SASFORKS

engineered tough

SAS™ FORKS SCORPION™

========20 SERIES=========

ENGINE PULLER OPERATOR MANUAL

========MANUAL v10=========

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INTRODUCTION LETTER (PAGE 3)
SAS™ SCORPION™ ENGINE PULLER

TO THE OWNERS, MANAGERS, AND OPERATORS OF LOADERS EQUIPPED WITH SAS™ SCORPION™ ENGINE PULLER & SAS FORKS

Safety is the most important issue in the workplace. Observing safety guidelines, equipment capacities and using common sense will provide a work environment that is safe and efficient for employees, management and customers. It is important that you and your operators read and understand the information included in this manual prior to use of this equipment.

Safety warnings are highlighted through out this manual. Understanding the significance of these symbols is important. The following is a definition of each symbol you will encounter in this manual

The Caution symbol is intended to draw your attention to important safety information, a hazard or precaution.

The Danger Symbol indicates a hazardous situation that if not avoided will result in serious injury or death

The Warning Symbol indicates a hazardous situation that if not avoided could result in serious injury or death

The Caution Symbol indicates a hazardous situation that if not avoided could result in minor injury or potential property damage

The Notice Symbol indicates worst credible severity of harm is property damage.

The following information laid out in this Operator Manual for SAS FORKS™ is intended to be a guide only, and is not meant to encompass all issues that may need to be addressed for your particular type of business operation.

If you encounter any additional information that would be helpful to us, or others, please contact us.

Thank you for your business,

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General Safety Guidelines (PAGE 4)
SAS™ SCORPION™ ENGINE PULLER

Operation of equipment should only be performed by qualified and trained individuals. All persons operating or working in the area of operation should read this manual and a copy of this manual should be kept with the equipment. To be considered qualified you must:

- Understand the written instructions supplied by the manufacturer of the device, the manufacturer of the wheel loader, all company rules and any applicable OSHA regulations
- Completed training including actual operation of the device
- Know and follow the safety rules and regulations of the jobsite
- Know and follow all guidelines outlined in this manual.

⚠WARNING Operation of equipment by un-qualified or un-trained individuals can result in serious injury or death. Verify all operators have received proper training on operation of this equipment.

⚠WARNING Not designed to be operated in an explosive environment. Only use this equipment in well ventilated areas, a sufficient distance away from flammable or explosive gases, liquids or other hazards to avoid risk of ignition. Operating this equipment in an explosive environment may cause an explosion and fire resulting in injury, death, and substantial property damage.

⚠WARNING Operation of equipment under the influence of illegal, prescribed or over the counter drugs can result in potential injury or property damage. Consult your physician before operation of this equipment while on medication.

⚠WARNING Inspect the device and perform all preventative maintenance before operation at the start of every shift. Failure to perform inspections or proper maintenance can result in equipment failure resulting in serious injury or property damage.

⚠WARNING Read operators manual and follow all safety procedures for the equipment this device is attached to. Failure to follow Manufacturers recommendations can result in serious injury and property damage.

⚠ DANGER This equipment is operated by high pressure hydraulics. Hydraulics are a stored power source and as such must be treated as energized at all times. Be certain pressure has been relieved prior to handling, inspecting or performing maintenance on this unit. Follow lockout tag out procedures and release all stored energy before servicing equipment. Failure to release energy or disable hydraulic energy can result in serious injury or death. High pressure fluids can also discharge at great velocity. Be certain to wear safety glasses while inspecting, operating and maintaining equipment.

⚠ DANGER This equipment has numerous moving components. Do not wear loose fitting clothing, rings, jewelry or other items that may become entangled in the device. Be aware of resulting pinch points and keep clear during operation, inspection and maintenance. Pinch points exist between the puller and vehicle, puller and wheel loader, failure to keep clear while in operation can result in serious injury or death.

⚠ DANGER Do not exceed posted weight limits on equipment or loader. Exceeding rated load limits will result in equipment damage, serious injury or death.

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General Safety Guidelines (PAGE 5)
SAS™ SCORPION™ ENGINE PULLER

PROTECTIVE EQUIPMENT & CLEAR OPERATING SPACE RECOMMENDED

- Safety glasses with side shields, •Leather gloves, •Hard hat
- Fire extinguishing equipment
- Spill kit (oil dry, absorbent towels, etc. as required by your company)
- Other such safety equipment to protect personnel from injury.
- Clear operating space: All personnel should be at least 50 feet away from operating loader and Scorpion Engine Puller.

WARNING Do not work under the fork or any object lifted by this equipment. An unexpected movement, shift in the object, or hydraulic failure may cause the forks and object drop. Serious injury or death may occur.

PERSONNEL TRAINING & PREPARATION

Prior to installation or use of this equipment all personnel should review the appropriate equipment & safety manuals and be trained by qualified personnel. Hazards, pinch points, and potential injury risks should be thoroughly covered to ensure personnel avoid these hazards at all times. Signed documentation certifying individual training is a must. Periodic refresher training meetings are highly recommended.

SITE PREPARATION RECOMMENDED

- Scorpion™ engine puller should only be used in areas that are equipped with proper fluid containment measures, to ensure capture and containment of residual fluids in accordance with any local, state, federal, building or environmental regulating body.
- No smoking, Safety glasses & Hard hat required signage is recommended.

VEHICLE PREPARATION PRIOR TO USING THE SCORPION™ ENGINE PULLER

- All batteries, mercury switches, air conditioning Freon, engine oil, transmission fluid, antifreeze and other fluids should be removed.
- Engines, transmissions, and other components will be damaged, and only be suitable for metals recycling, not as cores or resalable operable parts.

WARNING Vehicles contain several hazardous elements that pose explosion and fire hazards, such as electric batteries containing battery acid and gasoline. Be sure these are safely removed prior to using the engine puller. Failure to remove may result in explosion, fire hazard & injuries.

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CE SPECIFIC NOTICES

EMERGENCY STOP FUNCTION

To immediately stop the motion of this equipment:

1. Operator is to release joystick button(s).

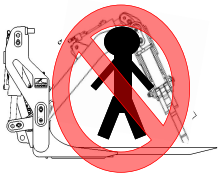
Additional secondary alternative measures to immediately stop the motion include:

2. Moving wheel loader's auxiliary hydraulic 3rd spool lever to neutral position
3. And/or turning off the ignition key of the wheel loader to shut off the engine,

All three emergency stop options above ultimately stop the flow of hydraulic fluid. Notice: even after emergency stop function is followed, there is residual stored hydraulic pressure in the system. See following:

THIS EQUIPMENT IS OPERATED BY HIGH PRESSURE HYDRAULICS.

Hydraulics are a stored power source and as such must be treated as energized at all times. Be certain pressure has been relieved prior to handling, inspecting or performing maintenance on this unit. Follow lockout tag out procedures and release all stored energy before servicing equipment. Failure to release energy or disable hydraulic energy can result in serious injury or death. High pressure fluids can also discharge at great velocity. Be certain to wear safety glasses while inspecting, operating and maintaining equipment.

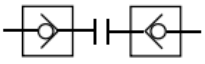


STAY CLEAR

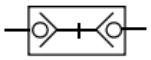
Do not lift persons with this equipment.
People should always stand a safe distance away from this equipment.
Do not go near or under this equipment or any object lifted by this equipment.

ENERGY ISOLATION

Follow Refer to page 16, "DISCONNECTION" item A through H.



The symbol at the left indicates hydraulic hose coupling quick release self sealing, which is recommended to be installed by the customer at the time this equipment is initially attached to the wheel loader.



POWER FAILURE

In the event of electrical or hydraulic supply failure from the wheel loader occurs, the equipment will stop further motion. Under normal circumstances the equipment is not expected to drop a load. *The symbol at the left indicates the hydraulic controls on this equipment are normally closed*. Thus without electrical power the gate valves are closed, in essence halting further movement.

SOUND

This equipment does not emit more than 70dba.

VIBRATIONS

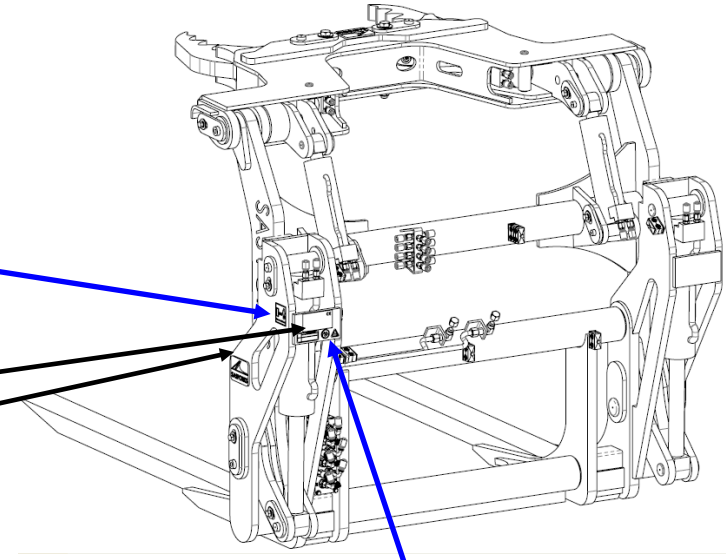
This equipment does not transfer vibrations in excess of 2.5m/s2.

OPERATING TEMPERATURE

This equipment is best suited to operate in temperatures between 30°F to 90°F with minimum allowable temperature –25°F and maximum temperature 150°F

General Safety Labeling (PAGE 7)
SAS™ SCORPION™ ENGINE PULLER

CE SPECIFIC LABEL LOCATIONS



LABEL 1: KEEP AWAY FROM MOVING PARTS

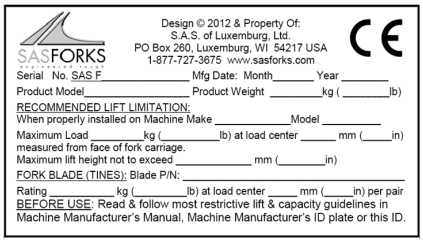
Label reorder # W-LAB-WARNING-PINCH

LABEL 2: HIGH PRESSURE HYDRAULICS.

Label reorder # W-LAB-PRES-503600

LABEL 3: READ EQUIPMENT MANUALS

Label reorder # W-LAB-READ-504060



LABEL 4: PRODUCT IDENTIFICATION LABEL

SERIAL NUMBER, MODEL, LIFT CAPACITIES

Label reorder # ID_PLATE-CE

LABEL 5: KEEP BACK 15 METERS (50 FEET)

Label reorder # W-LAB-STAYBACK50FT

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INSTALLATION (PAGE 8)
ADVANCE PREPARATION

TO HELP YOU GET UP AND RUNNING QUICKER WHEN YOUR SCORPION ARRIVES:

- Review this operator manual.
- Review your wheel loader manufacturer's manual & warranty document, if any. Installation of this attachment may void machine manufacturer warranty, if any.
- If you've optionally opted for SAS to be onsite to assist your mechanic with installation and provide training, please be sure the following items are completed:

Items you need to obtain before arrival of Scorpion:

- 7 Gallons of hydraulic fluid (specific for your machine)
- Locate area to mount control box or module (recommend dry area, clear of seat and door)
- Misc. nuts, bolts (1/4") or self tapping bolts
- Identify the hydraulic hose quick connections on your machine & obtain the
- corresponding female ends.
- Locate a local hydraulic hose supplier who can make two 3/4" diameter 4,000 PSI hoses with heavy duty quick connection fittings same day once proper length is determined during installation.

Tools your mechanic will need for installation:

Electric Drill & 1.25" hole drill saw

- Basic socket and wrench set
- 2 large adjustable wrenches or large wrench set
- Teflon tape or thread sealer
- Wire cutter/crimper

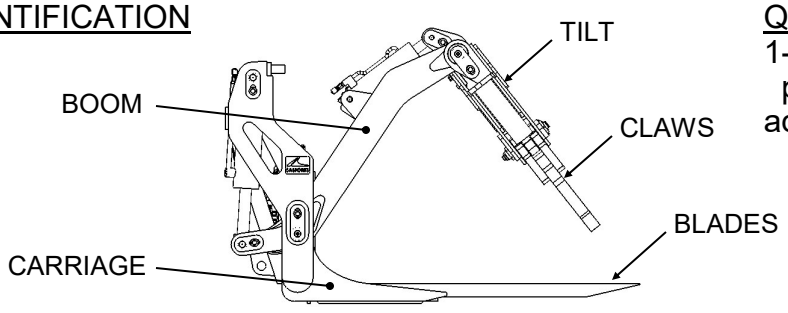
Service to do on your loader in advance:

- Have the maintenance personnel replace the hydraulic system filters & fluid
- (recommend pressure and flow test but not required)
- Inspect lift arm pins & bushings for wear (replace as needed)

Available for training:

- At least 20 vehicles with fluids & AC Freon drained & batteries removed available.
- Designate an area (where it is safe to run the Scorpion) & employee to operate unit
- Your loader operator (person who can have conversation in English) Thank you.

