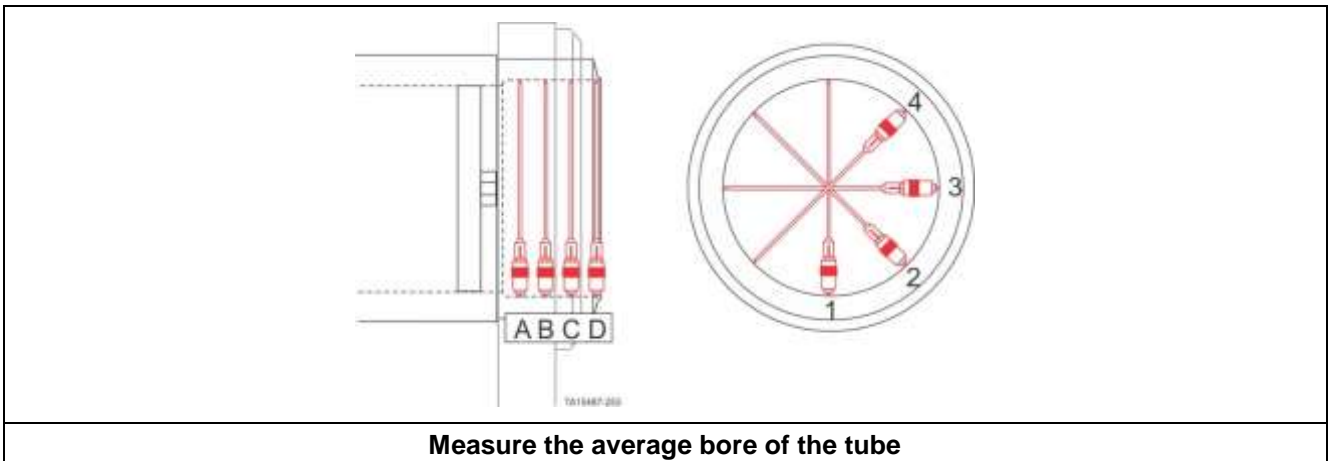
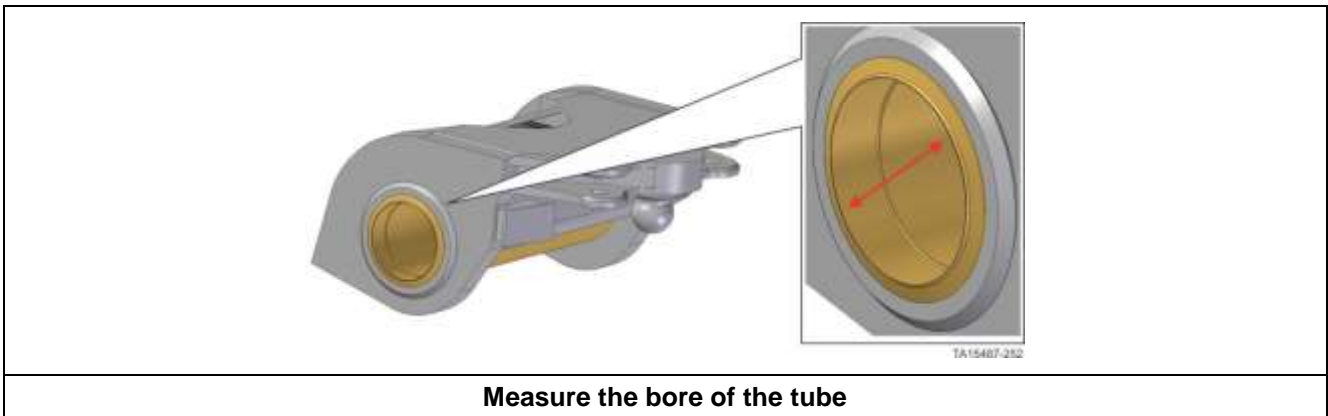


26. The preceding procedure destroys the ball and makes failure analysis impossible. There is another process that allows the ball to be removed in a large piece if crack failure analysis is desired. Contact the factory and details will be provided.



Tube Welding Preparation

1. Allow the tube to cool to less than 100° F (38° C).
2. Measure the bore of the tube with an inside micrometer. Measure in multiple directions and at various depths as shown.



Record all bore measurements and then determine the average bore measurement. (Add all of the measurements and divide by the number of measurements taken.) The following is a sample post heat form. A full size form is provided in the appendix.

A1		B1		C1		D1	
A2		B2		C2		D2	
A3		B3		C3		D3	
A4		B4		C4		D4	
Total:							
Average:							
Ball shoulder diameter: (Should be about .020" (0.508 mm) larger than the bore)							

NOTICE

It is normal and typical that the bore of a tube in a machine will be oval and tapered. This is due to the varying thickness of the thick plate around the tube.

- The average tube bore dimension should be between 0.015" and 0.025" (0.38 mm and 0.64 mm) less than the diameter of the shoulder on the new ball. The tube bore will typically be about 16.940" ± .005" (430.276 mm ± 0.127 mm).

Nominal ball shoulder diameter 70°F (21°C)	Average bore diameter in machine 70°F (21°C)
16.960" ± .002" (430.784 mm ± 0.0508 mm)	16.940" ± .005" (430.276 mm ± 0.127 mm)

- If the average bore dimension is not the specified size – then the tube bore will have to be re-machined to get the proper fit.

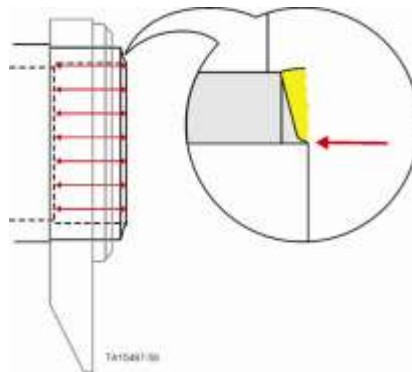
NOTICE

The process for re-machining a bore is as follows:

- The final bore should be machined in solid weld to get a good bore
 - Get a depth reference point to establish the shoulder position inside the tube
 - Machine 1/16" (1.6 mm) material from all sides of the bore. This is 1/8" (3.2 mm) increase in bore diameter
 - Preheat tube to 300° F (149° C)
 - Weld up the bore area with **E71T-12MJH4 FCAW wire**
 - Machine the bore to 16.940" ± .005" (430.276 mm ± 0.127 mm)
 - Machine the depth to specification
5. Measure the depth in eight locations around the tube to verify that the shoulder (or end of tube) is still in the correct location. Grind (or weld/grind) as necessary to obtain the correct dimension in all eight positions.

NOTICE

In particular – this length must NOT be longer than original or the ball will not be able to go back to the same position. This is critical if the original shoulder could not be located.



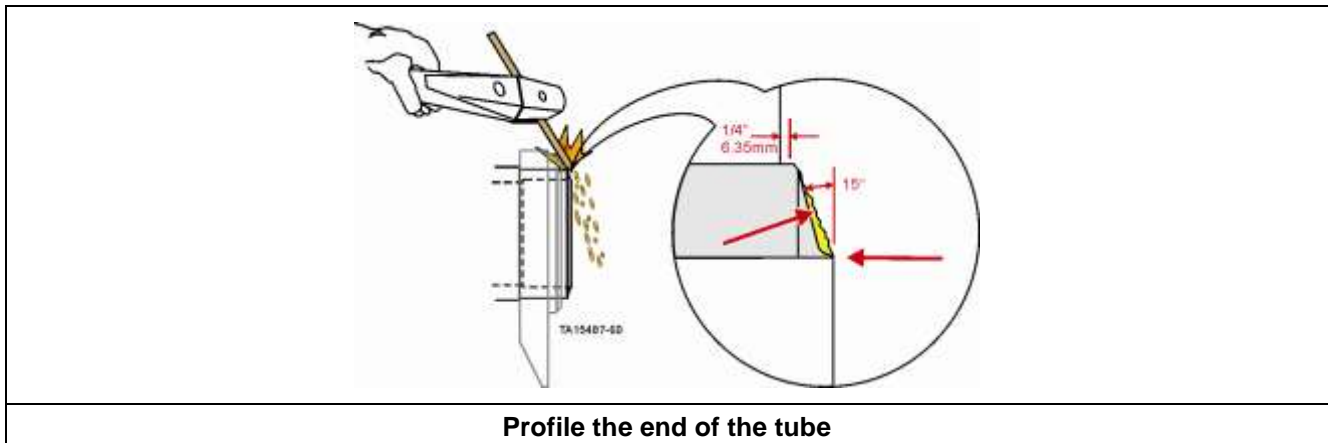
Measure the depth

P/N	Ball Type	Machine	Location	Depth
412-4128	9"	L-950, L-1150	Hoist cylinder	4.793" + 0.00 – 1/16" 121.74 mm + 0.00 – 1.5875 mm
		L-1350	Hoist cylinder	4.840" +0.00 – 1/16" 122.94 mm + 0.00 – 1.5875 mm
		L950, L-1150	Lift arm	4.840" +0.00 – 1/16" 122.94 mm + 0.00 – 1.5875 mm
416-8403	12"	L-1400, L-1800, L-1850	Hoist cylinder	4.840" +0.00 – 1/16" 122.94 mm + 0.00 – 1.5875 mm

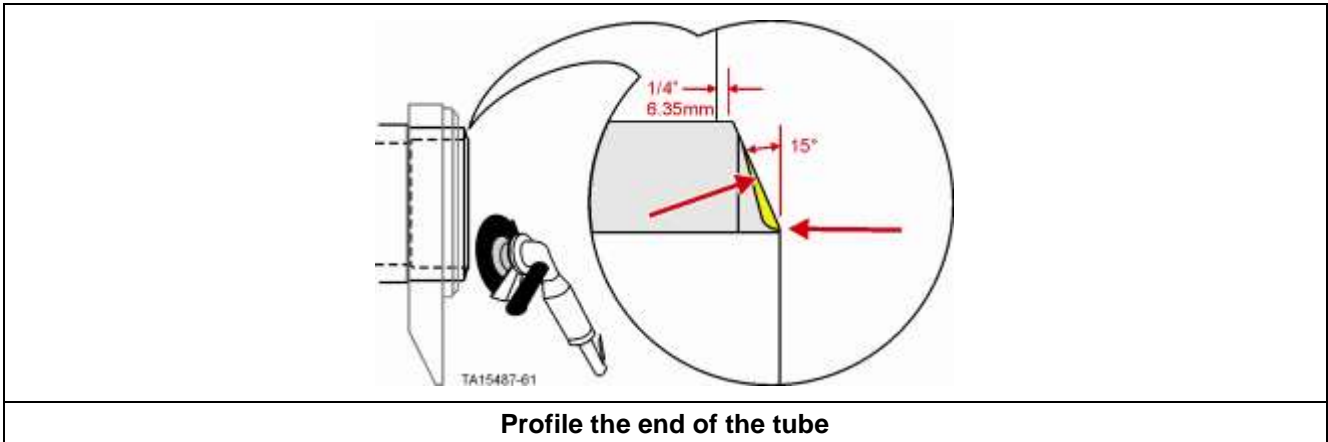
CAUTION

The shoulder length in the tube is a critical dimension. The shoulder length must be correct in order to get the correct clamping force on the new ball. If this length was damaged during removal of the ball – the shoulder must be repaired and rebores.

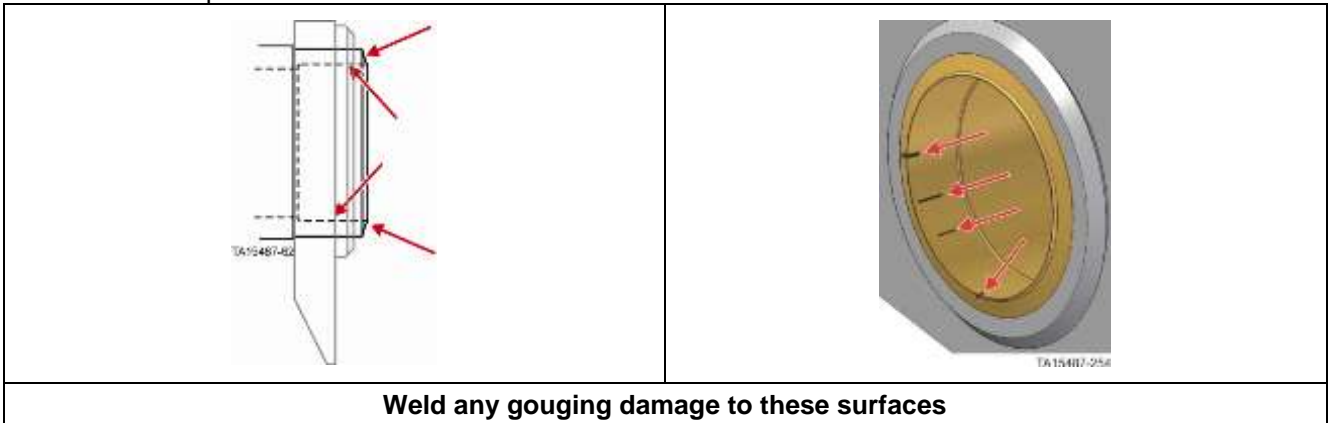
6. Remove weld material from the end of the tube with air arc to about 15° angle. Do not go below the 1/4" (6.35 mm) scribe line.



7. Finish it smooth to an approximate 15° angle by grinding. Do not go below the 1/4" (6.35 mm) scribe line.



- 8. Weld up any air-arc undercut damage to the end of the tube, or below the 1/4" (6.35 mm) scribe line, and to the ID of the tube.
 - a. Grind out any gouge marks to bare metal.
 - b. Preheat the weld area to 300° F (149° C).
 - c. Weld repairs with E7018 electrodes or E7xT- xxxx series wire.



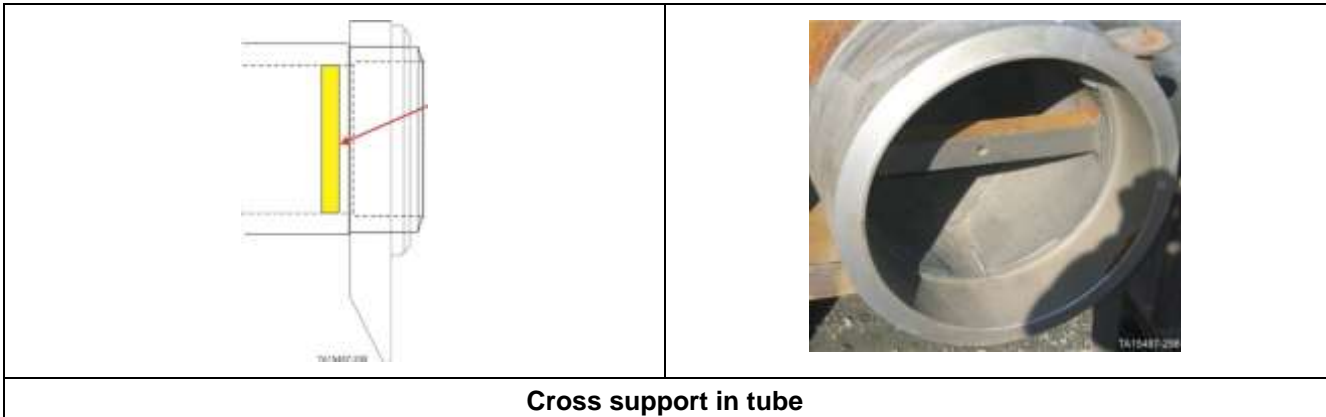
9. Grind the repairs smooth.

CAUTION

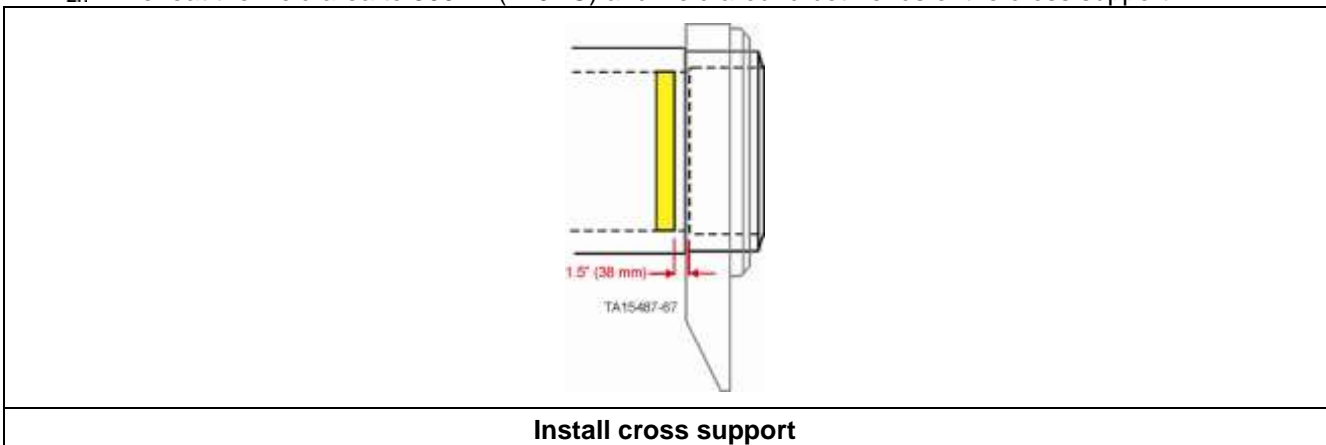
Take care when grinding on the ID of the tube to remove only the cap of the repair weld and nothing else. Do not change the ID of the tube. The dimension is critical to proper ball installation.

Install Nut on Cross Support

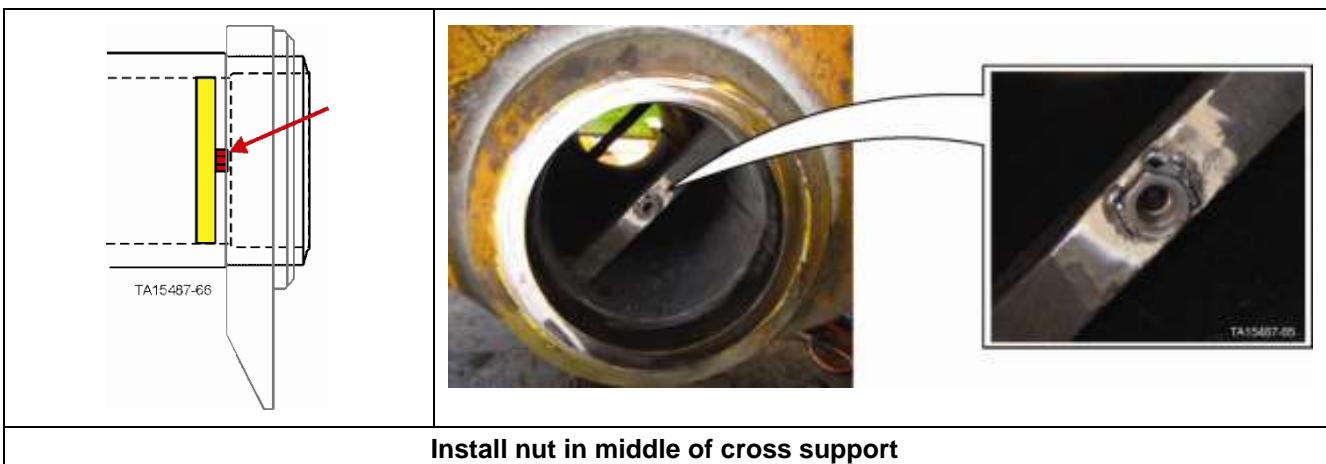
1. Inside most tubes will be a cross support welded across the ID of the tube.



2. If the cross support is not present, fabricate one from 1.5" - 2" (38-50 mm) square bar and weld in place approximately 1.5" (38 mm) into the tube from the machined step.
 - a. Preheat the weld area to 300° F (149° C) and weld around both ends of the cross support.



3. Weld a 1" NC nut in the middle of the cross support.

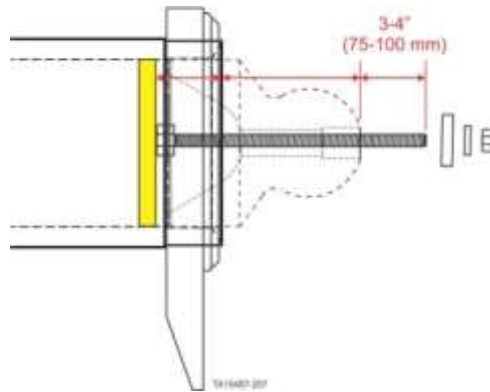


4. Make a 1" all thread rod support. The length of the rod should be long enough to stick through the ball about 3-4" (76.2 mm-101.6 mm) when fully installed.
5. This will require adding several measurements to determine the proper length.
 - a. Depth in tube to cross support.
 - b. Height of ball from shoulder to top of ball.
 - c. 3-4" (76.2 mm-101.6 mm) additional length.

NOTICE

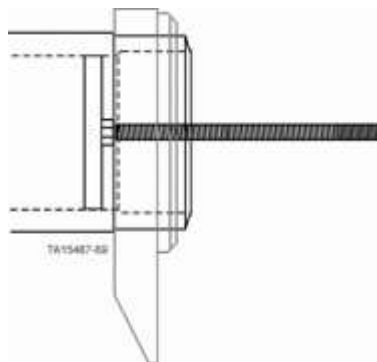
The length of this rod will vary from machine to machine because the cross supports are only used for fabrication of the tube and are not a precision item. The position of the cross supports will vary from machine to machine.

6. The following picture shows how to calculate the length of the all thread rod.



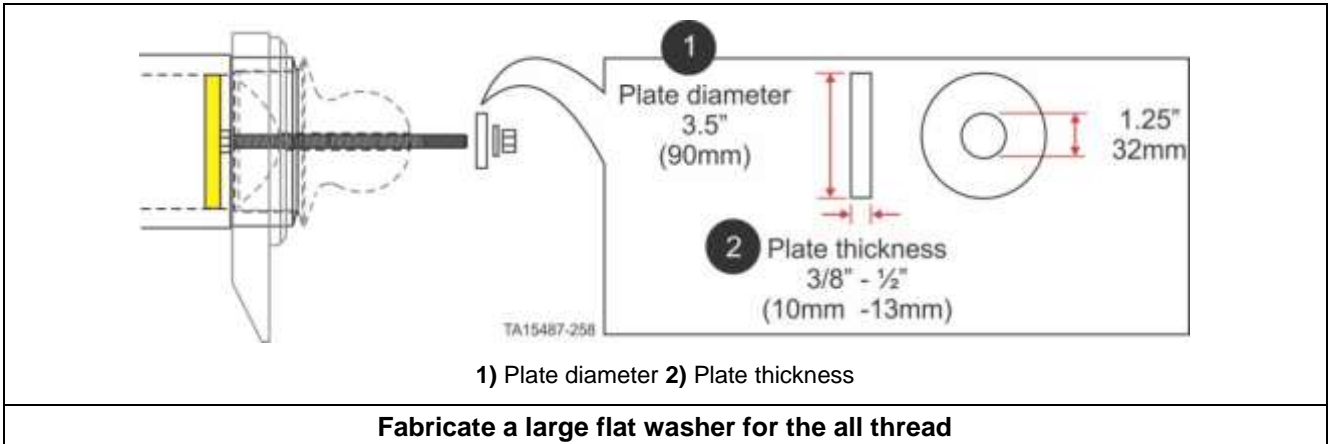
Cut a piece of 1" all thread

7. Place the all thread in position for installation of the ball.



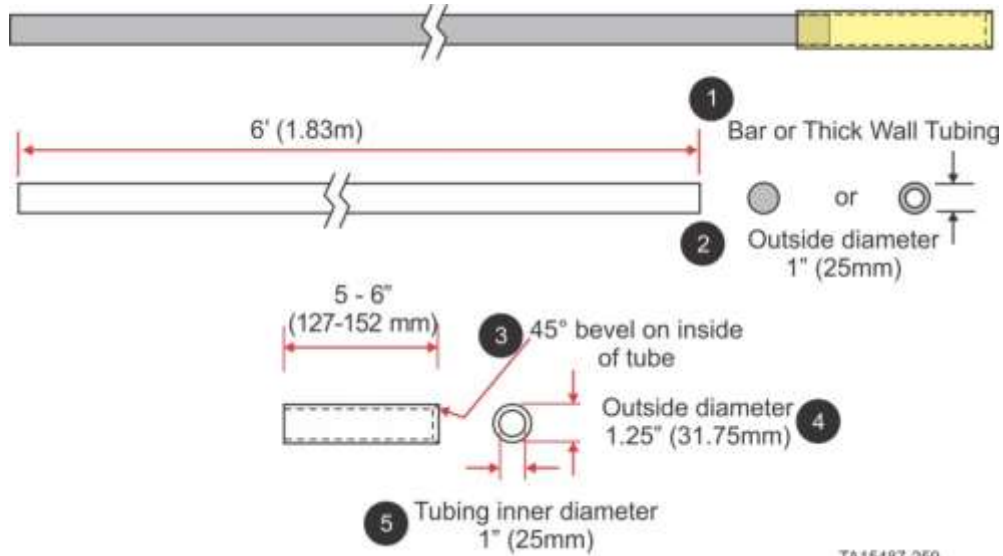
Install all thread rod

8. Fabricate a thick washer for retaining the ball.



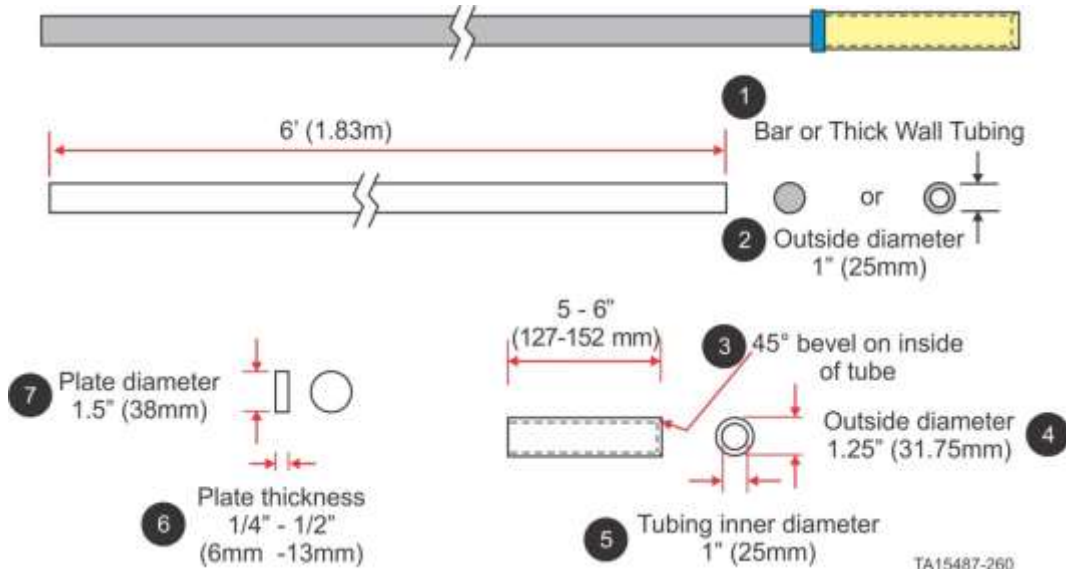
Installation Alignment Tool Fabrication

1. There are two types and P/N of Type A balls.
 - a. 412-4128 9" (228.6 mm) with a 1.25" (31.75 mm) bore.
 - b. 416-8403 12" (304.8 mm) with a 2" (50.8 mm) bore and 3" (76 mm) counterbore.
2. Fabricate the required ball installation alignment tool for each type as shown.



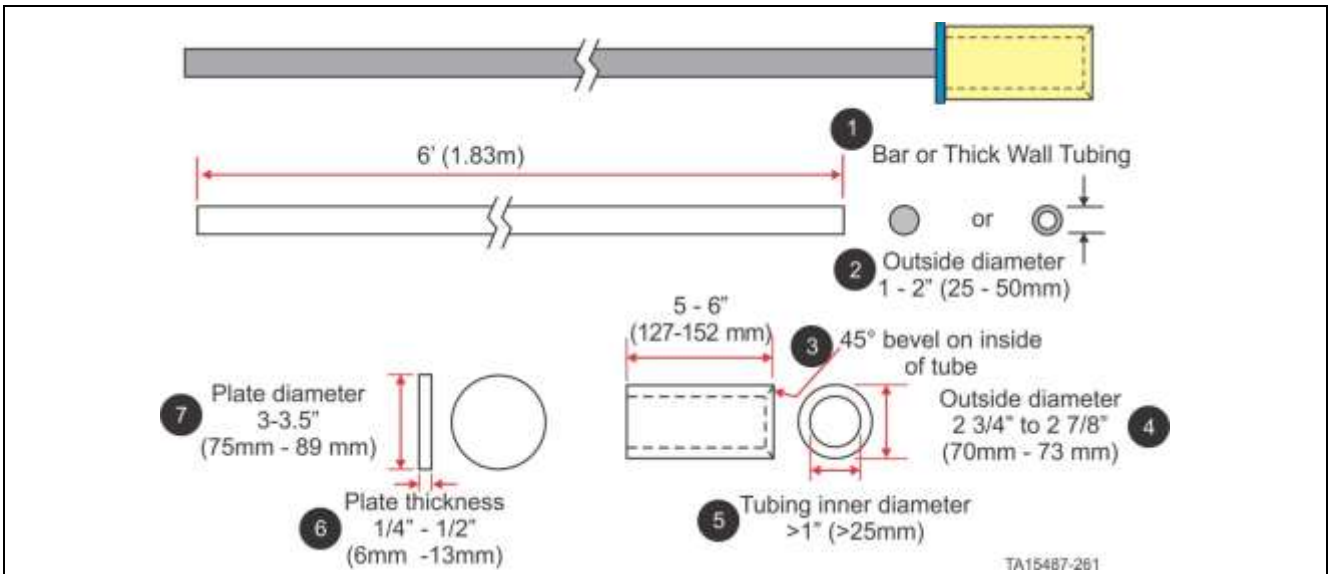
- 1) Bar or Thick Wall Tubing, 2) or Outside diameter 1" (25mm), 3) 45° bevel on inside of tube, 4) Outside diameter 1.25" (31.75mm), 5) Tubing inner diameter 1" (25mm)

***** OR *****



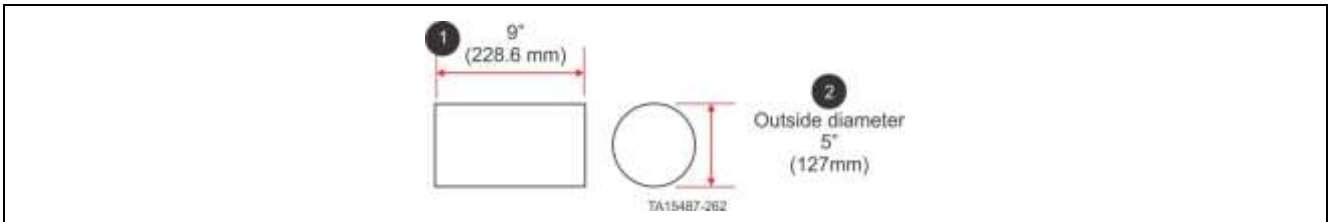
- 1) Bar or Thick Wall Tubing, 2) or Outside diameter 1" (25mm), 3) 45° bevel on inside of tube, 4) Outside diameter 1.25" (31.75mm), 5) Tubing inner diameter 1" (25mm), 6) Plate thickness 1/4" – 1/2" (6mm-13mm), 7) Plate diameter 1.5" (38mm)

Installation alignment bar for 412-4128 - 9" ball (2 methods shown to fabricate)



1) Bar or Thick Wall Tubing 2) or Outside diameter 1-2" (25-50mm) 3) 45° bevel on inside of tube 4) Outside diameter 2 3/4" to 2 7/8" (70-73 mm) 5) Tubing inner diameter >1" (>25 mm) 6) Plate thickness 1/4" – 1/2" (6 mm-13 mm) 7) Plate diameter 3-3.5" (75-89 mm)

Installation alignment bar for 416-8403 - 12" ball

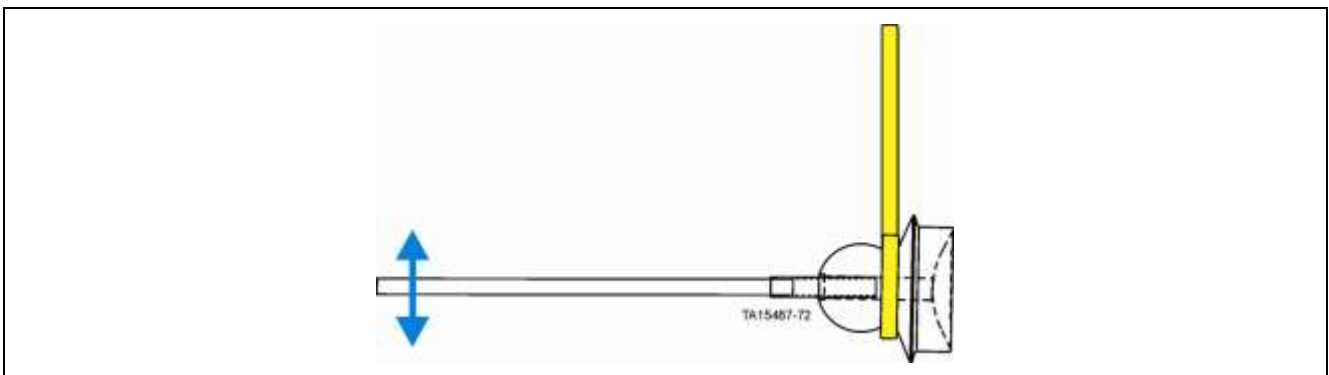


1) 9" (228.6 mm) 2) Outside diameter 5" (127 mm)



1) Hole to match bar diameter + 1/8" (+ 3 mm)

Counterweight

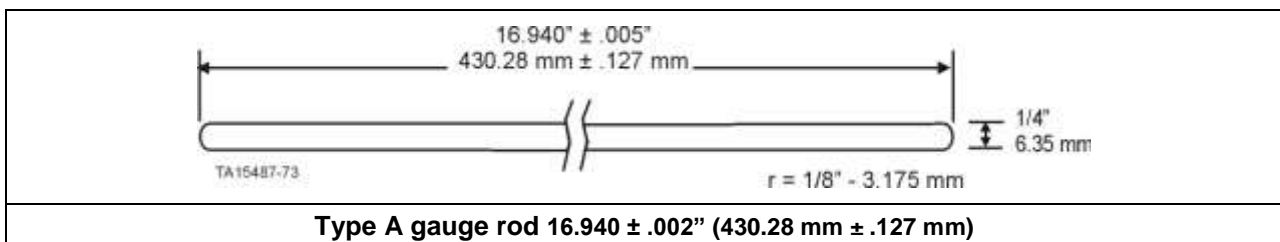
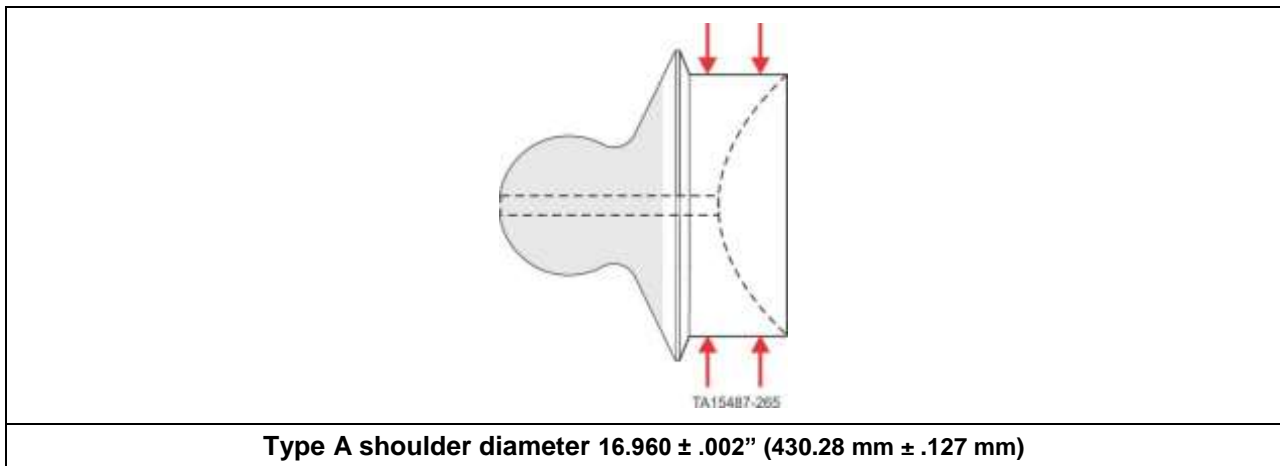


Installation alignment bar

Field Welding Procedures

3. Make a steel gauge rod tool, as shown in following table. The diameter is not critical but the tool must be made to the precise length measurement. Make the rod per the length shown in following table. This is critical to ensure that the frozen ball will enter freely into the heated bore of the tube.

Machine	Location	Ball Diameter	P/N	Ball Type	Base diameter	Gauge Rod Length
L-950	Hoist	9	412-4128	A	16.960 ± .002" (430.28 mm ± .127 mm)	16.940 ± .002" (430.28 mm ± .127 mm)
	Lift arm	12	416-8403			
L-1000	Lift arm	9	412-4128			
L-1100	Hoist	9	412-4128			
	Lift arm	12	416-8403			
L-1150	Hoist	9	412-4128			
	Lift arm	12	416-8403			
L-1350 Gen1	Hoist	9	412-4128			
	Lift arm	12	416-8403			
L-1350 Gen2	Hoist	12	416-8403			
	Lift arm	12	416-8403			
L-1400	Hoist	12	416-8403			
L-1800	Hoist	12	416-8403			
L-1850 Gen1/ Gen2	Hoist	12	416-8403			
Gauge rod length						



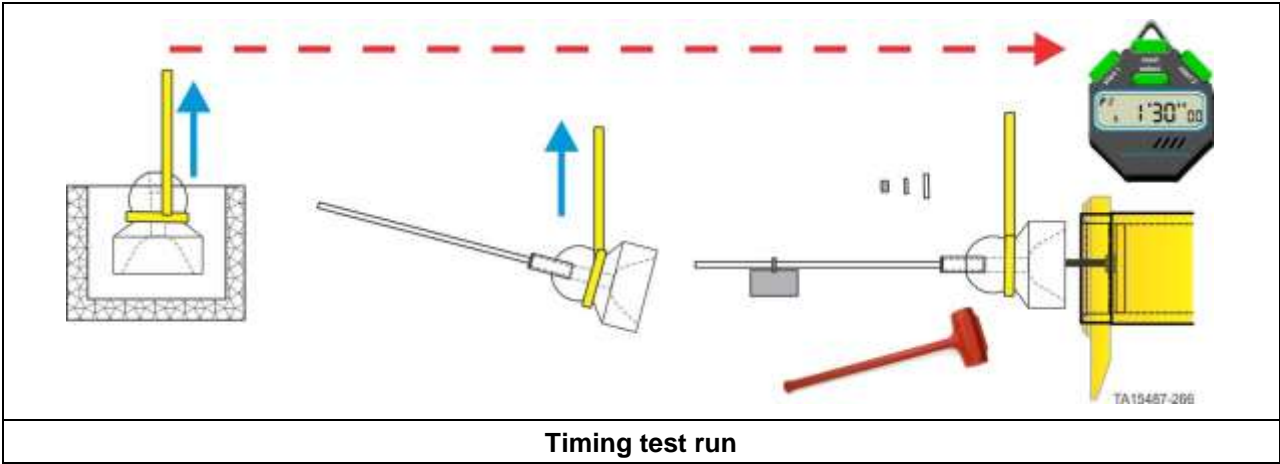
Ball Installation Rehearsal Test

There is a limited amount of time to install a frozen ball into the heated tube on the loader. A lot of handling is involved to get the ball out of the freezing container and to the frame. It is important to rehearse the process of getting the ball out of the freezer container and into position to be installed. If this process takes too long then the ball might not fit – or worse it might only go partially into the bore of the tube.

- 1. Position the cooling container near the loader in the location where the ball will be cooled.
- 2. Place the ball in the box.
- 3. Start timing
 - 1) Lift ball from box
 - 2) Put ball on positioning tool
 - 3) Lift ball into position for installation near tube where it would be ready to install
 - 4) All tooling, measurement devices, hammers, washers, nut, etc. must be in position and ready to go.
- 4. Stop timing.
- 5. The above actions must be completed in less than the time listed in the following table:

Ball location	Time
Lift arm ball	< 130 sec (2 min 10 seconds)
Hoist cylinder ball	< 100 sec (1 min 40 seconds)

- 6. Repeat the steps until the ball can be positioned in less time that what is listed in the table.



Ball Freezing Procedure

CAUTION

Dry ice (frozen carbon dioxide - CO₂) is not cold enough to use for ball installation - liquid nitrogen must be used. The result of using dry ice will likely be a ball that sticks before properly installed. It has to be cut out and a new one installed.

NOTICE

Each ball will typically require 2-3 VGL (total nitrogen capacity typically 350 liter and over) of liquid nitrogen to properly cool a single ball. This requirement may vary widely depending on local conditions, container size, altitude, etc.

1. The ball will be cooled with liquid nitrogen



2. Locate a container with inside dimensions that are large enough to contain the ball being frozen with a minimum of 3" (76 mm) free space in all directions. A container with minimum inside dimensions of 26" wide X 26" long X 26" tall (660 mm X 660 mm X 660 mm) can be used for any ball size.

P/N	Sphere Size	Diameter	Height
410-2456	7.5"	14" (356 mm)	11.7" (297 mm)
412-4128	9	20.1" (511 mm)	16.9" (429 mm)
416-8156	9	16" (407 mm)	12.5" (318 mm)
416-8403	12	20.1" (511 mm)	20" (508 mm)
423-3317	14	21.75" (553 mm)	24.8" (630 mm)
424-7949	12	20" (508 mm)	14.94" (380 mm)

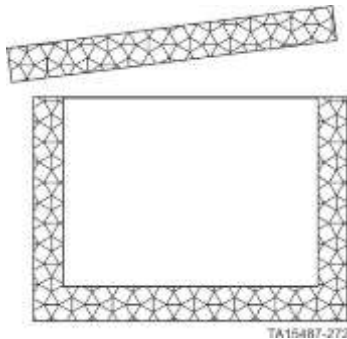


Typical insulated container

CAUTION

The interior of the container must be solid metal and sealed by welding so that the liquid nitrogen cannot run out. Silicone sealant is not suitable as it will disintegrate when exposed to liquid nitrogen.

3. The container must be insulated with good insulation material (fiberglass house insulation will not work) such as K-wool (kaowool) ceramic insulating material.

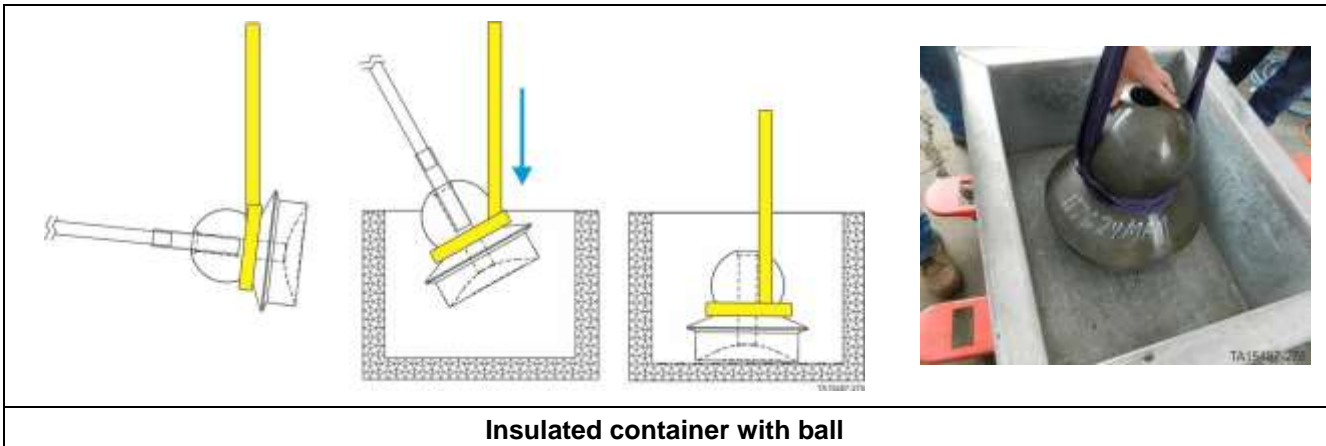


Insulated container

4. Pick up the ball with a 2" (50.8 mm) or equivalent nylon lifting strap. Ball weights are listed below.

P/N	Size	Weight	
410-2456	7.5	170 lb.	77 kg
412-4128	9	431 lb.	196 kg
416-8156	9	231 lb.	105 kg
416-8403	12	630 lb.	286 kg
423-3317	14	1220 lb.	553 kg
424-7949	12	431 lb.	195 kg

- 5. Place the ball into the container.



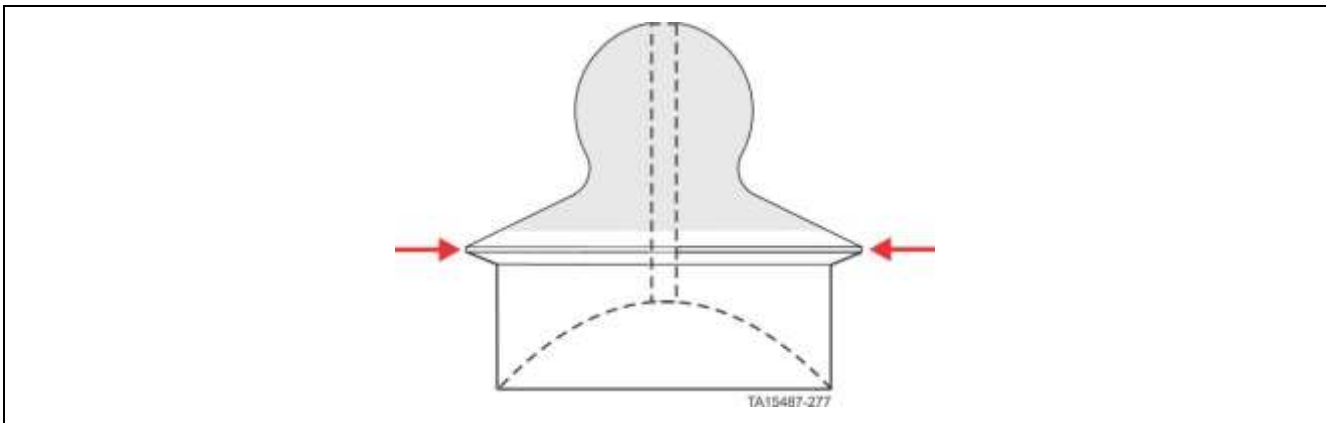
Insulated container with ball

⚠ WARNING

Chemical exposure and inhalation hazards exist when working with liquid nitrogen. Always wear appropriate Personal Protective Equipment (PPE) such as heavy loose fitting leather or cryogenic gloves, eye and face protection when handling liquid nitrogen. It should be used in a well-ventilated area. Follow all relevant local statutory requirements when handling liquid nitrogen. Failure to use proper PPE and follow all local statutory requirements for handling liquid nitrogen can cause chemical exposure and inhalation hazards resulting in serious injury or death.

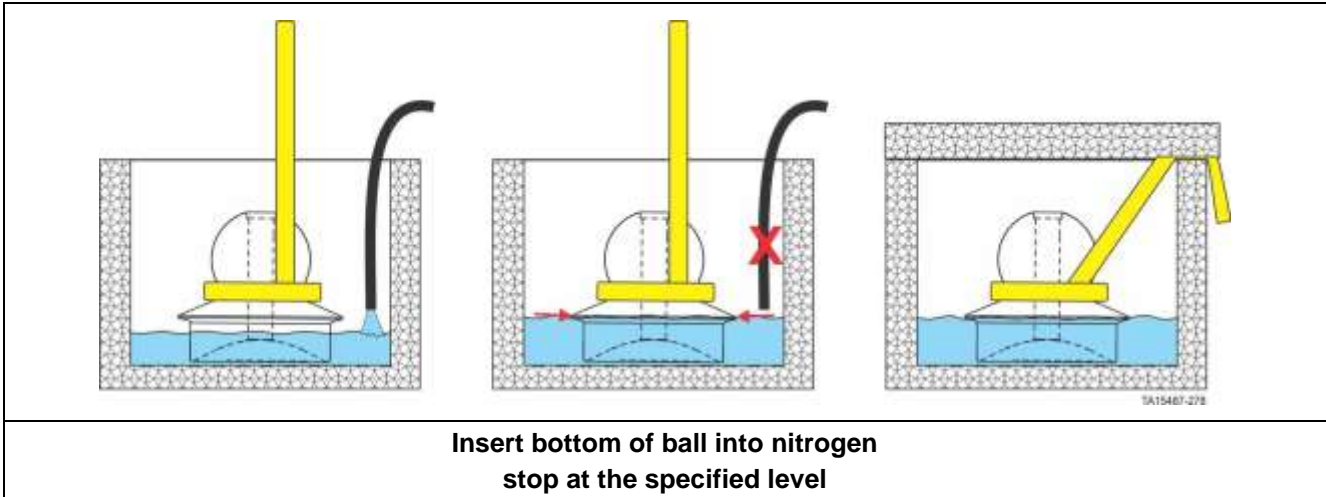
CAUTION

The carburized portion of the ball must not be immersed in liquid nitrogen or damage to the steel may occur. The gray portion in the following diagram is the carburized area. The white area is non-carburized and may be immersed in liquid nitrogen.



Gray is the carburized area White is the non carburized area

6. Slowly add liquid nitrogen until the level of the nitrogen is even with the edge of the flange as shown.



7. Only the non-carburized portion of the ball should be immersed in liquid nitrogen. To assure this the nitrogen should go no higher than the edge of the flange as shown.
8. Cover and freeze for the time listed in the table.

9"	35 minutes (after nitrogen level is correct)
12"	40 minutes (after nitrogen level is correct)
14"	45 minutes (after nitrogen level is correct)

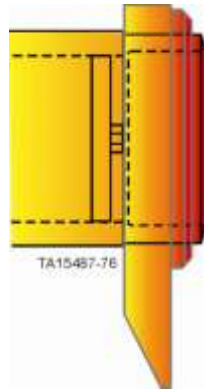


NOTICE

The liquid nitrogen will vaporize rapidly and it is normally necessary to add some periodically during the 30-40 minute time frame. Cover the container while the ball is cooling.

Tube Expansion

1. Heat is required to enlarge the tube bore. The five-inch slab around the tube is to be heated first, to about 300° F (149° C), and then the tube can be heated to 300° F (149° C).

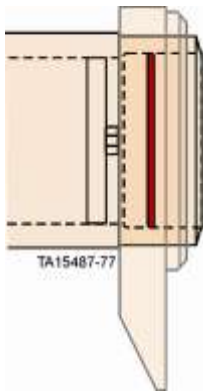


Heat the slab and tube

2. Use the gauge rod to check expansion of the tube. Gauge rod must go in to all parts of the machined shoulder of the tube and at all angles.

CAUTION

The tube will be hot. Use gloves to handle the gauge rod when measuring the bore diameter.

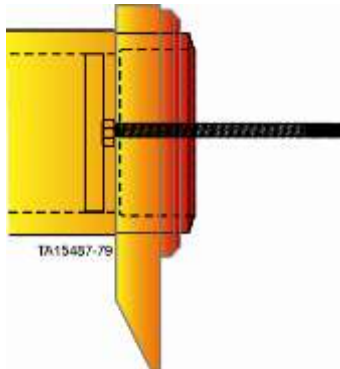


Check to make sure gauge rod freely enters all locations
(use gloves)

3. If gauge rod will not go into tube, increase the slab and tube temperature by 25° F (14° C) and recheck with gauge rod.

Ball Installation Procedure

1. Install threaded stud.

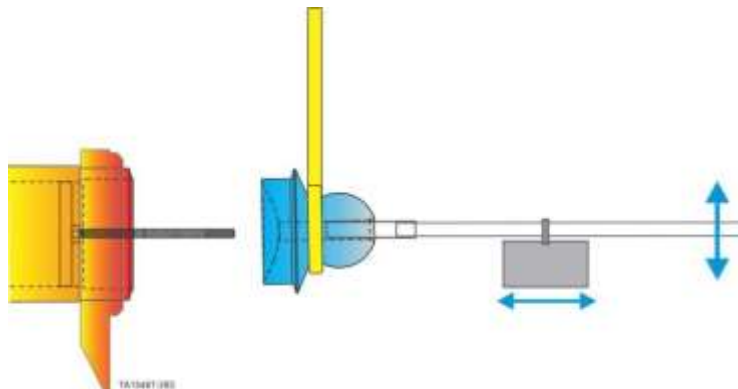


Install the threaded Stud

2. Hoist the frozen ball into position and align with the alignment tool.



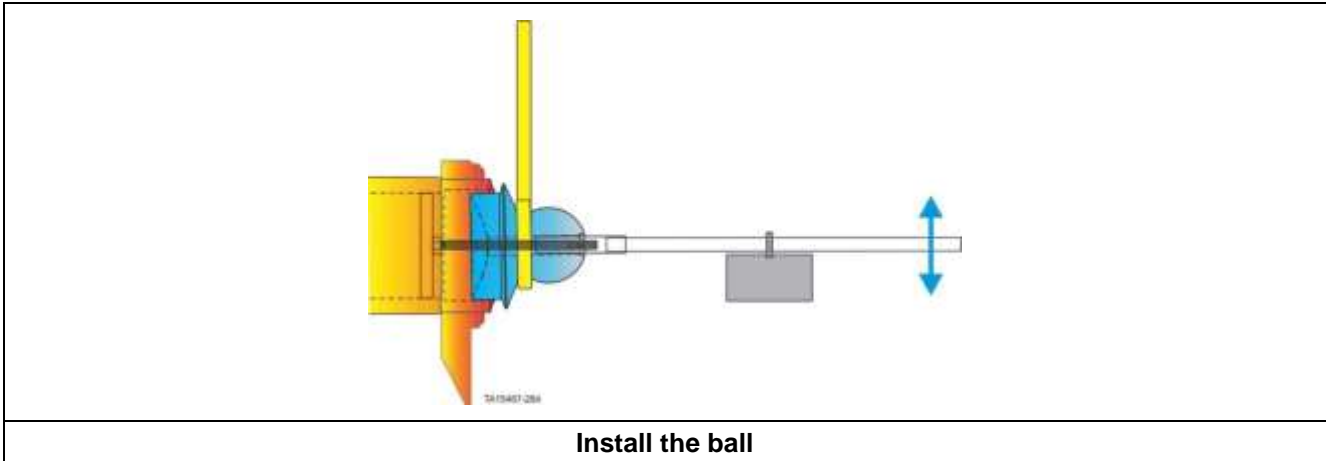
Install the alignment bar and hoist strap



Install the ball into the tube

3. Insert the ball into the tube. Use the alignment tool to level and position the ball while inserting it into the tube

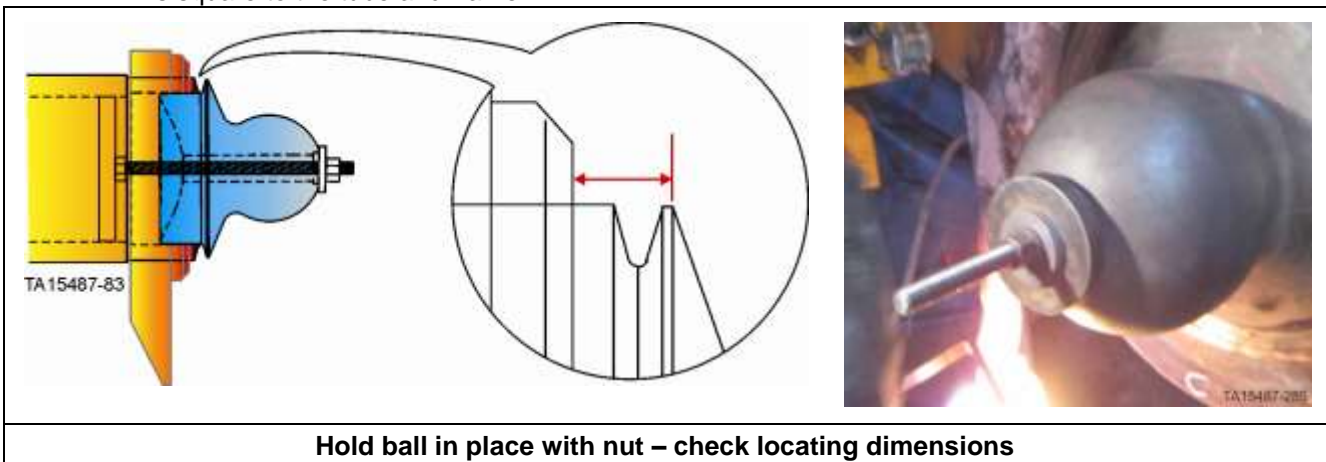
- The alignment tool should slip over the all thread as the ball enters the heated tube.



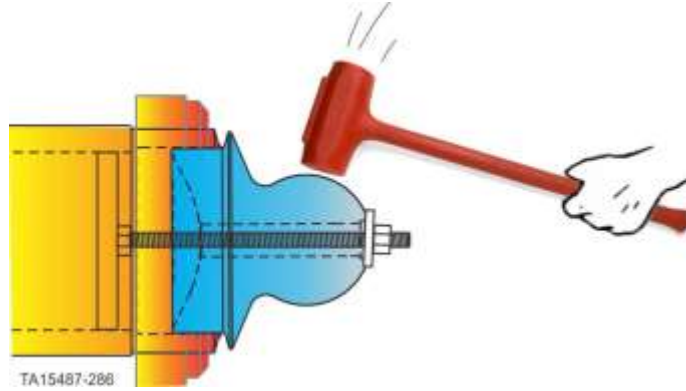
NOTICE

If the ball has been cooled properly and the tube has been heated properly you will typically have three to four minutes to locate and position the ball.

- As the base of the ball enters the tube, the all thread should become exposed. Insert the ball as far as it will go.
- Remove the alignment tool.
- Install large washer and nut on the all thread.
- Set the ball to the locating dimensions obtained, as discussed in "Preparation/Ball Removal."
 - These dimensions should be checked in three or four places around the ball to ensure that the ball is square to the tube and frame.



- b. Reposition as necessary with a dead blow hammer.

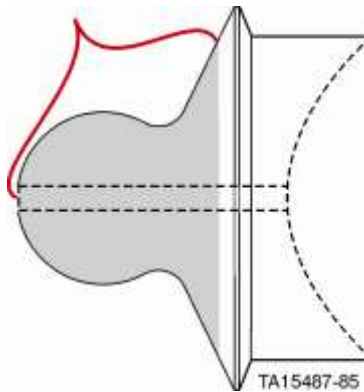


Use a dead blow hammer to adjust the ball in the bore

9. Hold this dimension until the ball temperature increases to the point that the ball is held snugly in place within the tube. This dimension must be held for proper ball location.

Ball Welding Procedure

1. The ball is carburized and there are special restrictions for preheating the ball.

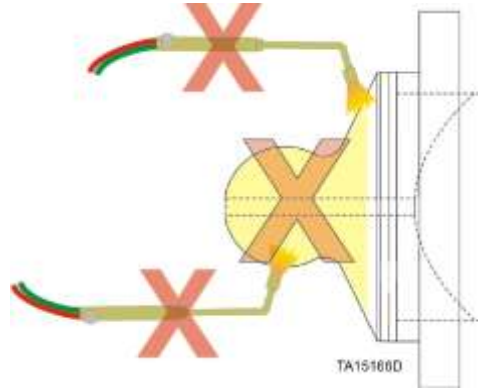


Carburized area

2. Preheat the weld area to 300° F (149° C) and maintain this temperature while welding out the joint.

CAUTION

DO NOT apply heat to the carburized neck or spherical portion of the ball base with a torch flame as this will reduce the hardness of the ball and can cause subsurface cracking.

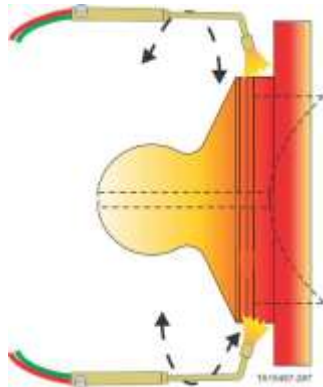


DO NOT apply torch flame to the carburized area of the ball

CAUTION

If a torch is used to apply heat– it must be moving or it will soften and damage the area of the steel it is heating.

3. The proper area for heating the weld area is shown:



Proper heating area – flame must move continuously

CAUTION

The torches must be moving continuously so that the steel in the tube, ball and frame is not overheated and damaged. **DO NOT** leave the flame in one location.

4. The ball can also be preheated using electrical heating with ceramic heating. The typical locations for mounting heaters are on the outside of the frame near the ball and around the tube on the inside of the frame.



Typical ceramic heater, recorder and elements

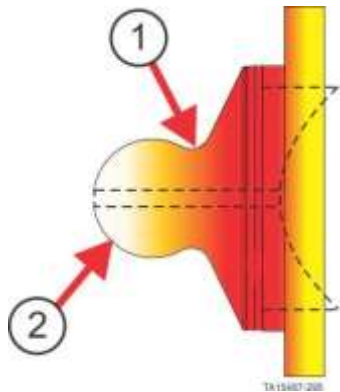


Typical ceramic heater locations on outside of frame



Typical ceramic heater locations on inside of frame

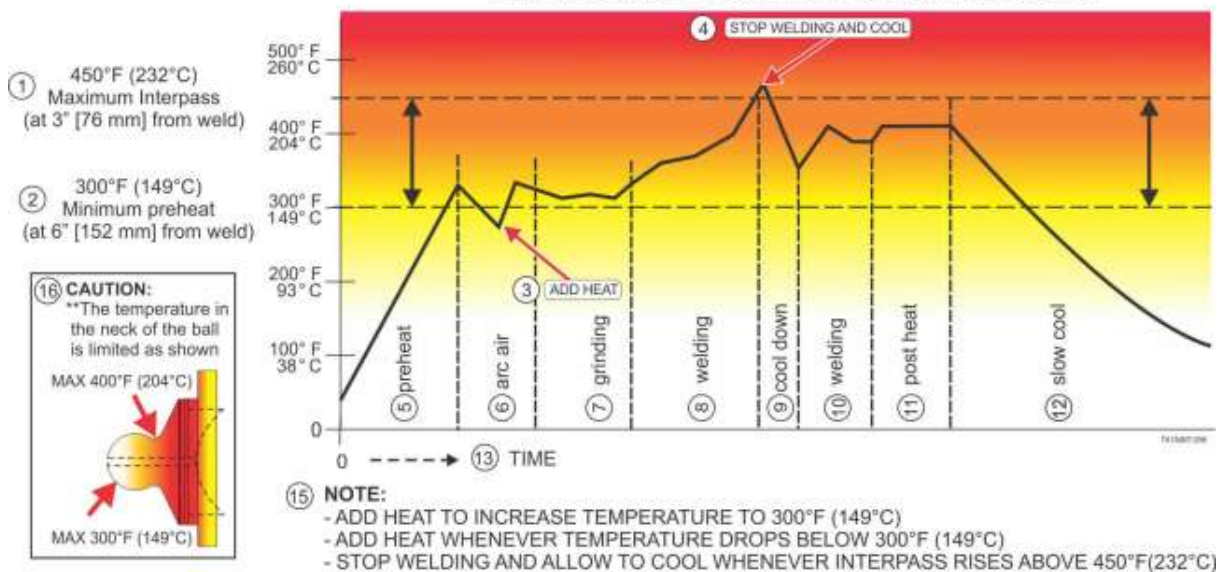
5. Monitor the maximum temperatures constantly during the welding process and do not exceed these temperatures during installation. If the temperature in neck gets to this level – the welding must be stopped so that the neck can cool down.



Maximum temperatures

- 1) Neck 400°F (204°C) 2) Ball 300°F (149°C)

**14 BALL INSTALLATION
TEMPERATURE LIMITS FOR WELDS** ON BALL INSTALLATION**



- 1) 450° (232°C) Maximum Interpass (at 3" [76 mm] from weld) 2) 300° (149°C) Minimum Preheat (at 6" [152 mm] from weld) 3) Add heat 4) Stop welding and cool 5) Preheat 6) Arc Air 7) Grinding 8) Welding 9) Cool Down 10) Welding 11) Post Heat 12) Slow Cool 13) Time 14) Ball Installation Temperature Limits for Welds** on Ball Installation 15) NOTE: - Add heat to increase temperature to 300°F (149°C) –Add heat whenever temperature drops below 300°F (149°C) –Stop welding and allow to cool whenever interpass rises above 450°F (232°C) 16) CAUTION: **The temperature in the neck of the ball is limited as shown Max 400°F (204°C) Max 300°F (149°C)

Preheat – maintained throughout the welding process

Welding Wire

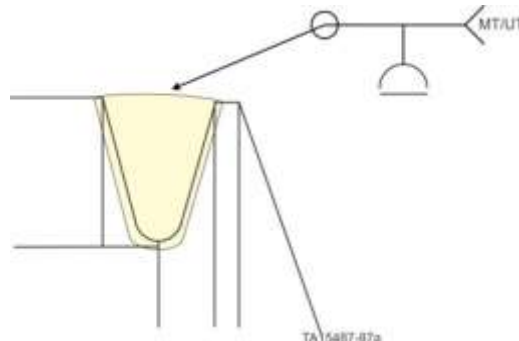
1. Typical wire sizes used for FCAW welding will be .045" (1.2 mm), .052" (1.4 mm) or 1/16" (1.6 mm) diameter. The most commonly used sizes are .052" (1.4 mm) or 1/16" (1.6 mm).
2. Wire consumable for field welding of ball installations is E8xT- xxxx series wire.

NOTICE

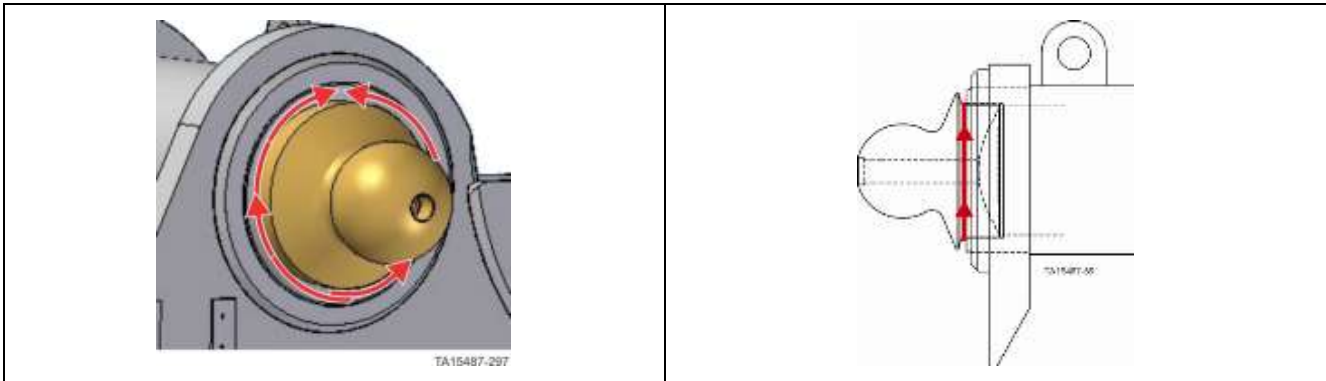
The factory will consider approving other wire types depending on the specifications of the wire. For example: Komatsu uses Lincoln Ultracore E71T-1MJ along with gas that is 75% Ar/25% CO₂ for installation of the balls. This combination of gas and wire gives a tensile strength of 83,000 psi (572 MPa) which meets the specifications for E80XX wire.

Electrodes

1. Electrodes for SMAW are specified to be low hydrogen in one of the following series (7018, 8018, 9018, etc.) as specified for each type of material and procedure.
2. Typical electrode sizes for SMAW will be 1/8" (3.2 mm) for root passes and 5/32" (4 mm) for the remainder.
3. Storage and handling of low hydrogen electrodes:
 - a. Use new low hydrogen electrodes that are provided in hermetically sealed packages. Do not use old electrodes for structural repairs. Old electrodes are defined as those that were removed from a sealed package more than 1 month earlier and have been kept in an oven.
 - b. Remove only one hour's supply of electrodes at a time. Keep the remainder in a ventilated holding oven at 225° F (107° C).
 - c. Bake previously opened packages of electrodes in a ventilated oven at 500° F (260° C) for two hours before using.
 - d. Electrodes taken from cardboard boxes or a non-airtight container should also be baked at 500° F (260° C) for two hours in a ventilated oven.
 - e. Then the electrodes should be placed immediately in a ventilated holding oven set at 225° F (107° C).
 - f. Any electrode exposed to the air for more than four hours should be re-baked per the instructions above.
4. Use an 80 series consumable for field welding of ball installations.
 - a. Weld with E-8018C3 series electrodes or E8xT-xxx FCAW wire.
 - b. If using SMAW E-8018C3 – weld the first 3 root passes with 1/8" (3.2 mm) rod.
5. Weld detail:

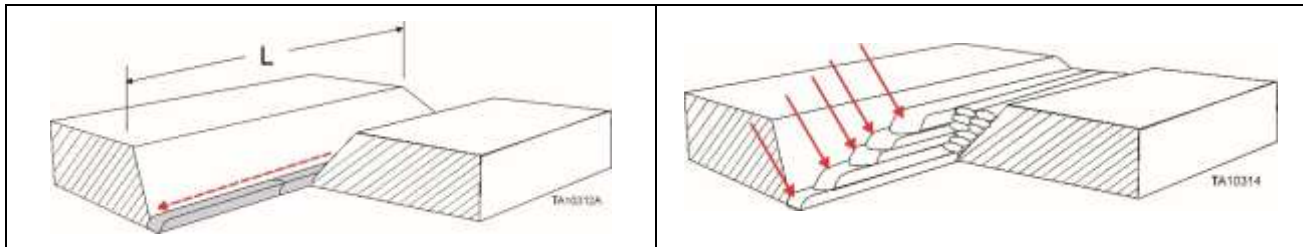


Weld profile



Each pass should be welded all around – vertical uphill

6. Each pass must be in vertical uphill orientation (NO downhill welding).
7. Finish each pass all around the diameter of the weld. DO NOT weld in sections.
8. Each weld pass must start and stop in a different location from the previous pass.



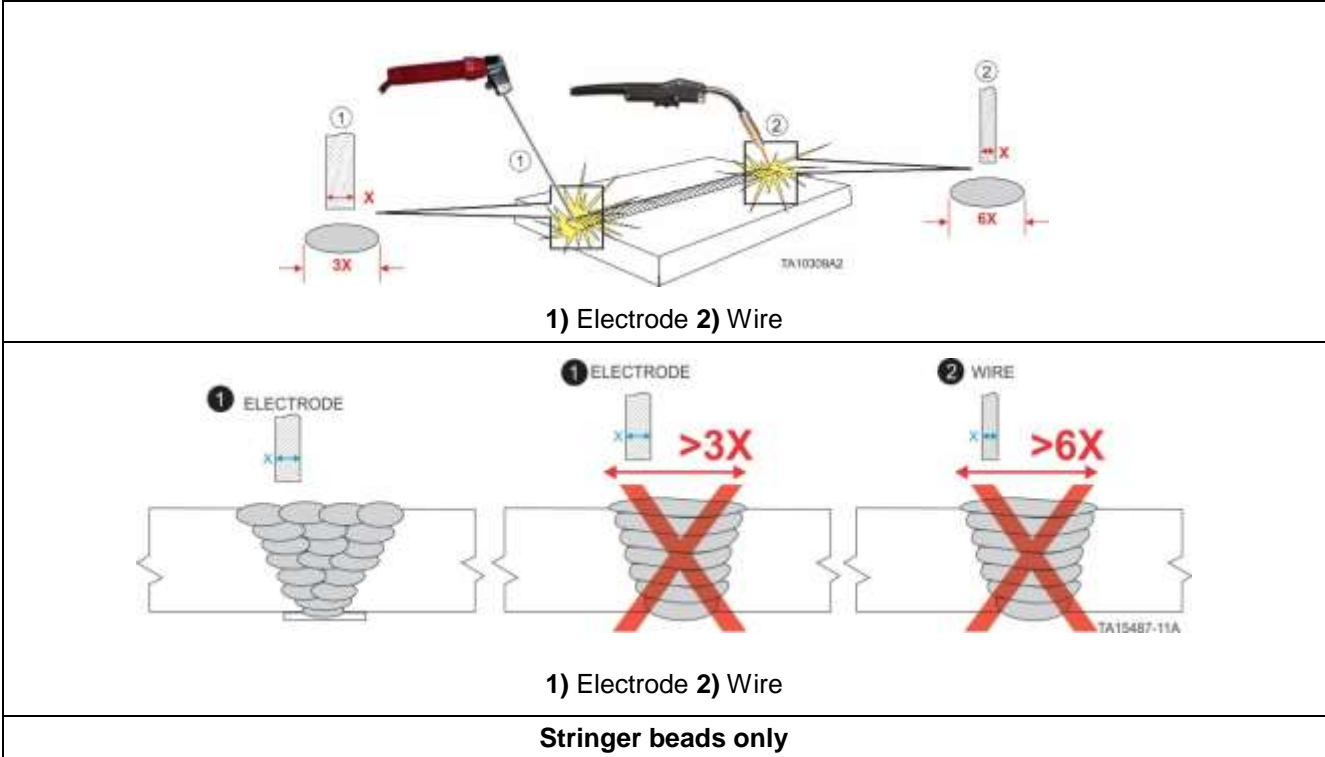
Each pass full length with start and stop in different locations

9. After welding the root pass, remove the slag with a needle scaler air tool.

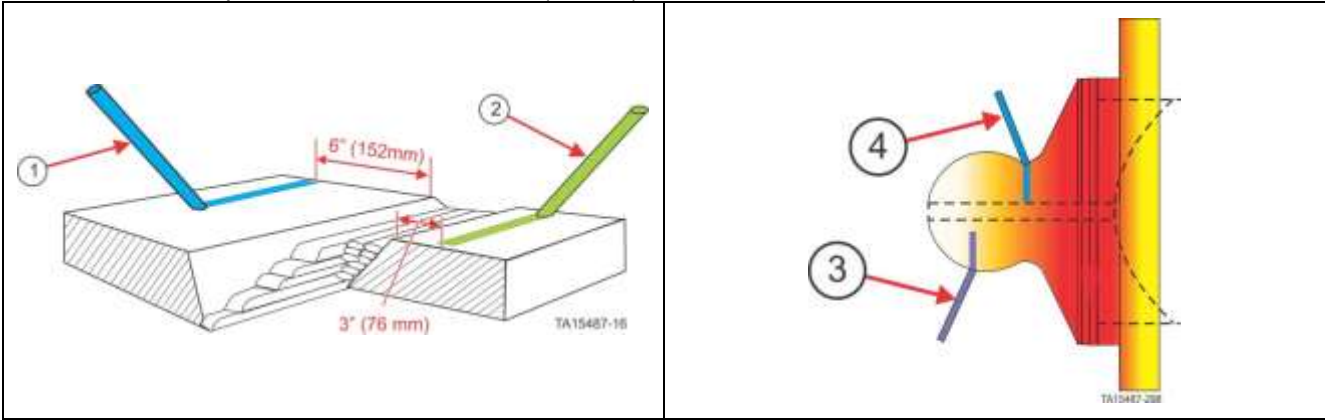


Needle scaler kit, scalars

10. If using SMAW E-8018C3 – weld the rest of the passes with 5/32” (4 mm) rod.
11. After welding each filler pass, remove the slag with a needle scaler air tool.
12. Do not weave weld. Only multi pass stringer beads are allowed.



13. Continue to monitor temperatures after each weld pass: The welding should be stopped whenever the interpass or neck temperature becomes hotter than specification. **DO NOT** force cool by using fans or water. Heat should be added if the temperature drops below the preheat minimum.
- Preheat temperature minimum 300° F (149° C) (Blue at 6" [152 mm]).
 - Interpass temperature maximum 450° F (232° C) (Green at 3" [76 mm]).
 - Neck temperature maximum 400° F (204° C).



Monitor temperatures during welding

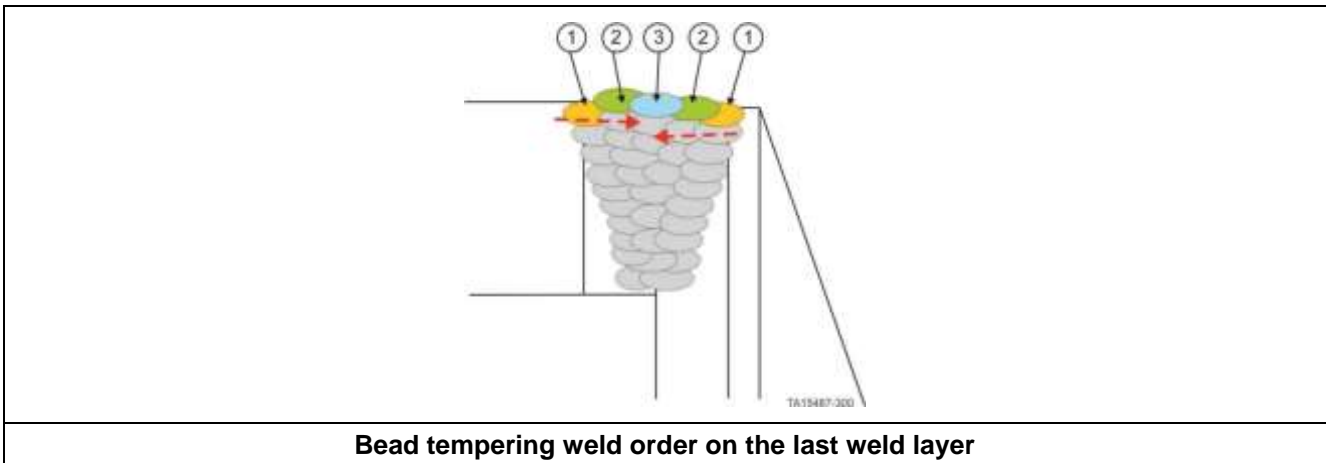
- 300° F (149° C) temperature stick for **preheat** temperature
- 450° F (232° C) temperature stick for **interpass** temperature
- 300° F (149° C) temperature stick for **ball** temperature
- 400° F (204° C) temperature stick for **neck** temperature

14. Record temperatures in the preheat and interpass heat logs every hour.

BALL PREHEAT AND INTERPASS RECORD (one record for each hoist and lift arm ball)						
Location:		Supervisor:				
Loader type and serial number:		Date:				
Ball description and location:		Ball serial number:				
Welder	Sequence	Actual clock time	Ball location (weld)	TEMPERATURE		
				Ball Neck	Ball Sphere	
1	0 HOUR		A			
			B			
2			C			
			D			
1	1 HOUR		A			
			B			
2			C			
			D			
1	2 HOUR		A			
			B			
2			C			
			D			

TA15487-406

Preheat and Interpass log sheet sample

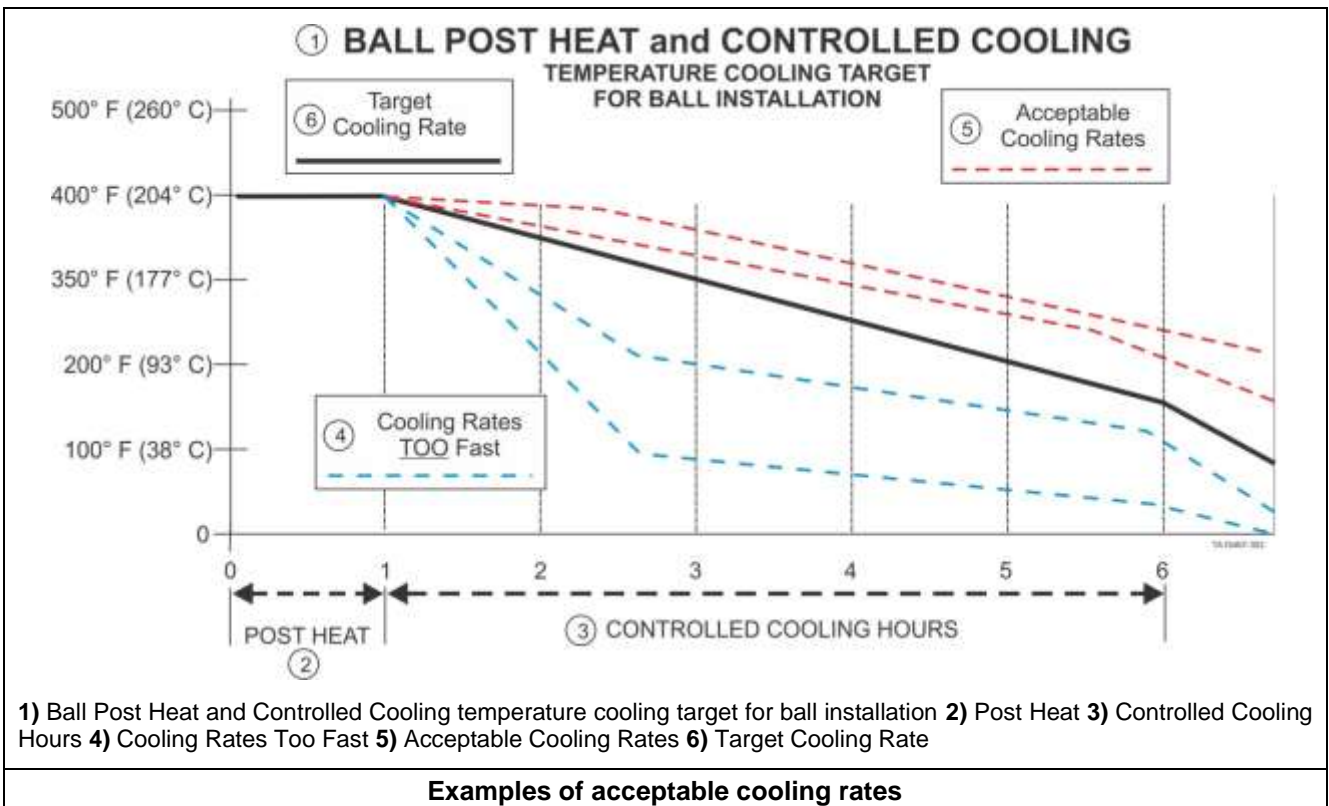
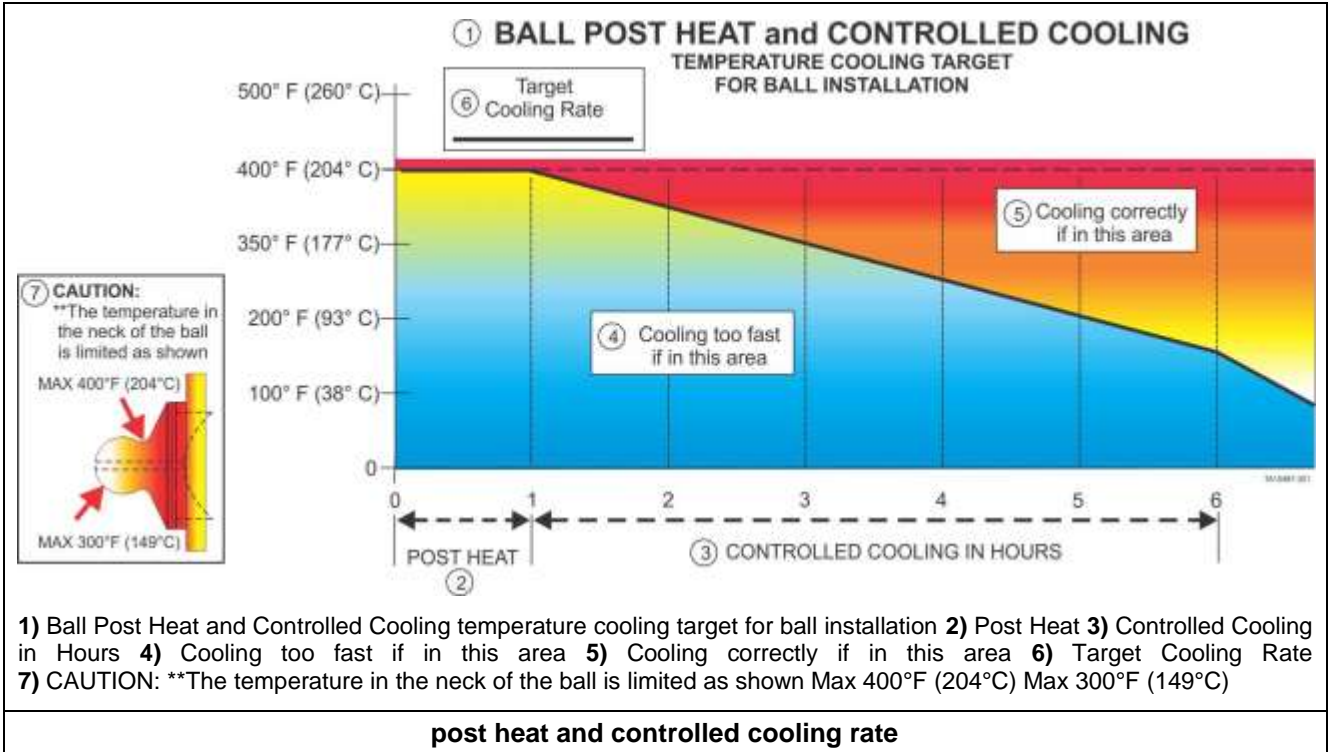


Bead tempering weld order on the last weld layer

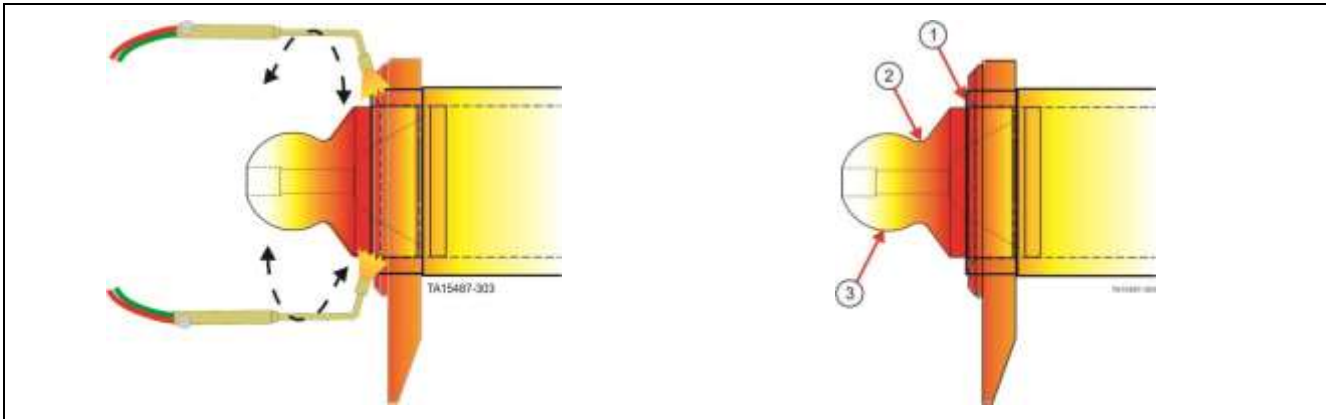
15. On the last layer, the weld sequence is critical. Proper sequencing of the welds (bead tempering) uses the heat from subsequent passes to temper the earlier passes. This will reduce the stress in the junction between the weld and the base material.

- a. The 1st pass must be on the base material.
- b. The 2nd pass must be above the 1st pass.
- c. The 3rd pass must be above the 2nd pass.

Post Heat and Controlled Cooling



1. Post heat for one hour at 400° F (204° C).



Post heat

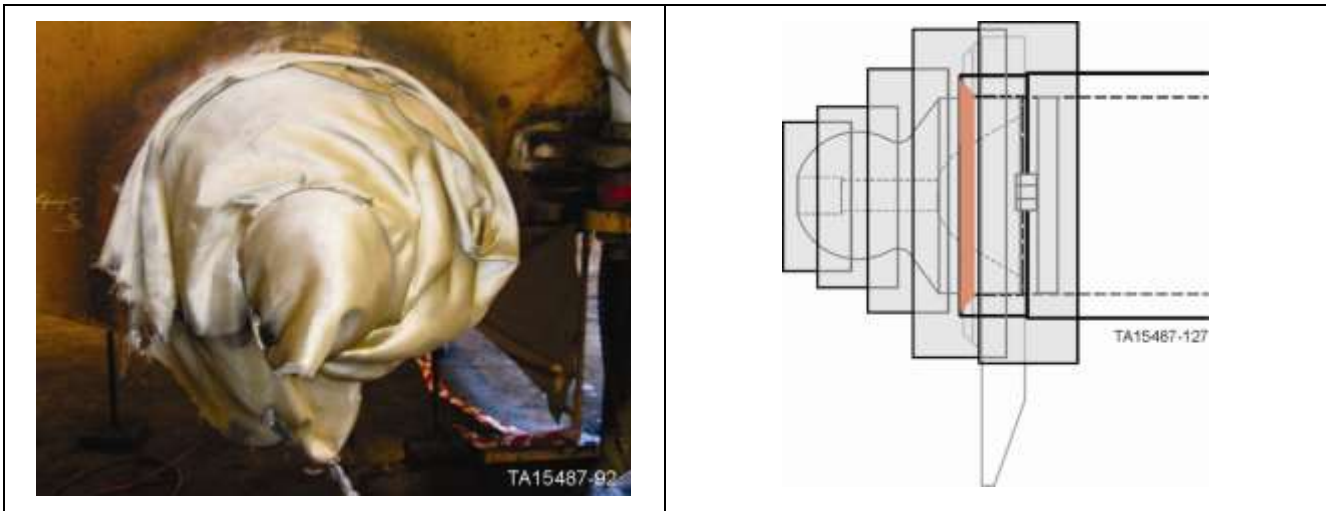
- 1) 400° F (204° C) Minimum
- 2) 400° F (204° C) Maximum
- 3) 300° F (149° C) Maximum

CAUTION

Excessive cooling rates may cause cracks. This must be closely monitored because the frame structure is a large heat sink and can dissipate heat very quickly.

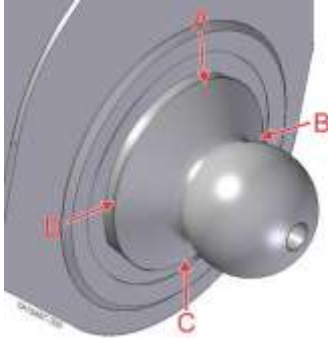
The temperature should drop no more than 50°F (18°C) degrees per hour after post heat completed.

2. After the post heat has been completed, then the ball is wrapped and the controlled cooling process begins. Wrap the ball and cross member to extend the cool down time.



Wrap to slow cool

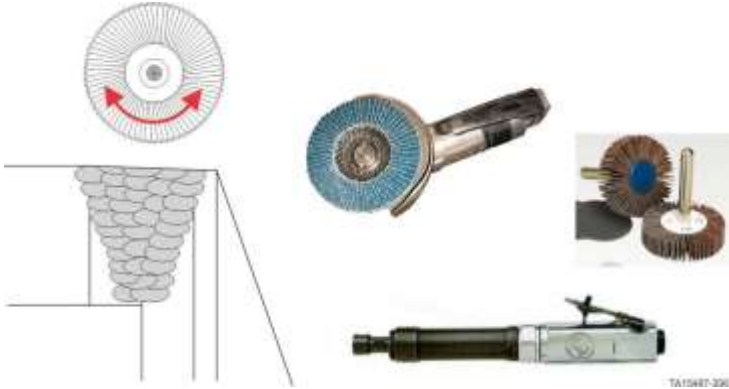
The following is a sample post heat form. A full size form is provided in the end of this section.



Action	Actual Clock Time	Elapsed time (minimum times)	Target Temp	Actual temp
Post Heat Starts		0	400° F (204° C)	A
				B
				C
				D
Post Heat Finishes		1.5 hour	300° F (150° C)	A
				B
				C
				D
Cooling		1.5 hour	375° F (191° C)	A
				B
				C
				D

Post Heat form sample

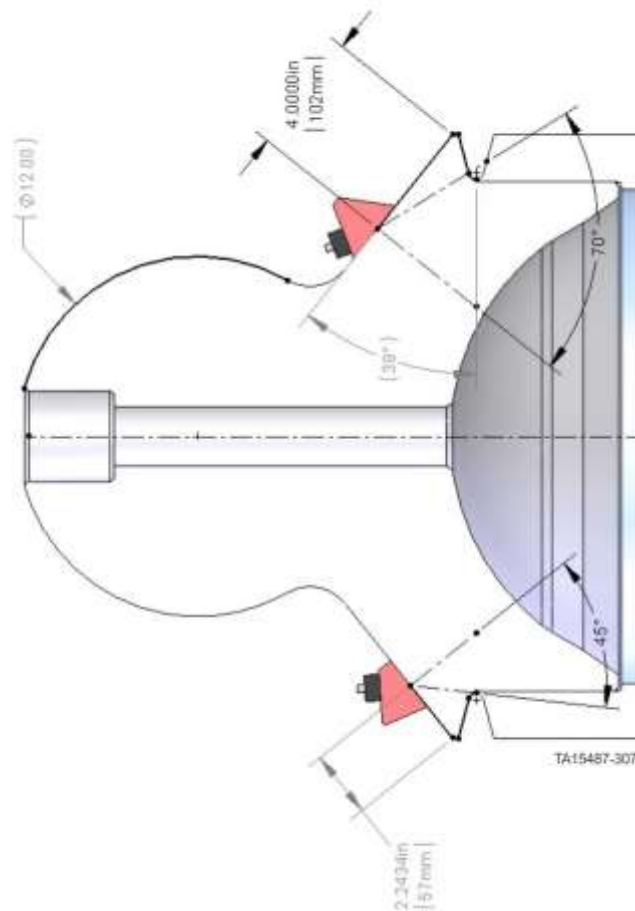
3. The cap passes must be blended smooth.
4. Blend grind the weld around the ball.
 - a. The grinding direction is across the weld.
 - b. The blend should not be undercut into the base plate.



Blend grind

5. Wait 48 hours and use MT or PT check for cracks.

6. UT the weld for defects



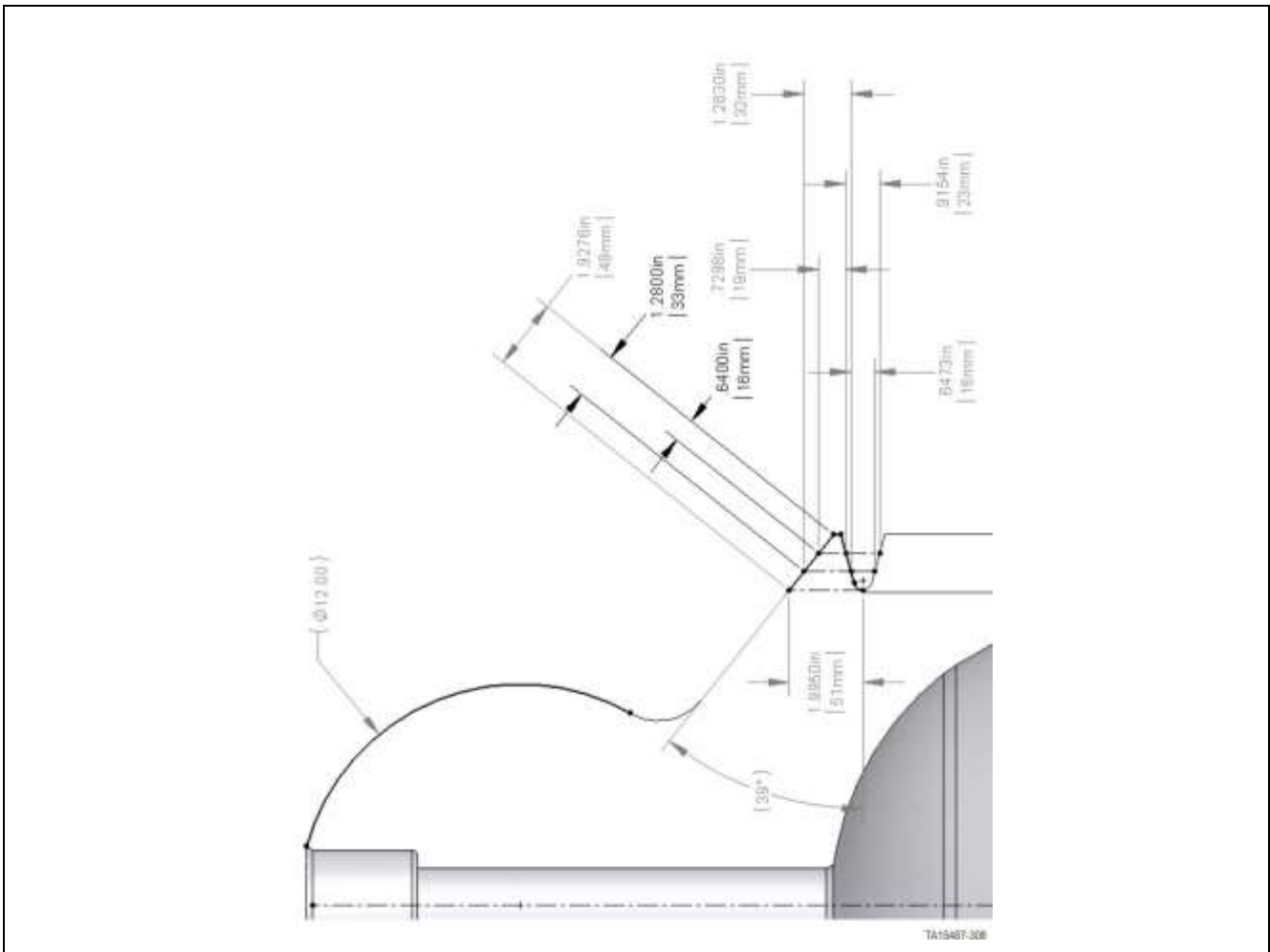
UT the weld for defects

**** UT Inspection standards of acceptance: AWS D14.4 2005 paragraph 8.3.4.6**

Any discontinuity whose reflection exceeds 80% of full screen height shall be rejected. Discontinuities whose reflections equal 20% or greater up to and including 80% of full screen height shall be evaluated as follows:

- a. If the discontinuity length exceeds $T/2$ (where T = thickness of the thinner member), it shall be rejected. In no case shall any single discontinuity length exceed 1-1/2" (40 mm)
- b. Any two discontinuities separated by less than $2L$ of sound metal (where L = length of the longest discontinuity), shall be considered a single discontinuity. The maximum distance between the outer extremities of any two-such discontinuities or the sum of their lengths, whichever is greater, shall not exceed the length specified in 8.3.5.6 (1) (a).

