

THIOKOL CORPORATION  
MODEL 1200-C  
OFF-HIGHWAY VEHICLES  
(From Serial No. 1622 on)

OPERATION, MAINTENANCE AND PARTS MANUAL

Supplied By

THIOKOL CORPORATION  
LOGAN DIVISION  
2503 NORTH MAIN STREET  
LOGAN, UTAH 84321  
Phone: (801) 753-0220

## INTRODUCTION

This manual is divided into two main sections. Part I covers vehicle operation, maintenance, adjustment and repair. Part II is the Parts Catalog which contains lists and illustrations of parts as they are used in the various vehicle assemblies. Both sections are preceded by a Table of Contents. Any differences which may exist between different model vehicles have been clearly indicated in the text and parts lists.

PART I

TABLE OF CONTENTS

MODEL 1200-C SPRYTE®

OPERATION AND MAINTENANCE MANUAL FOR VEHICLES  
EQUIPPED WITH FORD 300 CID ENGINE AND C-6 AUTOMATIC TRANSMISSION

<u>SECTION</u>		<u>PAGE</u>
	SPECIFICATIONS .....	1
I	OPERATING INSTRUCTIONS .....	2
	Pre-Starting Checks .....	2
	Starting Engine and Warm-up .....	2
	Driving Routines .....	3
	Stopping the Vehicle .....	3
II	MAINTENANCE PROCEDURES .....	4
	Engine and Engine Accessories .....	4
	Fuel System and Controls .....	4
	Suspension System .....	4
	Drive Line Components .....	5
	Drive Line Brake .....	5
	Electrical System .....	6
	Tracks .....	6
III	ASSEMBLY/DISASSEMBLY, TROUBLESHOOTING AND REPAIR OF THE STEERING DIFFERENTIAL .....	9
	Description and Operation .....	9
	Tools Required for Disassembly .....	9
	Alternatives to Thiokol Tools .....	11
	In-vehicle Adjustments and Repairs .....	12
	Disassembly of Steering Differential .....	13
	Drive Unit and Compensating Case Disassembly .....	15
	Bushing Replacement .....	15
	Pre-assembly Instructions .....	16
	Drive Unit and Compensating Case Assembly .....	17
	Measuring Drive Unit Assembly .....	18
	Determining Shim Pack .....	18
	Measuring Backlash .....	20
	Drive Axle Assembly .....	21
	Pinion Assembly .....	21
	Measuring Pinion Mounting Depth .....	21
	Checking Bearing Fit .....	22
	Assembly/Installation .....	23
	Bolt Torque Table .....	26

SECTION

PAGE NO.

III	ASSEMBLY/DISASSEMBLY, TROUBLESHOOTING AND REPAIR OF THE STEERING DIFFERENTIAL (CONT'D)	
	Common Adjustments and Repairs .....	28
	Troubleshooting .....	29
	Gear Tooth Contact Patterns .....	35
	Specifications .....	36
IV	STANDARD TOOLS .....	37
V	LUBRICATION INSTRUCTIONS .....	38
VI	SOME THINGS THE VEHICLE OPERATOR SHOULD KNOW .....	41

## SPECIFICATIONS

GENERAL: Thiokol Corporation's 1200-C Series off-highway vehicle is a track-laying type cargo and/or personnel carrier adapted for use over snow, marsh, muskeg and other marginal terrain.

<u>MODEL</u>	<u>WIDE TRACK</u>	<u>STANDARD TRACK</u>
1200-C (No. of passengers).....	2 to 10	2 to 10
Payload (passengers + cargo).....	1,900 lbs.	1,900 lbs.
Vehicle weight.....	6,548 lbs.	6,180 lbs.
Ground pressure: lbs./sq. in. at zero penetration		
Empty.....	0.736	0.876
Loaded.....	0.950	1.140
Total track area at zero penetration.....	8,900 in.	7,050 in.

### DIMENSIONS

Overall length.....	154 $\frac{1}{2}$ "	154 $\frac{1}{2}$ "
Overall width.....	118 $\frac{1}{8}$ "	99 $\frac{1}{2}$ "
Height with cab.....	84"	93" w/lights
Track width.....	45 $\frac{1}{8}$ "	36"
Ground clearance.....	11"	11"
Wheel tread width.....	73"	63 $\frac{1}{2}$ "

### PERFORMANCE DATA

Climbing ability:		
Dirt.....	to 100%	to 80%
Packed snow.....	to 80%	to 60%
Soft snow.....	to 55%	to 45%
Sidehilling ability.....	Approx. 75% of climbability	
Top speed.....	12.3 mph with standard 2.40:1 gear reduction. 16 mph with optional 1.83:1 gear reduction.	
Turning radius.....	15 ft.	15 ft.
Fuel consumption.....	2-5 gal. per hour of operation	
Fuel capacity.....	45 gallons	45 gallons
Engine.....	Ford 6-cyl., 300 cu. in., 170 hp O.H.V.	
Transmission.....	Ford C-6 3-speed automatic, aux. cooled	
Steering differential.....	Planetary controlled differential in oil bath	
Tire size.....	4.50/5.30 X 12 6-ply Monorail type (front, 8-ply)	

## SECTION I

### OPERATING PROCEDURES

#### PRE-STARTING CHECKS

Before starting the engine or driving the vehicle, the following items should be inspected:

Oil, fuel and coolant levels should be checked, and the area beneath the engine and drive line components should be inspected for any evidence of loss of lubricant or coolant.

All tires should be inspected for proper inflation (normally 90 psi).

Tracks should be inspected for proper tension and any damage from previous use. (Instructions for tightening tracks are given in the section on track maintenance.)

A short pre-trip inspection will always pay off and may prevent a serious breakdown in a remote area.

#### STARTING ENGINE AND WARM-UP

Place transmission shifting lever in "Park" position. Depress the accelerator pedal approximately 1/4 open and turn the ignition key clockwise.

To clear a flooded engine, depress the accelerator fully down and hold it in this position. Continue to crank the engine with the ignition key on until the engine clears and fires. After the engine has been cleared, it may be started in the normal manner.

Immediately upon starting the engine, check the oil pressure gauge to be sure oil is being supplied to the working parts of the engine. The oil pressure gauge should read at least 20 psi. If the reading is less than 20 psi, check the oil level and add oil as necessary.