COMPONENT IDENTIFICATION



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INSTALLATION GUIDELINES (PAGE 9)
SAS™ SCORPION™ ENGINE PULLER

⚠WARNING

►Installation of the Scorpion Engine Puller on a wheel loader requires interfacing with electrical power system and high pressure hydraulic systems. Installation should be performed by qualified individuals. Failure to follow these instructions and precautions noted in the wheel loader manufacturer's service manual can result in serious damage to equipment and/or result in injury or death.
►Failure of hydraulic system can result in serious injury and property damage
►Use caution while testing operation of this unit. Be aware of:
-Pinch Points, -High Pressure hydraulic fluids or stored energy
-Location of other individuals in the work area

NOTICE **Installation of purchased attachment may void machine manufacturer warranty, if any.**

Step 1. RELAYS: Find a location to mount relay module [B].
The location should be accessible enough to get into the box and wires, but out of the way so it will not get damaged. Mount box where it will not be exposed to the weather.
Needs to be within 5' of power supply

Step 2. JOYSTICK: Install joystick[C] to third function lever in cab
Remove current knob. Screw on new joystick with supplied adapter in the bottom of the joystick.
Standard bushing 10mm x 1.25. Drill and tap bushing as needed if your thread requirements differ.
Route wires to control box, avoid rubbing points.
Connect to proper connection on side of control box.

Do not clamp wire tightly with tie wraps

Step 3. POWER CABLE: Locate 15 amp fused lead and connect a 24V power supply which energizes with ignition key and a good ground connection for cable [A].
Route cable [A] and connect to control box [B].

Step 4. ATTACH SCORPION™ TO WHEEL LOADER
Quick coupler attachments: <u>Be sure lower locking pins fully extend to lock in coupler & Scorpion™</u>. This may require you to slightly lift or tilt the coupler to lock in. We recommend operator actually inspect each pin to be sure they are fully locked in.
Direct pin mounting: Remove existing pin attachment, align arms to Scorpion™ insert and fasten pins in place. Apply ample grease to all pins.

⚠WARNING

Quick coupler locking pins are integral to the attachment of this unit to wheel loader vehicle. Verify the pins are locked in fully prior to lifting unit or using the Scorpion. Failing to verify proper securement may cause the Scorpion Engine Puller falling off the loader resulting in property damage, injury or death.

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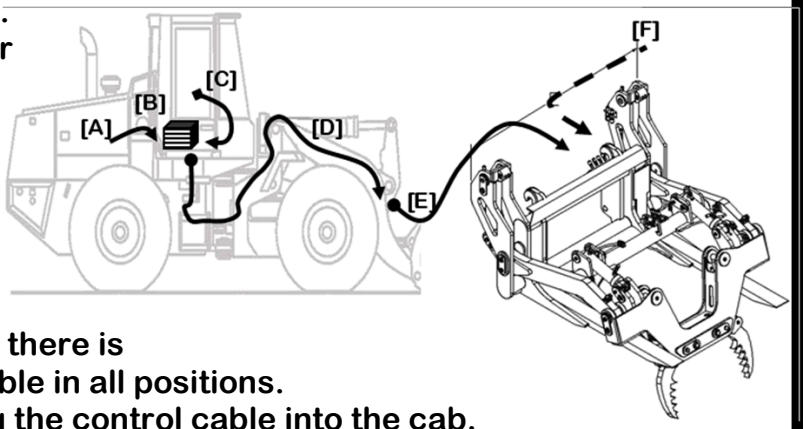
INSTALLATION GUIDELINES (PAGE 10)
SAS™ SCORPION™ ENGINE PULLER

Step 5. CONTROL CABLE: Determine a suitable location for the bulkhead connection end on cable [D] on the forward area of the left loader arm. Pick a location that cable [E] can reach and provides enough flex as the loader arms are lifted or tilted. This is typically 2' from the lower pivot point. Mount the bulkhead securely on the loader arms.



Run control cable [D] up loader arm, along hydraulic lines, following lines into frame & across frame articulation point, to cab of loader. Leave enough slack in the cable keeping in mind articulation of loader & lift of main arms so there is no tension on the control cable in all positions.

Find a suitable location to bring the control cable into the cab. Enter through a existing grommet or drill a hole large enough to fit the end of the wire through.

⚠ Protect the cable from rubbing on the edge of the hole, either install a rubber grommet or center the cable in the hole and fill around with silicone. Damage to wires can result in equipment failure leading to injury or property damage.

Step 6. IDENTIFY PRESSURE SIDE LINE ON LOADER by <u>pulling joystick lever back</u> briefly, you will see one of the lines move, or have someone hold the line to feel the pressure build. Label this line "Boom Lift Pressure".

Step 7. HYDRAULIC LINES: Determine adequate length of lines needed from existing third function connections on loader arms to bulkhead lines on Scorpion™.

To decide length of line; Raise unit, tilt unit full down; then measure distance required from bulkhead on Scorpion to loader connection. Make a loop in line to have sufficient length in hose to avoid creating tension in all positions.

Use a 4,000 PSI min hose to fit hydraulic quick coupler fittings on machine and ¾" (#12) male JIC fittings on the Scorpion™.

Attach the line (labeled "Boom Lift Pressure") which is pressurized when the joystick is pulled back to the bulkhead fitting on the Scorpion that is farthest from the loader. Clearly mark lines as desired or use opposite quick coupler set up to ensure proper reconnection after disconnected.

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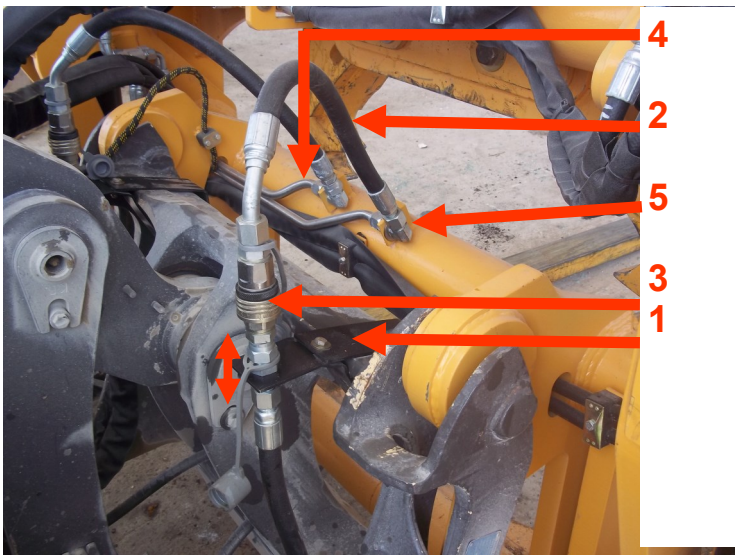
SAS™ SCORPION™ ENGINE PULLER Hydraulic Fitting

PROPER ALIGNMENT OF HOSE TO ENSURE STRAIGHT FITTING WILL PROMOTE LONG LIFE:

- Read the Scorpion operator manual. Wear safety glasses and gloves.
- Follow 'Disconnecting' instructions on page 9 of the manual to safely park Scorpion & depressurize system.
- **Goal is to align the hoses coming from the Scorpion carriage toward the wheel loader at an angle that allows the hydraulic quick coupler fittings to align squarely, eliminating side pressure.**
- 1. Note the position of any brackets which hold fittings.
- 2. Loosely attach hoses to the carriage and the loader mount.
- 3. Fit the hydraulic quick coupler fittings together.
- 4. Adjust either or both of these to allow good fit:
  - a) Reposition mounting bracket (1) which is fastened to the back of coupler up or down. And / Or
  - b) Loosen nut(s) (4) fastening the stainless steel line (only 1 turn) to 90 degree fitting on carriage,
  - c) Loosen lock nut on 90° fitting (5) to carriage

d) Reposition the angle of the fitting to allow the hose to smoothly transition from the Scorpion to the fitting on the black bracket RESULTING IN A STRAIGHT ON ALIGNED CONNECTION OF THE HYDRAULIC QUICK COUPLER FITTINGS.

- 5. Tighten lock nut (5) on 90 degree fitting on carriage
- 6. Tighten the nut(s) (4) fastening stainless steel line
- 7. Tighten all hose connections.
- 8. If equipped, secure black locking ring on hydraulic quick coupler fittings.
- 9. Check for leaks. Repair as needed.

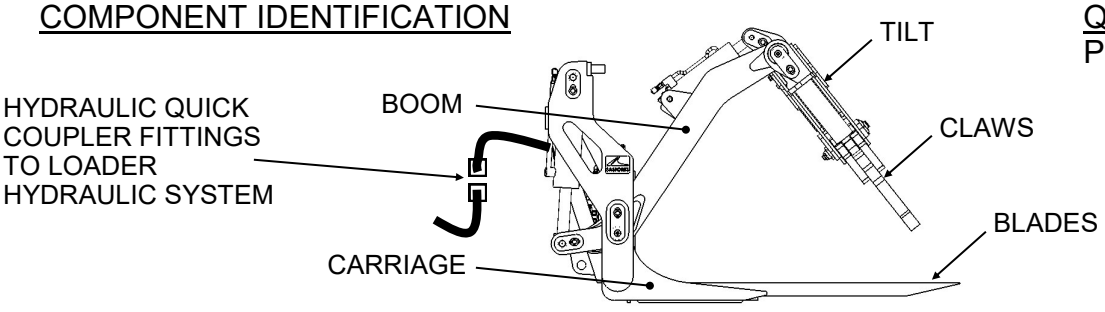


⚠ DANGER This equipment is operated by high pressure hydraulics. Hydraulics are a stored power source and as such must be treated as energized at all times. Be certain pressure has been relieved prior to handling, inspecting or performing maintenance on this unit. Follow lockout tag out procedures and release all stored energy before servicing equipment. Failure to release energy or disable hydraulic energy can result in serious injury or death. High pressure fluids can also discharge at great velocity. Be certain to wear safety glasses while inspecting, operating and maintaining equipment.

IMPROPER INSTALLATION & ALIGNMENT WILL CAUSE DAMAGE TO FITTINGS

- Misalignment may cause undue side pressure on the fittings.
- Failing to secure the black ring lock may cause the fitting to not be secure.
- Internal ball bearing parts may break out, fitting may fail and become disconnected.
- This condition will not be warranted.

COMPONENT IDENTIFICATION



QUESTIONS?
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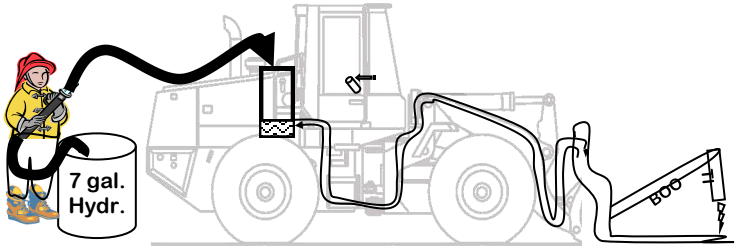
INSTALLATION GUIDELINES (PAGE 12)
SAS™ SCORPION™ ENGINE PULLER

Step 8. HYDRAULIC FLUID LEVEL. You will need to add 7 gallons at initial installation.

Check level regularly. Refer to the wheel loader manufacturer's manual for proper filling specifications. Failure to keep fluid at proper operating levels can result in equipment failure.



Step 9. INITIAL TEST FOR INTERFERENCE during lifting, tilting, or dumping movements

⚠WARNING

►Watch for pinch points. Stay clear of moving parts while equipment is in operation. Moving parts can cause serious injury or death

►Watch for leaking hydraulic fittings, fix any leaks and clean up spills if they occur. Hydraulic fluid can cause eye irritation and slippery conditions which can result in injury.

►Watch for unexpected movements or erratic operation, stop test if unexpected movement occurs. Stored energy can cause unexpected movements that can result in serious injury or death.

►Verify all individuals are clear before performing test.

Check for undesirable contact between loader lift arms and Scorpion framework. Watch for any loader arm, hoses, or cable pinch points.

Begin testing by moving control levers slowly:

A. With carriage on the ground, fully roll back (fork tips up)

B. With carriage lifted high, fully rotate to the dump position (for tips down)

<u>Pin attach units may require addition of mechanical stops</u>.

If you experience interference you may need to install special roll back or dump stops. Contact SAS Forks™ if you experience interference issues to discuss stop options.

Step 10. Check proper sequence. Engage button or trigger before moving joystick.

>Left button depressed: Pull back joystick to lift the "Boom".
Push forward on joystick to lower the "Boom"

>Right button depressed: Pull back joystick to swing "Tilt" away from loader
Push forward joystick to swing "Tilt" towards loader

>Trigger button depressed: Pull back joystick to squeeze "Claws" together
Push forward on joystick to open "Claws"

<u>If functions operate backwards switch main hydraulic lines from loader.</u>

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DAILY PRE-OPERATION INSPECTION (PAGE 13)
(Suggested minimum inspection guidelines)

> Inspection Required at start of each shift.
> Responsible Person: First employee to use this piece of equipment on each shift, each day.
> If you find any safety problems fix them immediately or tag and lock out this unit so no one uses it.
> Notify your supervisor about any problems and arrange for immdiate service.
> A record of repairs made should be attached to this sheet for proof of safe operating condition
> Park safely. Do not obstruct exit. set parking brake, lower forks with tips on ground, shut off lights.
> When this page is full, turn page into office for filing request a blank form.
> Office / Supervisor: Keep this completed sheet and associated records of repairs on file.