If the total accumulative length of discontinuities in any 12" (300 mm) of weld length exceeds $1T$, that weld length shall be rejected. When less than 12" (300 mm) of weld is inspected, the $1T$ criterion applies to the length inspected



UT the weld for defects

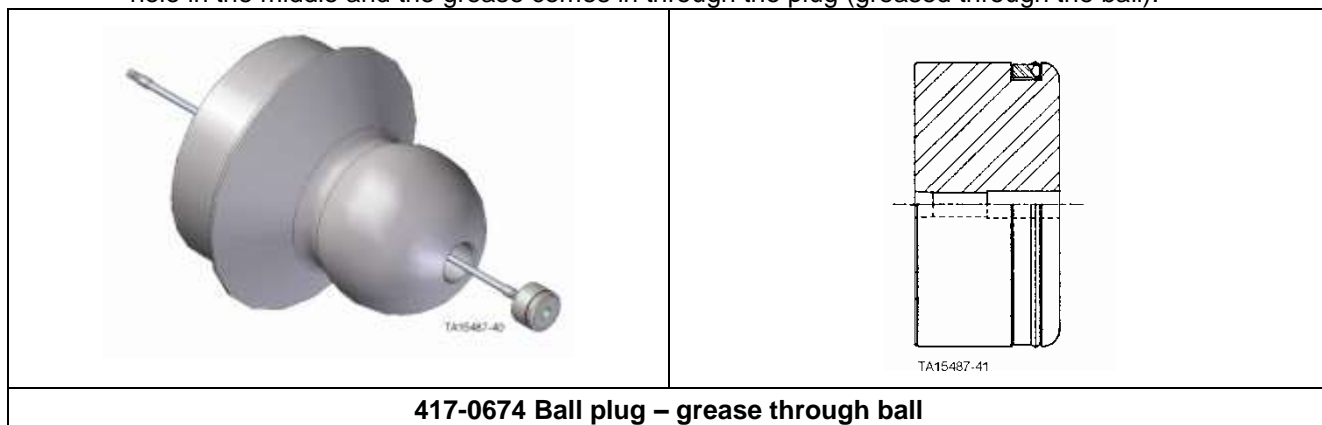
7. Repair any rejectable defects.
8. Paint the repair area.
9. Install the appropriate grease plug.

10. This plug could be one of several types:

- a. The Type A hoist cylinder ball on L-950, L-1150 and L-1350 used either a 407-8325 or 426-7874 plug and the ball was greased through the cap.



- b. The Type A hoist cylinder ball on the L-1850 and all of the Type A lift arm balls have a plug with a hole in the middle and the grease comes in through the plug (greased through the ball).



NOTICE

Re-Commissioning after Ball Replacement


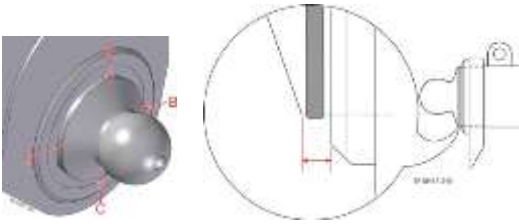
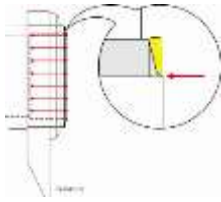
- After each ball has been replaced or repaired and all of welding/inspection procedures have been completed- specific assembly and maintenance items outlined in the Re-Commissioning Replacement Document must be done to assure proper function of the ball joints.
- Re-Commissioning Replacement Document is at the end of this chapter and a copy is also included in the Appendix of the Field Welding Procedure document.

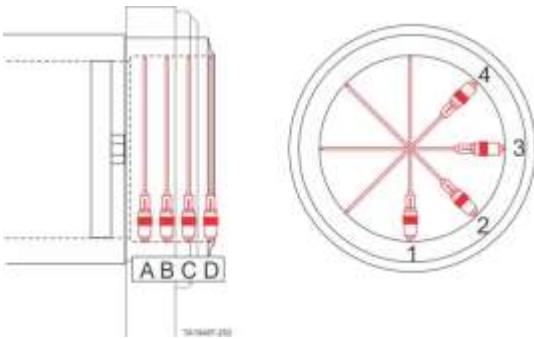
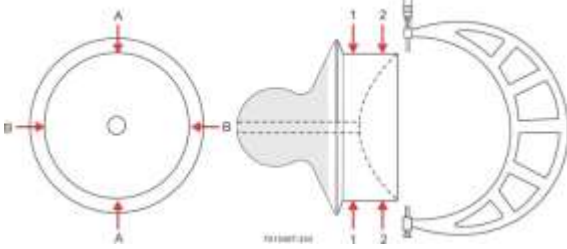
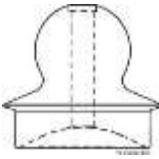
Type A - Hoist and Lift Arm Balls Worksheet

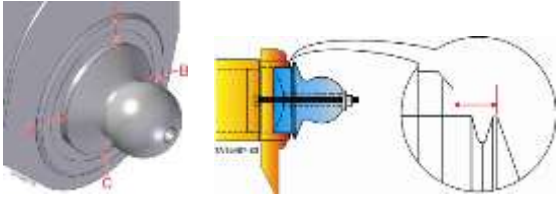
(Field Welding Procedure Chapter 3A)

General Information		
Date work started	Date work completed	
Machine type	L-1350 <input type="checkbox"/> L-1350G2 <input type="checkbox"/> L-1850 <input type="checkbox"/> L-1850G2 <input type="checkbox"/> L-2350 <input type="checkbox"/>	
Machine S/N		
Front frame S/N		
Machine location (mine name)		
Machine hours		
Ball hours (if known)		
Ball Information		
Ball location	Lift arm - RH <input type="checkbox"/> LH <input type="checkbox"/> Hoist - RH <input type="checkbox"/> LH <input type="checkbox"/>	
Ball size		
Ball markings – part number/serial number		
Sales Force/CCR		
Field Welding Procedure Specification (FWPS) used?	FW-0107 <input type="checkbox"/> FW-0108 <input type="checkbox"/> FW-0109 <input type="checkbox"/> FW-0110 <input type="checkbox"/>	
Personnel and Companies Involved		
Person responsible for filling in forms		
Supervisor company		
Supervisor name(s)		
Company for welding		
Personnel Names and certifications	1	2G <input type="checkbox"/> 3G <input type="checkbox"/> 4G <input type="checkbox"/> 6G <input type="checkbox"/> none <input type="checkbox"/>
Minimum certifications: AWS D1.1 (0r equivalent recognized welding code)	2	2G <input type="checkbox"/> 3G <input type="checkbox"/> 4G <input type="checkbox"/> 6G <input type="checkbox"/> none <input type="checkbox"/>
2G/3G (or 4G) for the process being used (FCAW or SMAW)	3	2G <input type="checkbox"/> 3G <input type="checkbox"/> 4G <input type="checkbox"/> 6G <input type="checkbox"/> none <input type="checkbox"/>
	4	2G <input type="checkbox"/> 3G <input type="checkbox"/> 4G <input type="checkbox"/> 6G <input type="checkbox"/> none <input type="checkbox"/>
	5	2G <input type="checkbox"/> 3G <input type="checkbox"/> 4G <input type="checkbox"/> 6G <input type="checkbox"/> none <input type="checkbox"/>

General Information		
	6	2G <input type="checkbox"/> 3G <input type="checkbox"/> 4G <input type="checkbox"/> 6G <input type="checkbox"/> none <input type="checkbox"/>
	7	2G <input type="checkbox"/> 3G <input type="checkbox"/> 4G <input type="checkbox"/> 6G <input type="checkbox"/> none <input type="checkbox"/>
	8	2G <input type="checkbox"/> 3G <input type="checkbox"/> 4G <input type="checkbox"/> 6G <input type="checkbox"/> none <input type="checkbox"/>
Company used for preheat		
Personnel Names	1	
	2	
	3	
Company used for monitoring and recording preheat		
Personnel Names	1	
	2	
Company for UT inspections		
Company for PT/MT inspections		
Personnel Names	1	
	2	
	3	
Welding Consumable and Equipment		
Welding equipment (brand and model)	Root Pass Build passes	
Welding consumable – root pass		
Weld machine settings for root pass	Volts _____ Amps _____.	
Welding consumable – build passes		
Gas used for welding consumable		
Diameter of consumable used		
Gas flow rate		
Weld machine settings at the welding machine	Volts _____ Amps _____.	
Volts and amps measured at the feeder or at work piece connections	Volts _____ Amps _____.	
Preheat method used	Gas flame <input type="checkbox"/> Type of gas used? Type of torch used? Moving or stationary?	

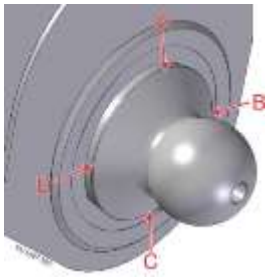
General Information		
	Electric heaters <input type="checkbox"/> Brand and type	
Temperature measuring method (temperature stick(crayon) must be used)	Temperature stick(crayon) <input type="checkbox"/> Brand? Temperature ranges? Temperature gun <input type="checkbox"/> Brand?	
Procedure Information		
Note two types of balls: Mark the check box for the type that you are changing. See table in Chapter 3 of field welding procedure	 Type A ball <input type="checkbox"/>	
Remove all rust preventative material or other contamination from the replacement ball	Yes <input type="checkbox"/> No <input type="checkbox"/>	
Pre-dimensions – prior to ball removal	Dimension:	
	A	
	B	
	C	
	D	
Remove ball base per procedures	YES <input type="checkbox"/> NO <input type="checkbox"/>	
Damage to the tube?	YES <input type="checkbox"/> NO <input type="checkbox"/>	
Procedure used to remove ball base?	Cut in pieces YES <input type="checkbox"/> NO <input type="checkbox"/> Remove one large piece YES <input type="checkbox"/> NO <input type="checkbox"/> Torch YES <input type="checkbox"/> NO <input type="checkbox"/> Arc air YES <input type="checkbox"/> NO <input type="checkbox"/>	
MT bore and face to look for cracks (If crack indications are found in the tube – raise preheat to 450° F)	YES <input type="checkbox"/> NO <input type="checkbox"/>	
Repair all torch or gouge digs on tube per procedures	YES <input type="checkbox"/> NO <input type="checkbox"/>	
Grind all repairs	YES <input type="checkbox"/> NO <input type="checkbox"/>	
MT bore and face to verify cracks have been repaired	YES <input type="checkbox"/> NO <input type="checkbox"/>	
Measure the tube depth to the machined shoulder in eight locations (tube at ambient temperature)	Measurements:	
	1	5
	2	6
	3	7
	4	8
If measurements exceed the specified length – grind down If measurements are less than the specified length the tube		

General Information				
will have to be build up and machine to specifications The bore length must be correct for proper ball fit after installation.				
Check bore dimensions (tube at ambient temperature) 	A1	A2	A3	A4
	B1	B2	B3	B4
	C1	C2	C3	C4
	D1	D2	D3	D4
Average dimensions of A,B,C,D		Average:		
Is line bore required? ** If line bore required – the bore must be pre-machined 1/16" (1.6 mm) oversize and then welded. Preheat required prior to welding. NOTE: The final bore dimension average must be .015" (.381 mm) to .025" (.635 mm) under the specification for a new tube to account for the crush of the frame ear.		YES <input type="checkbox"/> NO <input type="checkbox"/>		
If line bored – measure bore again:	A1	A2	A3	A4
	B1	B2	B3	B4
	C1	C2	C3	C4
	D1	D2	D3	D4
Measure the ball base OD (the part that will fit into the tube). 	A1		A2	
	B1		B2	
Trial test the time to transfer ball from the liquid nitrogen container to the tube ready for installation. You must be able to do this in less than 1 minute and 30 seconds.		Test time?		
Insulated container for liquid nitrogen		YES <input type="checkbox"/> NO <input type="checkbox"/>		
Amount of time ball in liquid nitrogen (40 minutes recommended)		Time:		
Level of liquid nitrogen during the freezing process? Mark line on picture- (no higher than the non carb area)				

General Information					
	Type A				
Verify that the pre dimensions taken earlier are met during ball installation. 	Dimension: <table border="1" style="width: 100%; border-collapse: collapse;"> <tr><td style="height: 20px;">A</td></tr> <tr><td style="height: 20px;">B</td></tr> <tr><td style="height: 20px;">C</td></tr> <tr><td style="height: 20px;">D</td></tr> </table>	A	B	C	D
A					
B					
C					
D					
Post heat and slow cool down.	Record temperatures as specified. Attach the post heat and cool down log.				
UT welds on type A balls.	UT (per AWS D14.4 Class 1 criteria) the welds on the ball base– attach report.				
Repair any rejectable defects and indications found with UT.					
48 Hour Inspections **All inspections after job complete are specified to be minimum of 48 hours after job completed (welded, post heat and slow cooled to ambient).	<ul style="list-style-type: none"> • MT/PT report on weld and ball 48 hours after job (welding and post heat) completed and fully cooled to ambient. • UT report on weld 48 hours after job complete (and cooled to ambient). 				

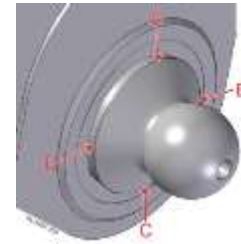
Ball Preheat and Interpass Record – Type A

(one record for each hoist and lift arm ball)

Location:	Supervisor:	
Loader type and serial number:	Date:	
Ball description and location:	Ball serial numbers:	

Welder	Sequence	Actual clock time	TEMPERATURE		
			Ball flange (near weld)	Ball Neck	Ball Sphere
1	0 HOUR		A		
			B		
			C		
			D		
2			A		
			B		
			C		
			D		
1	1 HOUR		A		
			B		
			C		
			D		
2			A		
			B		
			C		
			D		
1	2 HOUR		A		
			B		
			C		
			D		
2			A		
			B		
			C		
			D		
1	3 HOUR		A		
			B		
			C		
			D		
2			A		
			B		
			C		
			D		
1	4 HOUR		A		
			B		
			C		
			D		
2			A		
			B		
			C		
			D		
1	5 HOUR		A		
			B		
			C		
			D		
2			A		
			B		
			C		
			D		
1	6 HOUR		A		
			B		
			C		
			D		
2			A		
			B		
			C		
			D		
1	7 HOUR		A		
			B		
			C		
			D		
2			A		
			B		
			C		
			D		
1	8 HOUR		A		
			B		
			C		
			D		
2			A		
			B		
			C		
			D		
1	9 HOUR		A		
			B		
			C		
			D		
2			A		
			B		
			C		
			D		
1	10 HOUR		A		
			B		
			C		
			D		
2			A		
			B		
			C		
			D		
1	11 HOUR		A		
			B		
			C		
			D		
2			A		
			B		
			C		
			D		

Post Heat Record – Type A Ball
 Follow the post heat instructions previously explained in this chapter.



Action	Actual Clock Time	Elapsed time (minimum times)	Target Temp	Actual temp
Post Heat Starts		0	400° F (204° C)	A
				B
				C
				D
Post Heat Finishes		1 HOUR	400° F (204° C)	A
				B
				C
				D
Cooling		1.5 HOUR	375° F (191° C)	A
				B
				C
				D
Cooling		2 HOUR	350° F (177° C)	A
				B
				C
				D
Cooling		3 HOUR	300° F (149° C)	A
				B
				C
				D
Cooling		4 HOUR	250° F (121° C)	A
				B
				C
				D
Cooling		5 HOUR	200° F (66° C)	A
				B
				C
				D
Cooling		6 HOUR	150° F (66° C)	A
				B
				C
				D

Re-Commissioning after - Ball Replacement



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Re-Commissioning after Ball Replacement

Before beginning the re-commissioning process, ensure the following safety preparations have been followed.

Safety Preparations

WARNING

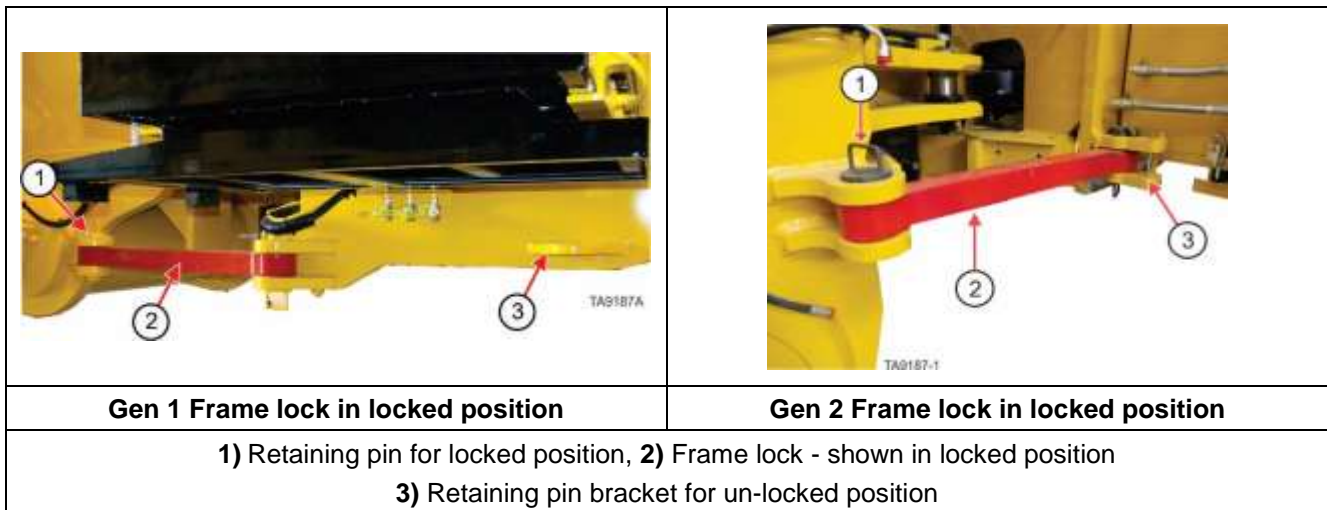
Crush hazards exist if the machine is started or moved while work processes are being performed on the machine. Place bucket flat and level on the ground. Place frame lock in the locked position and lock out the machine's starting capability before performing any work process. Follow all applicable lockout procedures and local rules and regulations for performing work processes. ANYONE performing inspections or service procedures to the machine should be familiar with ALL instructions and procedures contained in the machine's SERVICE MANUAL. Crush hazard could occur if the machine is started or moves while any type of work process is being conducted on the machine, resulting in serious injury or death.

Machine Shutdown and Lockout

1. Stop the wheel loader on flat level ground.
2. Place bucket flat and on level ground.
3. Move the frame lock to the locked position so that the frame cannot be steered.

WARNING

Crush hazards exist in machine pivot area and area between the tires. Do not enter these areas unless it is verified that the operator has control over the steering and that personnel locking the frame lock have good communication with the operator. Entering the pivot area and area between the tires while the machine is moving or pivoting (articulating) could cause crush hazards resulting in serious injury or death.



4. Set the parking brakes.
5. Shut off the engine.
6. Place wheel chocks in front and behind each wheel.
7. Lock out the machine's starting capability before performing any cleaning, inspections, or installation and repair procedure.

WARNING

Crush, shock, or other hazards exist if stored energy is not removed or isolated prior to working on the machine. Stored energy (hydraulic, electrical, pneumatic, mechanical, etc.) may be present if not isolated or released prior to working on the machine. Do not work on the machine without removing this stored energy (suspended loads, electrical power, air pressure, etc.). Risk of crushing, shock, or other physical injury exists if stored energy is not removed or isolated prior to working on the machine which could result in serious injury or death.

8. Turn the battery and engine isolation switches to the off position and install locks on the battery isolation switch.



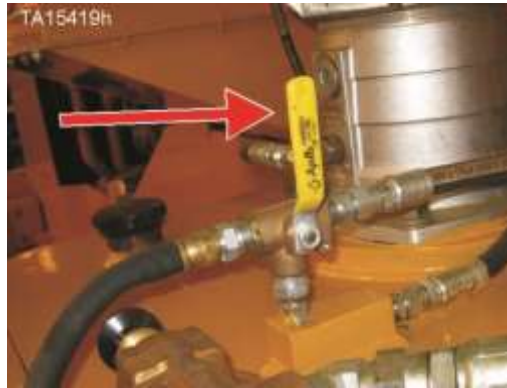
GEN 2 Isolation and Control switches assembly – Battery isolation switch in OFF position with locks in place

NOTICE

The GEN 2 Isolation and Control switches assembly is shown in this document. GEN 1 machines will have a different type of switch and box. The lock out/tag out requirements are the same.



9. Release the air from the hydraulic reservoir by using the hydraulic reservoir air valve (ball valve) on top of the reservoir. The supply line from main air system will be blocked and reservoir air will vent out the hose that runs down the outside of the hydraulic reservoir.

10. Turn the handle to the up position as shown.



Hydraulic reservoir air valve handle UP

11. Release the air from the various air storage reservoirs by opening all of the air bleed valves.

Generation 1	Generation 2
Three valves on left side of rear frame under electrical cabinet	Three valves on right side of rear frame under hydraulic reservoir
One valve on left side of front frame near frame lock and hoist cylinder ball cap	One valve on right side of front frame near hoist cylinder ball cap
	
Open air reservoir bleed valves	

WARNING

Crush hazards exist if all personnel are not cleared from the bucket and lift arm area before using the hydraulic hoist and bucket hydraulic pressure bleed down valves to relieve pressure from the hoist and bucket circuit. Assembly must be used only when the engine is NOT running. Before using the Manual Bleed Valve Assembly, refer to “HYDRAULIC AND GREASE SYSTEMS”, “MANUAL BLEED VALVE ASSEMBLY”, in Section 04 of the Service Manual for additional operational and safety information. Operating the manual bleed valve may cause the lift arms and bucket to descend rapidly. All personnel around the bucket and lift arms area shall be removed from the area before operating hydraulic hoist and bucket hydraulic pressure bleed down valves. Using the hydraulic bleed down valves could result in movement of the lift arms and bucket which could cause a crush hazard resulting serious injury or death.

12. Use the hydraulic pressure bleed down valves located in the front frame underneath the Husco valves to bleed any stored pressure in the hoist and bucket cylinders.

13. Turn each valve slowly counterclockwise as shown below and allow the pressure to bleed down.
14. Open the valve completely and leave it open during repairs.



CAUTION

Before performing welding operations on a machine, the fire suppression system circuit monitors panel's in-line fuse must be removed. The fuse is located in the battery box on some machines. Failure to do so may cause the system to actuate and/or damage the solid-state components of the system. Replace the in-line fuse before the machine has been started or after all welding operations have been completed.



Fire suppression in-line fuse located in loader battery box on some machines

⚠ WARNING

Fall hazard exists when working at heights. Be sure to take appropriate safety precautions when working at heights on the rear and front frames or the lift arms balls. Follow all required statutory regulations for working at height. Wear fall restraint when necessary to prevent falls. Failure to take appropriate safety precautions, including wearing fall restraint when necessary can cause fall hazards resulting in serious injury or death.

⚠ WARNING

Crush hazards exist if standing under, working, or placing any body part under hoisted/suspended components. Never stand under hoisted/suspended components. Ensure appropriate lifting devices are used, and blocking is adequate to prevent the component from unexpectedly moving during transportation. Refer to SAFETY, WARNINGS, AND CAUTIONS before attempting to remove the operator's cab. Failure to stay out from under hoisted/suspended components can cause crush hazard resulting in serious injury or death.

Assembly and Maintenance Items

After each ball has been replaced and all of the welding/inspection procedures completed – the following assembly and maintenance items must be done to assure proper function of the ball joint:

- 1) Obtain a machine download and analyze the data.
 - a. Any grease system alarms or warnings?
- 2) Assure that the grease plug is installed (hoist cylinder and lift arm balls).
 - a. Use new O-ring on the plug.
- 3) Install grease extension tube (frame articulation balls).
 - a. Use thread sealant on threads.
- 4) Grease hose and fitting is properly attached for each ball type.
 - a. The hose should be replaced to ensure reliability.
 - b. Pre-purge all grease lines with auto lube system grease, before installation.

CAUTION

Do not use standard EP grease to coat the ball, coat the liner, fill the ball or purge the grease system. Use only the specified auto lube system grease containing 3-5% moly, specified for the machine's operating conditions.

- 5) Install new brass liners in socket and cap.
- 6) Chase the threads in each of the tapped holes in the socket.
 - a. This must be done by hand – **DO NOT** use any form of power tool.
 - i. Use of a power tool can cause damage to the threads.

CAUTION

Never use any form of power tool to chase threads with a tap! Always turn the tap by hand! Power tools can remove the 'feel' of the tap 'cutting' material from the hole and this 'cutting' is not desirable. Never drive a tap with a rattle gun as it can cause the tap to chip fragments of the tap off and they become embedded in the base material, causing further damage to the capscrew at the time of installation.

- b. Use a slightly dull tap to minimize thread damage.

NOTICE

The threads in each hole have typically been slightly distorted by the tensioning of the capscrews. The cutting edge of a new tap should be slightly 'dulled' by buffing the cutting edge of the tap on a wire wheel. This will minimize thread cutting which can reduce thread strength and leave small fragments of steel shavings in the root of the thread.

- c. Use **ONLY** a bottoming type of tap. Taper and intermediate configuration taps must not be used.
- 7) Clean all of the tapped hole threads in the socket. Remove all contaminants and previous lubricants from each hole.

- 8) Install new capscrews.
 - a. If there is any doubt as to their history or condition – replace the capscrews.
 - b. New capscrews should be installed if the ball was broken.
 - i. If one lift arm ball was broken - replace the capscrews on both sides of lift arm.
 - c. Capscrews can be reused if:
 - i. They were properly torqued when originally installed.
 - ii. No sign of thread damage from installation or dropping on steel or ground.
 - iii. No signs of stretching.
 - iv. Threads are fully cleaned.
 - v. No signs of cracking near the clamp face of the capscrew.
 - vi. The clamp face is not galled.
 - vii. The 12-point head is not damaged.
- 9) Assembly lubrication.
 - a. Coat the OD of the ball with auto lube system grease.
 - b. Fill the hole in the ball with auto lube system grease.
 - c. Coat the socket and cap with a thin coat of auto lube system grease.
 - d. Coat the brass liners with auto lube system grease to fill the grooves in the liners.

CAUTION

Do not use standard EP grease to coat the ball, coat the liner, fill the ball or purge the grease system. Use only the specified auto lube system grease containing 3-5% moly, specified for the machine's operating conditions.

- 10) Verify that the lift arms fit on the balls without spreading or pulling together.
 - a. Verify that the lifting method is not pulling the arms together.
 - b. The arm width can be adjusted by heat striping if required.
 - c. Contact Komatsu Call Center for assistance (support@joyglobal.com)
- 11) Align the ball caps on the lift arm sockets.
 - a. Install the ball cap loosely and align the match marks
 - i. The caps are interchangeable left to right – but once they have been aligned and match marked – they should be always used in the specified location.
 - b. If they are not factory match marked – find the center and match mark.
 - c. Mark each one for Left (LH) or Right (RH).

NOTICE

The socket and cap are aligned and marked when the arms are NOT mounted on the machine.

- 12) Torque the cap screws for the ball caps.
 - a. Verify that the socket threaded holes and all capscrews are not contaminated with grease, anti-seize, etc.
 - b. 30W or engine oil for thread and shoulder lubrication.
 - c. Hand start ALL cap screws in the cap prior to tightening with air gun or torque wrench.
 - d. Use a small air wrench (1/2" drive max) to run the bolts fully home.

CAUTION

If any capscrew binds while running in by hand or with a small air impact wrench, **DO NOT** attempt to drive the capscrew deeper. Use a hand wrench and remove the capscrew. **DO NOT** use an air impact wrench to remove the capscrew.

- e. Follow the torque pattern.
 - f. Torque to the correct value.
- 13) Check the “snap” clearance on the ball.
- a. Adjust the snap clearance to specification by adding or removing shims.
- 14) Purge the grease line to the ball joint.
- a. **DO NOT** purge by cycling the grease system.
 - i. The injector only puts out a maximum of 1.3cc each time the grease system cycles. It is very difficult to fill the joint with grease at this rate – and wastes grease from excessive grease at all the other locations on the machine.
 - b. Remove the purge cap from the grease injector and fill the joint with grease using a grease gun.
 - c. Purge a minimum of 0.5 kilogram (1 pound) of grease through the joint **BEFORE** operation of the machine.

CAUTION

Do not use standard EP grease to purge the ball joint grease system. Use only the specified auto lube grease containing 3-5% moly, specified for the machine’s operating conditions.

- 15) Replace the in-line fuse on the fire suppression system if it was disengaged due to welding on the machine, this must be done before the machine has been started or after all welding operations have been completed.

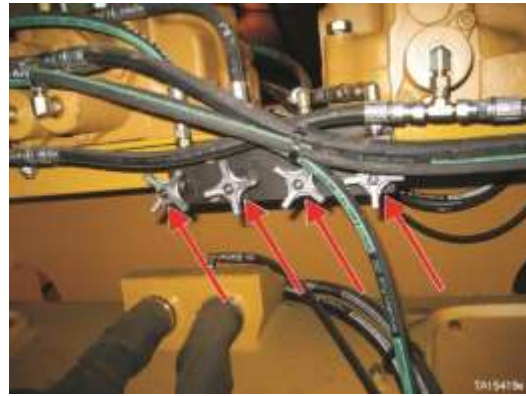
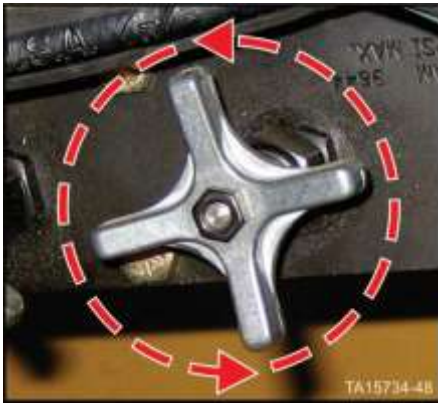
CAUTION

Failure to replace the fuse before operating the machine could result in a serious fire. Never run the machine unless the fuse has been replaced.



Fire suppression in-line fuse located in loader battery box on some machines

16) Close (turn clockwise) the hydraulic bleed valves in the front frame.



Close hydraulic bleed valves in front frame

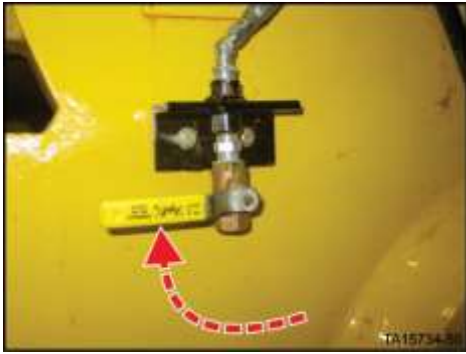
17) Close the hydraulic reservoir air valve on top of the hydraulic reservoir.



Close the hydraulic reservoir air valve

18) Close the air bleed valves.

Generation 1	Generation 2
Three valves on left side of rear frame under electrical cabinet	Three valves on right side of rear frame under hydraulic reservoir
One valve on left side of front frame near frame lock and hoist cylinder ball cap	One valve on right side of front frame near hoist cylinder ball cap



Close the valve under the hydraulic reservoir

- 19) Remove wheel chocks.
- 20) Remove any locks or tags from isolation box following all local regulations and turn both isolation switches to the on position.



GEN 2 Battery Isolation Box – locks removed – and switches moved to on position

- 21) Start machine and verify that grease injectors are functioning (Ref SIL-397.01).
 - a. System timer functioning – what is the setting?
 - b. Grease leaks?
 - c. System building pressure?
 - d. Grease Pressure?
 - e. Oil Supply Pressure?
 - f. Injectors functioning?
 - g. Grease Pressure at stall?
 - h. Injector for ball joint functioning?

Most of the items in the previous list are steps that are part of the standard assembly and commissioning of a new loader or a part of the normal maintenance items related to balls. Contact the Komatsu Call Center (support@joyglobal.com) if you are unable to locate the information or have questions pertaining to these assembly and maintenance practices. Most of these are covered in one or more of the following documents:

- Assembly Manual
- GEN 2 Service Manual
- SIL 439.01 Spherical Ball Bearing Joints
- SIL 413.00 Hoist Cylinder Spherical Ball Lubrication
- SIL-397.01 Auto Lube System Operation

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RE-Commissioning Worksheet

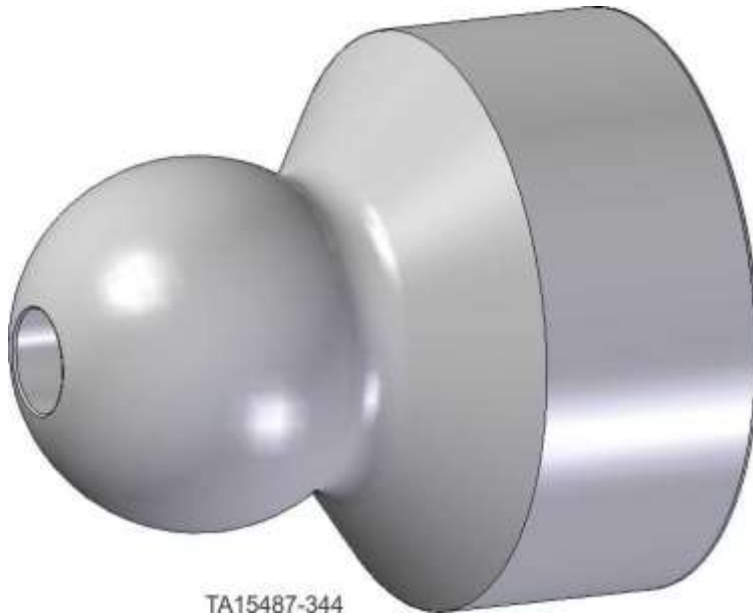
Machine:	Ball location changed:	Date:
S/N:	Replacement Ball S/N	Customer:

Item	Result	Comments	Date	Signature
Machine download	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Attach to the Sales Force Case related to this machine	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Analyze data for indications of grease system failures	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Grease Plug installed in hoist or lift arm ball	YES <input type="checkbox"/> NO <input type="checkbox"/>			
New O-ring	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Grease extension tube installed into articulation ball base	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Thread sealant used?	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Connect the grease hose	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Tighten hose and fitting	YES <input type="checkbox"/> NO <input type="checkbox"/>			
New Grease hose used?	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Install new brass liners in socket and cap	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Chase hole threads in socket by hand	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Clean hole threads in socket to remove all contaminants	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Install new capscrews	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Coat the OD of the ball with auto lube system grease	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Fill the hole in the ball with auto lube system grease	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Coat the ID of the socket and cap with a thin coat of auto lube system grease	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Coat the ID of the brass liner auto lube system grease	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Verify that the arms fit without spreading or pulling together	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Heat striping required?	YES <input type="checkbox"/> NO <input type="checkbox"/>			
<i>This section applies to Lift arm balls ONLY</i>				

Field Welding Procedures

Item	Result	Comments	Date	Signature
Align the ball caps on the lift arm sockets Match marks <i>This section applies to Lift arm balls ONLY</i>	YES <input type="checkbox"/> NO <input type="checkbox"/> YES <input type="checkbox"/> NO <input type="checkbox"/>			
Capscrew lubricant – 30W oil	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Hand start all capscrews	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Follow specified torque pattern	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Torque value	_____ ft-lb			
Purge the grease system to all balls that were replaced? Use external grease pump?	YES <input type="checkbox"/> NO <input type="checkbox"/> YES <input type="checkbox"/> NO <input type="checkbox"/>			
Check the snap clearance In or out of specification? Adjusted? Final value?	YES <input type="checkbox"/> NO <input type="checkbox"/> _____/mm YES <input type="checkbox"/> NO <input type="checkbox"/> YES <input type="checkbox"/> NO <input type="checkbox"/> _____/mm			
Verify grease system functioning: System timing Leaks? System building pressure? Oil supply pressure? Grease pressure at stall? Ball injector functioning? Injectors functioning?	_____ min/cycle YES <input type="checkbox"/> NO <input type="checkbox"/> YES <input type="checkbox"/> NO <input type="checkbox"/> _____ psi _____ psi YES <input type="checkbox"/> NO <input type="checkbox"/> YES <input type="checkbox"/> NO <input type="checkbox"/>			

CHAPTER 3B
Procedure “B” Ball Base with Straight Shoulder
Hoist Cylinder Ball and Lift Arm Ball



TA15487-344

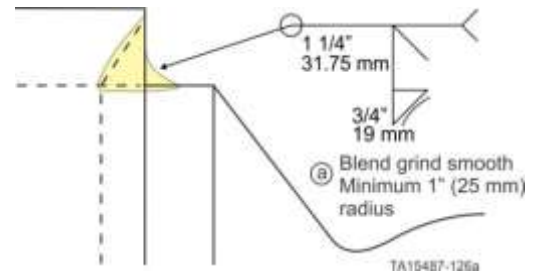
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Procedure	FW-0109
Revision	0
Written by	Joel Armstrong
Date	3/8/2010

Field Welding Procedure			
This document conforms to AWS D1.1/D14.3 Structural Welding Code and Australian Standards AS 1554.4			
Description	Installation of Hoist Cylinder Ball and Lift Arm Ball		
Notes	See attachment		
Welding Process	FCAW / SMAW		
Joint			
Type	Groove or Fillet		
Backing	If needed	Material	Mild Steel
Root Opening	+1/4 / -1/16" Per Attachment (+6.35 / -1.6 mm)		
Root face Dimension	+/- 1/16" Per Attachment (+/- 1.6 mm)		
Groove Angle (degrees)	+10/-5 Per Attachment	Radius	N/A
Back Gouging	Yes, if required	Method	Arc - Air
Other			
Base Metals			
Specification	ASTM A829 Grade 8620 Normalized	A151 4820H	3316 per SAE J1249 or ASTM A508 Grade 4N
Thickness	2.5" (63.5 mm)	9-12" (228-305mm)	14"(335.6 mm)
	Tube	Balls	Balls
Filler Metals			
AWS Specification	A5.20/A5.29		A5.1, A5.5
AWS Class	E71T-12MJH4 E81T1-NiMJH4		E7018-H4, E8018C3
Diameter	0.045", 0.052", 1/16" (1.2, 1.4, 1.6mm)		1/8", 5/32" (3.2,4mm)
Shielding		Positions Qualified	Flat, Horizontal, Vertical
Gas Composition	100% CO2 or Ar/CO2 75/25		Groove 1G, 2G, 3G, 4G
Flow Rate	35 – 45 cfh		Fillet 1F, 2F, 3F
Technique		Vertical Progression	Up
Stringer or Weave Bead	Stringer		Electrical Characteristics
Multi/Single Pass (per side)	Multiple		FCAW - Current DCEP
Peening	Yes		SMAW - Current DCEP
Interpass Cleaning	Chipping and or grinding		Other
Preheat and Interpass Temperatures			
Material Types			
Structural Steel	Castings	Q&T high strength steel	
Frame structure Bucket Blade	Lift Arm Torque Tube (1150, 1350,1850 Gen2, 2350) Upper part front frame (1350) Axles (some 1350) Sockets	Balls Bucket Lip Bucket adapters Lift arms Bell cranks	
Preheat			
Material Thickness	Structural Steel	Castings and high strength steel	
Distance from weld < or = 3/4" (< or = 19 mm)	6" (152 mm) minimum 125° F (52° C)	6" (152 mm) minimum 200° F (93° C)	
>3/4" to 1-1/2" (>19.05 to 38.1 mm)	225° F (107° C)	250° F (121° C)	
>1-1/2" to 2-1/2" (>38.1 to 63.5 mm)	250° F (121° C)	300° F(149° C)	
>2-1/2" (>63.5 mm)	300° F(149° C)	350° F(177° C)	
Interpass Temperature			
All thicknesses	500F (260° C) maximum	450F (232° C) maximum	
Post Heat Treatment			
400F (204° C) for one hour	Required: YES (X) NO ()		

Joint Detail



a) Blend grinds smooth Minimum 1"

Welding Parameters

(The FCAW welding parameters were obtained from the qualification of the LINCOLN Ultracore 712A80 used during Komatsu fabrication on Komatsu welding equipment. These numbers will likely vary depending on the specific welding equipment and consumable used for repairs.)

Weld Pass	Process	Filler Metal	Filler Diameter	Current Type	Amps	Volts	Travel Speed (ipm)	Wire Feed Speed	Welding Position
All	FCAW	E71T-1MJ	1/16"	DCEP	280-340	22-26	8-12	255-300	Flat & Horizontal
All	FCAW	E71T-1MJ	0.052"	DCEP	220-310	22-26	8-12	225-375	Flat & Horizontal
All	FCAW	E71T-1MJ	0.045"	DCEP	210-280	23-25	8-12	275-425	Flat & Horizontal
All	FCAW	E71T-1MJ	1/16"	DCEP	185-225	21-24	7-10	105-130	Vertical
All	FCAW	E71T-1MJ	0.052"	DCEP	195-235	21-24	7-10	200-375	Vertical
All	FCAW	E71T-1MJ	0.045"	DCEP	155-235	21-23	7-10	175-325	Vertical
All	SMAW	E7018	5/32"	DCEP	130-210	19-21	5-8	N/A	All
All	SMAW	E7018	1/8"	DCEP	90-160	19-21	5-8	N/A	All
All	SMAW	E8018C3	5/32"	DCEP	130-220	19-21	N/A	N/A	All
All	SMAW	E8018C3	1/8"	DCEP	90-160	19-21	N/A	N/A	All

Suggested Air Arc Parameters

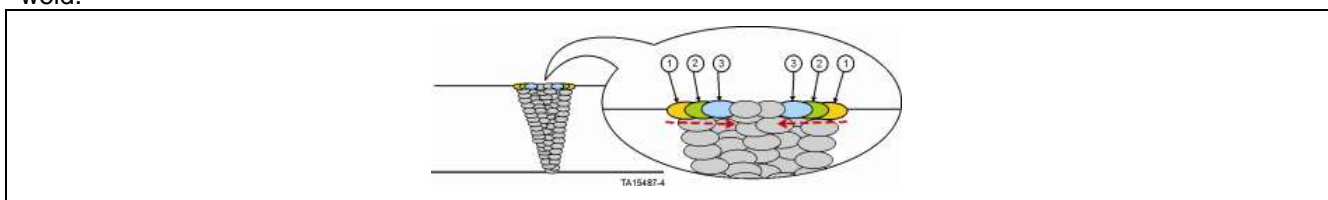
Electrode Diameter		Minimum Amps	Maximum Amps
Inches	Millimeter		
1/8	3.2	60	90
5/32	4.0	90	150
3/16	4.8	200	250
¼	6.4	300	400
5/16	7.9	350	450
3/8	9.5	450	600
½	12.7	800	1000
5/8	15.9	1000	1250
¾	19.1	1250	1600

Proper Electrode Selection for Field Welding

Material joint type	Rod consumable	Wire Consumable
Steel to steel	7018 series	E7xT- xxxx series
Steel to Casting	7018 series	E7xT- xxxx series
Casting Repair	8018 series	E8xT- xxxx series
Socket or Ball installation	8018 series	E8xT- xxxx series
Wear hardware installation on bucket	8018 series	E8xT- xxxx series

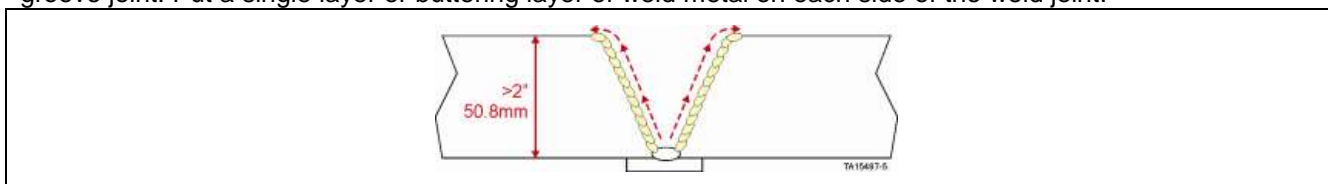
Bead Tempering Finish Passes

The last layer of weld passes must be completed starting from the base material toward the middle of the weld.



Butter Welds

On groove or fillet welds 2" (50.8 mm) deep or larger - butter weld the sides of the groove prior to welding the groove joint. Put a single layer or buttering layer of weld metal on each side of the weld joint.



Procedure for Type “B” Ball (These Balls Have a Flat Shoulder on the Base)

Safety Preparations

WARNING


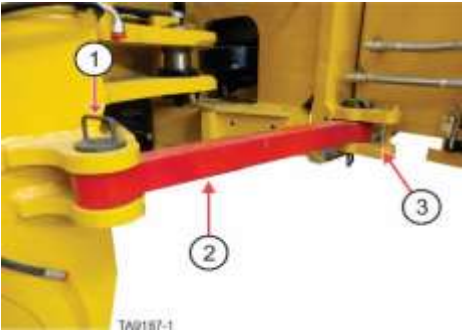
Crush hazards exist if the machine is started or moved while work processes are being performed on the machine. Place bucket flat and level on the ground. Place frame lock in the locked position and lock out the machine’s starting capability before performing any work process. Follow all applicable lockout procedures and local rules and regulations for performing work processes. ANYONE performing inspections or service procedures to the machine should be familiar with ALL instructions and procedures contained in the machine’s SERVICE MANUAL. Crush hazard could occur if the machine is started or moves while any type of work process is being conducted on the machine, resulting in serious injury or death.

Machine Shutdown and Lockout

1. Stop the wheel loader on flat level ground.
2. Place bucket flat and on level ground.
3. Move the frame lock to the locked position so that the frame cannot be steered.

WARNING

Crush hazards exist in machine pivot area and area between the tires. Do not enter these areas unless it is verified that the operator has control over the steering and that personnel locking the frame lock have good communication with the operator. Entering the pivot area and area between the tires while the machine is moving or pivoting (articulating) could cause crush hazards resulting in serious injury or death.

 <p>Diagram showing the Gen 1 frame lock mechanism in the locked position. A red frame lock (2) is secured by a retaining pin (1). A retaining pin bracket (3) is visible for the un-locked position. The label 'TA9187A' is present in the bottom right corner of the image.</p>	 <p>Diagram showing the Gen 2 frame lock mechanism in the locked position. A red frame lock (2) is secured by a retaining pin (1). A retaining pin bracket (3) is visible for the un-locked position. The label 'TA9187-1' is present in the bottom right corner of the image.</p>
<p>Gen 1 Frame lock in locked position</p>	<p>Gen 2 Frame lock in locked position</p>
<p>1) Retaining pin for locked position, 2) Frame lock - shown in locked position 3) Retaining pin bracket for un-locked position</p>	

4. Set the parking brakes.
5. Shut off the engine.
6. Place wheel chocks in front and behind each wheel.

7. Lock out the machine's starting capability before performing any cleaning, inspections, or installation and repair procedure.

WARNING

Crush, shock, or other hazards exist if stored energy is not removed or isolated prior to working on the machine. Stored energy (hydraulic, electrical, pneumatic, mechanical, etc.) may be present if not isolated or released prior to working on the machine. Do not work on the machine without removing this stored energy (suspended loads, electrical power, air pressure, etc.). Risk of crushing, shock, or other physical injury exists if stored energy is not removed or isolated prior to working on the machine which could result in serious injury or death.

8. Turn the battery and engine isolation switches to the off position and install locks on the battery isolation switch.



GEN 2 Isolation and Control switches assembly – Battery isolation switch in OFF position with locks in place

NOTICE

The GEN 2 Isolation and Control switches assembly is shown in this document. GEN 1 machines will have a different type of switch and box. The lock out/tag out requirements are the same.

9. Release the air from the hydraulic reservoir by using the hydraulic reservoir air valve (ball valve) on top of the reservoir. The supply line from main air system will be blocked and reservoir air will vent out the hose that runs down the outside of the hydraulic reservoir.
10. Turn the handle to the up position as shown.



Hydraulic reservoir air valve handle UP
--

11. Release the air from the various air storage reservoirs by opening all of the air bleed valves.

Generation 1	Generation 2
Three valves on left side of rear frame under electrical cabinet	Three valves on right side of rear frame under hydraulic reservoir
One valve on left side of front frame near frame lock and hoist cylinder ball cap	One valve on right side of front frame near hoist cylinder ball cap

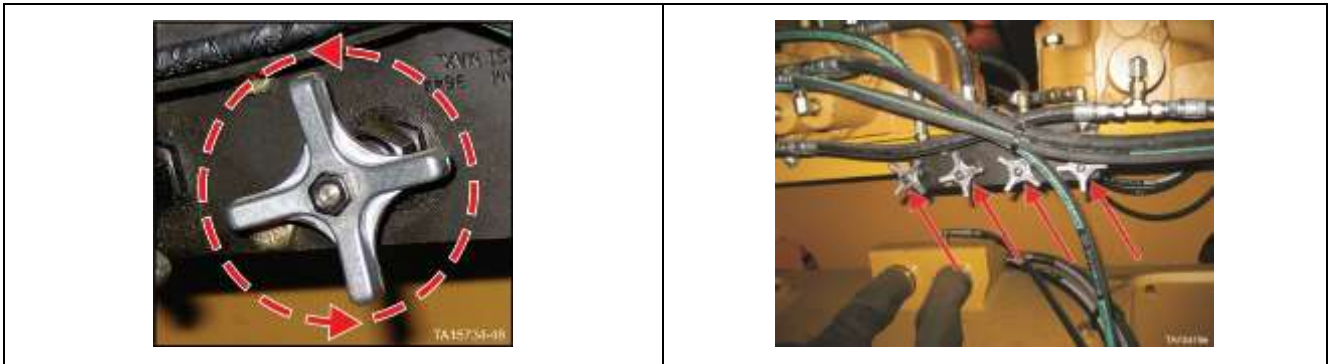


Open air reservoir bleed valves

WARNING

Crush hazards exist if all personnel are not cleared from the bucket and lift arm area before using the hydraulic hoist and bucket hydraulic pressure bleed down valves to relieve pressure from the hoist and bucket circuit. Assembly must be used only when the engine is **NOT** running. Before using the Manual Bleed Valve Assembly, refer to “HYDRAULIC AND GREASE SYSTEMS”, “MANUAL BLEED VALVE ASSEMBLY”, in Section 04 of the Service Manual for additional operational and safety information. Operating the manual bleed valve may cause the lift arms and bucket to descend rapidly. All personnel around the bucket and lift arms area shall be removed from the area before operating hydraulic hoist and bucket hydraulic pressure bleed down valves. Using the hydraulic bleed down valves could result in movement of the lift arms and bucket which could cause a crush hazard resulting serious injury or death.

12. Use the hydraulic pressure bleed down valves located in the front frame underneath the Husco valves to bleed any stored pressure in the hoist and bucket cylinders.
13. Turn each valve slowly counterclockwise as shown below and allow the pressure to bleed down.
14. Open the valve completely and leave it open during repairs.



CAUTION

Before performing welding operations on a machine, the fire suppression system circuit monitors panel's in-line fuse must be removed. The fuse is located in the battery box on some machines. Failure to do so may cause the system to actuate and/or damage the solid-state components of the system. Replace the in-line fuse before the machine has been started or after all welding operations have been completed.



Fire suppression in-line fuse located in loader battery box on some machines

⚠ WARNING

Fall hazard exists when working at heights. Be sure to take appropriate safety precautions when working at heights on the rear and front frames or the lift arms balls. Follow all required statutory regulations for working at height. Wear fall restraint when necessary to prevent falls. Failure to take appropriate safety precautions, including wearing fall restraint when necessary can cause fall hazards resulting in serious injury or death.

⚠ WARNING

Crush hazards exist if standing under, working, or placing any body part under hoisted/suspended components. Never stand under hoisted/suspended components. Ensure appropriate lifting devices are used, and blocking is adequate to prevent the component from unexpectedly moving during transportation. Refer to SAFETY, WARNINGS, AND CAUTIONS before attempting to remove the operator's cab. Failure to stay out from under hoisted/suspended components can cause crush hazard resulting in serious injury or death.

Burn Hazard

WARNING

Burn and inhalation hazards exist when welding or cutting on the machine. Cutting and welding can produce hot surfaces. Smokey condition can exist if a fire starts. Have qualified fire watch personnel present, and keep a fire extinguisher that meets all statutory regulations nearby during all cutting and welding operations. Failure to provide a qualified fire watch and an appropriate fire extinguisher can cause fire and inhalation hazards resulting in serious injury or death.

Summary

1. Lift arms will have to be removed to replace a lift arm ball.
2. Hoist cylinder will have to be removed to replace a hoist cylinder ball.
3. Welding Consumables:
 - 1) Crack repair in base material: E7018 electrode or E71T-12MJH4 wire.
 - 2) Ball installation: E-8018C3 electrode or E81T1-NiMJH4 wire.

NOTICE

The factory will consider approving other wire types depending on the specifications of the wire. For example: Komatsu uses Lincoln Ultracore E71T-1MJ along with gas that is 75% Ar/25% CO2 for installation of the balls. This combination of gas and wire gives a tensile strength of 83,000 psi (572 MPa) which meets the specifications for E80XX wire.

4. Slab preheat for air arc: 250° F (121° C) for 6" (152 mm) from weld in all directions.
5. Ball Freezing – 30-40 minutes in liquid nitrogen.
6. Frame/tube heating to 300° F (149° C) for ball installation.
7. Gauge the hole to ensure clearance prior to ball installation.
8. Slab preheat for welding: 300° F (149° C) for 6" (152 mm) from weld in all directions.
9. Interpass temperature maximum 450° F (232° C).
10. Stringer beads with each pass all around.
11. Post heat and slow cool.
12. Wait 48 hours and MT or PT weld area (magnetic particle or dye penetrant).
13. Re-Commissioning after Campaign all Replacement.

Preparation/Ball Removal

1. Prepare suitable protection to protect the personnel and loader from cold, wind, dust, etc.
2. If changing the hoist cylinder ball - remove the catwalk for the lift arm ball to allow access for the cable from the overhead crane. Install appropriate scaffolding equipment or stands and safety precautions for work at height.

WARNING

Fall hazard or crush hazard exist when working on scaffolding. The scaffolding or work stand must have the capacity to hold 3-4 people and the ball. The scaffold could collapse if it is not built sufficiently to hold the weight. It must also meet all local safety requirements. Failure to provide an appropriate scaffold can cause fall or crush hazards resulting in serious injury or death.

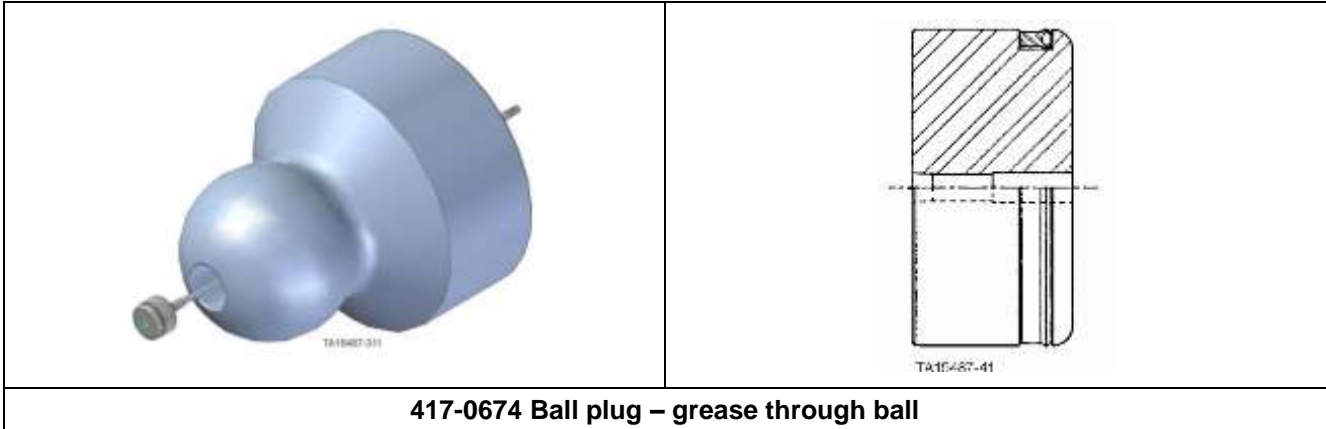


Provide protection

3. Remove the grease plug in the center hole. If you are unable to remove this plug then it is recommended to have a new plug available as the plug is typically damaged during ball removal.
4. The Type B hoist cylinder ball on the L-2350 and all of the Type B lift arm balls have a plug with a hole in the middle and the grease comes in through the plug. The plug should have threaded hole in the outside to allow it to be pulled out.

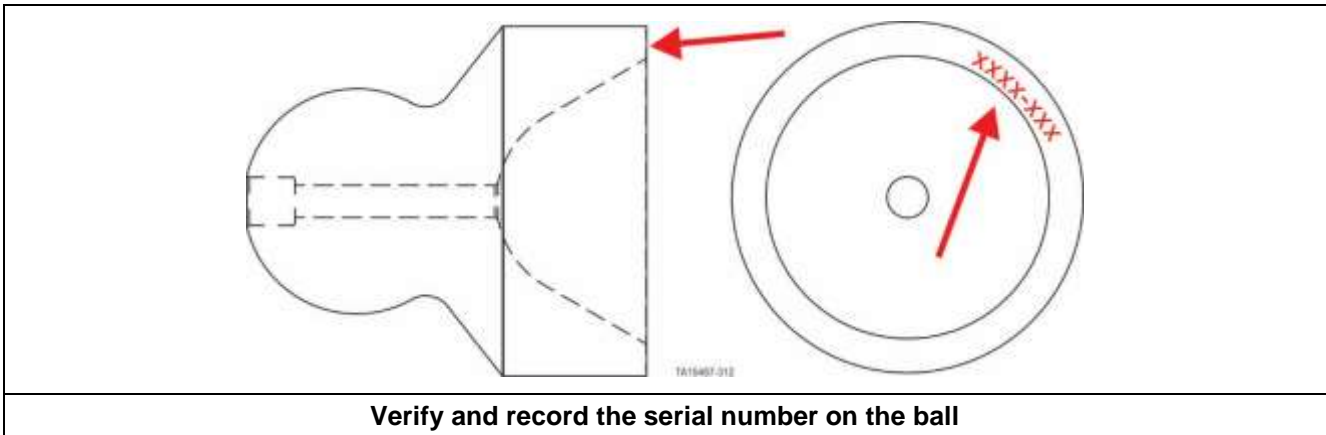
NOTICE

The 4" (101.6 mm) (used in 14" ball) and 3" (76 mm) (used in 12" ball) plugs are slightly different designs.



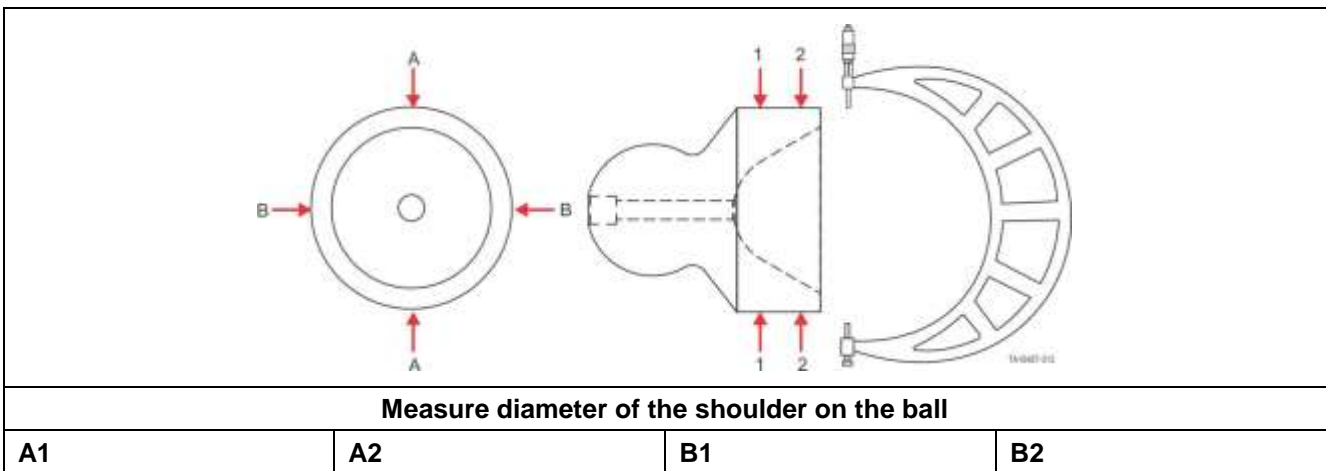
417-0674 Ball plug – grease through ball

5. Verify and record the serial number on the ball.



Verify and record the serial number on the ball

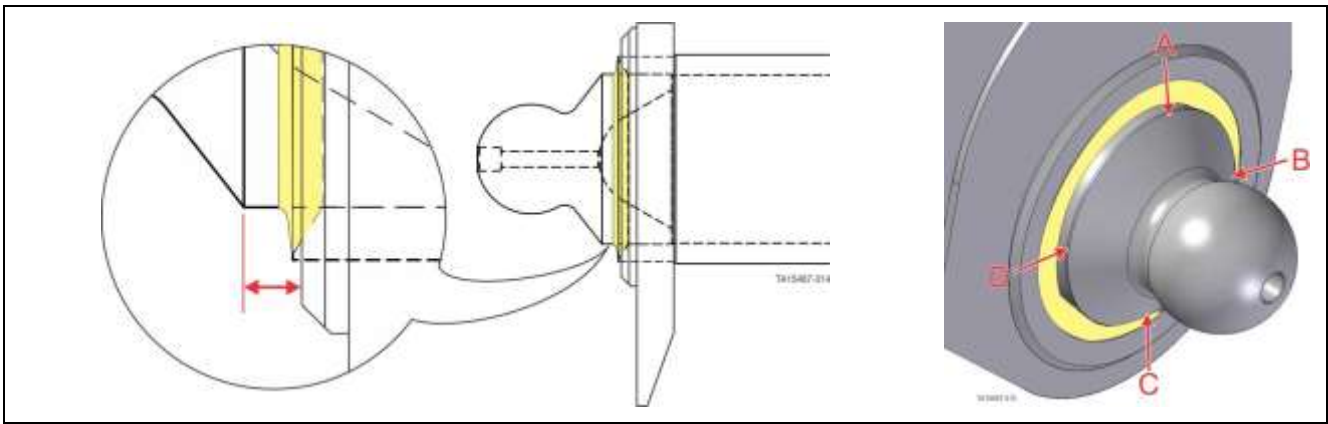
6. Verify the diameter of the shoulder on the ball.



Measure diameter of the shoulder on the ball

A1	A2	B1	B2
----	----	----	----

7. Before removing the damaged ball, locating dimensions must be established so that the new ball can be located properly and quickly when initially installed. The locating dimensions are taken from the shoulder of the ball base, across the weld joint, to the face of the side plate ring. Make three or four measurements around the ball.

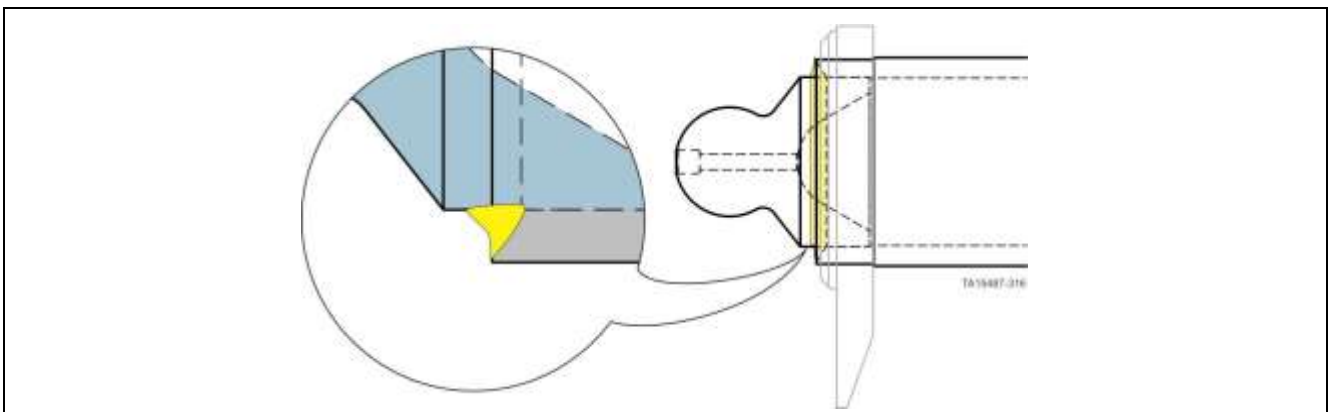


Reference measurements

A	B	C	D
---	---	---	---



Write the locating dimensions on the frame



Weld Profile

⚠ WARNING

Fire hazard exists when cutting off the ball. The area behind the ball may be filled with grease or other flammable contaminant. Always have a fire extinguisher nearby to put out any fires that result from cutting process. Failure to provide an appropriate fire extinguisher can cause a fire hazard resulting in serious injury or death.



Grease in tube

WARNING

Crush hazard exists when moving the ball. Install lifting eyes with at least 2000 pound (1000 kg) capacity to support the various pieces of the ball as they are removed. The balls are very heavy and if they were to fall they could cause injury or death. This is particularly true of the lift arm balls due to the height. Failure to provide equipment of sufficient strength to hold the weight of the ball can cause crush hazards resulting in serious injury or death.

416-8404	1207 lb. (547 kg)	14" ball
428-2561 supercedes	1219 lb. (553 kg)	14" ball
423-3317	1244 lb. (564 kg)	14" ball

8. Lifting eyes of at least 2000 lb. (1000 kg) lifting capacity should be installed on the various pieces prior to removal so the heavy pieces cannot fall and cause injury.
9. Grind a flat area on the ball in the area where the lifting eye is to be attached.

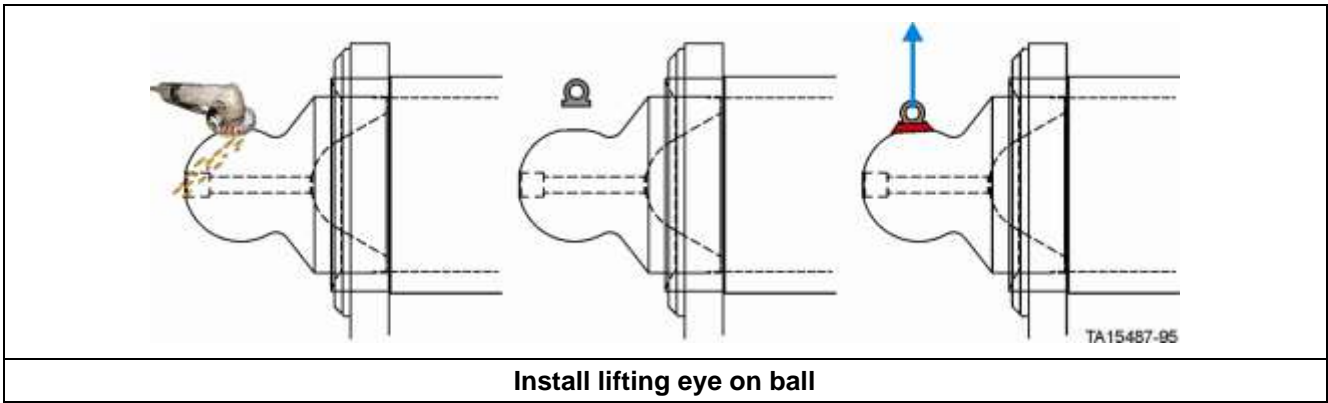
WARNING

Crush hazard exists when using the lifting eye. It is critical to grind through the carburized layer on the surface to ensure proper weld quality on the lifting eye. Failure to grind through the carburized layer can result in a weld that will fail when weight is applied. This could cause the ball to fall resulting in a crush hazard. Failure to grind through the carburized layer can cause crush hazards resulting in serious injury or death.

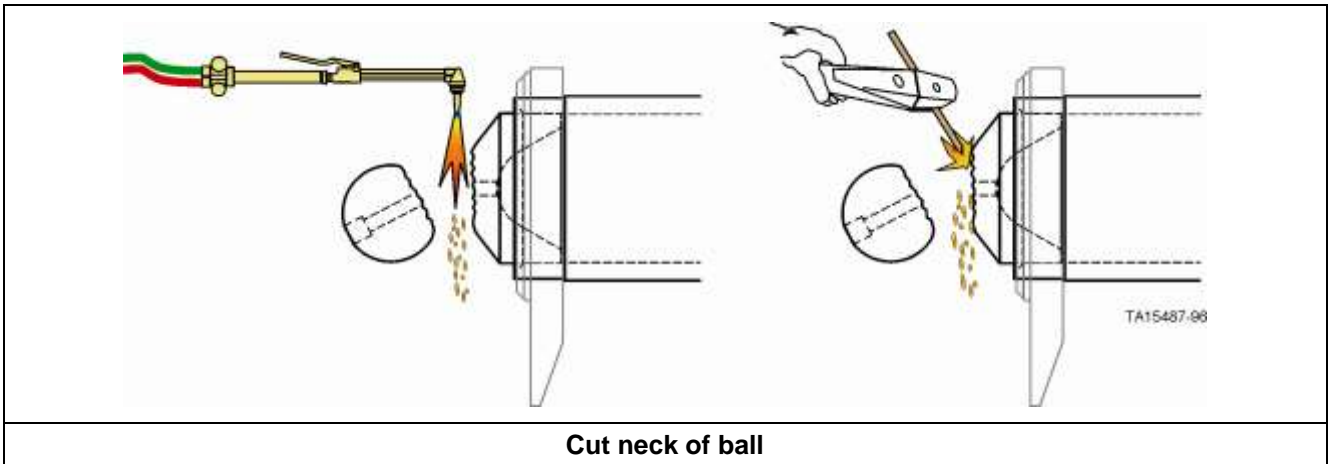
10. Grind at least .150" (4 mm) deep to get below the carburized surface of the ball.
11. Preheat to 300° F (149° C) and weld the lifting eye in place.

WARNING

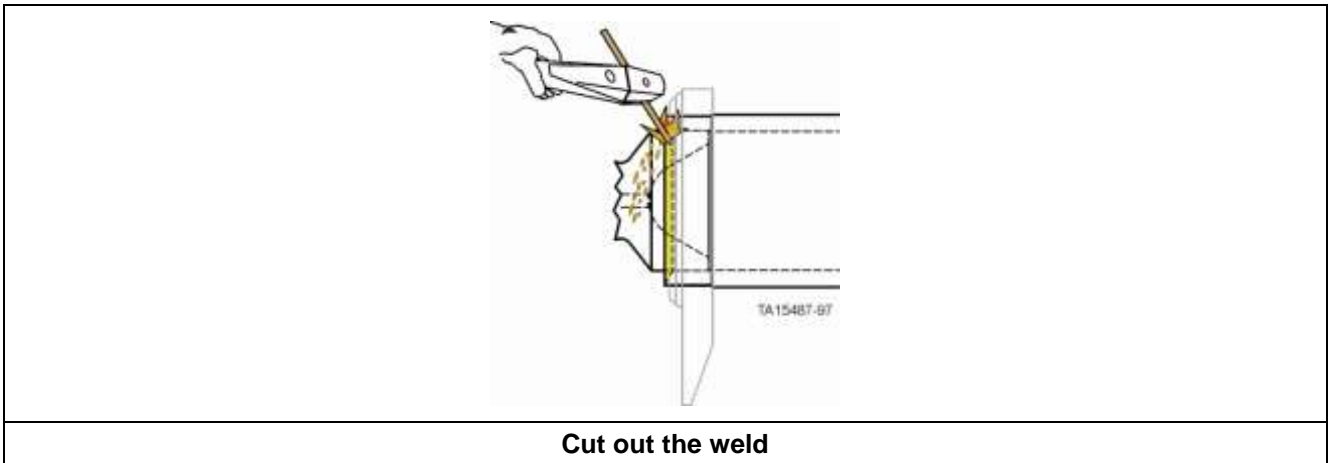
Crush hazard exists when using the lifting eye. Preheat is required when welding on a lifting eye in order to assure a quality weld suitable for lifting. Failure to preheat could lead to poor fusion and danger when lifting the ball. This could cause the ball to fall resulting in a crush hazard. Failure to properly preheat can cause crush hazards resulting in serious injury or death.



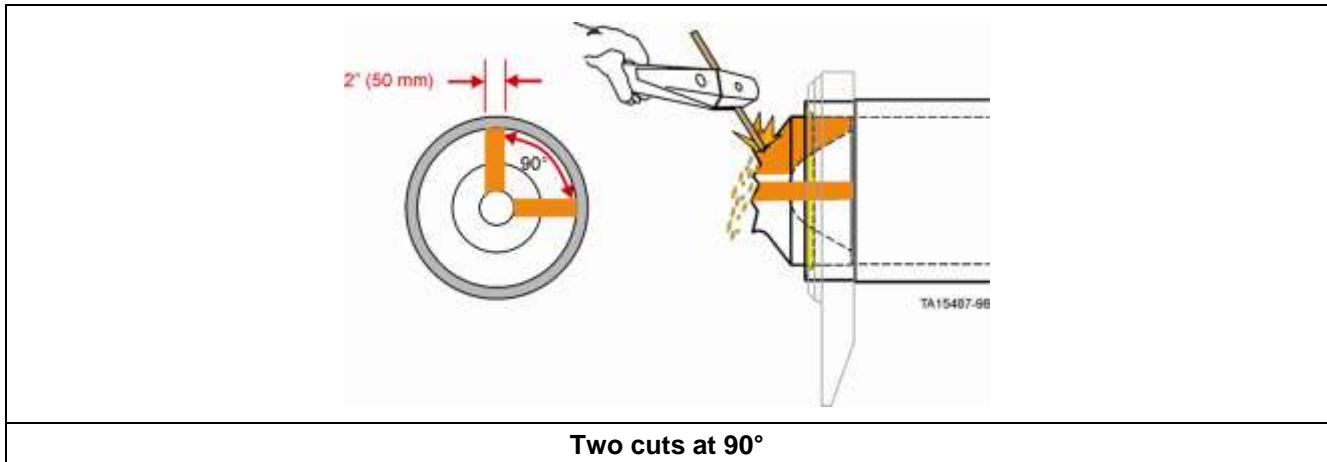
12. Use air-arc or oxy-fuel cutting process to cut the ball off at the neck.



13. Use air-arc to cut out the weld.



14. Make two air-arc cuts through the ball at 90° from each other as shown. Be careful not to cut into the tube. These cuts should be about 2" (50.8 mm) wide.



NOTICE

It is possible to remove a ball base in two pieces with a single cut across the ball base. However, this process is not shown in this document as the pieces are hard to remove and are very heavy.

WARNING

Crush hazard exists when moving the ball. Install lifting eyes with at least 2000 pound (1000 kg) capacity to support the various pieces of the ball as they are removed. The balls are very heavy and if they were to fall they could cause injury or death. This is particularly true of the lift arm balls due to the height. Failure to provide equipment of sufficient strength to hold the weight of the ball can cause crush hazards resulting in serious injury or death.

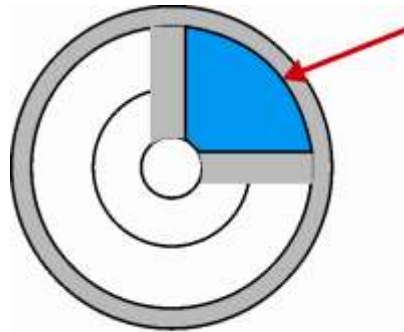
WARNING

Crush hazard exists when using the lifting eye. It is critical to grind through the carburized layer on the surface to ensure proper weld quality on the lifting eye. Failure to grind through the carburized layer can result in a weld that will fail when weight is applied. This could cause the ball to fall resulting in a crush hazard. Failure to grind through the carburized layer can cause crush hazards resulting in serious injury or death.

WARNING

Crush hazard exists when using the lifting eye. Preheat is required when welding on a lifting eye in order to assure a quality weld suitable for lifting. Failure to preheat could lead to poor fusion and danger when lifting the ball. This could cause the ball to fall resulting in a crush hazard. Failure to properly preheat can cause crush hazards resulting in serious injury or death.

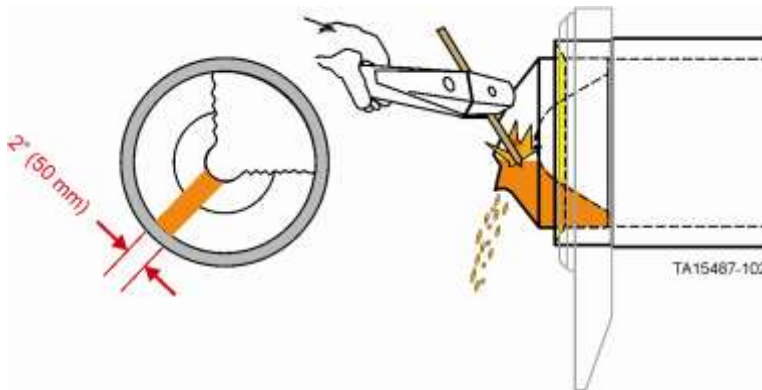
15. Remove the pie shaped section of the ball base.



TA15487-101

Remove pie piece

16. Make a 2" (50.8 mm) cut across remaining ball. Do not damage the tube.



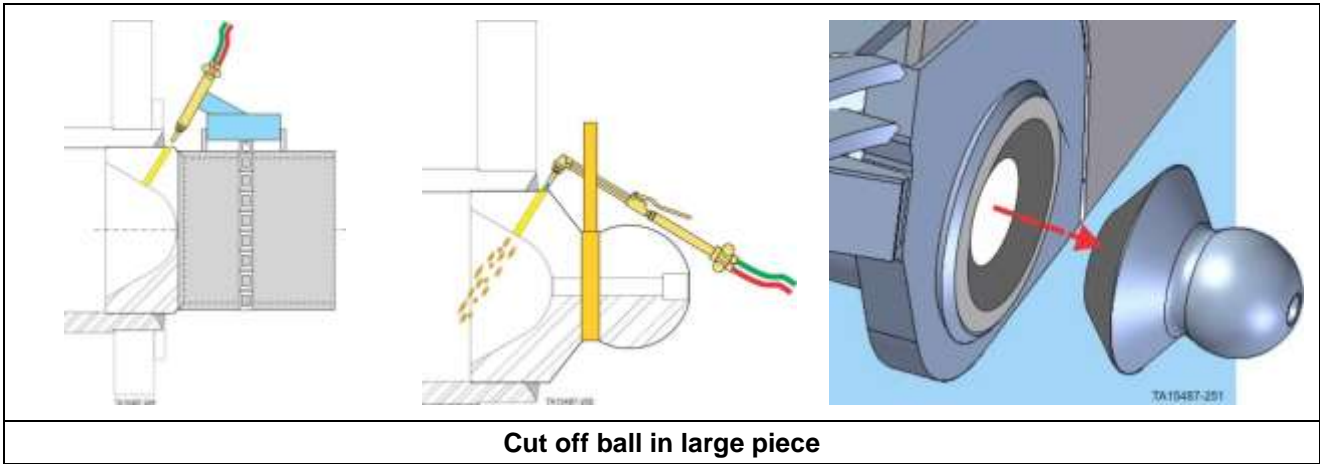
Cut 2" (50.8 mm) wide slot

17. Remove the remaining sections of the ball.

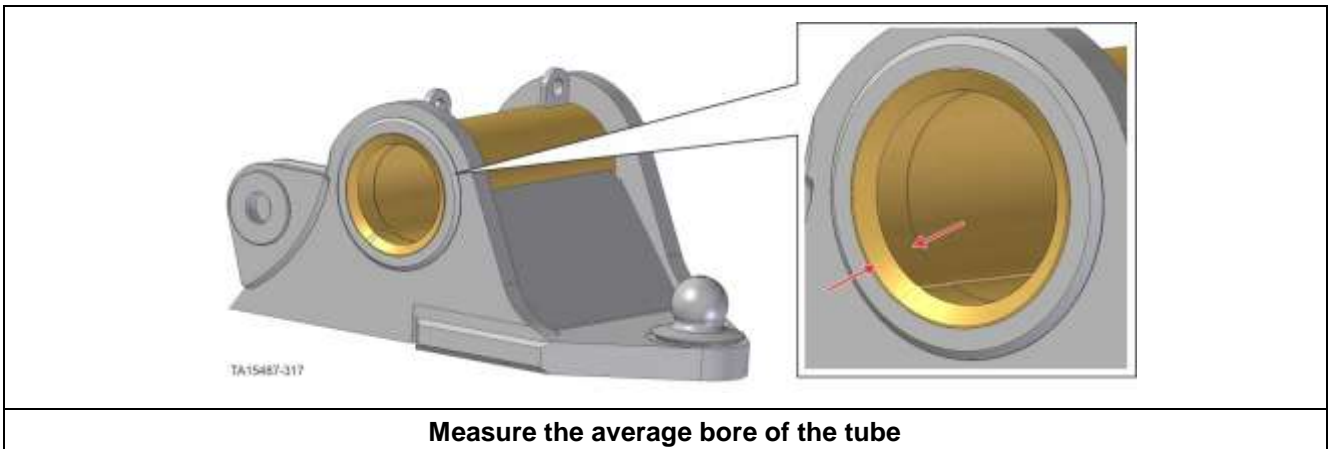


Remove all pieces of the ball

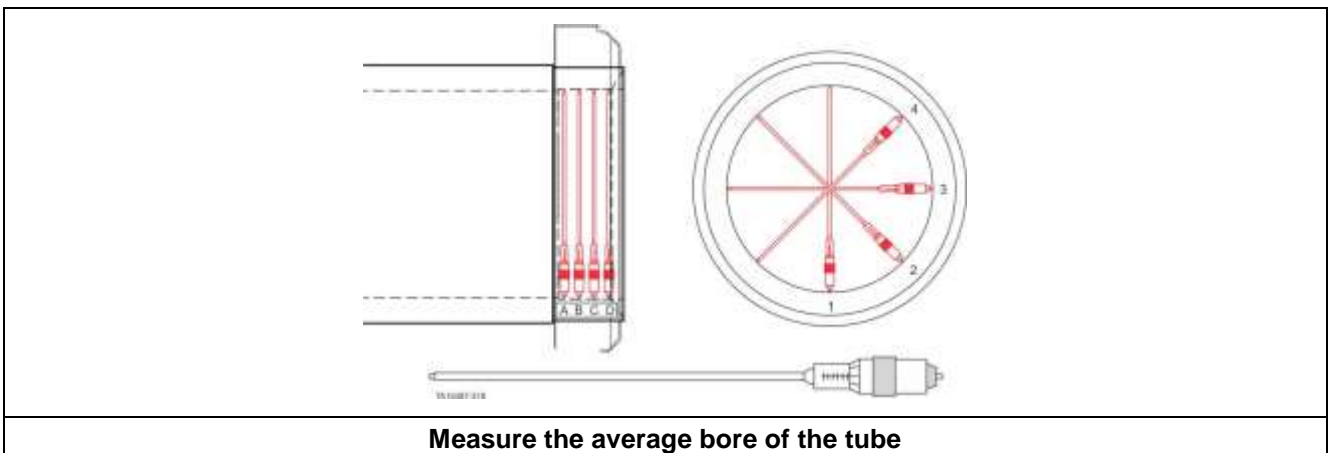
18. The preceding procedure destroys the ball and makes failure analysis impossible. There is another process that allows the ball to be removed in a large piece if crack failure analysis is desired. Contact the factory and details will be provided.



Tube Welding Preparation



1. The condition and dimensions of the tube is critical to have a successful ball installation.
2. Allow the tube to cool to less than 100° F (38° C).
3. Measure the bore of the tube with an inside micrometer. Measure in multiple directions and at various depths as shown.



4. Record all bore measurements and then determine the average bore measurement. (Add all of the measurements and divide by the number of measurements taken).
5. A sample chart follows – a full size worksheet is contained in the Appendix.

A1		B1		C1		D1	
A2		B2		C2		D2	
A3		B3		C3		D3	
A4		B4		C4		D4	
Total:							
Minimum:							
Maximum:							
Average:							
Ball shoulder diameter: (Should be about .020" [.508 mm] larger than the bore).							

NOTICE

It is normal and typical that the bore of a tube in a machine will be oval and tapered. This is due to the varying thickness of the thick plate around the tube.

6. The average tube bore dimension should be between .015" and .025" (0.38 mm and 0.64 mm) less than the diameter of the shoulder on the new ball. The tube bore will typically be about 21.730" ± .005" (551.942 mm ± 0.0127 mm).

Nominal Ball Shoulder Diameter	Average Tube Bore Diameter in Machine
21.750" ± .002" (552.45 mm ± 0.0508 mm)	21.730" ± .005" (551.942 mm ± 0.0127 mm)

7. If the average bore dimension is not the specified size – then the tube bore will have to be re-machined to get the proper fit.

NOTICE

The process for re-machining a bore is as follows:

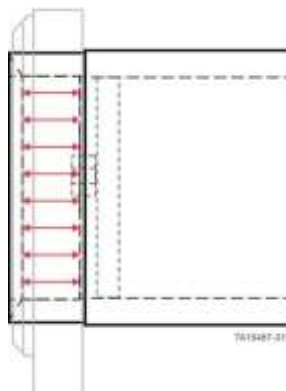
- The final bore should be machined in solid weld to get a good bore.
- Get a depth reference point to establish the shoulder position inside the tube.
- Machine 1/16" (1.6mm) material from all sides of the bore. This is 1/8" (3.2 mm) increase in bore diameter.
- Preheat tube to 300° F (149° C).
- Weld up the bore area with **E71T-12MJH4 FCAW wire**.
- Machine the bore to 21.730" ± .005" (551.942 mm ± 0.0127 mm).
- Machine the depth to specification.

Special Instructions for 4130 Tube Material

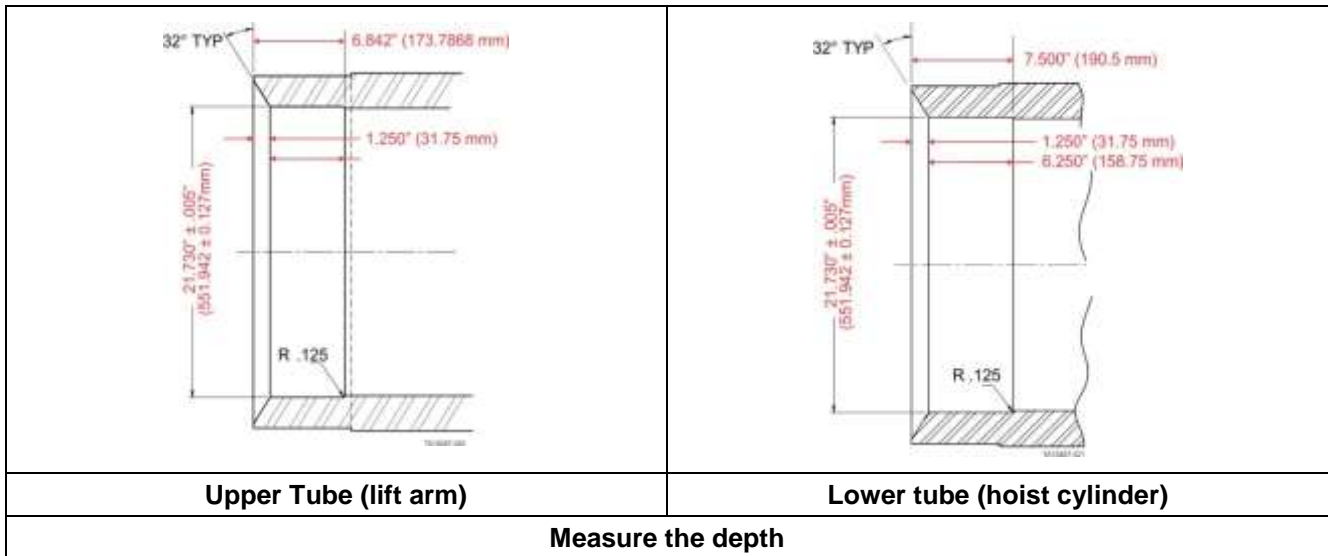
If you have indications that the material may be 4130 – the following must be done:

- Raise the preheat temperature for repairs to 450° F (232°).
- Follow the cool down rate of 50° F (28°) per hour after welding.

8. The end of the tube is cleaned up and the ID is beveled to about 32° angle. Leave a 5/16" (7.9375 mm) shoulder.



Measure the tube depth

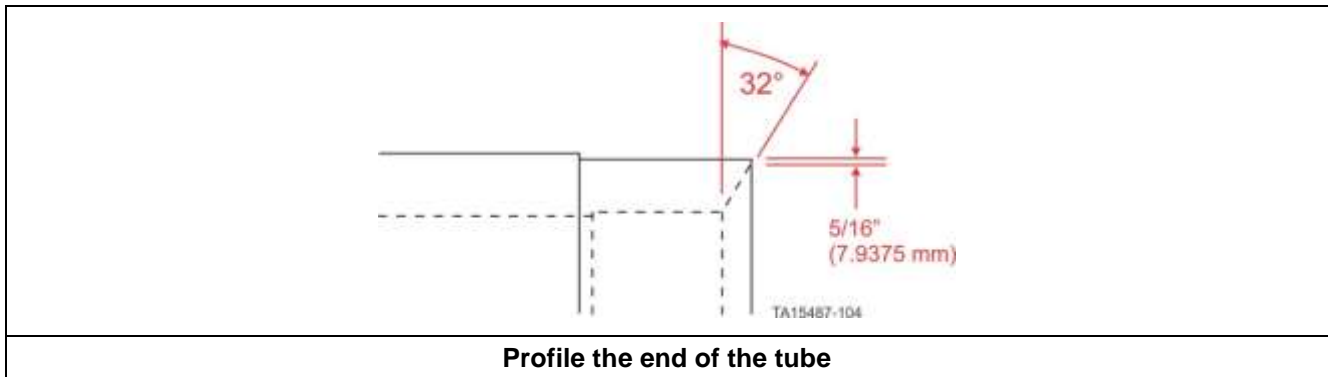


P/N	Ball type	Machine	Location	Depth
428-2561	14	L-2350	Hoist cylinder	7.500" (190.5mm) to end of tube
Supercedes			(lower ball)	6.250" (158.75mm) shoulder length
423-3317		L-1850, L-2350	Lift Arm	6.842" (173.79mm) to end of tube
			(upper ball)	5.592" (142.04mm) shoulder length

CAUTION

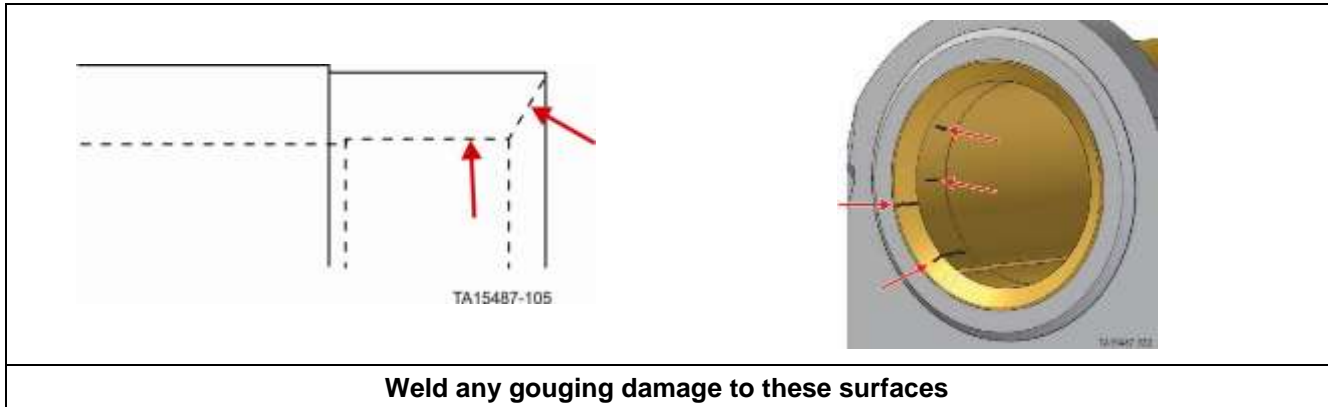
The shoulder length in the tube is a critical dimension. The shoulder length must be correct in order to get the correct clamping force on the new ball. If this length was damaged during removal of the ball – the shoulder must be repaired and rebored.

9. Grind to bare metal.



Profile the end of the tube

10. Repair any gouging damage.



- a. Grind out any gouge marks to bare metal.
- b. Preheat the weld area to 300° F (149° C).
- c. Weld with E7018 electrodes or E7XT- xxxx series wire.
- d. Inspect for cracks.



NOTICE

If you find cracks appearing in the upper lift arm ball tube near the air arc cutting or the repairs, it is likely that the tube material is a substitute material made from 4130. There were a few L1850 and L-2350 machines that had the upper lift arm ball tube made from 4130. The standard material is 8620 and the substitute was 4130. The substitute material had higher carbon content and cracking will sometimes appear during the gouging or repair process. This cracking can be controlled by preheating the tube to a higher temperature for the repair process and for the ball welding process.

Special Instructions for 4130 Tube Material

If you have indications that the material may be 4130 – the following must be done:

- Raise the preheat temperature for repairs to 450° F (232°C).
- Maintain the preheat temperature of 450° F (232°C) during ball installation.
- Post Heat at 500° F (260°C) for 30 minutes.
- Follow the cool down rate of 50° F (28°C) per hour.

11. Grind the repairs smooth.

CAUTION

Use caution when grinding on the ID of the tube to remove only the cap of the repair weld and nothing else. Do not change the ID of the tube. The dimension is critical to proper ball installation.

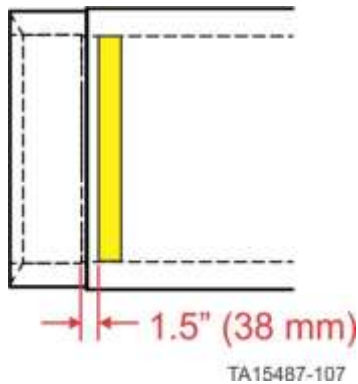
Install Nut on Cross Support

1. Inside most tubes will be a cross support welded across the ID of the tube.



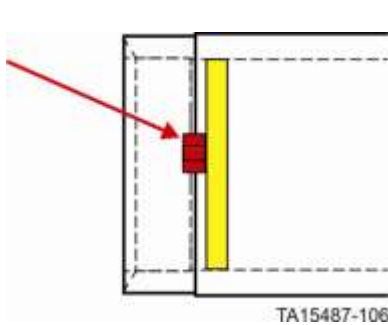
Cross support in tube

2. If the cross support is not present, fabricate one from 1.5" – 2" (38 – 50.8 mm) square bar and weld in place approximately 1.5" (38 mm) into the tube from the machined step.



Install cross support

- a. Preheat the weld area to 300° F (149° C) and weld around both ends of the cross support.
3. Weld a 1" NC nut in the middle of the cross support.



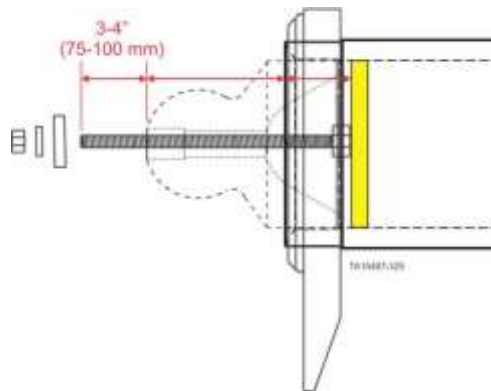
Install nut in middle of cross support

4. Make a 1" all thread bar. The length of the bar should be long enough to stick through the ball about 3-4" (76 mm - 101.6 mm) when fully installed.
5. This will require adding several measurements to determine the proper length.
 - a. Depth in tube to cross support.
 - b. Height of ball from shoulder to top of ball.
 - c. 3-4" (76 mm - 101.6 mm) additional length.

NOTICE

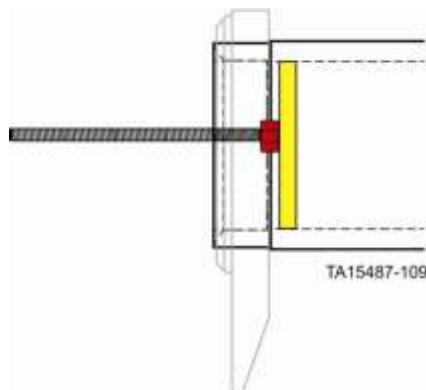
The length of this rod will vary from machine to machine because the cross supports are only used for fabrication of the tube and are not a precision item. The position of the cross supports will vary from machine to machine.