Warm up the engine at approximately 1200-1500 rpm until normal (180°) operating temperature is reached. After the engine is running smoothly, check all accessories to make sure they are functioning properly (lights, windshield wipers, gauges, etc.) Under extremely cold conditions, make certain the vehicle is allowed sufficient warm-up time before placing any load on the engine or transmission.

## DRIVING ROUTINES

The vehicle is equipped with a 3-speed automatic transmission. Normal starts are made by using "Drive." Steering is accomplished through the planetary differential at the rear of the vehicle. The differential is actuated hydraulically by pulling the steering levers. A turn to the left is made by pulling the left lever. A turn to the right is made by pulling the right lever. The levers should be firmly pulled so that crisp, definite turns are executed. Extreme force on the steering levers will not tighten the turning radius of the vehicle. It is only necessary to apply enough force to the steering lever to actuate the planetary system. Excessive force only wears out the hydraulic cylinders. A pull of 10-20 pounds should produce a normal turn. At high speed, the levers should be handled lightly, as the steering is quick and responsive. A skid could result from rough handling.

Under very cold conditions, it is extremely important that the vehicle be handled carefully until all members of the drive train are warm. Remember, lubricants are stiff and steel is brittle at extremely cold temperatures. Acceleration should be gradual, and the steering levers should be engaged gently until the driving and steering mechanisms are warmed up.

## STOPPING THE VEHICLE

The vehicle can be slowed or brought to a stop by pulling both steering levers simultaneously. When both steering levers are actuated, the steering bands act as brakes, and the vehicle is stopped in the same manner as with conventional hydraulic brakes.

The vehicle is equipped with an emergency hand brake. This brake is very effective in holding the vehicle on steep grades while recovering from an engine stall. In an emergency, the hand brake can be used to check the vehicle's speed. In addition to setting the hand brake, the transmission should be in "Park" when leaving the vehicle unattended.

## SECTION II

### MAINTENANCE PROCEDURES

#### ENGINE AND ENGINE ACCESSORIES

The engine, transmission, starter and generator are manufactured by Ford Motor Company.

##### Air Cleaner

The air cleaner supplied is a heavy-duty oil bath type. To service, remove top wing nut and lift out filter. Drain and clean oil cup. Refill to level indicated with same weight oil used in engine. Wash filter assembly in solvent every third or fourth oil change. Service each time crankcase oil is changed; more frequently under severe dust conditions.

##### Oil Filter

The oil filter supplied is of the disposable cartridge type. At each engine oil change, remove filter by hand or with a suitable strap wrench and discard the old filter. Apply a light film of oil to the rubber seal of the new filter and screw the filter on by hand until it seals, then tighten 1/2 turn. DO NOT OVERTIGHTEN. Refill the crankcase, operate the engine and check for leaks. Use Fram PH-7 replacement filter.

#### FUEL SYSTEM AND CONTROLS

The vehicle operates best on gasoline with an octane rating of 80-96. The use of premium grade is not necessary.

The fuel filter, located at the top of the fuel pump, should be serviced every 200 hours. Unscrew the canister from the top of the fuel pump. Remove and discard the filter element. Push a new element firmly into place. Screw on the canister until it seals and tighten 1/4 turn.

#### SUSPENSION SYSTEM

The wheel hubs are provided with grease fittings so that grease may be flushed through the bearings. The grease seals are installed with the sealing lip turned outward to allow excess grease to escape. The bearings should be flushed daily when operating in mud, water, silt, etc. Use a waterproof bearing grease.

The wheel bearings should also be removed, cleaned and repacked approximately once a year. Use an "all temperature grease"

(Mil-G-10924A) for packing the bearings. When replacing hubs on spindles, care should be taken to insure that the grease seal is properly fitted on the shoulder of the spindle. The wheel bearings are adjusted according to standard automotive practice. Spin the hub as the slotted nut is tightened until a slight drag is noticed. Back off the nut approximately one hole to relieve the drag. Install cotter pin.

To remove a front wheel from the vehicle, it is necessary to disconnect the track at the lacing connection. When the vehicle is on a reasonably level surface, it is usually not necessary to disconnect the track to remove wheels other than the front ones. In some cases, removal of the wheel will be facilitated by slacking off the track tension adjustment. Wheel installation will be easier if the tire is not inflated until after installation.

### DRIVE LINE COMPONENTS

Maintenance of the drive line components should normally consist of regular lubrication and occasional adjustment of the bands in the steering differential. The adjustment of the steering bands is described in the section on steering differential maintenance and repair.

### DRIVE LINE BRAKE

Periodic cleaning and lubrication of the brake cable and linkage will both improve the operation and prolong the life of the brake. If the disc is running true and the pads are still serviceable, no other maintenance is required. In normal service, pads will only need replacing after prolonged use.

The following adjustments should be made when brake pads are replaced:

1. Measure the clearance between each pad and the disc. This measurement should be .030 inch. If adjustment is required, loosen the locknuts and turn adjusting screws until the proper clearance is obtained. Make sure the brake shoes are parallel to each other after adjustment has been made.
2. Tighten adjusting screw and locknut.
3. Connect the cable and actuate the brake to make sure it is functioning properly.
4. Grease the pivot shaft zerk fittings.

When replacing pads, examine all parts for signs of unusual wear, damage or corrosion. Replace any unserviceable parts. Refer to the appropriate parts list for identification of parts.

### ELECTRICAL SYSTEM

The electrical system is a 12-volt system using standard automotive components.

The ignition switch has three positions. With the key vertical, the switch is "off" and there is no electrical power to the vehicle. Turning the key counter-clockwise from the "off" position engages the "accessory" position and supplies power to all accessories (lights, wipers, gauges, etc.). Turning the key clockwise from the "off" position engages the "on" position.

A wiring diagram is shown in Figure 15-36 of the Parts Catalog.

### TRACKS

#### Track Tension

Track tension is not critical on this vehicle. Running with the tracks excessively tight will reduce power and consume excess fuel due to increased rolling resistance. The tracks should only be tightened enough to eliminate excessive jumping or slippage of the tracks on the drive sprockets. Occasional jumping of one tooth between the track and sprocket is normal. This happens most often in tight turning conditions. It will be necessary to readjust track tension after the first few hours of operation due to an initial stretch of the track belting. In addition, after 50 hours of operation, track bolts should be retightened to the following torque specifications: lacing cleat bolts, 20-25 ft. lbs.; cleat bolts, 25-30 ft. lbs.; and tire guide bolts, 75-80 ft. lbs.