A. WHEEL LOADER GENERAL PRE-OPERATION INSPECTION

Think Safety First
Unit #.....
X=item OK .....
S=needs Service
.....

Week ____ Day #	--- Inspection --- Date	By Who	Hour Meter	Engine Off & Keys Out	Parking Brake Set	Engine Oil Level	Hydraulic Fluid Level	Antifreeze Level	Fan / Alternator Belts	Fuel System Leaks	Tire Condition	Tire Pressure	Tire Lug Bolts Tight	Hydraulic Hoses	Lift Arms / Chains	Grease Lifting Pins	Forks Secure	Seat Belt Operation	Fire Ext. Charged	Parking Brake	Dash Warning Lights	Fuel Level	Engine - No Noises	Horn	Lift operation	Steering System	Brake System	Reverse Warning
1																												
2																												
3																												
4																												
5																												
6																												
7																												

B. SAS™ SCORPION™ ENGINE PULLER PRE-OPERATION INSPECTION

Think Safety First
Unit #.....
X=item OK .....
S=needs Service
.....

Week ____ Day #	--- Inspection --- Date	By Who	Hour Meter	Engine Off & Keys Out	Parking Brake Set	Forks on the ground	Scorpion Boom Lowered	Quick Coupler (if any) free from cracks		Scorpion Forks Securely Mounted to Loader	Pivot Pin Lock Bolts	Pivot Pin Condition	Grease All Pins		Hydraulic Hoses Not Damaged or Worn	Power cable condition	Hydraulic Fitting Leaks		Scorpikn BOOM Free From Cracks	Scorpion TILT Free From Cracks	Scorpion CLAW mounting pins secure	Scorpion TOWERS Free From Cracks	Boom solid roll back rest pad in place	Scorpion FRAME Free From Cracks	Scorpion PLOW Free From Cracks	Scorpion Fork BLADES Free of cracks	Scorpion Fork BLADES Free of cracks	Scorpion smooth operation
	Manual Page Number Reference									6	11	11	11		11	12	13		14	14	14	16	16	16	16	16	16	8
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PULLING ENGINES (PAGE 14)
SAS™ SCORPION™ ENGINE PULLER

Operation Procedure

A. When tipping the forks up (roll back), tips down (dump), it is best to avoid unnecessarily bottoming out the stops to avoid possible damage to the stops, lift arms, or hydraulic cylinders. Always slow the movements when nearing a stop, including when raising the Scorpion™ "Boom" to fully raised position.

B. Approach the vehicle;
   1. Front wheel drive vehicles: Approach from the side of the timing belt, opposite the transmission, typically passenger side.
   2. Rear wheel drive vehicles: Approach directly from the front.

C. Position and set the forks down...
   1. Front wheel drive: Place fork on top of fire wall (cowl) and other fork over the radiator support, positioning the forks to allow you best visibility of the "Claws".
   2. Rear wheel drive: Place forks on top of both fenders, positioning forks to allow you best visibility of the "Claws".

D. Squeeze the trigger and reposition the "Claws" so they will clear the middle of the forks as they are lowered into the engine compartment.

E. Press the right button, move the joystick forward and move the "Tilt" about 1/2 way out. Reposition joystick to neutral and release the button.

F. Press the left button, move the joystick forward and lower the "Boom" down, positioning the "Claws" low on the engine block, on the end of the engine block farthest away from the transmission. Don't go too low that the "Claws" grab the frame.

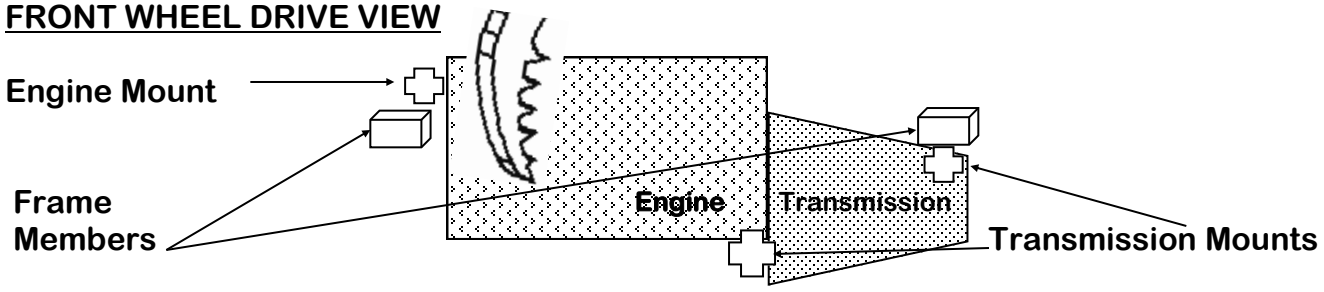
G. Squeeze trigger, move joystick backwards, causing "Claws" to grab engine block.

H. While continuing to hold the trigger and the joystick back, press the left button to cause the "Boom" to lift the engine out. This should break the passenger side mounts, then the center mounts, pulling the engine up, and begin to lift the transmission clear of the frame member. When lifted to maximum height, continue to hold the joystick back and holding the trigger. Only release the button. (Watch the front of the car, if the entire car is pulling up, you have caught the frame with the "Claws", reposition the "Claws" and try again.

I. Continuing to hold trigger & joystick back, now also press the right button to lift the "Tilt". This will provide additional lift height to clear the transmission out vehicle.

J. Transport the engine in the "Claws" to the desired location to deposit the engine and transmission, then press the left button and move the joystick forward to lower the "Boom". Then squeeze the trigger and move the joystick forward to open the "Claws" and release the engine and transmission. Be cautious not to open the "Claws" to far that they hit the forks.

FRONT WHEEL DRIVE VIEW



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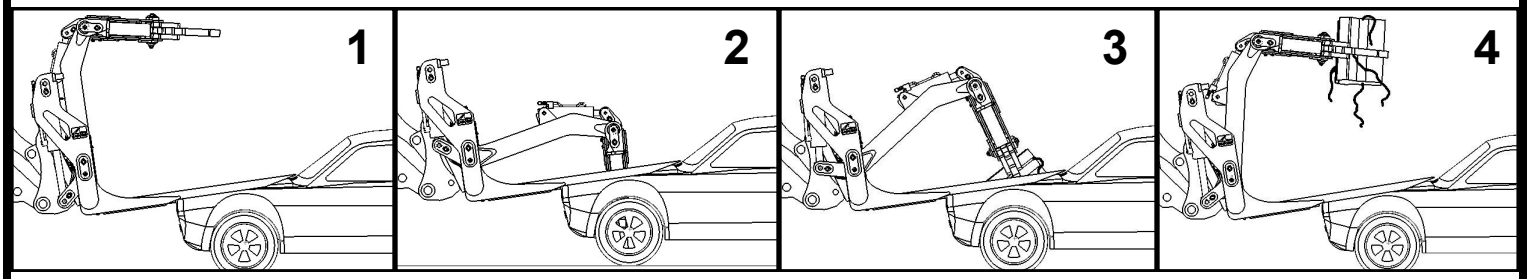
SAS™ SCORPION™ ENGINE PULLER USE

PROPER USE OF THE SCORPION ENGINE PULLER WILL ENSURE LONG LIFE:

- Read your manual
- Grease daily
- Method of proper use is covered on page 10 of the manual. This is a 4 step summary:
- 1. Always lower & set blades on top of car, securing car firmly to ground, position the claws (to clear blades) & position the tilt about 1/2 way out. (Tilt straight down off boom)
- 2. Lower the boom, allowing the claws to penetrate the engine compartment.
- 3. Securely clamp claws on engine.
- 4. While keeping the claws engaged raise boom to lift out engine.

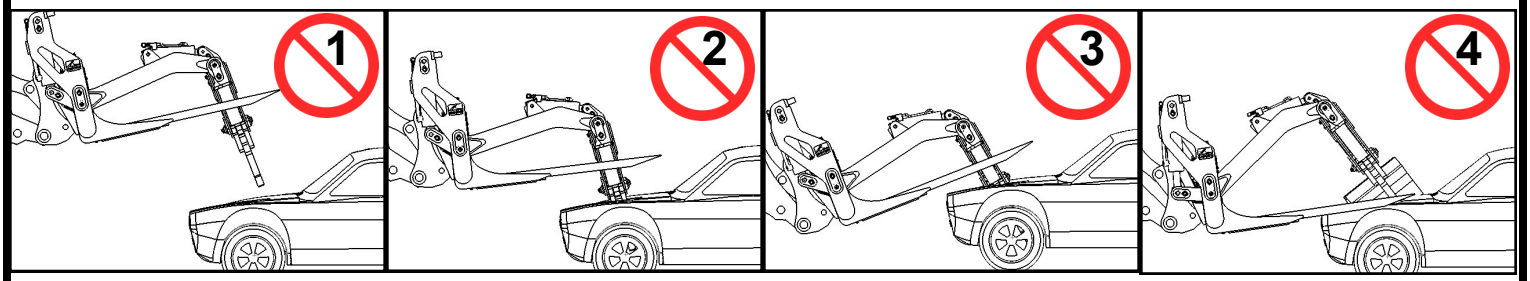


Failure to follow proper instructions or using Scorpion for any other purpose will void warranty.

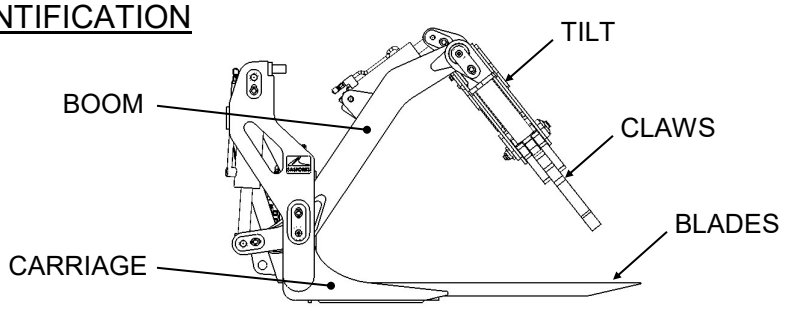
IMPROPER USE WILL CAUSE DAMAGE AND POTENTIAL CRACKING OF THE SCORPION

- **To prevent damage or potential personal injury <u>avoid the following actions</u>:**
- An example of improper use:
- 1. Lowering the boom, extending tilt fully forward & opening claws before approaching car.
- 2. Dropping the Scorpion down onto the car with the claws below the fork blades.
- 3. Clamping on engine & extracting without the blades securely holding down the car down.
- 4. Having the blades come in contact with car before engine in disengaged.

These operations will cause stress & cracking of the tilt assembly resulting in equipment damage.



COMPONENT IDENTIFICATION



CONNECTING / DISCONNECTING
SAS™ SCORPION™ ENGINE PULLER (PAGE 16)

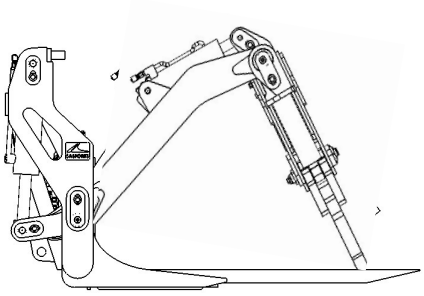
⚠WARNING Hydraulic system may have unexpected pressure. Always train operators on proper procedures. Set forks on the ground, depressurize hydraulic system, wear safety glasses, gloves and other personal protective equipment required by your workplace before attempting to disconnect hydraulic hoses. Practice lockout/tagout procedures to prevent operation of equipment while servicing. Failure to follow these instructions can result in serious injury or property damage.

DISCONNECTING:

When disconnecting from Scorpion™ Engine Puller

A. Set Scorpion down to position the blades flat on level ground.

B. Raise the "boom", then raise the "tilt", then open the "claws", gently lower the boom to allow the "claws" to touch the ground or blades. Avoid applying any down pressure. This position with the boom lowered and the tilt extended will allow weight to be balanced forward enough on the blades so the Scorpion™ will be stable.



C. Set the loader's parking brake.

D. Turn off the loader.

E. Turn the key of the loader back on without starting the engine.

F. Cycle through all joystick buttons moving the joystick forward and back several times to relieve all the hydraulic pressure in the lines.

G. Turn the key back off and remove hydraulic lines & control cable.

H. Carefully place control cable and hoses where they will not be damaged or get soiled.

I. Disengage the quick coupler and drive away.

NOTICE Do not allow the hydraulic connections to get dirty. Allowing dirt into the hydraulics will damage the Scorpion hydraulics and may cause catastrophic failure of the wheel loader's hydraulic pump.

CONNECTING:

To re-connect to the Scorpion™ Engine Puller

A. Drive straight up to the Scorpion™ avoid contact with hydraulic lines or control cable.

B. Engage the quick coupler. Visually verify quick coupler locking pins are fully engaged.

C. Turn off the loader.

D. Cycle joystick and other lift levers in cab to relieve pressure in hydraulic lines.

E. Connect hydraulic lines and control cable.

F. Start loader and ensure proper operation.

Always select and engage a button or trigger before moving the joystick.