6. The following picture shows how to calculate the length of the all thread.



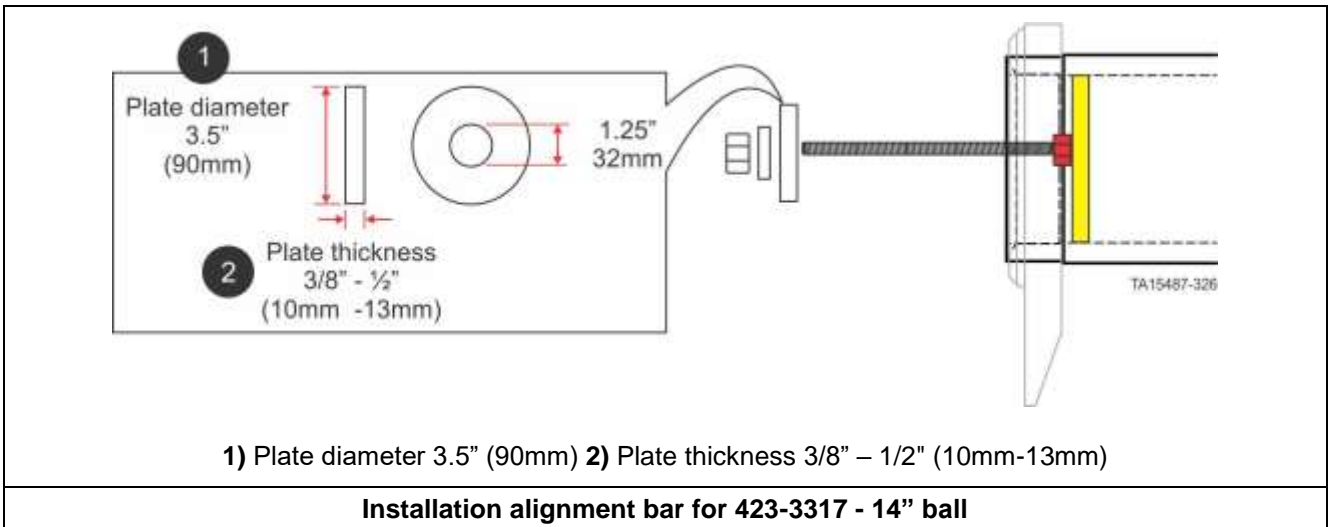
Cut a piece of 1" all thread

7. Place the all thread in position for installation of the ball.



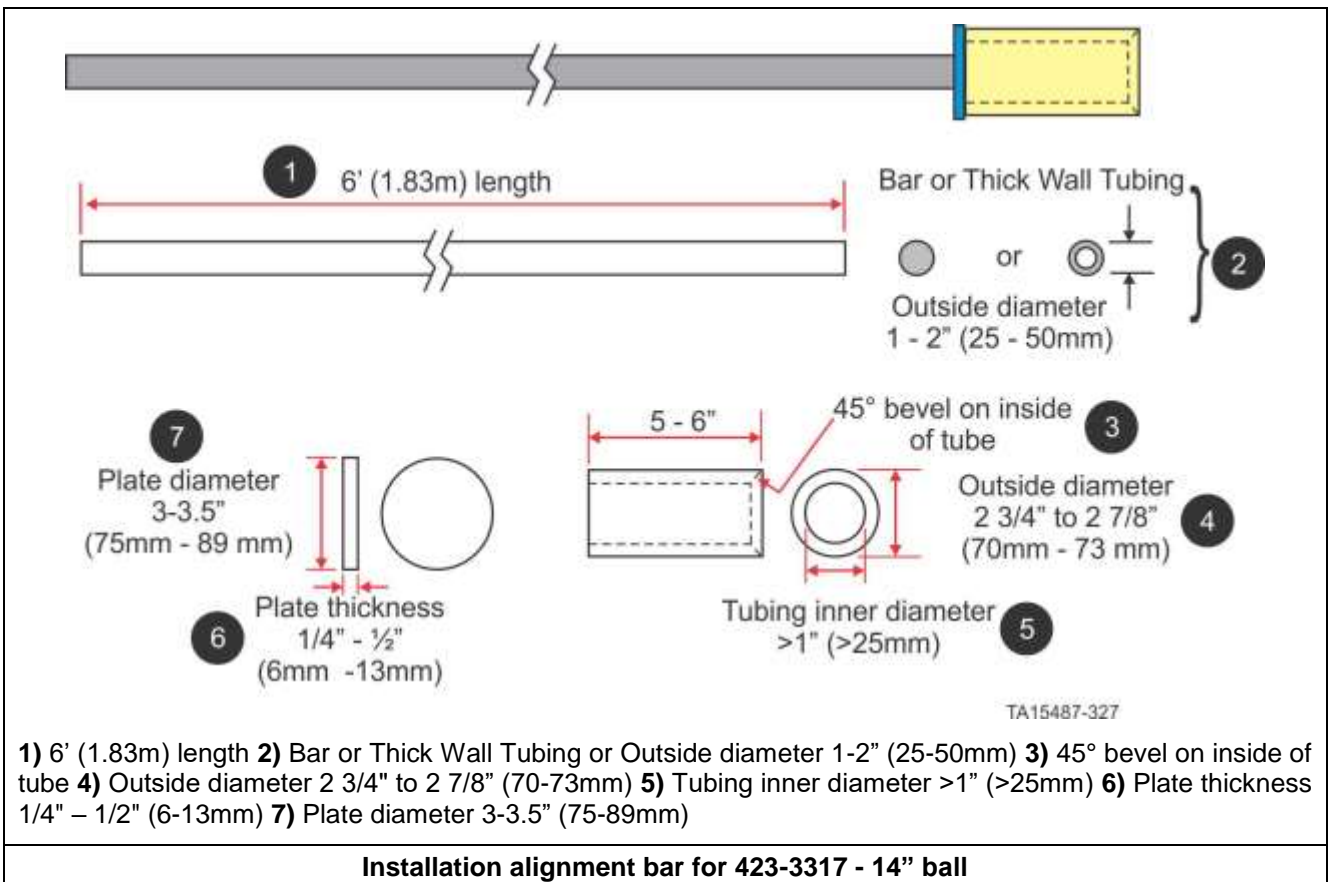
Install all thread rod

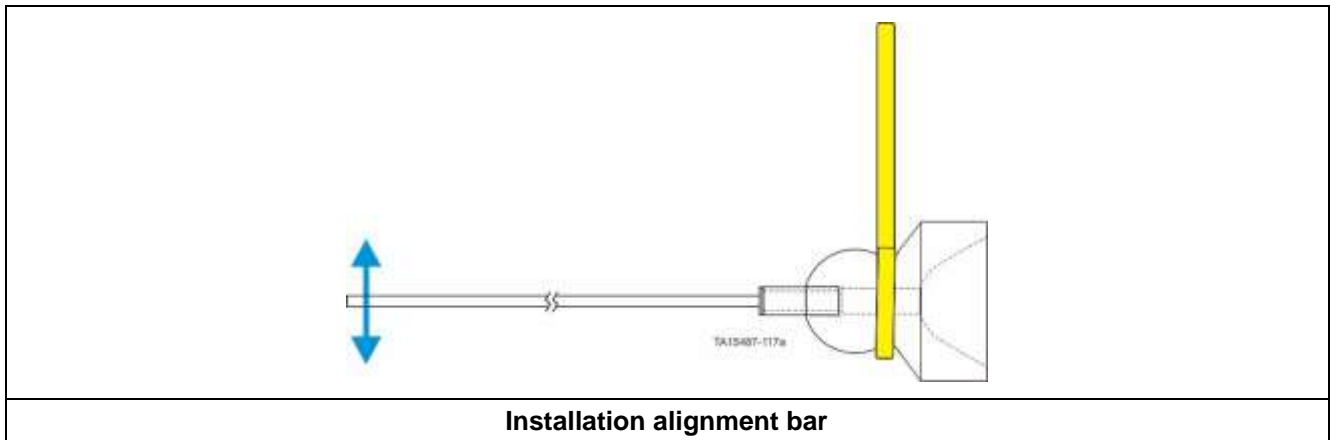
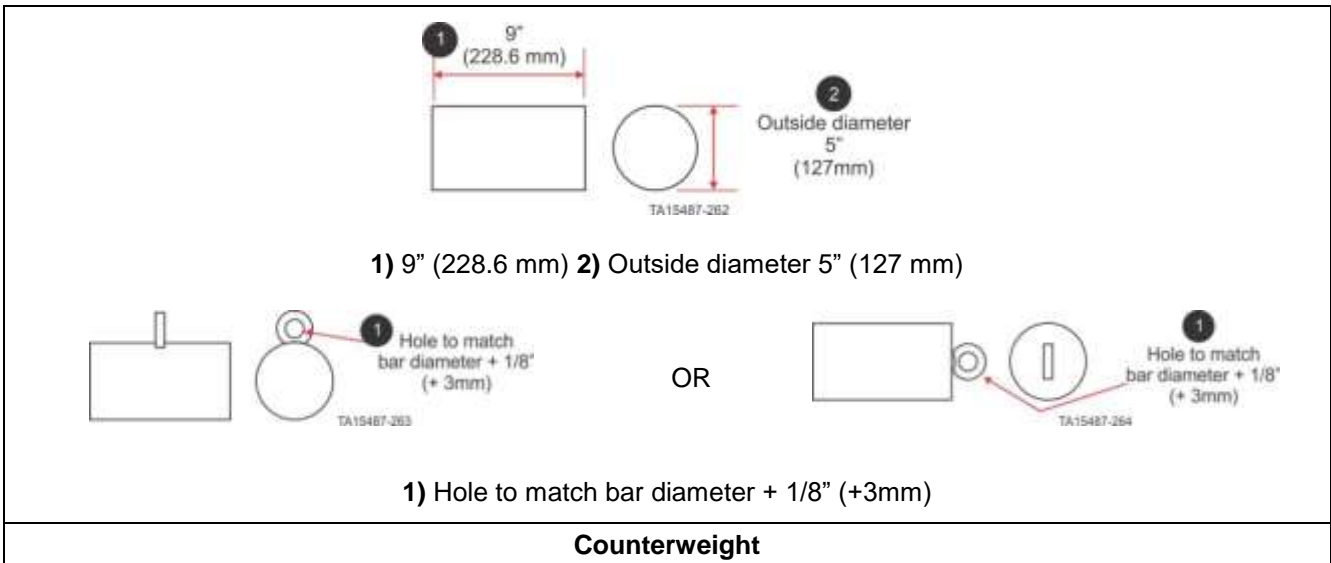
8. Fabricate a large washer to retain the ball with the all thread.



Installation Alignment Tool Fabrication

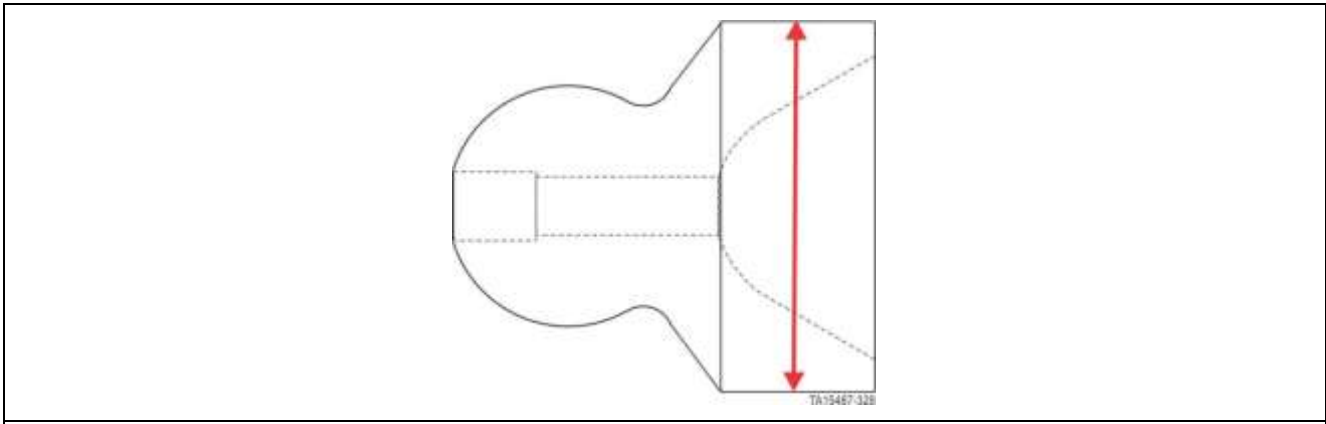
1. There have been two types and P/N of type B 14" balls.
 - a. 416-8404 14" ball with 4" (101.6 mm) bore (This ball has been replaced by 423-3317 – all new balls will be 423-3317)
 - b. 423-3317 14" ball with 3" (76 mm) bore.
2. Fabricate the required ball installation alignment tool for the 14" Type B ball.



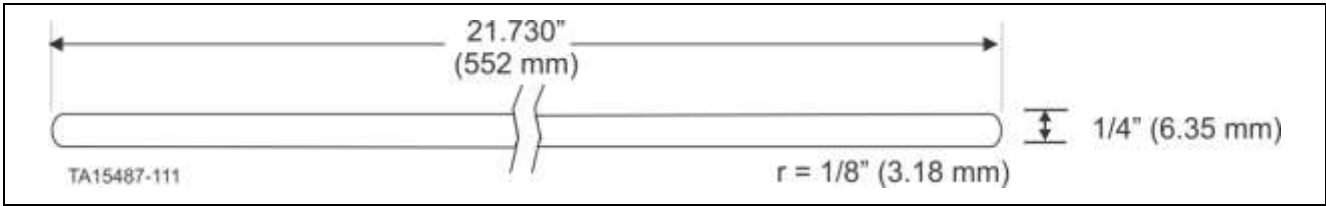


3. Make a steel gauge rod tool, as shown in following table. The diameter of the rod is not critical but the tool must be made to the precise length measurement. Make the rod per the length shown in following table. This is critical to ensure that the frozen ball will enter freely into the heated bore of the tube.

Machine	Location	Ball Diameter	P/N	Ball Type	Base diameter	Gauge Rod Length
L-1400/1800	Lift arm	14	416-8404	B	21.750 ± .002"	21.730 ± .002"
L-1850 Gen1/ Gen2	Lift arm	14	416-8404	B		
L-2350 Gen1/ Gen2	Hoist	14	423-3317	B		
	Lift arm	14	423-3317	B		
L-2350 Gen1/ Gen2	Hoist	14	428-2561	B		
	Lift arm	14	428-2561	B		



Ball base diameter - Type B



Gauge rod – the length is critical

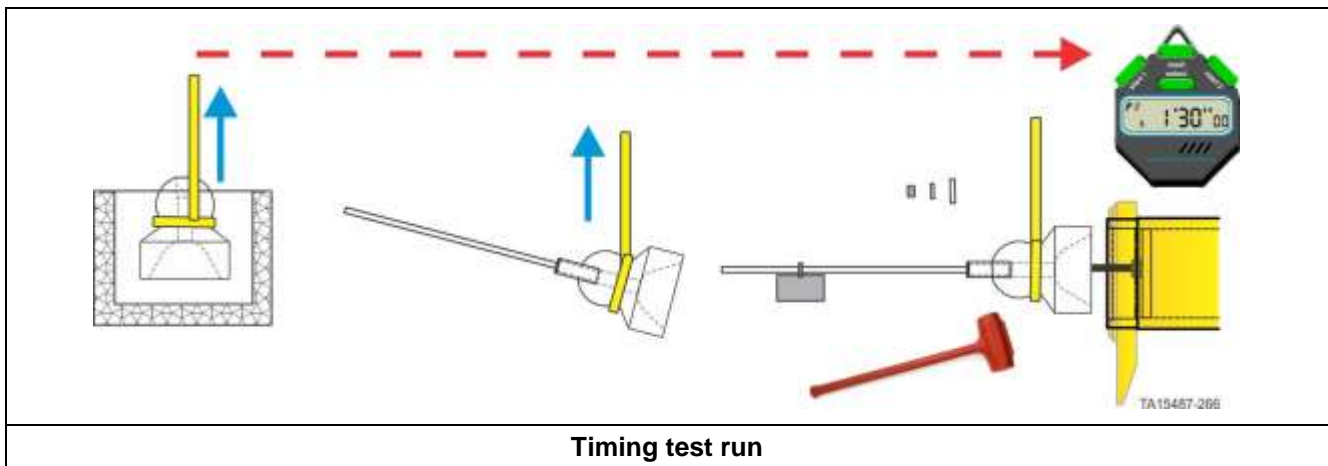
Ball Installation Rehearsal Test

There is a limited amount of time to install a frozen ball into the heated tube on the loader. A lot of handling is involved to get the ball out of the freezing container and to the frame. It is important to rehearse the process of getting the ball out of the freezer container and into position to be installed. If this process takes too long then the ball might not fit – or worse it might only go partially into the bore of the tube.

1. Position the cooling container near the loader in the location where the ball will be cooled.
2. Place the ball in the box.
3. Start timing.
 - 1) Lift ball from box.
 - 2) Put ball on positioning tool.
 - 3) Lift ball into position for installation near tube where it would be ready to install.
 - 4) All tooling, measurement devices, hammers, washers, nut, etc. must be in position and ready to go.
4. Stop timing.
5. The above actions must be completed in less than the time listed in the following table:

Ball Location	Time
Lift arm ball	< 130 sec (2 min 10 seconds)
Hoist cylinder ball	< 100 sec (1 min 40 seconds)

6. Repeat the steps until the ball can be positioned in less time that what is listed in the table.



Ball Freezing Procedure

CAUTION

Dry ice (frozen carbon dioxide - CO₂) is **NOT** cold enough to use for ball installation - liquid nitrogen must be used. The result of using dry ice will likely be a ball that sticks in the tube before properly installed. It would need to be cut out and a new ball installed.

NOTICE

Each ball will typically require 2-3 VGL (total nitrogen capacity typically 350 liter and over) of liquid nitrogen to properly cool a single ball. This requirement may vary widely depending on local conditions, container size, altitude, etc.

1. The ball will be cooled with liquid nitrogen.



Typical VGL with insulated container

2. Locate a container with inside dimensions that are large enough to contain the ball being frozen with a minimum of 3" (76mm) free space in all directions. A container with minimum inside dimensions of 26" wide X 26" long X 26" tall (660 mm X 660 mm X 660 mm) can be used for any ball size.

P/N	Sphere Size	Diameter	Height
410-2456	7.5"	14" (356 mm)	11.7" (297 mm)
412-4128	9	20.1" (511 mm)	16.9" (429 mm)
416-8156	9	16" (407 mm)	12.5" (318 mm)
416-8403	12	20.1" (511 mm)	20" (508 mm)
423-3317	14	21.75" (553 mm)	24.8" (630 mm)
424-7949	12	20" (508 mm)	14.94" (380 mm)
428-2561	14	21.75" (552 mm)	24.8" (630 mm)

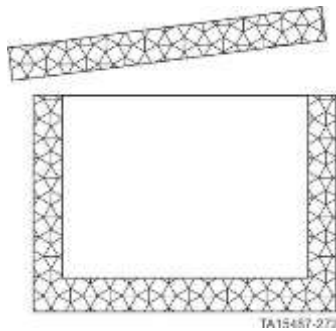


Typical insulated container

- The container must be insulated with good insulation material (fiberglass house insulation will not work) such as K-wool (kaowool) ceramic insulating material.

CAUTION

The interior of the container must be solid metal and sealed by welding so that the liquid nitrogen cannot run out. Silicone sealant is not suitable as it will disintegrate when exposed to liquid nitrogen.

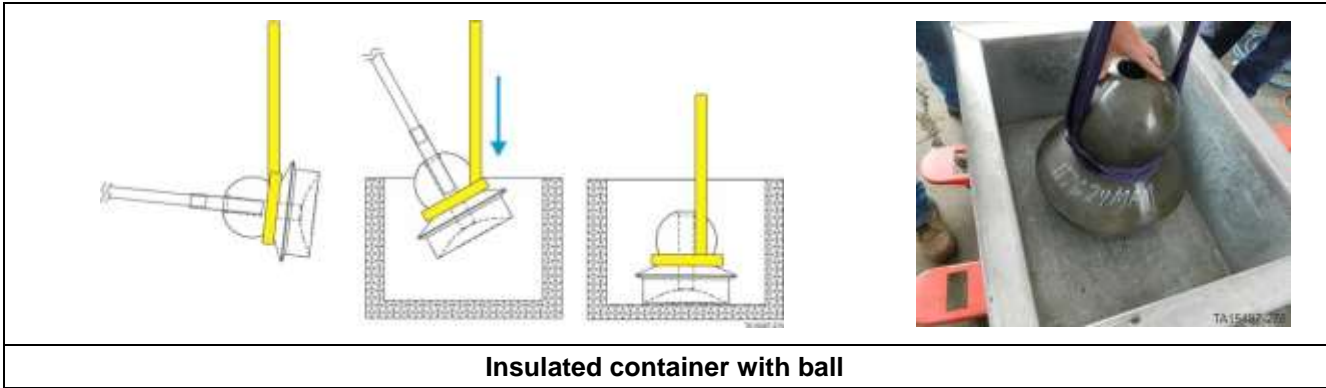


Insulated container

- Pick up the ball with a 2" (50.8 mm) or equivalent nylon lifting strap. Ball weights are listed below.

P/N	Size	Weight	
410-2456	7.5"	170 lb.	77 kg
412-4128	9	431 lb.	196 kg
416-8156	9	231 lb.	105 kg
416-8403	12	630 lb.	286 kg
423-3317	14	1220 lb.	553 kg
424-7949	12	431 lb.	195 kg
428-2561	14	1219 lb.	553kg

5. Place the ball into the container.

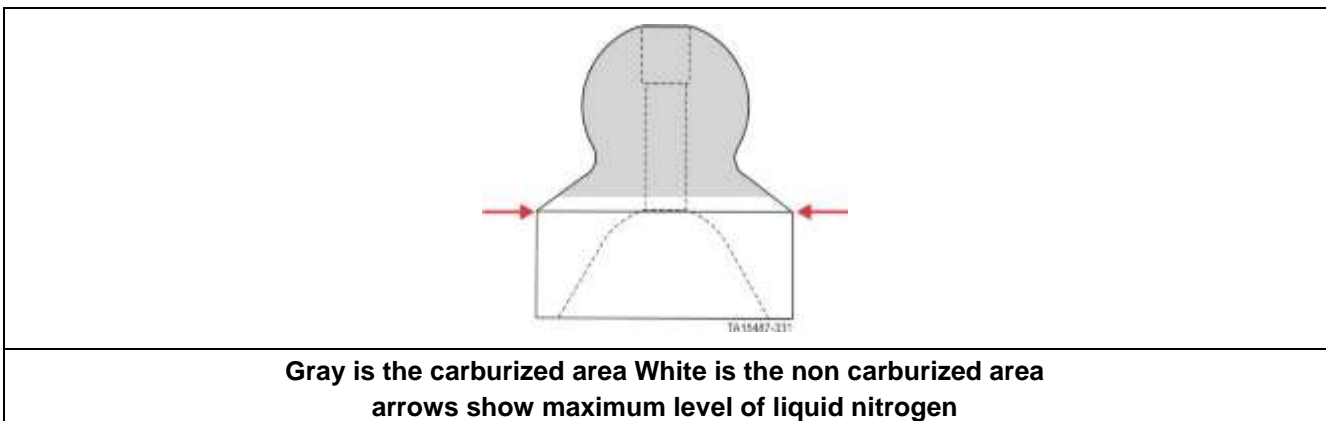


⚠ WARNING

Chemical exposure and inhalation hazards exist when working with liquid nitrogen. Always wear appropriate Personal Protective Equipment (PPE) such as heavy loose fitting leather or cryogenic gloves, eye and face protection when handling liquid nitrogen. It should be used in a well-ventilated area. Follow all relevant local statutory requirements when handling liquid nitrogen. Failure to use proper PPE and follow all local statutory requirements for handling liquid nitrogen can cause chemical exposure and inhalation hazards resulting in serious injury or death.

CAUTION

The carburized portion of the ball must not be immersed in liquid nitrogen or damage to the steel may occur. The gray portion in the following diagram is the carburized area. The white area is non-carburized and may be immersed in liquid nitrogen.

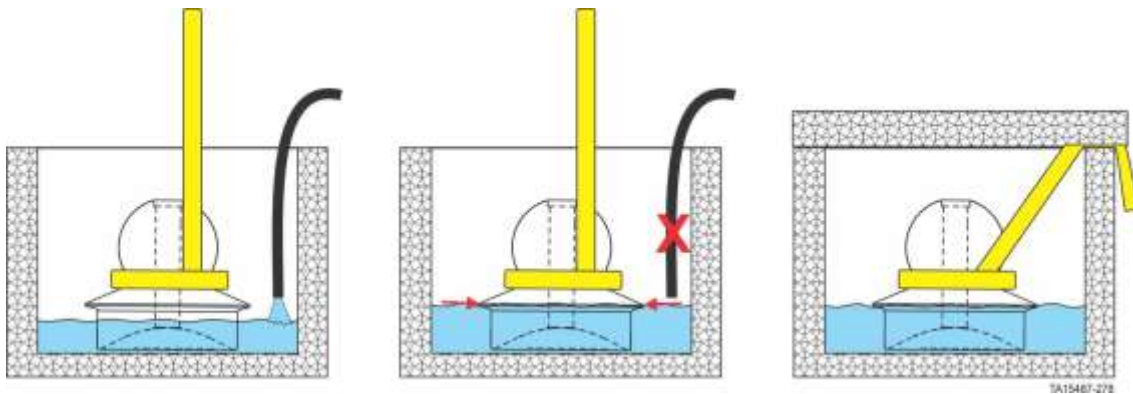


6. On oversized containers it is acceptable to fill in some of the empty space with clean cloth or other filler material so that less nitrogen will be required.



Insert filler material

7. Slowly add liquid nitrogen until the level of the nitrogen is even with the edge of the flange as shown.



Put Nitrogen into the container. stop at the specified level

⚠ CAUTION

It is important to stop at this level.

8. Cover and freeze for the time listed in the table.

9"	35 minutes (after nitrogen level is correct)
12"	40 minutes (after nitrogen level is correct)
14"	45 minutes (after nitrogen level is correct)

NOTICE

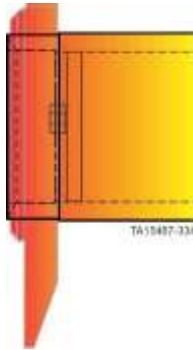
The liquid nitrogen will vaporize rapidly and it is normally necessary to add some periodically during the 30-40 minute time frame. Cover the container while the ball is cooling.



Insert nitrogen and cover to cool

Tube Expansion

1. Heat is required to enlarge the tube bore. The five-inch slab around the tube is to be heated first, to about 300° F (149° C), and then the tube can be heated to 300° F (149° C).

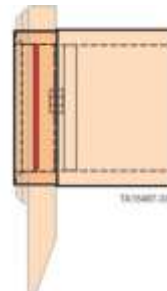


Heat the slab and tube

2. Use the gauge rod to check expansion of the tube. Gauge rod must go in to all parts of the machined shoulder of the tube and at all angles.

⚠ CAUTION

The tube is hot. Use gloves to handle the gauge rod when measuring the bore diameter.

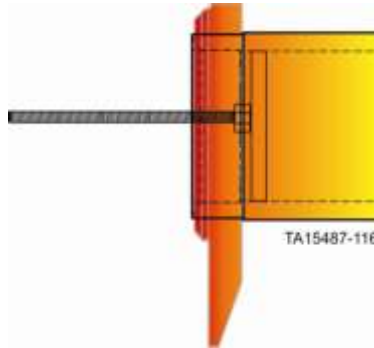


Check to make sure gauge rod freely enters all locations

3. If gauge rod will not go into tube, then increase slab and tube temperature by 25° F (14° C) and recheck with gauge rod.

Ball Installation Procedure

1. Install the all thread stud.



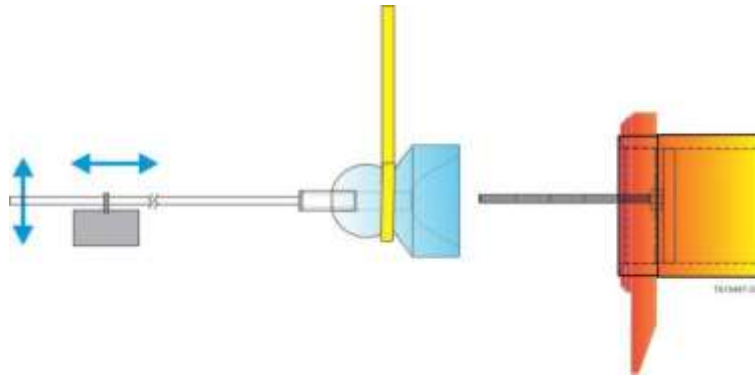
Install the all thread stud

2. Hoist the frozen ball into position and align with the alignment tool.



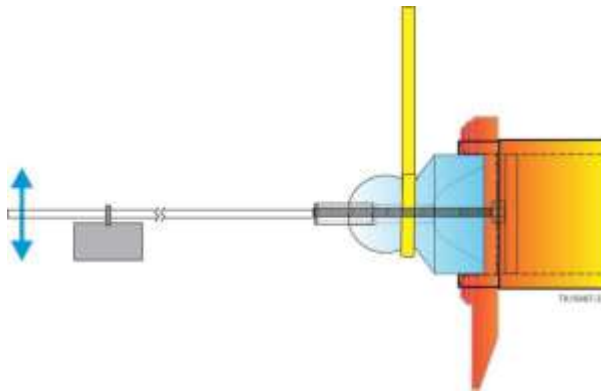
Install the alignment tool and hoist strap

3. Installation of the larger lift arm balls typically requires use of a moveable counterweight on the alignment tool. The counterweight can be adjusted to proper position to hold the ball level.



Counterweight on alignment tool

4. Insert the ball into the tube. Use the alignment tool to level and position the ball while inserting it into the tube.
5. The alignment tool should slip over the all thread as the ball enters the heated tube.

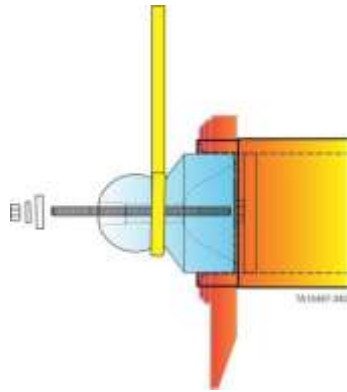


Install the ball

NOTICE

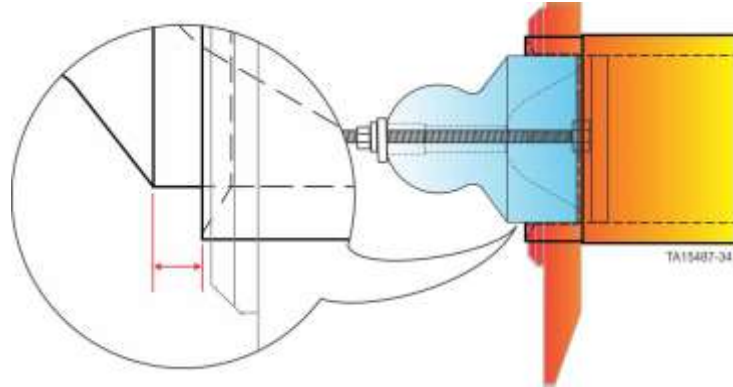
If the ball has been cooled properly and the tube has been heated properly you will typically have three to four minutes to locate and position the ball.

6. As the base of the ball enters the tube, the all thread should become exposed. Insert the ball as far as it will go.
7. Remove the alignment tool.
8. Install large washer and nut on the all thread stud.



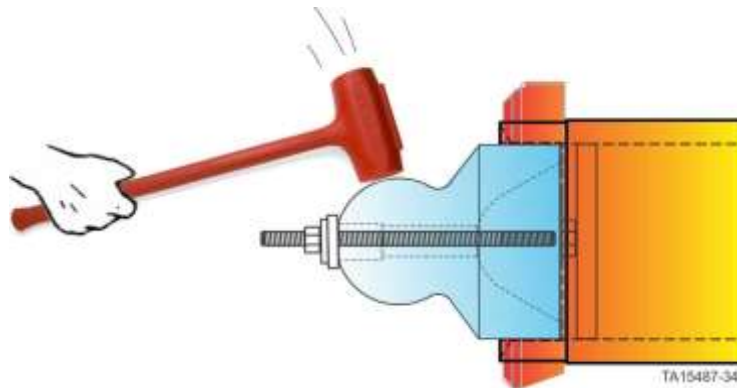
Install the nut and washer

9. Set the ball to the locating dimensions obtained before removing the old ball. In most cases the Type B ball will be bottomed out against the shoulder inside the tube.
 - a. These dimensions should be checked in three or four places around the ball to ensure that the ball is square to the tube and frame.



Hold ball in place with nut – check locating dimensions

- b. Reposition as necessary with a dead blow hammer.

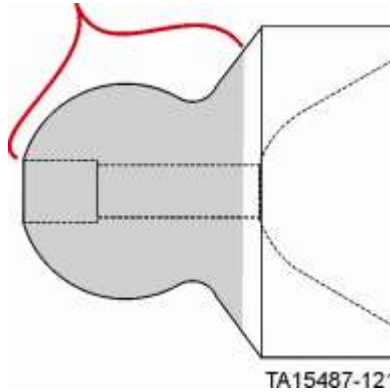


Use a dead blow hammer to adjust the ball in the bore

10. Hold this dimension until the ball temperature increases to the point that the ball is held snugly in place within the tube. This dimension must be held for proper ball location.

Ball Welding Procedure

1. Special restrictions apply for carburized and non-carburized balls for preheating the ball.

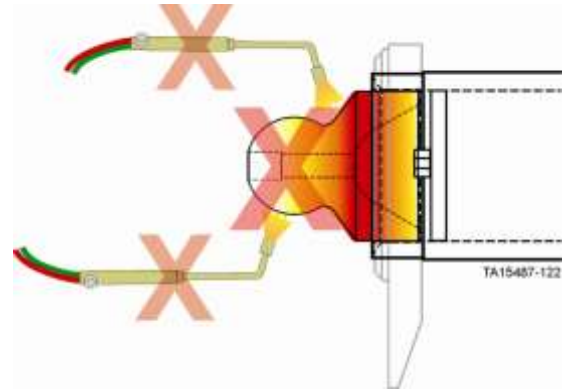


Carburized area

2. Preheat the weld area to 300° F (149° C) and maintain this temperature while welding out the joint.

CAUTION

DO NOT apply heat to the carburized neck or spherical portion of the ball base with a torch flame as this will reduce the hardness of the ball and can cause subsurface cracking.

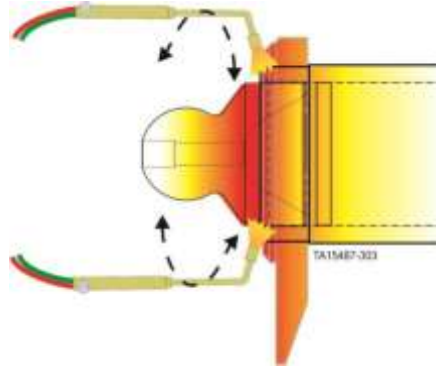


DO NOT apply torch flame to the neck or spherical area of the ball

CAUTION

If a torch is used to apply heat– it must be moving or it will soften and damage the area of the steel it is heating.

3. The proper area for heating the weld area is shown:



Proper heating area – keep the torch moving

4. The ball can also be preheated using electrical heating with ceramic heating. The typical locations for mounting heaters are on the outside of the frame near the ball and around the tube on the inside of the frame.



Typical ceramic heater, recorder and elements

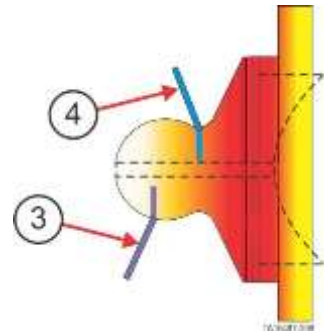
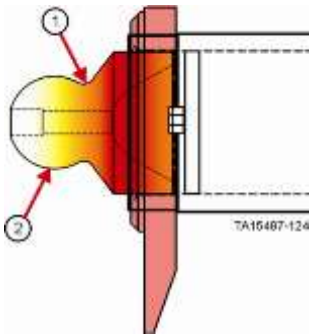


Typical ceramic heater locations on outside of frame



Typical ceramic heater locations on inside of frame

5. Monitor the maximum neck and ball temperatures constantly during the welding process and do not exceed these temperatures during installation. If the temperature in neck gets to this level – the welding must be stopped so that the neck can cool down.



Maximum temperatures

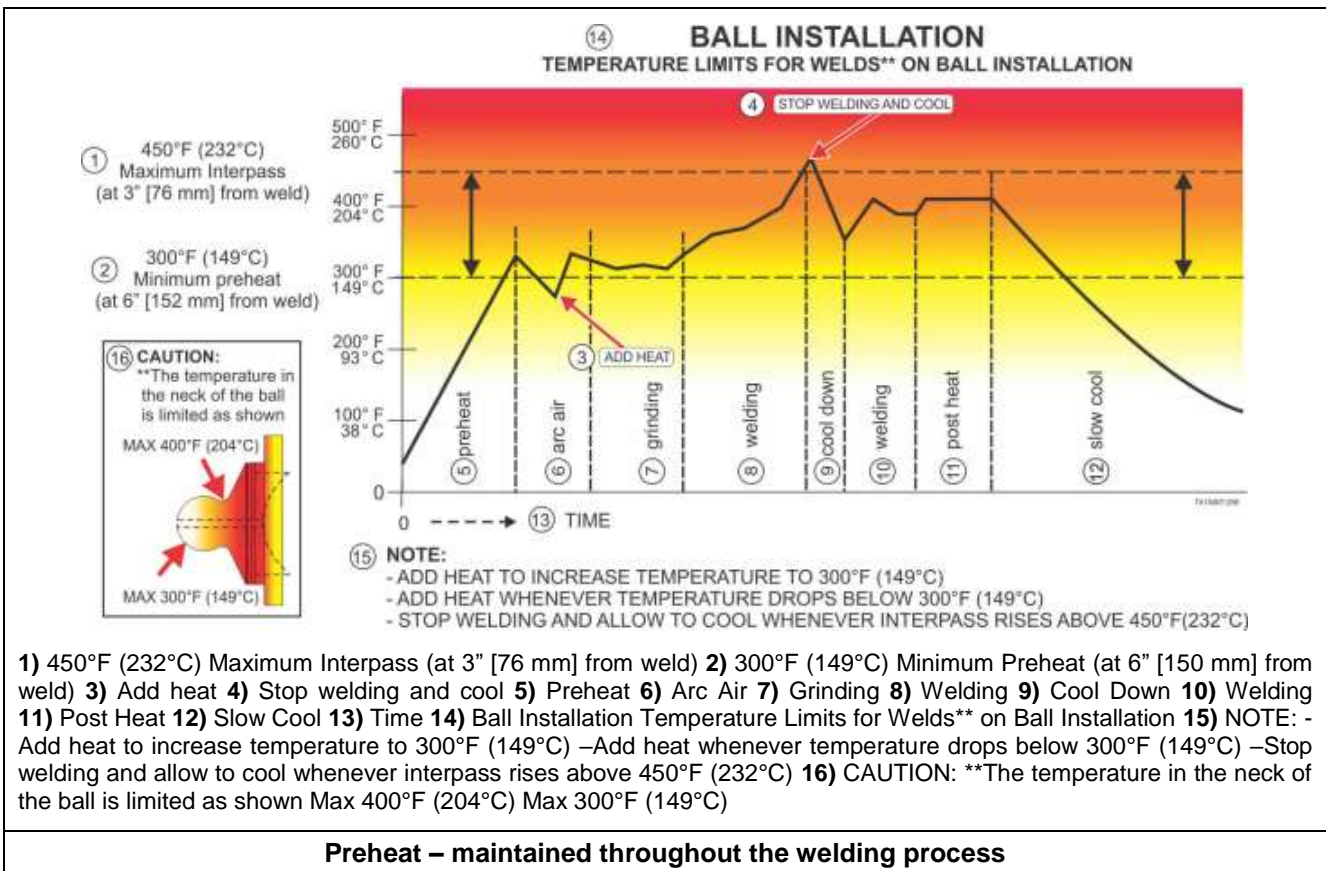
1. Neck 400° F (204° C)
2. Ball 300° F (149° C)

3. Ball 300° F (149° C)
4. Neck 400° F (204° C)

Special Instructions for 4130 Tube Material

If you have indications that the material may be 4130 – the following must be done:

- Raise the preheat temperature for repairs to 450° F (232°C).
- Maintain the preheat temperature of 450° F (232°C) during ball installation.
- Post Heat at 500° F (260°C) for 30 minutes.
- Follow the cool down rate of 50°F (28°C) per hour.



Welding Wire

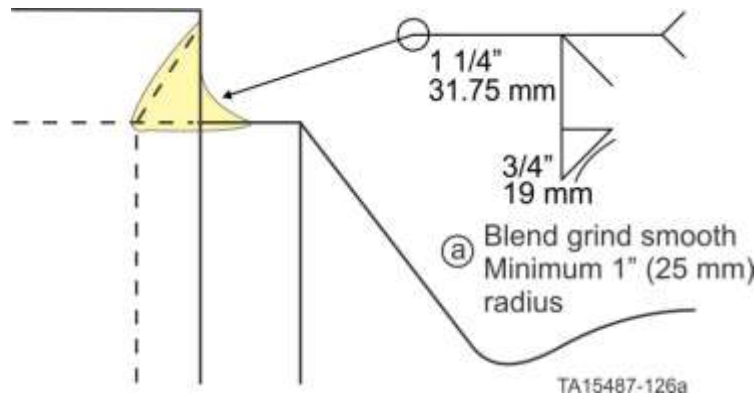
1. Typical wire sizes used for FCAW welding will be .045" (1.2 mm), .052" (1.4 mm), or 1/16" (1.6 mm) diameter. The most commonly used sizes are .052" (1.4 mm) or 1/16" (1.6 mm).
2. Wire consumable for field welding of ball installations is E8xT- xxxx series wire.

NOTICE

The factory will consider approving other wire types depending on the specifications of the wire. For example: Komatsu uses Lincoln Ultracore E71T-1MJ along with gas that is 75% Ar/25% CO2 for installation of the balls. This combination of gas and wire gives a tensile strength of 83,000 psi (572 MPa) which meets the specifications for E80XX wire.

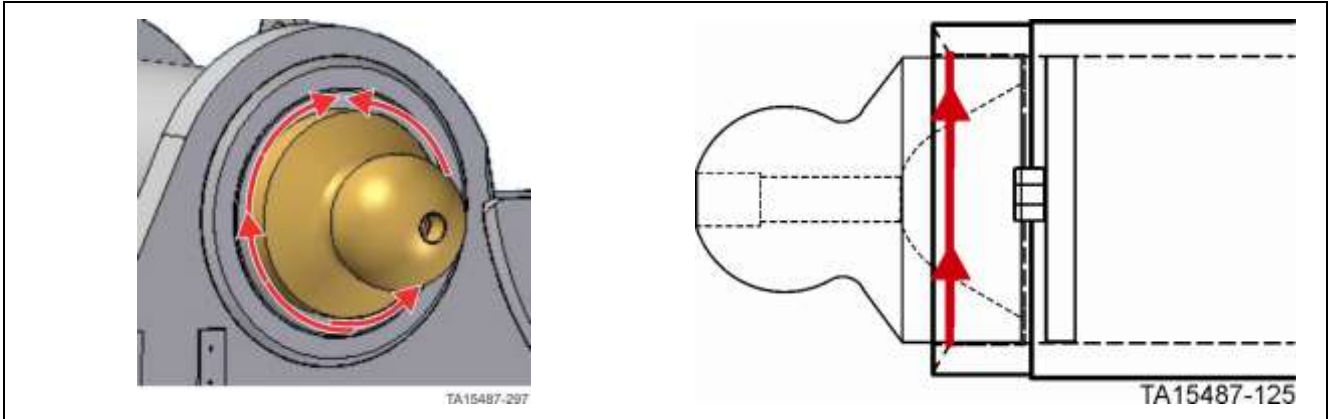
Electrodes

1. Electrodes for SMAW are specified to be low hydrogen in one of the following series (7018, 8018, 9018, etc.) as specified for each type of material and procedure.
2. Typical electrode sizes for SMAW will be 1/8" (3.2 mm) for root passes and 5/32" (4 mm) for the remainder.
3. Storage and handling of low hydrogen electrodes:
 - a. Use new low hydrogen electrodes that are provided in hermetically sealed packages. Do not use old electrodes for structural repairs. Old electrodes are defined as those that were removed from a sealed package more than 1 month earlier and have been kept in an oven.
 - b. Remove only one hour's supply of electrodes at a time. Keep the remainder in a ventilated holding oven at 225° F (107° C).
 - c. Bake previously opened packages of electrodes in a ventilated oven at 500° F (260° C) for two hours before using.
 - d. Electrodes taken from cardboard boxes or a non-airtight container should also be baked at 500° F (260° C) for two hours in a ventilated oven.
 - e. Then the electrodes should be placed immediately in a ventilated holding oven set at 225° F (107° C).
 - f. Any electrode exposed to the air for more than four hours should be re-baked per the instructions above.
4. Use an 80 series consumable for field welding of ball installations.
 - a. Weld with E-8018C3 series electrodes or E8xT-xxx FCAW wire.
 - b. If using SMAW E-8018C3 – weld the first 3 root passes with 1/8" (3.2 mm) rod.
5. Weld detail:



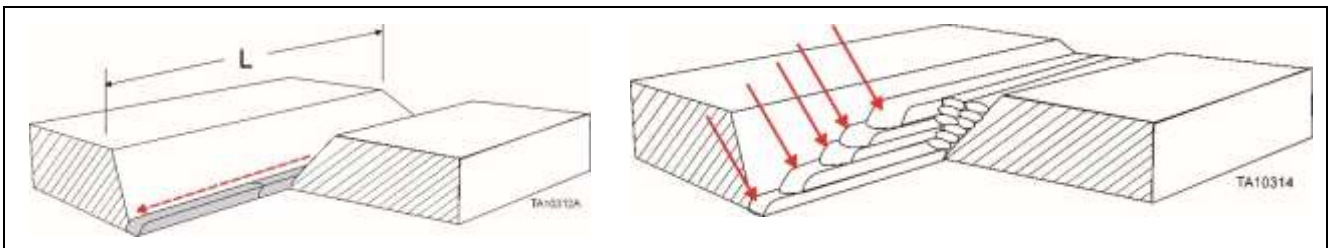
- a. Blend grind smooth Minimum 1" (25 mm) radius

Weld Profile



Each weld pass must be all the way around – vertical uphill

6. Each pass must be in vertical uphill orientation. (NO downhill welding)
7. Finish each pass all around the diameter of the weld. DO NOT weld in sections.
8. Each weld pass must start and stop in a different location from the previous pass.



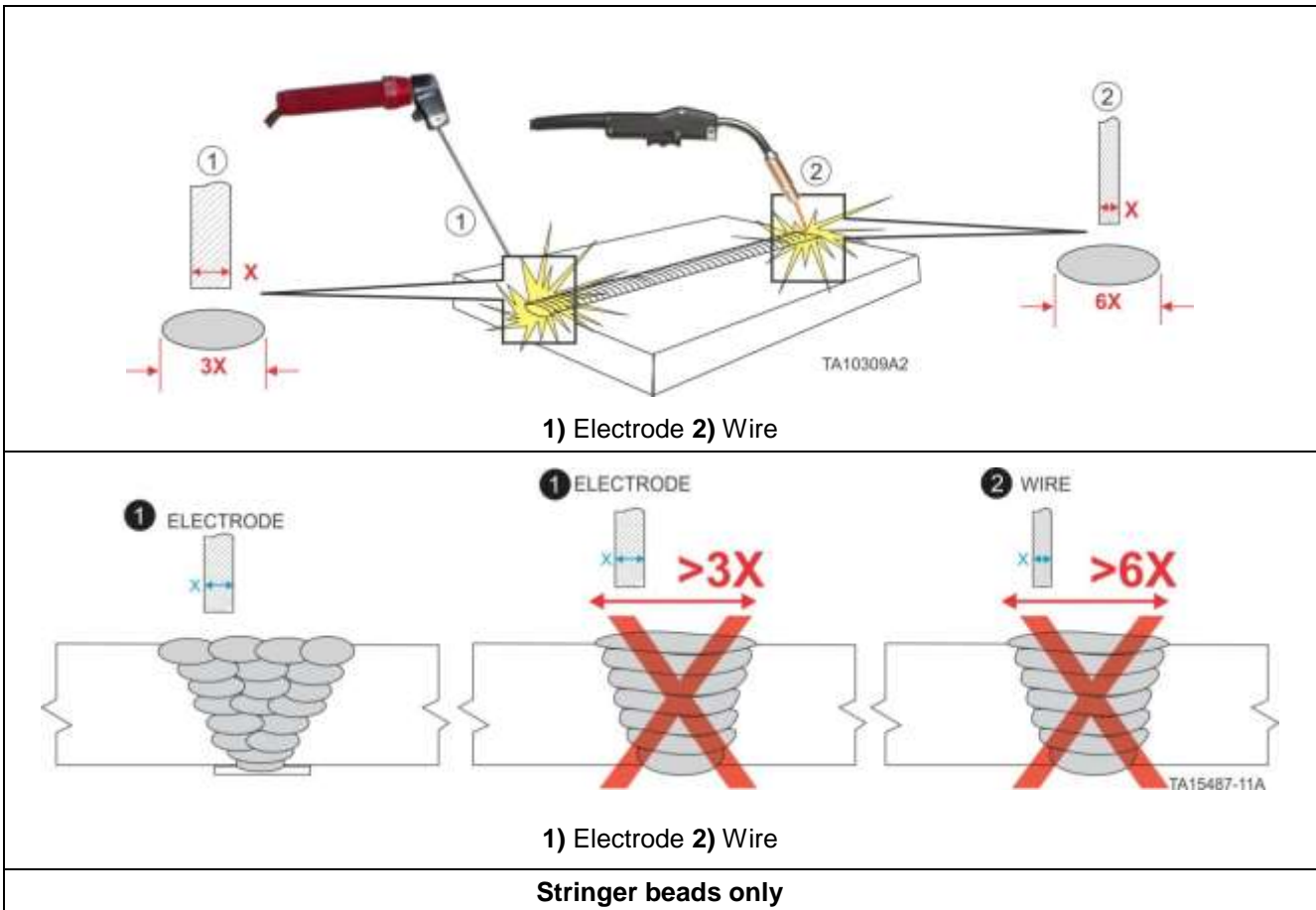
Each pass full length with start and stop in different locations

9. After welding the root pass remove the slag with a needle scaler air tool.



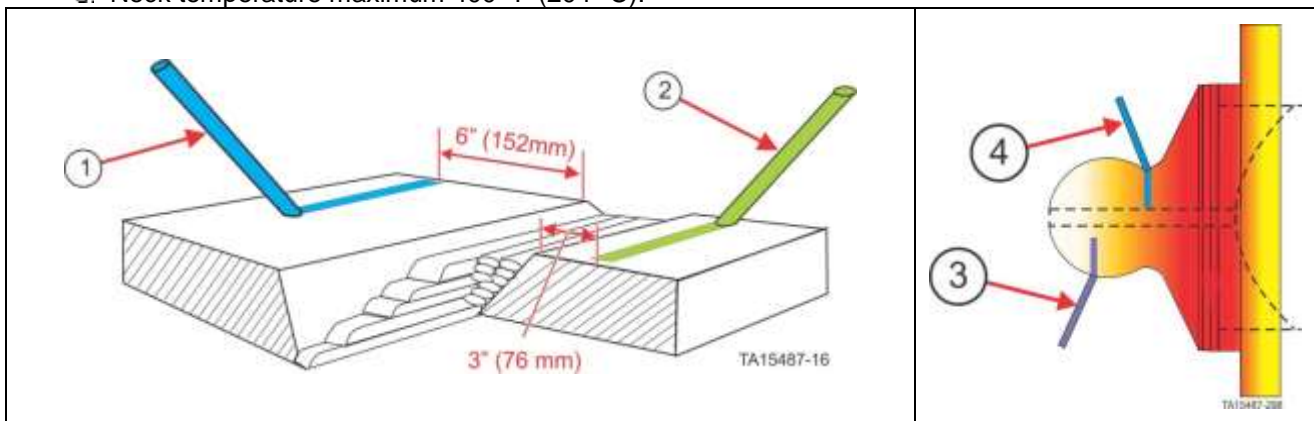
Needle scaler kit, scalers

10. Check the root pass for cracks with MT. The root pass must be free of cracks before proceeding.
11. If using SMAW E-8018C3 – weld the rest of the passes with 5/32" (4 mm) rod.
12. After welding each filler pass, remove the slag with a needle scaler air tool.
13. Do not weave weld. Only multi pass stringer beads are allowed.



14. Continue to monitor temperatures after each weld pass: The welding should be stopped whenever any of the monitored temperatures become hotter than specification. **DO NOT** force cool by using fans or water. Heat should be added if the temperature drops below the preheat minimum.

- a. Preheat temperature minimum 300° F (149° C), (Blue at 6" [152 mm]).
- b. Interpass temperature maximum 450° F (232° C) (Green at 3" [76 mm]).
- c. Neck temperature maximum 400° F (204° C).



Monitor temperatures during welding

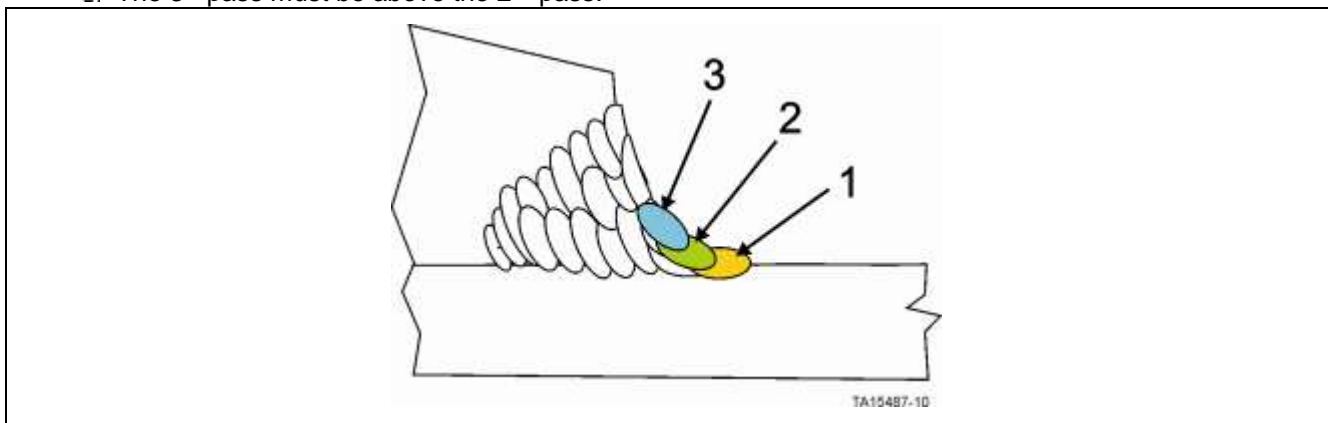
- 1) 300° F (149° C) temperature stick for **preheat** temperature
- 2) 450° F (232° C) temperature stick for **interpass** temperature
- 3) 300° F (149° C) temperature stick for **ball** temperature
- 4) 400° F (204° C) temperature stick for **neck** temperature

15. Record the temperatures in the preheat and interpass heat logs every hour. Measure the weld interpass temperature in 4 locations as shown and the ball neck and ball sphere as shown.

BALL PREHEAT AND INTERPASS RECORD (one record for each hoist and lift arm ball)					
Location:		Supervisor:			
Loader type and serial number:		Date:			
Ball description and location:		Ball serial number:			
Weld #	Sequence	Actual clock time	TEMPERATURE		
			7 locations (near weld)	Ball Neck	Ball Sphere
1	0 HOUR		A		
			D		
1	1 HOUR		A		
			B		
			C		
			D		
1	2 HOUR		A		
			B		
			C		
			D		

Preheat and Interpass log sheet samples

16. On the last layer the weld sequence is critical. Proper sequencing of the welds (bead tempering) uses the heat from subsequent passes to temper the earlier passes. This will reduce the stress in the junction between the weld and the base material.
- The 1st pass must be on the base material.
 - The 2nd pass must be above the 1st pass.
 - The 3rd pass must be above the 2nd pass.

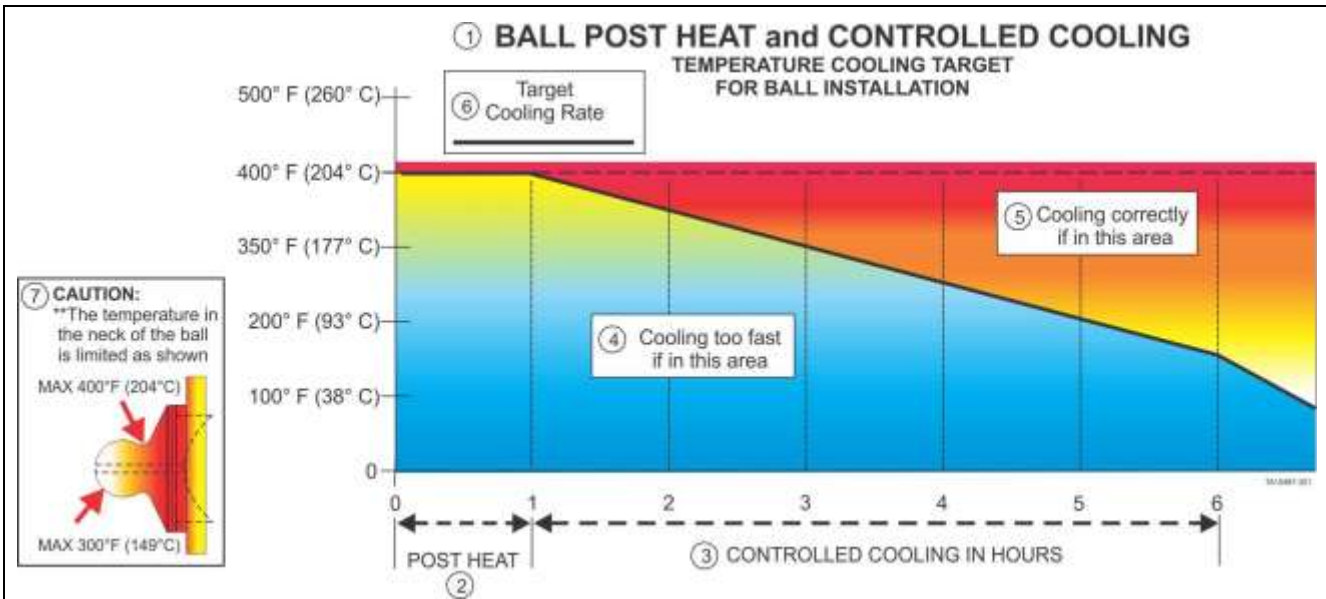


Bead tempering weld order on the last weld layer.

17. Inspect the weld profile with a profile gauge to assure it meets specifications. Add weld as required to meet specifications

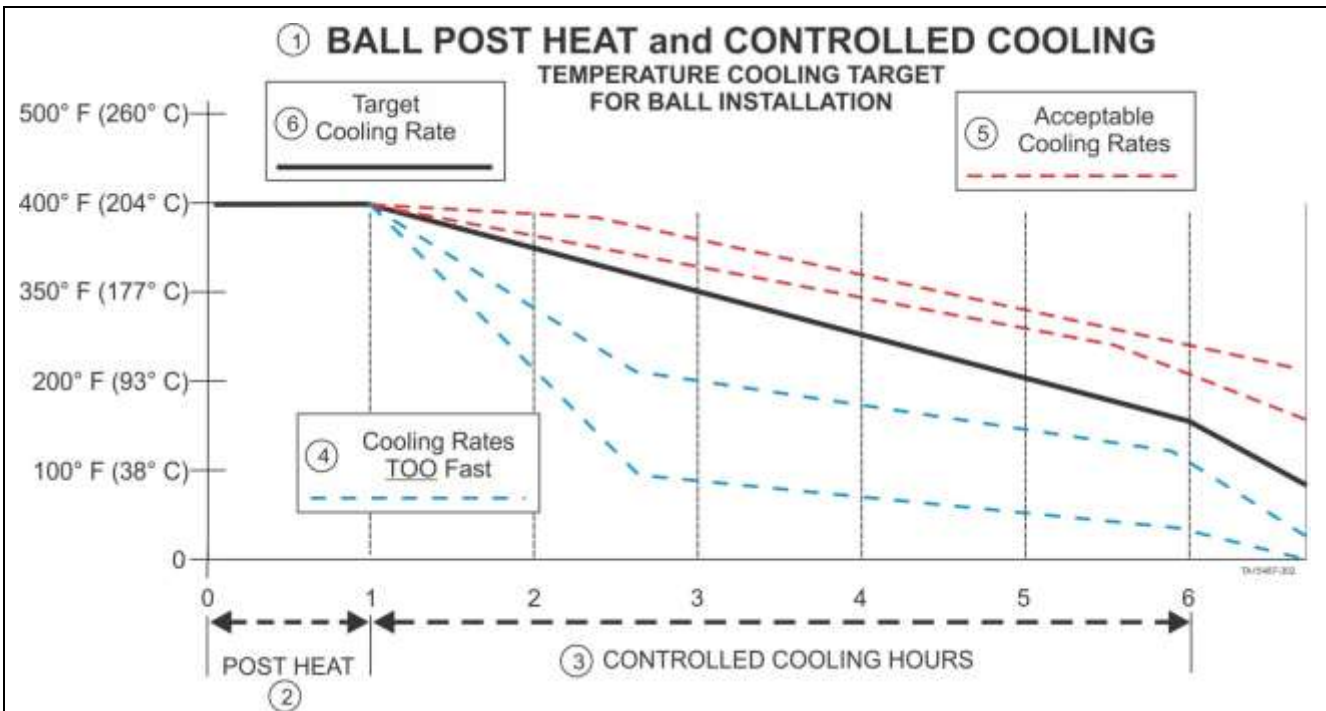
Post Heat and Controlled Cooling

1. Post heat for one hour at 400° F (204° C).



- 1) Ball Post Heat and Controlled Cooling temperature cooling target for ball installation
- 2) Post Heat
- 3) Controlled Cooling in Hours
- 4) Cooling too fast if in this area
- 5) Cooling correctly if in this area
- 6) Target Cooling Rate
- 7) CAUTION: **The temperature in the neck of the ball is limited as shown Max 400°F (204°C) Max 300°F (149°C)

Post heat and controlled cooling rate



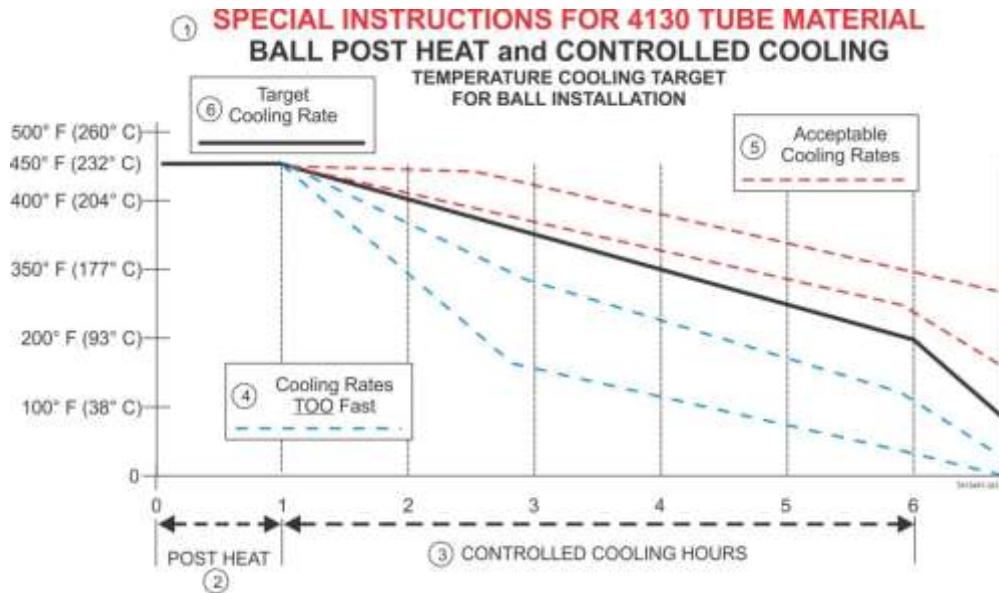
- 1) Ball Post Heat and Controlled Cooling temperature cooling target for ball installation
- 2) Post Heat
- 3) Controlled Cooling Hours
- 4) Cooling Rates Too Fast
- 5) Acceptable Cooling Rates
- 6) Target Cooling Rate

Examples of acceptable cooling rates

Special Instructions for 4130 Tube Material

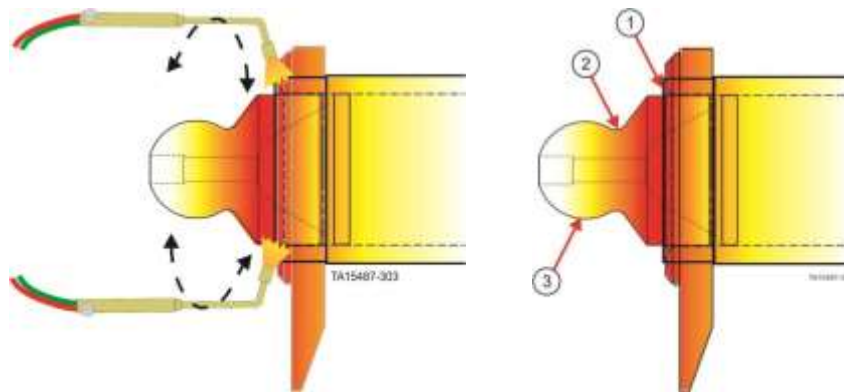
If you have indications that the material may be 4130 – the following must be done:

- Raise the preheat temperature for repairs to 450°F (232°C).
- Maintain the preheat temperature of 450°F (232°C) during ball installation.
- Post Heat at 500°F (260°C) for 30 minutes.
- Follow the cool down rate of 50°F (28°C) per hour.



1) Special Instructions for 4130 Tube Material – Ball Post Heat and Controlled Cooling – Temperature Cooling Target for Ball Installation 2) Post Heat 3) Controlled Cooling Hours 4) Cooling Rates Too Fast 5) Acceptable Cooling Rates 6) Target Cooling Rate

Special post heat and cooling requirements for 4130 tube material



Post heat

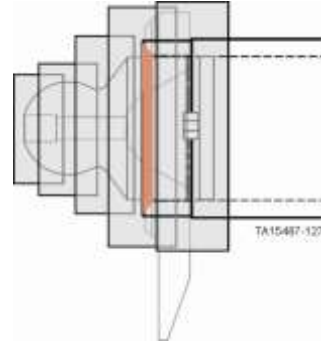
1) 400° F (204° C) Minimum, 2) 400° F (204° C) Maximum, 3) 300° F (149° C) Maximum

CAUTION

Excessive cooling rates may cause cracks. This must be closely monitored because the frame structure is a large heat sink and can dissipate heat very quickly.

The temperature should drop no more than 50°F (28°C) degrees per hour after post heat completed.

2. After the post heat has been completed, then the ball is wrapped and the controlled cooling process begins. Wrap the ball and cross member to extend the cool down time.



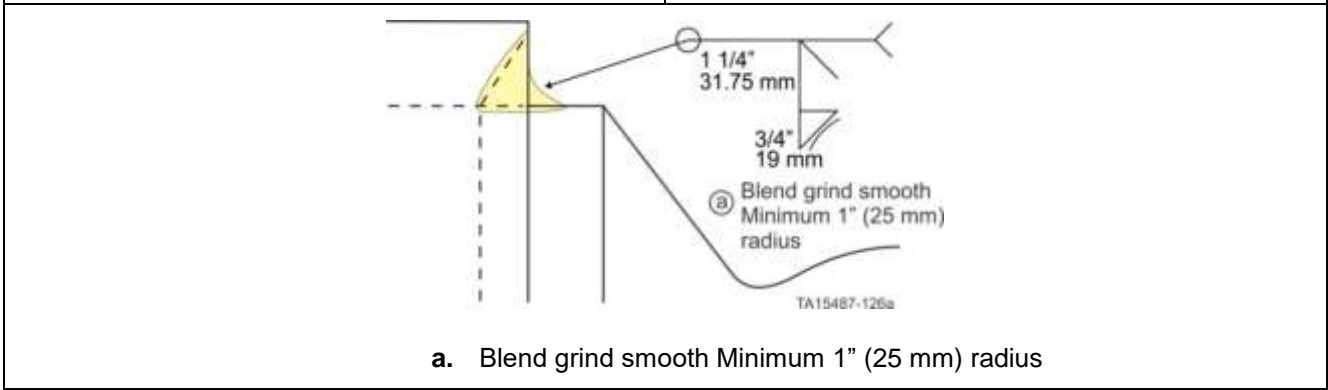
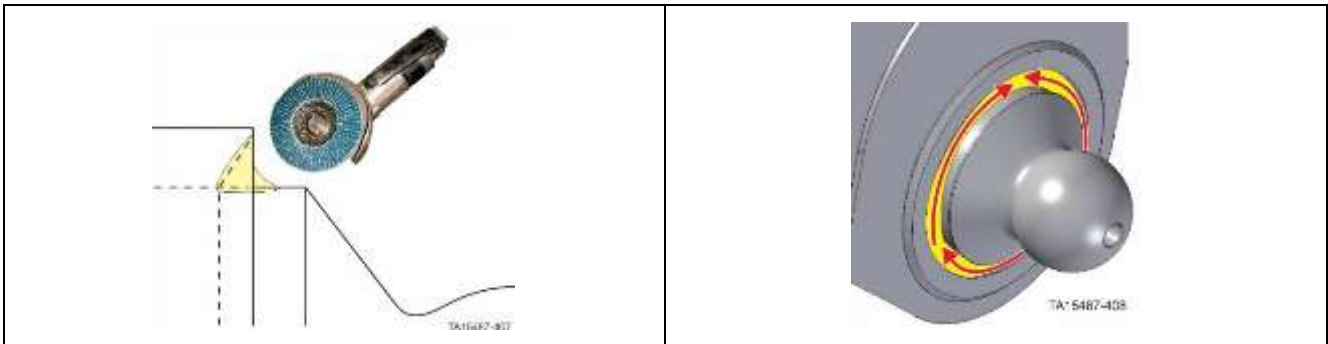
Wrap to slow cool

NOTICE

Blend grind smooth, all the way around ball weld, after the 48 hour post heat is complete.

No undercuts at edge of the final weld is permitted. Small undercuts can be blend ground.

Large undercuts must be corrected by weld repair.



a. Blend grind smooth Minimum 1" (25 mm) radius

Final weld call out

The following is a sample post heat form. A full size form is provided in the appendix.

Action	Actual Clock Time	Elapsed time (minimum times)	Target Temp	Actual temp
Post Heat Starts		0	400° F (204° C)	A
				B
				C
				D
Post Heat Finishes		1 hour	400° F (204° C)	A
				B
				C
				D
Cooling		1.5 hour	375° F (191° C)	A
				B
				C
				D

Post Heat form sample

Final Weld Inspection

48 hours (minimum) after the welds have been completed and cooled they should be inspected as follows:

NOTICE

The machine can be operated during the 48 hour time period.

1. 100% visual inspection of all replacement welds per AWS D14.4 CLASS III criteria.
2. MT/PT – Magnetic Particle or Dye Penetrant inspection of all replacement welds per AWS D14.4 CLASS III criteria.
3. All cracks and discontinuities should be repaired per previous procedures.
4. Paint the repair area.
5. Install the grease plug and grease hose.
 - a. The Type B hoist cylinder ball and lift arm balls have a plug with a hole in the middle and the grease comes in through the plug.



Ball plug – grease through ball

NOTICE

Re-Commissioning after Ball Replacement

- After each ball has been replaced or repaired and all of welding/inspection procedures have been completed- specific assembly and maintenance items outlined in the Re-Commissioning Replacement Document must be done to assure proper function of the ball joints.
- Re-Commissioning Replacement Document is at the end of this chapter and a copy is also included in the Appendix of the Field Welding Procedure document.

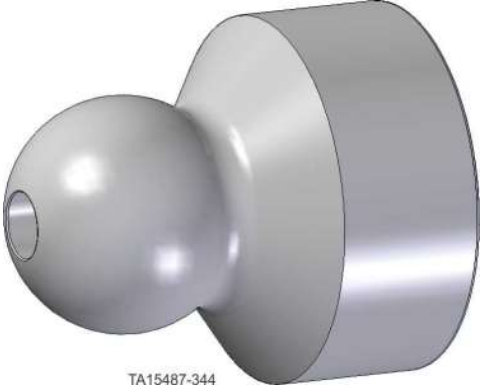
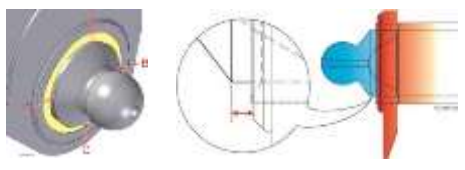
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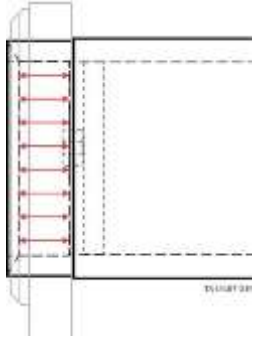
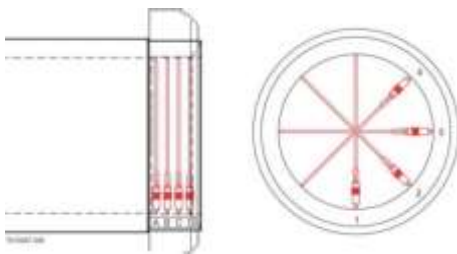
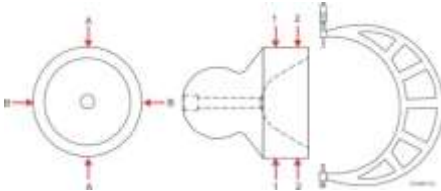
Type B Hoist and Lift Arm Balls Worksheet

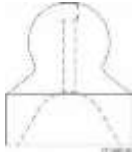
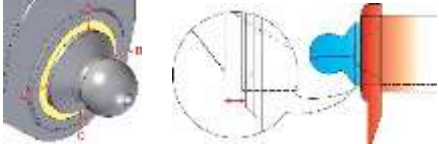
(Field Welding Procedure Chapter 3B)

General information		
Date work started	Date work completed	
Machine type	L-1350 <input type="checkbox"/> L-1350G2 <input type="checkbox"/> L-1850 <input type="checkbox"/> L-1850G2 <input type="checkbox"/> L-2350 <input type="checkbox"/>	
Machine S/N		
Front frame S/N		
Machine location (mine name)		
Machine hours		
Ball hours (if known)		
Ball Information		
Ball location	Lift arm - RH <input type="checkbox"/> LH <input type="checkbox"/> Hoist - RH <input type="checkbox"/> LH <input type="checkbox"/>	
Ball size		
Ball markings – part number/serial number		
Sales Force/CCR		
Field Welding Procedure Specification (FWPS) used?	FW-0107 <input type="checkbox"/> FW-0108 <input type="checkbox"/> FW-0109 <input type="checkbox"/> FW-0110 <input type="checkbox"/>	
Personnel and Companies Involved		
Person responsible for filling in forms		
Supervisor company		
Supervisor name(s)		
Company for welding		
Personnel Names and certifications	1	2G <input type="checkbox"/> 3G <input type="checkbox"/> 4G <input type="checkbox"/> 6G <input type="checkbox"/> none <input type="checkbox"/>
Minimum certifications: AWS D1.1 (or equivalent recognized welding code)	2	2G <input type="checkbox"/> 3G <input type="checkbox"/> 4G <input type="checkbox"/> 6G <input type="checkbox"/> none <input type="checkbox"/>
2G/3G (or 4G) for the process being used (FCAW or SMAW)	3	2G <input type="checkbox"/> 3G <input type="checkbox"/> 4G <input type="checkbox"/> 6G <input type="checkbox"/> none <input type="checkbox"/>
	4	2G <input type="checkbox"/> 3G <input type="checkbox"/> 4G <input type="checkbox"/> 6G <input type="checkbox"/> none <input type="checkbox"/>
	5	2G <input type="checkbox"/> 3G <input type="checkbox"/> 4G <input type="checkbox"/> 6G <input type="checkbox"/> none <input type="checkbox"/>
	6	2G <input type="checkbox"/> 3G <input type="checkbox"/> 4G <input type="checkbox"/> 6G <input type="checkbox"/> none <input type="checkbox"/>

General information		
	7	2G <input type="checkbox"/> 3G <input type="checkbox"/> 4G <input type="checkbox"/> 6G <input type="checkbox"/> none <input type="checkbox"/>
	8	2G <input type="checkbox"/> 3G <input type="checkbox"/> 4G <input type="checkbox"/> 6G <input type="checkbox"/> none <input type="checkbox"/>
Company used for preheat		
Personnel Names	1 2 3	
Company used for monitoring and recording preheat		
Personnel Names	1 2	
Company for UT inspections		
Company for PT/MT inspections		
Personnel Names	1 2 3	
Welding Consumable and Equipment		
Welding equipment (brand and model)	Root Pass Build passes	
Welding consumable – root pass		
Weld machine settings for root pass	Volts _____ Amps _____.	
Welding consumable – build passes		
Gas used for welding consumable		
Gas flow rate		
Weld machine settings at the welding machine	Volts _____ Amps _____.	
Volts and amps measured at the feeder or at work piece connections	Volts _____ Amps _____.	
Preheat method used	Gas flame <input type="checkbox"/> Type of gas used? Type of torch used? Moving or stationary? Electric heaters <input type="checkbox"/>	

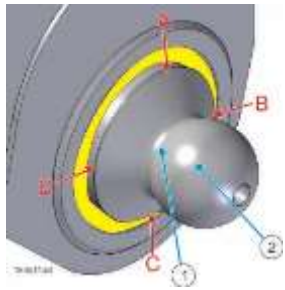
General information		
	Brand and type	
Temperature measuring method (temperature stick (crayon) must be used)	Temperature stick (crayon) <input type="checkbox"/> Brand? Temperature ranges? Temperature gun <input type="checkbox"/> Brand?	
Procedure Information		
Type B Ball procedure See Chapter 3B of Field Welding Procedure	 <p style="text-align: center;">TA15487-344</p> <p style="text-align: center;">Type B ball <input type="checkbox"/></p>	
Remove all rust preventative material or other contamination from the replacement ball	Yes <input type="checkbox"/> No <input type="checkbox"/>	
Pre-dimensions – prior to ball removal	Dimension:	
	A	
	B	
	C	
	D	
Remove ball base per procedures	YES <input type="checkbox"/> NO <input type="checkbox"/>	
Damage to the tube?	YES <input type="checkbox"/> NO <input type="checkbox"/>	
Procedure used to remove ball base?	Cut in pieces YES <input type="checkbox"/> NO <input type="checkbox"/> Remove one large piece YES <input type="checkbox"/> NO <input type="checkbox"/> Torch YES <input type="checkbox"/> NO <input type="checkbox"/> Arc air YES <input type="checkbox"/> NO <input type="checkbox"/>	
MT bore and face to look for cracks (If crack indications are found in the tube – raise preheat to 450° F [232°C])	YES <input type="checkbox"/> NO <input type="checkbox"/>	
Repair all torch or gouge digs on tube per procedures	YES <input type="checkbox"/> NO <input type="checkbox"/>	
Grind all repairs	YES <input type="checkbox"/> NO <input type="checkbox"/>	
MT bore and face to verify cracks have been repaired	YES <input type="checkbox"/> NO <input type="checkbox"/>	
Measure the tube depth to the machined shoulder in eight locations (tube at ambient temperature)	Measurements:	
	1	5
	2	6
	3	7

General information				
	4		8	
	If measurements exceed the specified length – grind down. If measurements are less than the specified length the tube will have to be build up and machine to specifications. The bore length must be correct for proper ball fit after installation.			
Check bore dimensions (tube at ambient temperature) 	A1	A2	A3	A4
	B1	B2	B3	B4
	C1	C2	C3	C4
	D1	D2	D3	D4
Average dimensions of A,B,C,D	Average:			
Is line bore required? ** If line bore required – the bore must be pre-machined 1/16" (1.6 mm) oversize and then welded. Preheat required prior to welding. NOTE: The final bore dimension average must be .015" (.381 mm) to .025" (.635 mm) under the specification for a new tube to account for the crush of the frame ear.	YES <input type="checkbox"/> NO <input type="checkbox"/>			
If line bored – measure bore again:	A1	A2	A3	A4
	B1	B2	B3	B4
	C1	C2	C3	C4
	D1	D2	D3	D4
Measure the ball base OD (the part that will fit into the tube). 	A1		A2	
	B1		B2	
Trial test the time to transfer ball from the liquid nitrogen container to the tube ready for installation. You must be able to do this in less than 1 minute and 30 seconds.	Test time?			
Insulated container for liquid nitrogen.	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Amount of time ball in liquid nitrogen	Time:			

General information	
(40 minutes recommended.)	
Level of liquid nitrogen during the freezing process? Mark line on picture- (no higher than the non carburized area)	
	Type B Ball
Verify that the pre dimensions taken earlier are met during ball installation.	Dimension:
	A
	B
	C
	D
Post heat and slow cool down.	Record temperatures as specified. Attach the post heat and cool down log.
Repair any rejectable defects and indications found with UT.	
48 Hour Inspections **All inspections after job complete are specified to be minimum of 48 hours after job completed (welded, post heat and slow cooled to ambient).	<ul style="list-style-type: none"> • MT/PT report on weld and ball 48 hours after job (welding and post heat) completed and fully cooled to ambient • UT report on weld 48 hours after job complete (and cooled to ambient)

Ball Preheat and Interpass Record – Type B Ball

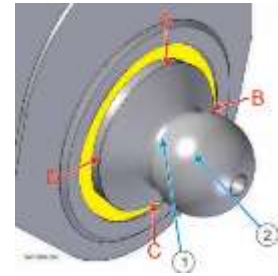
(one record for each hoist and lift arm ball)

Location:	Supervisor:	
Loader type and serial number:	Date:	
Ball description and location:	Ball serial numbers:	

Welder	Sequence	Actual clock time	TEMPERATURE		
			Ball flange (near weld)	Ball Neck	Ball Sphere
1	0 Hour		A		
			B		
			C		
			D		
2	0 Hour		A		
			B		
			C		
			D		
1	1 Hour		A		
			B		
			C		
			D		
2	1 Hour		A		
			B		
			C		
			D		
1	2 Hour		A		
			B		
			C		
			D		
2	2 Hour		A		
			B		
			C		
			D		
1	3 Hour		A		
			B		
			C		
			D		
2	3 Hour		A		
			B		
			C		
			D		
1	4 Hour		A		
			B		
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			D		
2	4 Hour		A		
			B		
			C		
			D		
1	5 Hour		A		
			B		
			C		
			D		
2	5 Hour		A		
			B		
			C		
			D		
1	6 Hour		A		
			B		
			C		
			D		
2	6 Hour		A		
			B		
			C		
			D		
1	7 Hour		A		
			B		
			C		
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2	7 Hour		A		
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			C		
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			B		
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2	9 Hour		A		
			B		
			C		
			D		
1	10 Hour		A		
			B		
			C		
			D		
2	10 Hour		A		
			B		
			C		
			D		
1	11 Hour		A		
			B		
			C		
			D		
2	11 Hour		A		
			B		
			C		
			D		

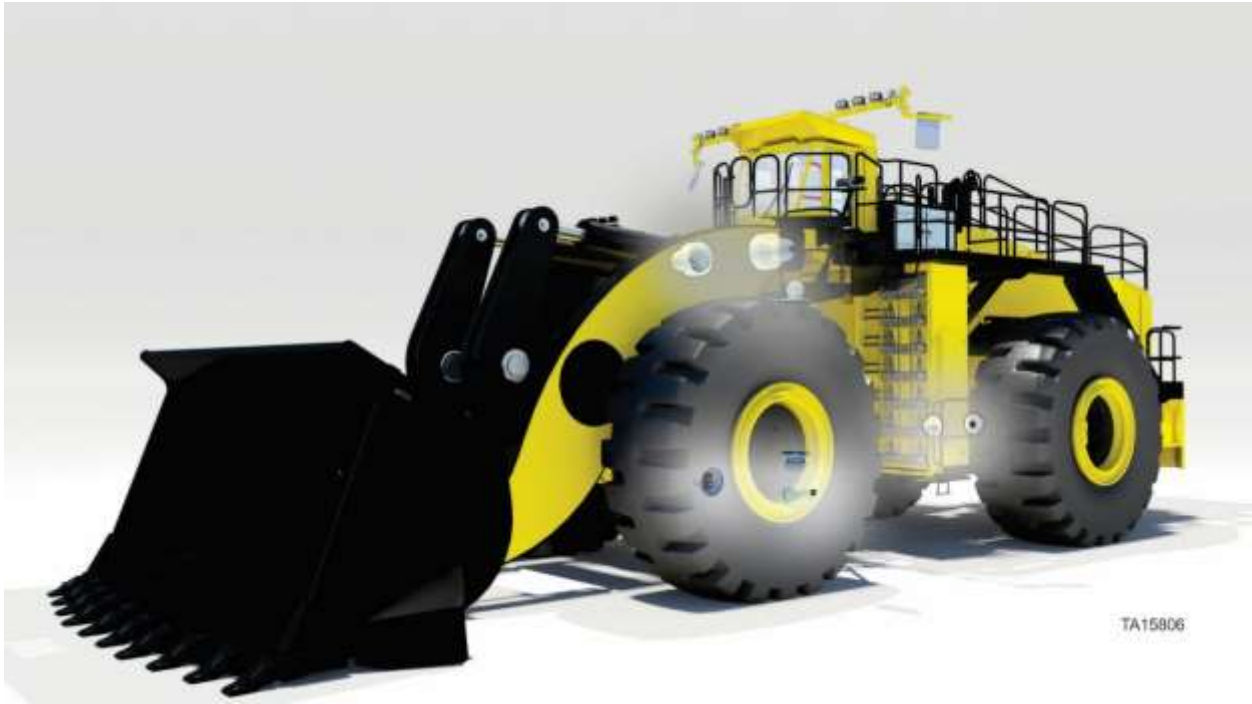
Post Heat Record – Type B Ball

Follow the post heat instructions previously explained in this chapter.



Action	Actual Clock Time	Elapsed time (minimum times)	Target Temp	Actual temp
Post Heat Starts		0	400° F (204° C)	A
				B
				C
				D
Post Heat Finishes		1 Hour	400° F (204° C)	A
				B
				C
				D
Cooling		1.5 Hour	375° F (191° C)	A
				B
				C
				D
Cooling		2 Hour	350° F (177° C)	A
				B
				C
				D
Cooling		3 Hour	300° F (149° C)	A
				B
				C
				D
Cooling		4 Hour	250° F (121° C)	A
				B
				C
				D
Cooling		5 Hour	200° F (66° C)	A
				B
				C
				D
Cooling		6 Hour	150° F (66° C)	A
				B
				C
				D

Re-Commissioning after - Ball Replacement



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Re-Commissioning after Ball Replacement

Before beginning the re-commissioning process, ensure the following safety preparations have been followed.

Safety Preparations

WARNING

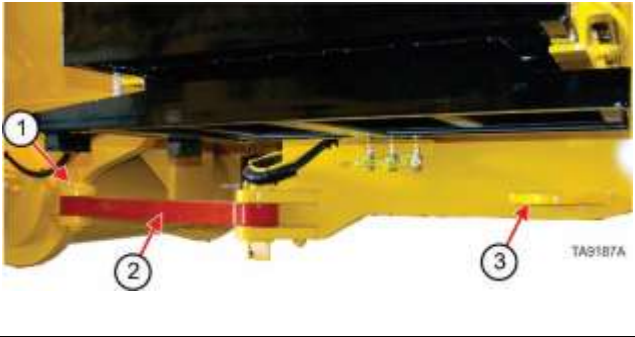
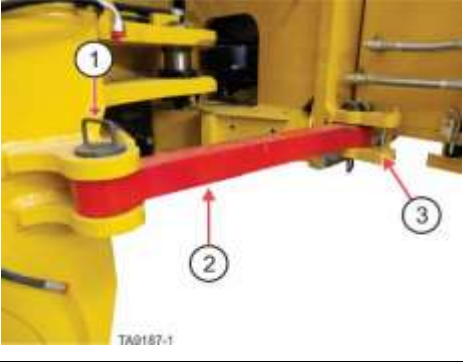
Crush hazards exist if the machine is started or moved while work processes are being performed on the machine. Place bucket flat and level on the ground. Place frame lock in the locked position and lock out the machine's starting capability before performing any work process. Follow all applicable lockout procedures and local rules and regulations for performing work processes. ANYONE performing inspections or service procedures to the machine should be familiar with ALL instructions and procedures contained in the machine's SERVICE MANUAL. Crush hazard could occur if the machine is started or moves while any type of work process is being conducted on the machine, resulting in serious injury or death.

Machine Shutdown and Lockout

1. Stop the wheel loader on flat level ground.
2. Place bucket flat and on level ground.
3. Move the frame lock to the locked position so that the frame cannot be steered.

WARNING

Crush hazards exist in machine pivot area and area between the tires. Do not enter these areas unless it is verified that the operator has control over the steering and that personnel locking the frame lock have good communication with the operator. Entering the pivot area and area between the tires while the machine is moving or pivoting (articulating) could cause crush hazards resulting in serious injury or death.

	
<p>Gen 1 Frame lock in locked position</p>	<p>Gen 2 Frame lock in locked position</p>
<p>1) Retaining pin for locked position, 2) Frame lock - shown in locked position 3) Retaining pin bracket for un-locked position</p>	

4. Set the parking brakes.

5. Shut off the engine.
6. Place wheel chocks in front and behind each wheel.
7. Lock out the machine's starting capability before performing any cleaning, inspections, or installation and repair procedure.

WARNING

Crush, shock, or other hazards exist if stored energy is not removed or isolated prior to working on the machine. Stored energy (hydraulic, electrical, pneumatic, mechanical, etc.) may be present if not isolated or released prior to working on the machine. Do not work on the machine without removing this stored energy (suspended loads, electrical power, air pressure, etc.). Risk of crushing, shock, or other physical injury exists if stored energy is not removed or isolated prior to working on the machine which could result in serious injury or death.

8. Turn the battery and engine isolation switches to the off position and install locks on the battery isolation switch.

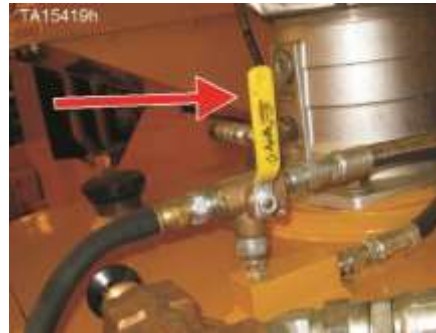


GEN 2 Isolation and Control switches assembly – Battery isolation switch in OFF position with locks in place

NOTICE

The GEN 2 Isolation and Control switches assembly is shown in this document. GEN 1 machines will have a different type of switch and box. The lock out/tag out requirements are the same.

9. Release the air from the hydraulic reservoir by using the hydraulic reservoir air valve (ball valve) on top of the reservoir. The supply line from main air system will be blocked and reservoir air will vent out the hose that runs down the outside of the hydraulic reservoir.
10. Turn the handle to the up position as shown.



Hydraulic reservoir air valve handle UP

11. Release the air from the various air storage reservoirs by opening all of the air bleed valves.

Three valves on right side of rear frame under hydraulic reservoir

One valve on right side of front frame near hoist cylinder ball cap

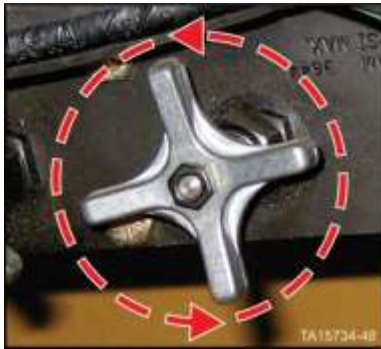


Open air reservoir bleed valves

WARNING

Crush hazards exist if all personnel are not cleared from the bucket and lift arm area before using the hydraulic hoist and bucket hydraulic pressure bleed down valves to relieve pressure from the hoist and bucket circuit. Assembly must be used only when the engine is NOT running. Before using the Manual Bleed Valve Assembly, refer to “HYDRAULIC AND GREASE SYSTEMS”, “MANUAL BLEED VALVE ASSEMBLY”, in Section 04 of the Service Manual for additional operational and safety information. Operating the manual bleed valve may cause the lift arms and bucket to descend rapidly. All personnel around the bucket and lift arms area shall be removed from the area before operating hydraulic hoist and bucket hydraulic pressure bleed down valves. Using the hydraulic bleed down valves could result in movement of the lift arms and bucket which could cause a crush hazard resulting serious injury or death.

12. Use the hydraulic pressure bleed down valves located in the front frame underneath the Husco valves to bleed any stored pressure in the hoist and bucket cylinders.
13. Turn each valve slowly counterclockwise as shown below and allow the pressure to bleed down.
14. Open the valve completely and leave it open during repairs.



CAUTION

Before performing welding operations on a machine, the fire suppression system circuit monitors panel's in-line fuse must be removed. The fuse is located in the battery box on some machines. Failure to do so may cause the system to actuate and/or damage the solid-state components of the system. Replace the in-line fuse before the machine has been started or after all welding operations have been completed.



Fire suppression in-line fuse located in loader battery box on some machines

⚠ WARNING

Fall hazard exists when working at heights. Be sure to take appropriate safety precautions when working at heights on the rear and front frames or the lift arms balls. Follow all required statutory regulations for working at height. Wear fall restraint when necessary to prevent falls. Failure to take appropriate safety precautions, including wearing fall restraint when necessary can cause fall hazards resulting in serious injury or death.

⚠ WARNING

Crush hazards exist if standing under, working, or placing any body part under hoisted/suspended components. Never stand under hoisted/suspended components. Ensure appropriate lifting devices are used, and blocking is adequate to prevent the component from unexpectedly moving during transportation. Refer to SAFETY, WARNINGS, AND CAUTIONS before attempting to remove the operator's cab. Failure to stay out from under hoisted/suspended components can cause crush hazard resulting in serious injury or death.

Assembly and Maintenance Items

After each ball has been replaced and all of the welding/inspection procedures completed – the following assembly and maintenance items must be done to assure proper function of the ball joint:

- 1) Obtain a machine download and analyze the data.
 - a. Any grease system alarms or warnings?
- 2) Assure that the grease plug is installed (hoist cylinder and lift arm balls).
 - a. Use new O-ring on the plug.
- 3) Install grease extension tube (frame articulation balls).
 - a. Use thread sealant on threads.
- 4) Grease hose and fitting is properly attached for each ball type.
 - a. The hose should be replaced to ensure reliability.
 - b. Pre-purge all grease lines with auto lube system grease, before installation.

CAUTION

Do not use standard EP grease to coat the ball, coat the liner, fill the ball, or purge the grease system. Use only the specified auto lube system grease containing 3-5% moly, specified for the machine's operating conditions.

- 5) Install new brass liners in socket and cap.
- 6) Chase the threads in each of the tapped holes in the socket.
 - a. This must be done by hand – **DO NOT** use any form of power tool.
 - i. Use of a power tool can cause damage to the threads.

CAUTION

Never use any form of power tool to chase threads with a tap! Always turn the tap by hand! Power tools can remove the 'feel' of the tap 'cutting' material from the hole and this 'cutting' is not desirable. Never drive a tap with a rattle gun as it can cause the tap to chip fragments of the tap off and they become embedded in the base material, causing further damage to the capscrew at the time of installation.

- b. Use a slightly dull tap to minimize thread damage.

NOTICE

The threads in each hole have typically been slightly distorted by the tensioning of the capscrews. The cutting edge of a new tap should be slightly 'dulled' by buffing the cutting edge of the tap on a wire wheel. This will minimize thread cutting which can reduce thread strength and leave small fragments of steel shavings in the root of the thread.

- c. Use ONLY a bottoming type of tap. Taper and intermediate configuration taps must not be used.
- 7) Clean all of the tapped hole threads in the socket. Remove all contaminants and previous lubricants from each hole.

- 8) Install new capscrews.
 - a. If there is any doubt as to their history or condition – replace the capscrews.
 - b. New capscrews should be installed if the ball was broken.
 - i. If one lift arm ball was broken - replace the capscrews on both sides of lift arm.
 - c. Capscrews can be reused if:
 - i. They were properly torqued when originally installed.
 - ii. No sign of thread damage from installation or dropping on steel or ground.
 - iii. No signs of stretching.
 - iv. Threads are fully cleaned.
 - v. No signs of cracking near the clamp face of the capscrew.
 - vi. The clamp face is not galled.
 - vii. The 12-point head is not damaged.
- 9) Assembly lubrication.
 - a. Coat the OD of the ball with auto lube system grease.
 - b. Fill the hole in the ball with auto lube system grease.
 - c. Coat the socket and cap with a thin coat of auto lube system grease.
 - d. Coat the brass liners with auto lube system grease to fill the grooves in the liners.

CAUTION

Do not use standard EP grease to coat the ball, coat the liner, fill the ball, or purge the grease system. Use only the specified auto lube system grease containing 3-5% moly, specified for the machine's operating conditions.

- 10) Verify that the lift arms fit on the balls without spreading or pulling together.
 - a. Verify that the lifting method is not pulling the arms together.
 - b. The arm width can be adjusted by heat striping if required.
 - c. Contact Komatsu Call Center for assistance (support@joyglobal.com).
- 11) Align the ball caps on the lift arm sockets.
 - a. Install the ball cap loosely and align the match marks.
 - i. The caps are interchangeable left to right – but once they have been aligned and match marked – they should be always used in the specified location.
 - b. If they are not factory match marked – find the center and match mark.
 - c. Mark each one for Left (LH) or Right (RH).

NOTICE

The socket and cap are aligned and marked when the arms are NOT mounted on the machine.

- 12) Torque the cap screws for the ball caps.
 - a. Verify that the socket threaded holes and all capscrews are not contaminated with grease, anti-seize, etc.
 - b. 30W or engine oil for thread and shoulder lubrication.
 - c. Hand start ALL cap screws in the cap prior to tightening with air gun or torque wrench.
 - d. Use a small air wrench (1/2" drive max) to run the bolts fully home.

CAUTION

If any capscrew binds while running in by hand or with a small air impact wrench, **DO NOT** attempt to drive the capscrew deeper. Use a hand wrench and remove the capscrew. **DO NOT** use an air impact wrench to remove the capscrew.

- e. Follow the torque pattern.
 - f. Torque to the correct value.
- 13) Check the “snap” clearance on the ball.
- a. Adjust the snap clearance to specification by adding or removing shims.
- 14) Purge the grease line to the ball joint.
- a. **DO NOT** purge by cycling the grease system.
 - i. The injector only puts out a maximum of 1.3cc each time the grease system cycles. It is very difficult to fill the joint with grease at this rate – and wastes grease from excessive grease at all the other locations on the machine.
 - b. Remove the purge cap from the grease injector and fill the joint with grease using a grease gun.
 - c. Purge a minimum of 0.5 kilogram (1 pound) of grease through the joint **BEFORE** operation of the machine.