It is difficult to give an exact setting for track tension because this varies somewhat with the temperature and environment in which the vehicle is operated. As a guide, the upper portion of the track should sag approximately 1/4 inch between adjacent wheels. Make this check only after driving the vehicle a few hundred yards and allowing it to coast to a stop. Tire pressure should be 90 psi when this check is made.

The only time it has been found necessary to run the tracks with more tension than described above is in severe terrain where muskeg, rocks and stumps are encountered during turning operations. In these conditions, the tracks should be tightened until the upper portion of the track has little or no sag

between wheels and the cleats make a slight impression in the front tires. After tightening the tracks, the vehicle should be driven a short distance. If the track tensions are unequal, the vehicle will tend to drift or veer slightly toward the side having the tighter track. Equalizing the tension will improve the directional stability of the vehicle and make it more pleasant to drive on long trips.

For long, cross-country runs where a minimum of turning and maneuvering is expected, a saving in gasoline and relief from track abuse can be gained by adjusting the track more loosely than normal.

#### If You Throw A Track

You run the risk of losing a track if you drive a vehicle into an area where the terrain is so uneven it causes the vehicle's tracks to become canted at sharp angles to the vehicle's body. A deeply-rutted dirt road may cause such a condition. A track partially in and partially out of a deep rut is tilted sharply out of its normally perpendicular relationship with the drive sprocket and wheels. When this occurs, you can literally drive the track right off of the vehicle.

If a track begins to come off while driving the vehicle up or down a slope in a canted position, stop the vehicle immediately. Before attempting to reposition the track, anchor the vehicle. If you lose a track going uphill or downhill, you will lose braking ability unless you pull both steering levers.

If the track has derailed to the inside of the tires rather than to the outside, it should be inspected to make sure it hasn't jammed before an attempt is made to move the vehicle. Attempting to move a vehicle with a jammed track may snap the track belting or drive axle. If the track is jammed and cannot be freed, it will have to be removed from the vehicle and repositioned manually. A tow vehicle or an anchored winch will be useful whenever a track has come completely off or must be removed from a vehicle.

#### Track Tension Adjustment

The vehicle should not be loaded while track adjustment is made. The front axle is mounted on sliding members at the forward end of the frame. Grease cylinders, which locate the sliding members, control the track tension. Apply grease through the grease nipple located on the side of the lower frame member to tighten tracks. To release track tension, remove grease fitting and allow grease to escape. It is helpful if you remove the grease zerk before undoing the belt lacing.

### Use of the Track Jacks

Two track jacks are provided with the vehicle. When connecting or disconnecting the belt lacings, one jack is placed on each side of the track to apply equal tension to the belts. By operating the jacks simultaneously, in small increments, the ends of the track sections can be brought together and the hinge bolts can be inserted or removed.

### SECTION III

## ASSEMBLY/DISASSEMBLY, TROUBLESHOOTING AND REPAIR OF THE STEERING DIFFERENTIAL

### DESCRIPTION AND OPERATION

The steering differential is a planetary controlled differential which provides directional and braking control for the vehicle. There are two steering drums within the differential. The right drum controls the rotation of the right rear axle and the left drum controls the rotation of the left rear axle. This control is achieved by actuating the hydraulically-controlled steering brake bands on either or both drums.

When the vehicle operator pulls the right-hand steering lever to make a right turn, the right steering brake band tightens around the right steering drum. With the right drum stationary, speed in the right track drops by one-third. Speed in the left track simultaneously increases by one-third and the left track powers the vehicle into a right turn. When the vehicle operator pulls both steering levers simultaneously, the brake bands tighten over both drums and the vehicle is stopped in the same manner as with conventional hydraulic brakes.

The differential unit itself utilizes six external and six internal pinions, as well as two compensating gears, to allow independent rotation of either steering drum while the other drum is slowed or stopped during a turn. In addition, an outboard reduction system is incorporated with the differential assembly to increase overall gear reduction.

### TOOLS REQUIRED FOR SERVICING STEERING DIFFERENTIAL

Thiokol offers a tool kit which includes specially designed tools for servicing items peculiar to the steering differential. These tools provide the mechanic in the field with everything necessary--over and above the standard tools in the mechanic's inventory--to completely disassemble the steering differential, check or correct critical specifications, make needed repairs and reassemble the unit in the shortest possible time. Of course, major repairs to the unit necessitate a well-equipped shop which includes an overhead crane or some form of heavy lifting equipment. In the section which follows this list, alternatives to the Thiokol tools have been provided for vehicle owners who do not have the complete kit.

<u>TOOL</u>	<u>PART NO.</u>	<u>FUNCTION</u>
Torque wrench	2130040	Bolt torque values in unit range from 12-140 ft. lbs.
Dial indicator	2130039	Measure backlash, steering drum runout
Lifting sling	2130038	For lowering drive unit ass'y into case and lifting ass'y out of case when double chain sling does not have proper clearance.
Double chain sling	2130037	For lifting drive unit ass'y. NOTE: THIS SLING SHOULD BE USED FOR ALL LIFTING OF THE DRIVE UNIT ASS'Y OTHER THAN THE ACTUAL LOWERING OF THE UNIT INTO THE CASE.
Spanner wrench	2130036	For removing drive unit bearing lock nuts when unit is out of case.
Puller	2130035	For bearing and external pinion removal.
Nut wrench tool (4)	2130034	Used in place of unitorque nuts when drive unit ass'y shim pack and backlash are being determined.
Nut and washer holder	2130033	Used to start nuts on bolts within the drive unit case where there is too little clearance to position nuts by hand.
Curved torque wrench extension (right-hand)	2130032-2	For torquing hard-to-reach nuts in drive unit case.
Curved torque wrench extension (left-hand)	2130032-1	For torquing hard-to-reach nuts in drive unit case.
Bearing lock nut removal tool (internal spanner)	2130031	Removal of drive unit bearing lock nuts while unit is in case.

<u>TOOL</u>	<u>PAR. NO.</u>	<u>FUNCTION</u>
Lifting beam	2130030	Used to support drive unit while it is in case, particularly when shim width is being determined.
Bearing puller plug	2130029	Used with puller to remove drive unit ass'y bearings.
Gasket and shim alignment tool	2130028	Used for quick alignment of gaskets and shims with bolt holes.
Steering band securing hooks	2130027	Used to hold steering bands in place on drums.
Bearing driver	2130026	Used for installing drive unit ass'y bearings.