>Left button depressed: Pull back joystick to lift the "Boom".
Push forward on joystick to lower the "Boom"

>Right button depressed: Pull back joystick to swing "Tilt" away from loader
Push forward joystick to swing "Tilt" towards loader

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PREVENTIVE MAINTENANCE
SAS™ SCORPION™ ENGINE PULLER (PAGE 17)

Daily maintenance will help ensure long term performance and prevent failures. Failure to follow preventive maintenance guidelines can result in equipment failure resulting in injury or property damage

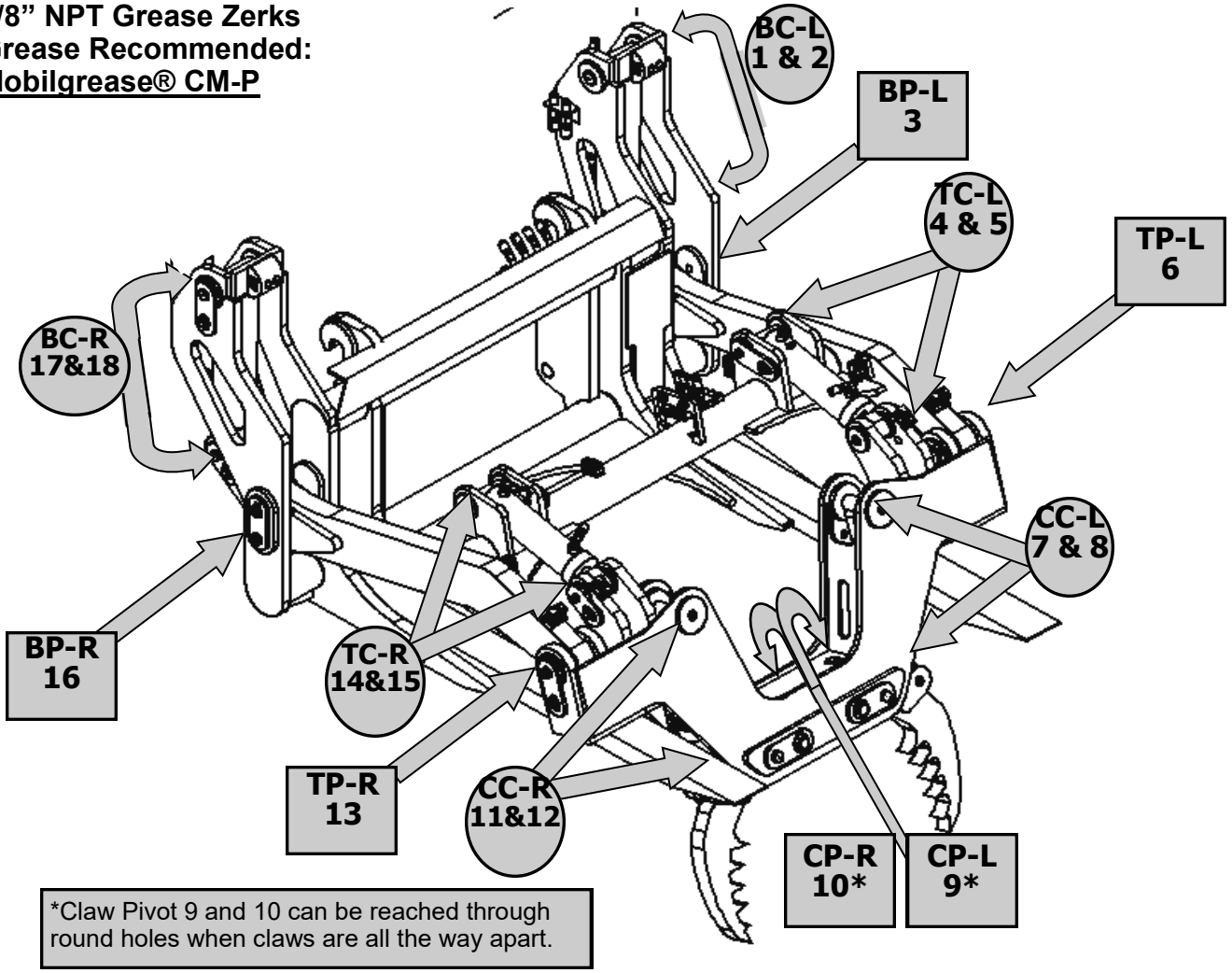
A. Daily: Grease all 18 points; with particular attention to Boom pivot points & cylinders.

Cylinder Grease Points
BC-L(R) Boom Cylinder-Left (Right)
TC-L(R) Tilt Cylinder-Left (Right)
CC-L(R) Claw Cylinder-Left (Right)

Pivot Point Grease Points
BP-L(R) Boom Pivot-Left (Right)
TP-L(R) Tilt Pivot-Left (Right)
CP-L(R) Claw Pivot-Left (Right)

B. Daily: Inspect all pivot point pins and retaining bolts to be sure properly secured.
C. Daily: Inspect forks, carriage, and Scorpion™ framework for damage.
D. Daily: Check loader hydraulic fluid level. Add fluid as required to maintain proper level.
E. Weekly: Inspect hose fittings to be sure they are tight.
F. Weekly: Inspect hoses for pinching or rubbing and correct or replace as needed.
G. Monthly: Inspect skid plates under the carriage.

1/8" NPT Grease Zerks
Grease Recommended:
Mobilgrease® CM-P



*Claw Pivot 9 and 10 can be reached through round holes when claws are all the way apart.

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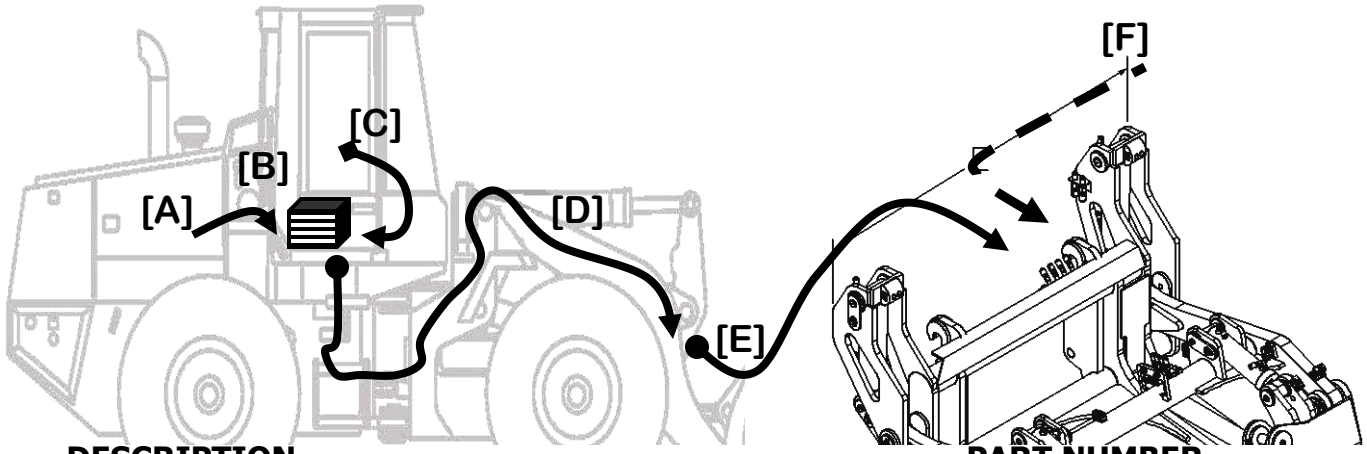
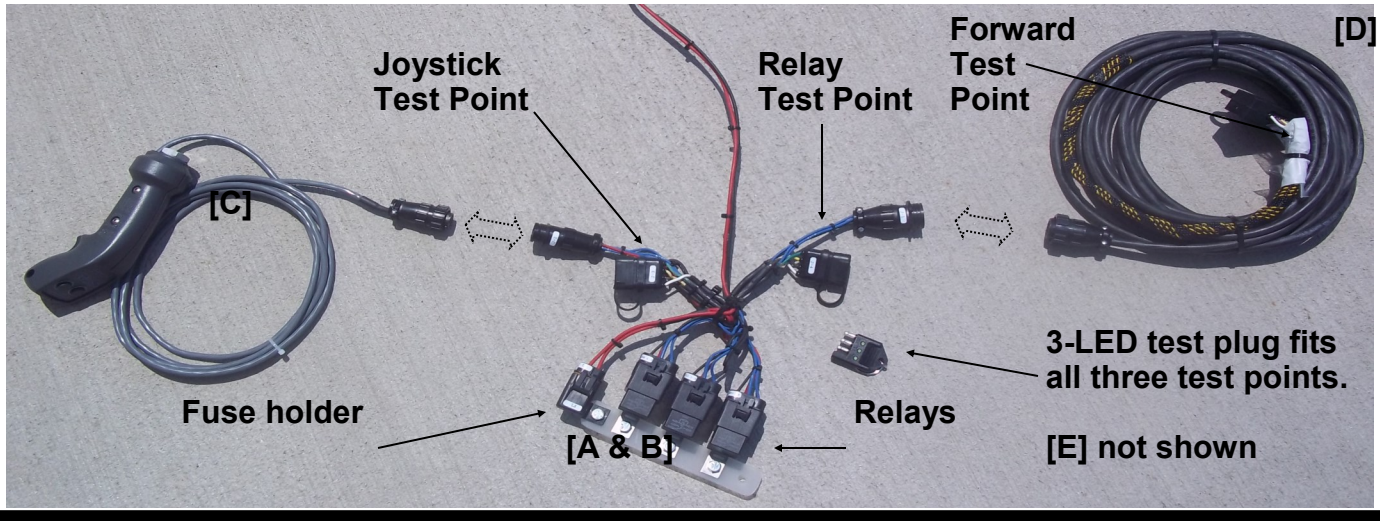
ELECTRONICS PARTS GUIDE (PAGE 18)
SAS™ SCORPION-20™ ENGINE PULLER



	DESCRIPTION		PART NUMBER
[..]	COMPLETE ELECTRICAL KIT (A,B,C,D,E) 24 VOLT		HC-KIT-S-24-1-20
	[..] OPTION: ELECTRICAL KIT (A,B,C,D,E) 24V VOLVO L70/L90		HC-KIT-S-PCKNPL-20
[A&B]	CONTROL MODULE W/LOCAL TEST & 2' PWR WIRE		HC-MOD-S-21478
	B.1 RELAY 24 VOLT (BLACK) SN:F4655 & NEWER	(3 REQ.)	HC-BRL-H-4RD933332
	B.2 15 AMP FUSE (TYPICAL AUTOMOTIVE STYLE FUSE)	(1 REQ.)	HC-FUS-...-ATC15
	A POWER SUPPLY CABLE (F4647 & EARLIER)	(1 REQ.)	HC-CAB-S-50265
	B CONTROL BOX ASSEMBLY (F4647 & EARLIER)	(1 REQ.)	HC-BOX-S-50267-1
	B.1 RELAY 24 VOLT (ORANGE) (F4097-F4647)	(3 REQ.)	HC-BRL-S-RT314024
	B.1 RELAY 24 VOLT (BLUE) (UP TO F4026)	(3 REQ.)	HC-BRL-I-50264
[C]	JOYSTICK & 10' CABLE ASSEMBLY W/PLUG		HC-JYA-S-50270
[D]	30' FORWARD CONTROL CABLE W/FLAT 4 WIRE PLUG		HC-CAB-S-50266-1
	USE HC-CAB-S-50266-1 FOR ALL SC30 & SC20 EXCEPT ALUM CONTROL PANEL TYPE		
	D OPTION: FORWARD CABLE L90 FOR **ALUMINUM** HC-PANEL-S-01 ONLY		HC-CAB-S-PCKNPL-28FT
[E]	7' JUMPER CABLE W/PLUGS (LOADER TO CARRIAGE)		HC-CAB-S-50274
	[E] OPTION: NO JUMPER CABLE ON PCKNPL KITS		N/A
[F.7]	SPLIT CABLE FOR DUAL VALVE BLOCKS W/COIL PLUGS		HC-CAB-S-50276
	[F.7] OPTION: SPECIAL SPLIT CABLE DUAL BLOCK (Use w/o Jumper Cable)		HC-CAB-S-PCKNPL-SC20
	OPTIONAL TEST LIGHTS		
	SINGLE LED CIRCUIT TESTER FOR WIRE AT HYDRAULIC BLOCK		**HC-PLG-I-TESTLIGHT-1**
	THREE LED CIRCUIT TESTER FOR FLAT 4 WIRE CABLE ON LOADER		**HC-PLG-I-TESTLIGHT-3**



We appreciate your business!

Thank you!