CAUTION

Do not use standard EP grease to purge the ball joint grease system. Use only the specified auto lube grease containing 3-5% moly, specified for the machine’s operating conditions.

- 15) Replace the in-line fuse on the fire suppression system if it was disengaged due to welding on the machine, this must be done before the machine has been started or after all welding operations have been completed.

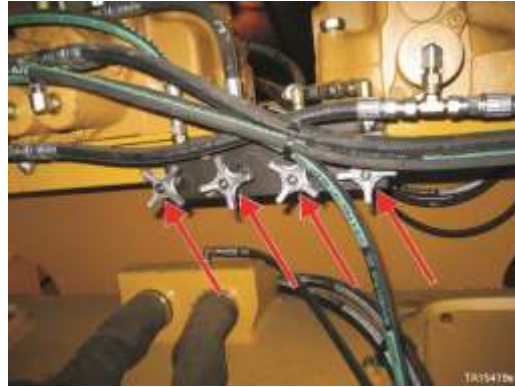
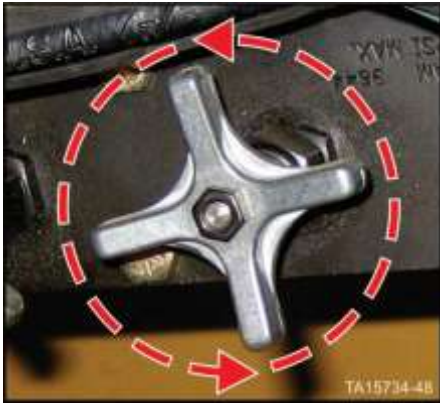
CAUTION

Failure to replace the fuse before operating the machine could result in a serious fire. Never run the machine unless the fuse has been replaced.



Fire suppression in-line fuse located in loader battery box on some machines

16) Close (turn clockwise) the hydraulic bleed valves in the front frame.



Close hydraulic bleed valves in front frame

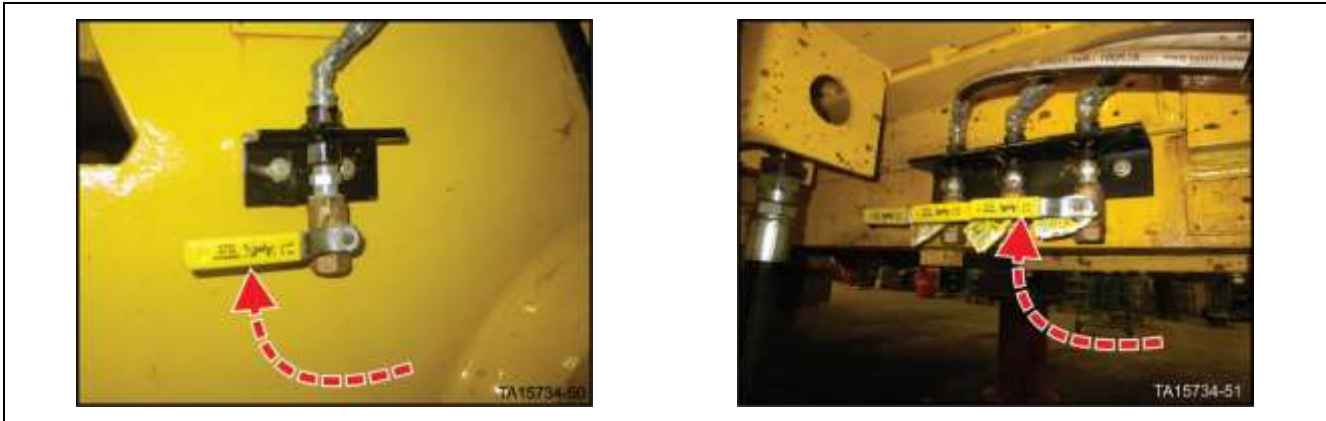
17) Close the hydraulic reservoir air valve on top of the hydraulic reservoir.



Close the hydraulic reservoir air valve

18) Close the air bleed valves.

Generation 1	Generation 2
Three valves on left side of rear frame under electrical cabinet	Three valves on right side of rear frame under hydraulic reservoir
One valve on left side of front frame near frame lock and hoist cylinder ball cap	One valve on right side of front frame near hoist cylinder ball cap



Close the valve under the hydraulic reservoir

- 19) Remove wheel chocks.
- 20) Remove any locks or tags from isolation box following all local regulations and turn both isolation switches to the on position.



Battery Isolation Box – locks removed – and switches moved to on position

- 21) Start machine and verify that grease injectors are functioning (Ref SIL-397.01).
 - a. System timer functioning – what is the setting?
 - b. Grease leaks?
 - c. System building pressure?
 - d. Grease Pressure?
 - e. Oil Supply Pressure?
 - f. Injectors functioning?
 - g. Grease Pressure at stall?
 - h. Injector for ball joint functioning?

Most of the items in the previous list are steps that are part of the standard assembly and commissioning of a new loader or a part of the normal maintenance items related to balls. Contact the Komatsu Call Center (support@joyglobal.com) if you are unable to locate the information or have questions pertaining to these assembly and maintenance practices. Most of these are covered in one or more of the following documents:

- Assembly Manual
- GEN 2 Service Manual
- SIL 439.01 Spherical Ball Bearing Joints
- SIL 413.00 Hoist Cylinder Spherical Ball Lubrication
- SIL-397.01 Auto Lube System Operation

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RE-Commissioning Worksheet

Machine:	Ball location changed:	Date:
S/N:	Replacement Ball S/N	Customer:

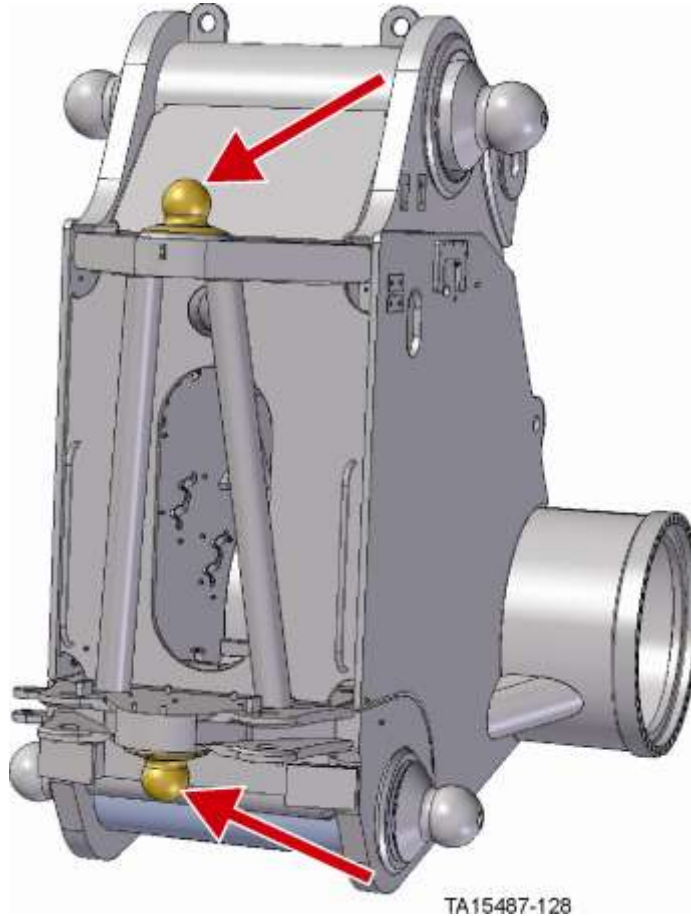
Item	Result	Comments	Date	Signature
Machine download	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Attach to the Sales Force Case related to this machine	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Analyze data for indications of grease system failures	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Grease Plug installed in hoist or lift arm ball	YES <input type="checkbox"/> NO <input type="checkbox"/>			
New O-ring	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Grease extension tube installed into articulation ball base	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Thread sealant used?	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Connect the grease hose	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Tighten hose and fitting	YES <input type="checkbox"/> NO <input type="checkbox"/>			
New Grease hose used?	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Install new brass liners in socket and cap	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Chase hole threads in socket by hand	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Clean hole threads in socket to remove all contaminants	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Install new capscrews	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Coat the OD of the ball with auto lube system grease	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Fill the hole in the ball with auto lube system grease	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Coat the ID of the socket and cap with a thin coat of auto lube system grease	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Coat the ID of the brass liner auto lube system grease	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Verify that the arms fit without spreading or pulling together	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Heat striping required?	YES <input type="checkbox"/> NO <input type="checkbox"/>			
<i>This section applies to Lift arm balls ONLY</i>				

Field Welding Procedures

Item	Result	Comments	Date	Signature
Align the ball caps on the lift arm sockets Match marks <i>This section applies to Lift arm balls ONLY</i>	YES <input type="checkbox"/> NO <input type="checkbox"/> YES <input type="checkbox"/> NO <input type="checkbox"/>			
Capscrew lubricant – 30W oil	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Hand start all capscrews	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Follow specified torque pattern	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Torque value	_____ ft-lb			
Purge the grease system to all balls that were replaced? Use external grease pump?	YES <input type="checkbox"/> NO <input type="checkbox"/> YES <input type="checkbox"/> NO <input type="checkbox"/>			
Check the snap clearance In or out of specification? Adjusted? Final value?	YES <input type="checkbox"/> NO <input type="checkbox"/> _____ "/mm YES <input type="checkbox"/> NO <input type="checkbox"/> YES <input type="checkbox"/> NO <input type="checkbox"/> _____ "/mm			
Verify grease system functioning: System timing Leaks? System building pressure? Oil supply pressure? Grease pressure at stall? Ball injector functioning? Injectors functioning?	_____ min/cycle YES <input type="checkbox"/> NO <input type="checkbox"/> YES <input type="checkbox"/> NO <input type="checkbox"/> _____ psi _____ psi YES <input type="checkbox"/> NO <input type="checkbox"/> YES <input type="checkbox"/> NO <input type="checkbox"/>			

CHAPTER 4

Frame Articulation Balls Replacement Procedure



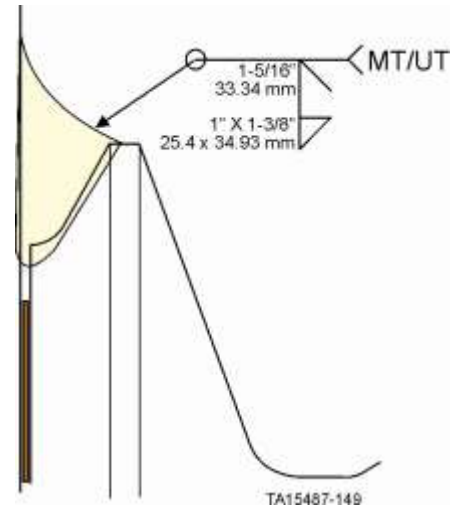
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Procedure	FW-0110
Revision	0
Written by	Joel Armstrong
Date	3/8/2010

Field Welding Procedure			
This document conforms to AWS D1.1/D14.3 Structural Welding Code and Australian Standards AS 1554.4			
Description	Front frame articulation balls		
Notes	See attachment		
Welding Process	FCAW / SMAW		
Joint			
Type	Groove or Fillet		
Backing	If needed	Material	Mild Steel
Root Opening	+1/4 / - 1/16" Per Attachment (+6.35 / -1.6 mm)		
Root face Dimension	+/- 1/16" Per Attachment (+/- 1.6 mm)		
Groove Angle (degrees)	+10/-5 Per Attachment	Radius	N/A
Back Gouging	Yes, if required	Method	Arc - Air
Other			
Base Metals			
Specification	ASTM A572 Modified	A151 4820H	
Thickness	6-7" (152-178 mm)	7.5 and 9" (191 and 229 mm)	
	Slab	Balls	
Filler Metals			
AWS Specification	A5.20/A5.29	A5.1, A5.5	
AWS Class	E71T-12MJH4 E81T1-NiMJH4	E7018-H4, E8018C3	
Diameter	0.045", 0.052", 1/16" (1.2, 1.4, 1.6 mm)	1/8", 5/32" (3.2, 4mm)	
Shielding		Positions Qualified	Flat, Vertical, Horizontal
Gas Composition	100% CO2 or Ar/CO2 75/25	Groove	1G, 2G, 3G, 4G
Flow Rate	35 – 45 cfh	Fillet	1F, 2F, 3F
Technique		Vertical Progression	Up
Stringer or Weave Bead	Stringer	Electrical Characteristics	
Multi/Single Pass (per side)	Multiple	FCAW - Current	DCEP
Peening	Yes	SMAW - Current	DCEP
Interpass Cleaning	Chipping and or grinding	Other	
Preheat and Interpass Temperatures			
Material Types			
Structural Steel	Castings	Q&T high strength steel	
Frame structure Bucket Blade	Lift Arm Torque Tube (1150, 1350, 1850 Gen2, 2350) Upper part front frame (1350) Axles (some 1350) Sockets	Balls Bucket Lip Bucket adapters Lift arms Bell cranks	
Preheat			
Material Thickness	Structural Steel	Castings and high strength steel	
Distance from weld	6" (152 mm) minimum	6" (152 mm) minimum	
< or = 3/4" (< or = 19.05 mm)	125° F (52° C)	200° F (93° C)	
>3/4" to 1-1/2" (>19.05 to 38.1 mm)	225° F (107° C)	250° F (121° C)	
>1-1/2" to 2-1/2" (>38.1 to 63.5 mm)	250° F (121° C)	300° F (149° C)	
>2-1/2" (>63.5 mm)	300° F (149° C)	350° F (177° C)	
Interpass Temperature			
All thicknesses	500°F (260° C) maximum	450°F (232° C) maximum	
Post Heat Treatment			
400°F (204° C) for one hour	Required: YES (X) NO ()		

Joint Detail



Welding Parameters

(The FCAW welding parameters were obtained from the qualification of the LINCOLN Ultracore 712A80 used during Komatsu fabrication on Komatsu welding equipment. These numbers will likely vary depending on the specific welding equipment and consumable used for repairs.)

Weld Pass	Process	Filler Metal	Filler Diameter	Current Type	Amps	Volts	Travel Speed (ipm)	Wire Feed Speed	Welding Position
All	FCAW	E71T-1MJ	1/16"	DCEP	280-340	22-26	8-12	255-300	Flat & Horizontal
All	FCAW	E71T-1MJ	0.052"	DCEP	220-310	22-26	8-12	225-375	Flat & Horizontal
All	FCAW	E71T-1MJ	0.045"	DCEP	210-280	23-25	8-12	275-425	Flat & Horizontal
All	FCAW	E71T-1MJ	1/16"	DCEP	185-225	21-24	7-10	105-130	Vertical
All	FCAW	E71T-1MJ	0.052"	DCEP	195-235	21-24	7-10	200-375	Vertical
All	FCAW	E71T-1MJ	0.045"	DCEP	155-235	21-23	7-10	175-325	Vertical
All	SMAW	E7018	5/32"	DCEP	130-210	19-21	5-8	N/A	All
All	SMAW	E7018	1/8"	DCEP	90-160	19-21	5-8	N/A	All
All	SMAW	E8018C3	5/32"	DCEP	130-220	19-21	N/A	N/A	All
All	SMAW	E8018C3	1/8"	DCEP	90-160	19-21	N/A	N/A	All

Suggested Air Arc Parameters

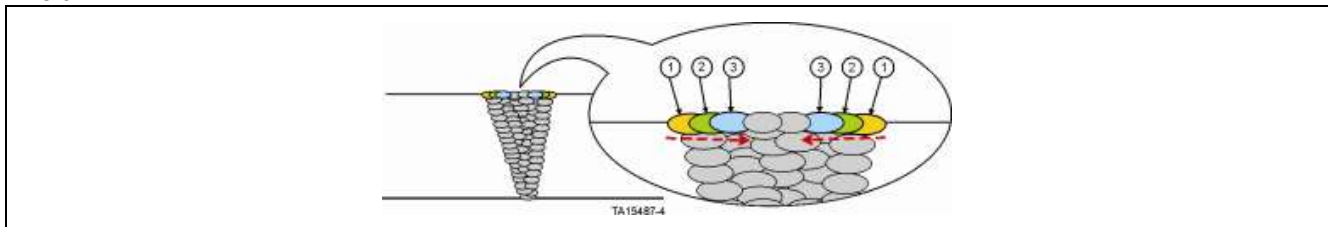
Electrode Diameter		Minimum Amps	Maximum Amps
Inches	Millimeter		
1/8	3.2	60	90
5/32	4.0	90	150
3/16	4.8	200	250
¼	6.4	300	400
5/16	7.9	350	450
3/8	9.5	450	600
½	12.7	800	1000
5/8	15.9	1000	1250
¾	19.1	1250	1600

Proper Electrode Selection for Field Welding

Material joint type	Rod consumable	Wire Consumable
Steel to steel	7018 series	E7xT- xxxx series
Steel to Casting	7018 series	E7xT- xxxx series
Casting Repair	8018 series	E8xT- xxxx series
Socket or Ball installation	8018 series	E8xT- xxxx series
Wear hardware installation on bucket	8018 series	E8xT- xxxx series

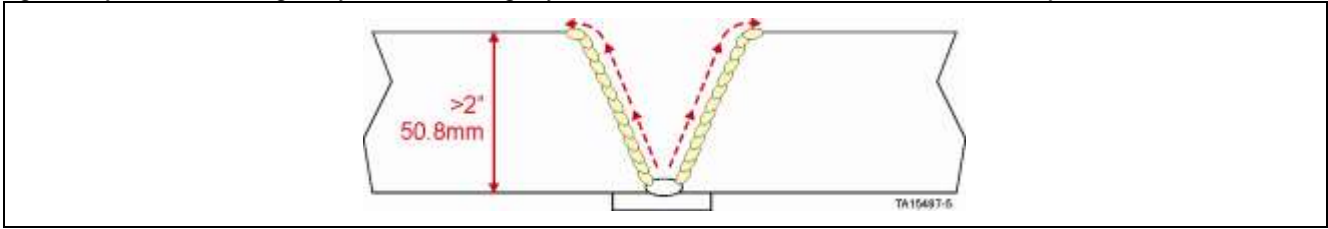
Bead Tempering Finish Passes

The last layer of weld passes must be completed starting from the base material toward the middle of the weld.



Butter Welds

On groove or fillet welds 2" (50.8 mm) deep or larger - butter weld the sides of the groove prior to welding the groove joint. Put a single layer or buttering layer of weld metal on each side of the weld joint.



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Frame Articulation Ball Field Replacement Procedure

NOTICE

The articulation balls on the front frame are matched to the articulation sockets in the rear frame. If an articulation ball is changed – the lower socket on the rear frame must also be changed so that the ball fit will be proper. If a socket is not changed there may be problems with installation of front frame, rapid wear of brass liners, neck wear problems, etc.

Safety Preparations

WARNING


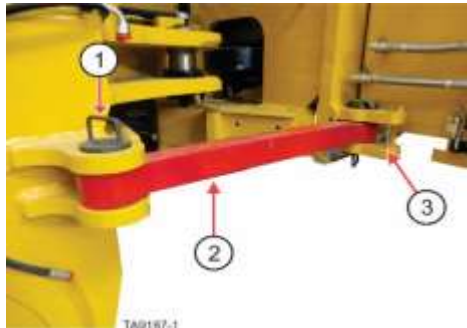
Crush hazards exist if the machine is started or moved while work processes are being performed on the machine. Place bucket flat and level on the ground. Place frame lock in the locked position and lock out the machine's starting capability before performing any work process. Follow all applicable lockout procedures and local rules and regulations for performing work processes. ANYONE performing inspections or service procedures to the machine should be familiar with ALL instructions and procedures contained in the machine's SERVICE MANUAL. Crush hazard could occur if the machine is started or moves while any type of work process is being conducted on the machine, resulting in serious injury or death.

Machine Shutdown and Lockout

1. Stop the wheel loader on flat level ground.
2. Place bucket flat and on level ground.
3. Move the frame lock to the locked position so that the frame cannot be steered.

WARNING

Crush hazards exist in machine pivot area and area between the tires. Do not enter these areas unless it is verified that the operator has control over the steering and that personnel locking the frame lock have good communication with the operator. Entering the pivot area and area between the tires while the machine is moving or pivoting (articulating) could cause crush hazards resulting in serious injury or death.

 <p>TA9187A</p>	 <p>TA9187-1</p>
<p>Gen 1 Frame lock in locked position</p>	<p>Gen 2 Frame lock in locked position</p>
<p>1) Retaining pin for locked position, 2) Frame lock - shown in locked position 3) Retaining pin bracket for un-locked position</p>	

4. Set the parking brakes.
5. Shut off the engine.
6. Place wheel chocks in front and behind each wheel.
7. Lock out the machine's starting capability before performing any cleaning, inspections, or installation and repair procedure.

⚠ WARNING

Crush, shock, or other hazards exist if stored energy is not removed or isolated prior to working on the machine. Stored energy (hydraulic, electrical, pneumatic, mechanical, etc.) may be present if not isolated or released prior to working on the machine. Do not work on the machine without removing this stored energy (suspended loads, electrical power, air pressure, etc.). Risk of crushing, shock, or other physical injury exists if stored energy is not removed or isolated prior to working on the machine which could result in serious injury or death.

8. Turn the battery and engine isolation switches to the off position and install locks on the battery isolation switch.



Isolation and Control switches assembly – Battery isolation switch in OFF position with locks in place

9. Release the air from the hydraulic reservoir by using the hydraulic reservoir air valve (ball valve) on top of the reservoir. The supply line from main air system will be blocked and reservoir air will vent out the hose that runs down the outside of the hydraulic reservoir.

10. Turn the handle to the up position as shown.



Hydraulic reservoir air valve handle UP

11. Release the air from the various air storage reservoirs by opening all of the air bleed valves.

Three valves on right side of rear frame under hydraulic reservoir

One valve on right side of front frame near hoist cylinder ball cap



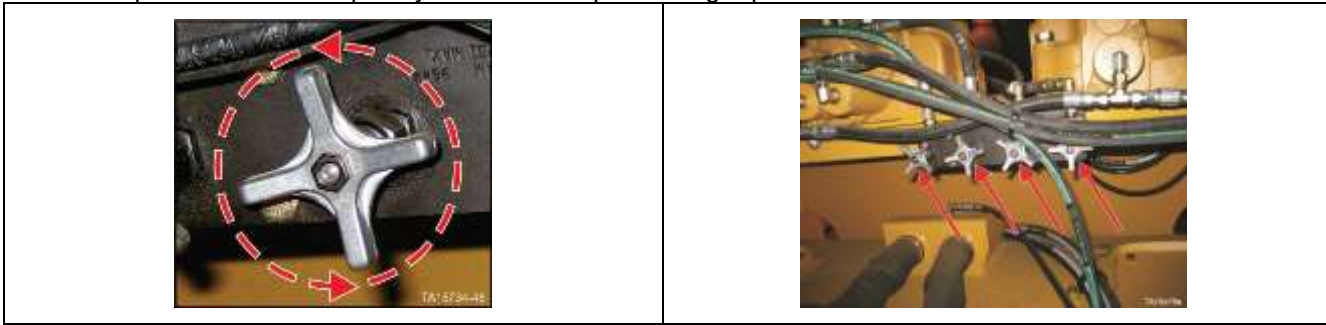
Figure 3. Open air reservoir bleed valves

WARNING

Crush hazards exist if all personnel are not cleared from the bucket and lift arm area before using the hydraulic hoist and bucket hydraulic pressure bleed down valves to relieve pressure from the hoist and bucket circuit. Assembly must be used only when the engine is NOT running. Before using the Manual Bleed Valve Assembly, refer to “HYDRAULIC AND GREASE SYSTEMS”, “MANUAL BLEED VALVE ASSEMBLY”, in Section 04 of the Service Manual for additional operational and safety information. Operating the manual bleed valve may cause the lift arms and bucket to descend rapidly. All personnel around the bucket and lift arms area shall be removed from the area before operating hydraulic hoist and bucket hydraulic pressure bleed down valves. Using the hydraulic bleed down valves could result in movement of the lift arms and bucket which could cause a crush hazard resulting serious injury or death.

12. Use the hydraulic pressure bleed down valves located in the front frame underneath the Husco valves to bleed any stored pressure in the hoist and bucket cylinders.

- 13. Turn each valve slowly counterclockwise as shown below and allow the pressure to bleed down.
- 14. Open the valve completely and leave it open during repairs.



CAUTION

Before performing welding operations on a machine, the fire suppression system circuit monitors panel's in-line fuse must be removed. The fuse is located in the battery box on some machines. Failure to do so may cause the system to actuate and/or damage the solid-state components of the system. Replace the in-line fuse before the machine has been started or after all welding operations have been completed.



Fire suppression in-line fuse located in loader battery box on some machines

⚠ WARNING

Fall hazard exists when working at heights. Be sure to take appropriate safety precautions when working at heights on the rear and front frames or the lift arms balls. Follow all required statutory regulations for working at height. Wear fall restraint when necessary to prevent falls. Failure to take appropriate safety precautions, including wearing fall restraint when necessary can cause fall hazards resulting in serious injury or death.

⚠ WARNING

Crush hazards exist if standing under, working, or placing any body part under hoisted/suspended components. Never stand under hoisted/suspended components. Ensure appropriate lifting devices are used, and blocking is adequate to prevent the component from unexpectedly moving during transportation. Refer to SAFETY, WARNINGS, AND CAUTIONS before attempting to remove the operator's cab. Failure to stay out from under hoisted/suspended components can cause crush hazard resulting in serious injury or death.

Burn Hazard

WARNING

Burn and inhalation hazards exist when welding or cutting on the machine. Cutting and welding can produce hot surfaces. Smokey condition can exist if a fire starts. Have qualified fire watch personnel present, and keep a fire extinguisher that meets all statutory regulations nearby during all cutting and welding operations. Failure to provide a qualified fire watch and an appropriate fire extinguisher can cause fire and inhalation hazards resulting in serious injury or death.

Summary

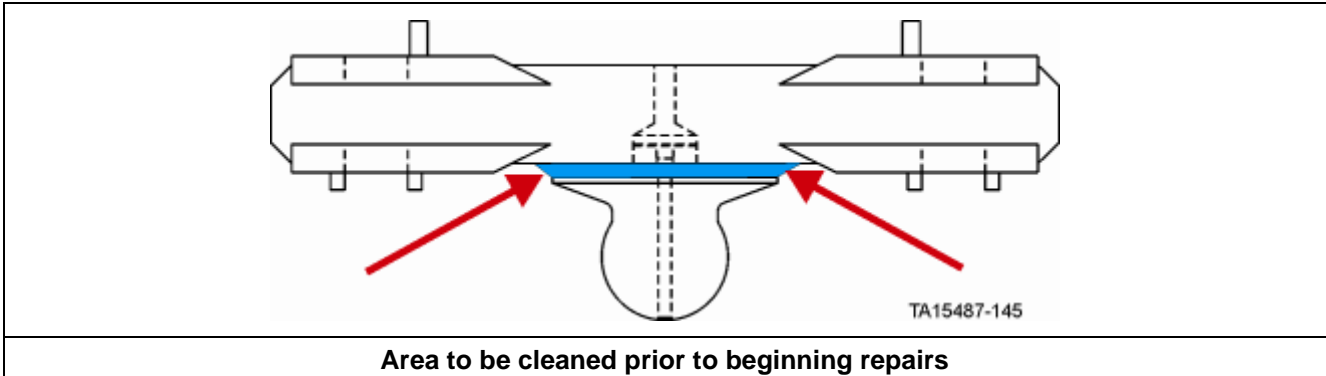
1. Frame will typically have to be separated to replace a ball.
2. Welding Consumables:
 - 1) Crack repair in base material: E7018 electrode or E71T-12MJH4 wire.
 - 2) Ball installation: E-8018C3 electrode or E81T1-NiMJH4 wire.
3. Slab preheat for air arc: 250° F (121° C) for 6" (152 mm) from weld in all directions.
4. Slab preheat for welding: 300° F (149° C) for 6" (152 mm) from weld in all directions.
5. Interpass temperature maximum 450° F (232° C).
6. Stringer beads.
7. Post heat and slow cool.
8. Wait 48 hours and UT (ultrasonic testing) and MT or PT weld area (magnetic particle or dye penetrant).
9. Re-Commissioning after Campaign Ball Replacement.

NOTICE

Komatsu uses Lincoln Ultracore E71T-1MJ along with gas that is 75% Ar/25% CO₂ for installation of the balls. This combination of gas and wire gives a tensile strength of 83,000 psi (572 MPa) which meets the specifications for E80XX wire.

Preparation and Crack Removal

1. Separate the front frame from the rear frame.
2. Clean the repair area free of dirt and grease.



3. Prepare suitable protection to protect the personnel and loader from cold, wind, dust, etc.
4. If changing the upper articulation ball - install appropriate scaffolding equipment or stands and safety precautions for work at height.

WARNING

Fall hazard or crush hazard exist when working on scaffolding. The scaffolding or work stand must have the capacity to hold 3-4 people and the ball. The scaffold could collapse if it is not built sufficiently to hold the weight. It must also meet all local safety requirements. Failure to provide an appropriate scaffold can cause fall or crush hazards resulting in serious injury or death.





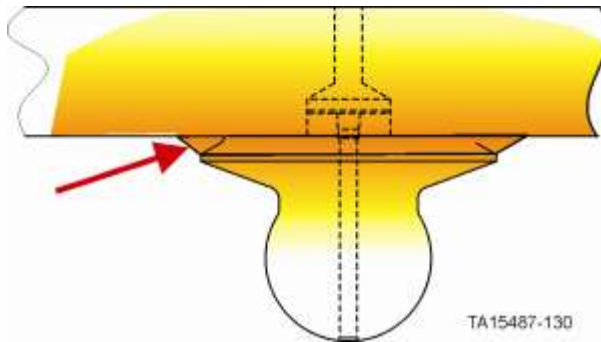
TA15487-241



TA15487-230

Provide protection

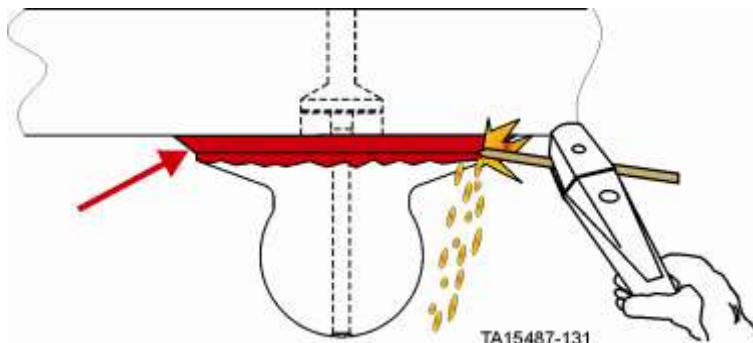
- Preheat the slab to 250° F (121° C) and use air arc to remove the old weld.



TA15487-130

Preheat ball base and slab

- Cut away the weld and ball material.



TA15487-131

Weld removal on frame articulation ball

CAUTION

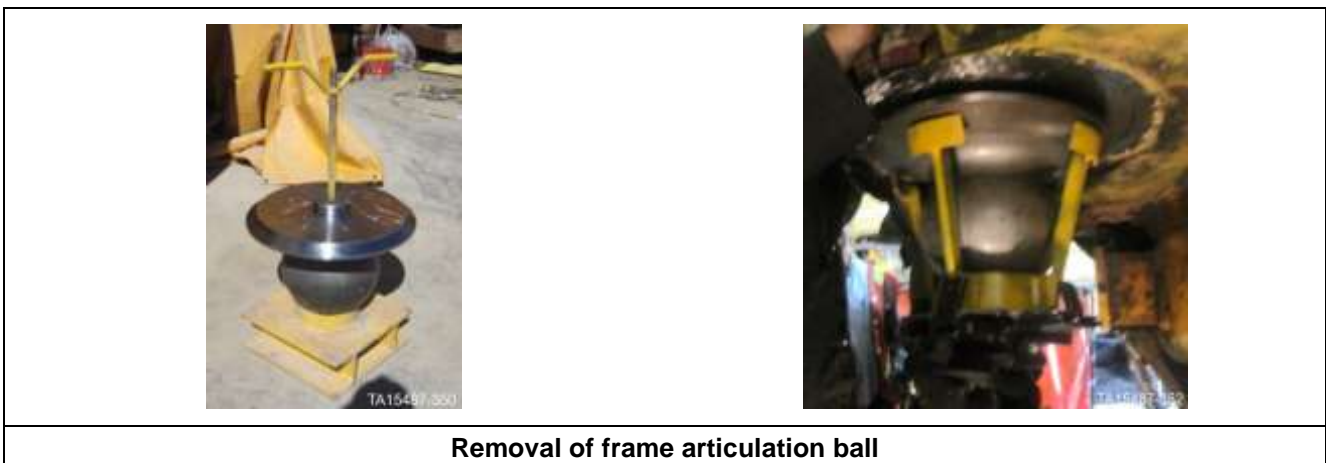
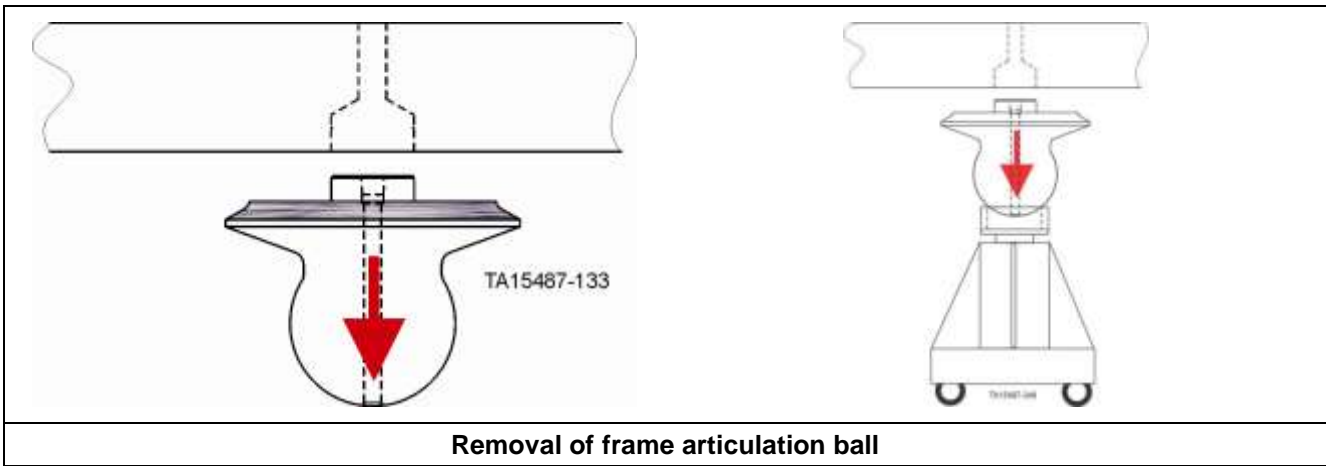
Do not cut into the slab.

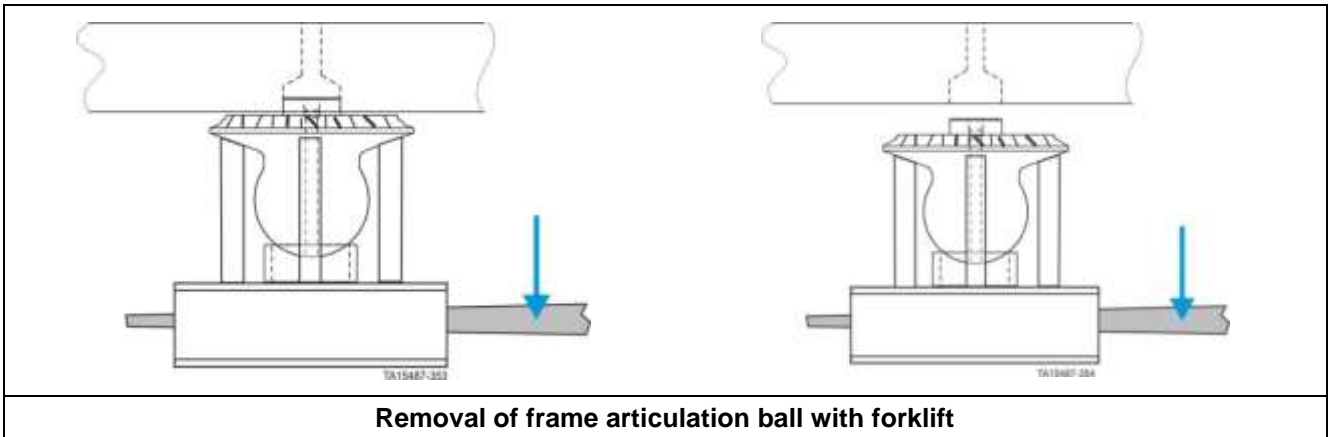
- The ball base is very heavy. Prepare suitable lifting to support the ball once it has been cut loose.

⚠ WARNING

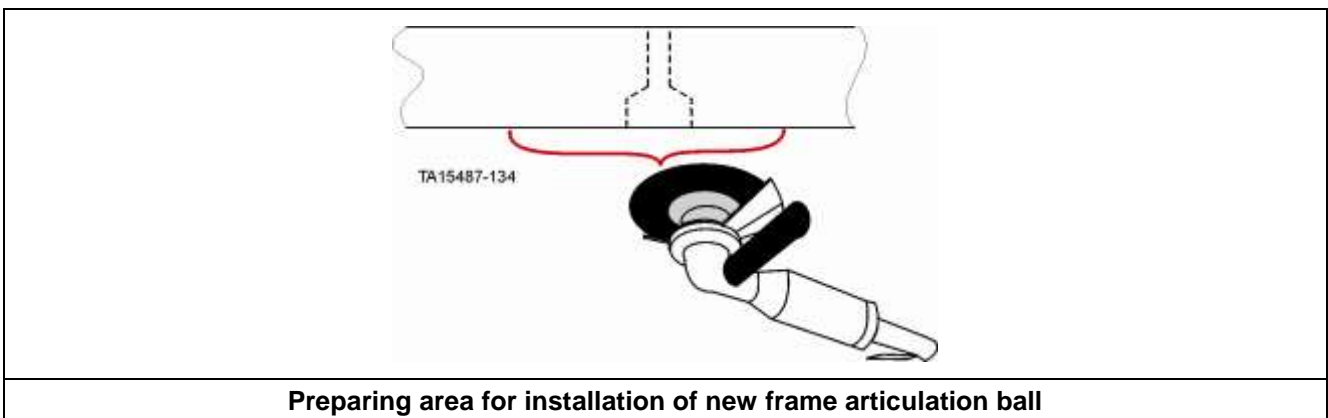
Crush hazard exists when cutting the ball loose from the frame. The ball base is heavy and should be properly supported prior to cutting it loose from the frame. If the ball is not properly supported, it can fall and cause a crush hazard. Failure to properly support the ball prior to cutting it from the frame can cause crush hazards resulting in serious injury or death.

Machine	Size	P/N	Weight
950/1150	7.5"	410-2456	170 lb.(77 kg)
1350/1850	9"	416-8156	231 lb. (105 kg)
L-1850 Gen2 / 2350	12"	424-7949	430 lb. (195 kg)

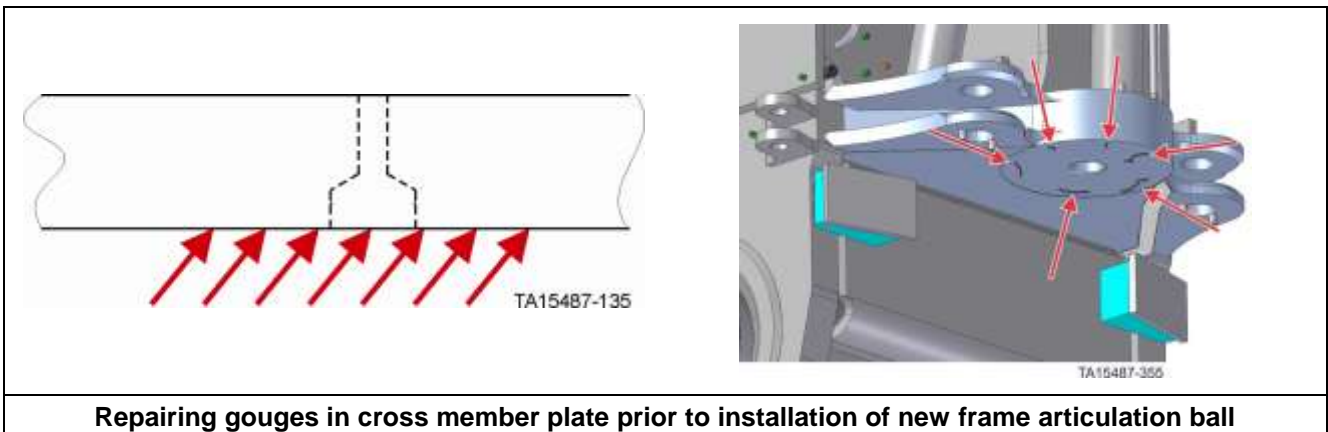




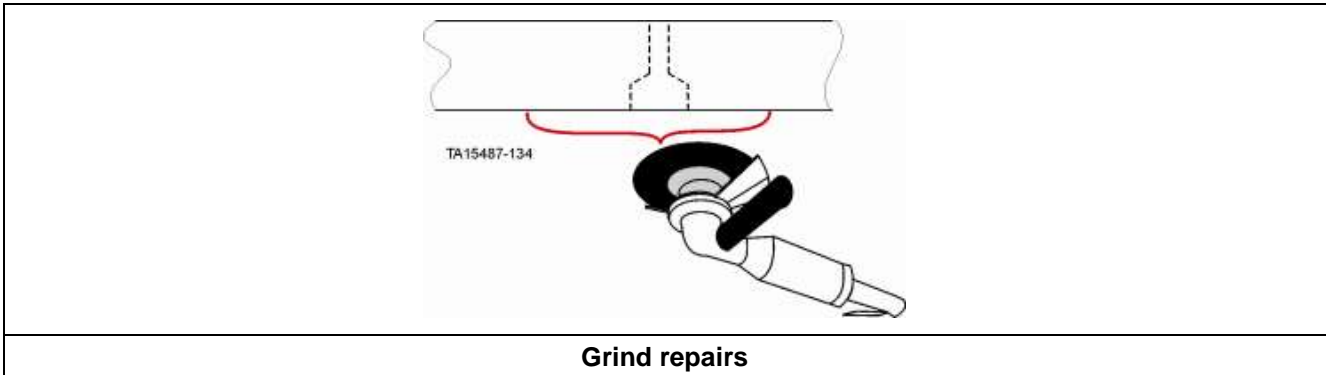
8. Grind the area smooth to remove any carbon left from the cutting process.



9. After grinding to clean smooth base material, inspect the slab plate with magnetic particle dry method to identify any cracks.
10. Remove the cracks with air carbon arc gouging process until they cannot be seen visibly, at the same time forming a single V groove with a 30-45 degree angle.
11. Use a hand grinder to grind the gouged surfaces smooth.
12. Inspect the ground out groove with magnetic particle dry method to verify that the cracks have been remove.
13. Repair any gouges or cracks in the cross member plate while it is still hot, using E70XX welding consumables.

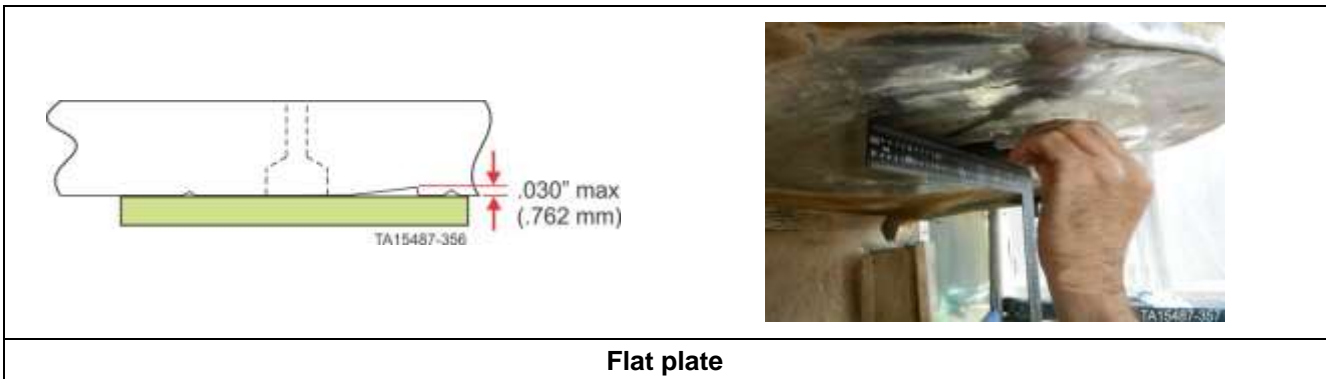


14. Grind smooth, any repairs to the slab.

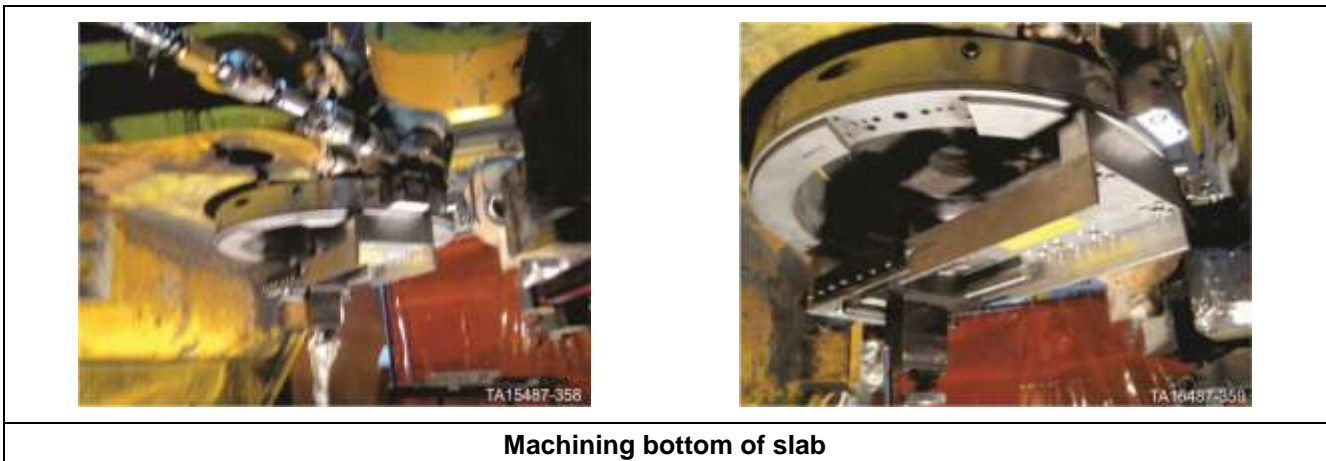


15. Measure flatness of the bottom of slab.

16. Maximum of .032" (.8mm) allowed in the contact area of the ball.

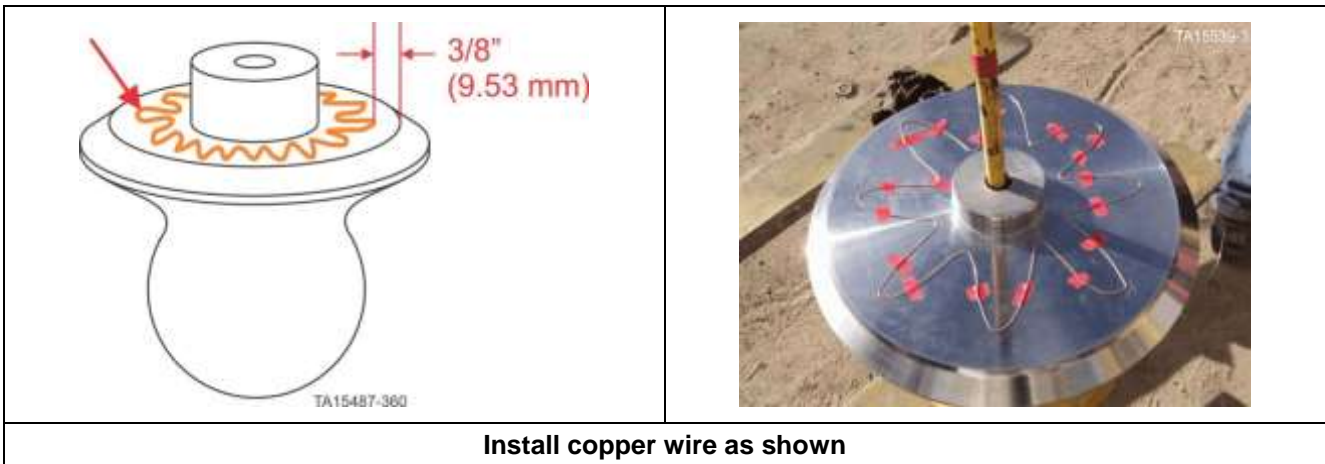


17. If the slab is not flat to this specification – then it will be required to machine the surface flat.



Ball Installation

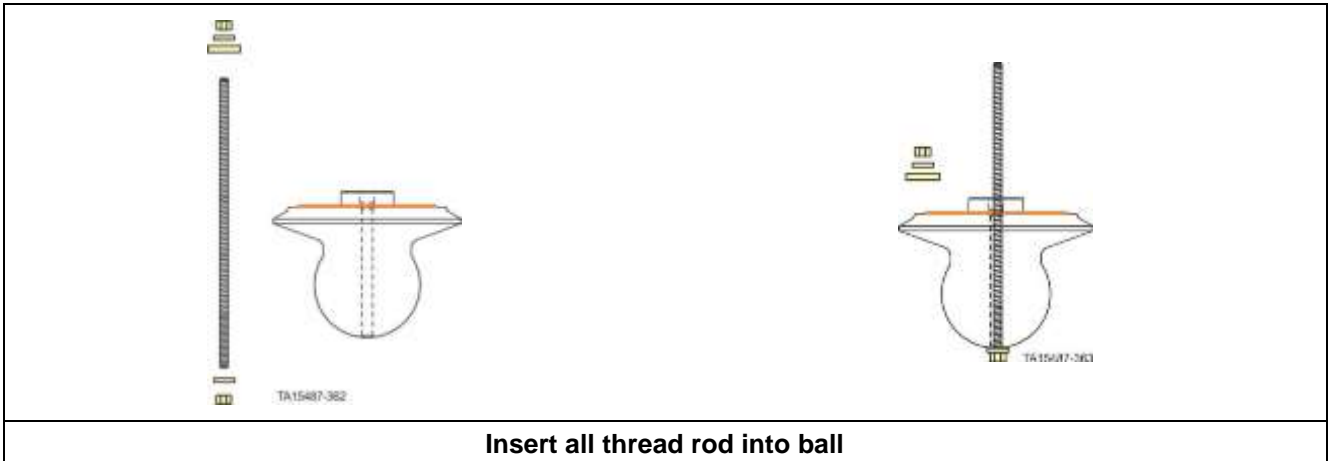
1. Place a 1/16" (1.59 mm) diameter (approximate) soft copper single conductor wire (typical 12 or 14 gauge electrical wiring is suitable) around the ball base in a weave pattern as shown. Space the wire away from the edge of the ball base so that the wire does not melt into the weld.



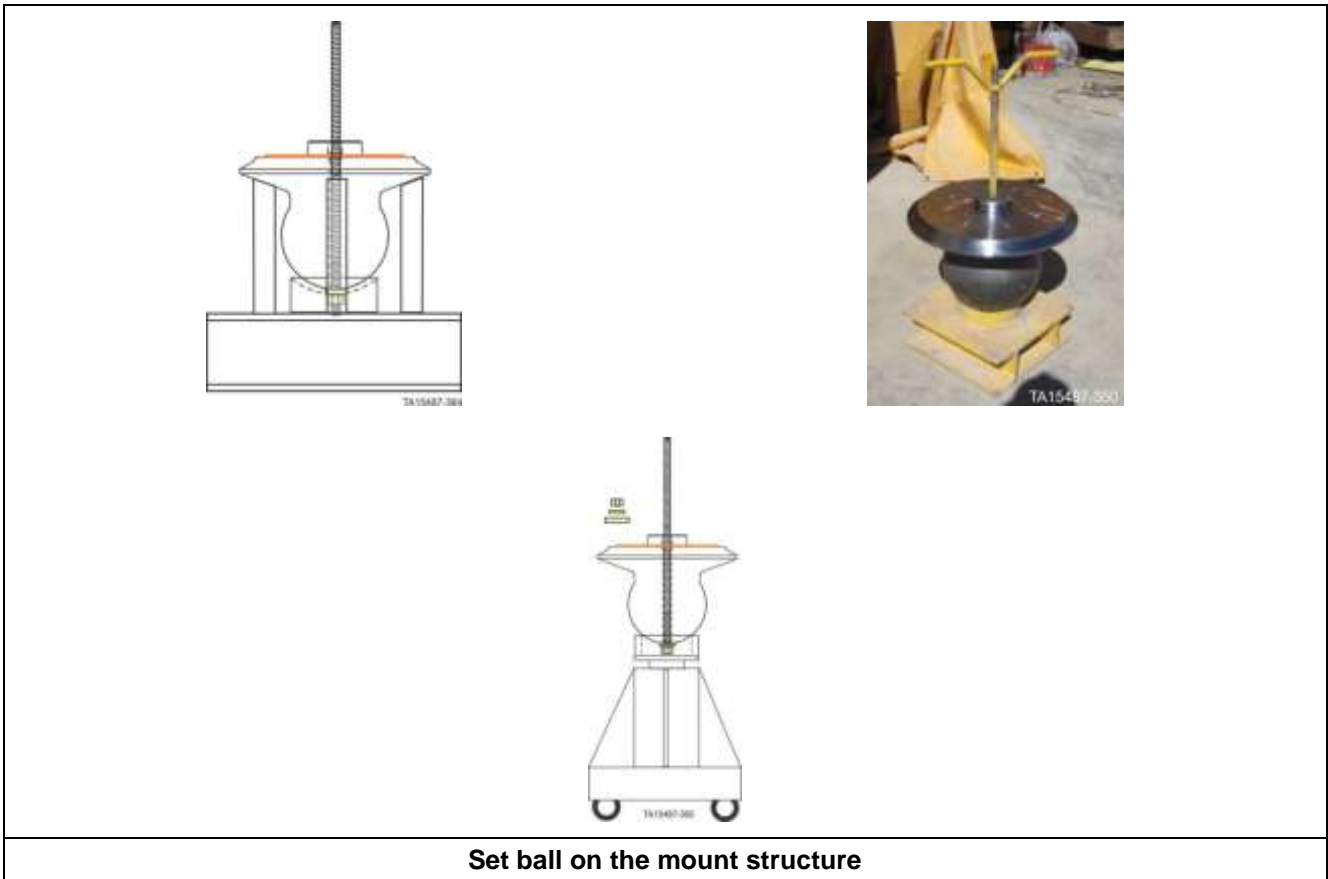
2. Tape the wire in place so it cannot move during subsequent handling.
3. NOTES for upper frame articulation ball:
 - a. If the upper frame articulation ball is being changed – the wire will be placed on the slab rather than the ball.

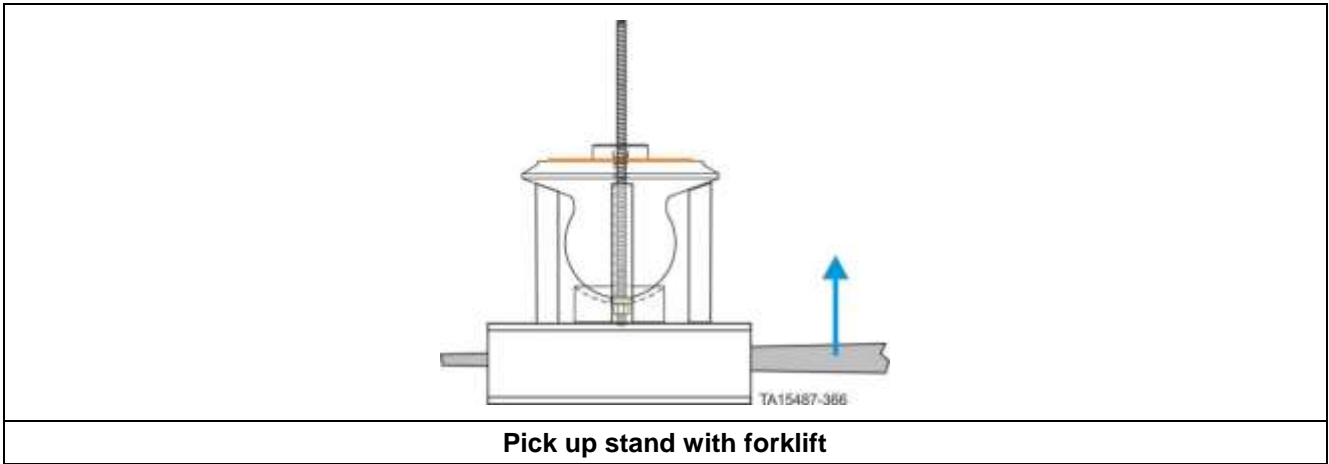


4. Insert all thread rod through the center of the ball.



5. Position the new ball base on a stand so that it can be lifted into position.

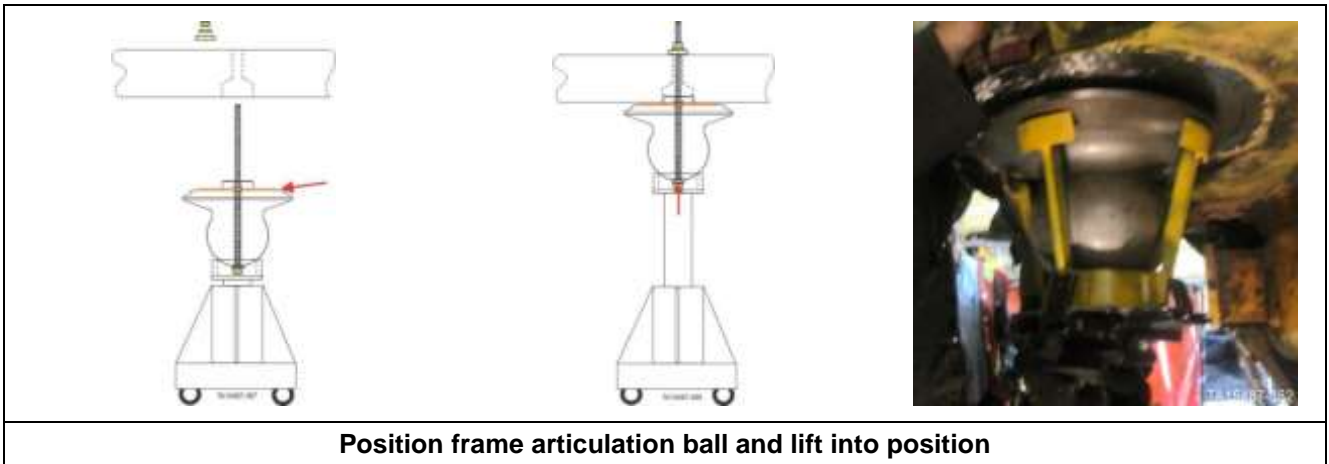




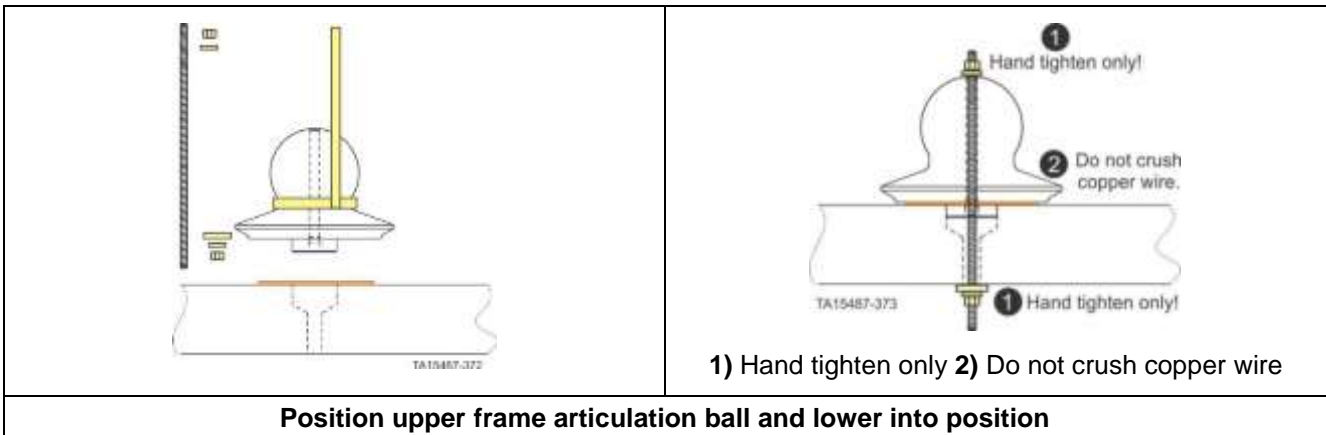
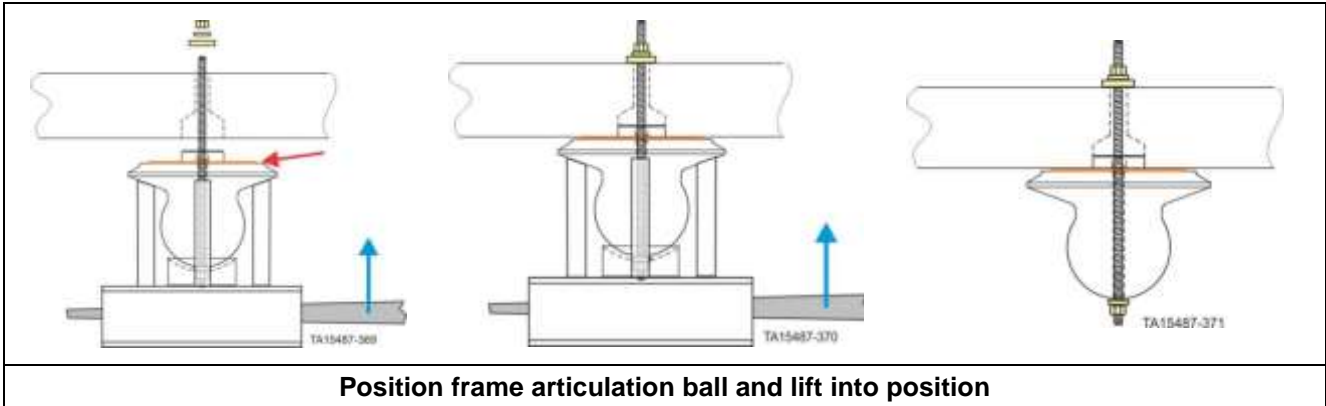
⚠ WARNING

Crush hazard exists when attaching the ball to the frame. The ball base is heavy and should be properly supported as it is attached to the frame. If the ball is not properly supported, it can fall and cause a crush hazard. Failure to properly support the ball when installing it on the frame can cause crush hazards resulting in serious injury or death.

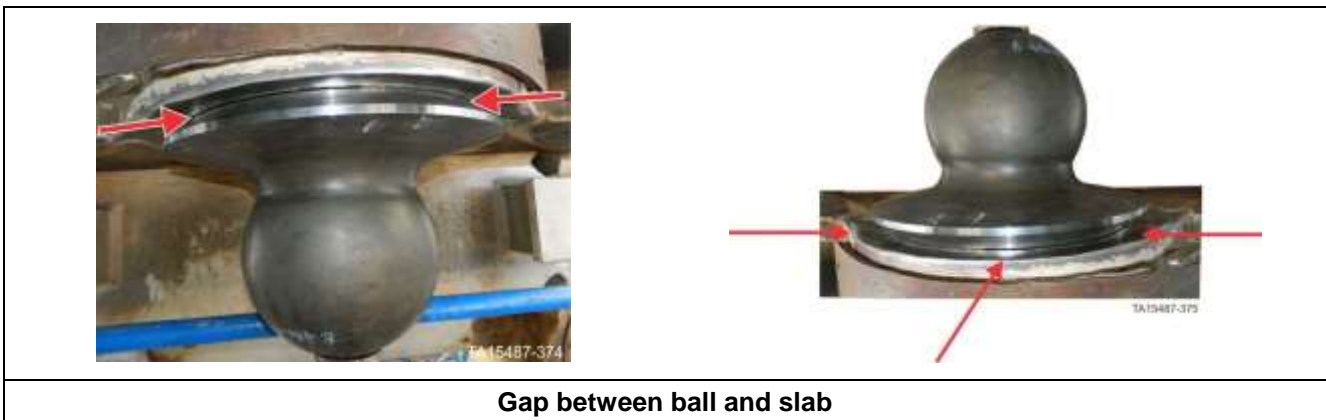
Frame Articulation Balls			
Machine	Size	P/N	Weight
950/1150	7.5"	410-2456	170 lb. (77 kg)
1350/1850	9"	416-8156	231 lb. (105 kg)
L-1850 Gen2/2350	12"	424-7949	430 lb. (195 kg)



6. Lift the ball base into position. The pilot hole in the cross member plate will position the ball properly.

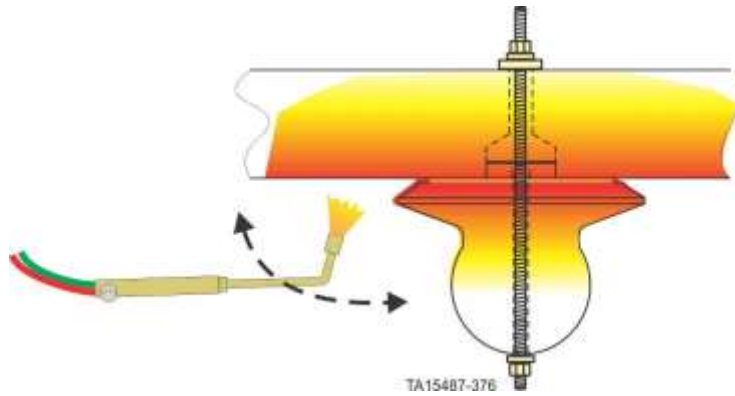


7. NOTE: for upper frame articulation ball -
- a. Lower ball into place.
 - b. Install all thread, washers and nuts.
 - c. Do not crush the wire – hand tighten only.
8. The gap between the slab and the ball should be the same 1/16" (1.6 mm) all around. If the gap is not the same then the ball should be removed and the problem corrected.



9. The nut on the all thread should be tightened enough to hold the ball in position. It should not be over tightened where it crushes the copper wire. The 1/16" (1.6 mm) spacing of the copper wire should be maintained.

- Preheat the plate around the perimeter of the ball base until the temperature is 300° F (149° C). Do not exceed this temperature on the ball.

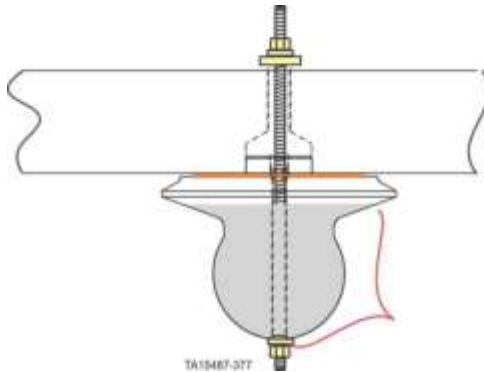


Preheat slab and ball base

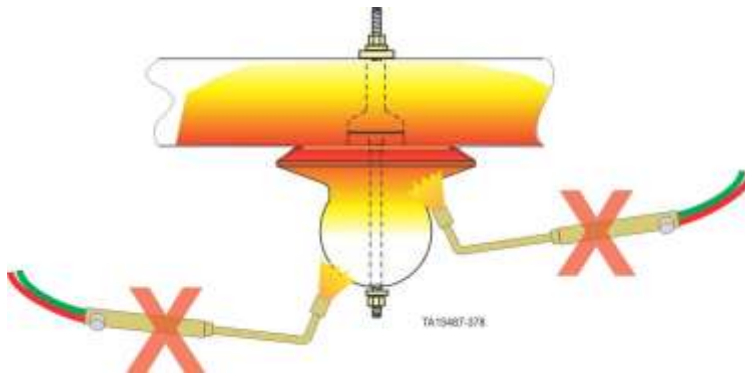
CAUTION

DO NOT apply heat or flame to the carburized neck or spherical portion of the ball base with a torch flame as this will reduce the hardness of the ball and can cause subsurface cracking.

- The spherical part of the ball base is heat treated by carburizing.



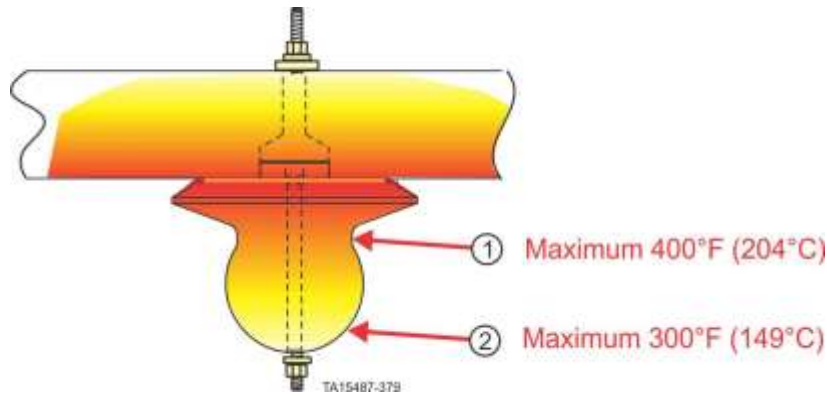
Carburized area of ball



DO NOT contact carburized area of ball with flame

12. Monitor the ball temperature during preheating and during the welding process:

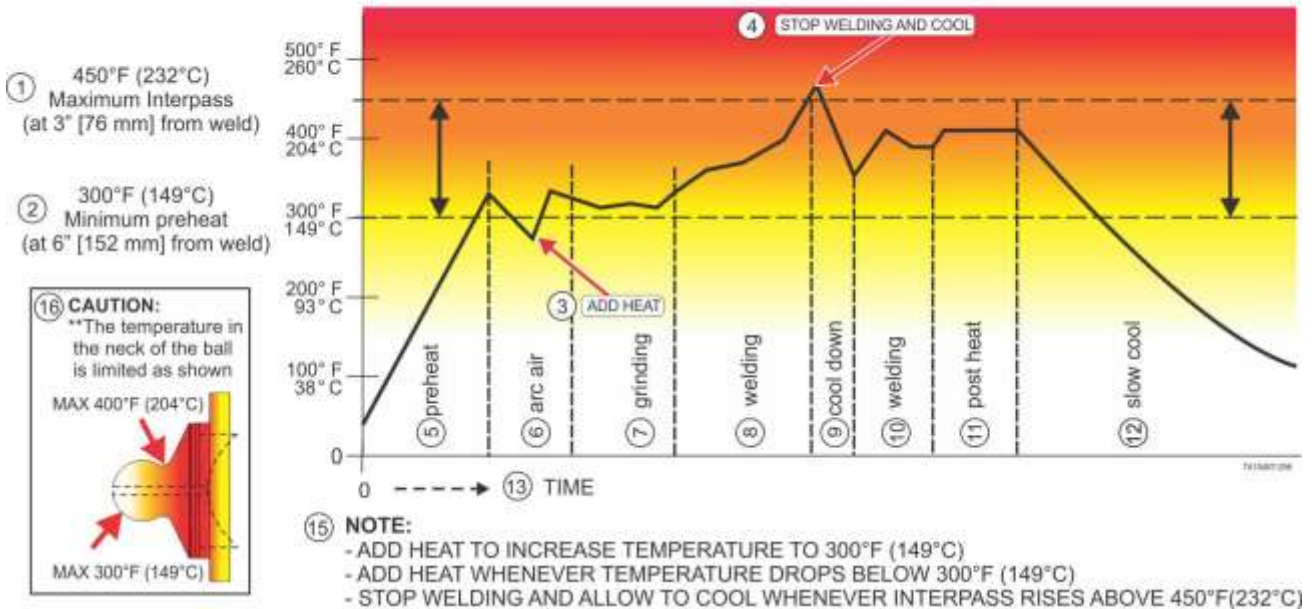
- a. Monitor the neck area of the ball base during welding to ensure that the temperature never exceeds 400° F (204° C). If the temperature comes close to this then the welding must be stopped and allow time for the ball to cool.
- b. Monitor the spherical area of the ball base during welding to ensure that the temperature never exceeds 300° F (149° C).



Maximum ball temperature

- 1. Maximum 400° F (204° C)
- 2. Maximum 300° F (149° C)

14 BALL INSTALLATION
TEMPERATURE LIMITS FOR WELDS** ON BALL INSTALLATION



- 1) 450° (232°C) Maximum Interpass (at 3" [76 mm] from weld)
- 2) 300° (149°C) Minimum Preheat (at 6" [152 mm] from weld)
- 3) Add heat
- 4) Stop welding and cool
- 5) Preheat
- 6) Arc Air
- 7) Grinding
- 8) Welding
- 9) Cool Down
- 10) Welding
- 11) Post Heat
- 12) Slow Cool
- 13) Time
- 14) Ball Installation Temperature Limits for Welds** on Ball Installation
- 15) NOTE: - Add heat to increase temperature to 300°F (149°C) -Add heat whenever temperature drops below 300°F (149°C) -Stop welding and allow to cool whenever interpass rises above 450°F (232°C)
- 16) CAUTION: **The temperature in the neck of the ball is limited as shown Max 400°F (204°C) Max 300°F (149°C)

Preheat – maintained throughout the welding process

Welding Wire

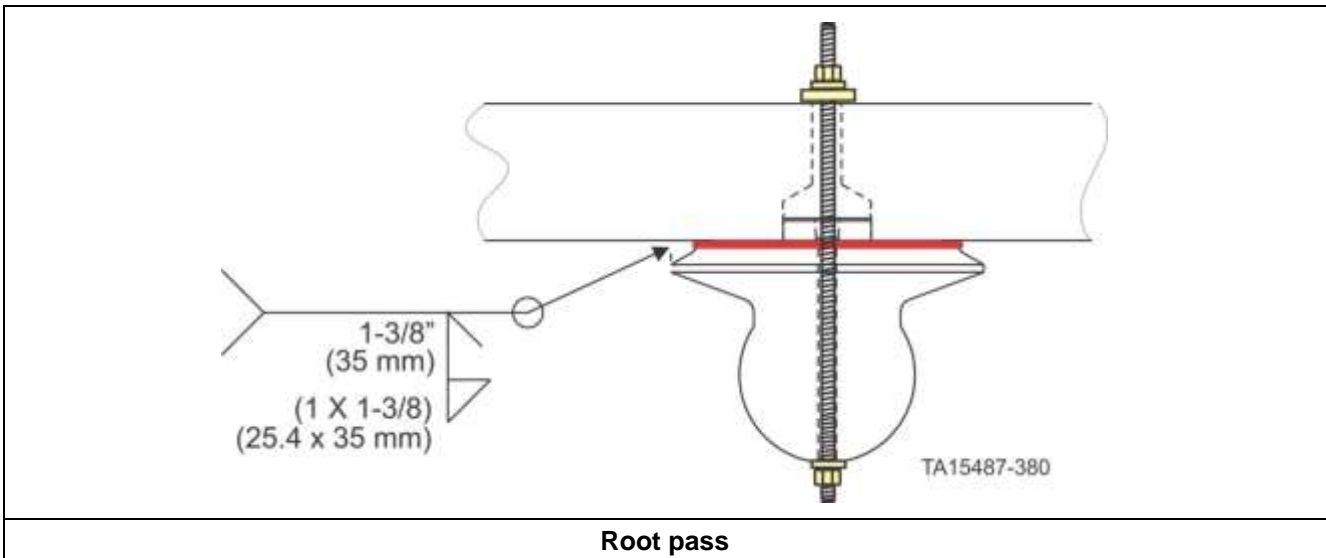
1. Typical wire sizes used for FCAW welding will be .045" (1.2 mm), .052" (1.4 mm) or 1/16" (1.6 mm) diameter. The most commonly used sizes are .052" (1.4 mm) or 1/16" (1.6 mm).
2. Wire consumable for field welding of ball installations is E8xT- xxxx series wire.

NOTICE

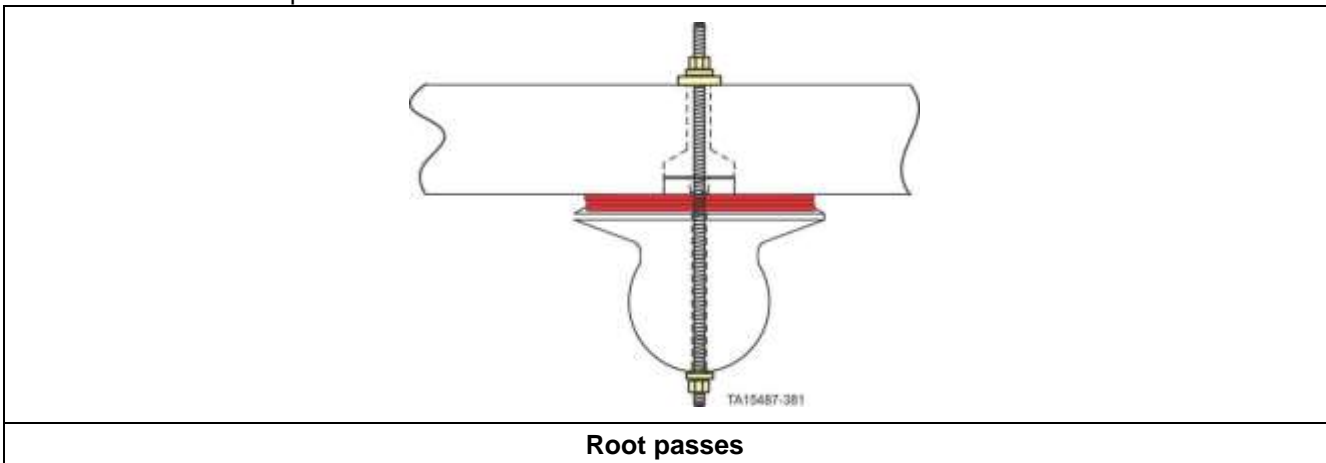
The factory will consider approving other wire types depending on the specifications of the wire. For example: Komatsu uses Lincoln Ultracore E71T-1MJ along with gas that is 75% Ar/25% CO₂ for installation of the balls. This combination of gas and wire gives a tensile strength of 83,000 psi (572 MPa) which meets the specifications for E80XX wire.

Electrodes

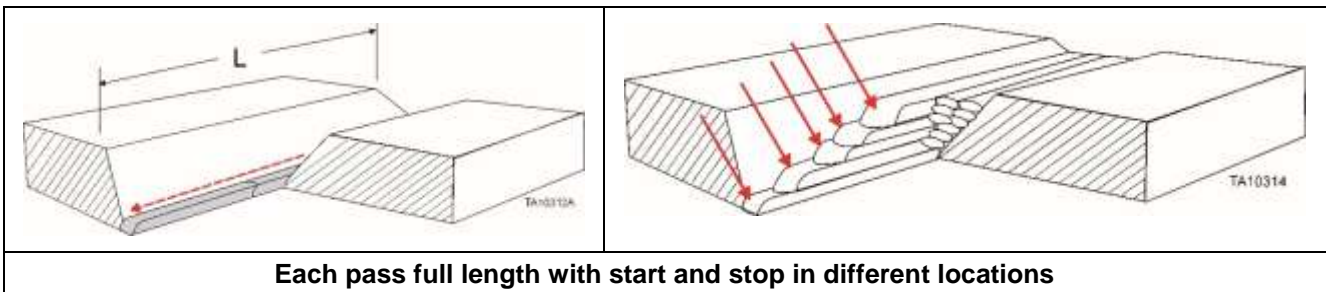
1. Electrodes for SMAW are specified to be low hydrogen in one of the following series (7018, 8018, 9018, etc.) as specified for each type of material and procedure.
2. Typical electrode sizes for SMAW will be 1/8" (3.2 mm) for root passes and 5/32" (4 mm) for the remainder.
3. Storage and handling of low hydrogen electrodes:
 - a. Use new low hydrogen electrodes that are provided in hermetically sealed packages. Do not use old electrodes for structural repairs. Old electrodes are defined as those that were removed from a sealed package more than 1 month earlier and have been kept in an oven.
 - b. Remove only one hour's supply of electrodes at a time. Keep the remainder in a ventilated holding oven at 225° F (107° C).
 - c. Bake previously opened packages of electrodes in a ventilated oven at 500° F (260° C) for two hours before using.
 - d. Electrodes taken from cardboard boxes or a non-airtight container should also be baked at 500° F (260° C) for two hours in a ventilated oven.
 - e. Then the electrodes should be placed immediately in a ventilated holding oven set at 225° F (107° C).
 - f. Any electrode exposed to the air for more than four hours should be re-baked per the instructions above.
4. Use an 80 series consumable for field welding of ball installations.
 - a. Weld root passes with E-8018C3 series 1/8" (3.2 mm) diameter electrodes.
 - b. If using SMAW E-8018C3 – weld the first 3 root passes with 1/8" (3.2 mm) rod.



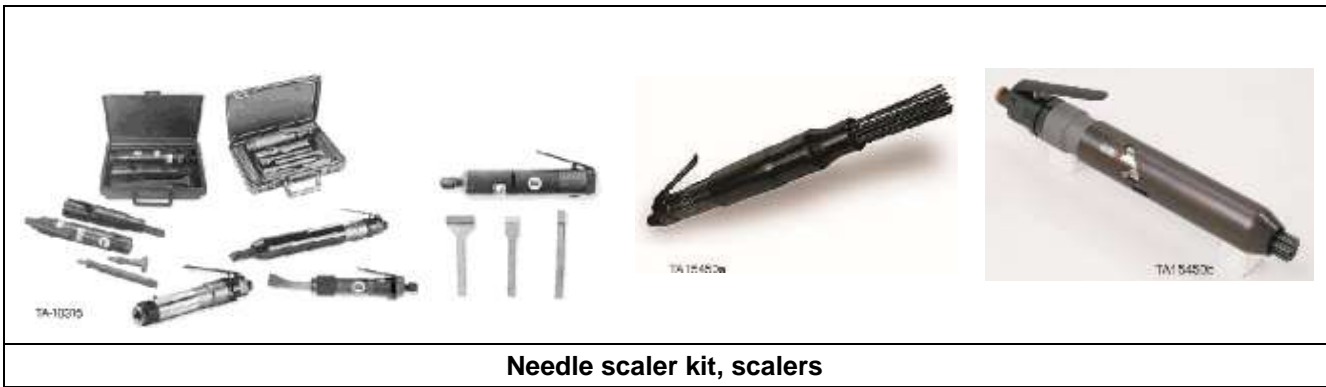
c. Weld the build passes with E-8018C3 series electrodes or E8xT-xxx FCAW wire.



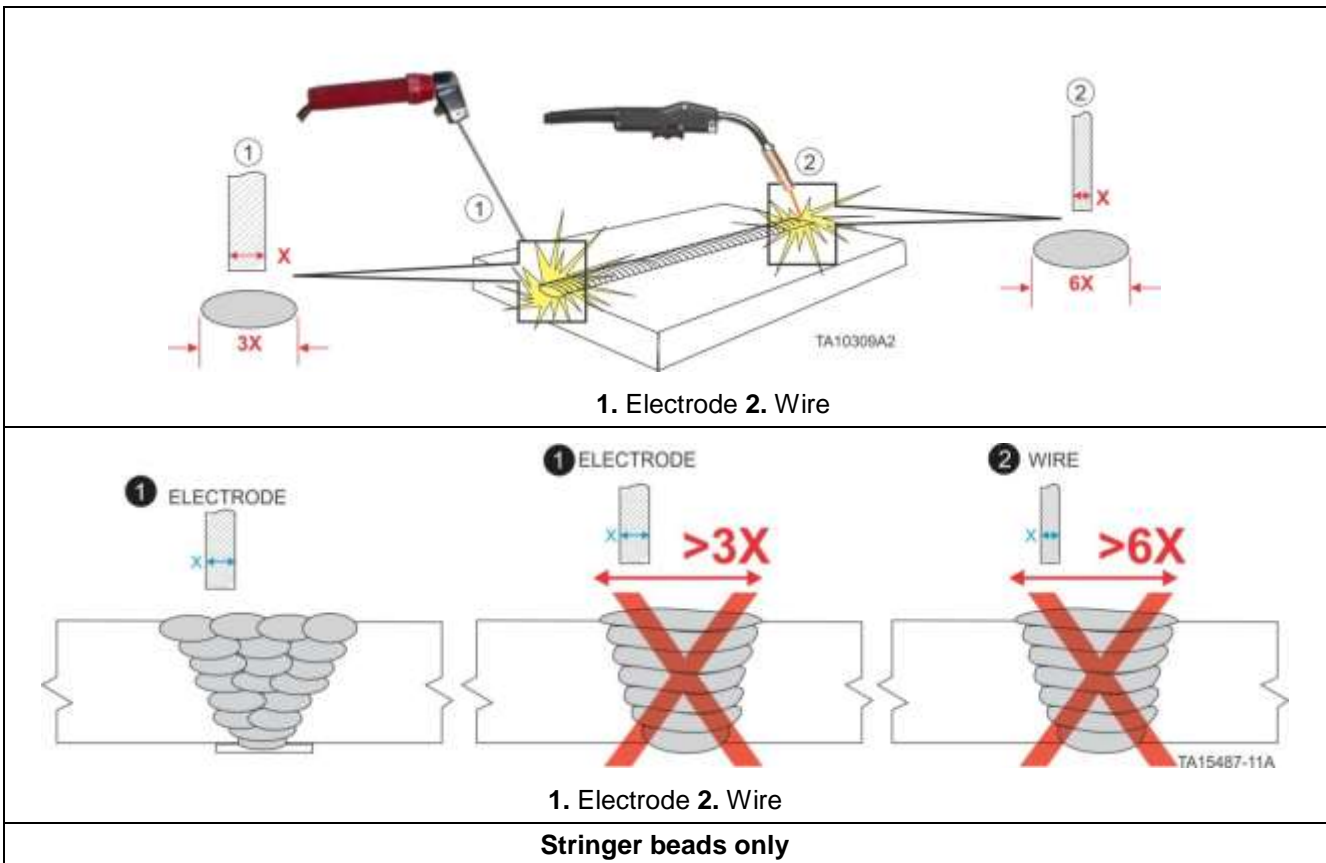
5. Finish each pass all around the diameter of the weld. DO NOT weld in sections.
6. Each weld pass must start and stop in a different location from the previous pass.



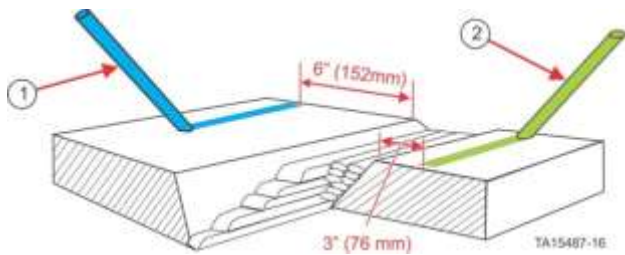
7. After welding each root pass remove the slag with a needle scaler air tool.



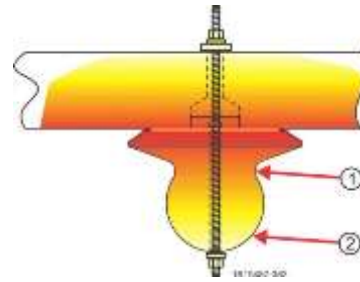
8. If using SMAW E-8018C3 – weld the rest of the passes with 5/32" (4 mm) rod.
9. After welding each filler pass, remove the slag with a needle scaler air tool.
10. Do not weave weld. Only multi pass stringer beads are allowed.



11. Continue to monitor temperatures after each weld pass: The welding should be stopped whenever the interpass or neck temperature becomes hotter than specification. DO NOT force cool by using fans or water. Heat should be added if the temperature drops below the preheat minimum.
 - a. Preheat temperature minimum 300° F (149° C).
 - b. Interpass temperature maximum 450° F (232° C).
 - c. Ball neck temperature maximum 400° F (204° C).



- 1) 300° F (149° C) temperature stick for preheat temperature
- 2) 450° f (232° c) temperature stick for interpass temperature



- 1) 400° F (204° C) temperature stick for neck temperature
- 2) 300° f (149° c) temperature stick for ball temperature

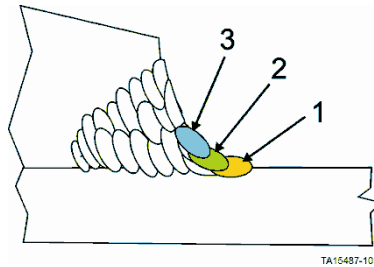
Monitor temperatures during welding

12. Record the temperatures in the preheat and interpass heat logs every hour.

BALL PREHEAT AND INTERPASS RECORD (articulation ball)						
Location:		Supervisor:				
Loader type and serial number:		Date:				
Ball description and location:		Ball serial numbers:				
Welder	Sequence	Actual clock time	TEMPERATURE			
			Ball face	Ball Neck	Ball Sphere	
1	0 HOUR		A			
2			B			
1	1 HOUR		C			
2			D			
1	2 HOUR		A			
2			B			
1	3 HOUR		C			
2			D			
1	4 HOUR		A			
2			B			
1	5 HOUR		C			
2			D			

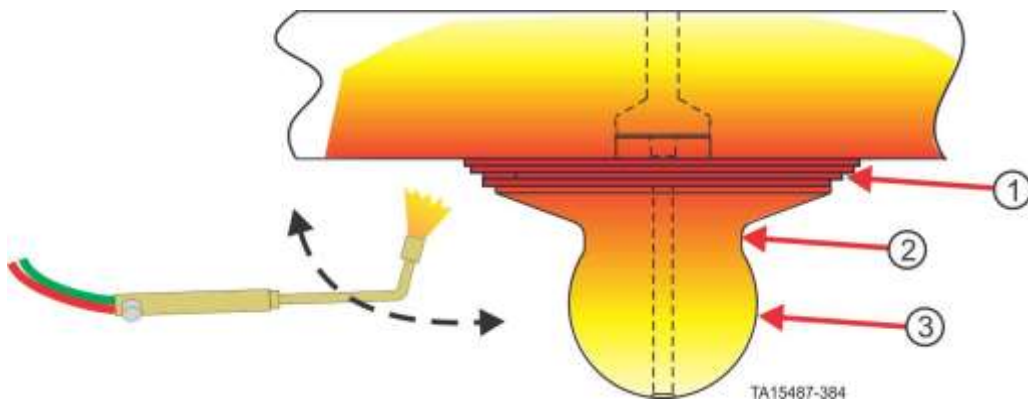
TA15487-383

13. On the last layer the weld sequence is critical. Proper sequencing of the welds (bead tempering) uses the heat from subsequent passes to temper the earlier passes. This will reduce the stress in the junction between the weld and the base material.
- 1st pass must be on the base material.
 - 2nd pass must be above the 1st pass.
 - 3rd pass must be above the 2nd pass.



Bead tempering weld order on the last weld layer.

14. The cap passes must be blended smooth.
15. Inspect the weld profile with a profile gauge to assure it meets specifications. Add weld as required to meet specifications.
16. Post heat to 400° F (204° C) for one hour.



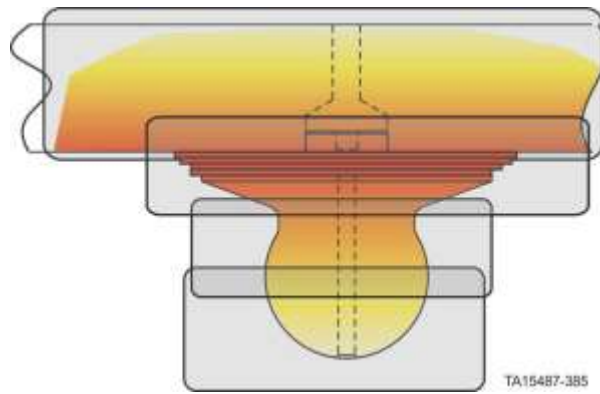
Post heat

- 400° F (204° C)
- 400° F (204° C) Maximum
- 300° F (149° C) Maximum

NOTICE

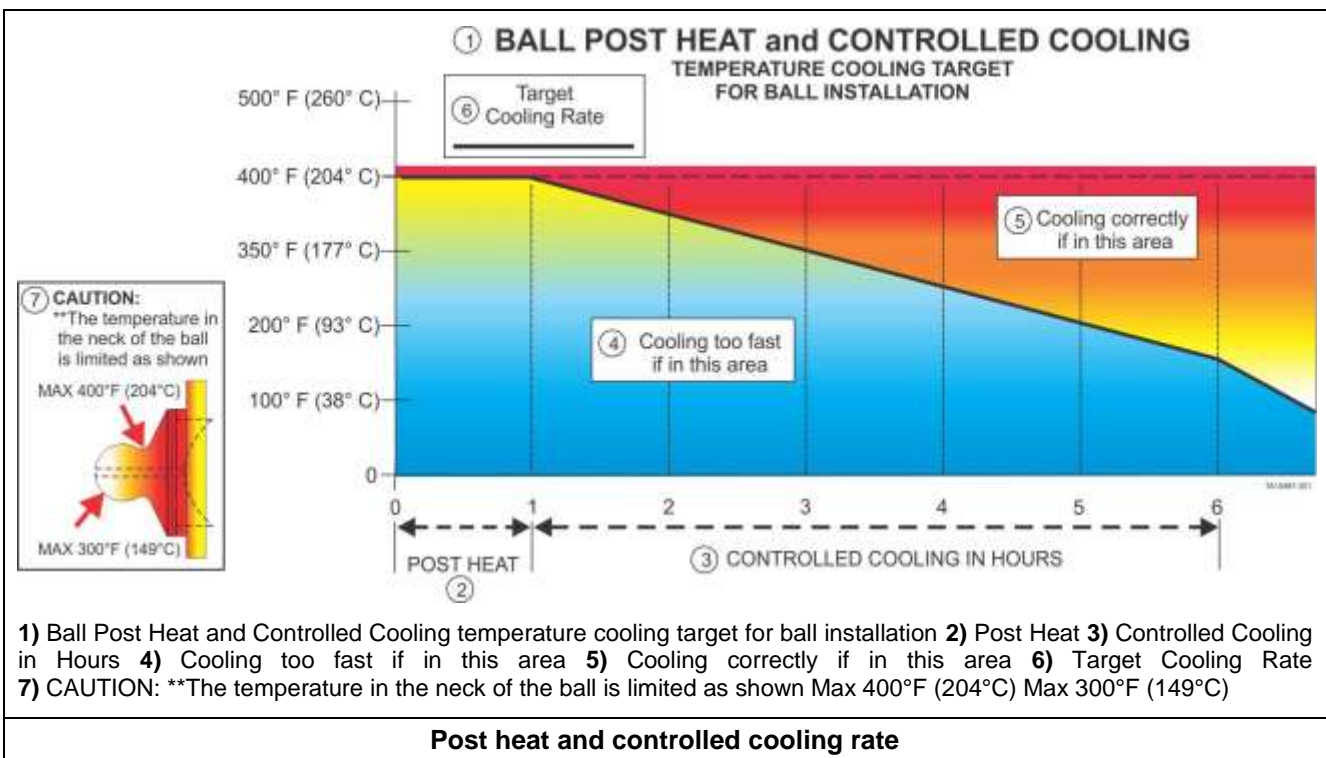
This post heat **ONLY** applies to the weld area. The neck and ball are still limited to the same maximum temperatures of 400° F (204° C) in the neck and 300° F (149° C) in the ball.

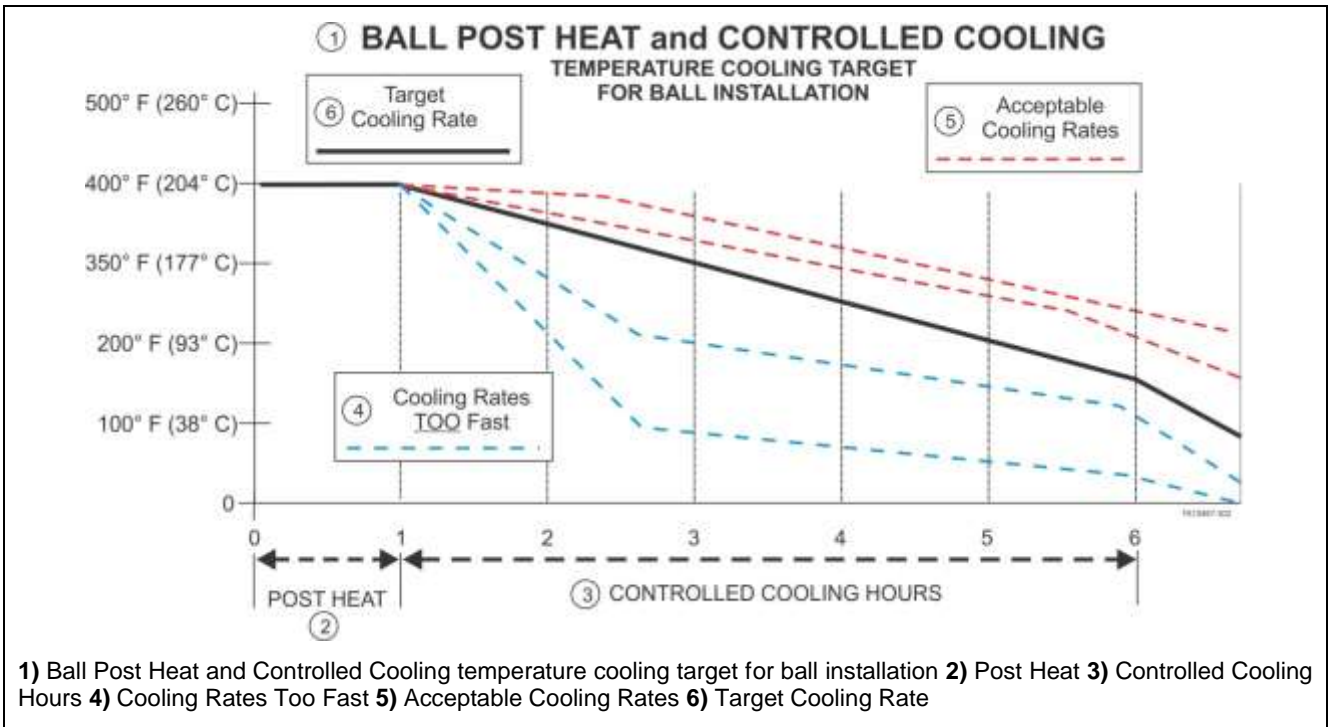
17. Cover the ball with insulation material and allow to slow cool.