#### ALTERNATIVES TO THIOKOL TOOLS

In addition to the standard tools normally found in a mechanic's inventory, servicing the steering differential will require a torque wrench with a torque range from 12-140 ft. lbs., a dial indicator and an adjustable puller. The list below offers alternatives to the specialized Thiokol tools mentioned in the previous section.

<u>THIOKOL TOOL</u>	<u>ALTERNATIVE TOOL</u>
Lifting sling	Any lifting sling capable of supporting 200 pounds which can be wrapped around the center of the drive unit ass'y so the unit can be tilted as it is being lowered into the case.
Double chain sling	Any chain sling with two hooks capable of supporting up to $\frac{1}{2}$ -ton (1,000 lbs.)
Nut wrench tool (4)	These tools are simply 5/8-11 NC nuts welded onto 12-inch metal handles. The tools save time and bolt/nut wear when determining shim pack width and backlash.
Nut and washer holder	A magnet on a handle can be substituted.
Bearing driver	A piece of pipe approx. 2 3/4" in diameter and 6" long.
Spanner wrench	Any 2" to 4 3/4 " adjustable spanner

### THIOKOL TOOL

Lifting beam

Bearing puller  
plug

Steering band  
securing hooks (2)

Gasket and shim  
alignment tool

Bearing nut  
removal tool  
(internal spanner)

Curved torque  
wrench extensions

### ALTERNATIVE TOOL

A 2 x 4 with two holes drilled in it at the points which would intersect the outside edges of the steering drums. Install two hooks through the holes with threaded shafts so that the drive unit ass'y height in the case can be adjusted by loosening or tightening the nuts on the hooks.

Any plate or block approx. 2" in diameter which can be held in place against the drive unit ass'y main bearing shaft and not interfere with bearing removal.

Coat-hanger wire or any flexible wire of similar gauge.

Any straight, rigid rod of smaller diameter than the bolt hole.

This is a specially designed single-purpose tool for which there is no ready substitute. The only method of removing the drive unit ass'y bearing lock nut while the unit is inside the case is with a chisel or punch. Great care must be taken not to damage the drive unit case if this method is used.

Straight box-end torque wrench extensions.

### IN-VEHICLE ADJUSTMENTS AND REPAIRS

The following adjustments and repairs can be made without removing the steering differential from the vehicle:

1. Steering band adjustment
2. Steering band replacement
3. Slave cylinder replacement or repair
4. Drive axle assembly repair or replacement, including replacement of oil seals, gaskets, bearings and the drive axle itself.
5. Drive axle housing repair or replacement, including replacement of gaskets and the drive axle housing itself.

6. Pinion assembly repair or replacement, including replacement of pinion oil seals, bearings, shims and pinion gear itself. NOTE: If pinion gear is replaced, backlash must be checked and set to specifications. This will require removal of the steering differential from the vehicle.
7. Backlash can be checked while the steering differential is mounted to the vehicle, but it cannot be adjusted unless the differential is removed from the vehicle.

## DISASSEMBLY OF STEERING DIFFERENTIAL

### Pre-disassembly Procedure

Complete disassembly of the steering differential requires removal of the unit from the vehicle. This means both tracks will have to be removed and the oil will have to be drained. Differential lubricant runs from the drive unit case through the outboard reduction housings to the bearings at the end of the axle housings. To drain the oil, remove the 3/4" magnetic drain plug located at the bottom rear of the drive unit case. When the case oil has completely drained, remove the 1/8" drain plugs located at the bottom rear of the inner outboard reduction cases. When the oil has completely drained from the outboard reduction cases, clean and replace all drain plugs.

1. Disconnect hydraulic slave cylinders from drive unit case lid. Mark cylinders to indicate proper position for reinstallation.
2. On vehicles equipped with heavy duty differential cooling, disconnect cooling system hoses at hose fittings. Disconnect wire from temperature sending unit. Do not remove hose fittings unless fittings are damaged and need replacement.
3. Remove 4 rubber mount hex head capscrews. These bolts run through the drive unit support brackets on the right and left sides of the drive unit case. The bolts have rubber bushings and spacing shims which have been installed at the factory to evenly mount the steering differential unit. Keep the bolts, bushings and shims together so they may be reinstalled in their original positions.
4. Remove outboard reduction housing guards, 4 bolts each.
5. Place floor jack under drive unit assembly or attach drive unit to an overhead crane.

6. Remove drive shaft from pinion shaft end yoke.
7. Remove 8 bolts (4 each side) which connect drive axle housings to lower chassis frame. Jack or block up rear of vehicle to remove steering differential.
8. Using overhead crane or floor jack, remove entire steering differential assembly from vehicle.
9. Remove 8 bolts (4 each side) which connect drive axle assembly to axle housings.
10. Remove drive axles from axle housings.
11. Remove 12 bolts (6 each side) which connect axle housings to outer outboard reduction cases.
12. Remove 28 bolts (14 each side) which connect outer outboard reduction housing cases to inner outboard reduction housing cases. It is likely that these two covers will have to be pried off. Use caution. The cover is aluminum and its mounting face is easily scored.
13. Remove bearings and gears from reduction housings. If necessary, use a suitable puller to remove bearings.
14. Remove stub shafts (2).
15. Remove 2 steering band adjusting nuts.
16. Remove steering lever and pushrod assemblies.
17. Remove drive unit case lid (18 bolts).
18. Remove 6 bolts (3 each side) which connect drive unit case support brackets to drive unit case.
19. Remove 8 bolts in pinion shaft mounting assembly and pull complete pinion assembly from case. Save the shim pack. If difficulty is encountered removing the pinion assembly, two threaded holes have been drilled in the pinion assembly bearing retainer to aid removal. The holes are tapped for a 3/8-16 NC bolt.
20. Remove 8 bolts (4 each side) which connect the inner outboard reduction housing case to the drive unit case.
21. Disconnect brake band rods from steering brake bands and remove rods and springs.
22. Disconnect steering brake bands from anchor plates and remove bands.

23. Remove 8 bolts (4 each plate) connecting anchor plates to drive unit case.
24. Attach lifting sling (Part #2130038 or alternative) to drive unit assembly and attach sling to overhead crane or winch.
25. Remove inner outboard reduction housings using a soft mallet.
26. Remove drive unit assembly from drive unit case. Tilt the unit toward the ring gear side and it will clear the sides of the case. Once the unit is out of the case, set it in a stable place and substitute the double chain sling (Part #2130037 or alternative) for all further lifting of the drive unit assembly outside of the case.