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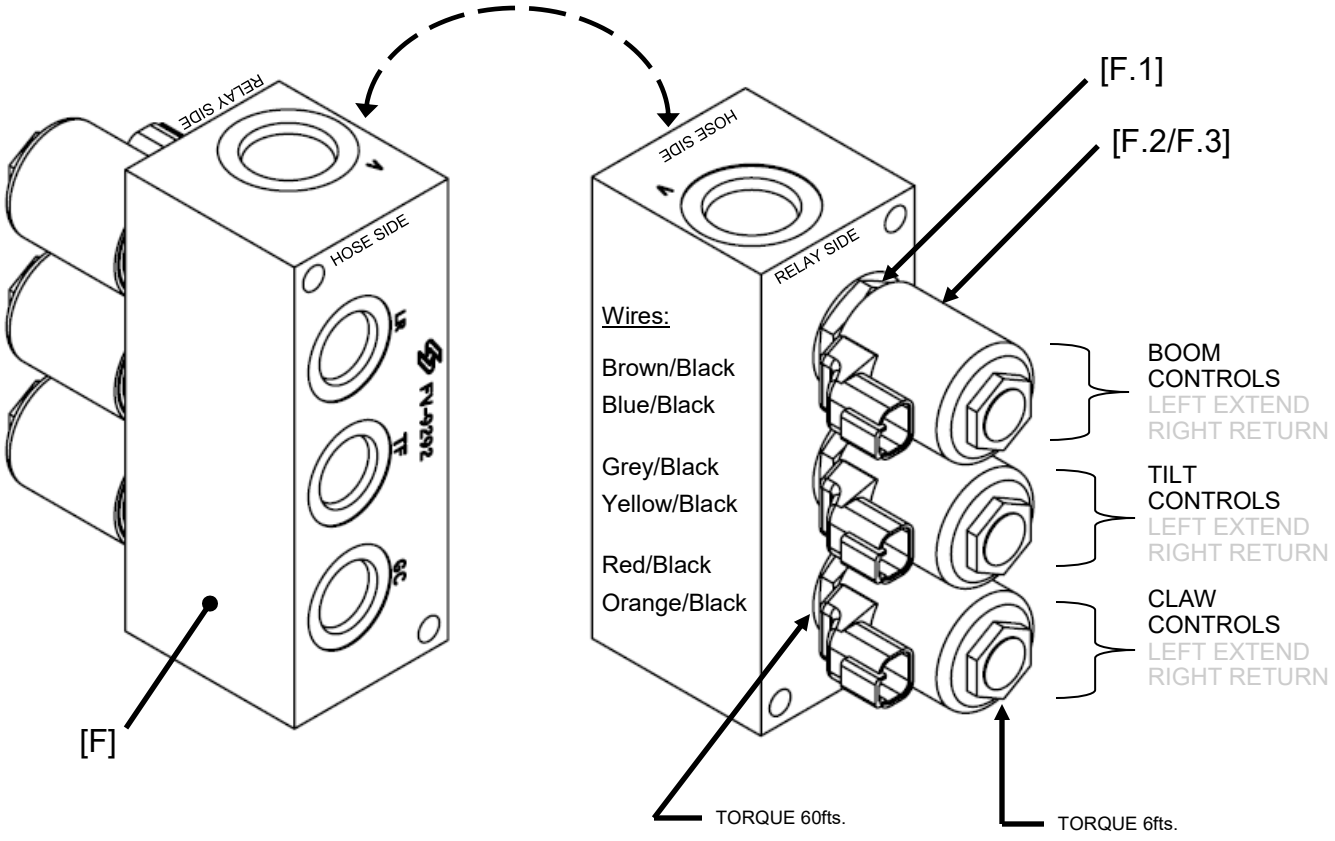
VALVE BLOCK PARTS GUIDE (PAGE 20)
SAS™ SCORPION-20™ ENGINE PULLER

Scorpion-20 has two Valve Blocks (one shown here)



DESCRIPTION	PART NUMBER
[F] HYDRAULIC VALVE BLOCK ASSY W/SOLENOIDS & COILS	HV-BLK-S-FV9292
F.1 SOLENOID CARTRIDGE VALVE (SCREWS IN BLOCK)(6 REQ.)	HV-CRT-V-SBV1112VC00
O-RING SIZE: SAE # 12—O-RING KIT (1 big & 1 small, 2 split)	HV-ORG-SA-5940
VALVE INSTALLATION NOTE: REQUIRES 1-1/4" WRENCH, TORQUE TO 60 FT LBS	
F.2 SOLENOID ELECTRIC COIL 24 VOLT STD (6 REQ.)	HV-COL-V-300AA00142A
COIL INSTALLATION NOTE: REQUIRES 7/8" WRENCH, TORQUE TO 6 FT LBS	
F.3 SOLENOID ELECTRIC COIL 12 VOLT OPTION (6 REQ.)	HV-COL-V-300AA00141A
F.7 DUAL VALVE BLOCK SPLIT CABLE W/FLAT PLUG	SEE PRIOR PAGE

[G] **UNASSIGNED**

⚠WARNING System may have stored hydraulic pressure. Disassembly of any hydraulic part, cartridge valve, coil, pressure relief valve or hose may result in sudden release of hydraulic fluid and may result in boom or tilt unexpected movement. Avoid this fluid or pinch hazard, only qualified personnel ship service this unit. Boom & tilt should be lowered to the ground & secured.

MOVEABLE PARTS GUIDE (PAGE 21)
SAS™ SCORPION-20™ ENGINE PULLER

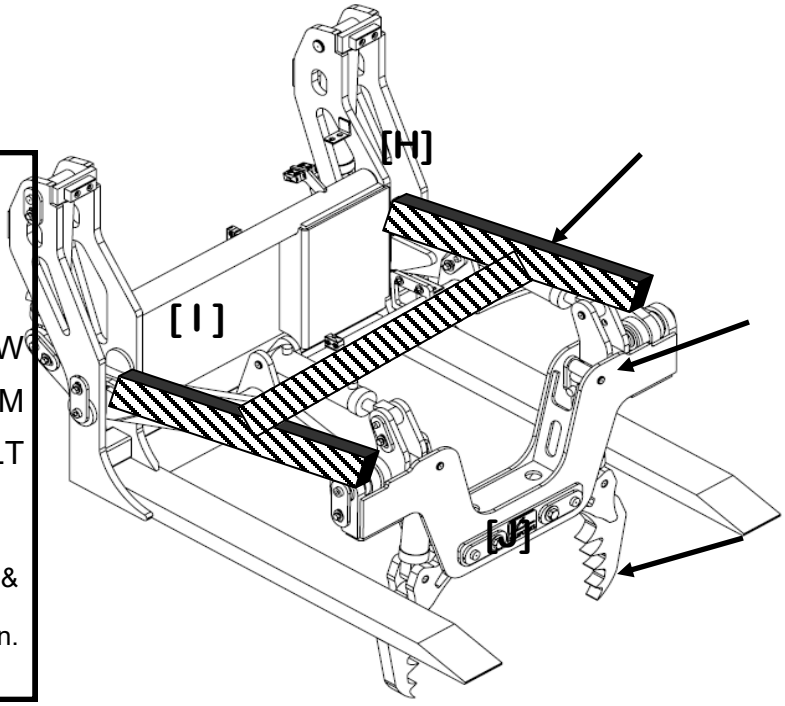
CAT924K, 930K, 938K
WITH JOYSTICK:
HC-JYA-C-356-5206
(forward button)

CLAW

BOOM

TILT

To operate:
Press & hold desired button & rock 3rd spool rocker switch
Stop: release rocker & button.



	DESCRIPTION	PART NUMBER
[H]	BOOM	EP-SC-20-BOOM-01

MOVEMENT OF BOOM:
PRESS LEFT BUTTON ON JOYSTICK
>PULL BACK ON JOYSTICK RAISES BOOM
<PUSH FORWARD ON JOYSTICK LOWERS BOOM

[I]	TILT	EP-SC-20-TILT-01

MOVEMENT OF TILT:
PRESS RIGHT BUTTON ON JOYSTICK
<PULL BACK ON JOYSTICK & TILT WILL SWING OUT AWAY FROM LOADER
>PUSH FORWARD ON JOYSTICK & TILT SWINGS TOWARD LOADER

[J]	CLAW (TWO REQUIRED)	EP-SC-20-CLAW-01

MOVEMENT OF CLAWS:
SQUEEZE JOYSTICK TRIGGER
<PULL BACK ON JOYSTICK; CLAWS WILL PINCH TOGETHER
>PUSH FORWARD ON JOYSTICK; CLAWS WILL MOVE APART

[K] UNASSIGNED

The moving parts shown on this page pose several pinch points. Keep all persons clear of pinch points at all times, including, but not limited to operation and maintenance activities. Failure to stay clear and avoid all pinch points could result in serious injury or death.

⚠WARNING

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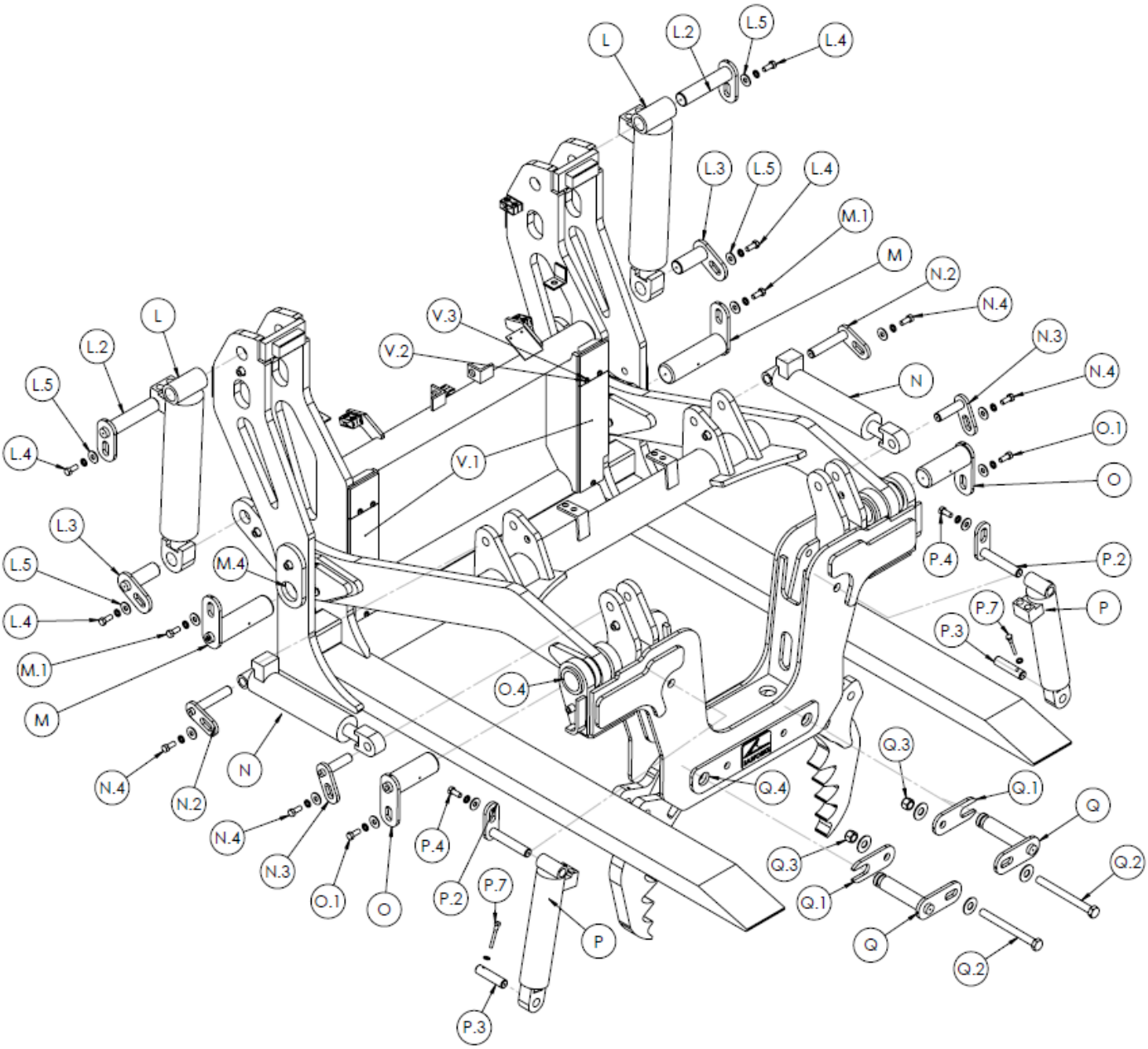
CYLINDER & PIN DIAGRAM (PAGE 22)
SAS™ SCORPION™-20 ENGINE PULLER