Slow cool (area covered with insulation)

18. Monitor the cooling rate:





Examples of acceptable cooling rates

CAUTION

The cooling rate is critical. Excessive cooling rates may cause cracks. This must be closely monitored because the frame structure is a large heat sink and can dissipate heat very quickly.

The following is a sample post heat form. A full size form is provided in the appendix.

ARTICULATION BALL POST HEAT

Follow the post heat instructions found in the ball replacement chapters of the "Field Welding Procedure (formally called LET-1)". The most up to date copy of this document is kept on the LeTrak knowledge base and KB article #436.

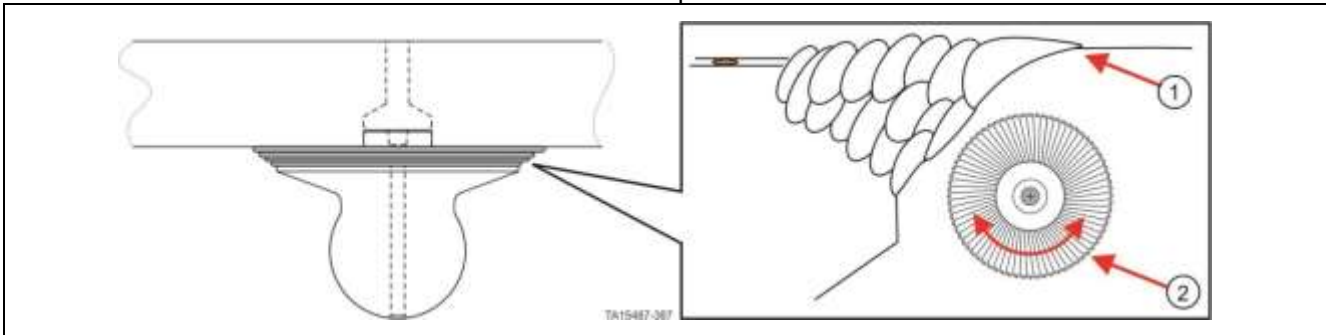
Action	Actual Clock Time	Elapsed Time (min / hr)	Target Temp	Actual temp
Post Heat Starts			400° F (204° C)	A B C D
Post Heat Finishes		1 hour	400° F (204° C)	A B C D
Cooling		1.5 hour	375° F (191° C)	A B C D
Cooling		2.5 hour	350° F (177° C)	A B C

TA15AB7-386

Post heat

19. After the weld has cooled sufficiently - blend grind the weld around the ball.

- a. The grinding direction is across the weld.
- b. The blend should not be undercut into the base plate.



Blend grind - smooth finish, no grinding marks

- 1. No undercut
- 2. Grinding across the weld direction

NOTICE

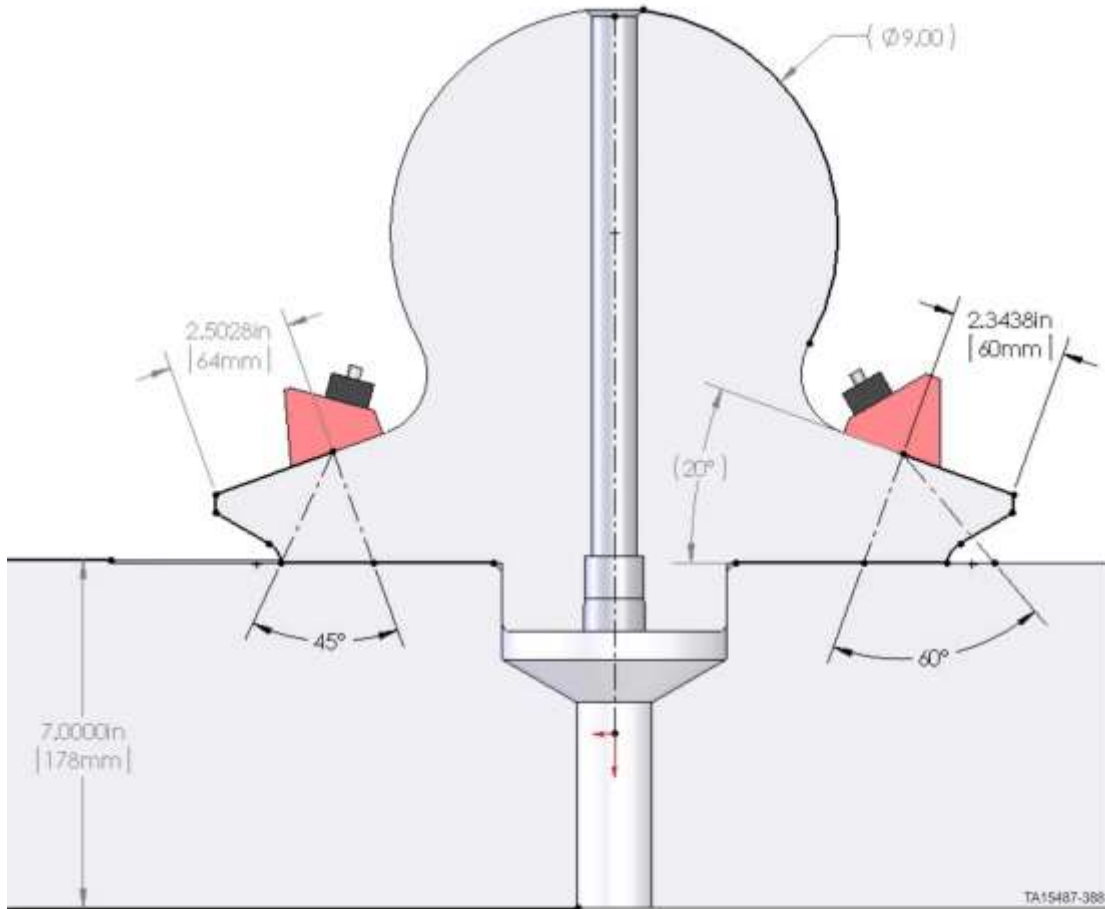
The inspections occur at a minimum of 48 hours after all processes (welding and post heat) have been completed and the weld is at ambient temperature.

20. After 48 hours inspect the weld with MT or PT.

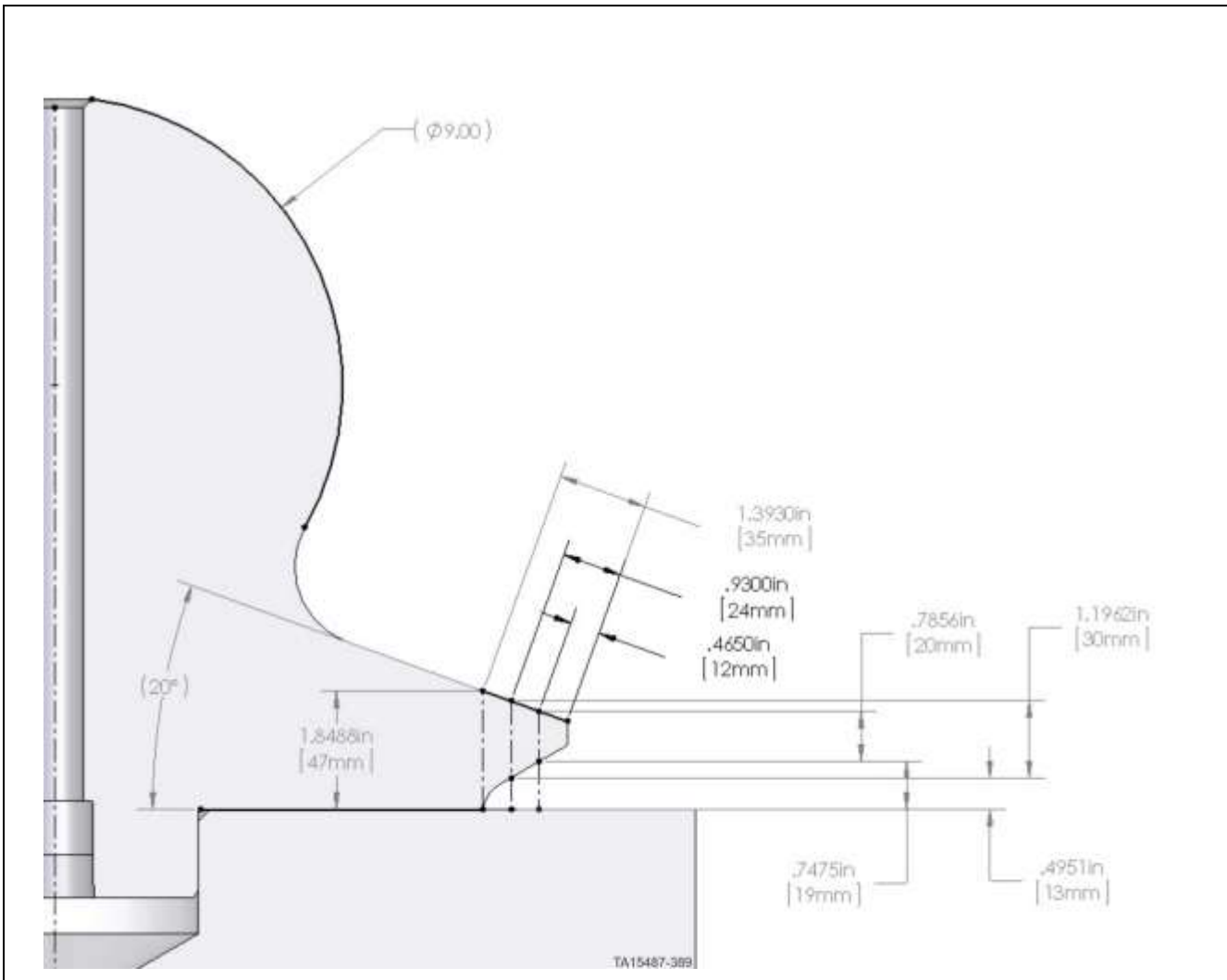
- 1) The inspector should provide a report.

21. After 48 hours inspect the weld with UT.

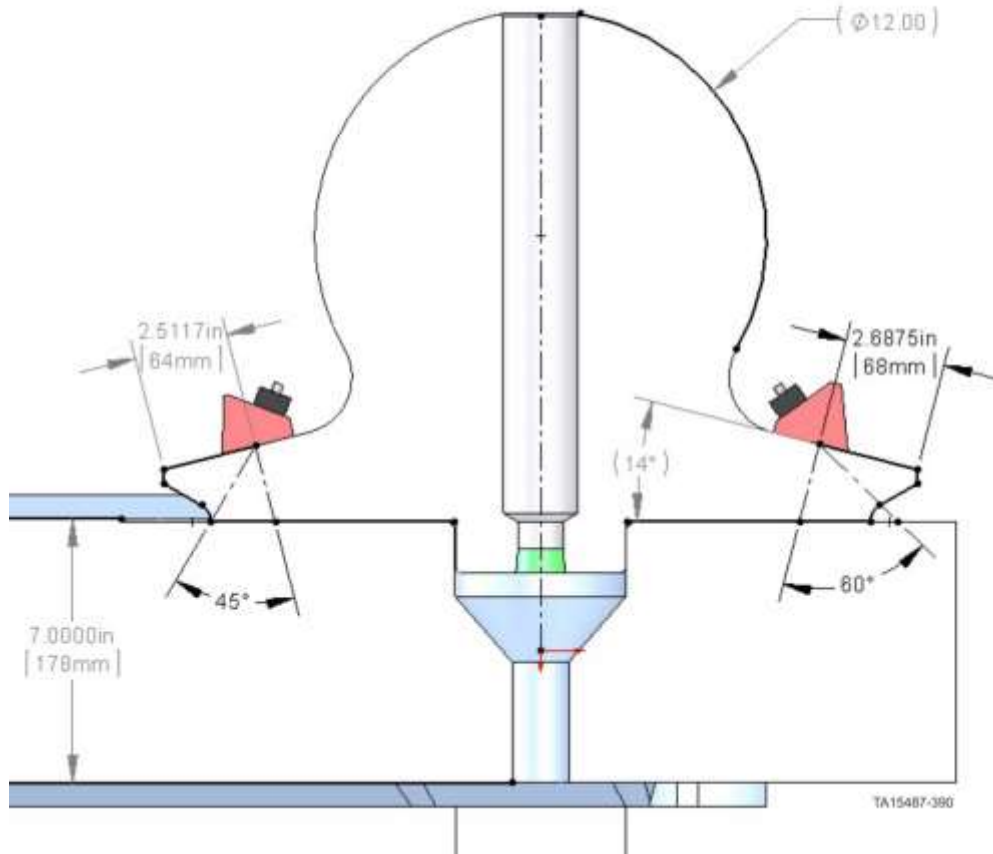
- 1) The inspector should provide a report.



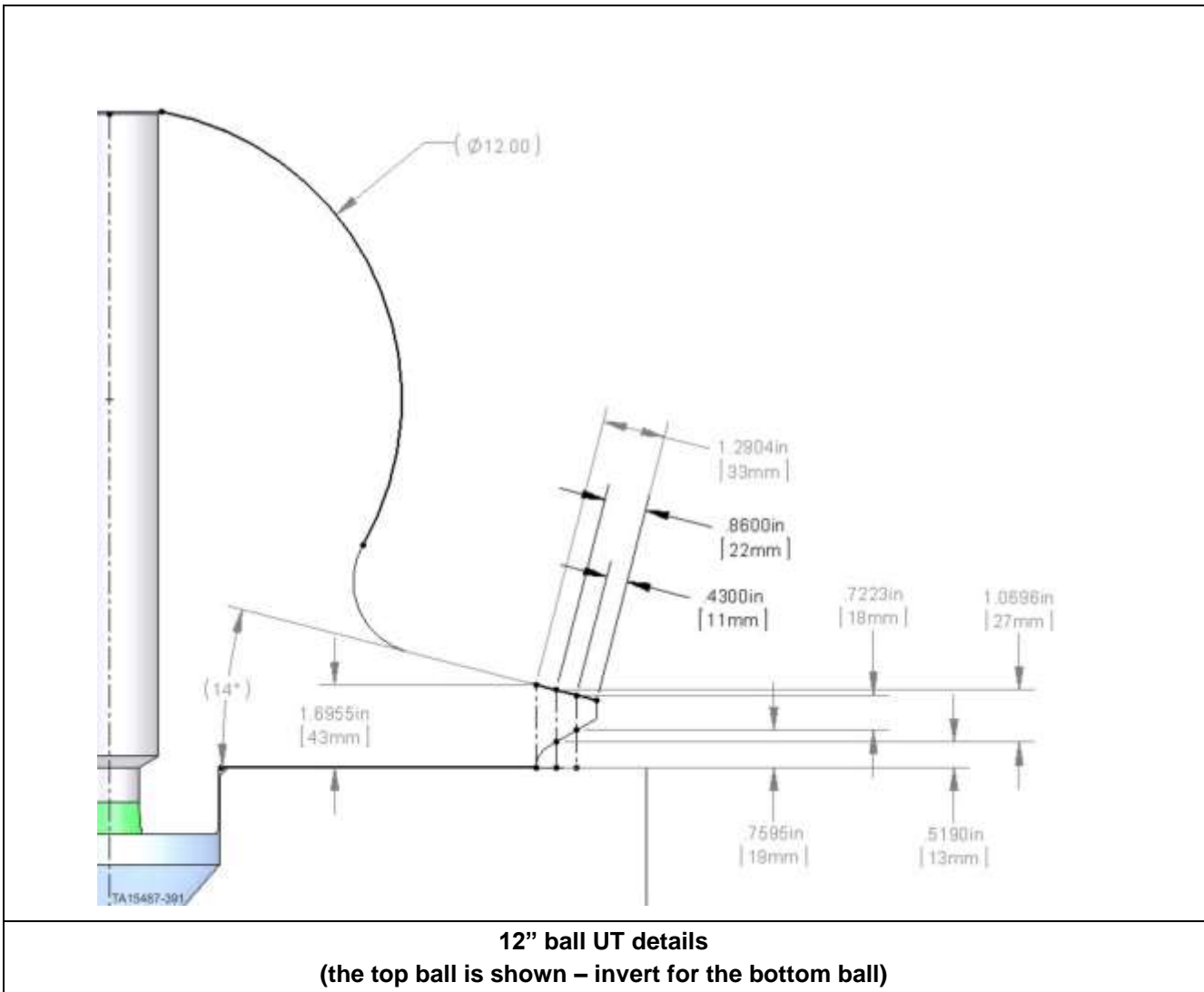
9" ball UT details
(the top ball is shown – invert for the bottom ball)



9" ball UT details
 (the top ball is shown – invert for the bottom ball)



12" ball UT details
 (the top ball is shown – invert for the bottom ball)

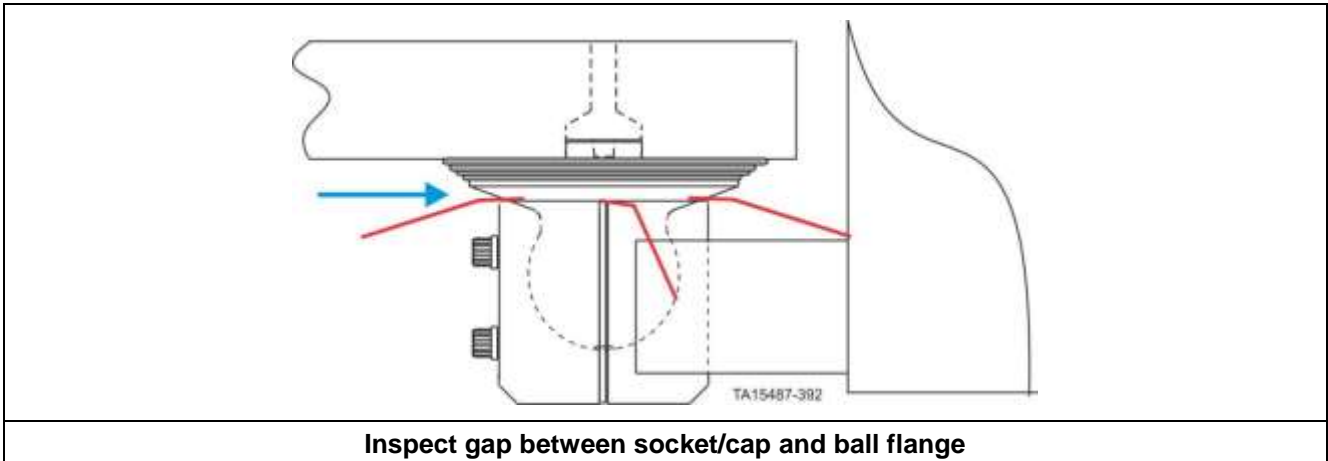


- 22. Paint the repair area.
- 23. Refit the frames together.

NOTICE

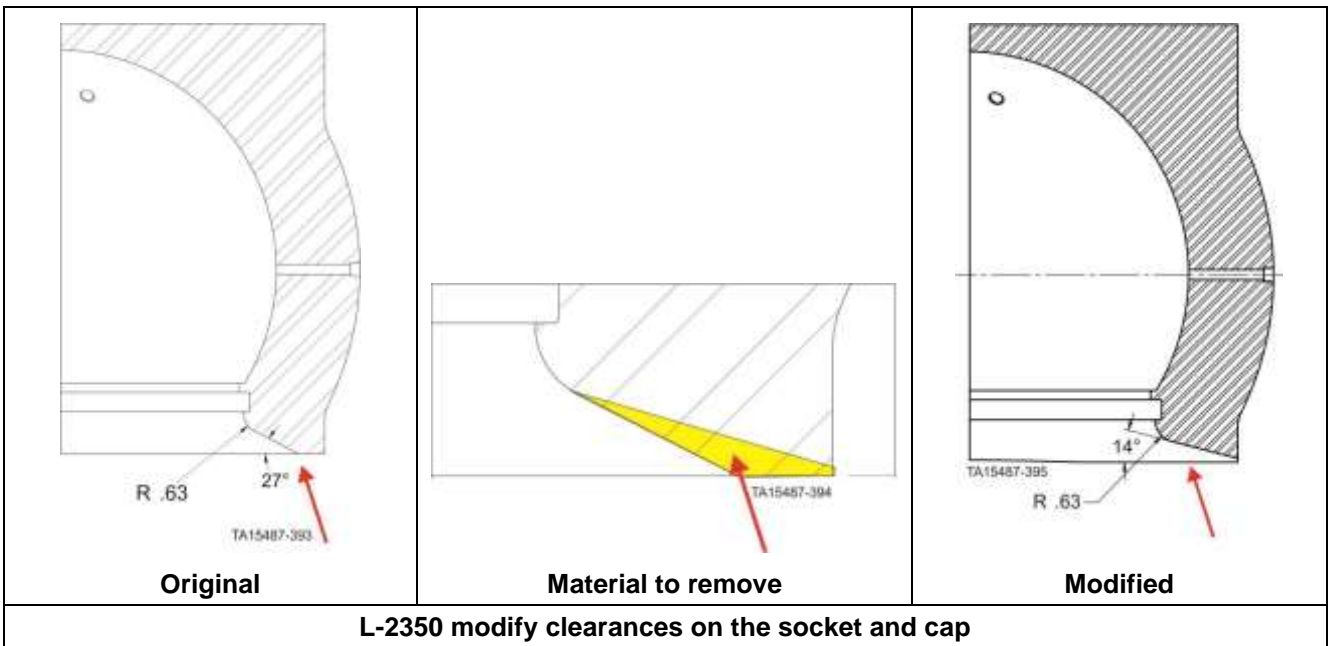
The position of the ball will typically change a small amount each time a new ball is installed. One of the articulation sockets must be replaced to ensure that the ball and socket have the proper clearance. Typically the lower socket is replaced as it is easier to access.

24. Check the socket gap.



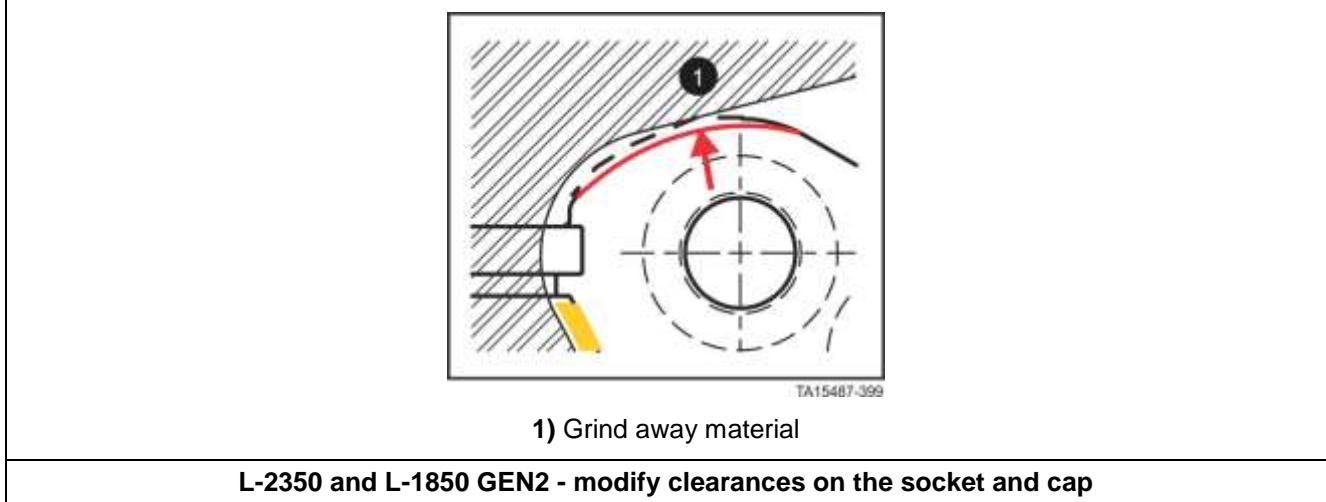
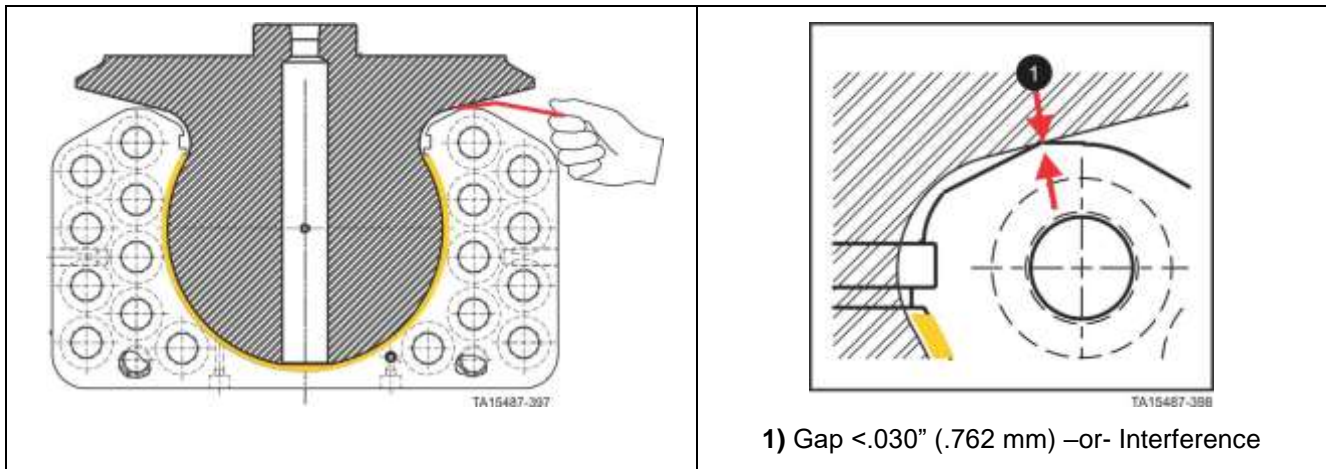
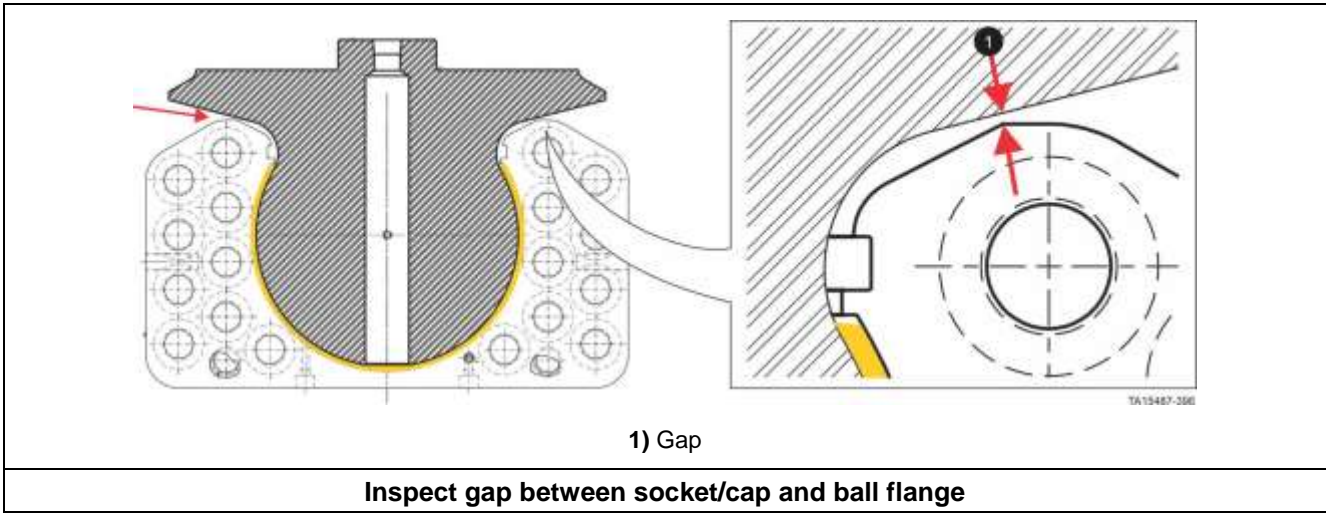
25. L-2350 and L-1850 GEN2 (12" frame articulation balls).

- 1) Prior to assembling the front frame to the rear frame – check the socket and cap to see if they meet revised specifications.
- 2) Grind or machine them as required.
- 3) If they are not corrected they can contact the flange of the ball and contribute to short ball life.

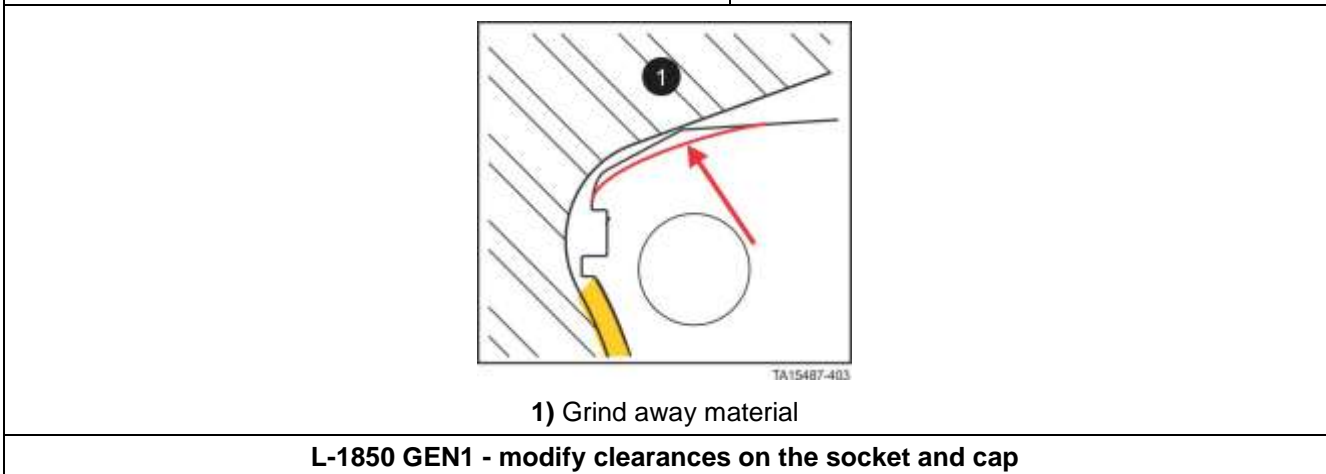
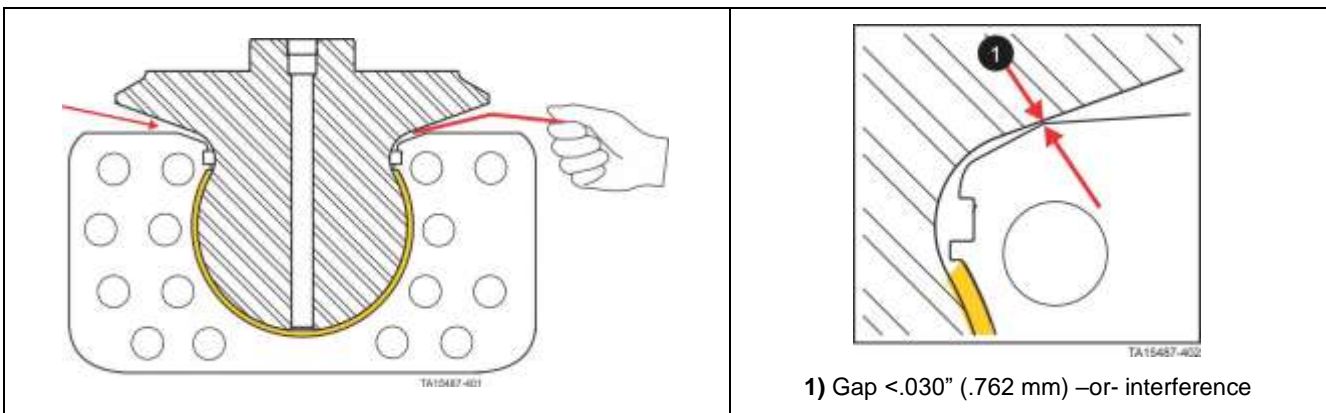
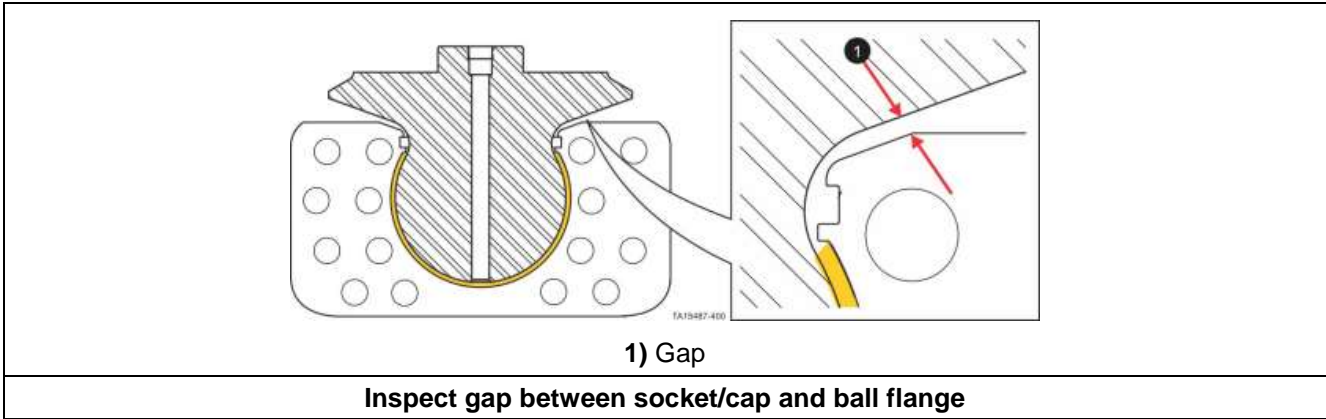


26. When the front frame on L1850 or L-2350 is joined to the rear frame it is important to check the gap between the socket/cap and the flange on the ball. There should be a minimum .030" (.762 mm) gap at all times when the machine is steered.

27. L-2350 and L-1850 GEN2 inspections.



28. L-1850 GEN1 (9" balls)



NOTICE

Re-Commissioning after Ball Replacement

- After each ball has been replaced or repaired and all of welding/inspection procedures have been completed- specific assembly and maintenance items outlined in the Re-Commissioning Replacement Document must be done to assure proper function of the ball joints.
- Re-Commissioning Replacement Document is at the end of this chapter and a copy is also included in the Appendix of the Field Welding Procedure document.

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Frame Articulation Ball (lower and upper) Change

(Field Welding Procedure Chapter 4)

General Information	
Date work started	
Date work completed	
Machine type	L-1350 <input type="checkbox"/> L-1350G2 <input type="checkbox"/> L-1850 <input type="checkbox"/> L-1850G2 <input type="checkbox"/> L-2350 <input type="checkbox"/>
Machine S/N	
Front frame S/N	
Machine location (mine name)	
Machine hours	
Ball Information	
Ball location	Articulation - Lower <input type="checkbox"/> Upper <input type="checkbox"/>
Ball size	
Ball markings – part number/serial number	
Sales Force/CCR	
Field Welding Procedure Specification (FWPS) used?	FW-0107 <input type="checkbox"/> FW-0108 <input type="checkbox"/> FW-0109 <input type="checkbox"/> FW-0110 <input type="checkbox"/>
Personnel and Companies Involved	
Person responsible for filling in forms	
Supervisor company	
Supervisor name(s)	

General Information		
Company for welding		
Personnel Names and certifications Minimum certifications: AWS D1.1 (Or equivalent recognized welding code) 2G/3G (or 4G) for the process being used (FCAW or SMAW)	1	2G <input type="checkbox"/> 3G <input type="checkbox"/> 4G <input type="checkbox"/> 6G <input type="checkbox"/> none <input type="checkbox"/>
	2	2G <input type="checkbox"/> 3G <input type="checkbox"/> 4G <input type="checkbox"/> 6G <input type="checkbox"/> none <input type="checkbox"/>
	3	2G <input type="checkbox"/> 3G <input type="checkbox"/> 4G <input type="checkbox"/> 6G <input type="checkbox"/> none <input type="checkbox"/>
	4	2G <input type="checkbox"/> 3G <input type="checkbox"/> 4G <input type="checkbox"/> 6G <input type="checkbox"/> none <input type="checkbox"/>
	5	2G <input type="checkbox"/> 3G <input type="checkbox"/> 4G <input type="checkbox"/> 6G <input type="checkbox"/> none <input type="checkbox"/>
	6	2G <input type="checkbox"/> 3G <input type="checkbox"/> 4G <input type="checkbox"/> 6G <input type="checkbox"/> none <input type="checkbox"/>
	7	2G <input type="checkbox"/> 3G <input type="checkbox"/> 4G <input type="checkbox"/> 6G <input type="checkbox"/> none <input type="checkbox"/>
	8	2G <input type="checkbox"/> 3G <input type="checkbox"/> 4G <input type="checkbox"/> 6G <input type="checkbox"/> none <input type="checkbox"/>
Company used for preheat		
Personnel Names	1	
	2	
	3	
Company used for monitoring and recording preheat		
Personnel Names	1	
	2	
Company for UT inspections		

General Information	
Personnel Names	1 2
Company for PT/MT inspections	
Personnel Names	1 2 3
Welding Consumable and Equipment	
Welding equipment (brand and model)	Root Pass Build passes
Welding consumable – root pass	
Weld machine settings for root pass	Volts _____ Amps _____.
Welding consumable – build passes	
Gas used for welding consumable	
Gas flow rate	
Weld machine settings at the welding machine	Volts _____ Amps _____.
Volts and amps measured at the feeder or work piece connections	Volts _____ Amps _____.
Preheat method used	Gas flame <input type="checkbox"/> Type of gas used? Type of torch used? Moving or stationary?

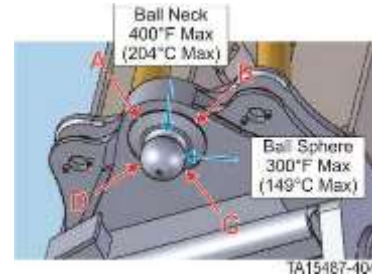
General Information	
	Electric heaters <input type="checkbox"/> Brand and type
Temperature measuring method (temperature sticks must be used)	Temperature stick or crayon <input type="checkbox"/> Brand? Temperature ranges? Temperature gun <input type="checkbox"/> Brand?
Remove all rust preventative material or other contamination from the replacement ball	Yes <input type="checkbox"/> No <input type="checkbox"/>
MT/PT on slab in ball area	After ball removal – attach report
Repair and gouge digs and cracks	Follow standard preheat and weld procedures in Field Welding Procedure for repairs
Grind smooth	YES <input type="checkbox"/> NO <input type="checkbox"/>
Check flatness of slab underneath the ball area with straight edge	No more than .030" (.762 mm) variance from flat allowed VARIANCE _____ ** Weld build up and machine flat if necessary
Install crush wire per specifications	YES <input type="checkbox"/> NO <input type="checkbox"/> Wire type used? Wire diameter used?
Install root pass with 7018 electrode. Wire is acceptable –IF <ul style="list-style-type: none"> a. the welder is fully qualified b. welder demonstrates capability to weld open joint with wire. c. NO weld spatter or welding wire is allowed under the ball base 	YES <input type="checkbox"/> NO <input type="checkbox"/>
MT dry powder the root pass and repair any weld defects	Any defects to repair? YES <input type="checkbox"/> NO <input type="checkbox"/>

General Information	
Continue welding with the E81T1-Ni1MJH4 flux cored welding wire on the remaining passes maintaining preheat and interpass temperatures	YES <input type="checkbox"/> NO <input type="checkbox"/>
Post heat and cool down	Record in post heat log – attach log
48 hour inspections (48 hours after the work was completed and the weld cooled to ambient)	Wet mag ultraviolet black light inspection of ball and weld per ASTM E1444 standard or ASTM A709 standards – attach report UT (per AWS D14.4 Class 1 criteria) the welds on the ball base– attach report
Repair any rejectable defects and indications found during the inspections	YES <input type="checkbox"/> NO <input type="checkbox"/>
Blend grind entire weld profile smooth on the ball	YES <input type="checkbox"/> NO <input type="checkbox"/>
No undercuts on the weld profiles	Undercuts found YES <input type="checkbox"/> NO <input type="checkbox"/> Undercuts repaired YES <input type="checkbox"/> NO <input type="checkbox"/>
Replace lower socket per procedure in Field Welding Procedure	YES <input type="checkbox"/> NO <input type="checkbox"/> Preload obtained:
Worksheets and reports to attach **All inspections after job complete are specified to be minimum of 48 hours after job completed and weld has slow cooled to ambient	<ul style="list-style-type: none"> • Welding log • Preheat log • MT/PT on slab after removal • MT/PT report on weld and ball 48 hours after job complete (and cooled to ambient) • UT report on weld 48 hours after job complete (and cooled to ambient)

Ball Preheat and Interpass Record (frame articulation ball)					
Location:		Supervisor:			
Loader type and serial number:		Date:			
Ball description and location:		Ball serial numbers:			
Welder	Sequence	Actual clock time	TEMPERATURE		
			Ball flange (near weld)	Ball Neck	Ball Sphere
1	0 Hour		A		
			B		
2			C		
			D		
1	1 Hour		A		
			B		
2			C		
			D		
1	2 Hour		A		
			B		
2			C		
			D		
1	3 Hour		A		
			B		
2			C		
			D		
1	4 Hour		A		
			B		
2			C		
			D		
1	5 Hour		A		
			B		
2			C		
			D		
1	6 Hour		A		
			B		
2			C		
			D		
1	7 Hour		A		
			B		
2			C		
			D		
1	8 Hour		A		
			B		
2			C		
			D		
1	9 Hour		A		
			B		
2			C		
			D		
1	10 Hour		A		
			B		
2			C		
			D		
1	11 Hour		A		
			B		
2			C		
			D		
1	12 Hour		A		
			B		
2			C		
			D		

Frame Articulation Ball Post Heat

Follow the post heat instructions previously explained in this chapter.



Action	Actual Clock Time	Elapsed Time (minimum times)	Target Temp	Actual Temp
Post Heat Starts		0	400° F (204° C)	A
				B
				C
				D
Post Heat Finishes		1 Hour	400° F (204° C)	A
				B
				C
				D
Cooling		1.5 Hour	375° F (191° C)	A
				B
				C
				D
Cooling		2 Hour	350° F (177° C)	A
				B
				C
				D
Cooling		3 Hour	300° F (149° C)	A
				B
				C
				D
Cooling		4 Hour	250° F (121° C)	A
				B
				C
				D
Cooling		5 Hour	200° F (66° C)	A
				B
				C
				D
Cooling		6 Hour	150° F (66° C)	A
				B
				C
				D

Re-Commissioning after - Ball Replacement



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Re-Commissioning after Ball Replacement

Before beginning the re-commissioning process, ensure the following safety preparations have been followed.

Safety Preparations

WARNING

Crush hazards exist if the machine is started or moved while work processes are being performed on the machine. Place bucket flat and level on the ground. Place frame lock in the locked position and lock out the machine's starting capability before performing any work process. Follow all applicable lockout procedures and local rules and regulations for performing work processes. ANYONE performing inspections or service procedures to the machine should be familiar with ALL instructions and procedures contained in the machine's SERVICE MANUAL. Crush hazard could occur if the machine is started or moves while any type of work process is being conducted on the machine, resulting in serious injury or death.

Machine Shutdown and Lockout

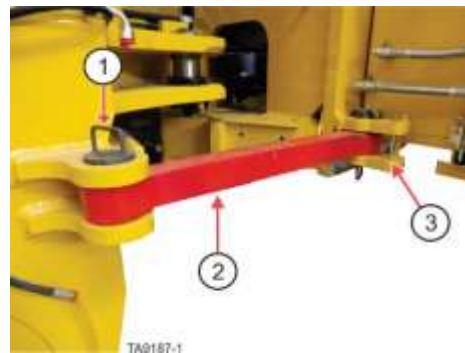
1. Stop the wheel loader on flat level ground.
2. Place bucket flat and on level ground.
3. Move the frame lock to the locked position so that the frame cannot be steered.

WARNING

Crush hazards exist in machine pivot area and area between the tires. Do not enter these areas unless it is verified that the operator has control over the steering and that personnel locking the frame lock have good communication with the operator. Entering the pivot area and area between the tires while the machine is moving or pivoting (articulating) could cause crush hazards resulting in serious injury or death.



Gen 1 Frame lock in locked position



Gen 2 Frame lock in locked position

- 1) Retaining pin for locked position, 2) Frame lock - shown in locked position
3) Retaining pin bracket for un-locked position

4. Set the parking brakes.
5. Shut off the engine.
6. Place wheel chocks in front and behind each wheel.

7. Lock out the machine's starting capability before performing any cleaning, inspections, or installation and repair procedure.

WARNING

Crush, shock, or other hazards exist if stored energy is not removed or isolated prior to working on the machine. Stored energy (hydraulic, electrical, pneumatic, mechanical, etc.) may be present if not isolated or released prior to working on the machine. Do not work on the machine without removing this stored energy (suspended loads, electrical power, air pressure, etc.). Risk of crushing, shock, or other physical injury exists if stored energy is not removed or isolated prior to working on the machine which could result in serious injury or death.

8. Turn the battery and engine isolation switches to the off position and install locks on the battery isolation switch.



GEN 2 Isolation and Control switches assembly – Battery isolation switch in OFF position with locks in place

NOTICE

The GEN 2 Isolation and Control switches assembly is shown in this document. GEN 1 machines will have a different type of switch and box. The lock out/tag out requirements are the same.

9. Release the air from the hydraulic reservoir by using the hydraulic reservoir air valve (ball valve) on top of the reservoir. The supply line from main air system will be blocked and reservoir air will vent out the hose that runs down the outside of the hydraulic reservoir.
10. Turn the handle to the up position as shown.



Hydraulic reservoir air valve handle UP

11. Release the air from the various air storage reservoirs by opening all of the air bleed valves.

Generation 1	Generation 2
Three valves on left side of rear frame under electrical cabinet	Three valves on right side of rear frame under hydraulic reservoir
One valve on left side of front frame near frame lock and hoist cylinder ball cap	One valve on right side of front frame near hoist cylinder ball cap

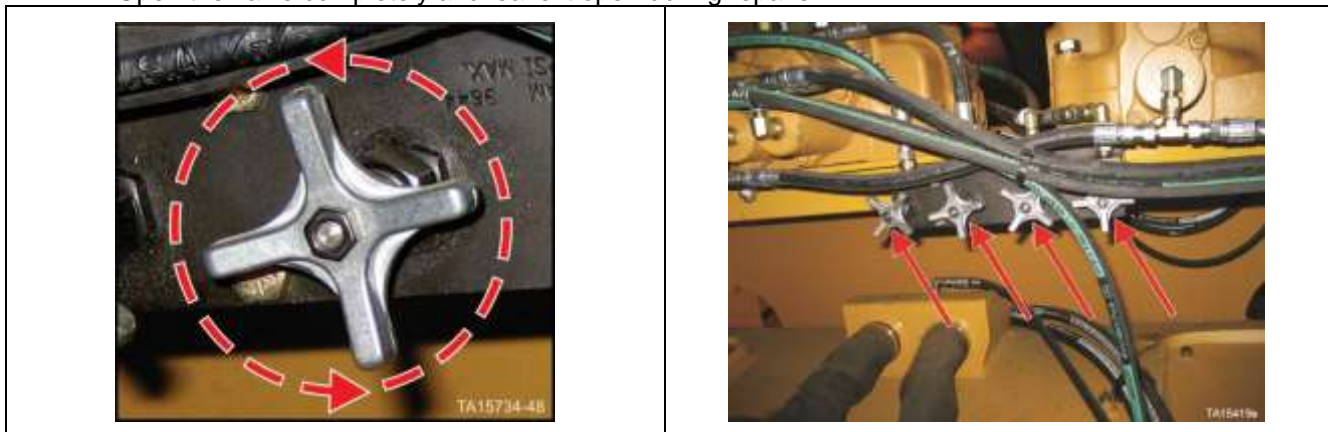


Open air reservoir bleed valves

⚠ WARNING

Crush hazards exist if all personnel are not cleared from the bucket and lift arm area before using the hydraulic hoist and bucket hydraulic pressure bleed down valves to relieve pressure from the hoist and bucket circuit. Assembly must be used only when the engine is NOT running. Before using the Manual Bleed Valve Assembly, refer to “HYDRAULIC AND GREASE SYSTEMS”, “MANUAL BLEED VALVE ASSEMBLY”, in Section 04 of the Service Manual for additional operational and safety information. Operating the manual bleed valve may cause the lift arms and bucket to descend rapidly. All personnel around the bucket and lift arms area shall be removed from the area before operating hydraulic hoist and bucket hydraulic pressure bleed down valves. Using the hydraulic bleed down valves could result in movement of the lift arms and bucket which could cause a crush hazard resulting serious injury or death.

12. Use the hydraulic pressure bleed down valves located in the front frame underneath the Husco valves to bleed any stored pressure in the hoist and bucket cylinders.
13. Turn each valve slowly counterclockwise as shown below and allow the pressure to bleed down.
14. Open the valve completely and leave it open during repairs.



CAUTION

Before performing welding operations on a machine, the fire suppression system circuit monitors panel's in-line fuse must be removed. The fuse is located in the battery box on some machines. Failure to do so may cause the system to actuate and/or damage the solid-state components of the system. Replace the in-line fuse before the machine has been started or after all welding operations have been completed.



Fire suppression in-line fuse located in loader battery box on some machines

⚠ WARNING

Fall hazard exists when working at heights. Be sure to take appropriate safety precautions when working at heights on the rear and front frames or the lift arms balls. Follow all required statutory regulations for working at height. Wear fall restraint when necessary to prevent falls. Failure to take appropriate safety precautions, including wearing fall restraint when necessary can cause fall hazards resulting in serious injury or death.

⚠ WARNING

Crush hazards exist if standing under, working, or placing any body part under hoisted/suspended components. Never stand under hoisted/suspended components. Ensure appropriate lifting devices are used, and blocking is adequate to prevent the component from unexpectedly moving during transportation. Refer to SAFETY, WARNINGS, AND CAUTIONS before attempting to remove the operator's cab. Failure to stay out from under hoisted/suspended components can cause crush hazard resulting in serious injury or death.

Assembly and Maintenance Items

After each ball has been replaced and all of the welding/inspection procedures completed – the following assembly and maintenance items must be done to assure proper function of the ball joint:

- 1) Obtain a machine download and analyze the data.
 - a. Any grease system alarms or warnings?
- 2) Assure that the grease plug is installed (hoist cylinder and lift arm balls).
 - a. Use new O-ring on the plug.
- 3) Install grease extension tube (frame articulation balls).
 - a. Use thread sealant on threads.
- 4) Grease hose and fitting is properly attached for each ball type.
 - a. The hose should be replaced to ensure reliability.

- b. Pre-purge all grease lines with auto lube system grease, before installation.

CAUTION

Do not use standard EP grease to coat the ball, coat the liner, fill the ball or purge the grease system. Use only the specified auto lube system grease containing 3-5% moly, specified for the machine's operating conditions.

- 5) Install new brass liners in socket and cap.
- 6) Chase the threads in each of the tapped holes in the socket.
 - a. This must be done by hand – **DO NOT** use any form of power tool.
 - i. Use of a power tool can cause damage to the threads.

CAUTION

Never use any form of power tool to chase threads with a tap! Always turn the tap by hand! Power tools can remove the 'feel' of the tap 'cutting' material from the hole and this 'cutting' is not desirable. Never drive a tap with a rattle gun as it can cause the tap to chip fragments of the tap off and they become embedded in the base material, causing further damage to the capscrew at the time of installation.

- b. Use a slightly dull tap to minimize thread damage.

NOTICE

The threads in each hole have typically been slightly distorted by the tensioning of the capscrews. The cutting edge of a new tap should be slightly 'dulled' by buffing the cutting edge of the tap on a wire wheel. This will minimize thread cutting which can reduce thread strength and leave small fragments of steel shavings in the root of the thread.

- c. Use ONLY a bottoming type of tap. Taper and intermediate configuration taps must not be used.
- 7) Clean all of the tapped hole threads in the socket. Remove all contaminants and previous lubricants from each hole.
- 8) Install new capscrews.
 - a. If there is any doubt as to their history or condition – replace the capscrews.
 - b. New capscrews should be installed if the ball was broken.
 - i. If one lift arm ball was broken - replace the capscrews on both sides of lift arm.
 - c. Capscrews can be reused if:
 - i. They were properly torqued when originally installed.
 - ii. No sign of thread damage from installation or dropping on steel or ground.
 - iii. No signs of stretching.
 - iv. Threads are fully cleaned.
 - v. No signs of cracking near the clamp face of the capscrew.
 - vi. The clamp face is not galled.
 - vii. The 12-point head is not damaged.
- 9) Assembly lubrication.
 - a. Coat the OD of the ball with auto lube system grease.

- b. Fill the hole in the ball with auto lube system grease.
- c. Coat the socket and cap with a thin coat of auto lube system grease.
- d. Coat the brass liners with auto lube system grease to fill the grooves in the liners.

CAUTION

Do not use standard EP grease to coat the ball, coat the liner, fill the ball or purge the grease system. Use only the specified auto lube system grease containing 3-5% moly, specified for the machine's operating conditions.

- 10) Verify that the lift arms fit on the balls without spreading or pulling together.
 - a. Verify that the lifting method is not pulling the arms together.
 - b. The arm width can be adjusted by heat striping if required.
 - c. Contact Komatsu Call Center for assistance (support@joyglobal.com).
- 11) Align the ball caps on the lift arm sockets.
 - a. Install the ball cap loosely and align the match marks.
 - i. The caps are interchangeable left to right – but once they have been aligned and match marked – they should be always used in the specified location.
 - b. If they are not factory match marked – find the center and match mark.
 - c. Mark each one for Left (LH) or Right (RH).

NOTICE

The socket and cap are aligned and marked when the arms are NOT mounted on the machine.

- 12) Torque the cap screws for the ball caps.
 - a. Verify that the socket threaded holes and all capscrews are not contaminated with grease, anti-seize, etc.
 - b. 30W or engine oil for thread and shoulder lubrication.
 - c. Hand start ALL cap screws in the cap prior to tightening with air gun or torque wrench.
 - d. Use a small air wrench (1/2" drive max) to run the bolts fully home.

CAUTION

If any capscrew binds while running in by hand or with a small air impact wrench, **DO NOT** attempt to drive the capscrew deeper. Use a hand wrench and remove the capscrew. **DO NOT** use an air impact wrench to remove the capscrew.

- e. Follow the torque pattern.
 - f. Torque to the correct value.
- 13) Check the “snap” clearance on the ball.
- a. Adjust the snap clearance to specification by adding or removing shims.
- 14) Purge the grease line to the ball joint.
- a. **DO NOT** purge by cycling the grease system.
 - i. The injector only puts out a maximum of 1.3cc each time the grease system cycles. It is very difficult to fill the joint with grease at this rate – and wastes grease from excessive grease at all the other locations on the machine.
 - b. Remove the purge cap from the grease injector and fill the joint with grease using a grease gun.
 - c. Purge a minimum of 0.5 kilogram (1 pound) of grease through the joint **BEFORE** operation of the machine.

CAUTION

Do not use standard EP grease to purge the ball joint grease system. Use only the specified auto lube grease containing 3-5% moly, specified for the machine’s operating conditions.

- 15) Replace the in-line fuse on the fire suppression system if it was disengaged due to welding on the machine, this must be done before the machine has been started or after all welding operations have been completed.

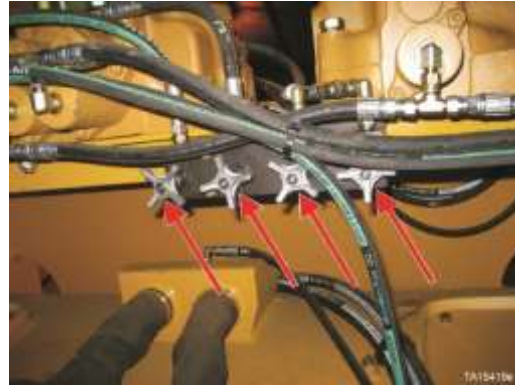
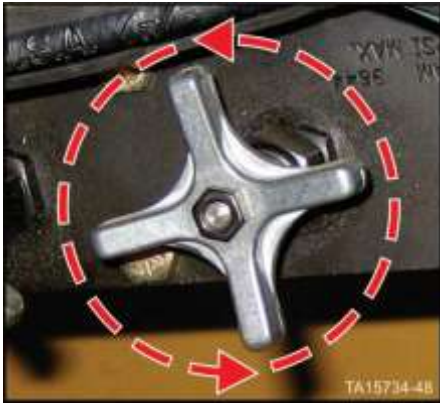
CAUTION

Failure to replace the fuse before operating the machine could result in a serious fire. Never run the machine unless the fuse has been replaced.



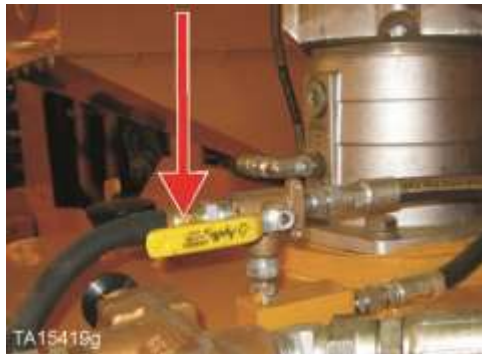
Fire suppression in-line fuse located in loader battery box on some machines

16) Close (turn clockwise) the hydraulic bleed valves in the front frame.



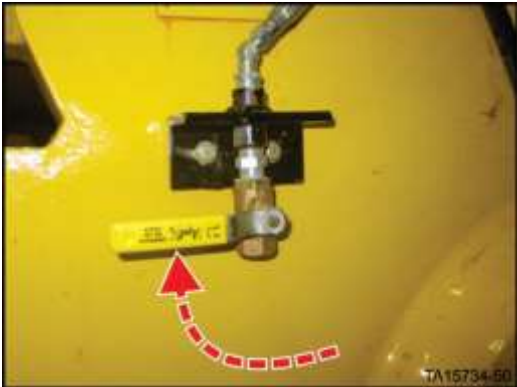

Close hydraulic bleed valves in front frame

17) Close the hydraulic reservoir air valve on top of the hydraulic reservoir.



Close the hydraulic reservoir air valve

18) Close the air bleed valves.

Generation 1	Generation 2
Three valves on left side of rear frame under electrical cabinet	Three valves on right side of rear frame under hydraulic reservoir
One valve on left side of front frame near frame lock and hoist cylinder ball cap	One valve on right side of front frame near hoist cylinder ball cap
	

Close the valve under the hydraulic reservoir

- 19) Remove wheel chocks.
- 20) Remove any locks or tags from isolation box following all local regulations and turn both isolation switches to the on position.



GEN 2 Battery Isolation Box – locks removed – and switches moved to on position

- 21) Start machine and verify that grease injectors are functioning (Ref SIL-397.01).
 - a. System timer functioning – what is the setting?
 - b. Grease leaks?
 - c. System building pressure?
 - d. Grease Pressure?
 - e. Oil Supply Pressure?
 - f. Injectors functioning?
 - g. Grease Pressure at stall?
 - h. Injector for ball joint functioning?

Most of the items in the previous list are steps that are part of the standard assembly and commissioning of a new loader or a part of the normal maintenance items related to balls. Contact the Komatsu Call Center (support@joyglobal.com) if you are unable to locate the information or have questions pertaining to these assembly and maintenance practices. Most of these are covered in one or more of the following documents:

- Assembly Manual
- GEN 2 Service Manual
- SIL 439.01 Spherical Ball Bearing Joints
- SIL 413.00 Hoist Cylinder Spherical Ball Lubrication
- SIL-397.01 Auto Lube System Operation

RE-Commissioning Worksheet

Machine:	Ball location changed:	Date:
S/N:	Replacement Ball S/N	Customer:

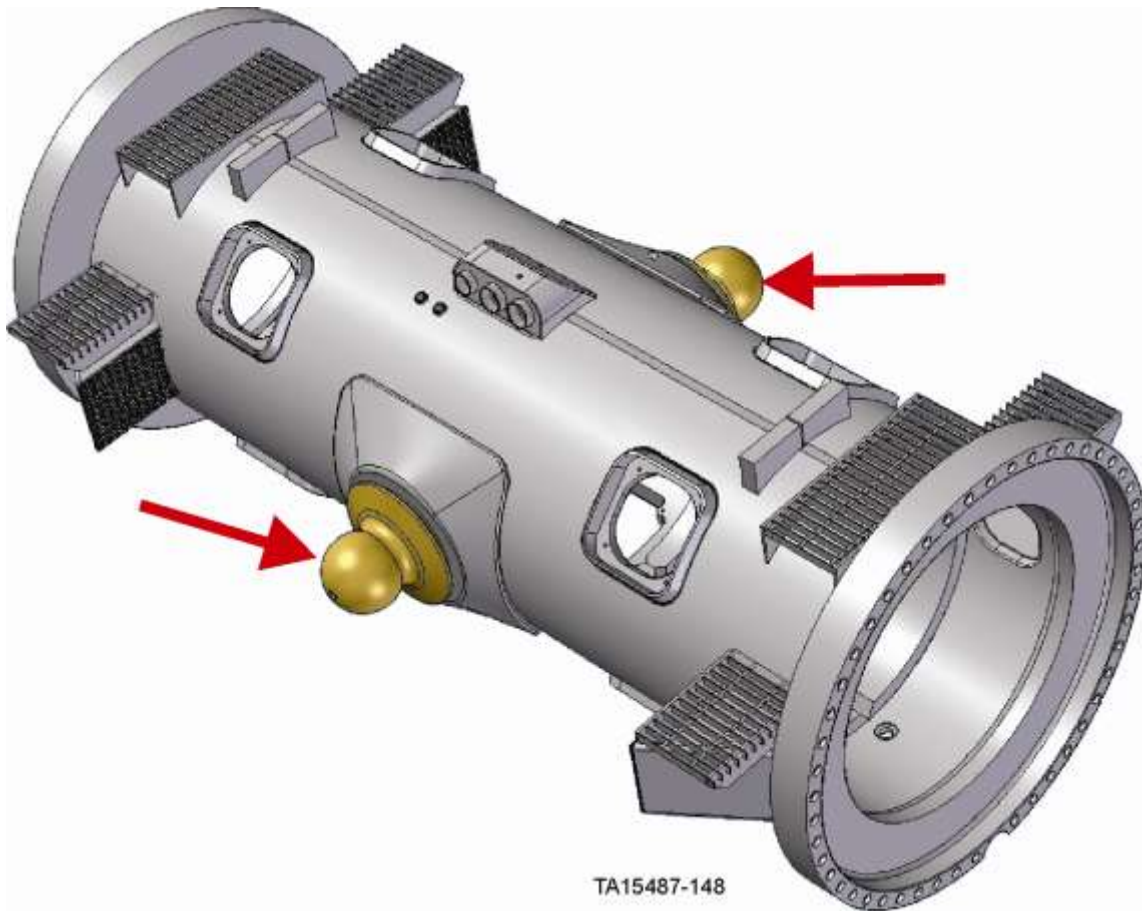
Item	Result	Comments	Date	Signature
Machine download	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Attach to the Sales Force Case related to this machine	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Analyze data for indications of grease system failures	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Grease Plug installed in <u>frame articulation ball base</u>	YES <input type="checkbox"/> NO <input type="checkbox"/>			
New O-ring	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Grease extension tube installed into <u>frame articulation ball base</u>	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Thread sealant used?	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Connect the grease hose	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Tighten hose and fitting	YES <input type="checkbox"/> NO <input type="checkbox"/>			
New Grease hose used?	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Install new brass liners in socket and cap	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Chase hole threads in socket by hand	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Clean hole threads in socket to remove all contaminants	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Install new capscrews	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Coat the OD of the ball with auto lube system grease	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Fill the hole in the ball with auto lube system grease	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Coat the ID of the socket and cap with a thin coat of auto lube system grease	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Coat the ID of the brass liner auto lube system grease	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Verify that the arms fit without spreading or pulling together	YES <input type="checkbox"/> NO <input type="checkbox"/>	Not applicable for Frame Articulation Ball Field Replacement		
Heat striping required?	YES <input type="checkbox"/> NO <input type="checkbox"/>			
<i>This section applies to Lift arm balls ONLY</i>				

Field Welding Procedures

Item	Result	Comments	Date	Signature
Align the ball caps on the lift arm sockets Match marks <i>This section applies to Lift arm balls ONLY</i>	YES <input type="checkbox"/> NO <input type="checkbox"/> YES <input type="checkbox"/> NO <input type="checkbox"/>	Not applicable for Frame Articulation Ball Field Replacement		
Capscrew lubricant – 30W oil	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Hand start all capscrews	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Follow specified torque pattern	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Torque value	_____ ft-lb			
Purge the grease system to all balls that were replaced? Use external grease pump?	YES <input type="checkbox"/> NO <input type="checkbox"/> YES <input type="checkbox"/> NO <input type="checkbox"/>			
Check the snap clearance In or out of specification? Adjusted? Final value?	YES <input type="checkbox"/> NO <input type="checkbox"/> _____/mm YES <input type="checkbox"/> NO <input type="checkbox"/> YES <input type="checkbox"/> NO <input type="checkbox"/> _____/mm			
Verify grease system functioning: System timing Leaks? System building pressure? Oil supply pressure? Grease pressure at stall? Ball injector functioning? Injectors functioning?	_____ min/cycle YES <input type="checkbox"/> NO <input type="checkbox"/> YES <input type="checkbox"/> NO <input type="checkbox"/> _____ psi _____ psi YES <input type="checkbox"/> NO <input type="checkbox"/> YES <input type="checkbox"/> NO <input type="checkbox"/>			

CHAPTER 5

Axle Articulation Balls Replacement Procedure



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Procedure	FW-0111
Revision	0
Written by	Joel Armstrong
Date	3/8/2010

Field Welding Procedure

This document conforms to AWS D1.1/D14.3 Structural Welding Code and Australian Standards AS 1554.4

Description	Axle articulation balls
Notes	See attachment
Welding Process	FCAW / SMAW

Joint			
Type	Groove or Fillet		
Backing	If needed	Material	Mild Steel
Root Opening	+1/4 / - 1/16" Per Attachment (+6.35 / -1.6 mm)		
Root face Dimension	+/- 1/16" Per Attachment (+/- 1.6 mm)		
Groove Angle (degrees)	+10/-5 Per Attachment	Radius	N/A
Back Gouging	Yes, if required	Method	Arc - Air
Other			

Base Metals			
Specification	ASTM A572 Modified	A151 4820H	
Thickness	6-7" (152-178 mm)	7.5 and 9" (191 and 229 mm)	
	Slab	Balls	

Filler Metals			
AWS Specification	A5.20/A5.29	A5.5	
AWS Class	E71T-1XX series	E8018C3	
Diameter	0.045", 0.052", 1/16" (1.2, 1.4, 1.6 mm)	1/8", 5/32" (3.2, 4mm)	

Shielding		Positions Qualified	Flat, Vertical, Horizontal
Gas Composition	100% CO ₂ or Ar/CO ₂ 75/25	Groove	1G, 2G, 3G, 4G
Flow Rate	35 – 45 cfh	Fillet	1F, 2F, 3F

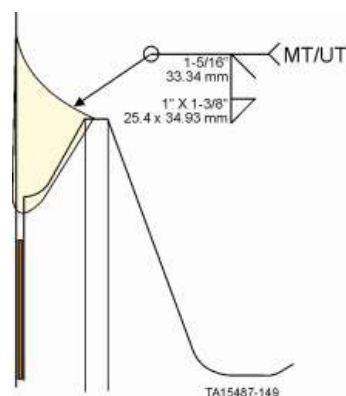
Technique		Vertical Progression	Up
Stringer or Weave Bead	Stringer	Electrical Characteristics	
Multi/Single Pass (per side)	Multiple	FCAW - Current	DCEP
Peening	Yes	SMAW - Current	DCEP
Interpass Cleaning	Chipping and or grinding	Other	

Preheat and Interpass Temperatures		
Material Types		
Structural Steel	Castings	Q&T high strength steel
Frame structure Bucket Blade	Lift Arm Torque Tube (1150, 1350, 1850 Gen2, 2350) Upper part front frame (1350) Axles (some 1350) Sockets	Balls Bucket Lip Bucket adapters Lift arms Bell cranks

Preheat		
Material Thickness	Structural Steel	Castings and high strength steel
Distance from weld	6" (152 mm) minimum	6" (152 mm) minimum
< or = 3/4" (< or = 19 mm)	125° F (52° C)	200° F (93° C)
>3/4" to 1-1/2" (>19.05 to 38.1 mm)	225° F (107° C)	250° F (121° C)
>1-1/2" to 2-1/2" (>38.1 to 63.5 mm)	250° F (121° C)	300° F (149° C)
>2-1/2" (>63.5 mm)	300° F (149° C)	350° F (177° C)

Interpass Temperature		
All thicknesses	500°F (260° C) maximum	450°F (232° C) maximum

Post Heat Treatment	
400°F (204° C) for one hour	Required: YES (X) NO ()

Joint Detail

Welding Parameters

(The FCAW welding parameters were obtained from the qualification of the LINCOLN Ultracore 712A80 used during Komatsu fabrication on Komatsu welding equipment. These numbers will likely vary depending on the specific welding equipment and consumable used for repairs.)

Weld Pass	Process	Filler Metal	Filler Diameter	Current Type	Amps	Volts	Travel Speed (ipm)	Wire Feed Speed	Welding Position
All	FCAW	E71T-1MJ	1/16"	DCEP	280-340	22-26	8-12	255-300	Flat & Horizontal
All	FCAW	E71T-1MJ	0.052"	DCEP	220-310	22-26	8-12	225-375	Flat & Horizontal
All	FCAW	E71T-1MJ	0.045"	DCEP	210-280	23-25	8-12	275-425	Flat & Horizontal
All	FCAW	E71T-1MJ	1/16"	DCEP	185-225	21-24	7-10	105-130	Vertical
All	FCAW	E71T-1MJ	0.052"	DCEP	195-235	21-24	7-10	200-375	Vertical
All	FCAW	E71T-1MJ	0.045"	DCEP	155-235	21-23	7-10	175-325	Vertical
All	SMAW	E7018	5/32"	DCEP	130-210	19-21	5-8	N/A	All
All	SMAW	E7018	1/8"	DCEP	90-160	19-21	5-8	N/A	All
All	SMAW	E8018C3	5/32"	DCEP	130-220	19-21	N/A	N/A	All
All	SMAW	E8018C3	1/8"	DCEP	90-160	19-21	N/A	N/A	All

Suggested Air Arc Parameters

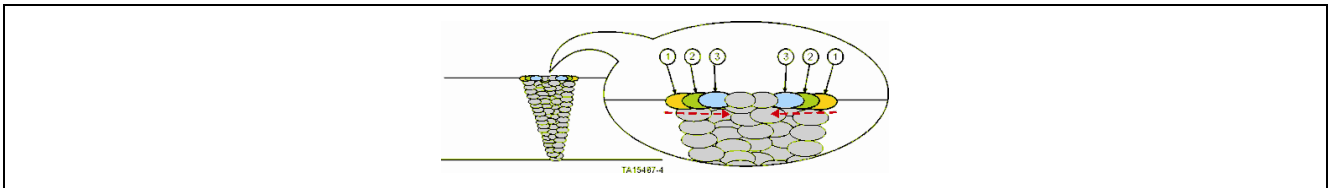
Electrode Diameter		Minimum Amps	Maximum Amps
Inches	Millimeter		
1/8	3.2	60	90
5/32	4.0	90	150
3/16	4.8	200	250
¼	6.4	300	400
5/16	7.9	350	450
3/8	9.5	450	600
½	12.7	800	1000
5/8	15.9	1000	1250
¾	19.1	1250	1600

Proper Electrode Selection for Field Welding

Material joint type	Rod consumable	Wire Consumable
Steel to steel	7018 series	E7xT- xxxx series
Steel to Casting	7018 series	E7xT- xxxx series
Casting Repair	8018 series	E8xT- xxxx series
Socket or Ball installation	8018 series	E8xT- xxxx series
Wear hardware installation on bucket	8018 series	E8xT- xxxx series

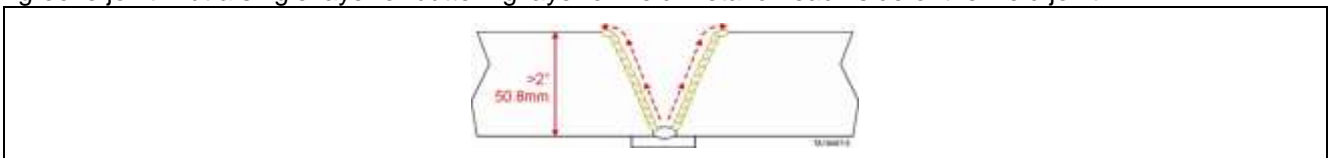
Bead Tempering Finish Passes

The last layer of weld passes must be completed starting from the base material toward the middle of the weld.



Butter Welds

On groove or fillet welds 2" (50.8 mm) deep or larger - butter weld the sides of the groove prior to welding the groove joint. Put a single layer or buttering layer of weld metal on each side of the weld joint.



Axle Articulation Ball Field Replacement Procedure

NOTICE

The articulation balls on the rear axle are matched to the articulation sockets in the rear frame. If an articulation ball is changed –one of the axle sockets must also be changed so that the ball fit will be proper. If a socket is not changed there may be problems with installation of rear axle, rapid wear of brass liners, neck wear problems, etc.

Safety Preparations

WARNING

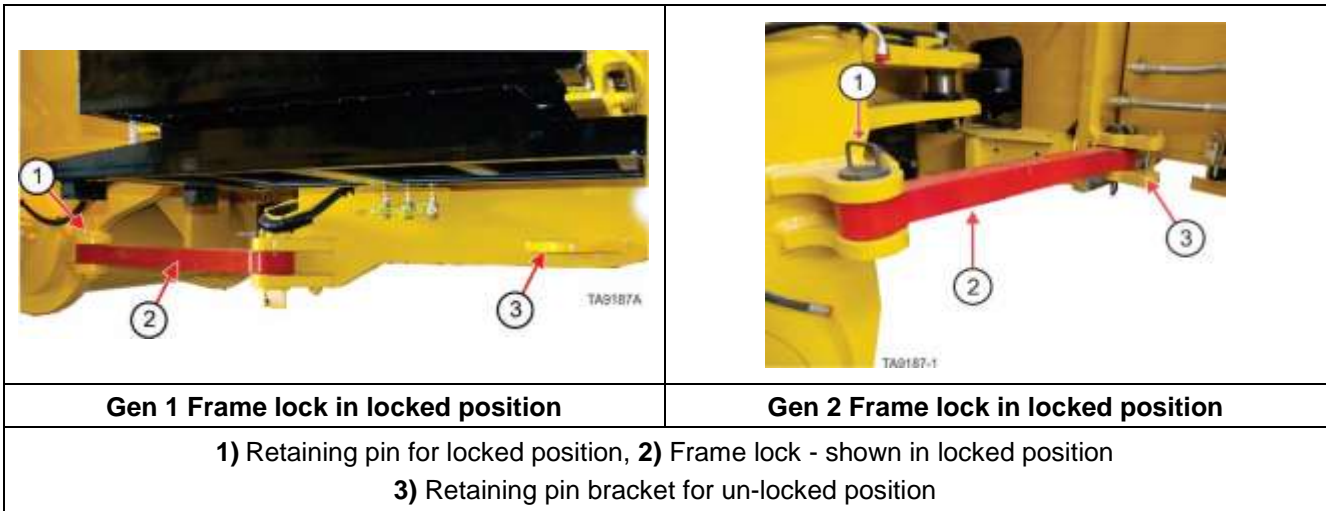
Crush hazards exist if the machine is started or moved while work processes are being performed on the machine. Place bucket flat and level on the ground. Place frame lock in the locked position and lock out the machine's starting capability before performing any work process. Follow all applicable lockout procedures and local rules and regulations for performing work processes. ANYONE performing inspections or service procedures to the machine should be familiar with ALL instructions and procedures contained in the machine's SERVICE MANUAL. Crush hazard could occur if the machine is started or moves while any type of work process is being conducted on the machine, resulting in serious injury or death.

Machine Shutdown and Lockout

1. Stop the wheel loader on flat level ground.
2. Place bucket flat and on level ground.
3. Move the frame lock to the locked position so that the frame cannot be steered.

WARNING

Crush hazards exist in machine pivot area and area between the tires. Do not enter these areas unless it is verified that the operator has control over the steering and that personnel locking the frame lock have good communication with the operator. Entering the pivot area and area between the tires while the machine is moving or pivoting (articulating) could cause crush hazards resulting in serious injury or death.



4. Set the parking brakes.
5. Shut off the engine.
6. Place wheel chocks in front and behind each wheel.
7. Lock out the machine's starting capability before performing any cleaning, inspections, or installation and repair procedure.

⚠ WARNING

Crush, shock, or other hazards exist if stored energy is not removed or isolated prior to working on the machine. Stored energy (hydraulic, electrical, pneumatic, mechanical, etc.) may be present if not isolated or released prior to working on the machine. Do not work on the machine without removing this stored energy (suspended loads, electrical power, air pressure, etc.). Risk of crushing, shock, or other physical injury exists if stored energy is not removed or isolated prior to working on the machine which could result in serious injury or death.

8. Turn the battery and engine isolation switches to the off position and install locks on the battery isolation switch.

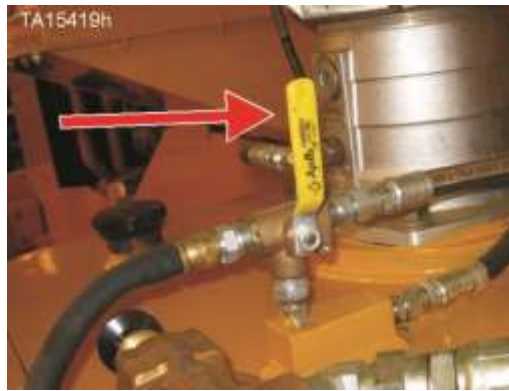


GEN 2 Isolation and Control switches assembly – Battery isolation switch in OFF position with locks in place

NOTICE

The GEN 2 Isolation and Control switches assembly is shown in this document. GEN 1 machines will have a different type of switch and box. The lock out/tag out requirements are the same.

9. Release the air from the hydraulic reservoir by using the hydraulic reservoir air valve (ball valve) on top of the reservoir. The supply line from main air system will be blocked and reservoir air will vent out the hose that runs down the outside of the hydraulic reservoir.
10. Turn the handle to the up position as shown.



Hydraulic reservoir air valve handle UP

11. Release the air from the various air storage reservoirs by opening all of the air bleed valves.

Generation 1	Generation 2
Three valves on left side of rear frame under electrical cabinet	Three valves on right side of rear frame under hydraulic reservoir
One valve on left side of front frame near frame lock and hoist cylinder ball cap	One valve on right side of front frame near hoist cylinder ball cap



Open air reservoir bleed valves

⚠ WARNING

Crush hazards exist if all personnel are not cleared from the bucket and lift arm area before using the hydraulic hoist and bucket hydraulic pressure bleed down valves to relieve pressure from the hoist and bucket circuit. Assembly must be used only when the engine is NOT running. Before using the Manual Bleed Valve Assembly, refer to “HYDRAULIC AND GREASE SYSTEMS”, “MANUAL BLEED VALVE ASSEMBLY”, in Section 04 of the Service Manual for additional operational and safety information. Operating the manual bleed valve may cause the lift arms and bucket to descend rapidly. All personnel around the bucket and lift arms area shall be removed from the area before operating hydraulic hoist and bucket hydraulic pressure bleed down valves. Using the hydraulic bleed down valves could result in movement of the lift arms and bucket which could cause a crush hazard resulting serious injury or death.

12. Use the hydraulic pressure bleed down valves located in the front frame underneath the Husco valves to bleed any stored pressure in the hoist and bucket cylinders.
13. Turn each valve slowly counterclockwise as shown below and allow the pressure to bleed down.
14. Open the valve completely and leave it open during repairs.



CAUTION

Before performing welding operations on a machine, the fire suppression system circuit monitors panel's in-line fuse must be removed. The fuse is located in the battery box on some machines. Failure to do so may cause the system to actuate and/or damage the solid-state components of the system. Replace the in-line fuse before the machine has been started or after all welding operations have been completed.



Fire suppression in-line fuse located in loader battery box on some machines

WARNING

Fall hazard exists when working at heights. Be sure to take appropriate safety precautions when working at heights on the rear and front frames or the lift arms balls. Follow all required statutory regulations for working at height. Wear fall restraint when necessary to prevent falls. Failure to take appropriate safety precautions, including wearing fall restraint when necessary can cause fall hazards resulting in serious injury or death.

WARNING

Crush hazards exist if standing under, working, or placing any body part under hoisted/suspended components. Never stand under hoisted/suspended components. Ensure appropriate lifting devices are used, and blocking is adequate to prevent the component from unexpectedly moving during transportation. Refer to SAFETY, WARNINGS, AND CAUTIONS before attempting to remove the operator's cab. Failure to stay out from under hoisted/suspended components can cause crush hazard resulting in serious injury or death.

Burn Hazard

WARNING

Burn and inhalation hazards exist when welding or cutting on the machine. Cutting and welding can produce hot surfaces. Smokey condition can exist if a fire starts. Have qualified fire watch personnel present, and keep a fire extinguisher that meets all statutory regulations nearby during all cutting and welding operations. Failure to provide a qualified fire watch and an appropriate fire extinguisher can cause fire and inhalation hazards resulting in serious injury or death.

Summary

1. Axle will have to be removed to install axle ball.
2. Axle will have to be rotated so that the ball is sitting vertical for horizontal welding.
3. Welding Consumables:
 - 1) Crack repair in base material: E7018 electrode or E7xT- xxxx series wire.
 - 2) Ball installation: E-8018C3 electrode or E8xT- xxxx series wire.

NOTICE

Komatsu uses Lincoln Ultracore E71T-1MJ along with gas that is 75% Ar/25% CO₂ for installation of the balls. This combination of gas and wire gives a tensile strength of 83,000 psi (572 MPa) which meets the specifications for E80XX wire.

4. Slab preheat for air arc: 250° F (121° C) for 6" (152 mm) from weld in all directions.
5. Slab preheat for welding: 300° F (149° C) for 6" (152 mm) from weld in all directions.
6. Interpass temperature maximum 450° F (232° C).
7. Stringer beads.
8. Post heat and slow cool.
9. Wait 48 hours and MT or PT weld area (magnetic particle or dye penetrant).

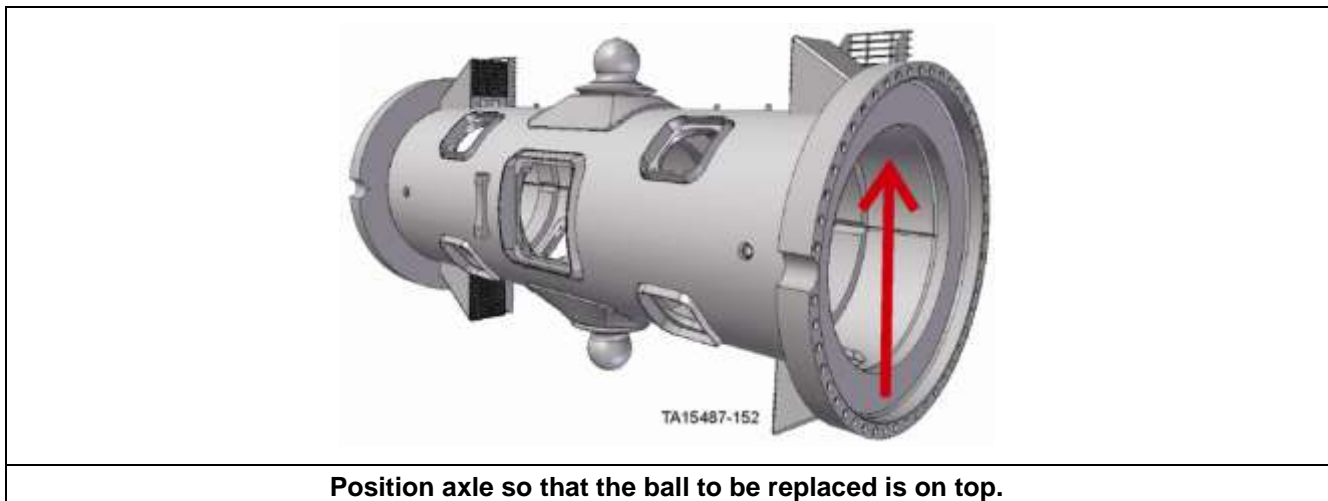
10. Re-Commissioning after Campaign Ball Replacement.

Preparation and Crack Removal

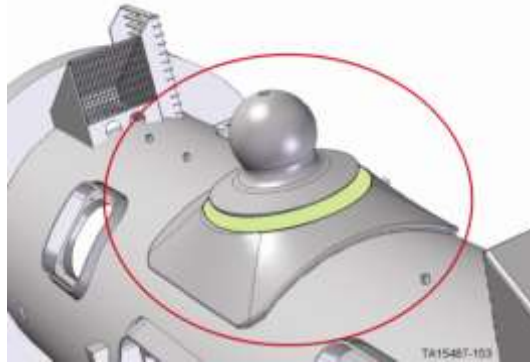
1. Separate the rear axle from the rear frame and place in a safe area.



2. Rotate the axle so that the ball to be replaced is on the top.



3. Support the axle so that it cannot rotate or move while being worked on.
4. Clean the ball base and the transition support so that they are free of dirt and grease.

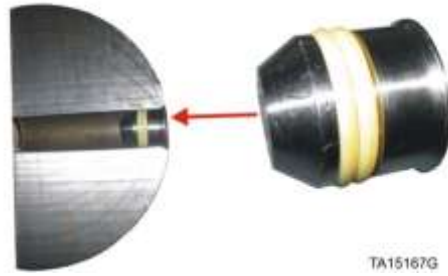


Clean area around the ball and transition plate.

- Remove the grease plug in the center hole. If you are unable to remove this plug then it is recommended to have a new plug available as the plug is typically damaged during ball removal. This plug could be one of several types:



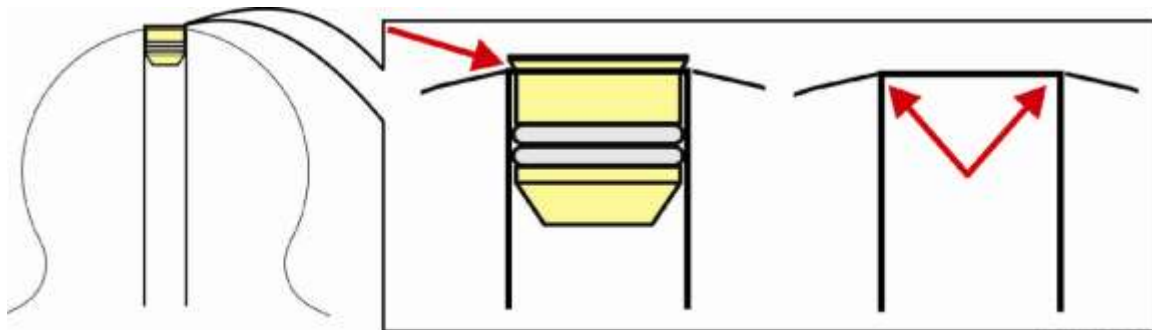
407-8325



426-7874

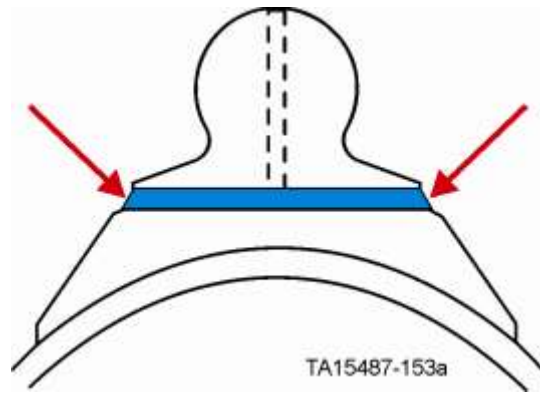
NOTICE

The 426-7874 plug will need some modification to use on some axle balls. The chamfer at the end of hole in the ball structure may not have been cut large enough and the plug may not insert properly into the ball. Grind the chamfer on the ball or grind down the plug.



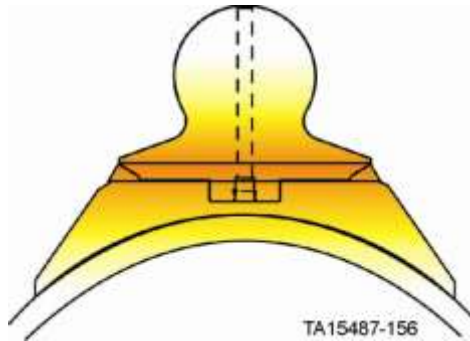
TA15487-155

426-7874 plug not fitting due to lack of chamfer



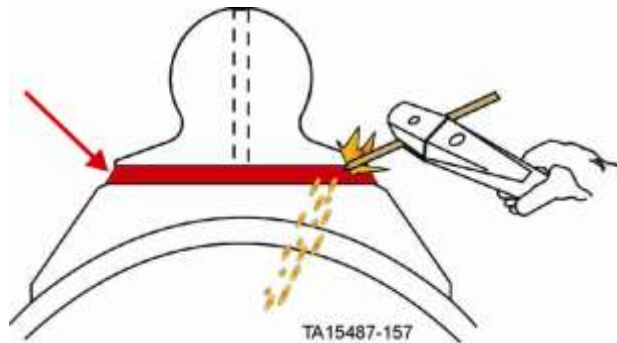
Area to be cleaned prior to beginning repairs

6. Preheat the weld area to 250° F (121° C) and use air arc to remove the old weld.



Preheat ball base and slab

7. Cut away weld and ball material and not the transition piece underneath.



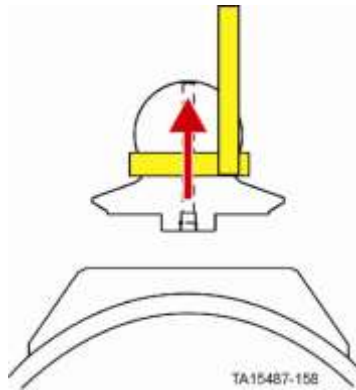
Weld removal on axle articulation ball

8. The ball base is very heavy. Prepare suitable lifting to support the ball once it has been cut loose.

⚠ WARNING

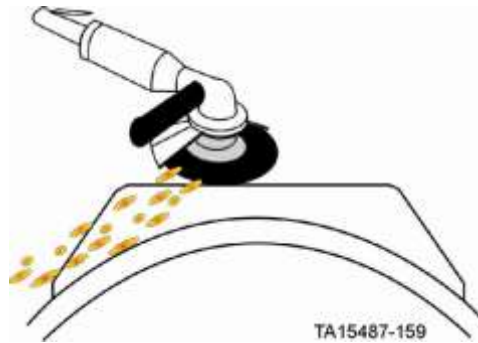
Crush hazard exists when lifting and removing the ball from the axle. The ball base is heavy and should be properly supported as it is removed from the axle. If the ball is not properly supported, it can fall and cause a crush hazard. Failure to properly support the ball when removing it from the axle can cause crush hazards resulting in serious injury or death.

Machine	Size	P/N	Weight
950/1150	7.5"	410-2456	170 lb.(77 kg)
1350/1850	9"	416-8156	231 lb. (105 kg)



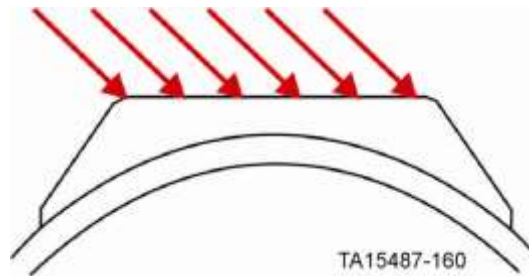
Removal of axle articulation ball

9. Grind the area smooth to remove any carbon left from the cutting process.



Preparing area for installation of new axle articulation ball

10. Repair any gouges or cracks in the transition plate while it is still hot, using E70XX welding consumables.



Repairing gouges in transition plate prior to installation of new pivot ball

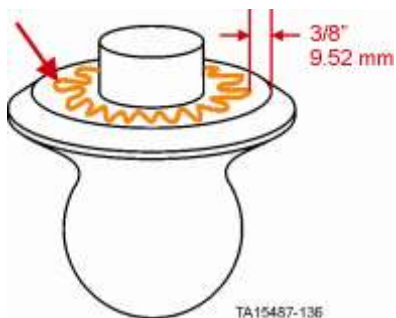
11. Grind any repairs to the transition plate smooth.



Grind repairs

Ball Installation

1. Place a 1/16" (1.6 mm) diameter (approximate) soft copper single conductor wire (typical 12 or 14 gauge electrical wiring is suitable) around the ball base in a weave pattern as shown. Space the wire away from the edge of the ball base so that the wire does not melt into the weld.
2. Tape the wire in place.



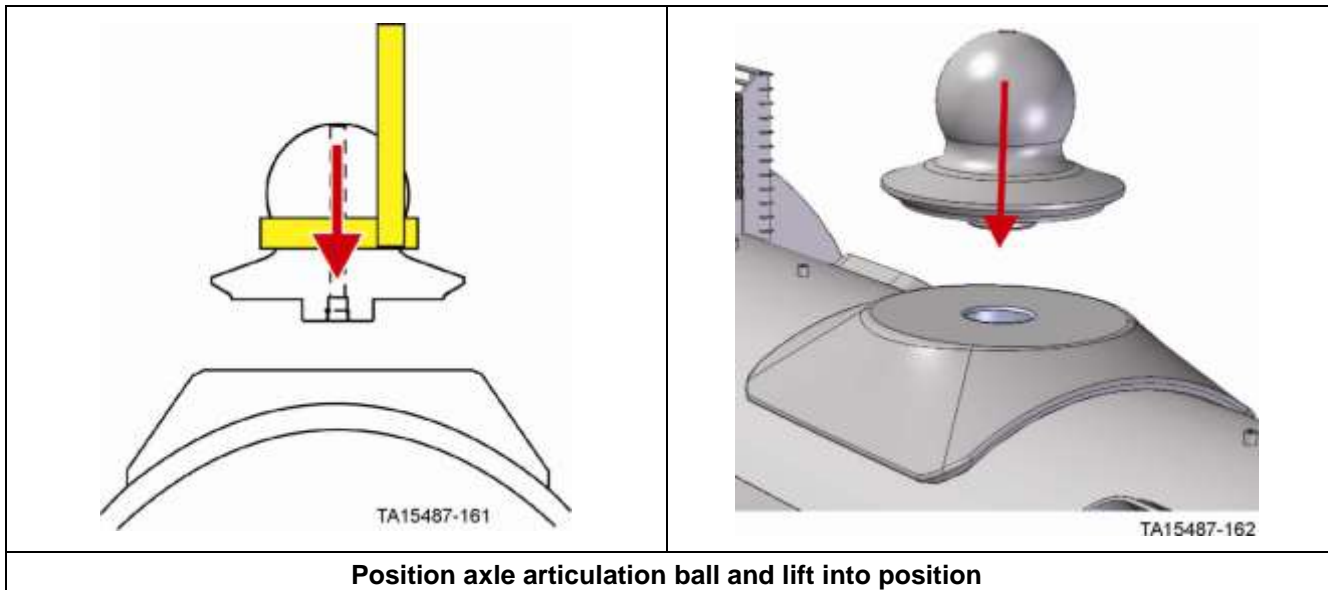
Install copper wire as shown

3. Position the new ball base onto the axle. If possible support the ball on a rolling stand so that it can be lifted into position.

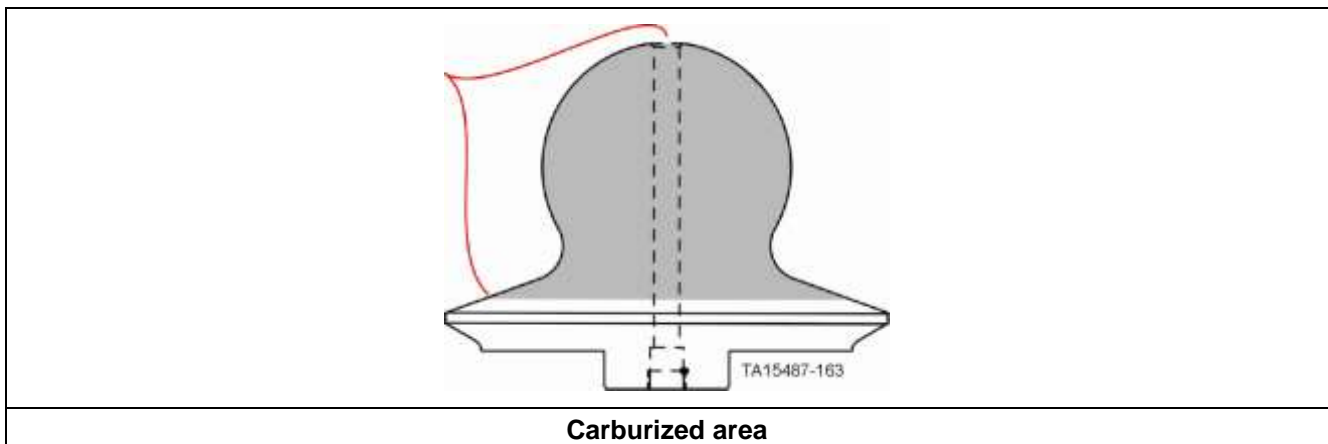
⚠ WARNING

Crush hazard exists when lifting and attaching the ball to the axle. The ball base is heavy and should be properly supported as it is attached to the axle. If the ball is not properly supported, it can fall and cause a crush hazard. Failure to properly support the ball when attaching it to the axle can cause crush hazards resulting in serious injury or death.