#### DRIVE UNIT AND COMPENSATING CASE DISASSEMBLY

1. Remove bearing locknuts and locking washers from both sides of drive unit assembly.
2. Use a puller to remove bearings from both sides of drive unit assembly.
3. Remove spacing washers and shims, taking care to keep right and left shim packs together so they may be reinstalled in their original positions.
4. Slide off steering drums.
5. Remove cotter pins from 6 external pinion nuts (3 each side) and remove 6 pinion nuts.
6. Remove 6 external pinions (3 each side) with suitable puller.
7. Mark compensating case in its original position with center punch.
8. Remove 6 bolts (3 each side) holding compensating case together. Internal pinions and compensating gears can now be removed for bushing inspection.

#### BUSHING REPLACEMENT

The compensating case cover internal pinion bushings should give a .004 to .005 inch clearance. If bushings are found to be worn beyond this tolerance, they should be replaced. Be sure to drill new oil holes when installing new bushings. After oil holes have been drilled, the compensating case should be bolted together and the bushings line reamed to give a .004 to .005 inch clearance.

If compensating case cover bushings are replaced, be sure to drill new oil holes and ream bushings to the .004-.005 inch tolerance. New steering drum bushings will not have to be reamed after installation if care is used when pressing the bushings in.

ASSEMBLY AND INSTALLATION OF STEERING DIFFERENTIAL

PRE-ASSEMBLY INSTRUCTIONS

Thiokol recommends that all gaskets, seals, ball and roller bearings, unitorque nuts and elastic stopnuts be replaced before the steering differential is reassembled. Replacement of these parts will extend the service life of the differential. A list of standard replacement parts, including part number, quantity required and part description, follows:

<u>PART #</u>	<u>QUANTITY</u>	<u>DESCRIPTION</u>
1209230	14	5/8-11 NC unitorque locknut for bolts connecting inner outboard reduction housing to drive unit case.
01528-28	8	1/2-20 NF unitorque locknut for bolts which mount outboard reduction housing guards
01525-40	2	1/2-20 NF elastic stopnut, steering band adjusting nut
01525-38	8	3/8-24 NF elastic stopnut for bolts connecting anchor plate to drive unit case
01525-41	8	9/16-18 NF elastic stopnut for bolts which connect axle housing mounting brackets to lower chassis frame
01525-39	4	7/16-20 NF elastic stopnut for bolts which connect drive unit case mounting brackets to chassis
0609106	2	Steering band rod seal
1209099	1	Drive pinion ass'y oil seal
01710-04	2	Drive axle ass'y oil seal
1209172	2	Ball bearings, main drive unit ass'y bearings
1209104	1	Ball bearings, drive pinion ass'y
1209143	1	Roller bearings, drive pinion ass'y

<u>PART #</u>	<u>QUANTITY</u>	<u>DESCRIPTION</u>
1209195	8	Ball bearings, outboard reduction gear bearings (4 each side)
0101739	2	Ball bearings, drive axle
2109144	2	Retainer collar, drive axle bearings
1209125	2	Gasket, anchor plate
1209192	1	Gasket, drive unit case lid
1209194	2	Gasket, install between axle housing and outer outboard reduction housing
1209191	2	Gasket, install between inner and outer outboard reduction housings
1209134-1	2	Gasket, install between inner outboard reduction and drive unit case
1209069	2	Gasket, install between drive axle ass'y and axle housing
1209127	1	Gasket, install between drive pinion bearing stop and bearing retainer. NOTE: <u>FOR 5.44 DIFFERENTIALS ONLY</u>

#### DRIVE UNIT AND COMPENSATING CASE ASSEMBLY

1. Stand compensating cover on end with ring gear teeth facing up.
2. Install compensating gear with long bearing side into cover (facing down).
3. Install compensating gear washer on short bearing side (facing up).
4. Install compensating case and center spacing washer.
5. Install other compensating gear with short bearing side and compensating gear washer into case.
6. Install internal pinions. Align keyways with center of compensating case, keyways facing away from center of case. NOTE: keyways cannot be aligned exactly straight, but will be off-center about one-half tooth.
7. Install other compensating case cover and case thru-bolts. Heads of bolts must be next to tapered end of pinion shafts.

8. Drive case cover dowels into place, aligned with center punch position marks.
9. Tighten thru-bolt nuts and install cotter pins.
10. Install wodruff keys, external pinions, nuts and cotter pins.
11. Install steering drum gear washers and steering drums. Test to see if drive unit assembly turns freely without binding. If unit does not turn freely, check tightness of thru-bolt nuts. When nuts are evenly tightened, assembly should turn freely.
12. Complete assembly by installing spacers, shims, ball bearings, locking washers and locknuts in their original positions.

#### MEASURING DRIVE UNIT ASSEMBLY

Complete drive unit assemblies shipped from Thiokol are pre-measured at the factory. However, if the vehicle owner rebuilds or repairs major components of his existing drive unit assembly, the width will have to be measured before the unit is installed in the case. This measurement is necessary for determining the shim pack needed to establish proper backlash. Before attempting to measure drive unit assembly width, the unit should be completely assembled, with steering drums, bearings, spacers, locking washers and locknuts in place. No shims should be installed. A height gauge and surface plate will be needed to determine the width.

1. Stand drive unit assembly on end on surface plate. It doesn't really matter which end, but the unit will be more stable if the ring gear side is down (gear teeth facing up).
2. Using height gauge, measure distance from outer bearing race to outer bearing race. Compute distance to thousandths of an inch (three decimal places).
3. See procedure for determining shim pack width.

#### ASSEMBLY AND INSTALLATION OF STEERING DIFFERENTIAL (DETERMINING SHIM PACK)

NOTE: THIS PROCEDURE IS USED WHEN INSTALLING A COMPLETELY NEW DRIVE UNIT ASSEMBLY SUPPLIED BY THIOKOL. COMPLETE DRIVE UNIT ASSEMBLIES SHIPPED FROM THE FACTORY HAVE BEEN PRE-MEASURED AND THE WIDTH DIMENSION WITHOUT SHIMS HAS BEEN ETCHED ON THE RING GEAR. THE SAME FORMULA APPLIES TO DRIVE UNIT ASSEMBLIES REBUILT OR REPAIRED BY THE VEHICLE OWNER, WITH THE EXCEPTION THAT THE DRIVE UNIT ASSEMBLY WILL HAVE TO BE MEASURED BY THE MECHANIC IN THE FIELD.