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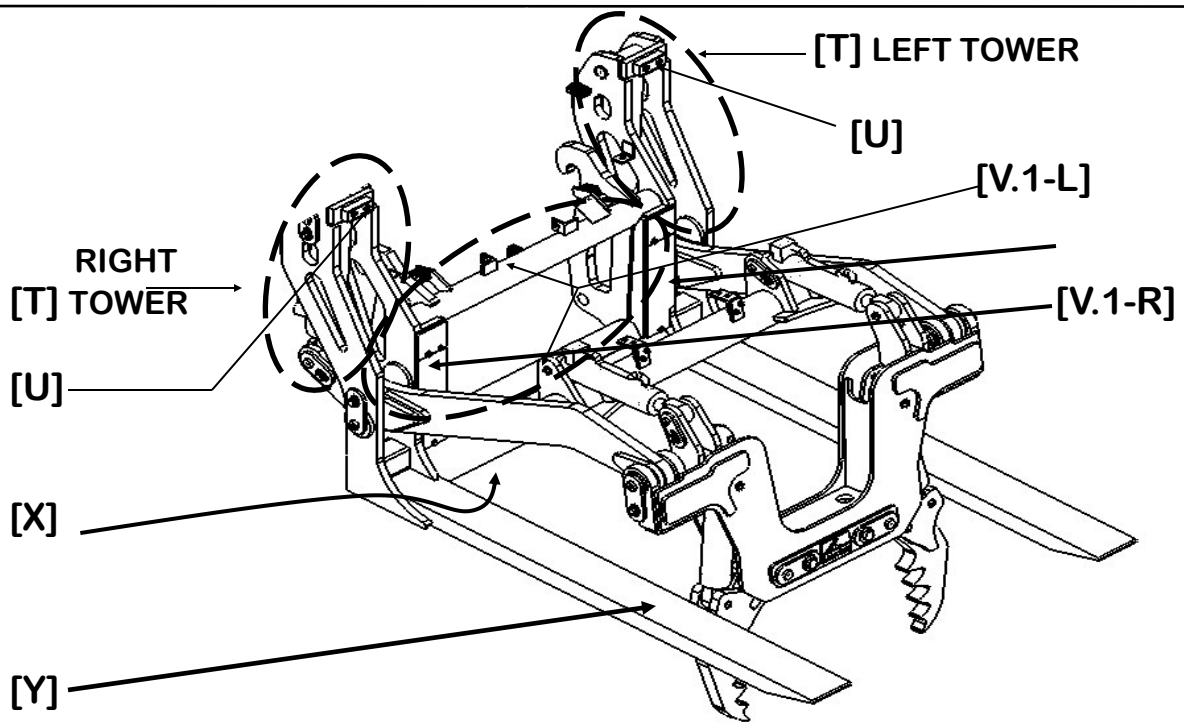
CYLINDER & PIN PARTS LIST (PAGE 23)
SAS™ SCORPION™-20 ENGINE PULLER

	DESCRIPTION	QTY	SAS BW PART NUMBER
[L]	**BOOM LIFT CYLINDER**	**2**	**HY-CYL-4.5X16.25-4K**
	L.1 INTERNAL SEAL REBUILD KIT FOR BOOM CYL	2	HK-4.5-203-870
	L.2 UPPER PIN (CYLINDER END ON BOOM CYL)	2	1112CARRIAGE ASY
	L.3 LOWER PIN (ROD END ON BOOM CYL)	2	1113BOOM ASY
	L.4 RETAINER BOLT BOOM CYL PINS	4	WBOLT 0.625X1.50 GR8
	L.5a WIDE FLAT WASHERS FOR RETAINER BOLTS	4 EA	WASHER-F 0.625 GRB
	L.5b LOCK WASHERS FOR RETAINER BOLTS	4 EA	WASHER-L 0.625 GR8
[M]	**MAIN BOOM PIVOT PIN**	**2**	**1113CARRIAGE ASY**
	M.1 RETAINER BOLT FOR BOOM PIVOT PIN	2	WBOLT 0.625X1.50 GR8
	M.2a WIDE FLAT WASHERS FOR RETAINER BOLTS	2 EA	WASHER-F 0.625 GRB
	M.2b LOCK WASHERS FOR RETAINER BOLTS	2 EA	WASHER-L 0.625 GR8
	M.4 BOOM PIVOT BUSHING	2	W-B3.002X3.750X4.750
[N]	**TILT CYLINDER**	**2**	**HY-CYL-3.5X10.25-4K**
	N.1 INTERNAL SEAL REBUILD KIT FOR TILT CYL	2	HK-3.50-203-869
	N.2 LOWER PIN (CYLINDER END ON TILT CYLINDER)	2	1112BOOM ASY
	N.3 UPPER PIN (ROD END ON TILT CYL)	2	1120TILT ASY
	N.4 RETAINER BOLT TILT CYL PINS	4	WBOLT 0.625X1.50 GR8
	N.5a WIDE FLAT WASHERS FOR RETAINER BOLTS	4 EA	WASHER-F 0.625 GRB
	N.5b LOCK WASHERS FOR RETAINER BOLTS	4 EA	WASHER-L 0.625 GR8
[O]	**MAIN TILT PIVOT PIN**	**2**	**1119TILT ASY**
	O.1 RETAINER BOLT FOR TILT PIVOT PIN	2	WBOLT 0.625X1.50 GR8
	O.2a WIDE FLAT WASHERS FOR RETAINER BOLTS	2 EA	WASHER-F 0.625 GRB
	O.2b LOCK WASHERS FOR RETAINER BOLTS	2 EA	WASHER-L 0.625 GR8
	O.4 TILT PIVOT BUSHING	2	W-B3.002X3.500X2.750
[P]	**CLAW CYLINDER**	**2**	**HY-CYL-03.5X10.25-4K**
	P.1 INTERNAL SEAL REBUILD KIT FOR CLAW CYL	2	HK-3.5-203-869
	P.2 UPPER PIN (CYLINDER END ON CLAW CYL)	2	1121TILT ASY
	P.3 LOWER PIN (ROD END ON CLAW CYL)	2	1103CLAW
	P.4 RETAINER BOLT FOR CLAW UPPER PIN	2	WBOLT 0.625X1.50 GR8
	P.5a WIDE FLAT WASHERS FOR RETAINER BOLTS	2 EA	WASHER-F 0.625 GRB
	P.5b LOCK WASHERS FOR RETAINER BOLTS	2 EA	WASHER-L 0.625 GR8
	P.7 RETAINER BOLT FOR CLAW LOWER PIN FOR ROD END	2	WPIN-SC CLAW
	P.8 LOCK WASHER FOR CLAW LOWER PIN FOR ROD END	2	WASHER-L 0.500 GR8
[Q]	**MAIN CLAW PIVOT PIN**	**2**	**1122TILT ASY**
	Q.1 REAR LOCKING EAR BRACKET	2	1006CARRIAGEPP-3152
	Q.2 GR8 LONG RETAINING BOLT	2	WBOLT 1.00X10.50 GR8
	Q.3 GR8 NYLOCKING NUT	2	WNUT 1.00-8-NY GR8
	Q.4 CLAW PIVOT BUSHING	2	W-B2.002X2.500X5.250

FRAMEWORK PARTS GUIDE (PAGE 24)
SAS™ SCORPION-20™ ENGINE PULLER



	DESCRIPTION		QTY	PART NUMBER
[T]	TOWER			N/A
[U]	BOOM SOLID REST PAD		2	N/A
[V]	CARRIAGE FRAME ASSEMBLY			N/A
	[V.1-L] LEFT VALVE BLOCK ACCESS PANEL		1	1125CARRIAGE-L
	[V.1-R] RIGHT VALVE BLOCK ACCESS PANEL		1	1125CARRIAGE-R
	[V.2] 3/8" BUTTON HEAD BOLT	(3 REQ.PER PANEL)	6	WBOLT 0.375X1.00 BTH
	[V.3] LOCK WASHER	(3 REQ.PER PANEL)	6	WASHER-L.375
[W]	UNASSIGNED			
[X]	SCRAPER BLADE		1	1110CARRIAGE
[Y]	BLADES		2	BTF-300-7.375-90-10T
[Z]	UNASSIGNED			

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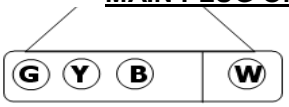
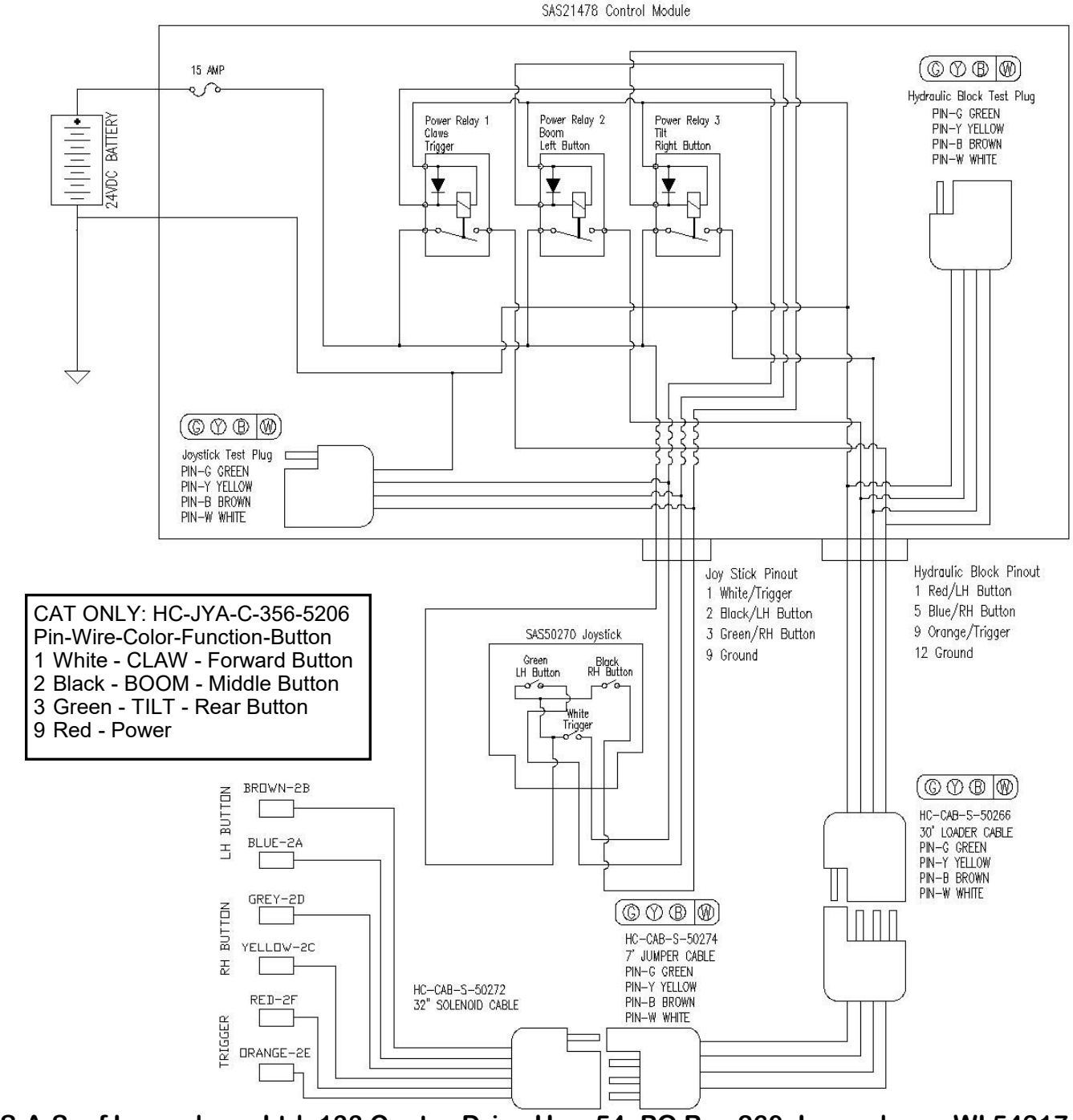
WIRING SCHEMATIC GUIDE (PAGE 25)
SAS™ SCORPION™ ENGINE PULLER

MAIN PLUG ON LOADER ARM (LEADING TO CONTROL BOX)



GREEN=BOOM POSITIVE WITH BUTTON PRESSED
YELLOW=TILT POSITIVE WITH BUTTON PRESSED
BROWN=CLAW POSITIVE WITH BUTTON PRESSED
WHITE= GROUND



CAT ONLY: HC-JYA-C-356-5206
Pin-Wire-Color-Function-Button
1 White - CLAW - Forward Button
2 Black - BOOM - Middle Button
3 Green - TILT - Rear Button
9 Red - Power

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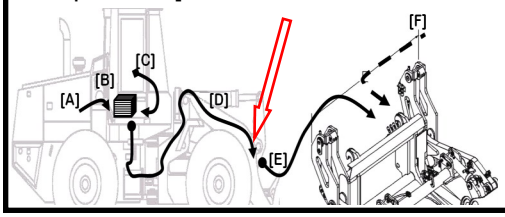
REPAIR FLOW CHART (PAGE 26)
SAS™ SCORPION™ ENGINE PULLER

⚠WARNING Hydraulic system may have stored energy. Electrical system is hazardous.
Be certain to follow all safety procedures and guidelines while trouble shooting.
Only qualified heavy equipment technicians should service this equipment.
Malfunctions of equipment can result in un-expected movements from stored energy. Failure to follow safe practices can result in property damage, injury or death.

Scorpion does not work properly or work at all?

1. Scorpion runs back words as compared to Operator Manual.
   - Yes → Cross over 3rd spool hoses
   - No ↓
2. Any visible hydraulic leaks on Scorpion or Loader?
   - Yes → Fix all leaks & start over
   - No ↓
3. Is the hydraulic tank fluid level full?
   - No → Fill with new & clean hydraulic fluid to full mark
   - Yes ↓
4. Is operator selecting & holding one button on Scorpion joystick down while moving 3rd spool lever to allow fluid flow?
   - No → Read Scorpion Manual. Keep a button pressed.
   - Yes ↓
4.1 Does function seem to drift or have low power?
   - Yes → Check each cylinder for that function for seal leak/bypass or rod/piston internal shear.
   - No ↓
5. Is jumper cable E secured between cable D on loader & Scorpion?
   - No → Secure cable E to D & F7
   - Yes ↓
6. Disconnect cable E from D. Attach 3-LED test light on forward test point on cable D on loader arm. [Engine off. Key 'on'. No joystick buttons pressed.] Are one or more of the LED lights powered on?