Machine	Size	P/N	Weight
950/1150	7.5"	410-2456	170 lb.(77 kg)
1350/1850	9"	416-8156	231 lb. (105 kg)

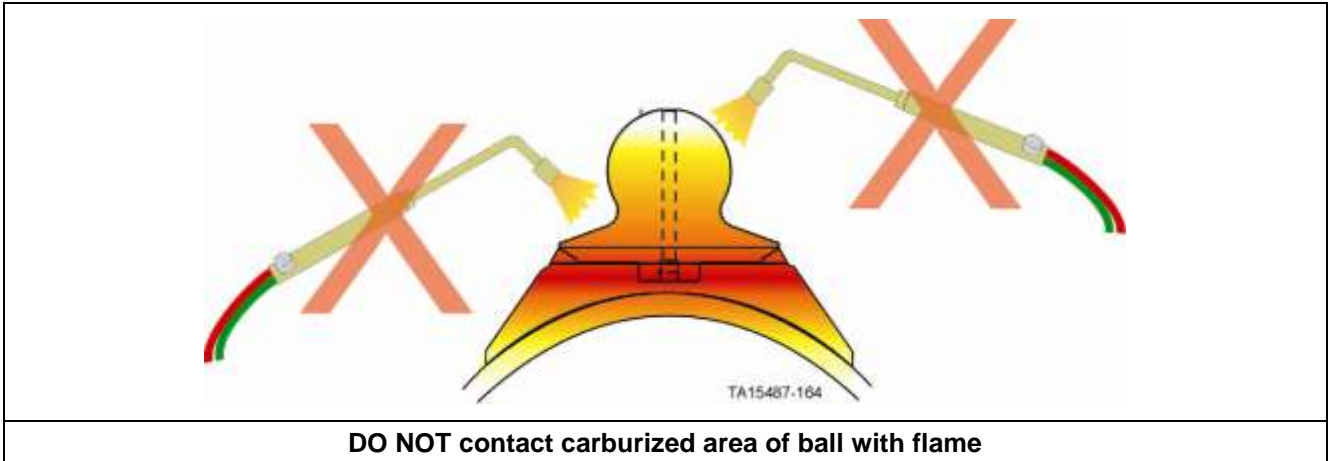


4. Lift the ball base into position. The pilot hole in the transition plate will position the ball properly.
5. The spherical and neck part of the ball base is hardened by a carburizing process as shown by the gray colored area in the following drawing.

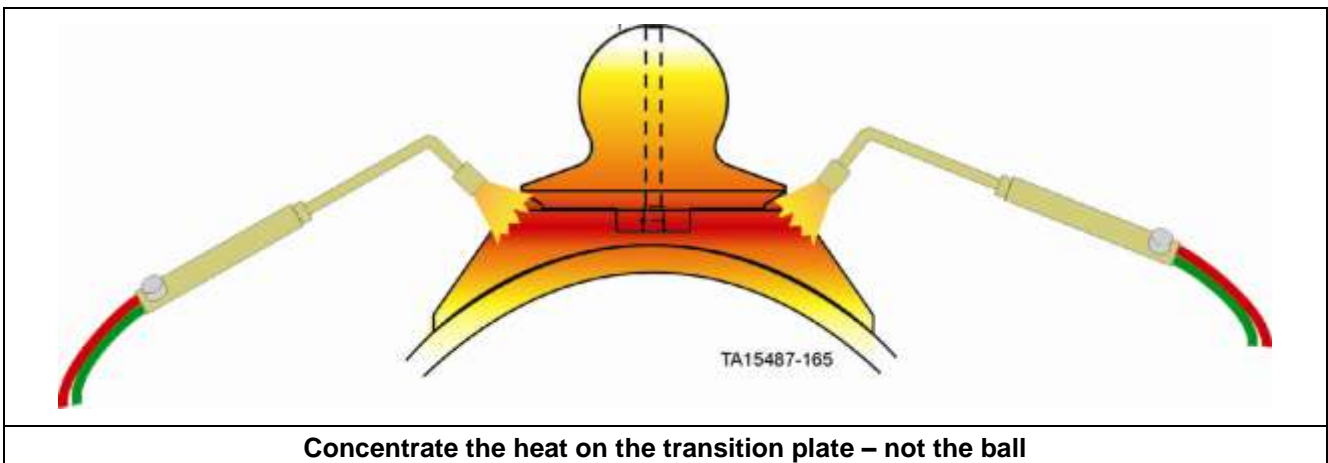


CAUTION

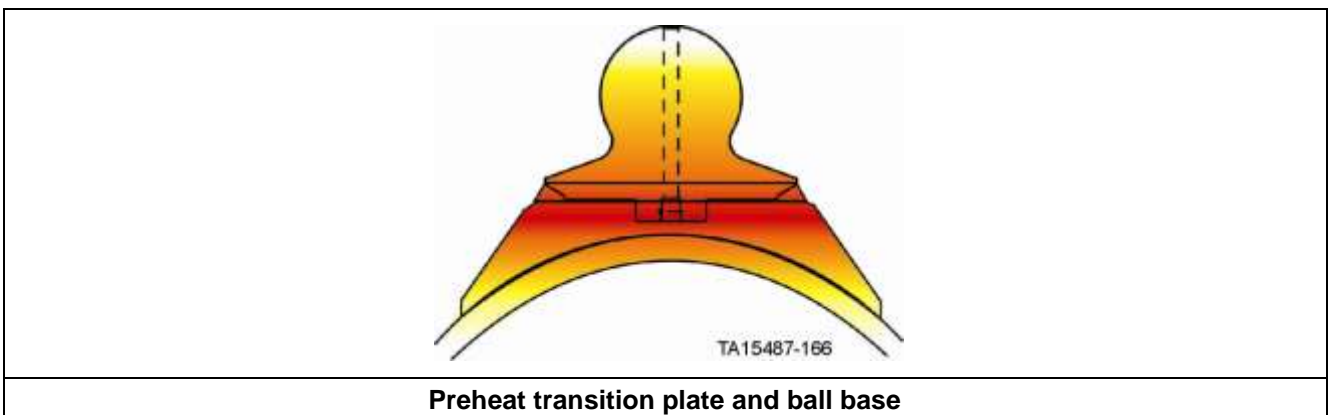
DO NOT apply heat or flame to the carburized neck or spherical portion of the ball base with a torch flame as this will reduce the hardness of the ball and can cause subsurface cracking.



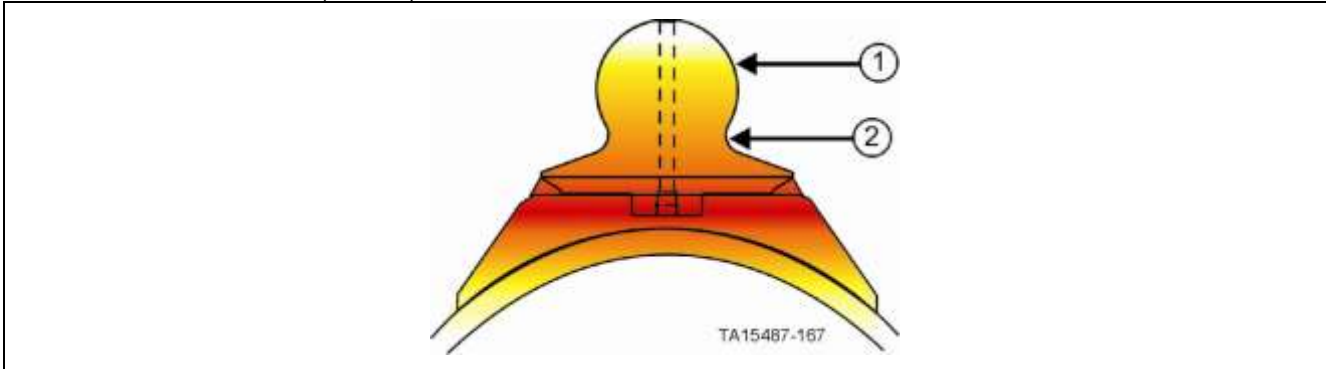
6. Heat the weld area by focusing the heat on the transition plate – DO NOT heat the ball.



7. Preheat the transition plate around the perimeter of the ball base until the temperature is 300° F (149° do not exceed this temperature on the ball).

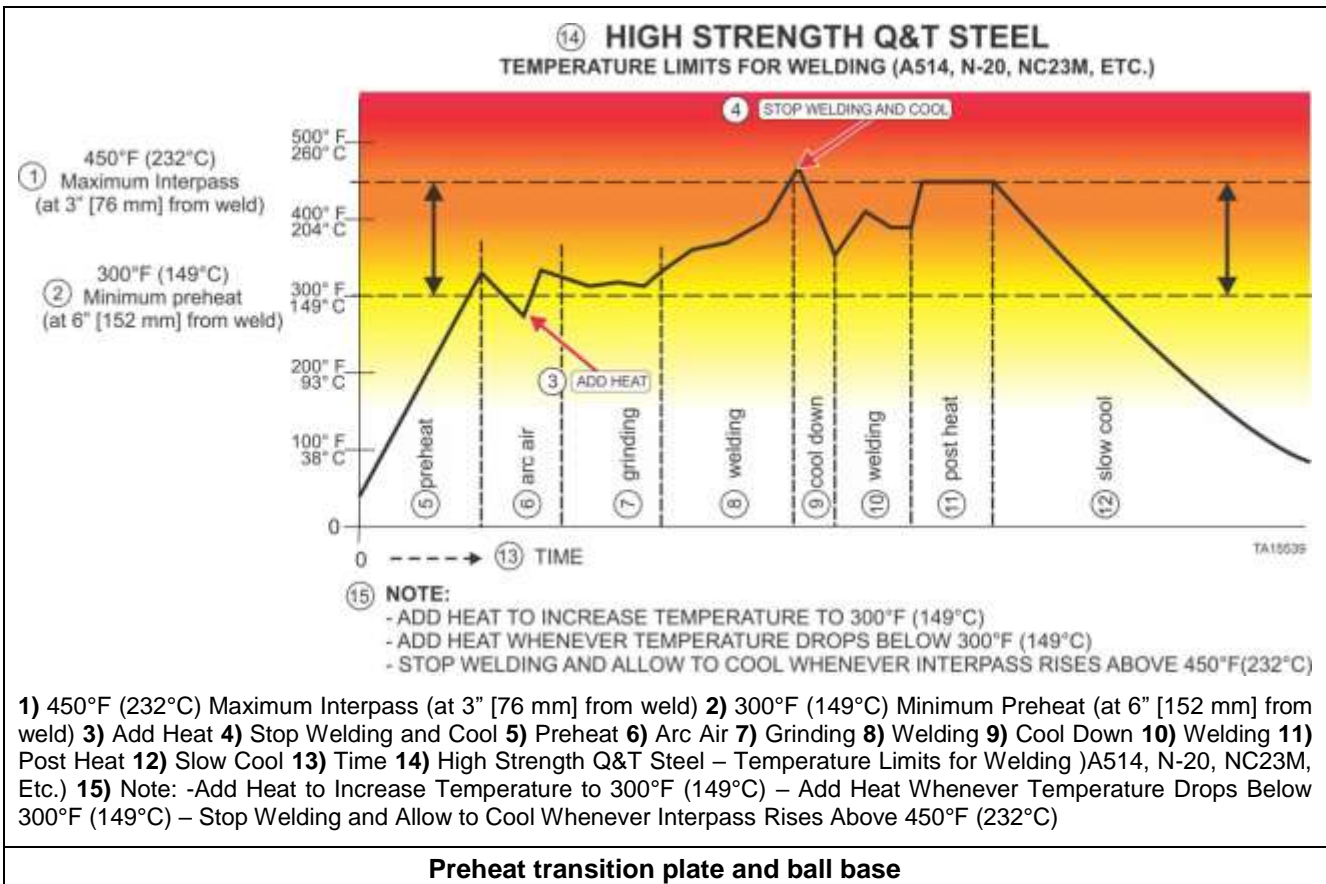


8. Monitor the ball temperature during preheating and during the welding process:
 - a. Monitor the neck area of the ball base during welding to ensure that the temperature never exceeds 400° F (204° C). If the temperature comes close to this then the welding must be stopped and allow time for the ball to cool.
 - b. Monitor the spherical area of the ball base during welding to ensure that the temperature never exceeds 300° F (149° C).



Maximum ball temperature

- 1) Maximum ball temperature 300° F (149° C).
- 2) Maximum neck temperature 400° F (204° C).



Welding Wire

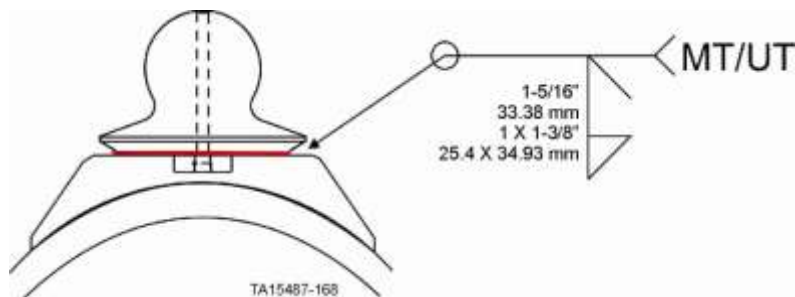
1. Typical wire sizes used for FCAW welding will be .045" (1.2 mm), .052" (1.4 mm) or 1/16" (1.6 mm) diameter. The most commonly used sizes are .052" (1.4 mm) or 1/16" (1.6 mm).
2. Wire consumable for field welding of ball installations is E8xT- xxxx series wire.

NOTICE

The factory will consider approving other wire types depending on the specifications of the wire. For example: Komatsu uses Lincoln Ultracore E71T-1MJ along with gas that is 75% Ar/25% CO₂ for installation of the balls. This combination of gas and wire gives a tensile strength of 83,000 psi (572 MPa) which meets the specifications for E80XX wire.

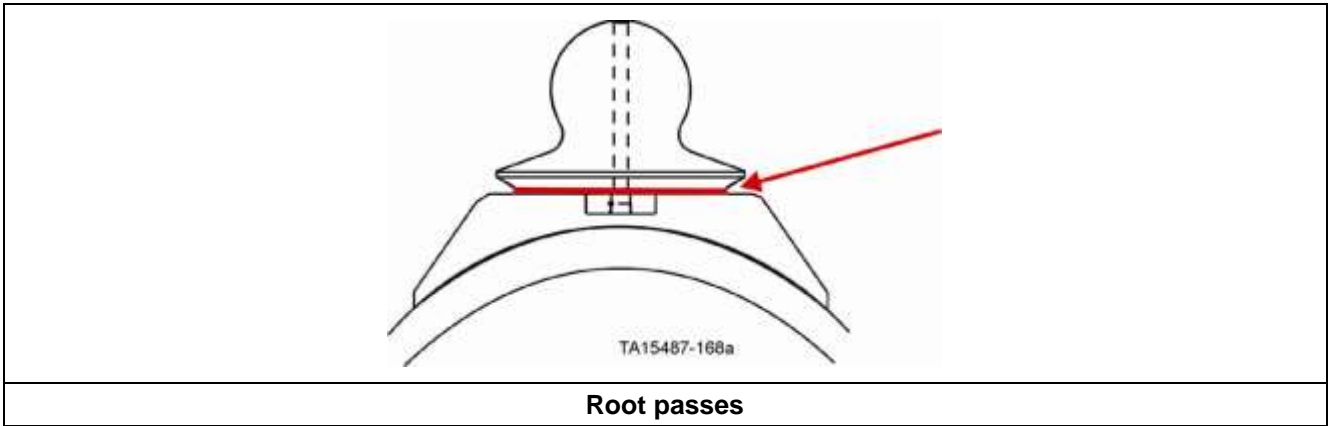
Electrodes

1. Electrodes for SMAW are specified to be low hydrogen in one of the following series (7018, 8018, 9018, etc.) as specified for each type of material and procedure.
2. Typical electrode sizes for SMAW will be 1/8" (3.2 mm) for root passes and 5/32" (4 mm) for the remainder.
3. Storage and handling of low hydrogen electrodes:
 - a. Use new low hydrogen electrodes that are provided in hermetically sealed packages. Do not use old electrodes for structural repairs. Old electrodes are defined as those that were removed from a sealed package more than 1 month earlier and have been kept in an oven.
 - b. Remove only one hour's supply of electrodes at a time. Keep the remainder in a ventilated holding oven at 225° F (107° C).
 - c. Bake previously opened packages of electrodes in a ventilated oven at 500° F (260° C) for two hours before using.
 - d. Electrodes taken from cardboard boxes or a non-airtight container should also be baked at 500° F (260° C) for two hours in a ventilated oven.
 - e. Then the electrodes should be placed immediately in a ventilated holding oven set at 225° F (107° C).
 - f. Any electrode exposed to the air for more than four hours should be re-baked per the instructions above.
4. Use an 80 series consumable for field welding of ball installations.
 - a. Weld with E-8018C3 series electrodes or E8xT-xxx FCAW wire.
 - b. If using SMAW E-8018C3 – weld the first 3 root passes with 1/8" (3.2 mm) rod.

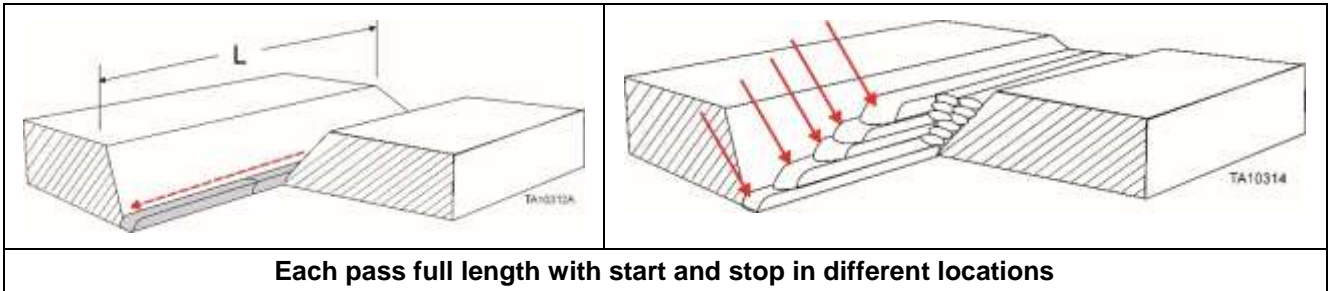


Weld specification

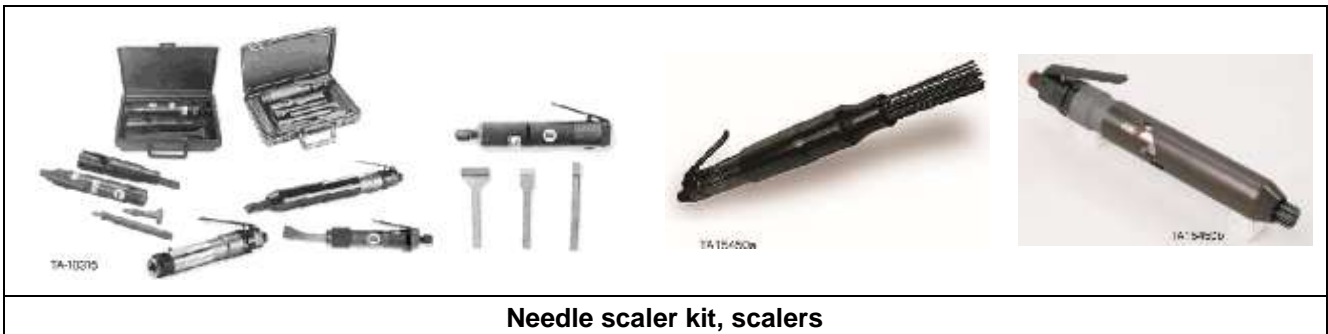
5. If using SMAW - use a 1/8" (3.2 mm) diameter rod for the first 3 root passes.



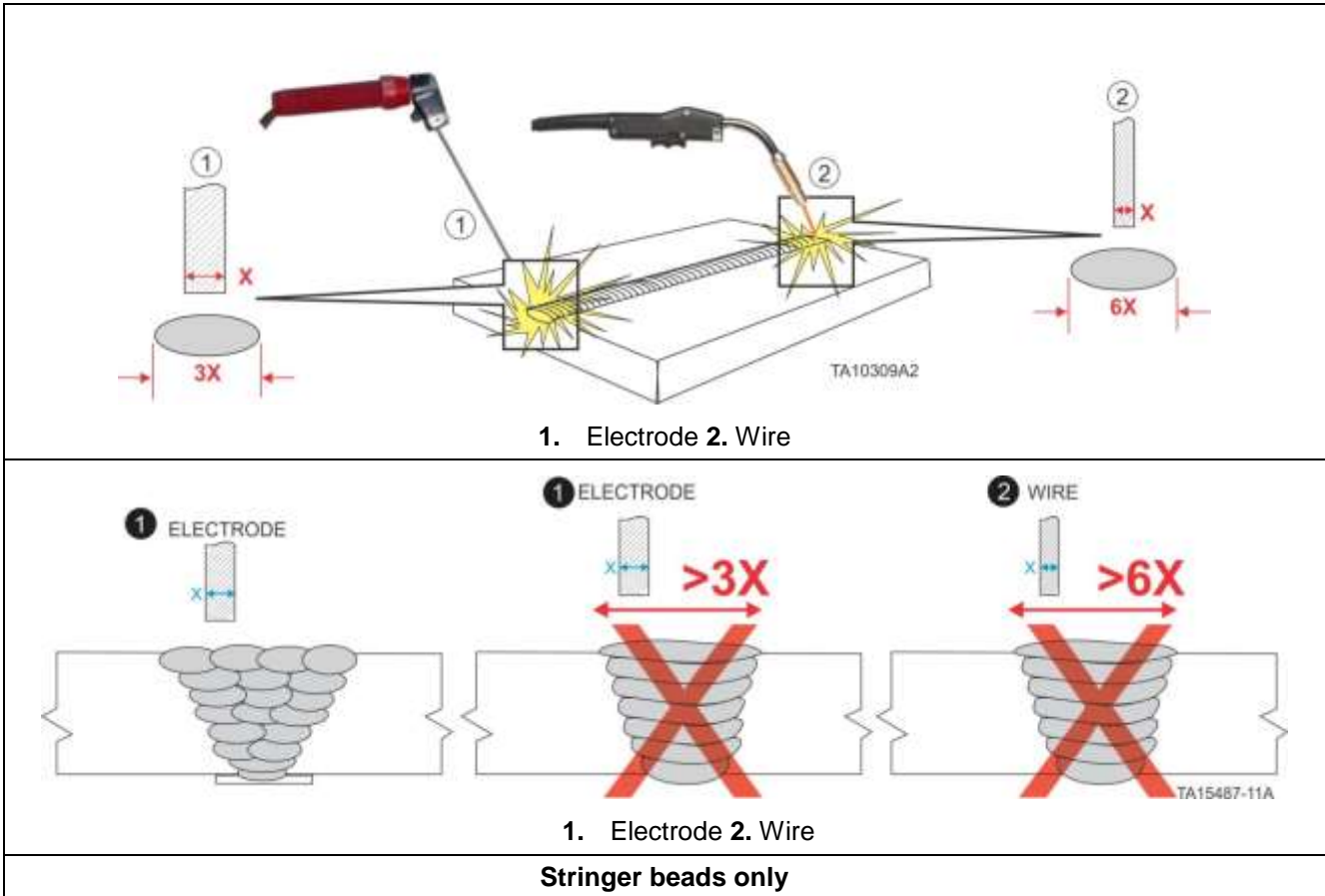
6. Finish each pass all around the diameter of the weld. DO NOT weld in sections.
7. Each weld pass must start and stop in a different location from previous pass.



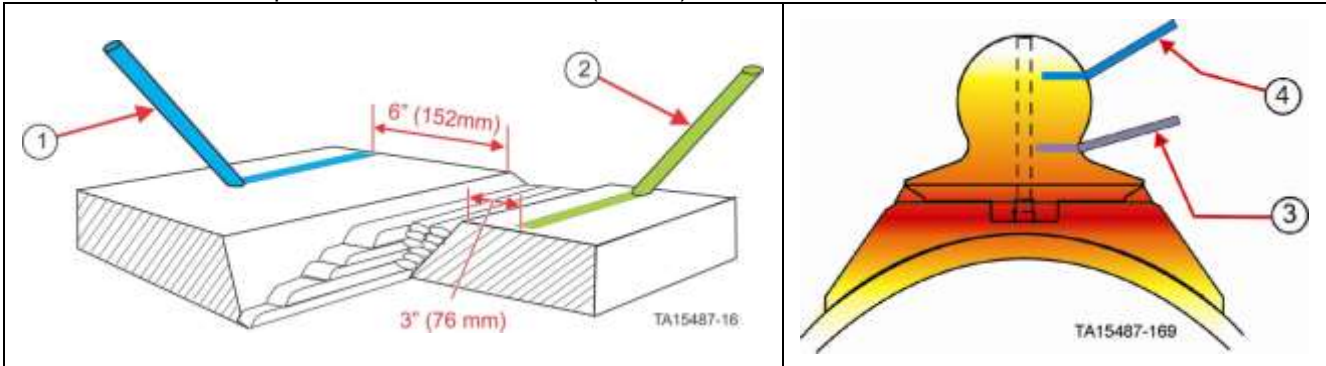
8. After welding each pass remove the slag with a needle scaler air tool.



- 9. If using SMAW E-8018C3 – weld the rest of the passes with 5/32" (4 mm) rod.
- 10. Do not weave weld. Only multi pass stringer beads are allowed.



11. Continue to monitor temperatures after each weld pass. The welding should be stopped whenever the interpass or neck temperature becomes hotter than specification. DO NOT force cool by using fans or water. Heat should be added if the temperature drops below the preheat minimum.
- Preheat temperature minimum 300° F (149° C).
 - Interpass temperature maximum 450° F (232° C).
 - Ball neck temperature maximum 400° F (204° C).



Monitor temperatures during welding

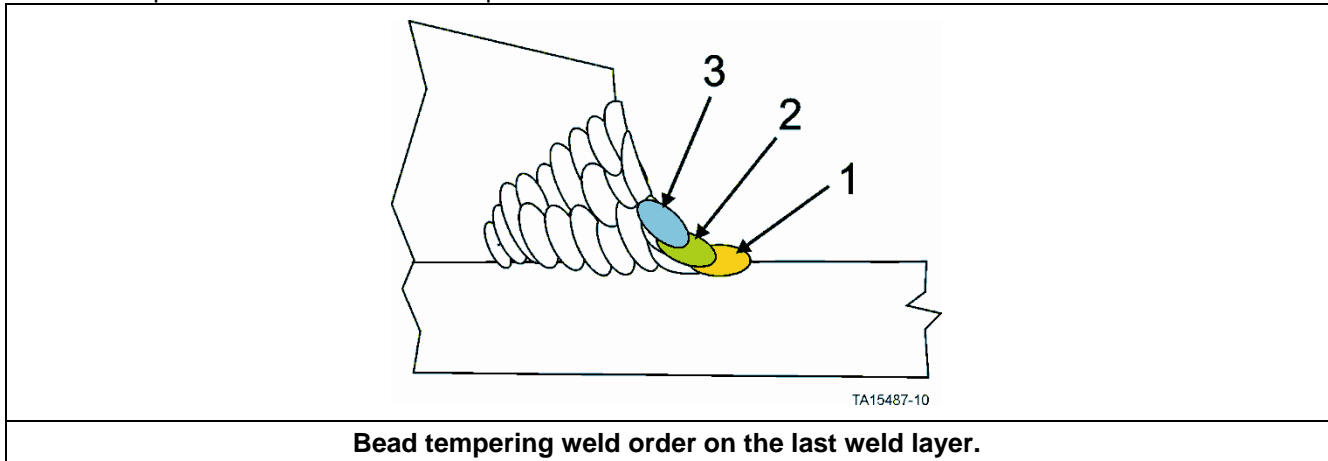
- 300° F (149° C) temperature stick for **preheat** temperature
- 450° F (232° C) temperature stick for **interpass** temperature
- 400° F (204° C) temperature stick for **neck** temperature
- 300° F (149° C) temperature stick for **ball** temperature

12. Record the temperatures in the preheat and interpass heat logs every hour.

PREHEAT LOG SHEET				INTERPASS LOG SHEET			
Job Description		Date		Job Description		Date	
Welder	Time	Temp.	Initial	Welder	Time	Temp.	Initial
	0				0		
	1 hour				1 hour		
	2 hour				2 hour		
	3 hour				3 hour		
	4 hour				4 hour		
	5 hour				5 hour		
	6 hour				6 hour		
	7 hour				7 hour		
	8 hour				8 hour		
	9 hour				9 hour		
	10 hour				10 hour		
	11 hour				11 hour		
	12 hour				12 hour		
	13 hour				13 hour		
	14 hour				14 hour		
	15 hour				15 hour		

SAMPLE

13. On the last layer the weld sequence is critical. Proper sequencing of the welds (bead tempering) uses the heat from subsequent passes to temper the earlier passes. This will reduce the stress in the junction between the weld and the base material.
- a. 1st pass must be on the base material.
 - b. 2nd pass must be above the 1st pass.
 - c. 3rd pass must be above the 2nd pass.

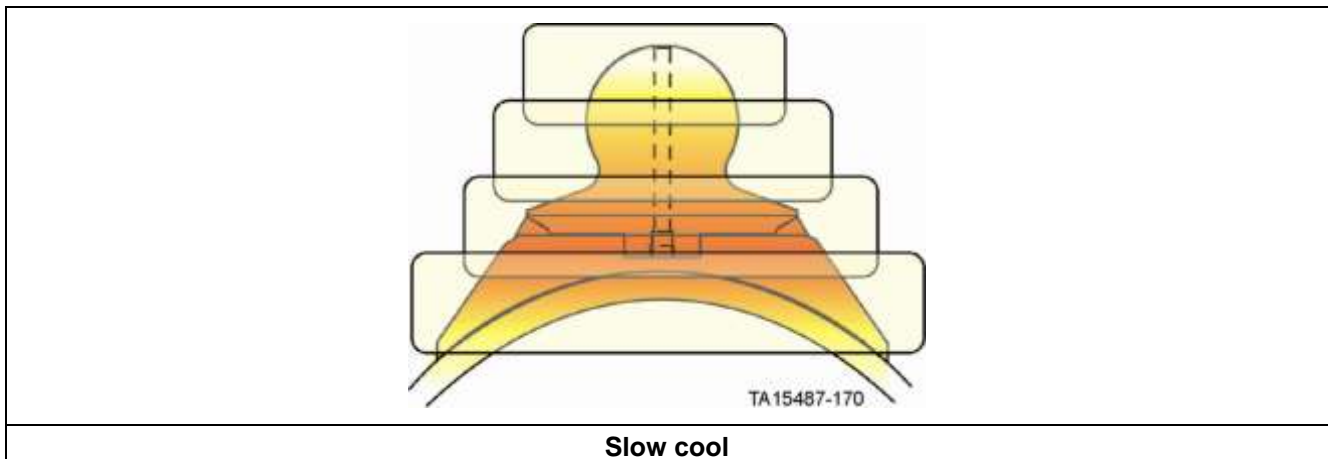


14. The cap passes must be blended smooth.
15. Post heat the weld area at 400° F (204° C) for a minimum of 1 hour.

CAUTION

This post heat **ONLY** applies to the weld area. The neck and ball are still limited to the same maximum temperatures of 400° F (204° C) in the neck and 300° F (149° C) in the ball.

16. Cover the ball with insulation material and allow to slow cool.



17. Monitor the cooling rate:

CAUTION

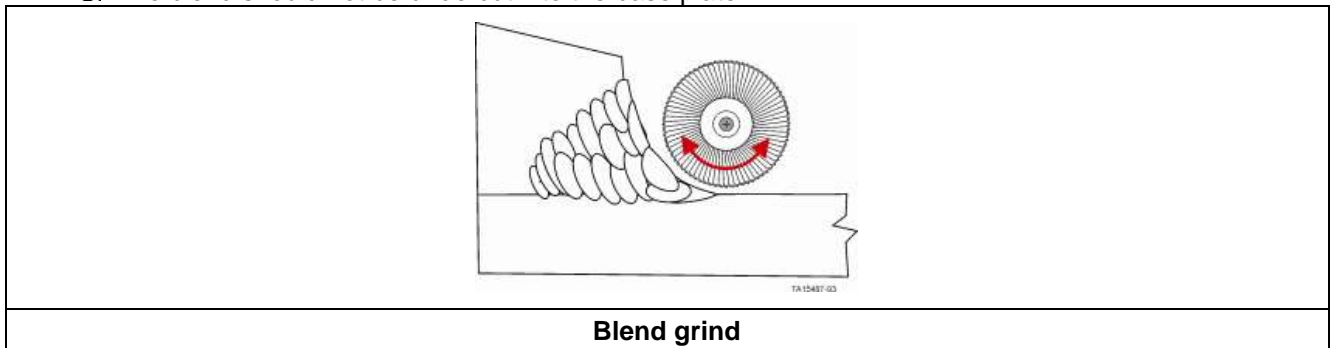
The cooling rate is critical. Excessive cooling rates may cause cracks. This must be closely monitored because the axle structure is a large heat sink and can dissipate heat very quickly.

The following is a sample post heat form. A full size form is provided in the appendix.

Weld Post Heat and Cool Down Log – (ball installation)		
Time	Target Temp	Actual Temp
Post heat:		
1 hour*	400° F (204° C)	
Cool Down: (minimum times listed)		
30 min	375° F (191° C)	
1 hour	350° F (177° C)	
2 hour	300° F (149° C)	
3 hour	250° F (121° C)	
4 hour	150° F (66° C)	

18. After the weld has cooled sufficiently - blend grind the weld around the ball.

- a. The grinding direction is across the weld.
- b. The blend should not be undercut into the base plate.

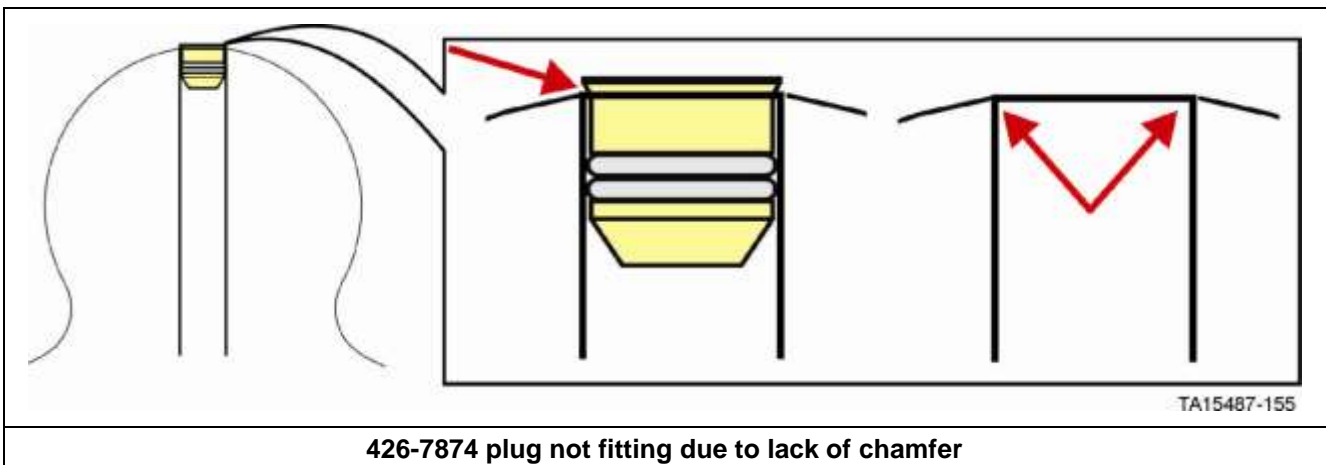


19. Install the grease plug in the center hole. This plug could be one of several types:

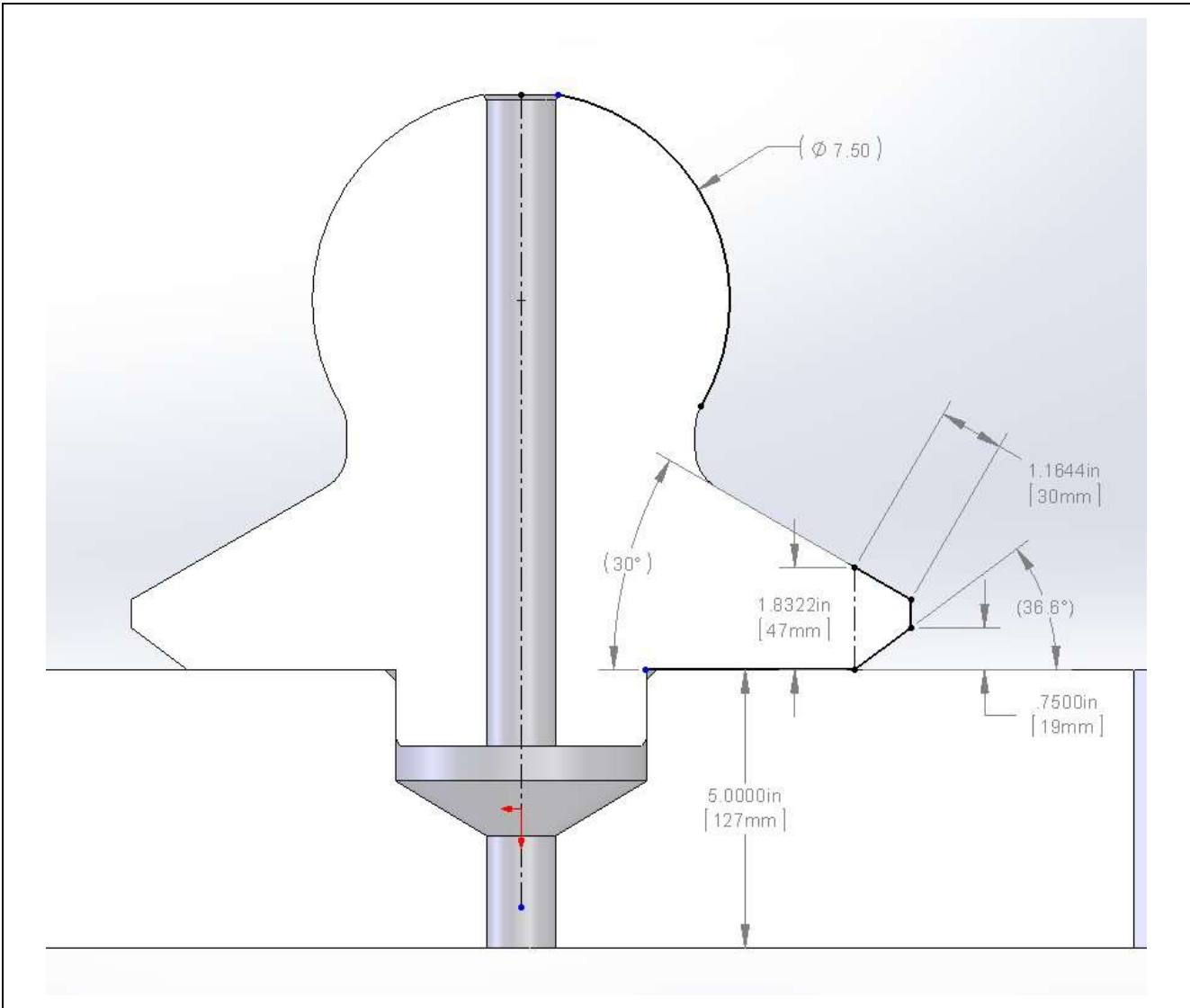


NOTICE

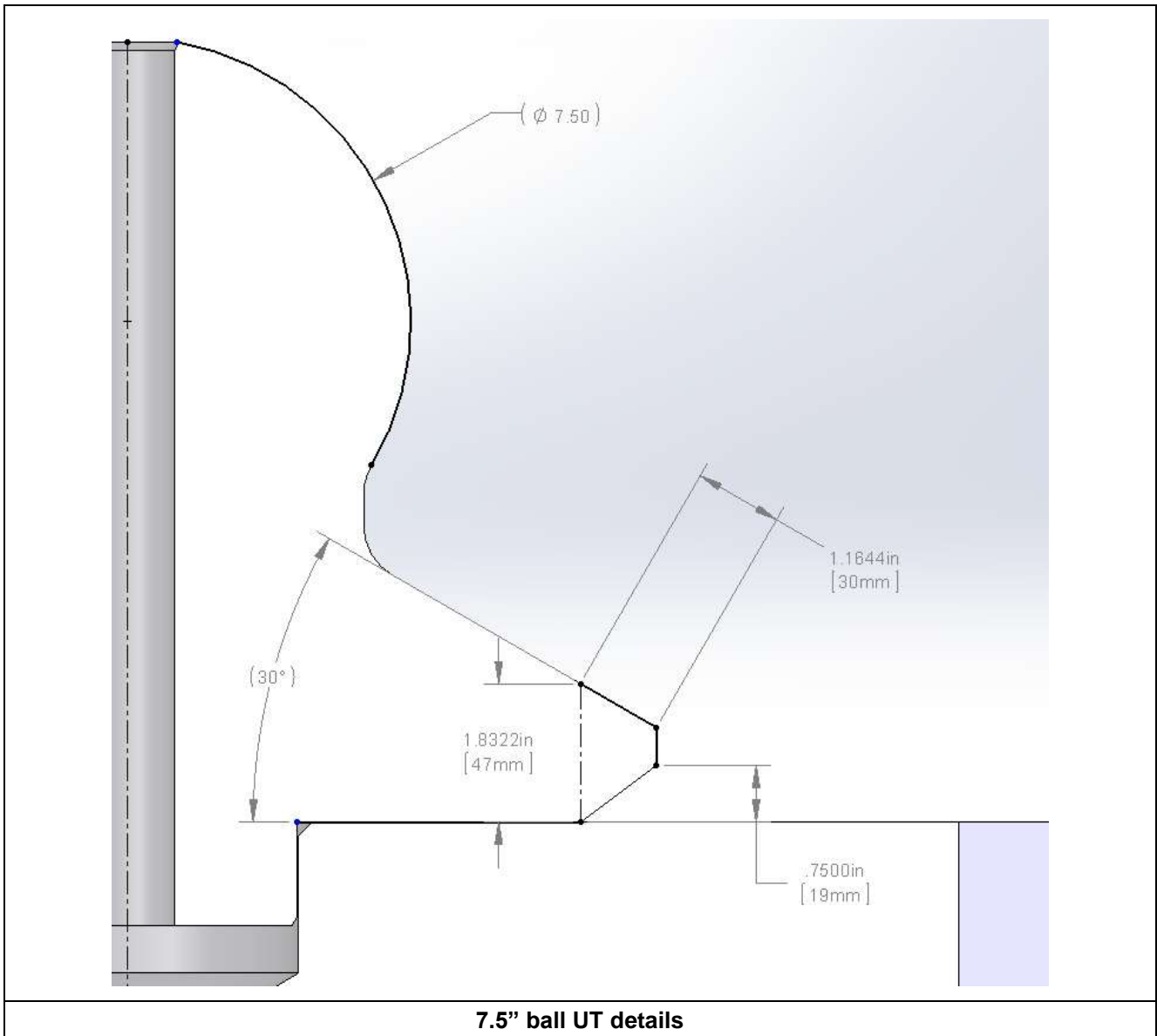
The 426-7874 plug will need some modification to use on some axle balls. The chamfer at the end of hole in the ball structure may not have been cut large enough and the plug may not insert properly into the ball. Grind the chamfer on the ball or grind down the plug.

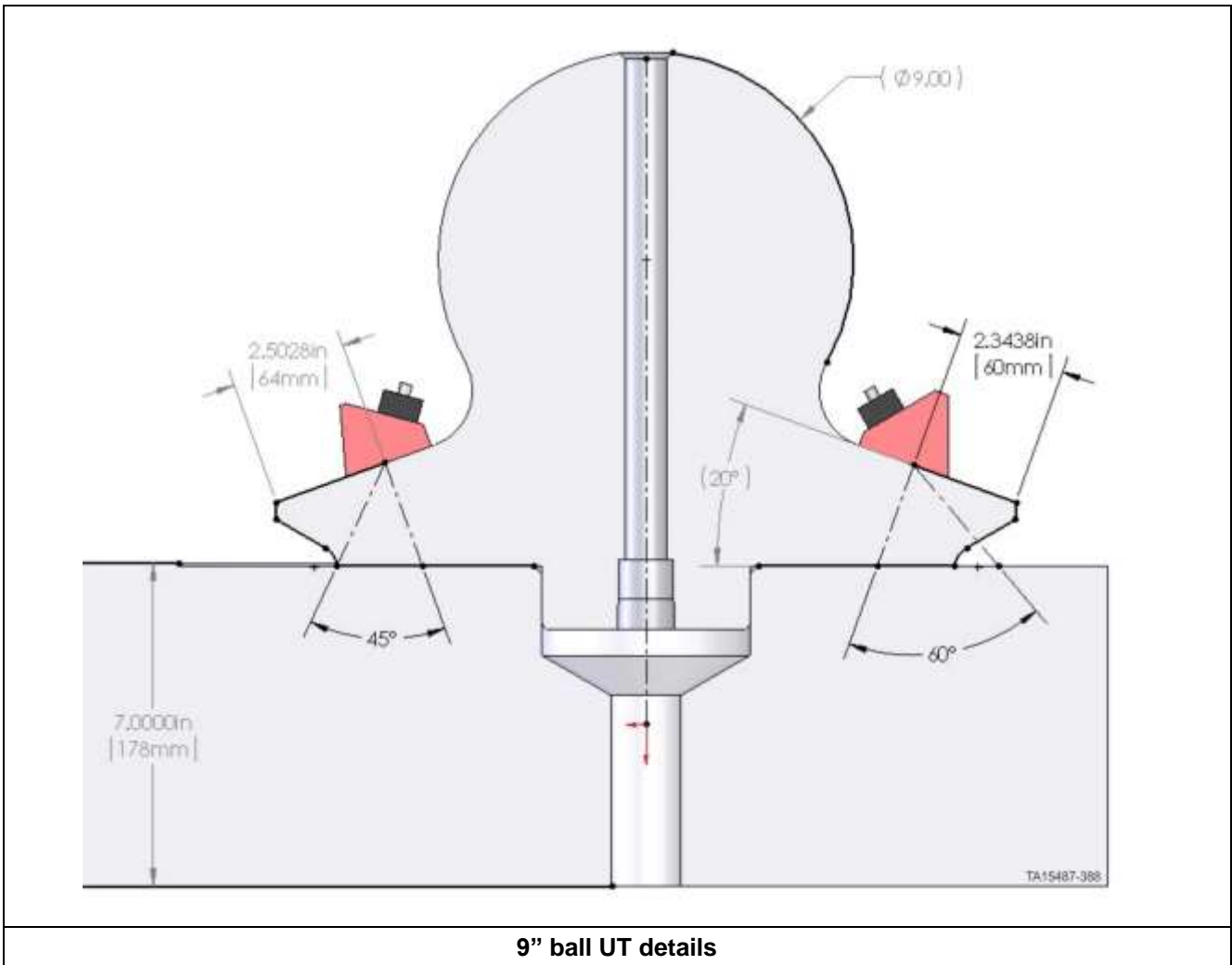


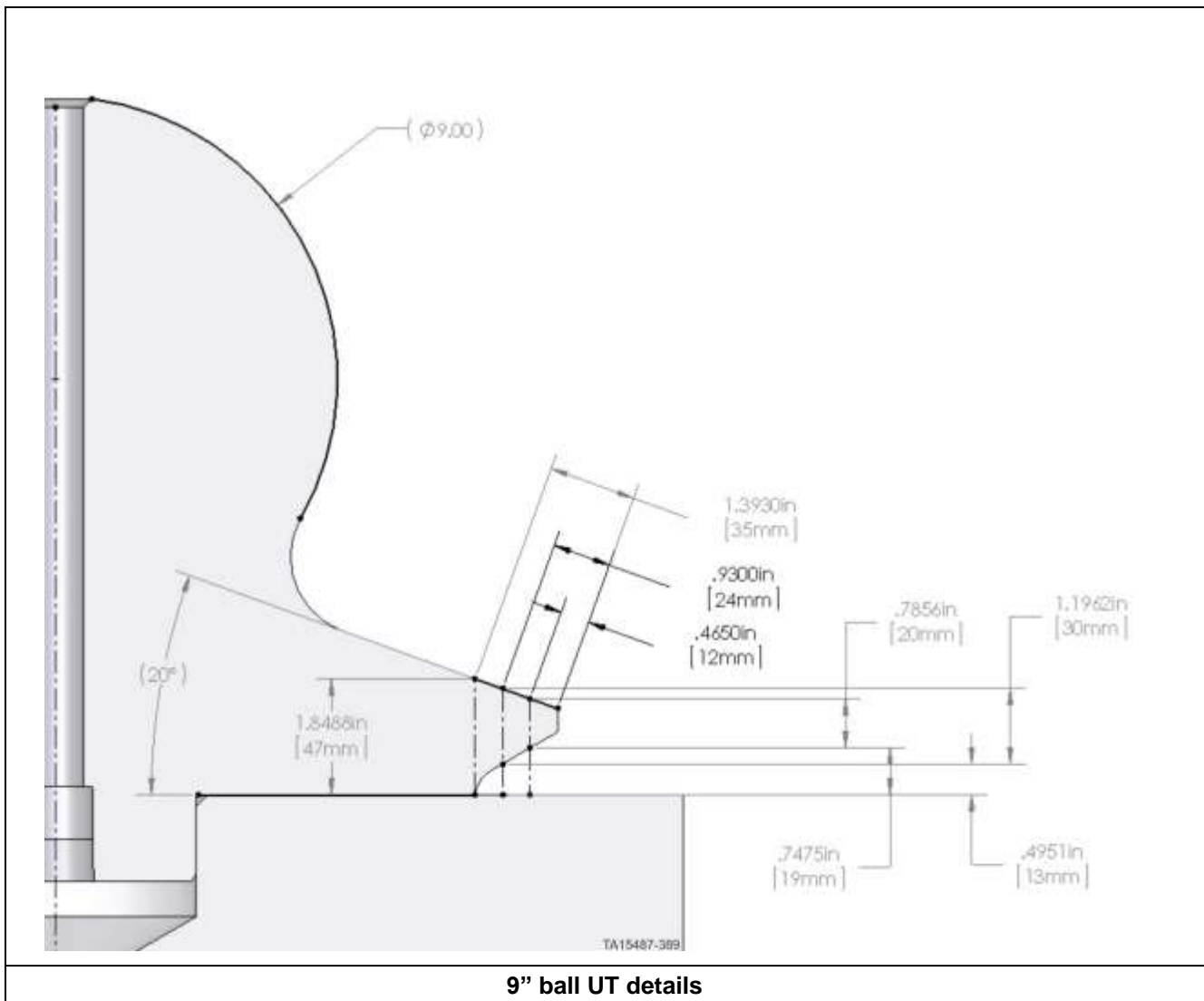
20. Wait 48 hours and UT (ultrasonic testing) and MT or PT weld area (magnetic particle or dye penetrant).



7.5" ball UT details







21. Paint the repair area.

22. Fit the axle to the machine.

NOTICE

The position of the ball will change a small amount each time a new ball is installed. One of the axle sockets must be replaced to ensure that the ball and socket have the proper clearance.

NOTICE

Re-Commissioning after Ball Replacement

- After each ball has been replaced or repaired and all of welding/inspection procedures have been completed- specific assembly and maintenance items outlined in the Re-Commissioning Replacement Document must be done to assure proper function of the ball joints.
- Re-Commissioning Replacement Document is at the end of this chapter and a copy is also included in the Appendix of the Field Welding Procedure document.

This documentation is required for warranty claims to be considered during the ball change out campaign.

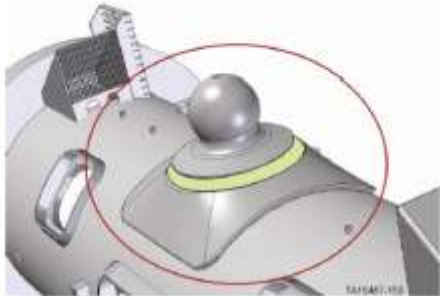
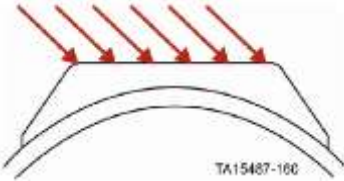
Documentation Required to be submitted with warranty claim for reimbursement	
<input type="checkbox"/>	Ball Installation Worksheet – for the specific ball type being changed
<input type="checkbox"/>	Heat log during the repair
<input type="checkbox"/>	Welding log
<input type="checkbox"/>	Post heat log
<input type="checkbox"/>	Wet mag particle check (MT) inspection report for weld– More than 48 hours after repair complete and slow cooled to ambient temperature

Axle Ball Worksheet

(Field Welding Procedure Chapter 5)

General Information	
Date work started	Date work completed
Machine type	L-1350 <input type="checkbox"/> L-1350G2 <input type="checkbox"/> L-1850 <input type="checkbox"/> L-1850G2 <input type="checkbox"/> L-2350 <input type="checkbox"/>
Machine S/N	
Machine location (mine name)	
Machine hours	
Ball hours (if known)	
BALL INFORMATION	
Ball location	Front axle ball - <input type="checkbox"/> Rear axle ball - <input type="checkbox"/>
Ball size	
Ball markings – part number/serial number	
Sales Force Case #	
Field Welding Procedure Specification (FWPS) used?	FW-0107 <input type="checkbox"/> FW-0108 <input type="checkbox"/> FW-0109 <input type="checkbox"/> FW-0110 <input type="checkbox"/> FW-0111 <input type="checkbox"/>
PERSONNEL AND COMPANIES INVOLVED	
Person responsible for filling in forms	
Supervisor company	
Supervisor name(s)	

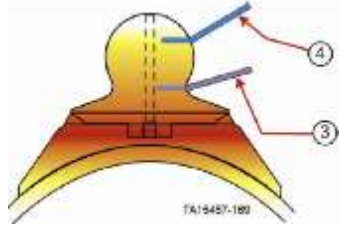
General Information		
Company for welding		
Personnel Names and certifications	1	2G <input type="checkbox"/> 3G <input type="checkbox"/> 4G <input type="checkbox"/> 6G <input type="checkbox"/> none <input type="checkbox"/>
Minimum certifications: AWS D1.1 (Or equivalent recognized welding code)	2	2G <input type="checkbox"/> 3G <input type="checkbox"/> 4G <input type="checkbox"/> 6G <input type="checkbox"/> none <input type="checkbox"/>
2G/3G (or 4G) for the process being used (FCAW or SMAW)	3	2G <input type="checkbox"/> 3G <input type="checkbox"/> 4G <input type="checkbox"/> 6G <input type="checkbox"/> none <input type="checkbox"/>
	4	2G <input type="checkbox"/> 3G <input type="checkbox"/> 4G <input type="checkbox"/> 6G <input type="checkbox"/> none <input type="checkbox"/>
	5	2G <input type="checkbox"/> 3G <input type="checkbox"/> 4G <input type="checkbox"/> 6G <input type="checkbox"/> none <input type="checkbox"/>
	6	2G <input type="checkbox"/> 3G <input type="checkbox"/> 4G <input type="checkbox"/> 6G <input type="checkbox"/> none <input type="checkbox"/>
	7	2G <input type="checkbox"/> 3G <input type="checkbox"/> 4G <input type="checkbox"/> 6G <input type="checkbox"/> none <input type="checkbox"/>
	8	2G <input type="checkbox"/> 3G <input type="checkbox"/> 4G <input type="checkbox"/> 6G <input type="checkbox"/> none <input type="checkbox"/>
Company used for preheating		
Personnel Names	1	
	2	
	3	
Company used for monitoring and recording preheat		
Personnel Names	1	
	2	
Company for UT inspections		
Company for PT/MT inspections		
Personnel Names	1	
	2	
	3	
WELDING CONSUMABLE AND EQUIPMENT		
Welding equipment (brand and model)	Root Pass Build passes	
Welding consumable – root pass		
Weld machine settings for root pass	Volts _____ Amps _____.	

General Information	
Welding consumable – build passes	
Gas used for welding consumable	
Gas flow rate	
Weld machine settings at the welding machine	Volts _____ Amps _____.
Volts and amps measured at the feeder or at work piece connections	Volts _____ Amps _____.
Preheat method used	Gas flame <input type="checkbox"/> Type of gas used? Type of torch used? Moving or stationary? Electric heaters <input type="checkbox"/> Brand and type
Temperature measuring method (temperature stick(crayon) must be used)	Temperature stick(crayon) <input type="checkbox"/> Brand? Temperature ranges? Temperature gun <input type="checkbox"/> Brand?
PROCEDURE INFORMATION	
Ball procedure See Chapter 5 of Feld Welding Procedure	
	Type axle ball <input type="checkbox"/>
Remove all rust preventative material or other contamination from the replacement ball	Yes <input type="checkbox"/> No <input type="checkbox"/>
Damage to the transition?	YES <input type="checkbox"/> NO <input type="checkbox"/>
Procedure used to remove ball base?	Cut in pieces YES <input type="checkbox"/> NO <input type="checkbox"/> Remove one large piece YES <input type="checkbox"/> NO <input type="checkbox"/> Torch YES <input type="checkbox"/> NO <input type="checkbox"/> Arc air YES <input type="checkbox"/> NO <input type="checkbox"/>
MT transition face to look for cracks (If crack indications are found in the transition repair	
	YES <input type="checkbox"/> NO <input type="checkbox"/>
Repair all torch or gouge digs on tube per procedures	YES <input type="checkbox"/> NO <input type="checkbox"/>
Grind all repairs	YES <input type="checkbox"/> NO <input type="checkbox"/>
MT face to verify cracks have been repaired	YES <input type="checkbox"/> NO <input type="checkbox"/>

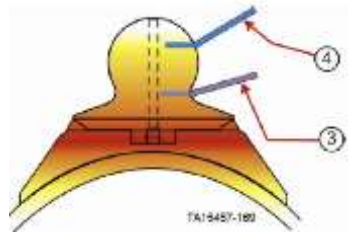
General Information	
Was 1/16" cooper wire used	YES <input type="checkbox"/> NO <input type="checkbox"/>
Repair any reject able defects and indications found with UT	
48 Hour Inspections **All inspections after job complete are specified to be minimum of 48 hours after job completed (welded, post heat and slow cooled to ambient)	<ul style="list-style-type: none">• MT/PT report on weld and ball 48 hours after job (welding and post heat) completed and fully cooled to ambient• UT report on weld 48 hours after job complete (and cooled to ambient)

BALL PREHEAT AND INTERPASS RECORD – Axle Ball

(one record for each hoist and lift arm ball)

Location:	Supervisor:	
Loader type and serial number:	Date:	
Ball description and location:	Ball serial numbers:	

Welder	Sequence	Actual clock time	TEMPERATURE		
			Ball flange (near weld)	Ball Neck	Ball Sphere
1	0 HOUR		A		
			B		
			C		
			D		
2	0 HOUR		A		
			B		
			C		
			D		
1	1 HOUR		A		
			B		
			C		
			D		
2	1 HOUR		A		
			B		
			C		
			D		
1	2 HOUR		A		
			B		
			C		
			D		
2	2 HOUR		A		
			B		
			C		
			D		
1	3 HOUR		A		
			B		
			C		
			D		
2	3 HOUR		A		
			B		
			C		
			D		
1	4 HOUR		A		
			B		
			C		
			D		
2	4 HOUR		A		
			B		
			C		
			D		
1	5 HOUR		A		
			B		
			C		
			D		
2	5 HOUR		A		
			B		
			C		
			D		
1	6 HOUR		A		
			B		
			C		
			D		
2	6 HOUR		A		
			B		
			C		
			D		
1	7 HOUR		A		
			B		
			C		
			D		
2	7 HOUR		A		
			B		
			C		
			D		
1	8 HOUR		A		
			B		
			C		
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2	8 HOUR		A		
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1	9 HOUR		A		
			B		
			C		
			D		
2	9 HOUR		A		
			B		
			C		
			D		
1	10 HOUR		A		
			B		
			C		
			D		
2	10 HOUR		A		
			B		
			C		
			D		
1	11 HOUR		A		
			B		
			C		
			D		
2	11 HOUR		A		
			B		
			C		
			D		

POST HEAT RECORD – Axle Ball Follow the post heat instructions 400°							
Action	Actual Clock Time	Elapsed time (minimum times)	Target Temp	Actual temp			
Post Heat Starts		0	400° F (204° C)	A			
				B			
				C			
				D			
Post Heat Finishes		1 hour	400° F (204° C)	A			
				B			
				C			
				D			
Cooling		1.5 hour	375° F (191° C)	A			
				B			
				C			
				D			
Cooling		2 hour	350° F (177° C)	A			
				B			
				C			
				D			
Cooling		3 hour	300° F (149° C)	A			
				B			
				C			
				D			
Cooling		4 hour	250° F (121° C)	A			
				B			
				C			
				D			
Cooling		5 hour	200° F (66° C)	A			
				B			
				C			
				D			
Cooling		6 hours	150° F (66° C)	A			
				B			
				C			
				D			

RE-Commissioning Worksheet Form

Machine:	Ball location changed:	Date:
S/N:	Replacement Ball S/N	Customer:

Item	Result	Comments	Date	Signature
Machine download	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Attach to the Sales Force Case related to this machine	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Analyze data for indications of grease system failures	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Grease Plug installed in <u>hoist or lift arm ball</u>	YES <input type="checkbox"/> NO <input type="checkbox"/>			
New O-ring	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Grease extension tube installed into <u>articulation ball base</u>	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Thread sealant used?	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Connect the grease hose	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Tighten hose and fitting	YES <input type="checkbox"/> NO <input type="checkbox"/>			
New Grease hose used?	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Install new brass liners in socket and cap	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Chase hole threads in socket by hand	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Clean hole threads in socket to remove all contaminants	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Install new capscrews	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Coat the OD of the ball with auto lube	YES <input type="checkbox"/> NO <input type="checkbox"/>			

Item	Result	Comments	Date	Signature
grease				
Fill the hole in the ball with <u>auto lube</u> grease	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Coat the ID of the socket and cap with a thin coat of <u>auto lube</u> grease	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Coat the ID of the brass liner <u>auto lube</u> grease	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Verify that the arms fit without spreading or pulling together Heat striping required? <i>This section applies to Lift arm balls ONLY</i>	YES <input type="checkbox"/> NO <input type="checkbox"/> YES <input type="checkbox"/> NO <input type="checkbox"/>			
Align the ball caps on the lift arm sockets Match marks <i>This section applies to Lift arm balls ONLY</i>	YES <input type="checkbox"/> NO <input type="checkbox"/> YES <input type="checkbox"/> NO <input type="checkbox"/>			
Capscrew lubricant – 30W oil	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Hand start all capscrews	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Follow specified torque pattern	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Torque value	_____ ft-lb			
Purge the grease system to all balls that were replaced? Use external grease pump?	YES <input type="checkbox"/> NO <input type="checkbox"/> YES <input type="checkbox"/> NO <input type="checkbox"/>			
Check the snap clearance	YES <input type="checkbox"/> NO <input type="checkbox"/> _____ "/mm			

Field Welding Procedures

Item	Result	Comments	Date	Signature
In or out of specification?	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Adjusted?	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Final value?	_____ "/mm			
Verify grease system functioning:				
System timing	_____ min/cycle			
Leaks?	YES <input type="checkbox"/> NO <input type="checkbox"/>			
System building pressure?	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Oil supply pressure?	_____ psi			
Grease pressure at stall?	_____ psi			
Ball injector functioning?	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Injectors functioning?	YES <input type="checkbox"/> NO <input type="checkbox"/>			

Re-Commissioning after - Ball Replacement



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Re-Commissioning after Ball Replacement

Before beginning the re-commissioning process, ensure the following safety preparations have been followed.

Safety Preparations

WARNING

Crush hazards exist if the machine is started or moved while work processes are being performed on the machine. Place bucket flat and level on the ground. Place frame lock in the locked position and lock out the machine's starting capability before performing any work process. Follow all applicable lockout procedures and local rules and regulations for performing work processes. ANYONE performing inspections or service procedures to the machine should be familiar with ALL instructions and procedures contained in the machine's SERVICE MANUAL. Crush hazard could occur if the machine is started or moves while any type of work process is being conducted on the machine, resulting in serious injury or death.

Machine Shutdown and Lockout

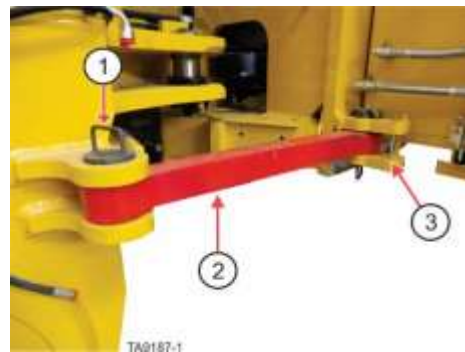
1. Stop the wheel loader on flat level ground.
2. Place bucket flat and on level ground.
3. Move the frame lock to the locked position so that the frame cannot be steered.

WARNING

Crush hazards exist in machine pivot area and area between the tires. Do not enter these areas unless it is verified that the operator has control over the steering and that personnel locking the frame lock have good communication with the operator. Entering the pivot area and area between the tires while the machine is moving or pivoting (articulating) could cause crush hazards resulting in serious injury or death.



Gen 1 Frame lock in locked position



Gen 2 Frame lock in locked position

- 1) Retaining pin for locked position, 2) Frame lock - shown in locked position
3) Retaining pin bracket for un-locked position

4. Set the parking brakes.

5. Shut off the engine.
6. Place wheel chocks in front and behind each wheel.
7. Lock out the machine's starting capability before performing any cleaning, inspections, or installation and repair procedure.

WARNING

Crush, shock, or other hazards exist if stored energy is not removed or isolated prior to working on the machine. Stored energy (hydraulic, electrical, pneumatic, mechanical, etc.) may be present if not isolated or released prior to working on the machine. Do not work on the machine without removing this stored energy (suspended loads, electrical power, air pressure, etc.). Risk of crushing, shock, or other physical injury exists if stored energy is not removed or isolated prior to working on the machine which could result in serious injury or death.

8. Turn the battery and engine isolation switches to the off position and install locks on the battery isolation switch.

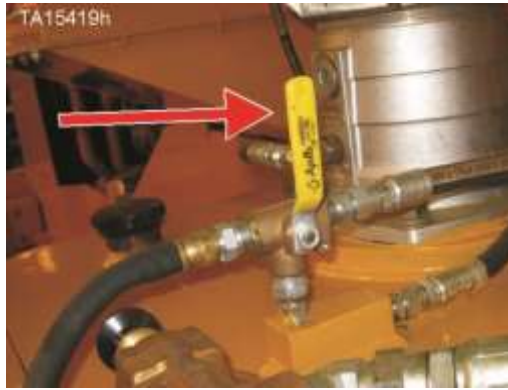


GEN 2 Isolation and Control switches assembly – Battery isolation switch in OFF position with locks in place

NOTICE

The GEN 2 Isolation and Control switches assembly is shown in this document. GEN 1 machines will have a different type of switch and box. The lock out/tag out requirements are the same.

9. Release the air from the hydraulic reservoir by using the hydraulic reservoir air valve (ball valve) on top of the reservoir. The supply line from main air system will be blocked and reservoir air will vent out the hose that runs down the outside of the hydraulic reservoir.
10. Turn the handle to the up position as shown.



Hydraulic reservoir air valve handle UP

11. Release the air from the various air storage reservoirs by opening all of the air bleed valves.

Generation 1	Generation 2
Three valves on left side of rear frame under electrical cabinet	Three valves on right side of rear frame under hydraulic reservoir
One valve on left side of front frame near frame lock and hoist cylinder ball cap	One valve on right side of front frame near hoist cylinder ball cap



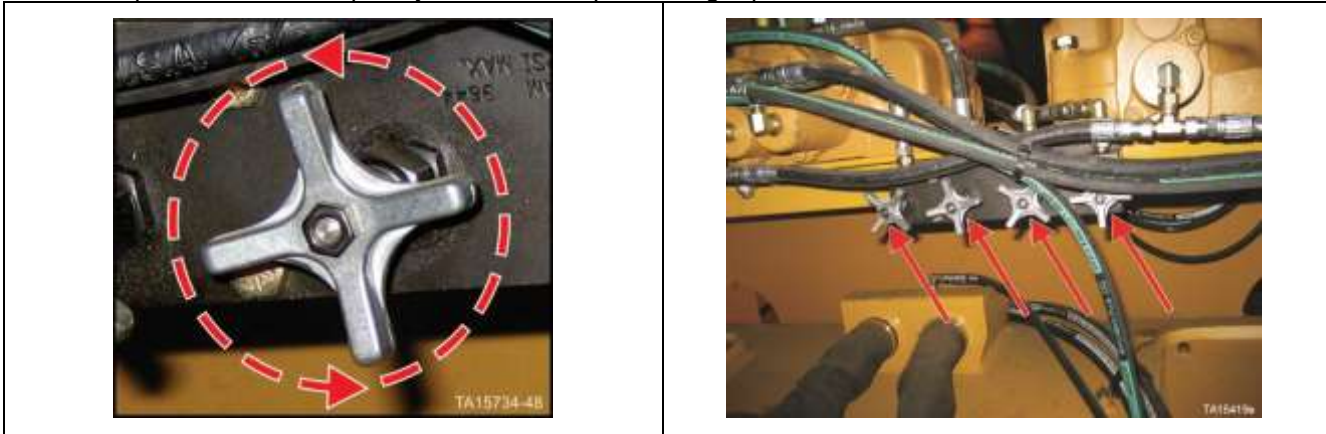
Open air reservoir bleed valves

⚠ WARNING

Crush hazards exist if all personnel are not cleared from the bucket and lift arm area before using the hydraulic hoist and bucket hydraulic pressure bleed down valves to relieve pressure from the hoist and bucket circuit. Assembly must be used only when the engine is NOT running. Before using the Manual Bleed Valve Assembly, refer to “HYDRAULIC AND GREASE SYSTEMS”, “MANUAL BLEED VALVE ASSEMBLY”, in Section 04 of the Service Manual for additional operational and safety information. Operating the manual bleed valve may cause the lift arms and bucket to descend rapidly. All personnel around the bucket and lift arms area shall be removed from the area before operating hydraulic hoist and bucket hydraulic pressure bleed down valves. Using the hydraulic bleed down valves could result in movement of the lift arms and bucket which could cause a crush hazard resulting serious injury or death.

Field Welding Procedures

12. Use the hydraulic pressure bleed down valves located in the front frame underneath the Husco valves to bleed any stored pressure in the hoist and bucket cylinders.
13. Turn each valve slowly counterclockwise as shown below and allow the pressure to bleed down.
14. Open the valve completely and leave it open during repairs.



CAUTION

Before performing welding operations on a machine, the fire suppression system circuit monitors panel's in-line fuse must be removed. The fuse is located in the battery box on some machines. Failure to do so may cause the system to actuate and/or damage the solid-state components of the system. Replace the in-line fuse before the machine has been started or after all welding operations have been completed.



Fire suppression in-line fuse located in loader battery box on some machines

WARNING

Fall hazard exists when working at heights. Be sure to take appropriate safety precautions when working at heights on the rear and front frames or the lift arms balls. Follow all required statutory regulations for working at height. Wear fall restraint when necessary to prevent falls. Failure to take appropriate safety precautions, including wearing fall restraint when necessary can cause fall hazards resulting in serious injury or death.

WARNING

Crush hazards exist if standing under, working, or placing any body part under hoisted/suspended components. Never stand under hoisted/suspended components. Ensure appropriate lifting devices are used, and blocking is adequate to prevent the component from unexpectedly moving during transportation. Refer to SAFETY, WARNINGS, AND CAUTIONS before attempting to remove the operator's cab. Failure to stay out from under hoisted/suspended components can cause crush hazard resulting in serious injury or death.

Assembly and Maintenance Items

After each ball has been replaced and all of the welding/inspection procedures completed – the following assembly and maintenance items must be done to assure proper function of the ball joint:

- 1) Obtain a machine download and analyze the data.
 - a. Any grease system alarms or warnings?
- 2) Assure that the grease plug is installed (hoist cylinder and lift arm balls).
 - a. Use new O-ring on the plug.
- 3) Install grease extension tube (frame articulation balls).
 - a. Use thread sealant on threads.
- 4) Grease hose and fitting is properly attached for each ball type.
 - a. The hose should be replaced to ensure reliability.
 - b. Pre-purge all grease lines with auto lube system grease, before installation.

CAUTION

Do not use standard EP grease to coat the ball, coat the liner, fill the ball or purge the grease system. Use only the specified auto lube system grease containing 3-5% moly, specified for the machine's operating conditions.

- 5) Install new brass liners in socket and cap.
- 6) Chase the threads in each of the tapped holes in the socket.
 - a. This must be done by hand – **DO NOT** use any form of power tool.
 - i. Use of a power tool can cause damage to the threads.

CAUTION

Never use any form of power tool to chase threads with a tap! Always turn the tap by hand! Power tools can remove the 'feel' of the tap 'cutting' material from the hole and this 'cutting' is not desirable. Never drive a tap with a rattle gun as it can cause the tap to chip fragments of the tap off and they become embedded in the base material, causing further damage to the capscrew at the time of installation.

- b. Use a slightly dull tap to minimize thread damage.

NOTICE

The threads in each hole have typically been slightly distorted by the tensioning of the capscrews. The cutting edge of a new tap should be slightly 'dulled' by buffing the cutting edge of the tap on a wire wheel. This will minimize thread cutting which can reduce thread strength and leave small fragments of steel shavings in the root of the thread.

- c. Use ONLY a bottoming type of tap. Taper and intermediate configuration taps must not be used.
- 7) Clean all of the tapped hole threads in the socket. Remove all contaminants and previous lubricants from each hole.
 - 8) Install new capscrews.
 - a. If there is any doubt as to their history or condition – replace the capscrews.
 - b. New capscrews should be installed if the ball was broken.
 - i. If one lift arm ball was broken - replace the capscrews on both sides of lift arm.
 - c. Capscrews can be reused if:
 - i. They were properly torqued when originally installed.
 - ii. No sign of thread damage from installation or dropping on steel or ground.
 - iii. No signs of stretching.
 - iv. Threads are fully cleaned.
 - v. No signs of cracking near the clamp face of the capscrew
 - vi. The clamp face is not galled.
 - vii. The 12-point head is not damaged.
 - 9) Assembly lubrication
 - a. Coat the OD of the ball with auto lube system grease.
 - b. Fill the hole in the ball with auto lube system grease.
 - c. Coat the socket and cap with a thin coat of auto lube system grease.
 - d. Coat the brass liners with auto lube system grease to fill the grooves in the liners.

CAUTION

Do not use standard EP grease to coat the ball, coat the liner, fill the ball or purge the grease system. Use only the specified auto lube system grease containing 3-5% moly, specified for the machine's operating conditions.

- 10) Verify that the lift arms fit on the balls without spreading or pulling together.
 - a. Verify that the lifting method is not pulling the arms together.
 - b. The arm width can be adjusted by heat striping if required.
 - c. Contact Komatsu Call Center for assistance (support@joyglobal.com).
- 11) Align the ball caps on the lift arm sockets.
 - a. Install the ball cap loosely and align the match marks.
 - i. The caps are interchangeable left to right – but once they have been aligned and match marked – they should be always used in the specified location.
 - b. If they are not factory match marked – find the center and match mark.
 - c. Mark each one for Left (LH) or Right (RH).

NOTICE

The socket and cap are aligned and marked when the arms are NOT mounted on the machine.

- 12) Torque the cap screws for the ball caps
 - a. Verify that the socket threaded holes and all capscrews are not contaminated with grease, anti-seize, etc.
 - b. 30W or engine oil for thread and shoulder lubrication.
 - c. Hand start ALL cap screws in the cap prior to tightening with air gun or torque wrench.
 - d. Use a small air wrench (1/2" drive max) to run the bolts fully home.

CAUTION

If any capscrew binds while running in by hand or with a small air impact wrench, DO NOT attempt to drive the capscrew deeper. Use a hand wrench and remove the capscrew. DO NOT use an air impact wrench to remove the capscrew.

- e. Follow the torque pattern.
- f. Torque to the correct value.
- 13) Check the "snap" clearance on the ball.
 - a. Adjust the snap clearance to specification by adding or removing shims.
- 14) Purge the grease line to the ball joint.
 - a. DO NOT purge by cycling the grease system.
 - i. The injector only puts out a maximum of 1.3cc each time the grease system cycles. It is very difficult to fill the joint with grease at this rate – and wastes grease from excessive grease at all the other locations on the machine.
 - b. Remove the purge cap from the grease injector and fill the joint with grease using a grease gun.
 - c. Purge a minimum of 0.5 kilogram (1 pound) of grease through the joint BEFORE operation of the machine.

CAUTION

Do not use standard EP grease to purge the ball joint grease system. Use only the specified auto lube grease containing 3-5% moly, specified for the machine's operating conditions.

- 15) Replace the in-line fuse on the fire suppression system if it was disengaged due to welding on the machine, this must be done before the machine has been started or after all welding operations have been completed.

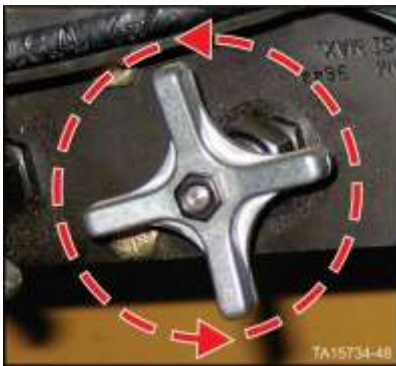
CAUTION

Failure to replace the fuse before operating the machine could result in a serious fire. Never run the machine unless the fuse has been replaced.



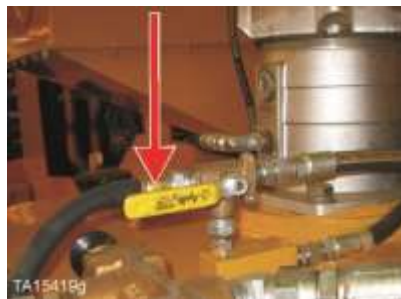
Fire suppression in-line fuse located in loader battery box on some machines

16) Close (turn clockwise) the hydraulic bleed valves in the front frame.



Close hydraulic bleed valves in front frame

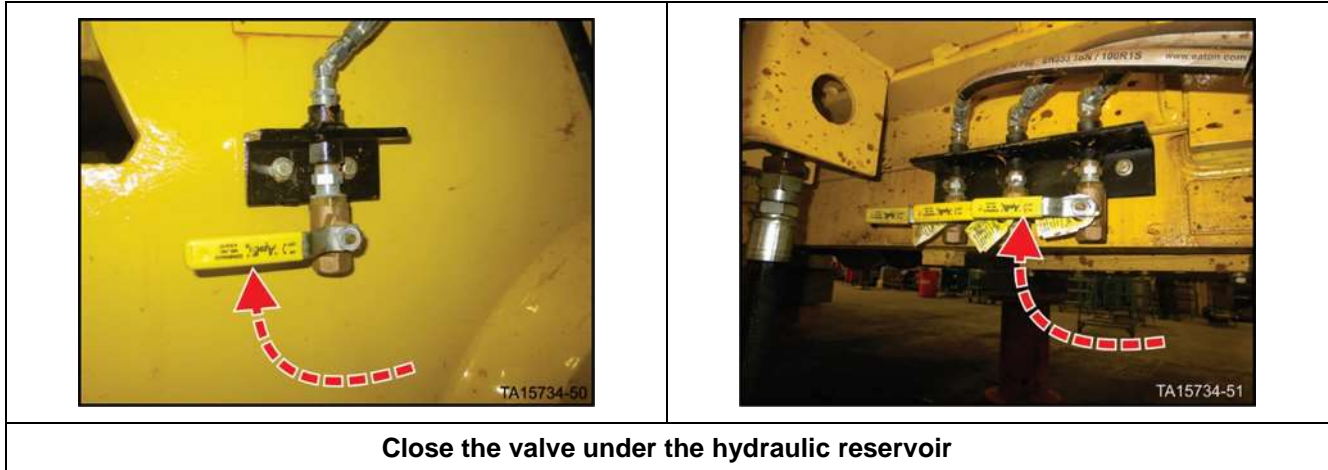
17) Close the hydraulic reservoir air valve on top of the hydraulic reservoir.



Close the hydraulic reservoir air valve

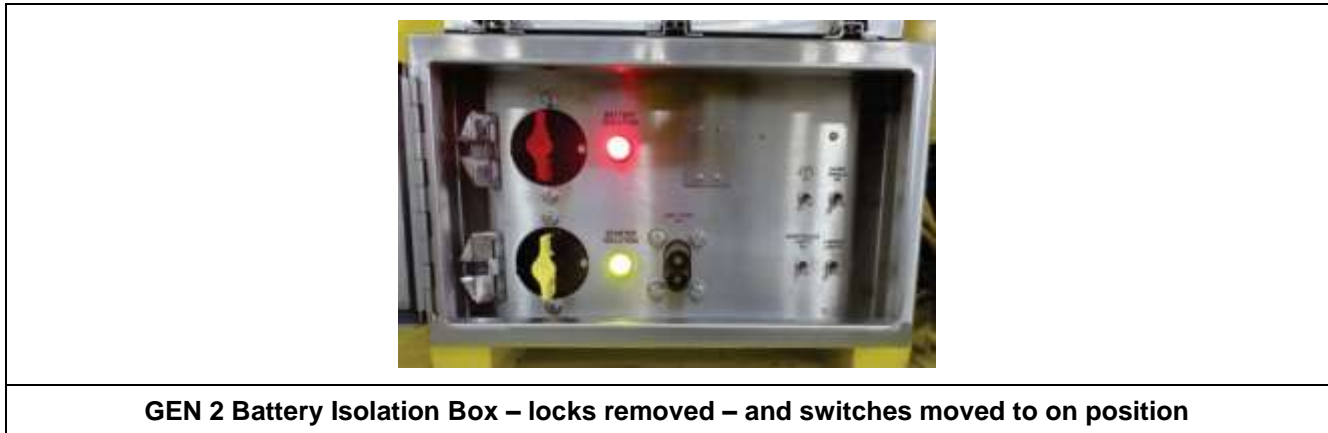
18) Close the air bleed valves.

Generation 1	Generation 2
Three valves on left side of rear frame under electrical cabinet	Three valves on right side of rear frame under hydraulic reservoir
One valve on left side of front frame near frame lock and hoist cylinder ball cap	One valve on right side of front frame near hoist cylinder ball cap



19) Remove wheel chocks.

20) Remove any locks or tags from isolation box following all local regulations and turn both isolation switches to the on position.



21) Start machine and verify that grease injectors are functioning (Ref SIL-397.01).

- a. System timer functioning – what is the setting?
- b. Grease leaks?
- c. System building pressure?
- d. Grease Pressure?
- e. Oil Supply Pressure?
- f. Injectors functioning?
- g. Grease Pressure at stall?
- h. Injector for ball joint functioning?

Most of the items in the previous list are steps that are part of the standard assembly and commissioning of a new loader or a part of the normal maintenance items related to balls. Contact the Komatsu Call Center

(support@joyglobal.com) if you are unable to locate the information or have questions pertaining to these assembly and maintenance practices. Most of these are covered in one or more of the following documents:

- Assembly Manual
- GEN 2 Service Manual
- SIL 439.01 Spherical Ball Bearing Joints
- SIL 413.00 Hoist Cylinder Spherical Ball Lubrication
- SIL-397.01 Auto Lube System Operation

RE-Commissioning Worksheet

Machine:	Ball location changed:	Date:
S/N:	Replacement Ball S/N	Customer:

Item	Result	Comments	Date	Signature
Machine download	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Attach to the Sales Force Case related to this machine	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Analyze data for indications of grease system failures	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Grease Plug installed in <u>axle articulation ball base</u>	YES <input type="checkbox"/> NO <input type="checkbox"/>			
New O-ring	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Grease extension tube installed into <u>axle articulation ball base</u>	YES <input type="checkbox"/> NO <input type="checkbox"/>	Not applicable for Axle Articulation Ball Field Replacement		
Thread sealant used?	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Connect the grease hose	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Tighten hose and fitting	YES <input type="checkbox"/> NO <input type="checkbox"/>			
New Grease hose used?	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Install new brass liners in socket and cap	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Chase hole threads in socket by hand	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Clean hole threads in socket to remove all contaminants	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Install new capscrews	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Coat the OD of the ball with auto lube system grease	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Fill the hole in the ball with auto lube system grease	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Coat the ID of the socket and cap with a thin coat of auto lube system grease	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Coat the ID of the brass liner auto lube system grease	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Verify that the arms fit without spreading or pulling together	YES <input type="checkbox"/> NO <input type="checkbox"/>	Not applicable for Axle Articulation Ball Field Replacement		
Heat striping required?	YES <input type="checkbox"/> NO <input type="checkbox"/>			
<i>This section applies to Lift arm balls ONLY</i>				

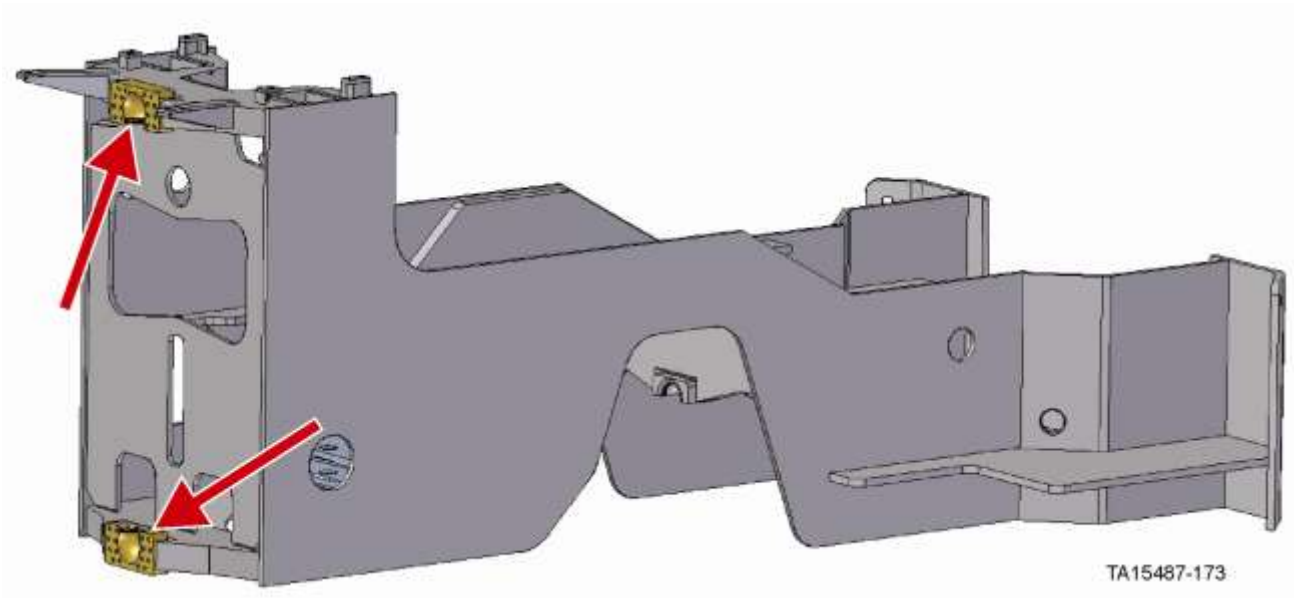
Field Welding Procedures

Item	Result	Comments	Date	Signature
Align the ball caps on the lift arm sockets Match marks <i>This section applies to Lift arm balls ONLY</i>	YES <input type="checkbox"/> NO <input type="checkbox"/> YES <input type="checkbox"/> NO <input type="checkbox"/>	Not applicable for Axle Articulation Ball Field Replacement		
Capscrew lubricant – 30W oil	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Hand start all capscrews	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Follow specified torque pattern	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Torque value	_____ ft-lb			
Purge the grease system to all balls that were replaced? Use external grease pump?	YES <input type="checkbox"/> NO <input type="checkbox"/> YES <input type="checkbox"/> NO <input type="checkbox"/>			
Check the snap clearance In or out of specification? Adjusted? Final value?	YES <input type="checkbox"/> NO <input type="checkbox"/> _____/mm YES <input type="checkbox"/> NO <input type="checkbox"/> YES <input type="checkbox"/> NO <input type="checkbox"/> _____/mm			
Verify grease system functioning: System timing Leaks? System building pressure? Oil supply pressure? Grease pressure at stall? Ball injector functioning? Injectors functioning?	_____ min/cycle YES <input type="checkbox"/> NO <input type="checkbox"/> YES <input type="checkbox"/> NO <input type="checkbox"/> _____ psi _____ psi YES <input type="checkbox"/> NO <input type="checkbox"/> YES <input type="checkbox"/> NO <input type="checkbox"/>			

CHAPTER 6

Frame Articulation Sockets

Field Replacement Procedure



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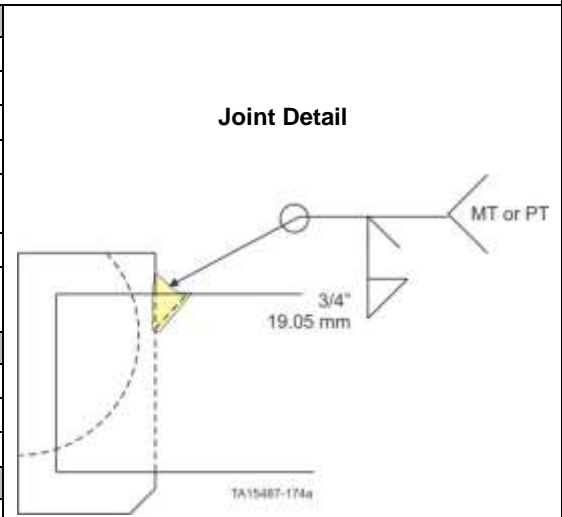


Procedure	FW-0112
Revision	0
Written by	Joel Armstrong
Date	3/8/2010

Field Welding Procedure

This document conforms to AWS D1.1/D14.3 Structural Welding Code and Australian Standards AS 1554.4

Description	Rear frame articulation sockets		
Notes	See attachment		
Welding Process	FCAW / SMAW		
Joint			
Type	Groove or Fillet		
Backing	If needed	Material	Mild Steel
Root Opening	+1/4 / - 1/16" Per Attachment (+6.35 / -1.6 mm)		
Root face Dimension	+/- 1/16" Per Attachment (+/- 1.6 mm)		
Groove Angle (degrees)	+10/-5 Per Attachment	Radius	N/A
Back Gouging	Yes, if required	Method	Arc - Air
Other			
Base Metals			
Specification	ASTM A572 Modified	ASTM A148 Grade 115-95	
Thickness	5-7" (127-178 mm)	7.5 and 9" (191 and 229 mm)	
	Slab	Sockets	
Filler Metals			
AWS Specification	A5.20/A5.29	A5.5	
AWS Class	E71T-1XX series	E8018C3	
Diameter	0.045", 0.052", 1/16" (1.2, 1.4, 1.6 mm)	1/8", 5/32" (3.2, 4mm)	
Shielding		Positions Qualified	Flat, Horizontal, Vertical
Gas Composition	100% CO ₂ or Ar/CO ₂ 75/25	Groove	1G, 2G, 3G, 4G
Flow Rate	35 – 45 cfh	Fillet	1F, 2F, 3F
Technique		Vertical Progression	Up
Stringer or Weave Bead	Stringer	Electrical Characteristics	
Multi/Single Pass (per side)	Multiple	FCAW - Current	DCEP
Peening	Yes	SMAW - Current	DCEP
Interpass Cleaning	Chipping and or grinding	Other	
Preheat and Interpass Temperatures			
Material Types			
Structural Steel	Castings	Q&T high strength steel	
Frame structure Bucket Blade	Lift Arm Torque Tube (1150, 1350, 1850 Gen2, 2350) Upper part front frame (1350) Axles (some 1350) Sockets	Balls Bucket Lip Bucket adapters Lift arms Bell cranks	
Preheat			
Material Thickness	Structural Steel	Castings and high strength steel	
Distance from weld	6" (152 mm) minimum	6" (152 mm) minimum	
< or = 3/4" (< or = 19 mm)	125° F (52° C)	200° F (93° C)	
>3/4" to 1-1/2" (>19.05 to 38.1 mm)	225° F (107° C)	250° F (121° C)	
>1-1/2" to 2-1/2" (>38.1 to 63.5 mm)	250° F (121° C)	300° F (149° C)	
>2-1/2" (>63.5 mm)	300° F (149° C)	350° F (177° C)	
Interpass Temperature			
All thicknesses	500°F (260° C) maximum	450°F (232° C) maximum	
Post Heat Treatment			
500°F (260° C) for one hour	Required: YES (X) NO ()		



Welding Parameters

(The FCAW welding parameters were obtained from the qualification of the LINCOLN Ultracore 712A80 used during Komatsu fabrication on Komatsu welding equipment. These numbers will likely vary depending on the specific welding equipment and consumable used for repairs.)

Weld Pass	Process	Filler Metal	Filler Diameter	Current Type	Amps	Volts	Travel Speed (ipm)	Wire Feed Speed	Welding Position
All	FCAW	E71T-1MJ	1/16"	DCEP	280-340	22-26	8-12	255-300	Flat & Horizontal
All	FCAW	E71T-1MJ	0.052"	DCEP	220-310	22-26	8-12	225-375	Flat & Horizontal
All	FCAW	E71T-1MJ	0.045"	DCEP	210-280	23-25	8-12	275-425	Flat & Horizontal
All	FCAW	E71T-1MJ	1/16"	DCEP	185-225	21-24	7-10	105-130	Vertical
All	FCAW	E71T-1MJ	0.052"	DCEP	195-235	21-24	7-10	200-375	Vertical
All	FCAW	E71T-1MJ	0.045"	DCEP	155-235	21-23	7-10	175-325	Vertical
All	SMAW	E7018	5/32"	DCEP	130-210	19-21	5-8	N/A	All
All	SMAW	E7018	1/8"	DCEP	90-160	19-21	5-8	N/A	All
All	SMAW	E8018C3	5/32"	DCEP	130-220	19-21	N/A	N/A	All
All	SMAW	E8018C3	1/8"	DCEP	90-160	19-21	N/A	N/A	All

Suggested Air Arc Parameters

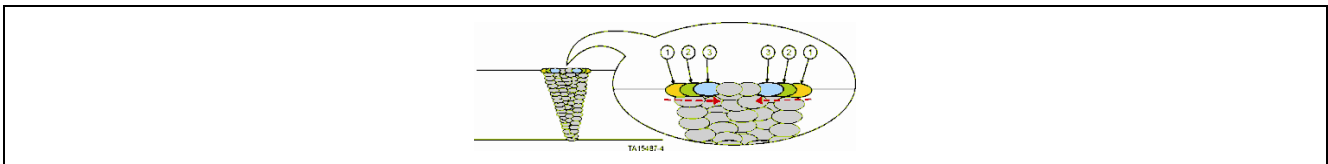
Electrode Diameter		Minimum Amps	Maximum Amps
Inches	Millimeter		
1/8	3.2	60	90
5/32	4.0	90	150
3/16	4.8	200	250
¼	6.4	300	400
5/16	7.9	350	450
3/8	9.5	450	600
½	12.7	800	1000
5/8	15.9	1000	1250
¾	19.1	1250	1600

Proper Electrode Selection for Field Welding

Material joint type	Rod consumable	Wire Consumable
Steel to steel	7018 series	E7xT- xxxx series
Steel to Casting	7018 series	E7xT- xxxx series
Casting Repair	8018 series	E8xT- xxxx series
Socket or Ball installation	8018 series	E8xT- xxxx series
Wear hardware installation on bucket	8018 series	E8xT- xxxx series

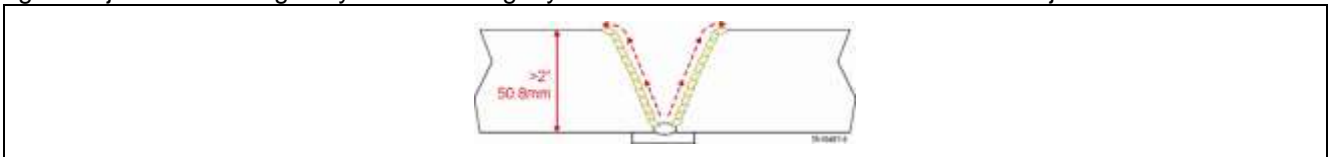
Bead Tempering Finish Passes

The last layer of weld passes must be completed starting from the base material toward the middle of the weld.



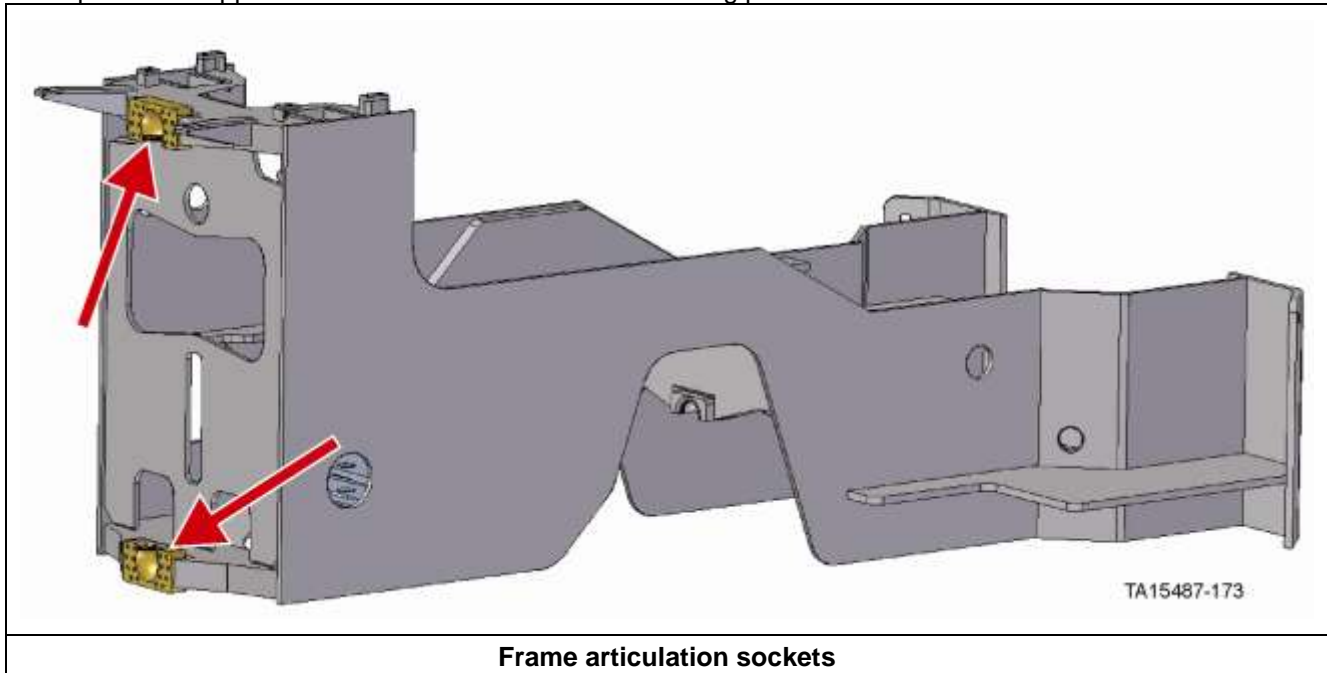
Butter Welds

On groove or fillet welds 2" (50.8 mm) deep or larger - butter weld the sides of the groove prior to welding the groove joint. Put a single layer or buttering layer of weld metal on each side of the weld joint.