1. Record the drive unit case width. Width is stamped on the upper right rear of the case, just below the case lid mounting face.
2. Record the inner reduction housing dimensions stamped on the top center of the gear housings.

3. Record the width of the drive unit assembly, etched on the ring gear. The width is recorded in the following format: "TC 14.XXX w/o". "W/O" means "without shims."
4. Add the two inner reduction housing dimensions together.
5. Subtract total in Step 4 from the case width (Step 1).
6. To account for the thickness of the gaskets used between the inner reduction housing and the drive unit case, add .030 (.015 for each gasket) to the figure from Step 5. Round off figure to 3 decimal places.
7. Subtract drive unit assembly width (Step 3) from the figure obtained in Step 6. The resultant figure is the total shim width needed. Divide this figure by 2 to get the shim width for each side of the drive unit ass'y.

EXAMPLE

Drive unit case width (Step 1) is 16.6159

Inner reduction housing dimensions are .9074 and .9077 (Step 2)

Drive unit assembly width (Step 3) is 14.759

Step 4. Add reduction housing dimensions together	.9074
	+ .9077
	1.8151

Step 5. Subtract total in Step 4 (1.8151) from case width (16.6159).	16.6159
	- 1.8151
	14.8008

Step 6. Add thickness of two gaskets to figure obtained in Step 5 (.015 + .015 = .030) and round off to 3 decimal places	14.8008
	+ .030
	14.831

Step 7. Subtract drive unit assembly width (Step 3) from figure obtained in Step 6.	14.831
	- 14.759
	.072

Divide the figure obtained in Step 7 by 2, and you have the width of the shim packs for the right and left sides of the drive unit assembly: .036 per side.

NOTE: Minimum backlash should be from .006 to .009 with no more than .008 difference between the minimum and maximum readings. Example: Minimum backlash is found to be .007. Maximum backlash should be no greater than .015 (.007 + .008).

7. If backlash is not within specifications, remove inner reduction housings from case. If the shop has the bearing locknut removal tool (Part #2130031), shims can be redistributed with the drive unit assembly in place. If the tool is not available, follow Steps 8-11.
8. Remove drive pinion assembly from case.
9. Remove drive unit assembly from case.
10. Remove bearing locknuts, locking washers and bearings from drive unit assembly.
11. Redistribute shims to correct backlash error. Add more shims to the ring gear side to decrease backlash. Remove shims from the ring gear side to increase backlash. Repeat Steps 1-6.

#### MEASURING BACKLASH

During reassembly, correct spacing of the drive unit assembly within the drive unit case must be made to insure proper backlash between the ring gear and drive pinion. Backlash is determined as follows:

1. Lower drive unit assembly into drive unit case.
2. Install inner outboard reduction housings with gaskets to drive unit case. It is not necessary to install all of the 14 bolts which mount the inner reduction housing to the drive unit case. Six bolts, positioned as shown, will suffice. Use nut wrench tools (Part #2130034) if available. If the shop does not have the nut wrench tools, use the old unit torque nuts and torque bolts to 50 ft. lbs.
3. Install drive pinion assembly with shims to drive unit case. Use No. 2 gasket sealer on case pinion assembly mounting face. Torque bolts to 21 ft. lbs.
4. Clamp dial indicator to drive unit case and position dial indicator head as shown. Mark first ring gear tooth to be measured with chalk or marking pen.
5. Place right hand on pinion end yoke, exerting slight outward pressure (pulling away from case) on end yoke of 6.14 gear ratio units or inward pressure (pushing into case) on end yoke of 5.44 gear ratio units.
6. Zero dial indicator with point of indicator on ring gear tooth. With right hand, rotate ring gear clockwise (to the right) until it fully engages with pinion and stops. Take reading on dial indicator. For optimum accuracy, take several readings on each tooth measured. Repeat this procedure every fourth or fifth tooth on the ring gear until you have completed one full revolution of the gear.

### DRIVE AXLE ASSEMBLY INSTRUCTIONS

1. Install double-lipped seal in bearing retainer plate.
2. Slide retainer plate onto axle shaft.
3. Press bearings onto axle shaft.
4. Press shrink ring onto axle shaft. Make sure assembly is snug against retainer plate.

In order to replace drive axle bearings and seals, the shrink ring must be cut from the axle shaft with a chisel. The bearings can then be pressed off.

### PINION ASSEMBLY INSTRUCTIONS

1. Press roller bearing onto pinion shaft. NOTE: If any numbers are stamped on the inner bearing race, install bearing with numbers facing the pinion gear.
2. Install large spacer with relief end facing toward the pinion gear.
3. On units with 6.14 ratio, install seal in bearing housing.
4. Install ball bearing in bearing retainer. NOTE: If any numbers are stamped on the inner bearing race, install bearing with numbers facing away from pinion gear.
5. On units with 6.14 ratio, install snap ring in bearing housing.
6. Press bearing retainer assembly onto pinion shaft.
7. Install spacer and end yoke.
8. Install spacer and pinion shaft nut. Tighten nut and align with cotter pin holes. Install cotter pin.

### MEASURING PINION MOUNTING DEPTH

1. Stand pinion assembly on surface plate with gear end up.
2. Using height gauge, measure distance from bearing housing inner mounting face to inner roller bearing race (inner race faces pinion gear).
3. Add 6.375 to dimension obtained in Step 2. 6.375 inches is the distance from the center of the differential bearing bores to the forward face of the pinion gear.
4. Subtract the figure obtained in Step 3 from the number stamped on the drive unit case pinion housing. The difference obtained is the width of the shim pack needed.

## CHECKING BEARING FIT

Thiokol recommends replacement of all bearings whenever the steering differential is disassembled for major servicing. However, even though the vehicle owner may intend to install all new bearings, the old bearings should be inspected for signs of unusual wear. In some cases, bearings inspected may have a brownish discoloration or film either on the outer face of the outer bearing race or on the inner face of the inner bearing race. This brownish discoloration indicates abnormal friction is occurring between the outer bearing race and the bearing housing or the inner race and the shaft or hub on which the bearing is mounted. Within the steering differential, there are 10 critical areas of inspection with regard to bearing fit. The areas and their respective measurements are as follows:

NOTE: ACCURATE MEASUREMENT OF THE AREAS LISTED BELOW REQUIRES PRECISION MEASURING INSTRUMENTS CALIBRATED TO A KNOWN STANDARD. AN OUTSIDE MICROMETER IS NEEDED FOR MEASURING SHAFT DIAMETERS. AN INSIDE MICROMETER OR DIAL BORE GAUGE IS NEEDED FOR MEASURING HOUSING DIAMETERS. BEFORE ANY SUCH MEASUREMENTS ARE TAKEN, THE STEERING DIFFERENTIAL SHOULD BE ALLOWED TO STAND AT ROOM TEMPERATURE (60-80 DEGREES) FOR 6 HOURS.