   - No → 6(a). Reconnect wire D & E. Engine on. Move 3rd spool lever. Are there signs that pressure is moving in lines?
     - No → Check hose connections & repair
     - Yes → Go to step 9
   - Yes ↓
7. Black relay set: Inside cab locate joystick test point. This flat 4 wire plug is near where joystick cable (smaller round plug) connects to the wire harness. Attach 3-LED test light on joystick test point.
   [Orange relay set: Watch for white lights inside control box.]
   Engine off. Key 'on'. No joystick buttons pressed.
   Are all three of the LED lights off?
   - No → Likely one of the joystick button contacts is damaged causing continuous contact. Replace joystick. p/n: HC-JYA-S-50270
   - Yes ↓
8. Black relay set: Inside cab locate relay test point. This flat 4 wire plug is near where cable D (larger round plug) connects to the wire harness. Attach 3-LED test light on relay test point.
   [Orange relay set: This skip to step 8]
   Engine off. Key 'on'. No joystick buttons pressed.]
   Are all three of the LED lights off?

   - No → Likely one of the relay contacts is bad causing continuous contact. Determine which relay by unplugging one relay at a time, until the LED goes off, and replace that one.
     Black p/n HC-BRL-H-4RD933332
     Orange p/n HC-BRL-S-RT314024
   - Yes ↓

Go to step 9

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REPAIR FLOW CHART (PAGE 27)
SAS™ SCORPION™ ENGINE PULLER

9. Engine off. Key 'on'. 3-LED test light connected to forward test point on cable D. Press 1 joystick button at a time; Does each of the three LED light up individually?

No → 9(a). Inside cab locate joystick test point. This flat 4 wire plug is near where joystick cable (smaller round plug) connects to wire harness. Attach 3-LED test light on joystick test point. Engine off. Key 'on'. Press 1 joystick button at a time; Does each of the three LED light up individually?

Yes

10. Does the customer's complaint include a comment that a function of the Scorpion quits periodically?' or sometimes it works and sometimes a function just won't work'?

No

Yes

11. Engine off. Key 'on'. Connect 3-LED to forward test point on cable D or joystick test point in cab. On joystick, press and hold the button that controls the Scorpion function that periodically fails, while moving the joystick lever forward & back. Watch LED light carefully, does it flicker?

Yes → Replace joystick & wire assy p/n: HC-JYA-S-50270

No

9(a). Yes

9(b). Inside cab locate relay test point. This flat 4 wire plug is near where cable D (larger round plug) connects to the wire harness. Attach 3-LED test light on relay test point. Engine off. Key 'on'. Press 1 joystick button at a time; Does each of the three LED light up individually?

Yes → Likely defect in cable D repair or replace. HC-CAB-S-50266-1

No → Identify individual defective relay and replace.

9(a). No → Is fuse, power & ground good?

Yes → Replace joystick HC-JYA-S-50270

No → Replace fuse, fix power & ground Go to step 6

12. Carefully inspect 7 FOOT jumper cable E (if equipped) for damage. Test for continuity of each wire. Is cable E good?

No → Replace cable E p/n: HC-CAB-S-50274

Yes

13. Carefully inspect plug & cable F on Scorpion. Is this cable visibly damaged?

Yes → Replace cable F
SC30 p/n: HC-CAB-S-50272
SC20 p/n: HC-CAB-S-50276

No

14. Cable E connected to cable D & F. Scorpion forks flat on ground, depressurize hydraulics. Sufficiently secure tilt and boom to prevent movement. Engine off. Remove service cover to access cable F and coils on hydraulic block. Connect 1-LED tester to one of the connectors for the function that is not working properly. If using standard test light, both leads must be connected, do not ground separately. (See valve block parts guide page). Key on. Press joystick button related to designated wire. Does 1-LED light up? Move LED tester to second connector & test second one.

No

Yes

15. Engine off. Key on. Remove coil. connect wire. Place steel screw driver inside coil. While the corresponding joystick button is pressed, does coil magnetize?

Yes → 16. Temporarily swap pair of coils & wires with another pair. Start engine. Test movements of Scorpion. Did problem move with the pair?

Yes → Go to step 1, Retest system, you missed something.

No → 17. Scorpion forks flat on ground. Engine off. Key off. Depressurize hydraulics. Sufficiently secure tilt & boom to prevent movement. Clean area to prevent dirt from entering hydraulic system. Have a qualified mechanic replace pair of cartridge valves. (If problem still present, then investigate cylinders for internal failure)

No → Replace coil

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TROUBLE SHOOTING (PAGE 28)
SAS™ SCORPION™ ENGINE PULLER

⚠WARNING Hydraulic system may have stored energy. Electrical system is hazardous. Be certain to follow all safety procedures and guidelines while trouble shooting. Only qualified heavy equipment technicians should service this equipment. Malfunctions of equipment can result in un-expected movements resulting from stored energy releases. Failure to follow safe procedures or practices can result in property damage, injury or death.

PROBLEM Key is 'on' & loader running, when I move the joystick, nothing works.

Fluid Checks:

STEP 1 Is hydraulic fluid level in tank of loader at proper level?
Yes - Go-to next step: No - Add needed fluid and retest.

STEP 2 Are hydraulic hoses properly attached from the wheel loader to Scorpion?
Yes - Go-to next step: No - Properly secure hoses from loader to Scorpion.

STEP 3 Some wheel loaders have hydraulic cut-outs, which turn off the 3rd spool when the other levers are moved. Is the operator only moving one lever in the cab at a time?
Yes - Go-to next step: No - Test only moving 3rd spool auxiliary hydraulic lever.

STEP 4 Check if your machine has a manual diverter valve at the front of the machine arms, where the auxiliary hydraulic function maybe shared with the quick coupler. Is the lever for this valve turned properly to divert fluid to Scorpion?
Yes - Go to next step. No - Move lever & lock in, to ensure fluid flow to Scorpion.

Electrical Control Checks:

STEP 5 Are you pressing & holding one button with moving the joystick?
Yes - Go-to next step: No - Proper operation requires to keep a button on the joystick pressed while moving joystick.

STEP 6 Are both front connectors properly plugged in? (cord D to E, and cord E to F)
Yes - Go-to next step: No - Properly attach wire connection and retest.

STEP 7 Attach a flat 4 wire 3 LED tester at end of cable D on wheel loader arm. Press one button at a time on the joystick. Did a LED light come on with each button?
Yes - Go-to step 12 No - Go to step 8

STEP 8 Do relay LED's light up in control box when joystick buttons are pushed?
No - Go-to next step. Yes - Inspect cable D connection at control box & inspect for damage. Replace cable if damaged.

STEP 9 Are all connectors for cables A, C, and D tightly secured to control box (B)?
Yes - Go-to next step: No - Properly attach & twist the outer lock to secure.

STEP 10 Is the fuse good between the power supply & control box?
Yes - Go-to next step: No - Replace fuse, and retest.

STEP 11 Check power source. Check ground source. Do you have good + / - source?
No - Fix source power and ground as needed. Yes - Contact local wheel loader service technician

⚠WARNING Before accessing Scorpion carriage service panel in step 12, be sure to secure boom to prevent becoming entangled in a pinch point, between the boom & carriage tower. Serious injury or death may result if proper safety precautions are not taken.

STEP 12 Check the wire leads in the Scorpion carriage, under the service access panel, that connect to each solenoid coil. When the buttons are pressed on the joystick, is there positive & negative in each pair of wires at the hydraulic block?
No—Replace carriage cable F Yes– Contact local wheel loader service technician.

TROUBLE SHOOTING (PAGE 29)
SAS™ SCORPION™ ENGINE PULLER

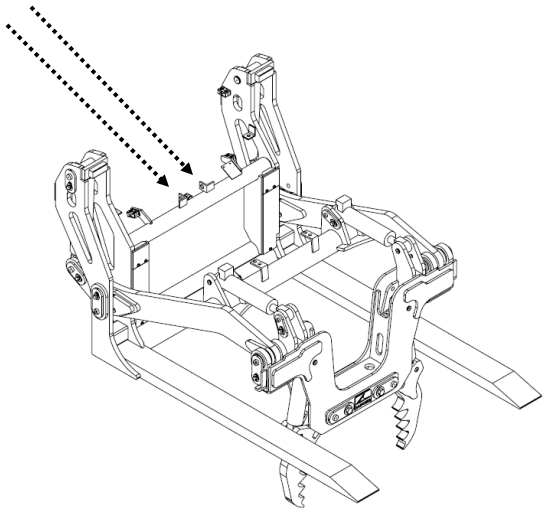
PROBLEM **The Scorpion parts move backwards—or opposite of the direction indicated in the manual.**

⚠WARNING Hydraulic system may have stored energy. Electrical system is hazardous. Be certain to follow all safety procedures and guidelines while trouble shooting.
Only qualified heavy equipment technicians should service this equipment.
Malfunctions of equipment can result in un-expected movements resulting from stored energy releases. Failure to follow safe procedures or practices can result in property damage, injury or death.

STEP 1 The main hydraulic lines routed from the wheel loader to the Scorpion are hooked up backwards to the Scorpion. Switch the two hoses where they connect to the Scorpion. Retest. Did that correct the problem?
Yes - End.
No - Go-to next step:

STEP 2 Check to be sure harness A, which provides the ground and power to the control box is hooked up properly. The wire with the fuse link should be positive power. The wire without the fuse should be ground. If the wires are not hooked up properly, then remove and hook up properly. Retest movement. Does the Scorpion work properly now?
Yes - End.
No - Go-to next step:

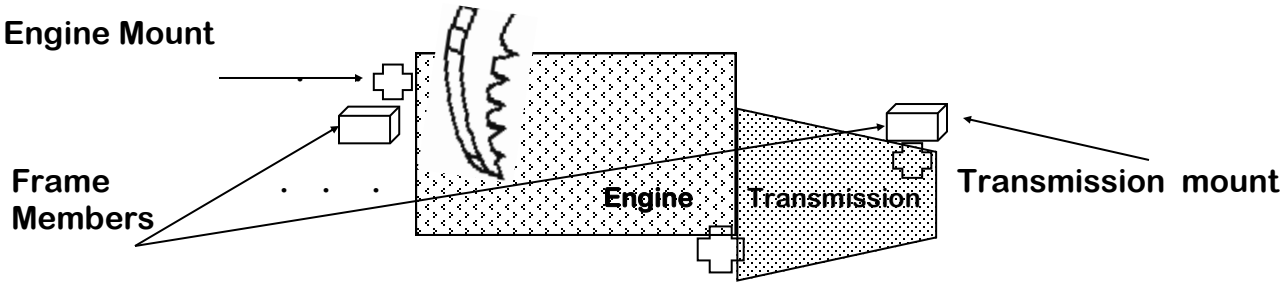
STEP 3 Contact a local wheel loader or hydraulics service technician or contact SAS with your Scorpion serial # for technical support.



TROUBLE SHOOTING (PAGE 30)
SAS™ SCORPION™ ENGINE PULLER

PROBLEM The Scorpion doesn't seem to have the power to pull engines out. The claws hold tight on the engine, but won't lift it out.

STEP 1 Check the fluid level in the hydraulic tank of the loader. Does the tank indicator show the fluid at the proper level?
No - Add needed fluid and retest.
Yes - Go-to next step:
STEP 2 Typically, immediately after installing the Scorpion, there may be air in the lines, which will reduce the effectiveness of the moving parts. Cycle the boom, tilt, and claws through the motions, completely from one position, to the other, several times. Then re-test at pulling an engine out. Did this resolve the issue?
Yes - End.
No - Go-to next step:
STEP 3 When grabbing the engine with the claws, try repositioning the claws on the far end of the engine, away from the transmission; typically on the block, near the timing chain. This will allow the Scorpion to lift one side of the engine.



breaking the side motor mounts, then gradually, breaking the center, and then opposite side motor mounts. Additionally, this method is the best method to successfully have the transmission come out with the engine at the same time, due to it will lift the engine side up and allow the transmission to pivot clear of the frame rail.
Did this method work better?
Yes—End.
No - Go-to next step.
STEP 4 Either inspect the tips of the claws or observe the front of the car to determine if you have the claws pushed too deeply into the engine compartment that you have hold of the frame or engine cross-member. This will result in the enter front of the car begin to bend, and try to be pulled up between the forks. Open the claws, and reposition, a bit less deep into the engine compartment to avoid grabbing the frame or cross-member. Did this work better?
Yes - End.
No - Go-to next step.
STEP 5 Contact a professional wheel loader service technician to see if your PSI on the auxiliary spool can be increased, but no greater than 4,000 PSI.
If that doesn't work, contact SAS with your Scorpion serial # for technical support.

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TROUBLE SHOOTING (PAGE 31)
SAS™ SCORPION™ ENGINE PULLER

PROBLEM The Scorpion claws won't hold onto the engine. The claws keep slipping off the engine.