Frame Articulation Ball Socket Field Replacement Procedure

This procedure applies to the articulation sockets for steering pivot.



Safety Preparations

WARNING

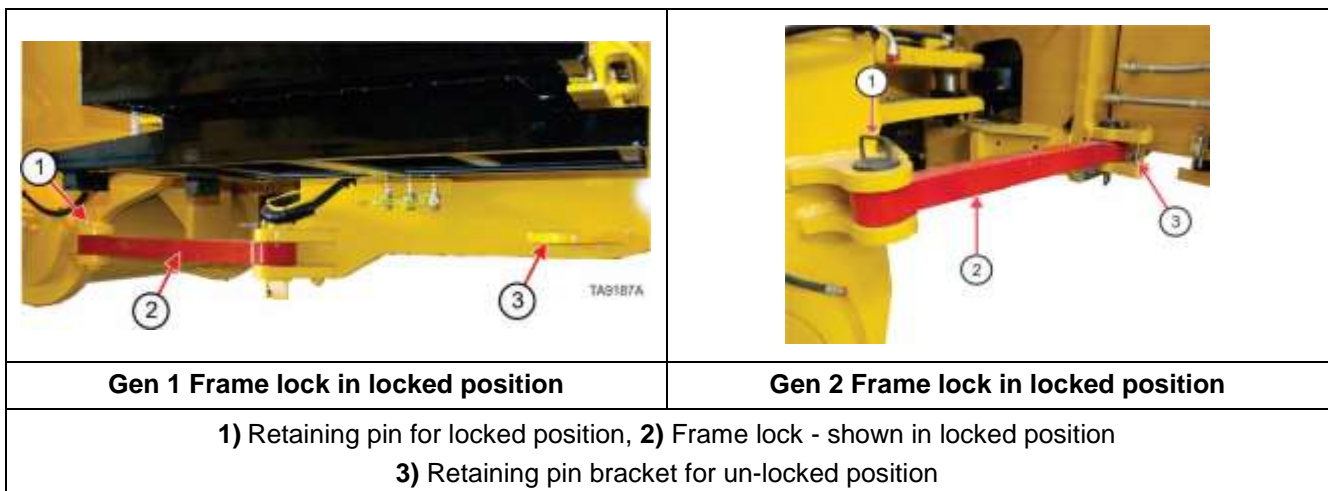
Crush hazards exist if the machine is started or moved while work processes are being performed on the machine. Place bucket flat and level on the ground. Place frame lock in the locked position and lock out the machine's starting capability before performing any work process. Follow all applicable lockout procedures and local rules and regulations for performing work processes. ANYONE performing inspections or service procedures to the machine should be familiar with ALL instructions and procedures contained in the machine's SERVICE MANUAL. Crush hazard could occur if the machine is started or moves while any type of work process is being conducted on the machine, resulting in serious injury or death.

Machine Shutdown and Lockout

1. Stop the wheel loader on flat level ground.
2. Place bucket flat and on level ground.
3. Move the frame lock to the locked position so that the frame cannot be steered.

⚠ WARNING

Crush hazards exist in machine pivot area and area between the tires. Do not enter these areas unless it is verified that the operator has control over the steering and that personnel locking the frame lock have good communication with the operator. Entering the pivot area and area between the tires while the machine is moving or pivoting (articulating) could cause crush hazards resulting in serious injury or death.

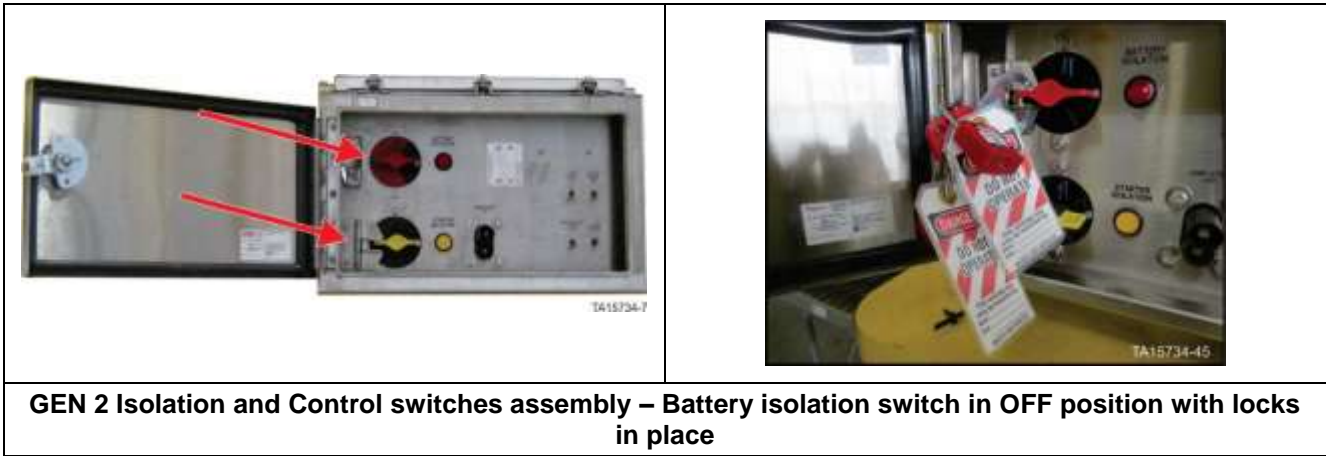


4. Set the parking brakes.
5. Shut off the engine.
6. Place wheel chocks in front and behind each wheel.
7. Lock out the machine's starting capability before performing any cleaning, inspections, or installation and repair procedure.

⚠ WARNING

Crush, shock, or other hazards exist if stored energy is not removed or isolated prior to working on the machine. Stored energy (hydraulic, electrical, pneumatic, mechanical, etc.) may be present if not isolated or released prior to working on the machine. Do not work on the machine without removing this stored energy (suspended loads, electrical power, air pressure, etc.). Risk of crushing, shock, or other physical injury exists if stored energy is not removed or isolated prior to working on the machine which could result in serious injury or death.

8. Turn the battery and engine isolation switches to the off position and install locks on the battery isolation switch.

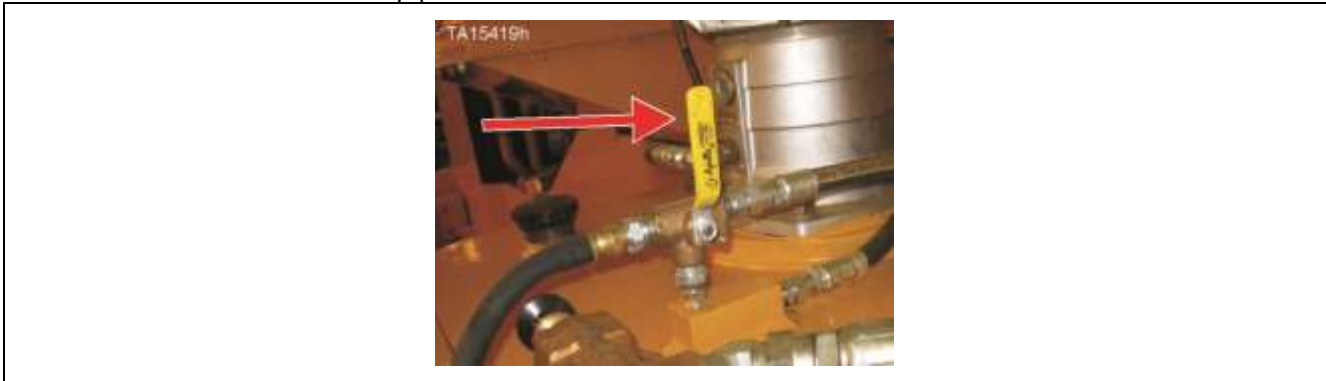


GEN 2 Isolation and Control switches assembly – Battery isolation switch in OFF position with locks in place

NOTICE

The GEN 2 Isolation and Control switches assembly is shown in this document. GEN 1 machines will have a different type of switch and box. The lock out/tag out requirements are the same.

9. Release the air from the hydraulic reservoir by using the hydraulic reservoir air valve (ball valve) on top of the reservoir. The supply line from main air system will be blocked and reservoir air will vent out the hose that runs down the outside of the hydraulic reservoir.
10. Turn the handle to the up position as shown.



Hydraulic reservoir air valve handle UP

11. Release the air from the various air storage reservoirs by opening all of the air bleed valves.

Generation 1	Generation 2
Three valves on left side of rear frame under electrical cabinet	Three valves on right side of rear frame under hydraulic reservoir
One valve on left side of front frame near frame lock and hoist cylinder ball cap	One valve on right side of front frame near hoist cylinder ball cap

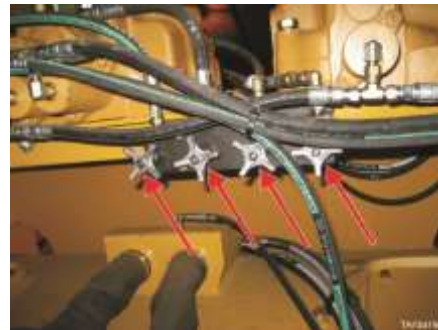
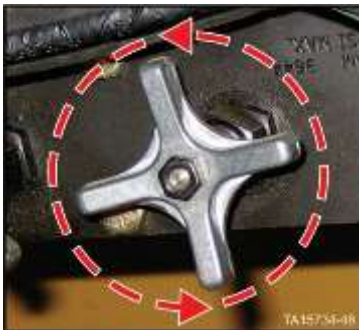


Open air reservoir bleed valves

⚠ WARNING

Crush hazards exist if all personnel are not cleared from the bucket and lift arm area before using the hydraulic hoist and bucket hydraulic pressure bleed down valves to relieve pressure from the hoist and bucket circuit. Assembly must be used only when the engine is NOT running. Before using the Manual Bleed Valve Assembly, refer to “HYDRAULIC AND GREASE SYSTEMS”, “MANUAL BLEED VALVE ASSEMBLY”, in Section 04 of the Service Manual for additional operational and safety information. Operating the manual bleed valve may cause the lift arms and bucket to descend rapidly. All personnel around the bucket and lift arms area shall be removed from the area before operating hydraulic hoist and bucket hydraulic pressure bleed down valves. Using the hydraulic bleed down valves could result in movement of the lift arms and bucket which could cause a crush hazard resulting serious injury or death.

12. Use the hydraulic pressure bleed down valves located in the front frame underneath the Husco valves to bleed any stored pressure in the hoist and bucket cylinders.
13. Turn each valve slowly counterclockwise as shown below and allow the pressure to bleed down.
14. Open the valve completely and leave it open during repairs.



CAUTION

Before performing welding operations on a machine, the fire suppression system circuit monitors panel’s in-line fuse must be removed. The fuse is located in the battery box on some machines. Failure to do so may cause the system to actuate and/or damage the solid-state components of the system. Replace the in-line fuse before the machine has been started or after all welding operations have been completed.



Fire suppression in-line fuse located in loader battery box on some machines

WARNING

Fall hazard exists when working at heights. Be sure to take appropriate safety precautions when working at heights on the rear and front frames or the lift arms balls. Follow all required statutory regulations for working at height. Wear fall restraint when necessary to prevent falls. Failure to take appropriate safety precautions, including wearing fall restraint when necessary can cause fall hazards resulting in serious injury or death.

WARNING

Crush hazards exist if standing under, working, or placing any body part under hoisted/suspended components. Never stand under hoisted/suspended components. Ensure appropriate lifting devices are used, and blocking is adequate to prevent the component from unexpectedly moving during transportation. Refer to SAFETY, WARNINGS, AND CAUTIONS before attempting to remove the operator's cab. Failure to stay out from under hoisted/suspended components can cause crush hazard resulting in serious injury or death.

Burn Hazard

WARNING

Burn and inhalation hazards exist when welding or cutting on the machine. Cutting and welding can produce hot surfaces. Smokey condition can exist if a fire starts. Have qualified fire watch personnel present, and keep a fire extinguisher that meets all statutory regulations nearby during all cutting and welding operations. Failure to provide a qualified fire watch and an appropriate fire extinguisher can cause fire and inhalation hazards resulting in serious injury or death.

Summary

1. Frame will typically have to be separated to replace a socket.
2. Welding Consumables:
 - 1) Crack repair in frame base material: E7018 electrode or E7xT- xxxx series wire.
 - 2) Socket repair: E-8018C3 electrode or E8xT- xxxx series wire.
 - 3) Socket installation: E-8018C3 electrode or E8xT- xxxx series wire.
3. Slab preheat for air arc: 250° F (121° C) for 6" (152 mm) from weld in all directions.
4. Slab preheat for welding: 300° F (149° C) for 6" (152 mm) from weld in all directions.
5. Stringer beads.
6. Post heat and slow cool.
7. Wait 48 hours and MT or PT weld area (magnetic particle or dye penetrant).
8. Re-Commissioning after Campaign Ball Replacement.

Frame Articulation Ball Socket Replacement Procedure

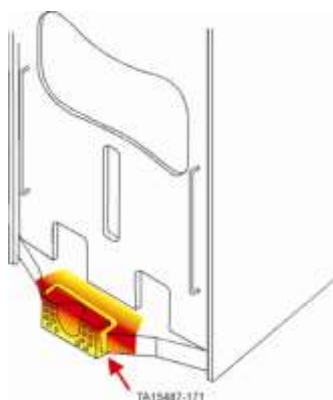
1. Clean the area free of dirt and grease.
2. Remove any hoses or wires that may be affected by the heat.
3. Preheat the cross member plate to 300° F (149° C) to at least 6" (152 mm) in all directions from the weld.
4. Cut the weld from around the socket using arc air.

NOTICE

Remove only the weld and socket material – do not remove material from the slab.

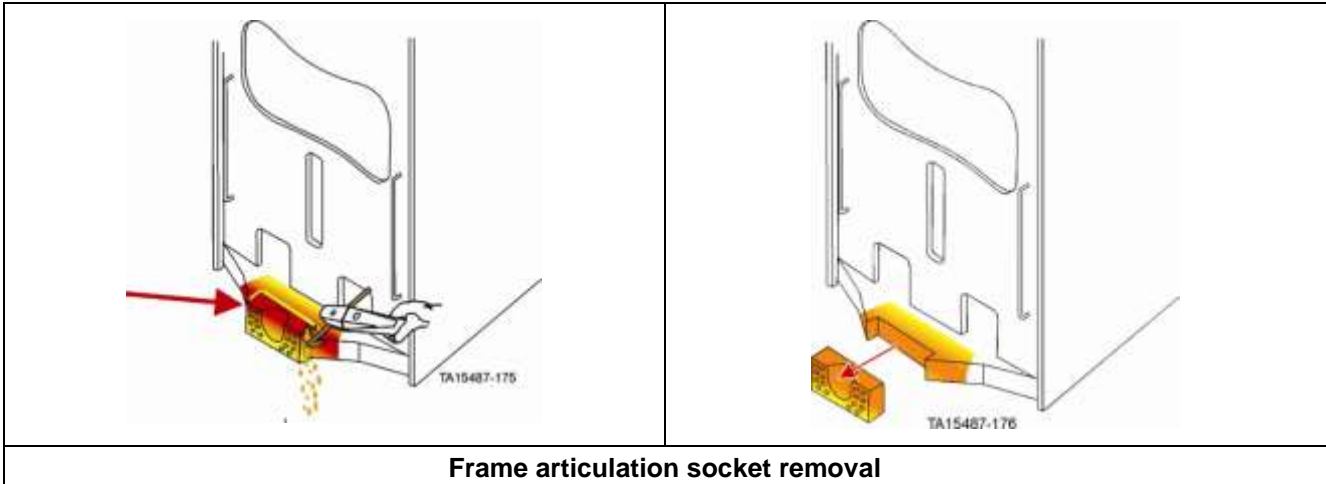
NOTICE

It is always preferable to use a new socket for setting the clearances. However, if a new socket is not available and it is necessary to reuse the old socket – take extra care and remove minimal weld material so that neither the socket nor frame is damaged.

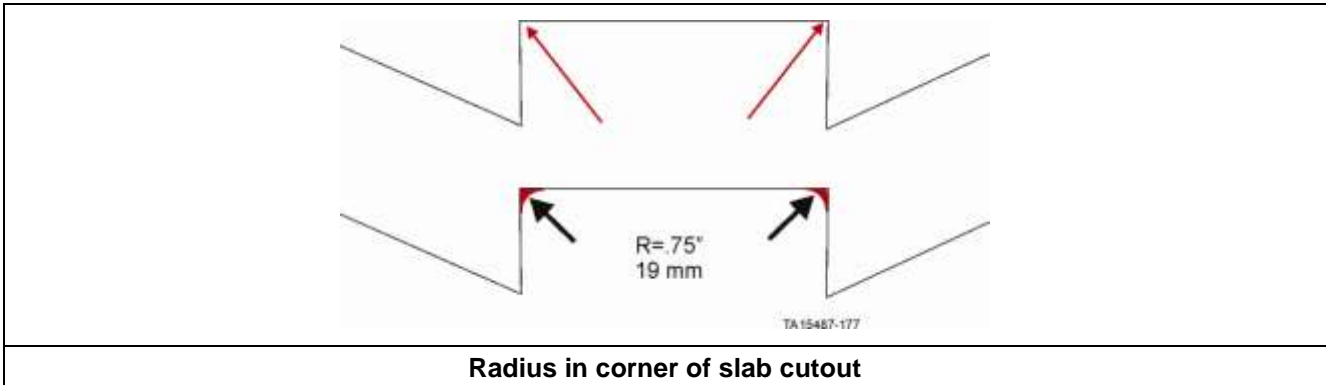


Preheat for weld removal

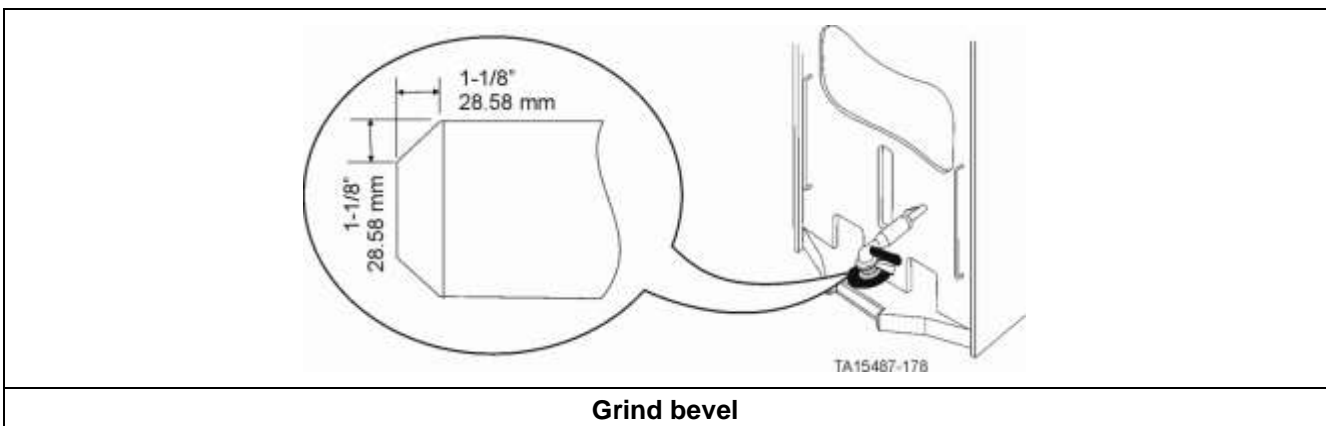
- Remove the socket.



- Inspect the corner of the cutout in the slab. The corners should have a $\frac{3}{4}$ " (19 mm) radius. It is mandatory to add welds in the corner using E70XX consumables and blend grind an approximate $\frac{3}{4}$ " (19 mm) radius on the cross member slab.



- Bevel the cross member slab with $1 \frac{1}{8}$ " (28.56 mm) bevel as shown.
- Grind the bevels smooth and remove all carbon marks.



- Inspect slab using Non Destructive Examinations (NDE) such as Magnetic Particle Inspection (MT) or Dye Penetrant Testing (PT).
- Repair any gouges or cracks in the cross member plate while it is still hot, using 70XX consumables.

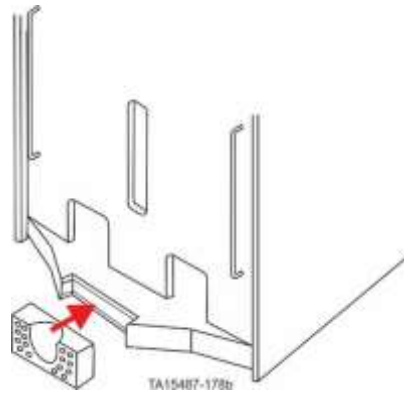
11. Grind the repairs smooth and remove all carbon marks.

Special Instructions if the Socket is being Reused

If the original socket is being reused:

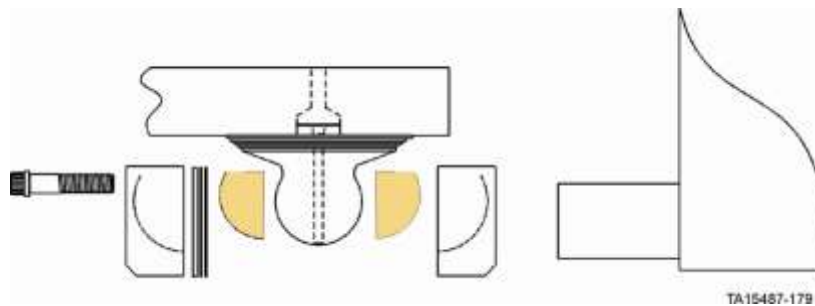
- Grind off the weld material
- MT/PT the socket to look for cracks
- Repair any cracks found

12. Fit the new socket to the slab to be sure that it will fit into the slot. Adjust the slab as required by grinding so that the socket will fit.



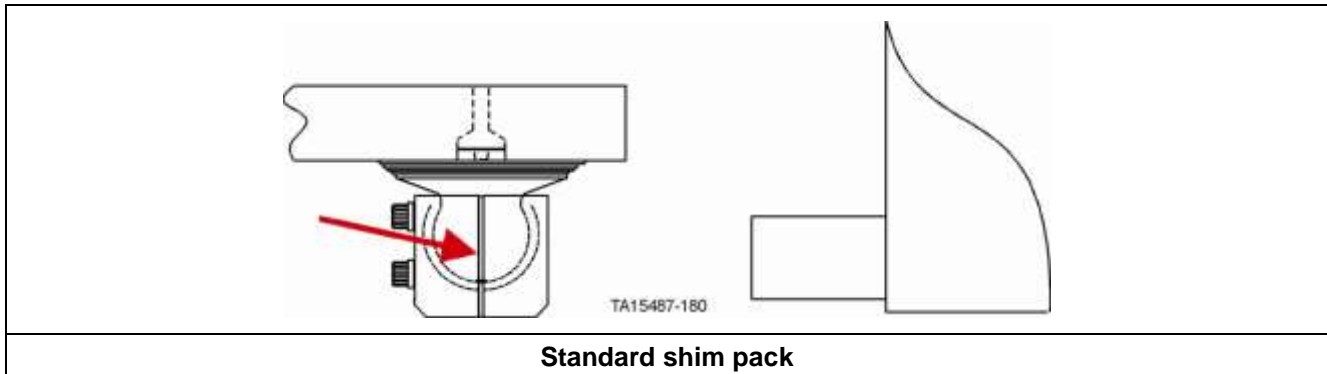
Fit the new socket

13. Hoist the ball cap, liners, spacers, shims and socket up to the ball base.



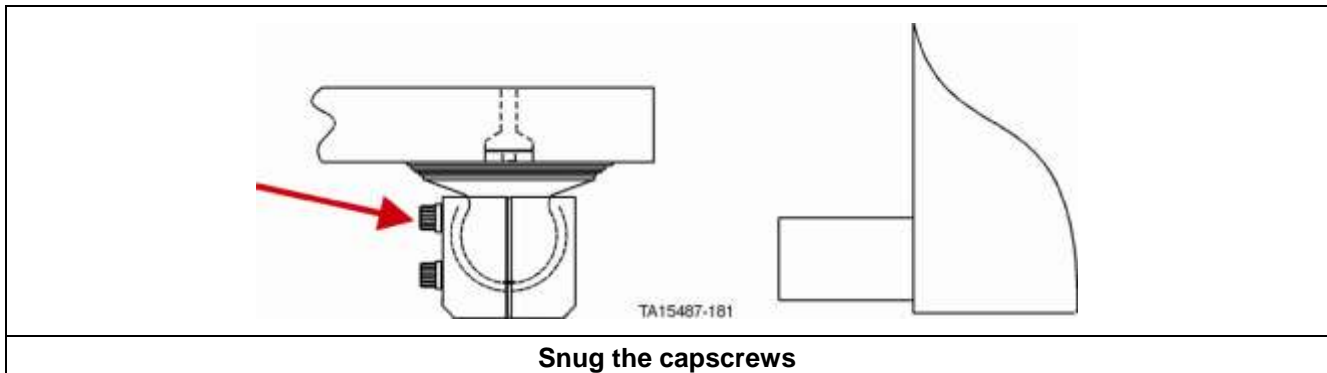
Exploded view of parts

- 14.** Install with a less shims (or no shims) than normal. The amount will vary depending on the condition of the brass.



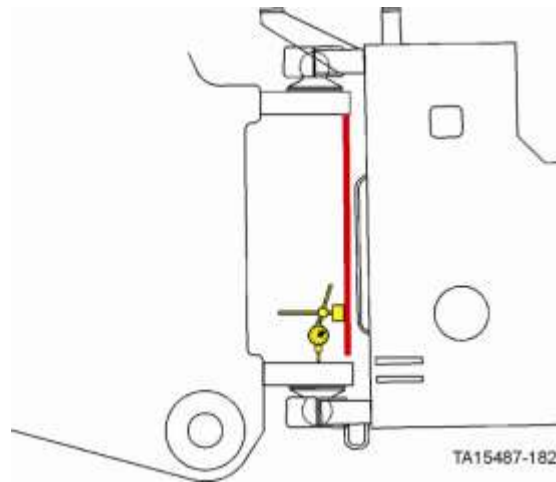
Standard shim pack

- 15.** Snug the capscrews so that the socket/cap can still move when tapped on with a hammer. It should stay in position – but still move when struck. The socket and cap must be able to move slightly so the socket can be aligned with the cut out in the slab.



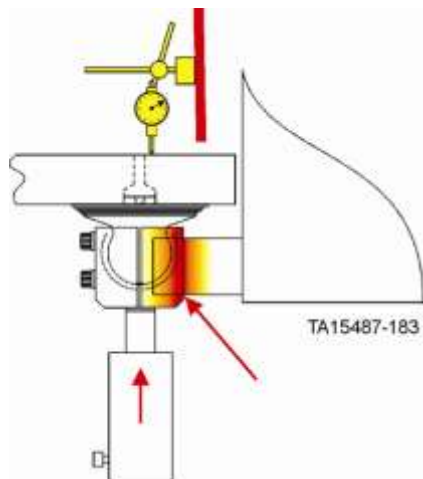
Snug the capscrews

- 16.** Join the machine halves together, allowing the socket to seat firmly against the rear of the notch in the cross member plate.
- 17.** Install the top (opposite) cap, spacer, shims and liner and tighten bolts. The top joint should be set to be free to move with normal clearances.
- 18.** Tighten the capscrews to hold the top (opposite) socket in position.
- 19.** Snug the capscrews to securely hold socket being replaced.
- 20.** The following steps are for the frame articulation sockets.
- Weld a bar (round or angle or tube) of appropriate length to the top slab. It should have clearance with the bottom slab.
 - Mount a dial indicator to measure slab movement (near the center of the mount for the ball).



Install mount bar and dial indicator

- c. Place a jack beneath the ball cap and socket.
- d. Zero the dial indicator.
- e. Push up with jack until movement is noted on the dial indicator.



Press on ballcap and socket – till .010” - .015” (0.254 – 0.381 mm) deflection is found (.005” to .007” [.127 to .178 mm] if front frame has either support tubes or it has a box structure like a 950/1150

NOTICE

If the upper socket is being replaced then the cab should be removed.

- 21. It will be necessary to build a small structure to push against when the top socket is replaced. The following shows a suggested structure. Be sure to use all standard preheat requirements before welding the structure to the slab. Once socket positioning is completed the structure must be carefully removed and the surface ground. Do not weld near the edge of the slab.



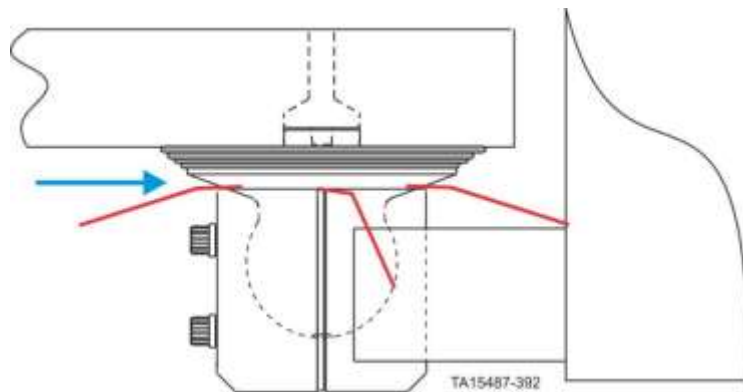
Push structure for upper socket

NOTICE

.010" to .015" (0.254 – 0.381 mm) if frame does NOT have support tubes.

.005" to .007" (0.127 – 0.1778 mm) if the front frame has either support tubes or it has a box structure like a 950/1150.

22. Align the socket and cap. It should be aligned so that they are square to the ball with equal clearance all around.



Align socket

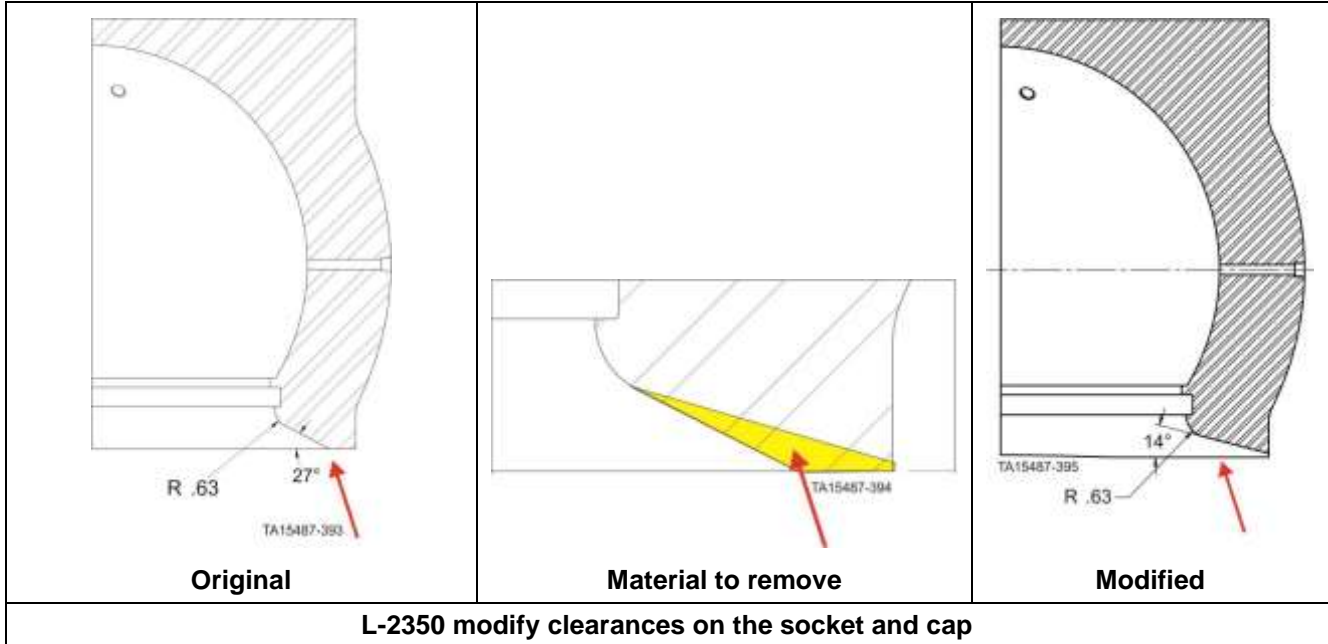
NOTICE

The position of the ball will typically change a small amount each time a new ball is installed. One of the articulation sockets must be replaced to ensure that the ball and socket have the proper clearance. Typically the lower socket is replaced as it is easier to access.

23. L-2350 and L-1850 GEN2 (12" articulation balls).

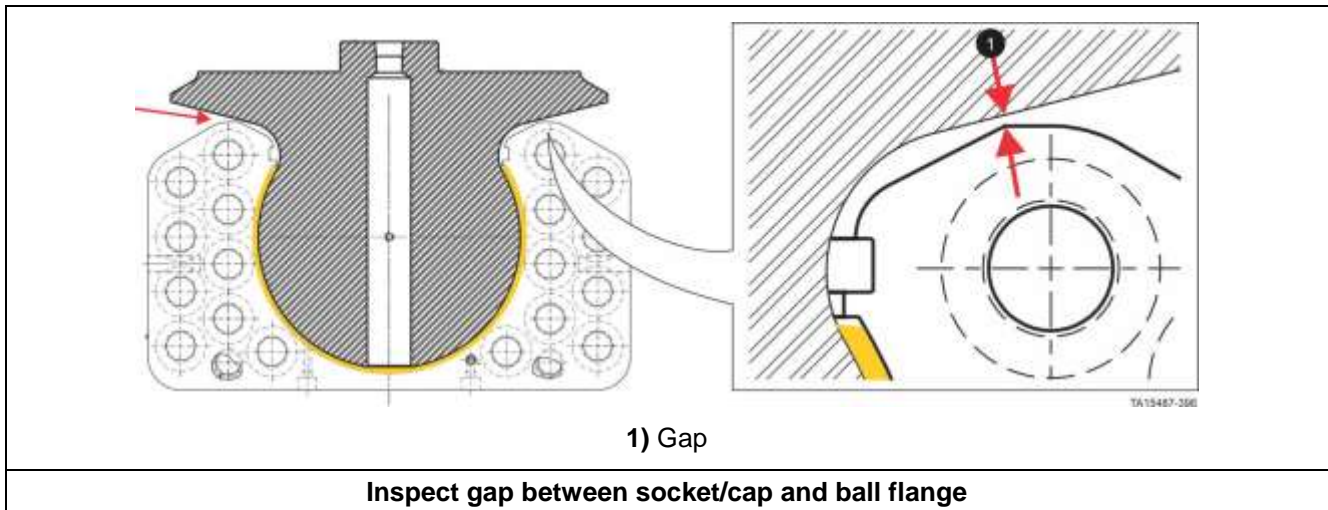
- 1) Prior to assembling the front frame to the rear frame – check the socket and cap to see if they meet revised specifications.
- 2) Grind or machine them as required.

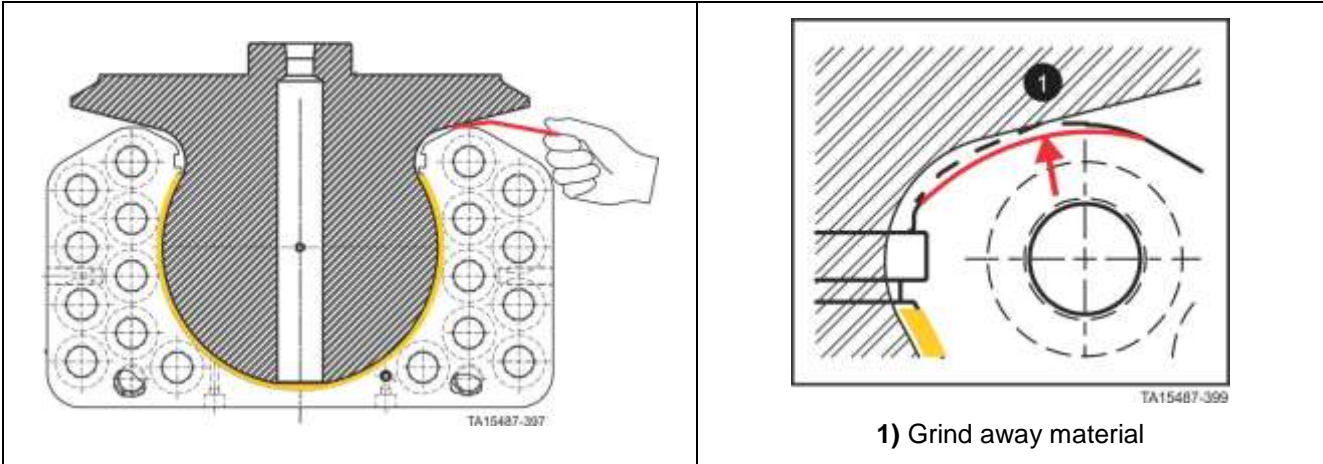
- 3) If they are not corrected they can contact the flange of the ball and contribute to short ball life.



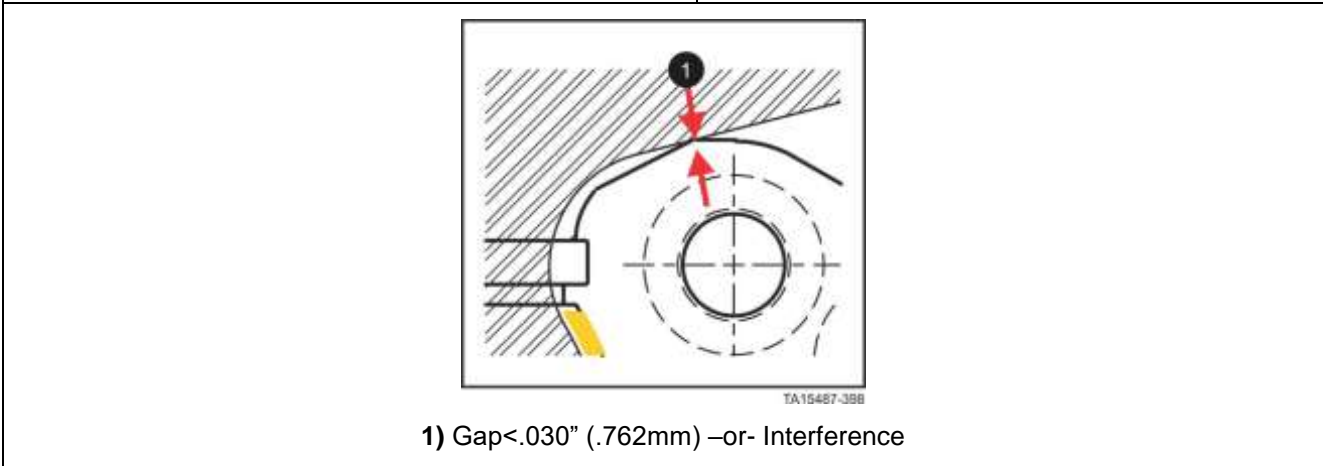
24. When the front frame on L1850 or L-2350 is joined to the rear frame it is important to check the gap between the socket/cap and the flange on the ball. There should be a minimum .030" (.762 mm) gap at all times when the machine is steered.

25. L-2350 and L-1850 GEN2 inspections





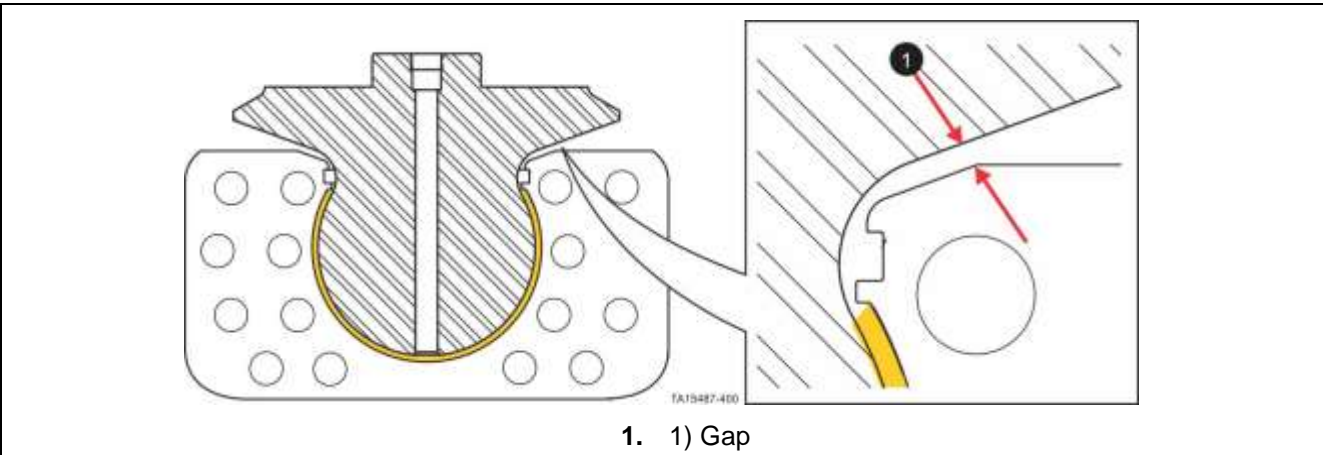
1) Grind away material



1) Gap < .030" (.762mm) –or– Interference

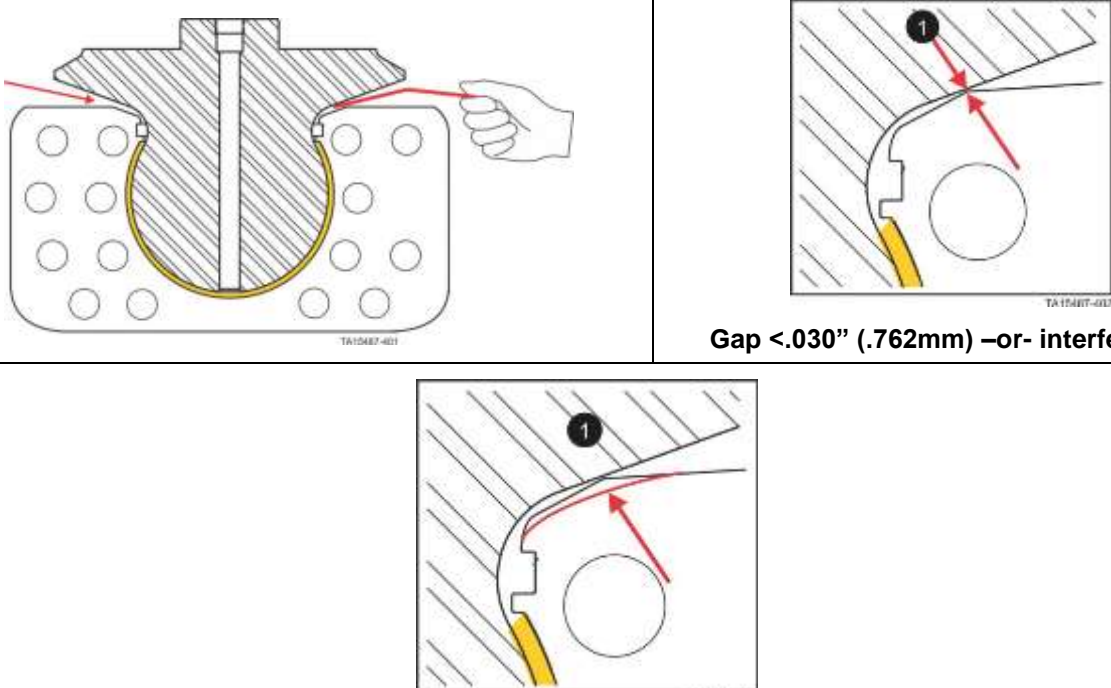
L-2350 and L-1850 GEN2 - modify clearances on the socket and cap

26. L-1850 GEN1 (9" balls)



1. 1) Gap

Inspect gap between socket/cap and ball flange



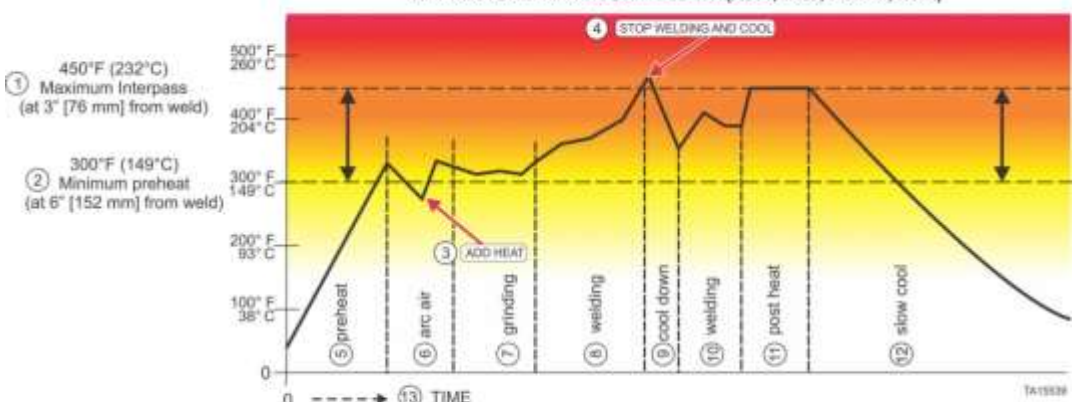
Gap <.030" (.762mm) –or- interference

1) Grind away material

L-1850 GEN1 - modify clearances on the socket and cap

27. Heat the socket and cross member slab in an area 6" (152 mm) from the weld area on the socket to 300° F (149° C).

14 HIGH STRENGTH Q&T STEEL
TEMPERATURE LIMITS FOR WELDING (A514, N-20, NC23M, ETC.)



15 NOTE:
 - ADD HEAT TO INCREASE TEMPERATURE TO 300°F (149°C)
 - ADD HEAT WHENEVER TEMPERATURE DROPS BELOW 300°F (149°C)
 - STOP WELDING AND ALLOW TO COOL WHENEVER INTERPASS RISES ABOVE 450°F (232°C)

1) 450°F (232°C) Maximum Interpass (at 3" [76 mm] from weld) 2) 300°F (149°C) Minimum Preheat (at 6" [152 mm] from weld) 3) Add Heat 4) Stop Welding and Cool 5) Preheat 6) Arc Air 7) Grinding 8) Welding 9) Cool Down 10) Welding 11) Post Heat 12) Slow Cool 13) Time 14) High Strength Q&T Steel – Temperature Limits for Welding (A514, N-20, NC23M, Etc.) 15) Note: -Add Heat to Increase Temperature to 300°F (149°C) – Add Heat Whenever Temperature Drops Below 300°F (149°C) – Stop Welding and Allow to Cool Whenever Interpass Rises Above 450°F (232°C)

Preheat transition plate and ball base

28. Tack weld the socket firmly into place using welding consumables as listed in following paragraphs.

Welding Wire

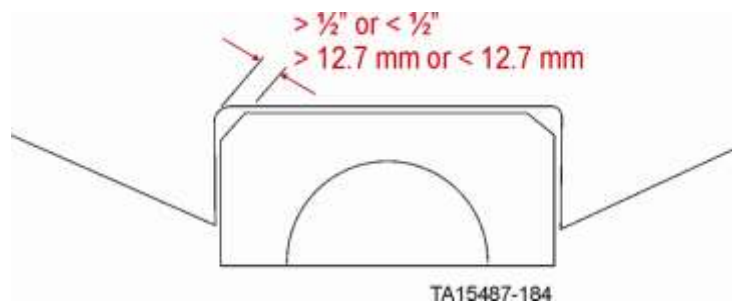
1. Typical wire sizes used for FCAW welding will be .045" (1.2 mm), .052" (1.4 mm) or 1/16" (1.6 mm) diameter. The most commonly used sizes are .052" (1.4 mm) or 1/16" (1.6 mm).
2. Wire consumable for field welding of ball installations is E8xT- xxxx series wire.

NOTICE

The factory will consider approving other wire types depending on the specifications of the wire. For example: Komatsu uses Lincoln Ultracore E71T-1MJ along with gas that is 75% Ar/25% CO₂ for installation of the balls. This combination of gas and wire gives a tensile strength of 83,000 psi (572 MPa) which meets the specifications for E80XX wire.

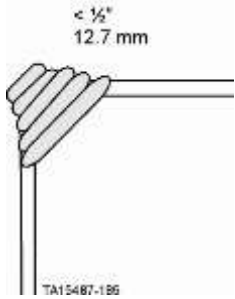

Electrodes

1. Electrodes for SMAW are specified to be low hydrogen E-8018C3 for ball socket installation.
2. Typical electrode sizes for SMAW will be 1/8" (3.2 mm) for root passes and 5/32" (4 mm) for the remainder.
3. Storage and handling of low hydrogen electrodes:
 - a. Use new low hydrogen electrodes that are provided in hermetically sealed packages. Do not use old electrodes for structural repairs. Old electrodes are defined as those that were removed from a sealed package more than 1 month earlier and have been kept in an oven.
 - b. Remove only one hour's supply of electrodes at a time. Keep the remainder in a ventilated holding oven at 225° F (107° C).
 - c. Bake previously opened packages of electrodes in a ventilated oven at 500° F (260° C) for two hours before using.
 - d. Electrodes taken from cardboard boxes or a non-airtight container should also be baked at 500° F (260° C) for two hours in a ventilated oven.
 - e. Then the electrodes should be placed immediately in a ventilated holding oven set at 225° F (107° C).
 - f. Any electrode exposed to the air for more than four hours should be re-baked per the instructions above.
4. Weld with E-8018C3 series electrodes or E8xT-xxx FCAW wire.
5. If using SMAW E-8018C3 – weld the first 3 root passes with 1/8" (3.2 mm) rod.
6. Examine the corners of the socket and the frame slab for gaps.



Examine corners for gaps

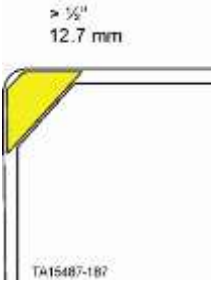
7. Gaps of less than 1/2" (12.7 mm) can be bridged with multipass stringer welds.

	
<p>Bridge welding (gap less than 1/2" [12.7 mm])</p>	<p>Weave welding across the gap NOT permitted</p>

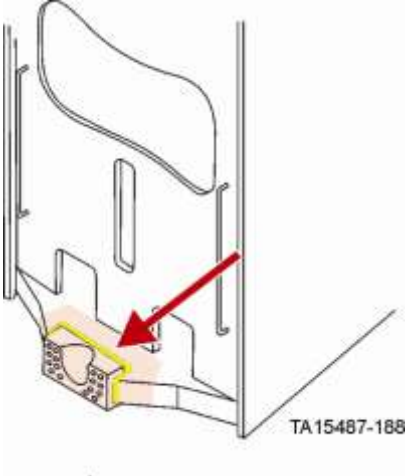
CAUTION

DO NOT use weave welding to bridge the gap. This will crack and cause further problems.

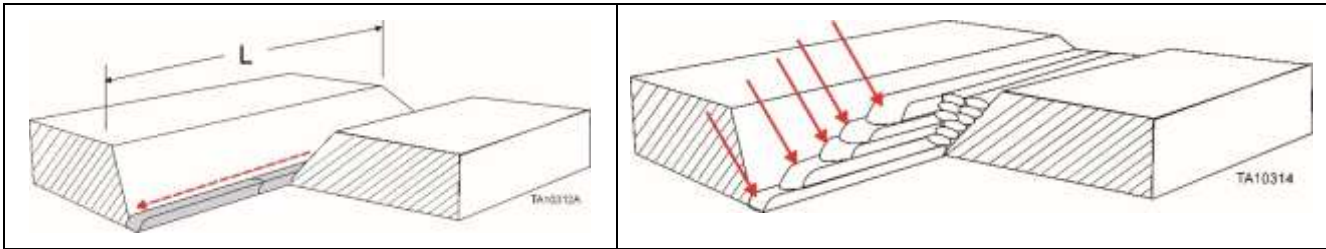
- If the gap is over 1/2" (12.7 mm) then a backer plate of approximate 1/4" (6.35 mm) thick plate should be inserted into the gap to use as a backer strip for the root pass welds.


<p style="text-align: center;">Fill corner with backer strip if gap is over 1/2" (12.7 mm)</p>

- Finish each pass all around the diameter of the weld. **DO NOT** weld in sections.


<p style="text-align: center;">weld passes – all around the socket</p>

- Each weld pass must start and stop in a different location from the previous pass.



Each pass is full length with start and stop in different locations

11. After welding each root pass remove the slag with a needle scaler air tool.

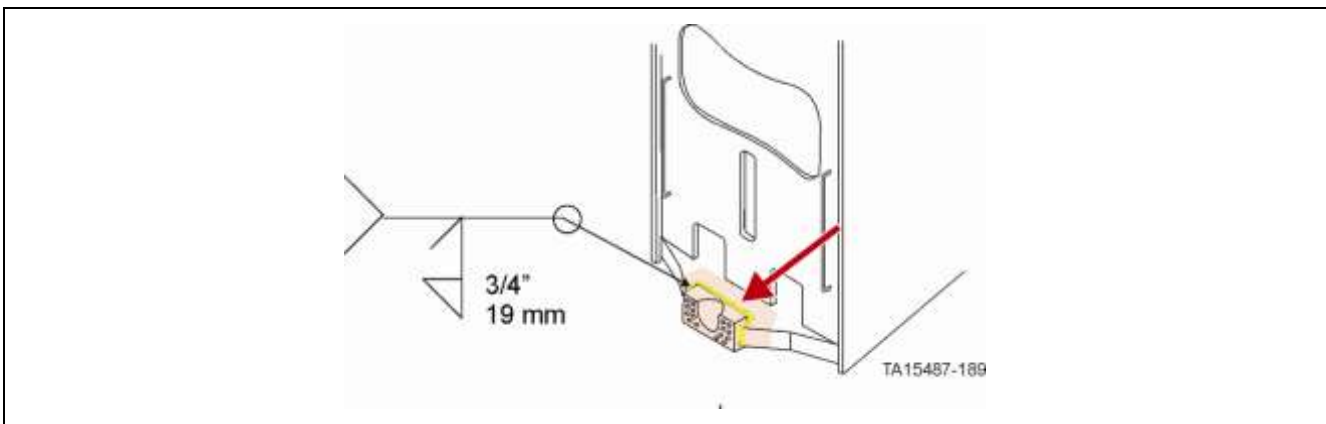


Needle scaler kit, scalers

12. Check the root pass for cracks with MT. (magnetic particle testing)

CAUTION

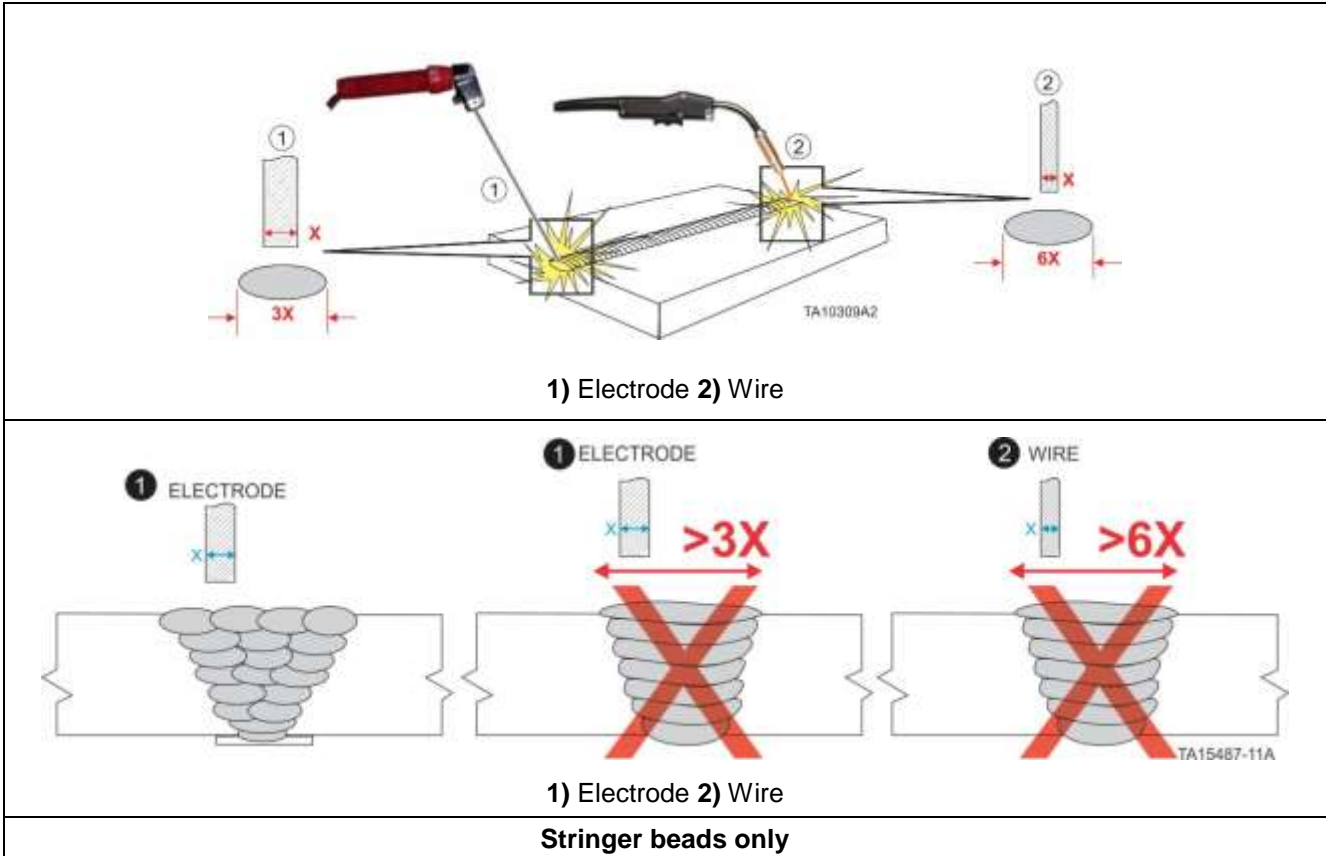
Complete passes all the way around are required. Do not weld out one side or top or bottom completely - or warpage of the socket will result.



Single pass all the way around

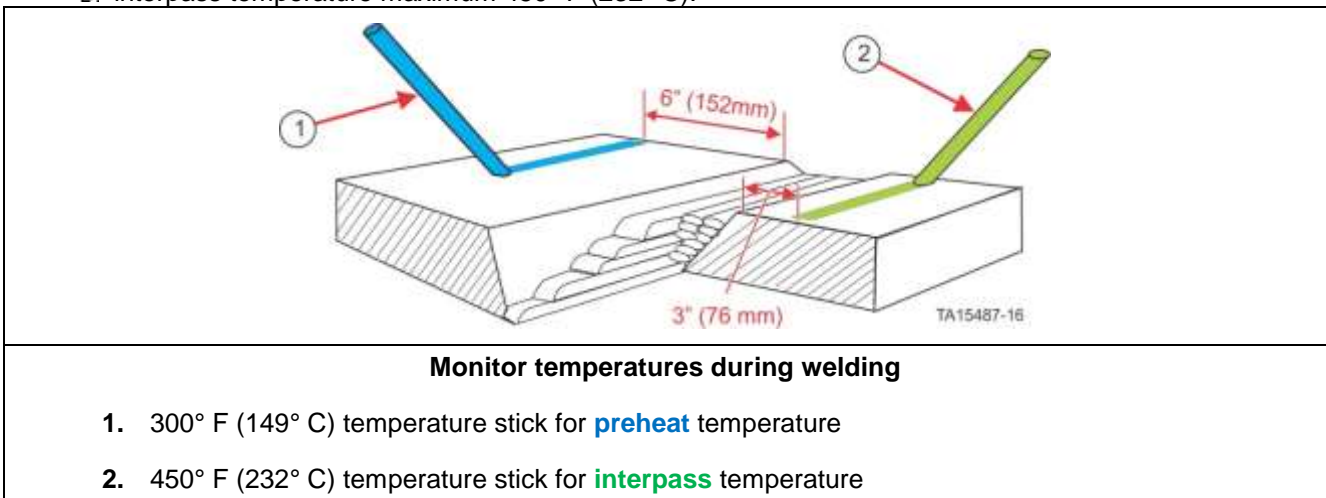
13. If using SMAW E-8018C3 – weld the rest of the passes with 5/32” (4 mm) rod.

14. Do not weave weld. Only multi pass stringer beads are allowed.



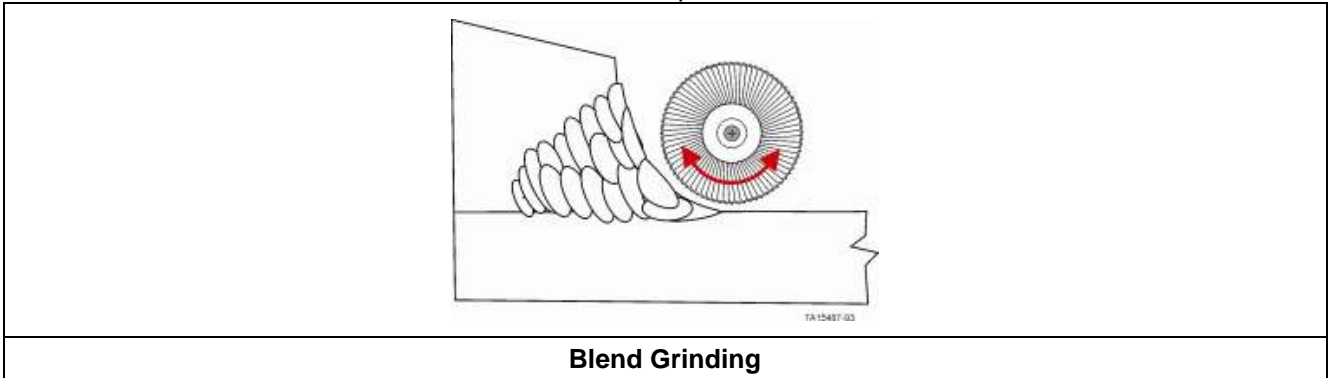
15. Continue to monitor and record temperatures after each weld pass: The welding should be stopped whenever the interpass or neck temperature become hotter than specification. **DO NOT** force cool by using fans or water. Heat should be added if the temperature drops below the preheat minimum.

- a. preheat temperature minimum 300° F (149° C).
- b. interpass temperature maximum 450° F (232° C).



16. The cap weld passes must be blended smooth.

- 17. Blend grind the weld around the socket.
 - a. The grinding direction is across the weld.
 - b. The blend should not be undercut into the base plate.

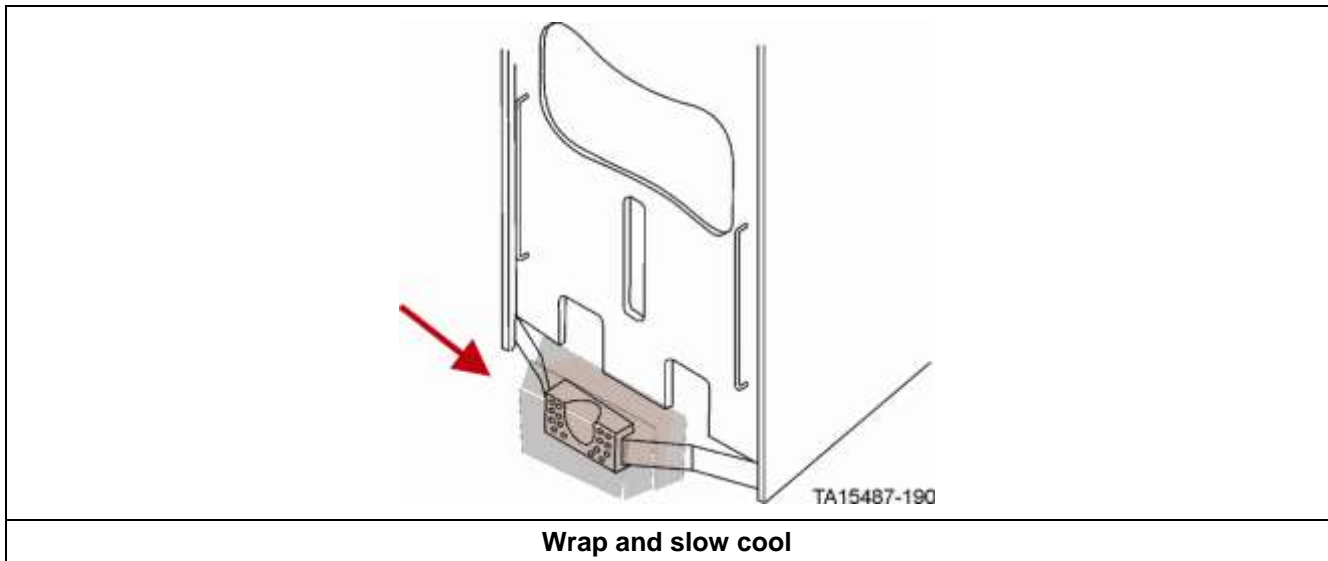


- 18. Post heat the joint at 500°F (260°C).
- 19. The following is a sample post heat form. A full size form is provided in the appendix.

Weld Post Heat and Cool Down Log		
Casting Repairs		
<i>(Does not apply to ball installation)</i>		
Time	Target Temperature	Actual Temperature
Post heat:		
1 hour*	500° F (260° C)	
Cool Down: (minimum times listed)		
30 min	475° F (246° C)	
1 hour	450° F (232° C)	
2 hour	400° F (204° C)	
3 hour	350° F (177° C)	

SAMPLE

20. Wrap the socket and cross member plate to extend the cool downtime. The ball socket must slow cool down to at least 100° F (38° C) before reassembling.



21. Inspect completed weld by Magnetic Particle Inspection (MT) or Dye Penetrant Testing (PT).
22. Repair any defects found following all standard repair processes including preheat.
23. Paint the weld repair area.
24. Follow the reassembly procedure outlined in the Service Manual.
25. After assembly, check the steering pivot ball cap shim tolerances and adjust as required.

NOTICE

Re-Commissioning after Ball Replacement

- After each ball has been replaced or repaired and all of welding/inspection procedures have been completed- specific assembly and maintenance items outlined in the Re-Commissioning Replacement Document must be done to assure proper function of the ball joints.
- Re-Commissioning Replacement Document is at the end of this chapter and a copy is also included in the Appendix of the Field Welding Procedure document.

Re-Commissioning after - Ball Replacement



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Re-Commissioning after Ball Replacement

Before beginning the re-commissioning process, ensure the following safety preparations have been followed.

Safety Preparations

WARNING

Crush hazards exist if the machine is started or moved while work processes are being performed on the machine. Place bucket flat and level on the ground. Place frame lock in the locked position and lock out the machine's starting capability before performing any work process. Follow all applicable lockout procedures and local rules and regulations for performing work processes. ANYONE performing inspections or service procedures to the machine should be familiar with ALL instructions and procedures contained in the machine's SERVICE MANUAL. Crush hazard could occur if the machine is started or moves while any type of work process is being conducted on the machine, resulting in serious injury or death.

Machine Shutdown and Lockout

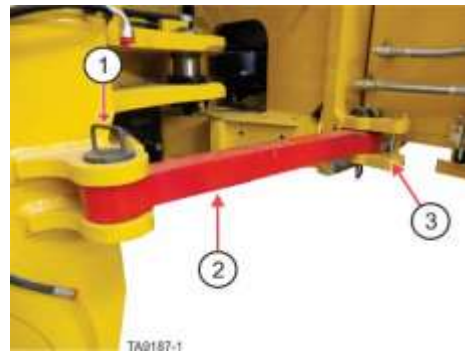
1. Stop the wheel loader on flat level ground.
2. Place bucket flat and on level ground.
3. Move the frame lock to the locked position so that the frame cannot be steered.

WARNING

Crush hazards exist in machine pivot area and area between the tires. Do not enter these areas unless it is verified that the operator has control over the steering and that personnel locking the frame lock have good communication with the operator. Entering the pivot area and area between the tires while the machine is moving or pivoting (articulating) could cause crush hazards resulting in serious injury or death.



Gen 1 Frame lock in locked position



Gen 2 Frame lock in locked position

- 1) Retaining pin for locked position, 2) Frame lock - shown in locked position
3) Retaining pin bracket for un-locked position

4. Set the parking brakes.
5. Shut off the engine.
6. Place wheel chocks in front and behind each wheel.

7. Lock out the machine's starting capability before performing any cleaning, inspections, or installation and repair procedure.

WARNING

Crush, shock, or other hazards exist if stored energy is not removed or isolated prior to working on the machine. Stored energy (hydraulic, electrical, pneumatic, mechanical, etc.) may be present if not isolated or released prior to working on the machine. Do not work on the machine without removing this stored energy (suspended loads, electrical power, air pressure, etc.). Risk of crushing, shock, or other physical injury exists if stored energy is not removed or isolated prior to working on the machine which could result in serious injury or death.

8. Turn the battery and engine isolation switches to the off position and install locks on the battery isolation switch.



GEN 2 Isolation and Control switches assembly – Battery isolation switch in OFF position with locks in place

NOTICE

The GEN 2 Isolation and Control switches assembly is shown in this document. GEN 1 machines will have a different type of switch and box. The lock out/tag out requirements are the same.

9. Release the air from the hydraulic reservoir by using the hydraulic reservoir air valve (ball valve) on top of the reservoir. The supply line from main air system will be blocked and reservoir air will vent out the hose that runs down the outside of the hydraulic reservoir.

10. Turn the handle to the up position as shown.



Hydraulic reservoir air valve handle UP

11. Release the air from the various air storage reservoirs by opening all of the air bleed valves.

Generation 1	Generation 2
Three valves on left side of rear frame under electrical cabinet	Three valves on right side of rear frame under hydraulic reservoir
One valve on left side of front frame near frame lock and hoist cylinder ball cap	One valve on right side of front frame near hoist cylinder ball cap

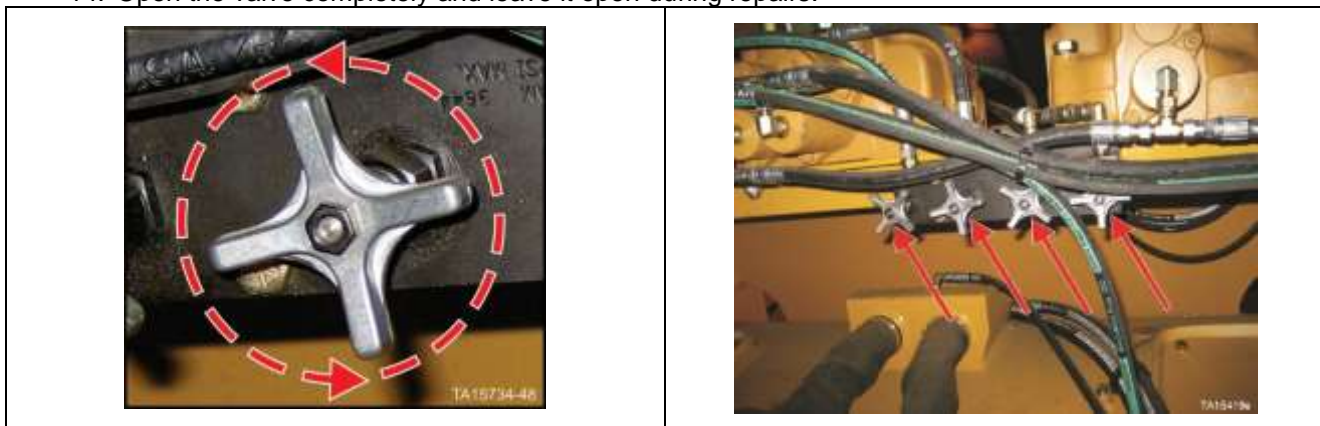


Open air reservoir bleed valves

⚠ WARNING

Crush hazards exist if all personnel are not cleared from the bucket and lift arm area before using the hydraulic hoist and bucket hydraulic pressure bleed down valves to relieve pressure from the hoist and bucket circuit. Assembly must be used only when the engine is NOT running. Before using the Manual Bleed Valve Assembly, refer to “HYDRAULIC AND GREASE SYSTEMS”, “MANUAL BLEED VALVE ASSEMBLY”, in Section 04 of the Service Manual for additional operational and safety information. Operating the manual bleed valve may cause the lift arms and bucket to descend rapidly. All personnel around the bucket and lift arms area shall be removed from the area before operating hydraulic hoist and bucket hydraulic pressure bleed down valves. Using the hydraulic bleed down valves could result in movement of the lift arms and bucket which could cause a crush hazard resulting serious injury or death.

12. Use the hydraulic pressure bleed down valves located in the front frame underneath the Husco valves to bleed any stored pressure in the hoist and bucket cylinders.
13. Turn each valve slowly counterclockwise as shown below and allow the pressure to bleed down.
14. Open the valve completely and leave it open during repairs.



CAUTION

Before performing welding operations on a machine, the fire suppression system circuit monitors panel's in-line fuse must be removed. The fuse is located in the battery box on some machines. Failure to do so may cause the system to actuate and/or damage the solid-state components of the system. Replace the in-line fuse before the machine has been started or after all welding operations have been completed.



Fire suppression in-line fuse located in loader battery box on some machines

WARNING

Fall hazard exists when working at heights. Be sure to take appropriate safety precautions when working at heights on the rear and front frames or the lift arms balls. Follow all required statutory regulations for working at height. Wear fall restraint when necessary to prevent falls. Failure to take appropriate safety precautions, including wearing fall restraint when necessary can cause fall hazards resulting in serious injury or death.

WARNING

Crush hazards exist if standing under, working, or placing any body part under hoisted/suspended components. Never stand under hoisted/suspended components. Ensure appropriate lifting devices are used, and blocking is adequate to prevent the component from unexpectedly moving during transportation. Refer to **SAFETY, WARNINGS, AND CAUTIONS** before attempting to remove the operator's cab. Failure to stay out from under hoisted/suspended components can cause crush hazard resulting in serious injury or death.

Assembly and Maintenance Items

After each ball has been replaced and all of the welding/inspection procedures completed – the following assembly and maintenance items must be done to assure proper function of the ball joint:

- 1) Obtain a machine download and analyze the data.
 - a. Any grease system alarms or warnings?
- 2) Assure that the grease plug is installed (hoist cylinder and lift arm balls).
 - a. Use new O-ring on the plug.
- 3) Install grease extension tube (frame articulation balls).
 - a. Use thread sealant on threads.
- 4) Grease hose and fitting is properly attached for each ball type.
 - a. The hose should be replaced to ensure reliability.
 - b. Pre-purge all grease lines with auto lube system grease, before installation.

CAUTION

Do not use standard EP grease to coat the ball, coat the liner, fill the ball or purge the grease system. Use only the specified auto lube system grease containing 3-5% moly, specified for the machine's operating conditions.

- 5) Install new brass liners in socket and cap.
- 6) Chase the threads in each of the tapped holes in the socket.
 - a. This must be done by hand – **DO NOT** use any form of power tool.
 - i. Use of a power tool can cause damage to the threads.

CAUTION

Never use any form of power tool to chase threads with a tap! Always turn the tap by hand! Power tools can remove the 'feel' of the tap 'cutting' material from the hole and this 'cutting' is not desirable. Never drive a tap with a rattle gun as it can cause the tap to chip fragments of the tap off and they become embedded in the base material, causing further damage to the capscrew at the time of installation.

- b. Use a slightly dull tap to minimize thread damage.

NOTICE

The threads in each hole have typically been slightly distorted by the tensioning of the capscrews. The cutting edge of a new tap should be slightly 'dulled' by buffing the cutting edge of the tap on a wire wheel. This will minimize thread cutting which can reduce thread strength and leave small fragments of steel shavings in the root of the thread.

- c. Use ONLY a bottoming type of tap. Taper and intermediate configuration taps must not be used.
- 7) Clean all of the tapped hole threads in the socket. Remove all contaminants and previous lubricants from each hole.
- 8) Install new capscrews.
 - a. If there is any doubt as to their history or condition – replace the capscrews.
 - b. New capscrews should be installed if the ball was broken.
 - i. If one lift arm ball was broken - replace the capscrews on both sides of lift arm.
 - c. Capscrews can be reused if:
 - i. They were properly torqued when originally installed.
 - ii. No sign of thread damage from installation or dropping on steel or ground.
 - iii. No signs of stretching.
 - iv. Threads are fully cleaned.
 - v. No signs of cracking near the clamp face of the capscrew.
 - vi. The clamp face is not galled.
 - vii. The 12-point head is not damaged.
- 9) Assembly lubrication.
 - a. Coat the OD of the ball with auto lube system grease.
 - b. Fill the hole in the ball with auto lube system grease.
 - c. Coat the socket and cap with a thin coat of auto lube system grease.
 - d. Coat the brass liners with auto lube system grease to fill the grooves in the liners.

CAUTION

Do not use standard EP grease to coat the ball, coat the liner, fill the ball or purge the grease system. Use only the specified auto lube system grease containing 3-5% moly, specified for the machine's operating conditions.

- 10) Verify that the lift arms fit on the balls without spreading or pulling together.
 - a. Verify that the lifting method is not pulling the arms together.
 - b. The arm width can be adjusted by heat striping if required.
 - c. Contact Komatsu Call Center for assistance (support@joyglobal.com).
- 11) Align the ball caps on the lift arm sockets.
 - a. Install the ball cap loosely and align the match marks.
 - i. The caps are interchangeable left to right – but once they have been aligned and match marked – they should be always used in the specified location.
 - b. If they are not factory match marked – find the center and match mark.
 - c. Mark each one for Left (LH) or Right (RH).

NOTICE

The socket and cap are aligned and marked when the arms are NOT mounted on the machine.

- 12) Torque the cap screws for the ball caps
 - a. Verify that the socket threaded holes and all capscrews are not contaminated with grease, anti-seize, etc.
 - b. 30W or engine oil for thread and shoulder lubrication.
 - c. Hand start ALL cap screws in the cap prior to tightening with air gun or torque wrench.
 - d. Use a small air wrench (1/2" drive max) to run the bolts fully home.

CAUTION

If any capscrew binds while running in by hand or with a small air impact wrench, DO NOT attempt to drive the capscrew deeper. Use a hand wrench and remove the capscrew. DO NOT use an air impact wrench to remove the capscrew.

- e. Follow the torque pattern.
- f. Torque to the correct value.
- 13) Check the "snap" clearance on the ball.
 - a. Adjust the snap clearance to specification by adding or removing shims.
- 14) Purge the grease line to the ball joint.
 - a. DO NOT purge by cycling the grease system.
 - i. The injector only puts out a maximum of 1.3cc each time the grease system cycles. It is very difficult to fill the joint with grease at this rate – and wastes grease from excessive grease at all the other locations on the machine.
 - b. Remove the purge cap from the grease injector and fill the joint with grease using a grease gun.
 - c. Purge a minimum of 0.5 kilogram (1 pound) of grease through the joint BEFORE operation of the machine.

CAUTION

Do not use standard EP grease to purge the ball joint grease system. Use only the specified auto lube grease containing 3-5% moly, specified for the machine's operating conditions.

- 15) Replace the in-line fuse on the fire suppression system if it was disengaged due to welding on the machine, this must be done before the machine has been started or after all welding operations have been completed.

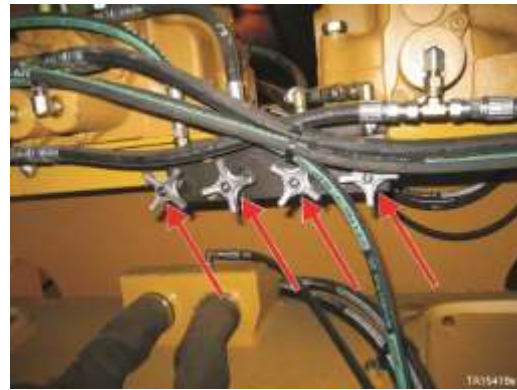
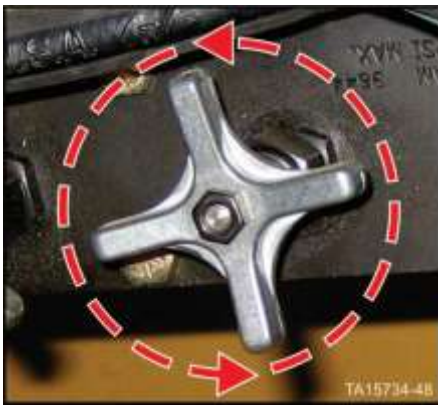
CAUTION

Failure to replace the fuse before operating the machine could result in a serious fire. Never run the machine unless the fuse has been replaced.



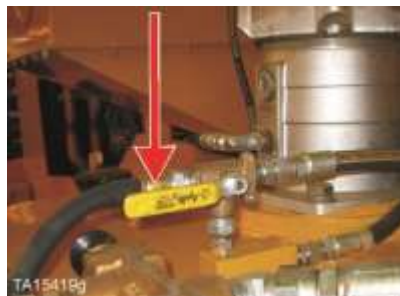
Fire suppression in-line fuse located in loader battery box on some machines

16) Close (turn clockwise) the hydraulic bleed valves in the front frame.



Close hydraulic bleed valves in front frame

17) Close the hydraulic reservoir air valve on top of the hydraulic reservoir.



Close the hydraulic reservoir air valve

18) Close the air bleed valves.

Generation 1	Generation 2
Three valves on left side of rear frame under electrical cabinet	Three valves on right side of rear frame under hydraulic reservoir
One valve on left side of front frame near frame lock and hoist cylinder ball cap	One valve on right side of front frame near hoist cylinder ball cap



Close the valve under the hydraulic reservoir

- 19) Remove wheel chocks.
- 20) Remove any locks or tags from isolation box following all local regulations and turn both isolation switches to the on position.



GEN 2 Battery Isolation Box – locks removed – and switches moved to on position

- 21) Start machine and verify that grease injectors are functioning (Ref SIL-397.01).
 - a. System timer functioning – what is the setting?
 - b. Grease leaks?
 - c. System building pressure?
 - d. Grease Pressure?
 - e. Oil Supply Pressure?
 - f. Injectors functioning?
 - g. Grease Pressure at stall?
 - h. Injector for ball joint functioning?

Most of the items in the previous list are steps that are part of the standard assembly and commissioning of a new loader or a part of the normal maintenance items related to balls. Contact the Komatsu Call Center (support@joyglobal.com) if you are unable to locate the information or have questions pertaining to these assembly and maintenance practices. Most of these are covered in one or more of the following documents:

- Assembly Manual
- GEN 2 Service Manual
- SIL 439.01 Spherical Ball Bearing Joints
- SIL 413.00 Hoist Cylinder Spherical Ball Lubrication
- SIL-397.01 Auto Lube System Operation

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RE-Commissioning Worksheet

Machine:	Ball location changed:	Date:
S/N:	Replacement Ball S/N	Customer:

Item	Result	Comments	Date	Signature
Machine download	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Attach to the Sales Force Case related to this machine	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Analyze data for indications of grease system failures	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Grease Plug installed in <u>hoist or lift arm ball</u>	YES <input type="checkbox"/> NO <input type="checkbox"/>	Not applicable for Frame Articulation Ball Field Replacement		
New O-ring	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Grease extension tube installed into <u>frame articulation ball base</u>	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Thread sealant used?	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Connect the grease hose	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Tighten hose and fitting	YES <input type="checkbox"/> NO <input type="checkbox"/>			
New Grease hose used?	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Install new brass liners in socket and cap	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Chase hole threads in socket by hand	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Clean hole threads in socket to remove all contaminants	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Install new capscrews	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Coat the OD of the ball with auto lube system grease	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Fill the hole in the ball with auto lube system grease	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Coat the ID of the socket and cap with a thin coat of auto lube system grease	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Coat the ID of the brass liner auto lube system grease	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Verify that the arms fit without spreading or pulling together	YES <input type="checkbox"/> NO <input type="checkbox"/>	Not applicable for Frame Articulation Ball Field Replacement		
Heat striping required?	YES <input type="checkbox"/> NO <input type="checkbox"/>			
<i>This section applies to Lift arm balls ONLY</i>				

Field Welding Procedures

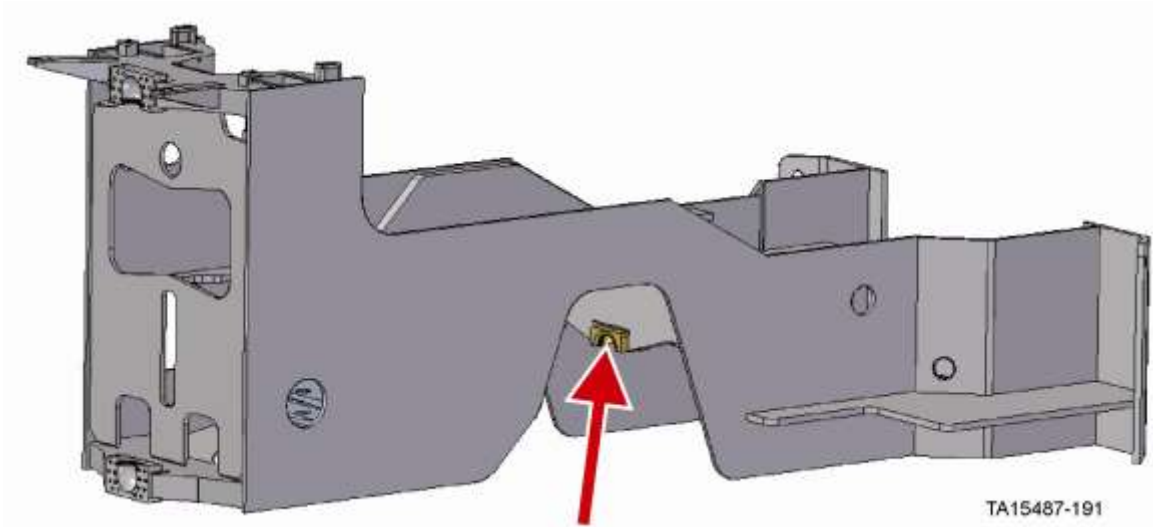
Item	Result	Comments	Date	Signature
Align the ball caps on the lift arm sockets Match marks <i>This section applies to Lift arm balls ONLY</i>	YES <input type="checkbox"/> NO <input type="checkbox"/> YES <input type="checkbox"/> NO <input type="checkbox"/>	Not applicable for Frame Articulation Ball Field Replacement		
Capscrew lubricant – 30W oil	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Hand start all capscrews	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Follow specified torque pattern	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Torque value	_____ ft-lb			
Purge the grease system to all balls that were replaced? Use external grease pump?	YES <input type="checkbox"/> NO <input type="checkbox"/> YES <input type="checkbox"/> NO <input type="checkbox"/>			
Check the snap clearance In or out of specification? Adjusted? Final value?	YES <input type="checkbox"/> NO <input type="checkbox"/> _____/mm YES <input type="checkbox"/> NO <input type="checkbox"/> YES <input type="checkbox"/> NO <input type="checkbox"/> _____/mm			
Verify grease system functioning: System timing Leaks? System building pressure? Oil supply pressure? Grease pressure at stall? Ball injector functioning? Injectors functioning?	____ min/cycle YES <input type="checkbox"/> NO <input type="checkbox"/> YES <input type="checkbox"/> NO <input type="checkbox"/> ____ psi ____ psi YES <input type="checkbox"/> NO <input type="checkbox"/> YES <input type="checkbox"/> NO <input type="checkbox"/>			

CHAPTER 7

Axle Pivot Ball Sockets

Field Replacement Procedure

Rear Frame

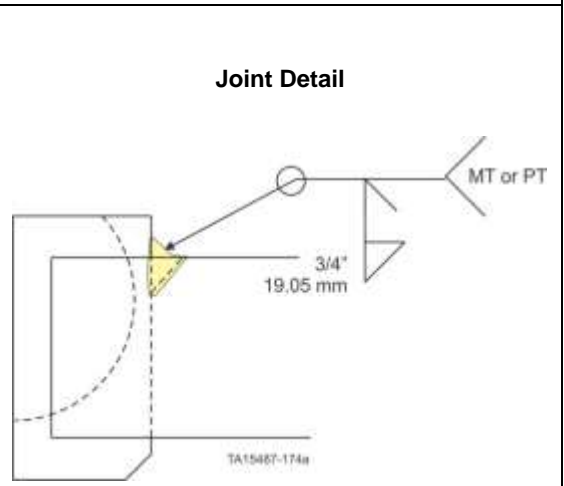


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Procedure	FW-0113
Revision	0
Written by	Joel Armstrong
Date	3/8/2010

Field Welding Procedure			
This document conforms to AWS D1.1/D14.3 Structural Welding Code and Australian Standards AS 1554.4			
Description	Rear frame articulation sockets		
Notes	See attachment		
Welding Process	FCAW / SMAW		
Joint			
Type	Groove or Fillet		
Backing	If needed	Material	Mild Steel
Root Opening	+1/4 / - 1/16" Per Attachment(+6.35 / -1.6 mm)		
Root face Dimension	+/- 1/16" Per Attachment(+/- 1.6 mm)		
Groove Angle (degrees)	+10/-5 Per Attachment	Radius	N/A
Back Gouging	Yes, if required	Method	Arc - Air
Other			
Base Metals			
Specification	ASTM A572 Modified	ASTM A148 Grade 115-95	
Thickness	5-7" (127-178 mm)	7.5 and 9" (191 and 229 mm)	
	Slab	Sockets	
Filler Metals			
AWS Specification	A5.20/A5.29	A5.29	
AWS Class	E71T-1XX series	E8018C3	
Diameter	0.045", 0.052", 1/16" (12, 1.4, 1.6 mm)	1/8", 5/32" (3.2, 4mm)	
Shielding		Positions Qualified	Flat, Horizontal, Vertical
Gas Composition	100% CO2 or Ar/CO2 75/25	Groove	1G, 2G, 3G, 4G
Flow Rate	35 – 45 cfh	Fillet	1F, 2F, 3F
Technique		Vertical Progression	Up
Stringer or Weave Bead	Stringer	Electrical Characteristics	
Multi/Single Pass (per side)	Multiple	FCAW - Current	DCEP
Peening	Yes	SMAW - Current	DCEP
Interpass Cleaning	Chipping and or grinding	Other	
Preheat and Interpass Temperatures			
Material Types			
Structural Steel	Castings	Q&T high strength steel	
Frame structure Bucket Blade	Lift Arm Torque Tube (1150, 1350, 1850 Gen 2, 2350) Upper part front frame (1350) Axles (some 1350) Sockets	Balls Bucket Lip Bucket adapters Lift arms Bell cranks	
Preheat			
Material Thickness	Structural Steel	Castings and high strength steel	
Distance from weld < or = 3/4" (< or = 19 mm)	6" (152 mm) minimum 125° F (52° C)	6" (152 mm) minimum 200° F (93° C)	
>3/4" to 1-1/2" (>19.05 to 38.1 mm)	225° F (107° C)	250° F (121° C)	
>1-1/2" to 2-1/2" (>38.1 to 63.5 mm)	250° F (121° C)	300° F (149° C)	
>2-1/2" (>63.5 mm)	300° F (149° C)	350° F (177° C)	
Interpass Temperature			
All thicknesses	500°F (260° C) maximum	450°F (232° C) maximum	
Post Heat Treatment			
500°F (260° C) for one hour	Required: YES (X) NO ()		



Welding Parameters

(The FCAW welding parameters were obtained from the qualification of the LINCOLN Ultracore 712A80 used during Komatsu fabrication on Komatsu welding equipment. These numbers will likely vary depending on the specific welding equipment and consumable used for repairs.)

Weld Pass	Process	Filler Metal	Filler Diameter	Current Type	Amps	Volts	Travel Speed (ipm)	Wire Feed Speed	Welding Position
All	FCAW	E71T-1MJ	1/16"	DCEP	280-340	22-26	8-12	255-300	Flat & Horizontal
All	FCAW	E71T-1MJ	0.052"	DCEP	220-310	22-26	8-12	225-375	Flat & Horizontal
All	FCAW	E71T-1MJ	0.045"	DCEP	210-280	23-25	8-12	275-425	Flat & Horizontal
All	FCAW	E71T-1MJ	1/16"	DCEP	185-225	21-24	7-10	105-130	Vertical
All	FCAW	E71T-1MJ	0.052"	DCEP	195-235	21-24	7-10	200-375	Vertical
All	FCAW	E71T-1MJ	0.045"	DCEP	155-235	21-23	7-10	175-325	Vertical
All	SMAW	E7018	5/32"	DCEP	130-210	19-21	5-8	N/A	All
All	SMAW	E7018	1/8"	DCEP	90-160	19-21	5-8	N/A	All
All	SMAW	E8018C3	5/32"	DCEP	130-220	19-21	N/A	N/A	All
All	SMAW	E8018C3	1/8"	DCEP	90-160	19-21	N/A	N/A	All

Suggested Air Arc Parameters

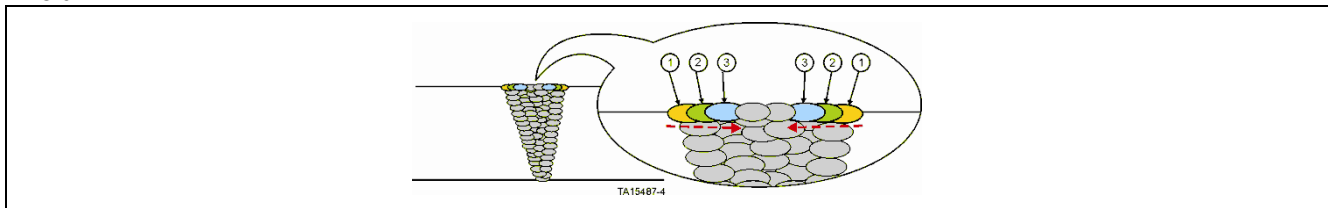
Electrode Diameter		Minimum Amps	Maximum Amps
Inches	Millimeter		
1/8	3.2	60	90
5/32	4.0	90	150
3/16	4.8	200	250
¼	6.4	300	400
5/16	7.9	350	450
3/8	9.5	450	600
½	12.7	800	1000
5/8	15.9	1000	1250
¾	19.1	1250	1600

Proper Electrode Selection for Field Welding

Material joint type	Rod consumable	Wire Consumable
Steel to steel	7018 series	E7xT- xxxx series
Steel to Casting	7018 series	E7xT- xxxx series
Casting Repair	8018 series	E8xT- xxxx series
Socket or Ball installation	8018 series	E8xT- xxxx series
Wear hardware installation on bucket	8018 series	E8xT- xxxx series

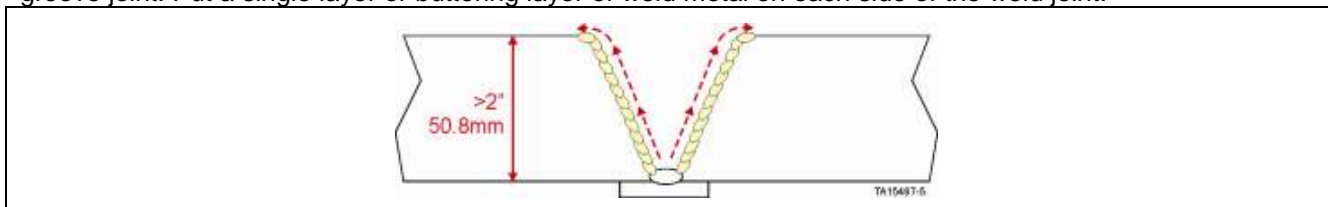
Bead Tempering Finish Passes

The last layer of weld passes must be completed starting from the base material toward the middle of the weld.



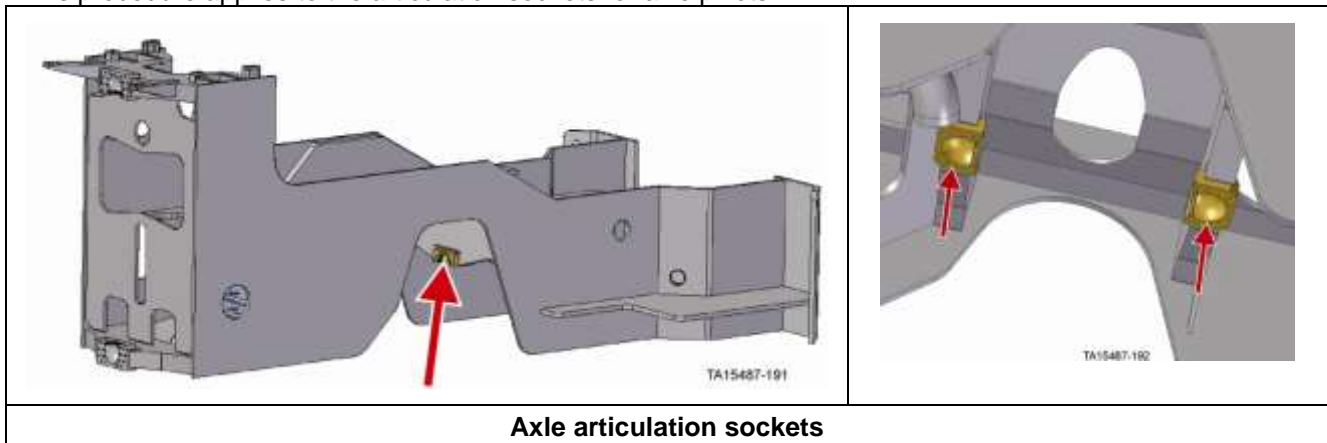
Butter Welds

On groove or fillet welds 2" (50.8 mm) deep or larger - butter weld the sides of the groove prior to welding the groove joint. Put a single layer or buttering layer of weld metal on each side of the weld joint.