1. Outside diameter of the pinion shaft at the point where the pinion roller bearings are mounted. Measurement: 1.9684" to 1.9688"
2. Outside diameter of the pinion shaft at the point where the pinion ball bearings are mounted. Measurement: 1.7715" to 1.7720"
3. Outside diameter of the shaft on which the drive unit assembly ball bearings are mounted. Measurement: 2.1653" to 2.1659"
4. Outside diameter of the hubs of the reduction gears on which the reduction gear ball bearings are mounted. Measurement: 2.7558" to 2.7564"
5. Outside diameter of the drive axle shafts at the point where the ball bearings are mounted. Measurement: 1.9684" to 1.9689"
6. Inside diameter of the drive unit case pinion housing at the point where the roller bearings seat. Measurement: 4.3307" to 4.3316"
7. Inside diameter of the pinion bearing housing at the point where the ball bearings seat. Measurement: 3.9369" to 3.9377"
8. Inside diameter of the inner reduction case bearing housings at the point where the drive unit assembly ball bearings seat. Measurement: 4.7243" to 4.7251"
9. Inside diameter of the inner and outer reduction case bearing housings at the point where the reduction gear bearings seat. Measurement: 4.3306" to 4.3314"

10. Inside diameter of the drive axle housings at the point where the drive axle bearings seat. Measurement: 3.5432" to 3.5440"

If the steering differential has a bearing problem and inspection of the unit reveals measurements which are not within the tolerances listed above, contact the Thiokol factory service department.

#### ASSEMBLY AND INSTALLATION OF STEERING DIFFERENTIAL

The following procedure assumes that drive unit assembly width, pinion mounting depth, shim pack width and backlash have been determined at the appropriate assembly stage. These procedures are explained in detail in other sections of this manual. Refer to the procedures mentioned above at the appropriate assembly stage.

---

**NOTE:** Unless otherwise specified, lubricate all bolt threads with 30W oil before installation. A chart listing the size, part number, function, quantity, torque value and any special instructions for every bolt used in the steering differential follows this procedure. Refer to the chart if any doubt exists as to the placement, torque value, lubrication or function of any bolt.

---

1. Inspect drive unit case to make certain no washers, nuts or debris have fallen into case.
2. Attach double chain lifting sling (Part #2130037 or alternative) to drive unit assembly.
3. Attach steering bands to steering drums using steering band securing hooks (Part #2130027 or alternative).
4. Lower drive unit assembly until it comes to rest on top of drive unit case and substitute lifting sling (Part #2130038 or alternative) for double chain sling.
5. Lower drive unit assembly into case. Tilt unit toward the ring gear side as it is being lowered and it will clear the sides of the case.
6. Install inner outboard reduction housings with gaskets. Use soft mallet to seat housings. No gasket sealer is used with these gaskets. (NOTE: See procedure for determining shim pack width and backlash.)
7. Insert the four 5/8-11NC x 2½ flat head cap screws in the counter-sunk holes in each reduction housing. Coat the bolt threads with molylube anti-sieze or equivalent and torque bolts to 140 ft. lbs.

---

**WARNING:** OMISSION OF THE MOLYLUBE OR EQUIVALENT LUBRICATION MAY RESULT IN BOLT FAILURE AT OR BELOW THE SPECIFIED TORQUE VALUE.

---

Insert 5/8-11 NC x 2 3/4 hex head cap screws in the spot faced holes inside the reduction housings. Coat the bolt threads with molybde anti-sieze or equivalent (see WARNING) and torque to 130 ft. lbs.

8. Install drive pinion assembly with shims. (NOTE: See procedure for measuring pinion mounting depth.) Coat drive unit case pinion mounting face with No. 2 gasket sealer. Install locks on bolts and torque bolts to 21 ft. lbs. Do not lock bolts yet.
9. Install drive unit support brackets. Use two 5/8-11 NC x 2 1/4 hex head cap screws in the center holes of the support brackets. Coat bolt threads with molybde anti-sieze or equivalent (see WARNING) and No. 2 gasket sealer. Torque to 130 ft. lbs.
10. After shim pack width and backlash have been computed and set to specifications, lock drive unit bearing locking washer to drive unit bearing locknut. Lock bolt locks over pinion mounting bolts.
11. Install stub shafts, inserting small splined end into drive unit case. Install reduction housing gears and bearings. Use soft mallet to seat gears.
12. Install outer outboard reduction housing with gasket. No gasket sealer is used here. Use grease to hold gasket in place. Torque bolts to 21 ft. lbs.
13. Install new brake band rod seals.
14. Install anchor plates with gaskets. Coat bolts with No. 2 gasket sealer, but do not use sealer on gaskets. Torque bolts to 21 ft. lbs. Install anchor links to anchor plates using clevis and cotter pins.
15. Secure steering brake bands to anchor links with clevis and cotter pins. Install brake band rods, springs and spacers with clevis and cotter pins. To protect brake band rod seals during brake band rod installation, cover rod threads with shim stock or heavy gauge aluminum foil before inserting rods through seals.
16. Install steering lever and pushrod assemblies to anchor plates with clevis and cotter pins.
17. Install new 1/2-20 elastic NF stopnuts on each steering brake band rod. (NOTE: See procedure for adjusting steering bands using steering band adjusting nuts.)
18. Install drive axle housings with gaskets. Axle housings should be mounted with chassis mounting plate vertical and facing the front of the vehicle. Use No. 2 gasket sealer on both sides of gaskets. Coat bolt threads with No. 2 gasket sealer and torque bolts to 90 ft. lbs.

19. Install drive axle assemblies with gaskets. Use No. 2 gasket sealer on both sides of gaskets. Torque bolts to 21 ft. lbs. (NOTE: See procedure for bearing and seal replacement on drive axles.)
20. Install drive unit case lid with gasket. New gaskets must have four additional holes punched in them during installation to accommodate dowel pins. Use No. 2 gasket sealer on both sides of gasket. Torque bolts to 12 ft. lbs.
21. Install drive sprockets. Torque nuts to 70 ft. lbs.
22. Using overhead crane or floor jack, move steering differential assembly to vehicle for installation. Rear of vehicle must be jacked up to install steering differential. Mount drive axle housings to lower chassis frame. Torque bolts to 75-85 ft. lbs. Mount drive unit support brackets to chassis, using rubber bushings, shims and bolts in their original positions. Torque bolts to 25-30 ft. lbs.
23. Mount steering slave cylinders in their original positions on drive unit case lid. Connect cooling system hoses to hose fittings on drive unit case. Connect wire to temperature sending unit.