STEP 1 Check the fluid level in the hydraulic tank of the loader. Does the tank indicator show the fluid at the proper level?
No - Add needed fluid and retest.
Yes - Go-to next step:
STEP 2 Typically, immediately after installing the Scorpion, there may be air in the lines, which will reduce the effectiveness of the moving parts. Cycle the boom, tilt, and claws through the motions, completely from one position, to the other, several times. Then re-test at pulling an engine out. Did this resolve the issue?
Yes - End.
No - Go-to next step:
STEP 3 Squeeze and hold the trigger, while the auxiliary function lever is pulled back. Continuously hold the trigger, while also selecting the boom lift button, then alternating to the tilt lift button, after the boom has reached it's full lift.
Did this technique resolve the issue?
Yes—End.
No—Go-to next step.
STEP 4 Contact a local wheel loader or hydraulics service technician or contact SAS with your Scorpion serial # for advice on the telephone.

PROBLEM The transmissions seem to break off often when pulling engines.

STEP 1 See #3.3 for resolution.

PROBLEM The hydraulic line connections for the auxiliary function on the loader arms pop off.

STEP 1 Typically this is a result of not engaging the line quick couplers fully. Check for dirt in the fittings that may not allow the fitting to fully engage.
Yes—End.
No—Go-to next step.
STEP 2 The fitting coupler may have an outside collar that may need to be rotated to lock in place. Check the fitting, and rotate as needed to lock in.
Yes—End.
No—Go-to next step.
STEP 3 Contact a local wheel loader or hydraulics service technician or contact SAS with your Scorpion serial # for technical support.

TROUBLE SHOOTING (PAGE 32)
SAS™ SCORPION™ ENGINE PULLER

PROBLEM The tilt, boom, or claws seem to move by themselves.

STEP 1 Are you selecting one of the buttons or trigger on the joystick before moving joystick?
No - Only move the joystick forward or back after you have selected one of the buttons or engaged the trigger. If you move the joystick without selecting one of these, you are sending the full pressure of hydraulic fluid into a closed valve control body, which will dead head the fluid and may cause some bleed by the solenoids.
Yes - Go-to next step:
STEP 2 Identify specifically which item is moving when that unit is not engaged. Do you have one function that is moving by itself consistently?
Yes - Replace the appropriate pair of solenoids cartridge valves in the valve block which control this specific function.
No - If this only happens very rarely, you may have dirt in your hydraulic system which is interfering with the solenoid valve closing and sealing properly. Be sure prior to connecting hydraulic fittings, that both ends are clean.
If problems persist; go-to next step:
STEP 3 Contact a local wheel loader or hydraulics service technician or contact SAS with your Scorpion serial # for technical support.

PROBLEM The claws on the Scorpion™ get misaligned or off-set to one side.

STEP 1 This is common due to the shared hydraulic lines between the two cylinders. This design is necessary to allow both claws to fully move into the engine compartment to secure against engine. To correct, be sure the claws are clear from the forks, then engage the claw function by squeezing the trigger, and pushing the joystick forward. This is cause the claws to spread apart. Keep engaged until claws move fully to open extended dead end. Did this get both claws even?
Yes - End.
No - Go-to next step.
STEP 2 Run claws from fully open to fully closed. Fully pressurize when in each direction to force claws to even out. Did this correctly even out claws?
Yes - End.
No—Go-to next step.
STEP 3 Check for interference by claws, such as broken auto parts, rocks, or other debris. Remove debris carefully with a pry bar. Do not place hands near any moving parts. Residual pressure may cause claws to move unexpectedly.
Yes - End.
No—Go-to next step.
STEP 4 Contact a local wheel loader or hydraulics service technician or contact SAS with your Scorpion serial # for technical support.

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TROUBLE SHOOTING (PAGE 33)
SAS™ SCORPION™ ENGINE PULLER

PROBLEM I either can't disconnect the hydraulic quick disconnect fittings on the loader or I can't connect them. I push real hard and they still won't come off / on.

⚠WARNING Hydraulic system may have stored energy. Be certain to follow all safety procedures and guidelines while trouble shooting. Malfunctions of equipment can result in unexpected movements resulting from stored energy releases. Only qualified heavy equipment technicians should service this equipment. Failure to follow safe procedures or practices can result in property damage, injury or death.

STEP 1 Is the loader engine turned off?
No - Turn off engine, and follow next step.
Yes - Go-to next step

STEP 2 Did you release the pressure from the lines by:

A. Placing the Scorpion™ flat on the ground. Set the parking brake on the loader.
B. Position the "Boom", "Tilt" and "Claws" so they are forward, gently resting on the ground or on the forks.
C. Shut off the engine of the loader and turn the key off.
D. Turn the key 'on' (without starting engine) then move each hydraulic control lever forward and back a few times.
E. Press each button on the joystick and move the joystick forward and back a few times.
F. Turn off the key; then briefly move joystick forward and back.

Now try to either remove or install the hydraulic lines (with gloves and safety glasses) Did this work?
Yes - End.
No - Go-to next step

STEP 3 Closely inspect the fittings, as they may have a twist lock feature. (Common on Volvo machines for example)
Yes - End.
No - Go-to next step

STEP 4 Closely inspect the fittings for damage or other reasons why they will not connect / disconnect. Try to resolve.
Yes - End.
No - Go-to next step

STEP 5 Contact a local wheel loader or hydraulics service technician at your expense, or contact SAS with your Scorpion serial # for technical support.

PROBLEM Hydraulic hose quick connect fitting pop off.

Follow STEPS 1,2,3,4, above.

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WELD NOTICE (PAGE 34)
SAS™ SCORPION-20™ ENGINE PULLER

⚠WARNING

DO NOT MAKE UNAUTHORIZED WELDS TO SAS FORKS™

To prolong the life of the SAS FORK™ assembly, do not weld on the forks except as shown in this diagram. Improper welding repairs can result in equipment failure resulting in injury or death. If you need to make any other repairs on the SAS FORKS™, please contact S.A.S. of Luxemburg, Ltd. Engineering and discuss the situation with them.

NOTICE

RECOMMENDED PRECAUTIONS TO TAKE PRIOR TO WELDING

-Weld repairs should only be performed by qualified individuals.
-Completely disconnect the Scorpion from the wheel loader before welding.
Do not weld if connected to wheel loader due to the risk of damage to the loader's electrical system.
-Disconnect hydraulic valve block electrical cord from the loader and carriage.
-Connect the welder ground directly to the part being welded. Avoid attaching ground across any pivot points; this may cause an arch to form damaging the pivot point.

LIMITED WARRANTY (PAGE 35)
SAS™ SCORPION™ ENGINE PULLER

SAFETY
Buyer accepts responsibility to; (1) Ensure that all personnel that will use and/or work in area of purchased product will read safety ID plate and Operators Manual For SAS (product) FORKS™ and the Machine Manufacturer's Operators Manual, prior to use; and (2) Ensure that all personnel follow the safety guidelines outlined on these materials. (3) To determine and compare the weight of the original machine's attachment, to the new SAS FORKS™ or other attachment purchased herein, and reduce the lift capacity as needed to accommodate the increase in the attachment weight if any. (4) Observe the most restrictive weight capacity specified on any machine and/or attachment. (5) Buyer has duty to inspect equipment & attachment regularly.
S.A.S. OF LUXEMBURG, LTD. IS NOT RESPONSIBLE FOR SAFETY IN THE FIELD.

GOALS OF THE S.A.S. OF LUXEMBURG, LTD. LIMITED WARRANTY PROCEDURE
·ASSURE MINIMUM CUSTOMER DOWNTIME by resolving the problem correctly on a timely basis.
·ASSURE END-USER CONFIDENCE while maintaining an equitable Warranty expense for both your company and SAS.
·PRODUCT IMPROVEMENT. We have an engineering staff ready to assist you. Call us at 1-877-SAS-FORK (1-877-727-3675)
Please call SAS before attempting any repair, modification, or questionable job applications.

LIMITED WARRANTY FOR SAS FORKS™

For products that S.A.S. of Luxemburg, Ltd. (SAS) manufactures, SAS warrants that such products conform to all specifications for materials and workmanship for the period of time indicated below, after delivery, when used in compliance with the SAS FORKS™ Operator Manual.

PRODUCT	LIMITED WARRANTY PERIOD	ITEM	COVERED
SCORPION™	1 year from original ship date	CARRIAGE & FRAME	DEFECTS IN MATERIALS & WORKMANSHIP
SCORPION™	90 days from original ship date	Hydraulic cylinders, controls, joystick.	DEFECTS IN MATERIALS

SAS does not warrant the products that it does not manufacture. Rather, all warranties, if any, for these products are supplied by the manufacture. SELLER EXPRESSLY DISCLAIMS ALL OTHER WARRANTIES, WHETHER EXPRESSED OR IMPLIED, INCLUDING THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

CALL FOR WARRANTY CONSIDERATION: To be considered for warranty repairs or replacement buyer must notify SAS of any warranty claim within 10 days after such claim arises, and prior to expiration of the warranty period and prior to the performance of any repairs being done, otherwise buyer waives all rights to such claim.
· Obtain the SAS Fork serial number & call SAS at 920-845-2198. Clearly describe the problem and the operation that was taking place when it occurred.
· Buyer is to return defective assembly, freight prepaid, or photographic evidence clearly showing the problem area and details of failure to SAS for review. When necessary, a factory representative may evaluate the problem in the field.

WHAT SAS WILL DO: SAS will examine the defective product, and the details of the failure. If SAS determines that the failure of materials or workmanship was proven to be within the terms of this limited warranty, SAS will, at it's option, repair or replace, FOB the factory, in Luxemburg, WI, USA, the defective product. If the product cannot be returned to the factory, SAS may approve field repair of defective product. SAS will approve an appropriate amount of hours and cost for the repair before authorizing repairs to begin. No provisions will be made for incidental damages, mileage, travel time, overtime, downtime, or special freight charges.

CONDITIONS THAT WILL VOID YOUR WARRANTY: Failures, which in our determination were the result of:
· Improper installation.
· Misapplication - See SAS FORKS™ Operator Manual.
· Misuse or Improper operation – See SAS FORKS™ Operator Manual.
· Exceeding the weight and/or lift limitation posted on the Identification Plate attached the SAS FORKS™.
· Negligence or Failure to perform routine inspection and/or maintenance as outlined in the SAS FORKS™ Operator Manual.
· Unauthorized modification, welding, burning, grinding, installation of non-factory skid plates, etc.
in the SAS FORKS™ Operator Manual or as provided in a written authorization directly from SAS factory Engineers.).
· Continued use after a malfunction of the hydraulic system in the forklift or loader.
· Accidental damage.

LIMITED WARRANTY REMEDIES: Buyer must notify SAS of any warranty claim within 10 days after such claim arises; otherwise buyer waves all rights to such claim. Unless agreed otherwise in writing. Buyer's sole remedy for breach of warranty is, at seller's option, the repair of the defect, or the providing of a replacement part F.O.B. seller's office. **Seller will not be responsible for costs of shipping, travel time, travel expense, dismantling or reassembling the product**. Further, seller will not be liable for any direct, indirect, consequential, incidental, or special damages arising out of a breach of warranty. These remedies are exclusive, and all other warranty remedies are excluded.

PROPRIETARY RIGHTS: All designs and other proprietary rights provided by SAS to Buyer are to remain the property of S.A.S., and Buyer shall honor all proprietary legends. Buyer agrees not to copy the design of S.A.S.™ Forks & SAS Scorpion or hire a third party to copy. S.A.S. may use product modification ideas suggested by user, without any obligation to originator of modification suggestion. If S.A.S. chooses to implement such product modification such becomes property of S.A.S. of Luxemburg, Ltd.

LIMITATION OF LIABILITY: The seller's price is based on the enforceability of this limitation of liability, and the buyer understands that the price would be substantially higher without this limitation. Seller shall have no liability to buyer for lost profits or for special, consequential, exemplary, or incidental damages of any kind, whether arising in contract, tort, product-liability, or otherwise, even if advised of the potential damages in advance.
· In no event shall seller be liable to buyer for any damages whatsoever in excess of the contract price.
· In the event that any warranty or warranty remedy fails of its essential purpose, or is held to be invalid or unenforceable for any reason, in consideration of the other provisions of this agreement, the parties understand and agree that all limitations of liability under this provision will nevertheless remain in effect.

SEVERABILITY: Any legally unenforceable provision may be severed from this agreement, and the remaining terms and conditions will be enforced as a whole.

SALES TERMS: SAS FORKS SALES TERMS document is included as part of this document. See www.sasforks.com/SalesTerms.pdf

Declaration of Conformity for CE Marking
EU Directive 2006/42/EC (Machinery Directive)

SAS FORKS
133 Center Drive Hwy 54
Luxemburg, WI 54217
USA

We declare that the products listed below conform to the listed provisions of the following Council Directives

Model	Description
Scorpion engine puller	Hydraulically actuated attachment for wheel loader used to extract vehicle engines for salvage operations

Conforms to the following directives:

2006/42/EC Machinery Directive

Date of CE Marking: 10/1/2012

Technical Construction File is maintained at:

SAS Forks
133 Center Drive Hwy 54
Luxemburg, WI 54217 USA

Paul Secker, President
S.A.S. of Luxemburg, Ltd.
DBA: SAS FORKS
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Luxemburg WI 54217-0260 U.S.A.