Axle Articulation Ball Socket Field Replacement

This procedure applies to the articulation sockets for axle pivots.



Safety Preparations

WARNING

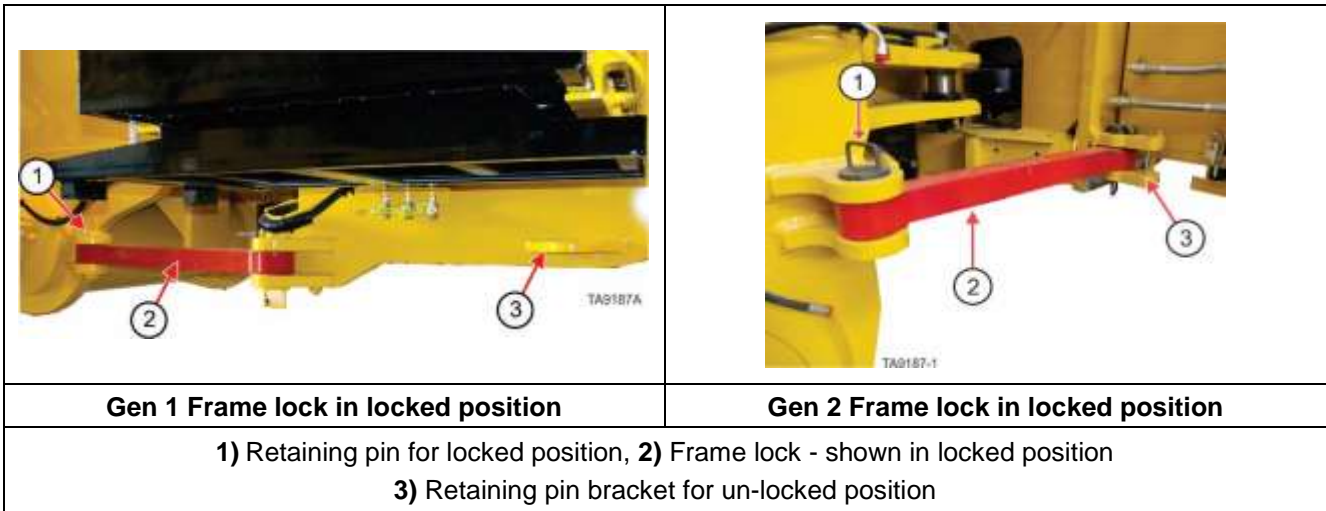
Crush hazards exist if the machine is started or moved while work processes are being performed on the machine. Place bucket flat and level on the ground. Place frame lock in the locked position and lock out the machine's starting capability before performing any work process. Follow all applicable lockout procedures and local rules and regulations for performing work processes. ANYONE performing inspections or service procedures to the machine should be familiar with ALL instructions and procedures contained in the machine's SERVICE MANUAL. Crush hazard could occur if the machine is started or moves while any type of work process is being conducted on the machine, resulting in serious injury or death.

Machine Shutdown and Lockout

1. Stop the wheel loader on flat level ground.
2. Place bucket flat and on level ground.
3. Move the frame lock to the locked position so that the frame cannot be steered.

WARNING

Crush hazards exist in machine pivot area and area between the tires. Do not enter these areas unless it is verified that the operator has control over the steering and that personnel locking the frame lock have good communication with the operator. Entering the pivot area and area between the tires while the machine is moving or pivoting (articulating) could cause crush hazards resulting in serious injury or death.

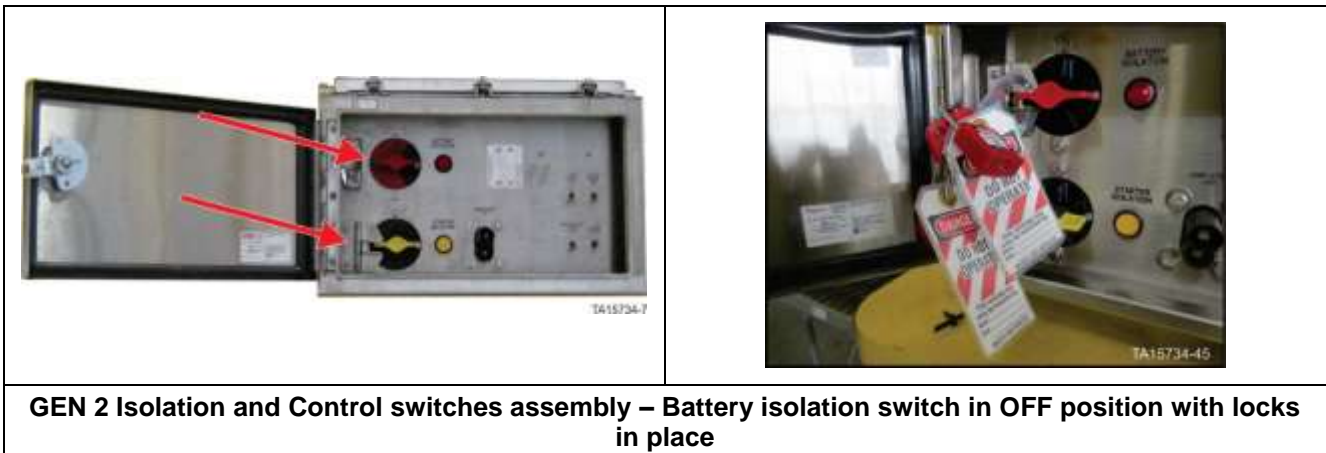


4. Set the parking brakes.
5. Shut off the engine.
6. Place wheel chocks in front and behind each wheel.
7. Lock out the machine's starting capability before performing any cleaning, inspections, or installation and repair procedure.

⚠ WARNING

Crush, shock, or other hazards exist if stored energy is not removed or isolated prior to working on the machine. Stored energy (hydraulic, electrical, pneumatic, mechanical, etc.) may be present if not isolated or released prior to working on the machine. Do not work on the machine without removing this stored energy (suspended loads, electrical power, air pressure, etc.). Risk of crushing, shock, or other physical injury exists if stored energy is not removed or isolated prior to working on the machine which could result in serious injury or death.

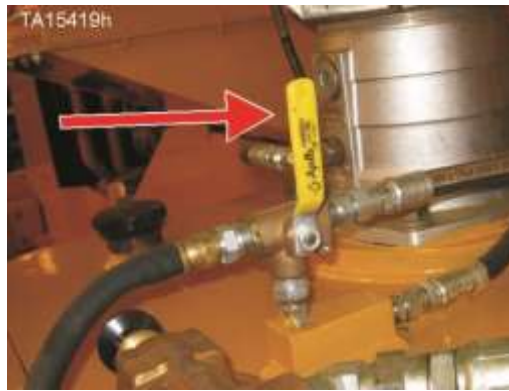
8. Turn the battery and engine isolation switches to the off position and install locks on the battery isolation switch.



NOTICE

The GEN 2 Isolation and Control switches assembly is shown in this document. GEN 1 machines will have a different type of switch and box. The lock out/tag out requirements are the same.

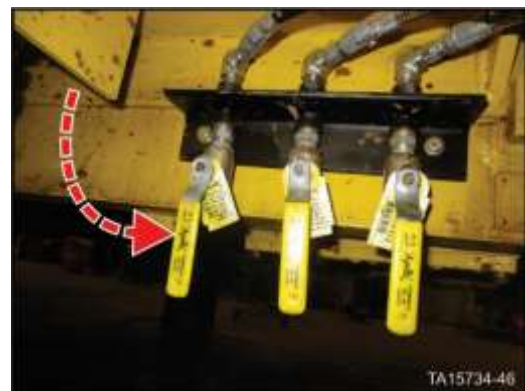
9. Release the air from the hydraulic reservoir by using the hydraulic reservoir air valve (ball valve) on top of the reservoir. The supply line from main air system will be blocked and reservoir air will vent out the hose that runs down the outside of the hydraulic reservoir.
10. Turn the handle to the up position as shown.



Hydraulic reservoir air valve handle UP

11. Release the air from the various air storage reservoirs by opening all of the air bleed valves.

Generation 1	Generation 2
Three valves on left side of rear frame under electrical cabinet	Three valves on right side of rear frame under hydraulic reservoir
One valve on left side of front frame near frame lock and hoist cylinder ball cap	One valve on right side of front frame near hoist cylinder ball cap



Open air reservoir bleed valves

⚠ WARNING

Crush hazards exist if all personnel are not cleared from the bucket and lift arm area before using the hydraulic hoist and bucket hydraulic pressure bleed down valves to relieve pressure from the hoist and bucket circuit. Assembly must be used only when the engine is NOT running. Before using the Manual Bleed Valve Assembly, refer to “HYDRAULIC AND GREASE SYSTEMS”, “MANUAL BLEED VALVE ASSEMBLY”, in Section 04 of the Service Manual for additional operational and safety information. Operating the manual bleed valve may cause the lift arms and bucket to descend rapidly. All personnel around the bucket and lift arms area shall be removed from the area before operating hydraulic hoist and bucket hydraulic pressure bleed down valves. Using the hydraulic bleed down valves could result in movement of the lift arms and bucket which could cause a crush hazard resulting serious injury or death.

12. Use the hydraulic pressure bleed down valves located in the front frame underneath the Husco valves to bleed any stored pressure in the hoist and bucket cylinders.
13. Turn each valve slowly counterclockwise as shown below and allow the pressure to bleed down.
14. Open the valve completely and leave it open during repairs.



CAUTION

Before performing welding operations on a machine, the fire suppression system circuit monitors panel’s in-line fuse must be removed. The fuse is located in the battery box on some machines. Failure to do so may cause the system to actuate and/or damage the solid-state components of the system. Replace the in-line fuse before the machine has been started or after all welding operations have been completed.



Fire suppression in-line fuse located in loader battery box on some machines

WARNING

Fall hazard exists when working at heights. Be sure to take appropriate safety precautions when working at heights on the rear and front frames or the lift arms balls. Follow all required statutory regulations for working at height. Wear fall restraint when necessary to prevent falls. Failure to take appropriate safety precautions, including wearing fall restraint when necessary can cause fall hazards resulting in serious injury or death.

WARNING

Crush hazards exist if standing under, working, or placing any body part under hoisted/suspended components. Never stand under hoisted/suspended components. Ensure appropriate lifting devices are used, and blocking is adequate to prevent the component from unexpectedly moving during transportation. Refer to SAFETY, WARNINGS, AND CAUTIONS before attempting to remove the operator's cab. Failure to stay out from under hoisted/suspended components can cause crush hazard resulting in serious injury or death.

Burn Hazard

WARNING

Burn and inhalation hazards exist when welding or cutting on the machine. Cutting and welding can produce hot surfaces. Smokey condition can exist if a fire starts. Have qualified fire watch personnel present, and keep a fire extinguisher that meets all statutory regulations nearby during all cutting and welding operations. Failure to provide a qualified fire watch and an appropriate fire extinguisher can cause fire and inhalation hazards resulting in serious injury or death.

Summary

1. Axle will have to be removed to replace a socket.
2. Welding Consumables:
 - 1) Crack repair in frame base material: E7018 electrode or E7xT- xxxx series wire.
 - 2) Socket repair: E-8018C3 electrode or E8xT- xxxx series wire.
 - 3) Socket installation: E-8018C3 electrode or E8xT- xxxx series wire.
3. Slab preheat for air arc: 300° F (149° C) for 6" (152 mm) from weld in all directions.
4. Slab preheat for welding: 300° F (149° C) for 6" (152 mm) from weld in all directions.
5. Stringer beads.
6. Post heat and slow cool.
7. Wait 48 hours and MT or PT weld area (magnetic particle or dye penetrant).
8. Re-Commissioning after Campaign Ball Replacement.

Axle Articulation Ball Socket Replacement Procedure

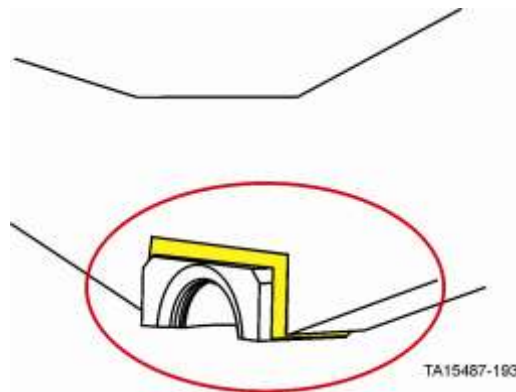
1. Remove the axle. The procedure for axle removal will vary from location to location. Follow all local statutory requirements for handling such a large structure:



Remove the axle

Machine	Axle Weight <i>(The listed weights are approximate only)</i>
L-950	6100 lb. (2767 kg)
L-1150	5375 lb. (2438 kg)
L-1350	8800 lb. (3992 kg)
L-1850	10,275 lb. (4662 kg)
L-2350	10,600 lb. (4808 kg)

2. Clean the area around the socket so that it is free of dirt and grease.

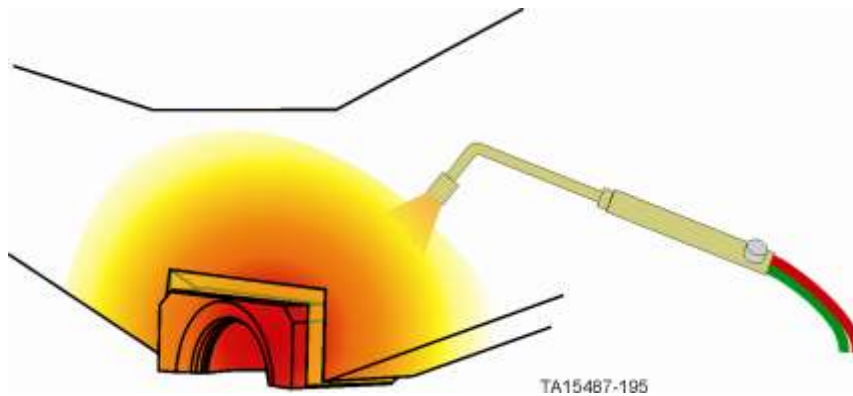


Clean articulation socket and slab

3. In cold or windy areas – cover the axle area so that the structures will maintain preheat better.



4. Remove any hoses or wires that may be affected by the heat.
5. Preheat the cross member plate to at least 300° F (149° C) at 6" (152 mm) away in all directions from the weld.

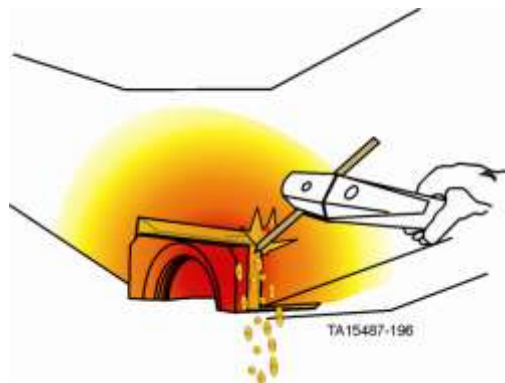


Preheat articulation socket and slab

6. Cut the weld from around the socket using arc air.

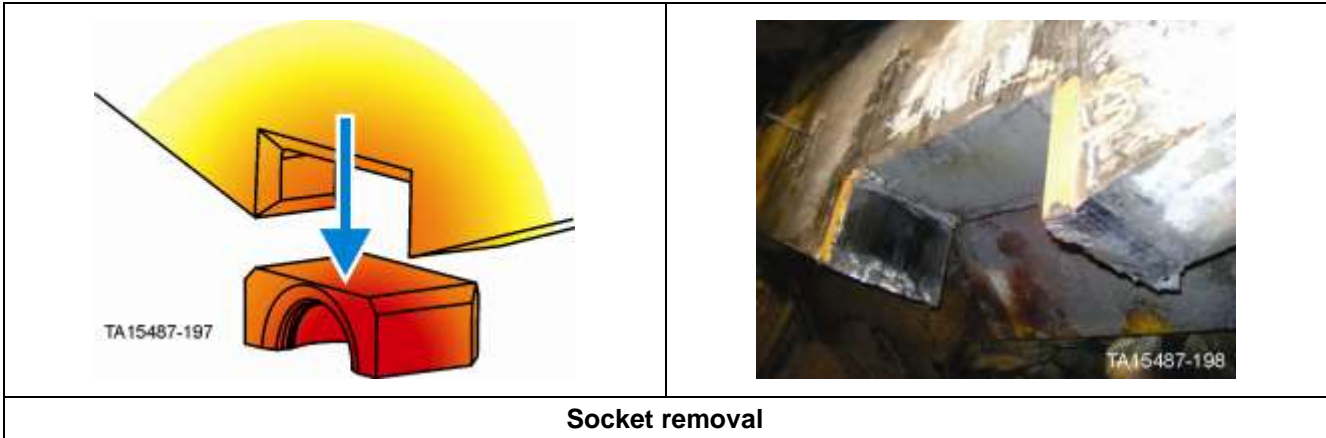
NOTICE

Remove only the weld and socket material – do not remove material from the slab.



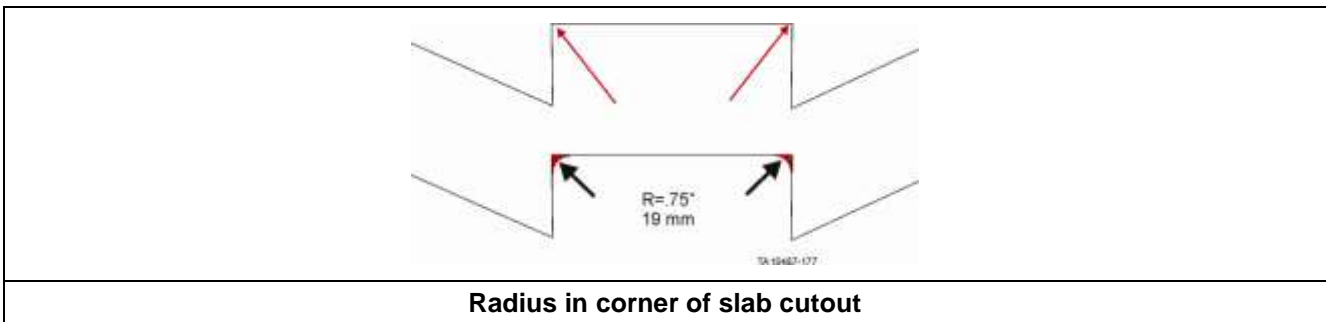
Arc air removal of weld/socket

7. Remove the socket.



8. Inspect the corner of the cutout in the slab. The corners should have a 3/4" (19 mm) radius. It is mandatory to add welds in the corner using E70XX consumables and blend grind an approximate 3/4" (19 mm) radius on the slab.

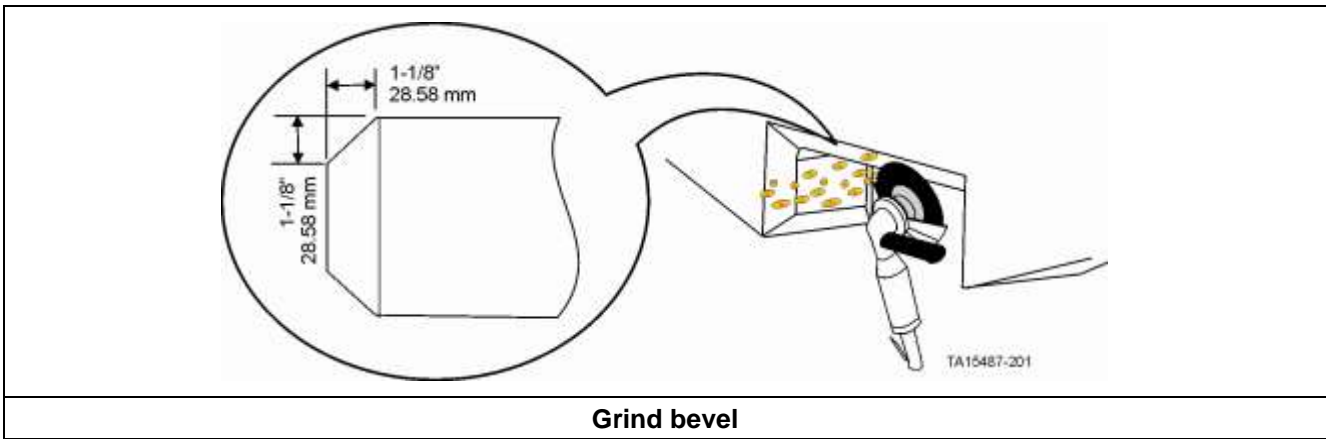
9. All repairs must be done using proper preheat.



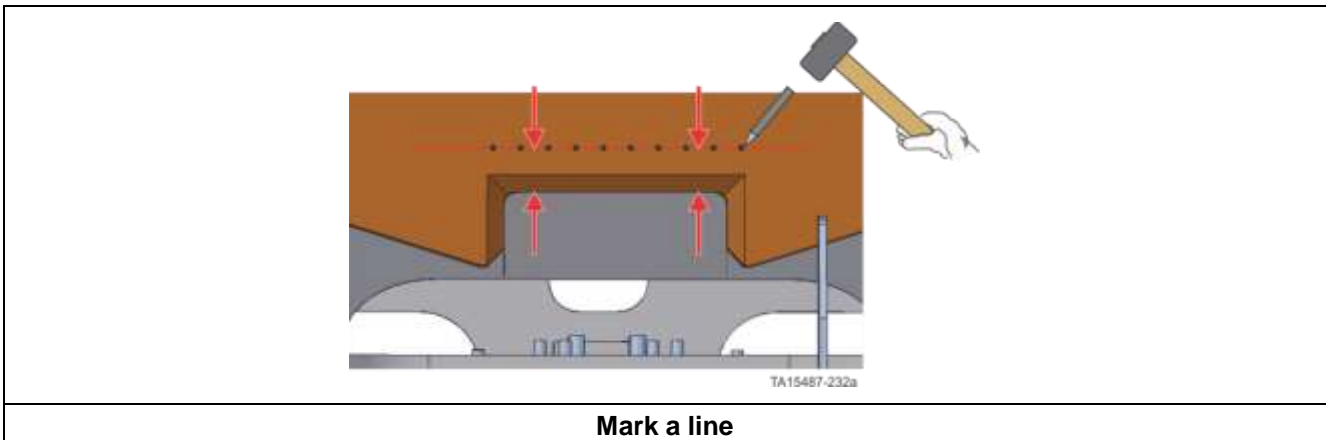
10. Mark the cross member slab with 1-1/8" (28.56 mm) bevel as shown.



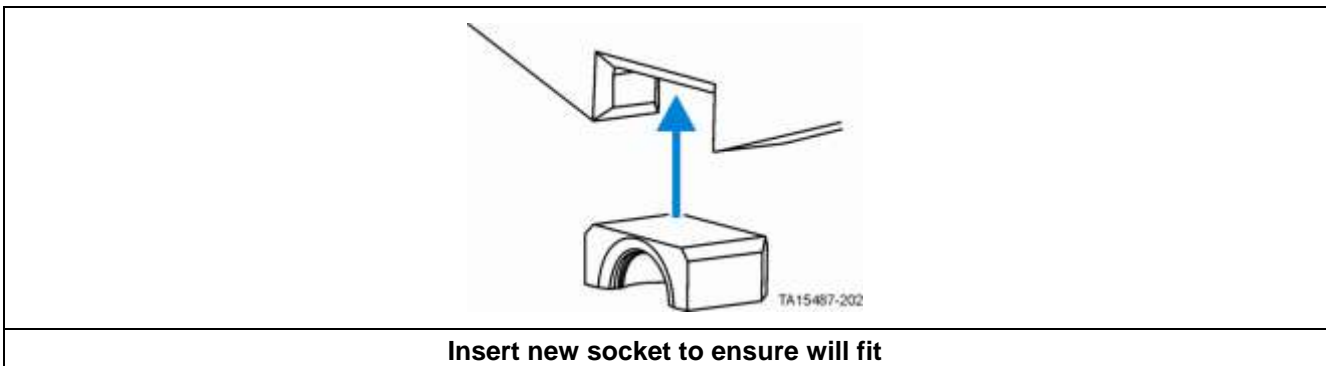
11. Grind the bevels smooth and remove all carbon marks.



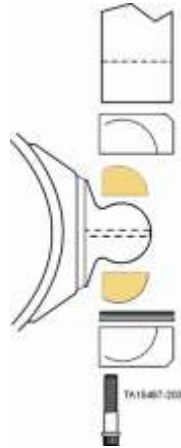
12. Inspect slab using Non Destructive Examinations (NDE) such as Magnetic Particle Inspection (MT) or Dye Penetrant Testing (PT).
13. Repair any gouges or cracks in the cross member slab plate while it is still hot, using 70XX consumables. Maintain proper preheat during the repairs.
14. Grind the repairs smooth and remove all carbon marks.
15. Mark a line parallel to the top of the cutout. This will be used to square up the socket during installation.



16. Fit the new socket to the slab to be sure that it will fit into the slot. Adjust the slab as required by grinding so that the socket will fit.

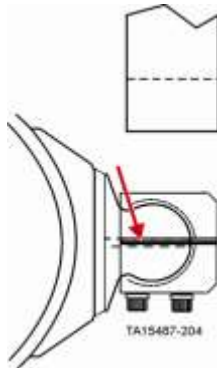


17. Hoist the ball cap, liners, spacers, shims, and socket up to the ball base.



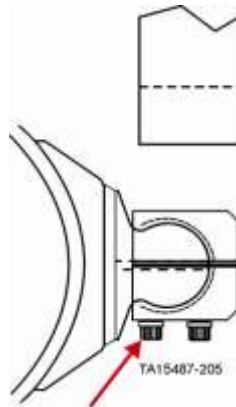
Exploded view of parts

18. Install with less spacers and shims than would normally be used.



Standard shim pack

19. Snug the capscrews. The socket and cap should be snug on the ball – but at same time they must be able to move slightly so the socket can be aligned with the cut out in the slab.



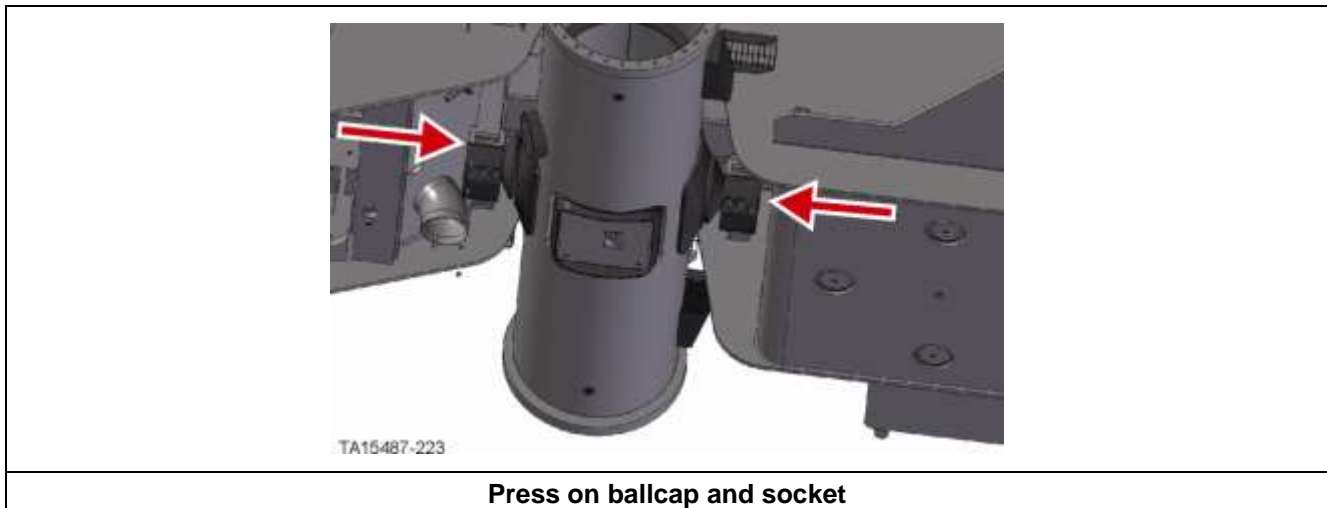
Snug capscrews

20. Install brass liner in the opposite socket.

21. Insert the axle allowing the socket to seat firmly against the rear of the notch in the cross member plate.



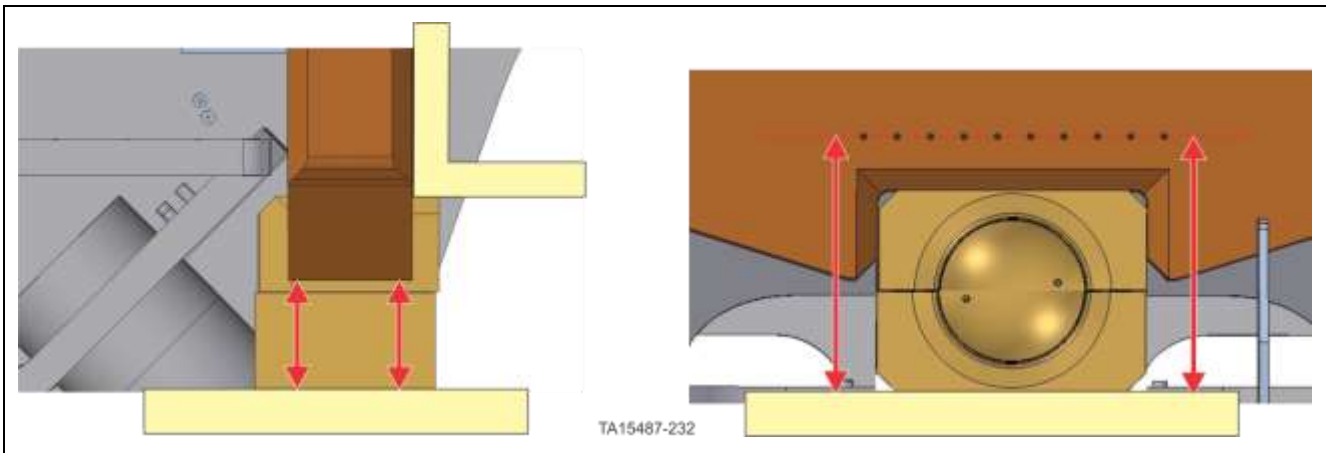
22. Install the opposite cap, spacer, shims and liner and tighten capscrews.
23. Tighten the capscrews on opposite socket to hold in position.
24. Tighten the capscrews on socket being installed to hold socket secure.
25. Use a small pancake ram and apply 3-5 tons to the socket and cap being replaced. (Deflection is not checked like the steering pivot.)



NOTICE

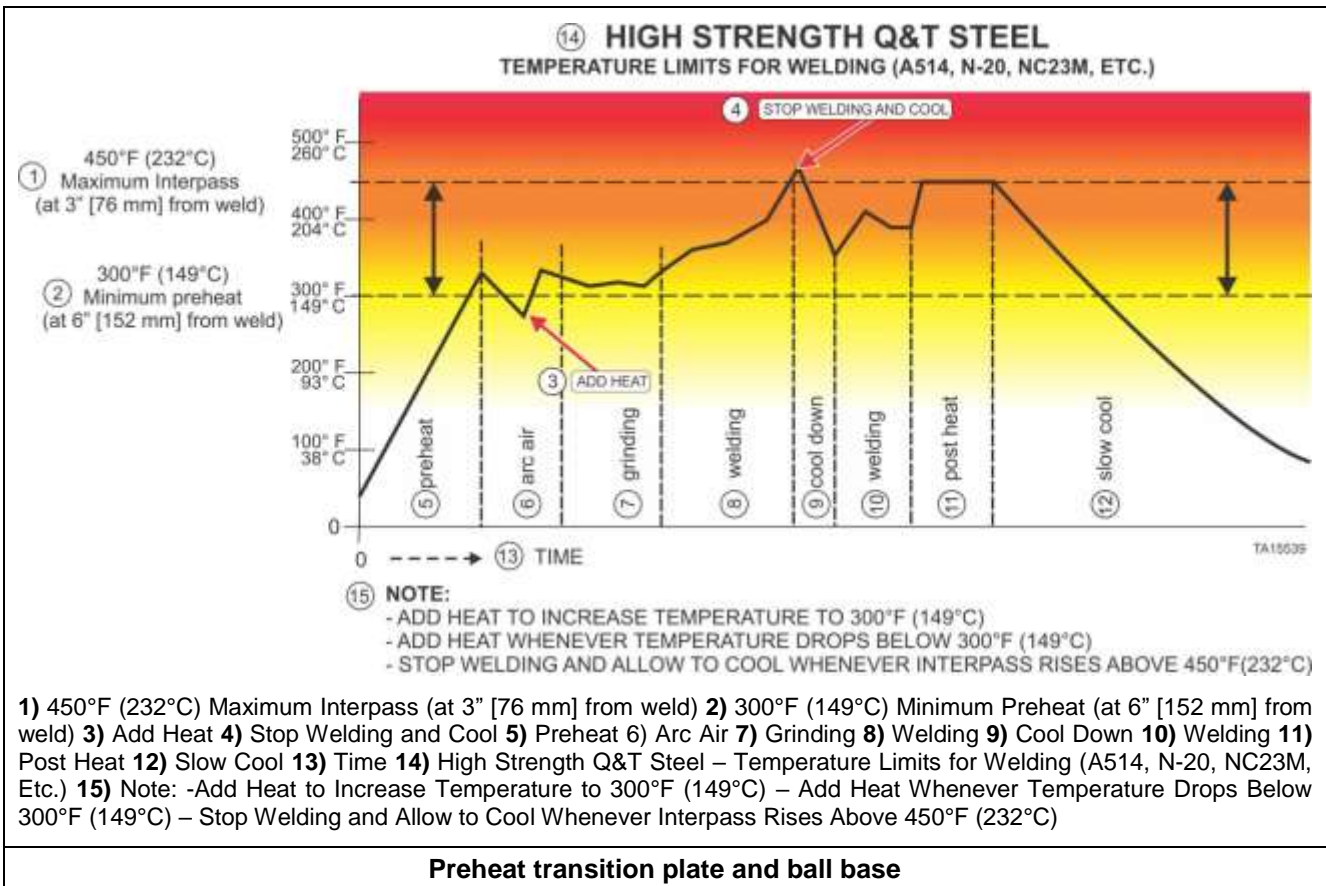
This may require addition of a temporary stop block for the pancake ram to press against.

26. Align the socket side to side and front to rear. It should be square to the slab.



Align socket

27. Heat the socket and cross member slab in an area 6" (152 mm) from the weld area on the socket to 300° F (149° C).



1) 450°F (232°C) Maximum Interpass (at 3" [76 mm] from weld) 2) 300°F (149°C) Minimum Preheat (at 6" [152 mm] from weld) 3) Add Heat 4) Stop Welding and Cool 5) Preheat 6) Arc Air 7) Grinding 8) Welding 9) Cool Down 10) Welding 11) Post Heat 12) Slow Cool 13) Time 14) High Strength Q&T Steel – Temperature Limits for Welding (A514, N-20, NC23M, Etc.) 15) Note: -Add Heat to Increase Temperature to 300°F (149°C) – Add Heat Whenever Temperature Drops Below 300°F (149°C) – Stop Welding and Allow to Cool Whenever Interpass Rises Above 450°F (232°C)

28. Tack weld the socket firmly into place using the recommended consumables listed in following paragraphs. (Preheat is required.)



Socket tack welded in place

Welding Wire

1. Typical wire sizes used for FCAW welding will be .045" (1.2 mm), .052" (1.4 mm) or 1/16" (1.6 mm) diameter. The most commonly used sizes are .052" (1.4 mm) or 1/16" (1.6 mm).
2. Wire consumable for field welding of ball installations is E8xT- xxxx series wire.

NOTICE

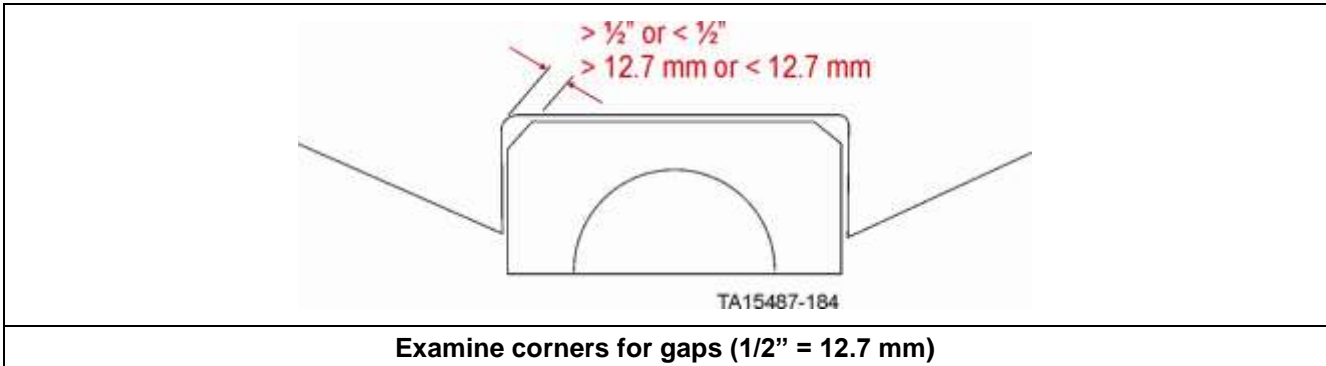
The factory will consider approving other wire types depending on the specifications of the wire. For example: Komatsu uses Lincoln Ultracore E71T-1MJ along with gas that is 75% Ar/25% CO₂ for installation of the balls. This combination of gas and wire gives a tensile strength of 83,000 psi (572 MPa) which meets the specifications for E80XX wire.

Electrodes

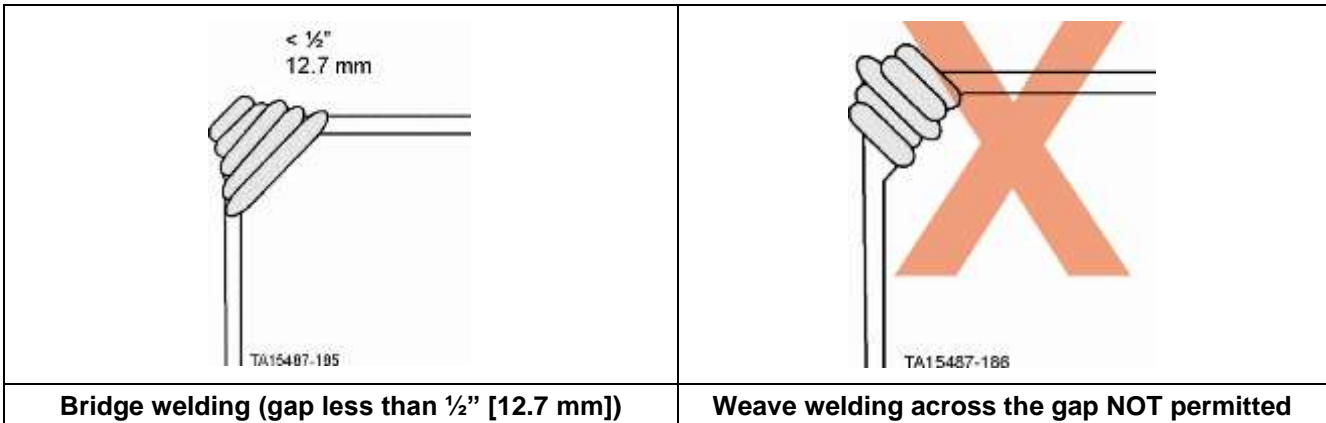
1. Electrodes for SMAW are specified to be low hydrogen E-8018C3 for ball socket installation.
2. Typical electrode sizes for SMAW will be 1/8" (3.2 mm) for root passes and 5/32" (4 mm) for the remainder.
3. Storage and handling of low hydrogen electrodes:
 - a. Use new low hydrogen electrodes that are provided in hermetically sealed packages. Do not use old electrodes for structural repairs. Old electrodes are defined as those that were removed from a sealed package more than 1 month earlier and have been kept in an oven.
 - b. Remove only one hour's supply of electrodes at a time. Keep the remainder in a ventilated holding oven at 225° F (107° C).
 - c. Bake previously opened packages of electrodes in a ventilated oven at 500° F (260° C) for two hours before using.
 - d. Electrodes taken from cardboard boxes or a non-airtight container should also be baked at 500° F (260° C) for two hours in a ventilated oven.
 - e. Then the electrodes should be placed immediately in a ventilated holding oven set at 225° F (107° C).
 - f. Any electrode exposed to the air for more than four hours should be re-baked per the instructions above.

Field Welding Procedures

4. Weld with E-8018C3 series electrodes or E8xT-xxx FCAW wire.
5. If using SMAW E-8018C3 – weld the first 3 root passes with 1/8" (3.2 mm) rod.
6. Remove the axle to complete the welds.
7. Examine the corners of the socket and the frame slab for gaps.



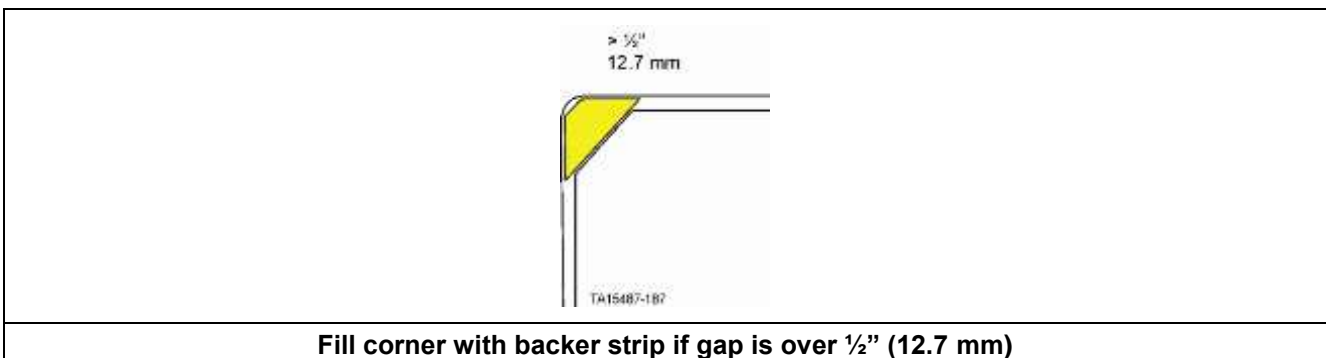
8. Gaps of less than $\frac{1}{2}"$ (12.7 mm) can be bridged with multipass stringer welds.



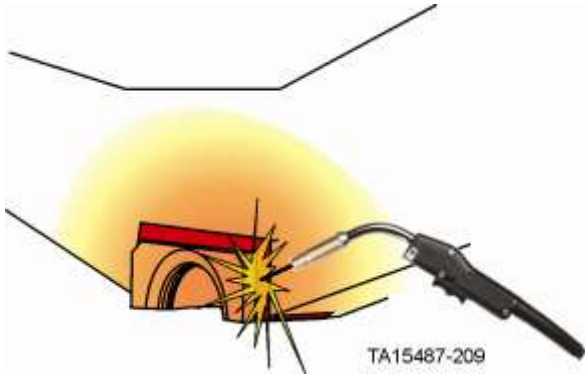
CAUTION

DO NOT use weave welding to bridge the gap. This will crack and cause further problems

9. If the gap is over $\frac{1}{2}"$ (12.7 mm) then a backer plate of approximate $\frac{1}{4}"$ (6.35 mm) thick plate should be inserted into the gap to use as a backer strip for the root pass welds.



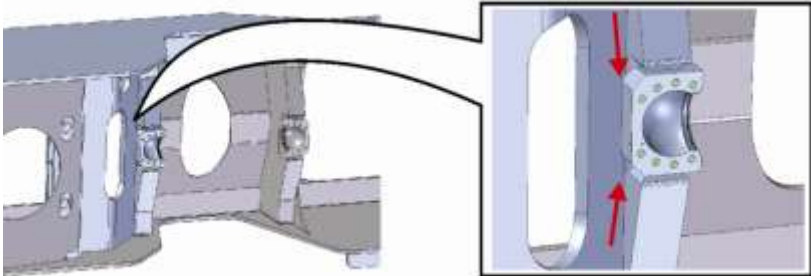
10. Finish each pass all around the diameter of the weld. DO NOT weld in sections.



Root passes – all around the socket

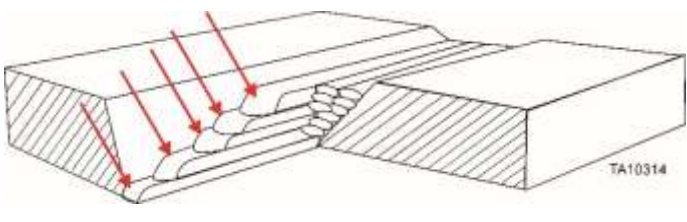
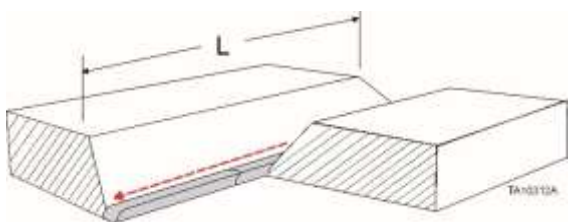
NOTICE

It is normally not possible to put a full weld around the front side of a replacement front socket due to the frame stiffener plate. (On a new frame this socket is welded to the slab – prior to installation into the frame structure.) It is acceptable to leave this area unwelded during a socket replacement. Weld the sides and as much of the front that can be reached.



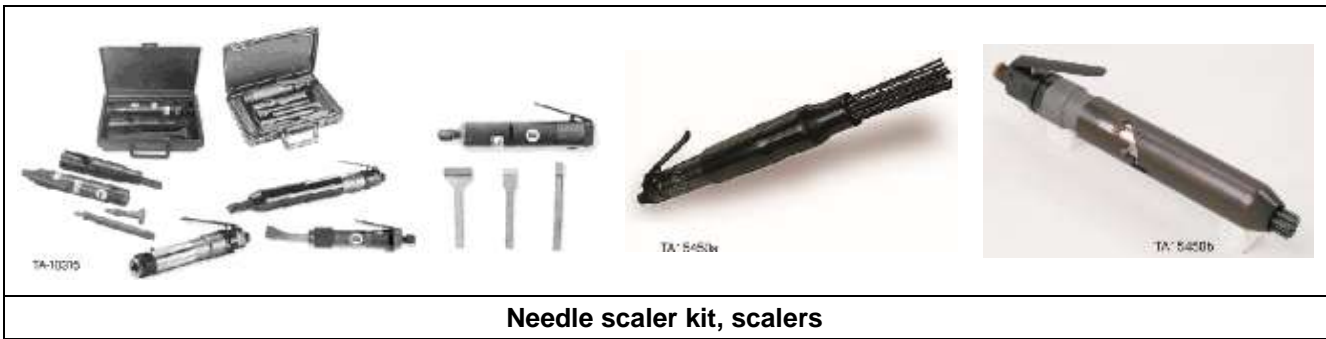
Area that typically cannot be welded on replacement socket

11. Each weld pass must start and stop in a different location from the previous pass.



Each pass is full length with start and stop in different locations

12. After welding each root pass remove the slag with a needle scaler air tool.

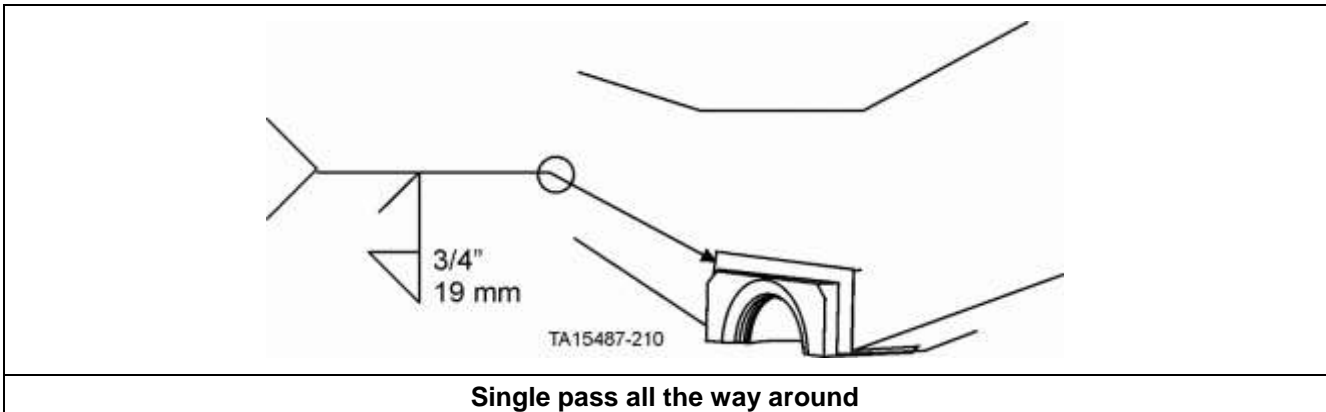


Needle scaler kit, scalars

13. Check the root pass for cracks with MT.

CAUTION

Complete passes all the way around are required. Do not weld out one side or top or bottom completely - or warpage of the socket will result.

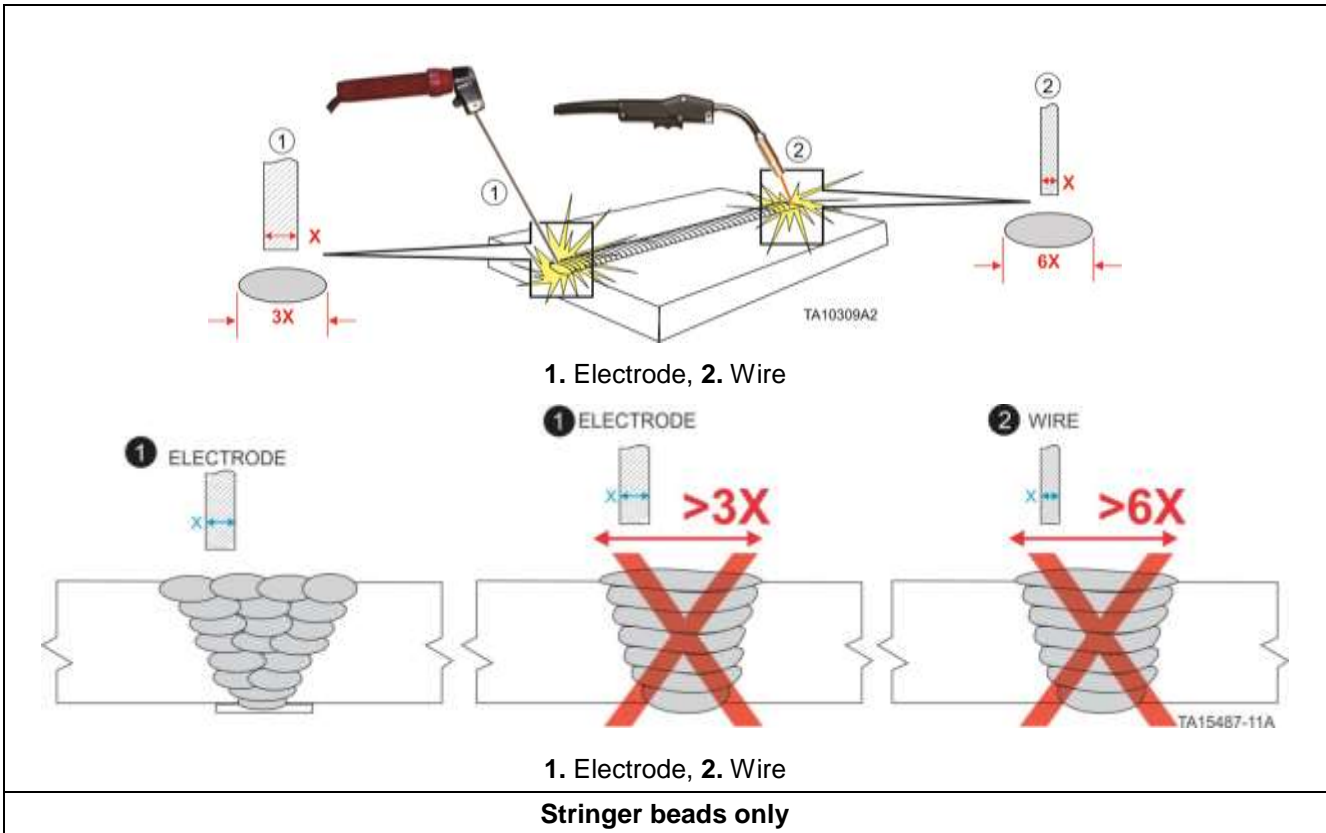


Single pass all the way around

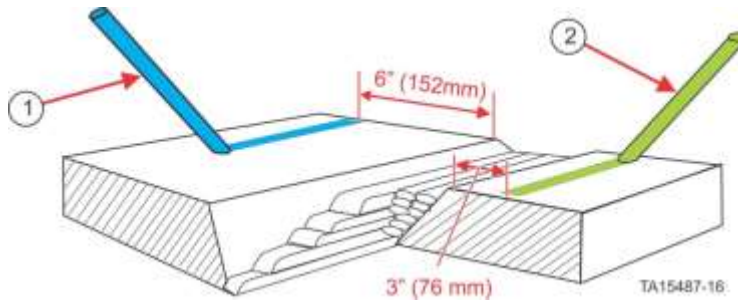
14. If using SMAW E-8018C3 – weld the rest of the passes with 5/32" (4 mm) rod.

- Use a needle scaler to remove slag after each pass.

15. Do not weave weld. Only multi pass stringer beads are allowed.



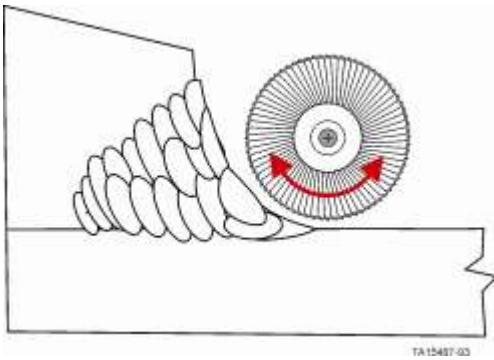
16. Continue to monitor and record temperatures after each weld pass: The welding should be stopped whenever the interpass or neck temperature become hotter than specification. DO NOT force cool by using fans or water. Heat should be added if the temperature drops below the preheat minimum.
- a. preheat temperature minimum 300° F (149° C).
 - b. interpass temperature maximum 450° F (232° C).



Monitor temperatures during welding

- 1. 300° F (149° C) temperature stick for **preheat** temperature
- 2. 450° F (232° C) temperature stick for **interpass** temperature

17. The cap weld passes must be blended smooth.
18. Blend grind the weld around the socket.
- a. The grinding direction is across the weld.
 - b. The blend should not be undercut into the base plate.



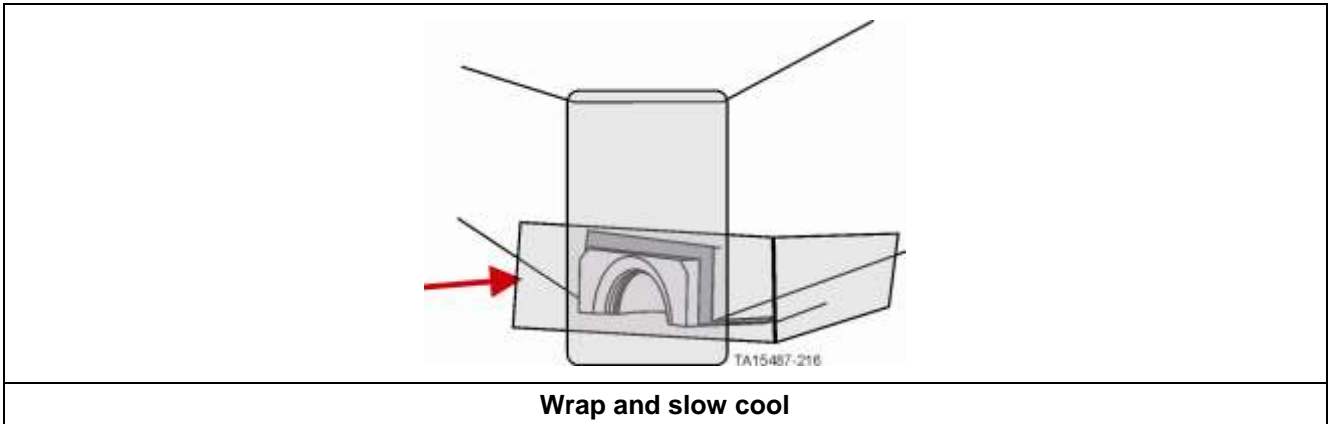
Blend grinding

19. Post heat the joint at 500°F (260° C).

The following is a sample post heat form. A full size form is provided in the appendix.

Weld Post Heat and Cool Down Log Casting Repairs <i>(Does not apply to ball installation)</i>		
Time	Target Temperature	Actual Temperature
Post heat:		
1 hour*	500° F (260° C)	
Cool Down: (minimum times listed)		
30 min	475° F (246° C)	
1 hour	450° F (232° C)	
2 hour	400° F (204° C)	
3 hour	350° F (177° C)	
4 hour	250° F (121° C)	
5 hour	150° F (66° C)	

- 20.** Wrap the socket and cross member plate to extend the cool down time. The ball socket must cool down to at least 100° F (38° C) before reassembling.



- 21.** Per AWS D1.1 the weld should be inspected at least 48 hours after completion by Magnetic Particle Inspection (MT) or Dye Penetrant Testing (PT).



Inspect weld

- 22.** Repair any defects found by following all standard repair processes including preheat.

- 23.** Paint the weld repair area.



Paint the weld repair area

- 24.** Follow the reassembly procedure outlined in the Service Manual.

- 25.** After assembly, check the axle articulation ball cap shim tolerances and adjust as required.

NOTICE

Re-Commissioning after Ball Replacement

- After each ball has been replaced or repaired and all of welding/inspection procedures have been completed- specific assembly and maintenance items outlined in the Re-Commissioning Replacement Document must be done to assure proper function of the ball joints.
- Re-Commissioning Replacement Document is at the end of this chapter and a copy is also included in the Appendix of the Field Welding Procedure document.

Re-Commissioning after - Ball Replacement



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Re-Commissioning after Ball Replacement

Before beginning the re-commissioning process, ensure the following safety preparations have been followed.

Safety Preparations

WARNING

Crush hazards exist if the machine is started or moved while work processes are being performed on the machine. Place bucket flat and level on the ground. Place frame lock in the locked position and lock out the machine's starting capability before performing any work process. Follow all applicable lockout procedures and local rules and regulations for performing work processes. ANYONE performing inspections or service procedures to the machine should be familiar with ALL instructions and procedures contained in the machine's SERVICE MANUAL. Crush hazard could occur if the machine is started or moves while any type of work process is being conducted on the machine, resulting in serious injury or death.

Machine Shutdown and Lockout

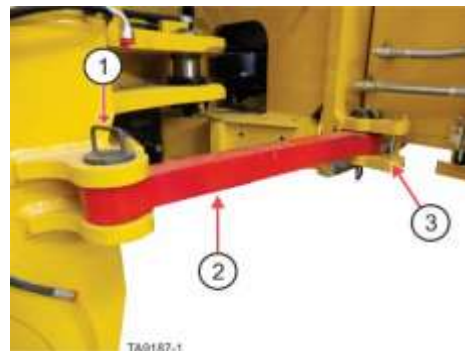
1. Stop the wheel loader on flat level ground.
2. Place bucket flat and on level ground.
3. Move the frame lock to the locked position so that the frame cannot be steered.

WARNING

Crush hazards exist in machine pivot area and area between the tires. Do not enter these areas unless it is verified that the operator has control over the steering and that personnel locking the frame lock have good communication with the operator. Entering the pivot area and area between the tires while the machine is moving or pivoting (articulating) could cause crush hazards resulting in serious injury or death.



Gen 1 Frame lock in locked position



Gen 2 Frame lock in locked position

- 1) Retaining pin for locked position, 2) Frame lock - shown in locked position
3) Retaining pin bracket for un-locked position

4. Set the parking brakes.
5. Shut off the engine.

6. Place wheel chocks in front and behind each wheel.
7. Lock out the machine's starting capability before performing any cleaning, inspections, or installation and repair procedure.

WARNING

Crush, shock, or other hazards exist if stored energy is not removed or isolated prior to working on the machine. Stored energy (hydraulic, electrical, pneumatic, mechanical, etc.) may be present if not isolated or released prior to working on the machine. Do not work on the machine without removing this stored energy (suspended loads, electrical power, air pressure, etc.). Risk of crushing, shock, or other physical injury exists if stored energy is not removed or isolated prior to working on the machine which could result in serious injury or death.

8. Turn the battery and engine isolation switches to the off position and install locks on the battery isolation switch.



GEN 2 Isolation and Control switches assembly – Battery isolation switch in OFF position with locks in place

NOTICE

The GEN 2 Isolation and Control switches assembly is shown in this document. GEN 1 machines will have a different type of switch and box. The lock out/tag out requirements are the same.

9. Release the air from the hydraulic reservoir by using the hydraulic reservoir air valve (ball valve) on top of the reservoir. The supply line from main air system will be blocked and reservoir air will vent out the hose that runs down the outside of the hydraulic reservoir.
10. Turn the handle to the up position as shown.



Hydraulic reservoir air valve handle UP

11. Release the air from the various air storage reservoirs by opening all of the air bleed valves.

Generation 1	Generation 2
Three valves on left side of rear frame under electrical cabinet	Three valves on right side of rear frame under hydraulic reservoir
One valve on left side of front frame near frame lock and hoist cylinder ball cap	One valve on right side of front frame near hoist cylinder ball cap

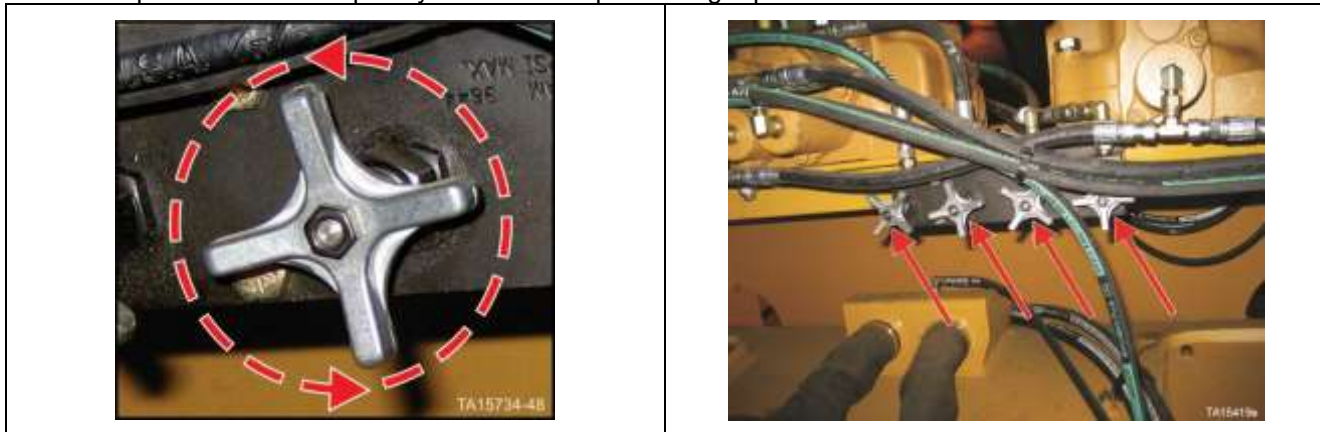


Open air reservoir bleed valves

⚠ WARNING

Crush hazards exist if all personnel are not cleared from the bucket and lift arm area before using the hydraulic hoist and bucket hydraulic pressure bleed down valves to relieve pressure from the hoist and bucket circuit. Assembly must be used only when the engine is NOT running. Before using the Manual Bleed Valve Assembly, refer to “HYDRAULIC AND GREASE SYSTEMS”, “MANUAL BLEED VALVE ASSEMBLY”, in Section 04 of the Service Manual for additional operational and safety information. Operating the manual bleed valve may cause the lift arms and bucket to descend rapidly. All personnel around the bucket and lift arms area shall be removed from the area before operating hydraulic hoist and bucket hydraulic pressure bleed down valves. Using the hydraulic bleed down valves could result in movement of the lift arms and bucket which could cause a crush hazard resulting serious injury or death.

12. Use the hydraulic pressure bleed down valves located in the front frame underneath the Husco valves to bleed any stored pressure in the hoist and bucket cylinders.
13. Turn each valve slowly counterclockwise as shown below and allow the pressure to bleed down.
14. Open the valve completely and leave it open during repairs.



CAUTION

Before performing welding operations on a machine, the fire suppression system circuit monitors panel's in-line fuse must be removed. The fuse is located in the battery box on some machines. Failure to do so may cause the system to actuate and/or damage the solid-state components of the system. Replace the in-line fuse before the machine has been started or after all welding operations have been completed.



Fire suppression in-line fuse located in loader battery box on some machines

WARNING

Fall hazard exists when working at heights. Be sure to take appropriate safety precautions when working at heights on the rear and front frames or the lift arms balls. Follow all required statutory regulations for working at height. Wear fall restraint when necessary to prevent falls. Failure to take appropriate safety precautions, including wearing fall restraint when necessary can cause fall hazards resulting in serious injury or death.

WARNING

Crush hazards exist if standing under, working, or placing any body part under hoisted/suspended components. Never stand under hoisted/suspended components. Ensure appropriate lifting devices are used, and blocking is adequate to prevent the component from unexpectedly moving during transportation. Refer to **SAFETY, WARNINGS, AND CAUTIONS** before attempting to remove the operator's cab. Failure to stay out from under hoisted/suspended components can cause crush hazard resulting in serious injury or death.

Assembly and Maintenance Items

After each ball has been replaced and all of the welding/inspection procedures completed – the following assembly and maintenance items must be done to assure proper function of the ball joint:

- 1) Obtain a machine download and analyze the data.
 - a. Any grease system alarms or warnings?
- 2) Assure that the grease plug is installed (hoist cylinder and lift arm balls).
 - a. Use new O-ring on the plug.
- 3) Install grease extension tube (frame articulation balls).
 - a. Use thread sealant on threads.
- 4) Grease hose and fitting is properly attached for each ball type.
 - a. The hose should be replaced to ensure reliability.
 - b. Pre-purge all grease lines with auto lube system grease, before installation.

CAUTION

Do not use standard EP grease to coat the ball, coat the liner, fill the ball or purge the grease system. Use only the specified auto lube system grease containing 3-5% moly, specified for the machine's operating conditions.

- 5) Install new brass liners in socket and cap.
- 6) Chase the threads in each of the tapped holes in the socket.
 - a. This must be done by hand – **DO NOT** use any form of power tool.
 - i. Use of a power tool can cause damage to the threads.

CAUTION

Never use any form of power tool to chase threads with a tap! Always turn the tap by hand! Power tools can remove the 'feel' of the tap 'cutting' material from the hole and this 'cutting' is not desirable. Never drive a tap with a rattle gun as it can cause the tap to chip fragments of the tap off and they become embedded in the base material, causing further damage to the capscrew at the time of installation.

- b. Use a slightly dull tap to minimize thread damage.

NOTICE

The threads in each hole have typically been slightly distorted by the tensioning of the capscrews. The cutting edge of a new tap should be slightly 'dulled' by buffing the cutting edge of the tap on a wire wheel. This will minimize thread cutting which can reduce thread strength and leave small fragments of steel shavings in the root of the thread.

- c. Use ONLY a bottoming type of tap. Taper and intermediate configuration taps must not be used.
- 7) Clean all of the tapped hole threads in the socket. Remove all contaminants and previous lubricants from each hole.
- 8) Install new capscrews.
 - a. If there is any doubt as to their history or condition – replace the capscrews.
 - b. New capscrews should be installed if the ball was broken.
 - i. If one lift arm ball was broken - replace the capscrews on both sides of lift arm.
 - c. Capscrews can be reused if:
 - i. They were properly torqued when originally installed.
 - ii. No sign of thread damage from installation or dropping on steel or ground.
 - iii. No signs of stretching.
 - iv. Threads are fully cleaned.
 - v. No signs of cracking near the clamp face of the capscrew.
 - vi. The clamp face is not galled.
 - vii. The 12-point head is not damaged.
- 9) Assembly lubrication.
 - a. Coat the OD of the ball with auto lube system grease.
 - b. Fill the hole in the ball with auto lube system grease.
 - c. Coat the socket and cap with a thin coat of auto lube system grease.
 - d. Coat the brass liners with auto lube system grease to fill the grooves in the liners.

CAUTION

Do not use standard EP grease to coat the ball, coat the liner, fill the ball or purge the grease system. Use only the specified auto lube system grease containing 3-5% moly, specified for the machine's operating conditions.

- 10) Verify that the lift arms fit on the balls without spreading or pulling together.
 - a. Verify that the lifting method is not pulling the arms together.
 - b. The arm width can be adjusted by heat striping if required.
 - c. Contact Komatsu Call Center for assistance (support@joyglobal.com).
- 11) Align the ball caps on the lift arm sockets.
 - a. Install the ball cap loosely and align the match marks.
 - i. The caps are interchangeable left to right – but once they have been aligned and match marked – they should be always used in the specified location.
 - b. If they are not factory match marked – find the center and match mark.
 - c. Mark each one for Left (LH) or Right (RH).

NOTICE

The socket and cap are aligned and marked when the arms are NOT mounted on the machine.

- 12) Torque the cap screws for the ball caps.
 - a. Verify that the socket threaded holes and all capscrews are not contaminated with grease, anti-seize, etc.
 - b. 30W or engine oil for thread and shoulder lubrication.
 - c. Hand start ALL cap screws in the cap prior to tightening with air gun or torque wrench.
 - d. Use a small air wrench (1/2" drive max) to run the bolts fully home.

CAUTION

If any capscrew binds while running in by hand or with a small air impact wrench, DO NOT attempt to drive the capscrew deeper. Use a hand wrench and remove the capscrew. DO NOT use an air impact wrench to remove the capscrew.

- e. Follow the torque pattern.
- f. Torque to the correct value.
- 13) Check the "snap" clearance on the ball.
 - a. Adjust the snap clearance to specification by adding or removing shims.
- 14) Purge the grease line to the ball joint.
 - a. DO NOT purge by cycling the grease system.
 - i. The injector only puts out a maximum of 1.3cc each time the grease system cycles. It is very difficult to fill the joint with grease at this rate – and wastes grease from excessive grease at all the other locations on the machine.
 - b. Remove the purge cap from the grease injector and fill the joint with grease using a grease gun.
 - c. Purge a minimum of 0.5 kilogram (1 pound) of grease through the joint BEFORE operation of the machine.

CAUTION

Do not use standard EP grease to purge the ball joint grease system. Use only the specified auto lube grease containing 3-5% moly , specified for the machine's operating conditions.

- 15) Replace the in-line fuse on the fire suppression system if it was disengaged due to welding on the machine, this must be done before the machine has been started or after all welding operations have been completed.

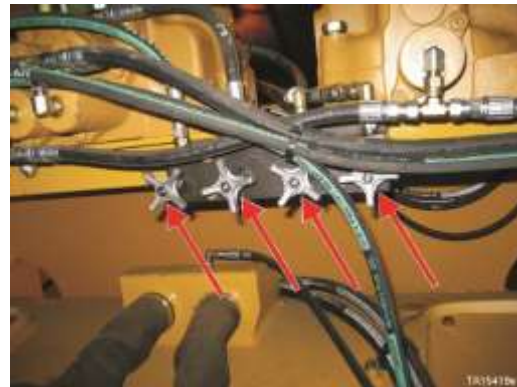
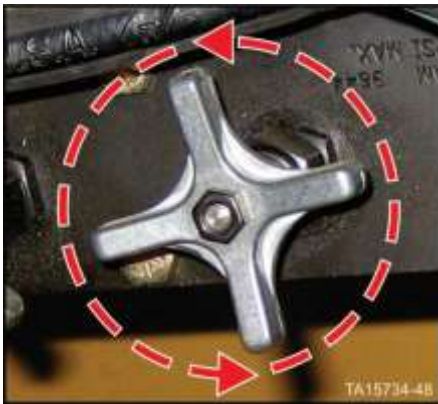
CAUTION

Failure to replace the fuse before operating the machine could result in a serious fire. Never run the machine unless the fuse has been replaced.



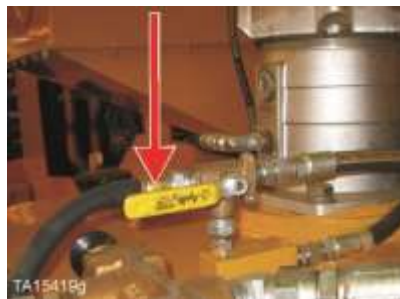
Fire suppression in-line fuse located in loader battery box on some machines

16) Close (turn clockwise) the hydraulic bleed valves in the front frame.



Close hydraulic bleed valves in front frame

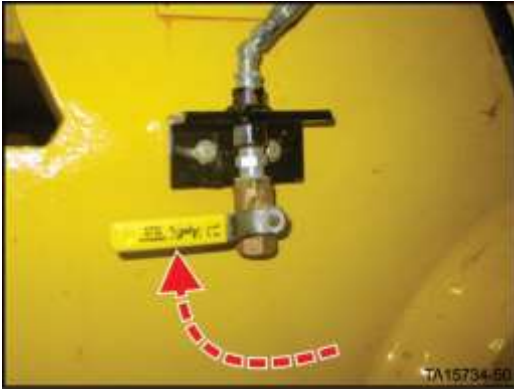
17) Close the hydraulic reservoir air valve on top of the hydraulic reservoir.



Close the hydraulic reservoir air valve

18) Close the air bleed valves.

Generation 1	Generation 2
Three valves on left side of rear frame under electrical cabinet	Three valves on right side of rear frame under hydraulic reservoir
One valve on left side of front frame near frame lock and hoist cylinder ball cap	One valve on right side of front frame near hoist cylinder ball cap



Close the valve under the hydraulic reservoir

- 19) Remove wheel chocks.
- 20) Remove any locks or tags from isolation box following all local regulations and turn both isolation switches to the on position.



GEN 2 Battery Isolation Box – locks removed – and switches moved to on position

- 21) Start machine and verify that grease injectors are functioning (Ref SIL-397.01).
 - a. System timer functioning – what is the setting?
 - b. Grease leaks?
 - c. System building pressure?
 - d. Grease Pressure?
 - e. Oil Supply Pressure?
 - f. Injectors functioning?
 - g. Grease Pressure at stall?
 - h. Injector for ball joint functioning?

Most of the items in the previous list are steps that are part of the standard assembly and commissioning of a new loader or a part of the normal maintenance items related to balls. Contact the Komatsu Call Center (support@joyglobal.com) if you are unable to locate the information or have questions pertaining to these assembly and maintenance practices. Most of these are covered in one or more of the following documents:

- Assembly Manual
- GEN 2 Service Manual
- SIL 439.01 Spherical Ball Bearing Joints
- SIL 413.00 Hoist Cylinder Spherical Ball Lubrication
- SIL-397.01 Auto Lube System Operation

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RE-Commissioning Worksheet

Machine:	Ball location changed:	Date:
S/N:	Replacement Ball S/N	Customer:

Item	Result	Comments	Date	Signature
Machine download	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Attach to the Sales Force Case related to this machine	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Analyze data for indications of grease system failures	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Grease Plug installed in hoist or lift arm ball	YES <input type="checkbox"/> NO <input type="checkbox"/>	Not applicable for Frame Articulation Ball Field Replacement		
New O-ring	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Grease extension tube installed into articulation ball base	YES <input type="checkbox"/> NO <input type="checkbox"/>	Not applicable for Frame Articulation Ball Field Replacement		
Thread sealant used?	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Connect the grease hose	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Tighten hose and fitting	YES <input type="checkbox"/> NO <input type="checkbox"/>			
New Grease hose used?	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Install new brass liners in socket and cap	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Chase hole threads in socket by hand	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Clean hole threads in socket to remove all contaminants	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Install new capscrews	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Coat the OD of the ball with auto lube system grease	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Fill the hole in the ball with auto lube system grease	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Coat the ID of the socket and cap with a thin coat of auto lube system grease	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Coat the ID of the brass liner auto lube system grease	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Verify that the arms fit without spreading or pulling together	YES <input type="checkbox"/> NO <input type="checkbox"/>	Not applicable for Frame Articulation Ball Field Replacement		
Heat striping required?	YES <input type="checkbox"/> NO <input type="checkbox"/>			
<i>This section applies to Lift arm balls ONLY</i>				

Field Welding Procedures

Item	Result	Comments	Date	Signature
Align the ball caps on the lift arm sockets Match marks <i>This section applies to Lift arm balls ONLY</i>	YES <input type="checkbox"/> NO <input type="checkbox"/> YES <input type="checkbox"/> NO <input type="checkbox"/>	Not applicable for Frame Articulation Ball Field Replacement		
Capscrew lubricant – 30W oil	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Hand start all capscrews	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Follow specified torque pattern	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Torque value	_____ ft-lb			
Purge the grease system to all balls that were replaced? Use external grease pump?	YES <input type="checkbox"/> NO <input type="checkbox"/> YES <input type="checkbox"/> NO <input type="checkbox"/>			
Check the snap clearance In or out of specification? Adjusted? Final value?	YES <input type="checkbox"/> NO <input type="checkbox"/> _____/mm YES <input type="checkbox"/> NO <input type="checkbox"/> YES <input type="checkbox"/> NO <input type="checkbox"/> _____/mm			
Verify grease system functioning: System timing Leaks? System building pressure? Oil supply pressure? Grease pressure at stall? Ball injector functioning? Injectors functioning?	_____ min/cycle YES <input type="checkbox"/> NO <input type="checkbox"/> YES <input type="checkbox"/> NO <input type="checkbox"/> _____ psi _____ psi YES <input type="checkbox"/> NO <input type="checkbox"/> YES <input type="checkbox"/> NO <input type="checkbox"/>			

Appendix

1. Preheat temperature log sheet.
2. Interpass temperature log sheet.
3. Weld post heat and cool down log (Q&T steel plate).
4. Weld post heat and cool down log (Castings).
5. Weld post heat and cool down log sheet (for ball installation).
6. Tube ID measurement worksheet.
7. Re-Commissioning after Ball Replacement.

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Preheat Log Sheet

Job Description		Date	
Welder	Time	Temperature	Initial
	0		
	1 hour		
	2 hour		
	3 hour		
	4 hour		
	5 hour		
	6 hour		
	7 hour		
	8 hour		
	9 hour		
	10 hour		
	11 hour		
	12 hour		
	13 hour		
	14 hour		
	15 hour		

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Interpass Log Sheet

Job Description		Date	
Welder	Time	Temperature	Initial
	0		
	1 hour		
	2 hour		
	3 hour		
	4 hour		
	5 hour		
	6 hour		
	7 hour		
	8 hour		
	9 hour		
	10 hour		
	11 hour		
	12 hour		
	13 hour		
	14 hour		
	15 hour		

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Weld Post Heat and Cool Down Log Q&T Steel Plate

(Does not apply to ball installation)

Time	Target Temperature	Actual Temperature
Post heat:		
1 hour*	450° F (232° C)	
Cool Down: (minimum times listed)		
30 min	425° F (218° C)	
1 hour	400° F (204° C)	
2 hour	350° F (177° C)	
3 hour	250° F (121° C)	
4 hour	150° F (66° C)	

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Weld Post Heat and Cool Down Log Casting Repairs

(Does not apply to ball installation)

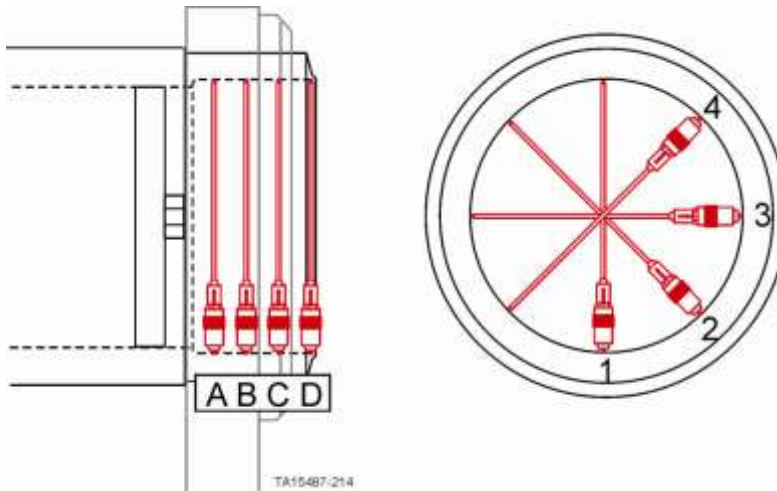
Time	Target Temperature	Actual Temperature
Post heat:		
1 hour*	500° F (260° C)	
Cool Down: (minimum times listed)		
30 min	475° F (246° C)	
1 hour	450° F (232° C)	
2 hour	400° F (204° C)	
3 hour	350° F (177° C)	
4 hour	250° F (121° C)	
5 hour	150° F (66° C)	

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Weld Post Heat and Cool Down Log – (Ball Installation)		
Time	Target Temperature	Actual Temperature
Post heat:		
1 hour*	400° F (204° C)	
Cool Down: (minimum times listed)		
30 min	375° F (191° C)	
1 hour	350° F (177° C)	
2 hour	300° F (149° C)	
3 hour	250° F (121° C)	
4 hour	150° F (66° C)	

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Tube ID Measurement Worksheet	
A1	
A2	
A3	
A4	
B1	
B2	
B3	
B4	
C1	
C2	
C3	
C4	
D1	
D2	
D3	
D4	
Total	
Average = Total/ qty measurements	



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Re-Commissioning after - Ball Replacement



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Re-Commissioning after Ball Replacement

Before beginning the re-commissioning process, ensure the following safety preparations have been followed.

Safety Preparations

WARNING

Crush hazards exist if the machine is started or moved while work processes are being performed on the machine. Place bucket flat and level on the ground. Place frame lock in the locked position and lock out the machine's starting capability before performing any work process. Follow all applicable lockout procedures and local rules and regulations for performing work processes. ANYONE performing inspections or service procedures to the machine should be familiar with ALL instructions and procedures contained in the machine's SERVICE MANUAL. Crush hazard could occur if the machine is started or moves while any type of work process is being conducted on the machine, resulting in serious injury or death.

Machine Shutdown and Lockout

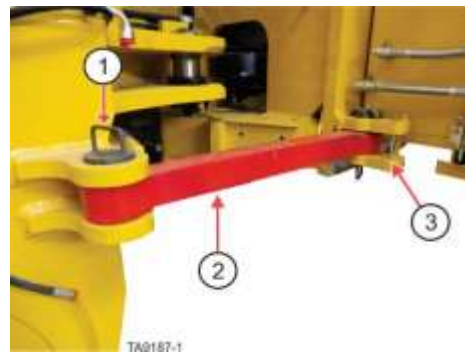
1. Stop the wheel loader on flat level ground.
2. Place bucket flat and on level ground.
3. Move the frame lock to the locked position so that the frame cannot be steered.

WARNING

Crush hazards exist in machine pivot area and area between the tires. Do not enter these areas unless it is verified that the operator has control over the steering and that personnel locking the frame lock have good communication with the operator. Entering the pivot area and area between the tires while the machine is moving or pivoting (articulating) could cause crush hazards resulting in serious injury or death.



Gen 1 Frame lock in locked position



Gen 2 Frame lock in locked position

- 1) Retaining pin for locked position, 2) Frame lock - shown in locked position
3) Retaining pin bracket for un-locked position

4. Set the parking brakes.

5. Shut off the engine.
6. Place wheel chocks in front and behind each wheel.
7. Lock out the machine's starting capability before performing any cleaning, inspections, or installation and repair procedure.

WARNING

Crush, shock, or other hazards exist if stored energy is not removed or isolated prior to working on the machine. Stored energy (hydraulic, electrical, pneumatic, mechanical, etc.) may be present if not isolated or released prior to working on the machine. Do not work on the machine without removing this stored energy (suspended loads, electrical power, air pressure, etc.). Risk of crushing, shock, or other physical injury exists if stored energy is not removed or isolated prior to working on the machine which could result in serious injury or death.

8. Turn the battery and engine isolation switches to the off position and install locks on the battery isolation switch.



GEN 2 Isolation and Control switches assembly – Battery isolation switch in OFF position with locks in place

NOTICE

The GEN 2 Isolation and Control switches assembly is shown in this document. GEN 1 machines will have a different type of switch and box. The lock out/tag out requirements are the same.

9. Release the air from the hydraulic reservoir by using the hydraulic reservoir air valve (ball valve) on top of the reservoir. The supply line from main air system will be blocked and reservoir air will vent out the hose that runs down the outside of the hydraulic reservoir.

10. Turn the handle to the up position as shown.



Hydraulic reservoir air valve handle UP

11. Release the air from the various air storage reservoirs by opening all of the air bleed valves.

Generation 1	Generation 2
Three valves on left side of rear frame under electrical cabinet	Three valves on right side of rear frame under hydraulic reservoir
One valve on left side of front frame near frame lock and hoist cylinder ball cap	One valve on right side of front frame near hoist cylinder ball cap



Open air reservoir bleed valves

⚠ WARNING

Crush hazards exist if all personnel are not cleared from the bucket and lift arm area before using the hydraulic hoist and bucket hydraulic pressure bleed down valves to relieve pressure from the hoist and bucket circuit. Assembly must be used only when the engine is NOT running. Before using the Manual Bleed Valve Assembly, refer to “HYDRAULIC AND GREASE SYSTEMS”, “MANUAL BLEED VALVE ASSEMBLY”, in Section 04 of the Service Manual for additional operational and safety information. Operating the manual bleed valve may cause the lift arms and bucket to descend rapidly. All personnel around the bucket and lift arms area shall be removed from the area before operating hydraulic hoist and bucket hydraulic pressure bleed down valves. Using the hydraulic bleed down valves could result in movement of the lift arms and bucket which could cause a crush hazard resulting serious injury or death.

12. Use the hydraulic pressure bleed down valves located in the front frame underneath the Husco valves to bleed any stored pressure in the hoist and bucket cylinders.
13. Turn each valve slowly counterclockwise as shown below and allow the pressure to bleed down.
14. Open the valve completely and leave it open during repairs.



CAUTION

Before performing welding operations on a machine, the fire suppression system circuit monitors panel's in-line fuse must be removed. The fuse is located in the battery box on some machines. Failure to do so may cause the system to actuate and/or damage the solid-state components of the system. Replace the in-line fuse before the machine has been started or after all welding operations have been completed.



⚠ WARNING

Fall hazard exists when working at heights. Be sure to take appropriate safety precautions when working at heights on the rear and front frames or the lift arms balls. Follow all required statutory regulations for working at height. Wear fall restraint when necessary to prevent falls. Failure to take appropriate safety precautions, including wearing fall restraint when necessary can cause fall hazards resulting in serious injury or death.

⚠ WARNING

Crush hazards exist if standing under, working, or placing any body part under hoisted/suspended components. Never stand under hoisted/suspended components. Ensure appropriate lifting devices

are used, and blocking is adequate to prevent the component from unexpectedly moving during transportation. Refer to **SAFETY, WARNINGS, AND CAUTIONS** before attempting to remove the operator's cab. Failure to stay out from under hoisted/suspended components can cause crush hazard resulting in serious injury or death.

Assembly and Maintenance Items

After each ball has been replaced and all of the welding/inspection procedures completed – the following assembly and maintenance items must be done to assure proper function of the ball joint:

- 1) Obtain a machine download and analyze the data.
 - a. Any grease system alarms or warnings?
- 2) Assure that the grease plug is installed (hoist cylinder and lift arm balls).
 - a. Use new O-ring on the plug.
- 3) Install grease extension tube (frame articulation balls).
 - a. Use thread sealant on threads.
- 4) Grease hose and fitting is properly attached for each ball type.
 - a. The hose should be replaced to ensure reliability.
 - b. Pre-purge all grease lines with auto lube system grease, before installation.

CAUTION

Do not use standard EP grease to coat the ball, coat the liner, fill the ball or purge the grease system. Use only the specified auto lube system grease containing 3-5% moly, specified for the machine's operating conditions.

- 5) Install new brass liners in socket and cap.
- 6) Chase the threads in each of the tapped holes in the socket.
 - a. This must be done by hand – **DO NOT** use any form of power tool.
 - i. Use of a power tool can cause damage to the threads.

CAUTION

Never use any form of power tool to chase threads with a tap! Always turn the tap by hand! Power tools can remove the 'feel' of the tap 'cutting' material from the hole and this 'cutting' is not desirable. Never drive a tap with a rattle gun as it can cause the tap to chip fragments of the tap off and they become embedded in the base material, causing further damage to the capscrew at the time of installation.

- b. Use a slightly dull tap to minimize thread damage.

NOTICE

The threads in each hole have typically been slightly distorted by the tensioning of the capscrews. The cutting edge of a new tap should be slightly 'dulled' by buffing the cutting edge of the tap on a wire wheel. This will minimize thread cutting which can reduce thread strength and leave small fragments of steel shavings in the root of the thread.

- c. Use ONLY a bottoming type of tap. Taper and intermediate configuration taps must not be used.
- 7) Clean all of the tapped hole threads in the socket. Remove all contaminants and previous lubricants from each hole.
- 8) Install new capscrews.
 - a. If there is any doubt as to their history or condition – replace the capscrews.
 - b. New capscrews should be installed if the ball was broken.
 - i. If one lift arm ball was broken - replace the capscrews on both sides of lift arm.
 - c. Capscrews can be reused if:
 - i. They were properly torqued when originally installed.
 - ii. No sign of thread damage from installation or dropping on steel or ground.
 - iii. No signs of stretching.
 - iv. Threads are fully cleaned.
 - v. No signs of cracking near the clamp face of the capscrew.
 - vi. The clamp face is not galled.
 - vii. The 12-point head is not damaged.
- 9) Assembly lubrication.
 - a. Coat the OD of the ball with auto lube system grease.
 - b. Fill the hole in the ball with auto lube system grease.
 - c. Coat the socket and cap with a thin coat of auto lube system grease.
 - d. Coat the brass liners with auto lube system grease to fill the grooves in the liners.

CAUTION

Do not use standard EP grease to coat the ball, coat the liner, fill the ball or purge the grease system. Use only the specified auto lube system grease containing 3-5% moly, specified for the machine's operating conditions.

- 10) Verify that the lift arms fit on the balls without spreading or pulling together.
 - a. Verify that the lifting method is not pulling the arms together.
 - b. The arm width can be adjusted by heat striping if required.
 - c. Contact Komatsu Call Center for assistance (support@joyglobal.com).
- 11) Align the ball caps on the lift arm sockets.
 - a. Install the ball cap loosely and align the match marks.
 - i. The caps are interchangeable left to right – but once they have been aligned and match marked – they should be always used in the specified location.
 - b. If they are not factory match marked – find the center and match mark.
 - c. Mark each one for Left (LH) or Right (RH).

NOTICE

The socket and cap are aligned and marked when the arms are NOT mounted on the machine.

- 12) Torque the cap screws for the ball caps
 - a. Verify that the socket threaded holes and all capscrews are not contaminated with grease, anti-seize, etc.
 - b. 30W or engine oil for thread and shoulder lubrication.
 - c. Hand start ALL cap screws in the cap prior to tightening with air gun or torque wrench.
 - d. Use a small air wrench (1/2" drive max) to run the bolts fully home.

CAUTION

If any capscrew binds while running in by hand or with a small air impact wrench, **DO NOT** attempt to drive the capscrew deeper. Use a hand wrench and remove the capscrew. **DO NOT** use an air impact wrench to remove the capscrew.

- e. Follow the torque pattern.
 - f. Torque to the correct value.
- 13) Check the “snap” clearance on the ball.
- a. Adjust the snap clearance to specification by adding or removing shims.
- 14) Purge the grease line to the ball joint.
- a. **DO NOT** purge by cycling the grease system.
 - i. The injector only puts out a maximum of 1.3cc each time the grease system cycles. It is very difficult to fill the joint with grease at this rate – and wastes grease from excessive grease at all the other locations on the machine.
 - b. Remove the purge cap from the grease injector and fill the joint with grease using a grease gun.
 - c. Purge a minimum of 0.5 kilogram (1 pound) of grease through the joint **BEFORE** operation of the machine.

CAUTION

Do not use standard EP grease to purge the ball joint grease system. Use only the specified auto lube grease containing 3-5% moly , specified for the machine’s operating conditions.

- 15) Replace the in-line fuse on the fire suppression system if it was disengaged due to welding on the machine, this must be done before the machine has been started or after all welding operations have been completed.

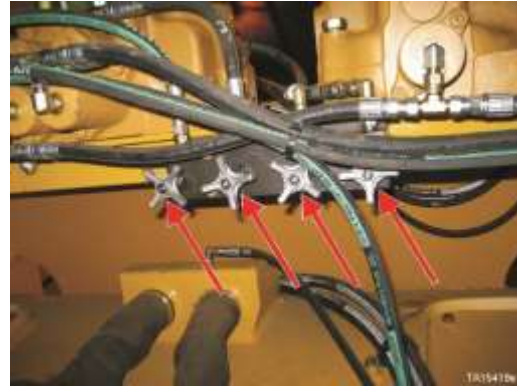
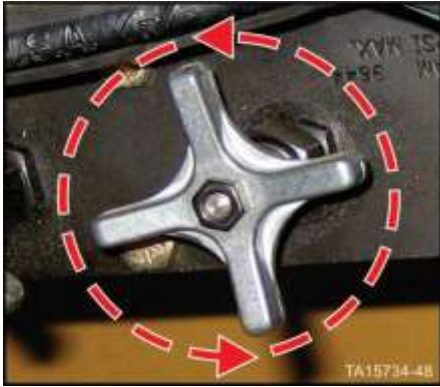
CAUTION

Failure to replace the fuse before operating the machine could result in a serious fire. Never run the machine unless the fuse has been replaced.



Fire suppression in-line fuse located in loader battery box on some machines

16) Close (turn clockwise) the hydraulic bleed valves in the front frame.





Close hydraulic bleed valves in front frame

17) Close the hydraulic reservoir air valve on top of the hydraulic reservoir.



Close the hydraulic reservoir air valve

18) Close the air bleed valves.

Generation 1	Generation 2
Three valves on left side of rear frame under electrical cabinet	Three valves on right side of rear frame under hydraulic reservoir
One valve on left side of front frame near frame lock and hoist cylinder ball cap	One valve on right side of front frame near hoist cylinder ball cap
	
<p>Close the valve under the hydraulic reservoir</p>	

- 19) Remove wheel chocks.
- 20) Remove any locks or tags from isolation box following all local regulations and turn both isolation switches to the on position.



GEN 2 Battery Isolation Box – locks removed – and switches moved to on position

- 21) Start machine and verify that grease injectors are functioning (Ref SIL-397.01).
 - i. System timer functioning – what is the setting?
 - j. Grease leaks?
 - k. System building pressure?
 - l. Grease Pressure?
 - m. Oil Supply Pressure?
 - n. Injectors functioning?
 - o. Grease Pressure at stall?
 - p. Injector for ball joint functioning?

Most of the items in the previous list are steps that are part of the standard assembly and commissioning of a new loader or a part of the normal maintenance items related to balls. Contact the Komatsu Call Center (support@joyglobal.com) if you are unable to locate the information or have questions pertaining to these assembly and maintenance practices. Most of these are covered in one or more of the following documents:

- Assembly Manual
- GEN 2 Service Manual
- SIL 439.01 Spherical Ball Bearing Joints
- SIL 413.00 Hoist Cylinder Spherical Ball Lubrication
- SIL-397.01 Auto Lube System Operation

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RE-Commissioning Worksheet

Machine:	Ball location changed:	Date:
S/N:	Replacement Ball S/N	Customer:

Item	Result	Comments	Date	Signature
Machine download	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Attach to the Sales Force Case related to this machine	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Analyze data for indications of grease system failures	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Grease Plug installed in hoist or lift arm ball	YES <input type="checkbox"/> NO <input type="checkbox"/>			
New O-ring	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Grease extension tube installed into articulation ball base	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Thread sealant used?	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Connect the grease hose	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Tighten hose and fitting	YES <input type="checkbox"/> NO <input type="checkbox"/>			
New Grease hose used?	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Install new brass liners in socket and cap	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Chase hole threads in socket by hand	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Clean hole threads in socket to remove all contaminants	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Install new capscrews	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Coat the OD of the ball with auto lube system grease	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Fill the hole in the ball with auto lube system grease	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Coat the ID of the socket and cap with a thin coat of auto lube system grease	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Coat the ID of the brass liner auto lube system grease	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Verify that the arms fit without spreading or pulling together	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Heat striping required?	YES <input type="checkbox"/> NO <input type="checkbox"/>			
<i>This section applies to Lift arm balls ONLY</i>				

Field Welding Procedures

Item	Result	Comments	Date	Signature
Align the ball caps on the lift arm sockets Match marks <i>This section applies to Lift arm balls ONLY</i>	YES <input type="checkbox"/> NO <input type="checkbox"/> YES <input type="checkbox"/> NO <input type="checkbox"/>			
Capscrew lubricant – 30W oil	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Hand start all capscrews	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Follow specified torque pattern	YES <input type="checkbox"/> NO <input type="checkbox"/>			
Torque value	_____ ft-lb			
Purge the grease system to all balls that were replaced? Use external grease pump?	YES <input type="checkbox"/> NO <input type="checkbox"/> YES <input type="checkbox"/> NO <input type="checkbox"/>			
Check the snap clearance In or out of specification? Adjusted? Final value?	YES <input type="checkbox"/> NO <input type="checkbox"/> _____/mm YES <input type="checkbox"/> NO <input type="checkbox"/> YES <input type="checkbox"/> NO <input type="checkbox"/> _____/mm			
Verify grease system functioning: System timing? Leaks? System building pressure? Oil supply pressure? Grease pressure at stall? Ball injector functioning? Injectors functioning?	_____ min/cycle YES <input type="checkbox"/> NO <input type="checkbox"/> YES <input type="checkbox"/> NO <input type="checkbox"/> _____ psi _____ psi YES <input type="checkbox"/> NO <input type="checkbox"/> YES <input type="checkbox"/> NO <input type="checkbox"/>			