BOLT & PART #	QTY.	FUNCTION	TORQUE	SPECIAL INSTRUCTIONS
5/8-11 NC x 2½ lg. Flat head cap screw #1209229-3	4	Mount inner outboard reduction housing to drive unit ass'y case.	140 ft. lbs.	Coat threads with molybde anti-sieze or equivalent, use with unitorque nut.
5/8-11 NC x 2-3/4 lg. Hex head cap screw #01505-198	8	Mount inner outboard reduction housing to drive unit ass'y case and secure drive unit support bracket to drive unit ass'y case.	130 ft. lbs.	Coat threads with molybde anti-sieze or equivalent, use with unitorque nut. <u>NOTE:</u> Four of these bolts secure the drive unit support bracket and should be coated with No. 2 gasket sealer as well as molybde.
5/8-11 NC x 2-1/4 lg. Hex head cap screw #01505-195	2	Mount inner outboard reduction housing to drive unit ass'y case and secure drive unit support bracket to drive unit ass'y case. <u>NOTE:</u> These two bolts run through the center hole in the right and left hand support brackets.	130 ft. lbs.	Coat threads with molybde anti-sieze or equivalent and No. 2 gasket sealer, use with unitorque nut.
5/8-11 NC x 1½ lg. Hex head cap screw #01501-192	12	Mount axle housing to outer outboard reduction housing case.	90 ft. lbs.	Lubricate threads with 30W oil at No. 2 gasket sealer.
3/8-16 NC x 1-3/4 lg. Hex head cap screw #01505-73	28	Mount outer outboard reduction housing case to inner outboard reduction housing case.	21 ft. lbs.	Lubricate threads with 30W oil.
3/8-24 NF x 1-1/4 lg. Hex head cap screw #01500-70	8	Mount outboard axle ass'y to axle housing.	18-21 ft. lbs.	Lubricate threads with 30W oil.
3/8-16 NC x 1-3/4 lg. Hex head cap screw #01505-73	8	Secure drive pinion ass'y to drive unit ass'y case.	21 ft. lbs.	Lubricate threads with 30W oil.
3/8-24 NF x 1½ lg. Hex head cap screw	8	Mount steering band anchor plate to drive unit ass'y case.	21 ft. lbs.	Coat threads with No. 2 gasket sealer and 30W oil.

BOLT & PART #	QTY.	FUNCTION	TORQUE	SPECIAL INSTRUCTIONS
5/16-18 NC x 3/4 lg. Hex head cap screw #01501-36	18	Mount drive unit ass'y case lid to drive unit ass'y case.	12 ft. lbs.	Lubricate threads with 30W oil.
1/4-20 NC x 5/8 lg. Hex head cap screw #01501-5	4	Mount steering slave cylinders to drive unit ass'y case lid	Unnecessary	Lubricate threads with 30W oil.
9/16-18 NF x 1 1/2 lg. Hex head cap screw #01504-162	8	Mount steering differential ass'y to vehicle lower chassis frame	75-85 ft. lbs.	Lubricate threads with 30W oil.
7/16-20 NF x 3-3/4 lg. Hex head cap screw #01500-111	4	Mount steering differential ass'y to vehicle chassis.	25-30 ft. lbs.	Lubricate threads with 30W oil.

## COMMON ADJUSTMENTS AND REPAIRS

### Steering Band Adjustment

Tighten adjusting nuts until steering bands affect the rolling resistance of the vehicle. Loosen adjusting nuts one full turn, or until bands no longer affect the rolling resistance of the vehicle. To check this adjustment, drive the vehicle in second gear at 2 or 3 miles-per-hour, shift to neutral and let the vehicle coast to a stop. By doing this several times with loose and tight adjustments, it will be easier to determine when steering bands are dragging.

**CAUTION:** DO NOT OPERATE THE VEHICLE WITH EXCESSIVE STEERING BAND DRAG. THIS WILL INDUCE HEAVY WEAR ON THE BRAKE LINING AND MAY CAUSE DIFFERENTIAL OVERHEATING. DO NOT EXCEED A TORQUE VALUE OF 30 FT. LBS. ON THE STEERING BAND ADJUSTING NUT. EXCESSIVE TORQUE WILL DAMAGE THE STEERING LINKAGE.

### Bleeding Steering System

Remove the master cylinder cap and fill the cylinder with type SAE 70RI heavy-duty brake fluid. Replace cap to avoid contamination or loss of fluid during bleeding operation. Open bleeder valves on slave cylinders by turning valves 1/4 to 1/2 turn counter-clockwise (to the left). Slowly pull back steering levers, one at a time, to force fluid from the bleeder valves. While the levers are all the way back (in the position used to stop the vehicle), retighten bleeder valves. Repeat this operation until all air is removed from the system and the steering levers no longer feel "spongy."

**CAUTION:** DO NOT USE FLUIDS IN THIS SYSTEM WHICH DO NOT CONFORM TO SAE 70 RI SPECIFICATIONS. THEY WILL DAMAGE THE SEALS AND LOCK UP THE STEERING CONTROLS.

### Installing Steering Bands

1. Disconnect hydraulic hoses from slave cylinders.
2. Remove steering band adjusting nuts.
3. Remove drive unit case lid.
4. Remove spacer, spring and brake band rod assembly.
5. Remove steering band anchor links.
6. Remove old steering bands.
7. Install new steering bands.
8. Install anchor links.
9. Install spacer, spring and brake band rod assemblies.
10. Install steering band adjusting nuts.
11. Install new drive unit case lid gasket with No. 2 gasket sealer applied to both sides of gasket.
12. Install drive unit case lid.
13. Connect hydraulic hoses to slave cylinders.

TROUBLESHOOTING STEERING DIFFERENTIAL

IMPORTANT: This troubleshooting procedure applies to both the Model 1200 and the Model 2100 vehicle. When using this procedure, disregard all references to the Model 2100.

SYMPTOM

POSSIBLE CAUSE

REMEDY

<p>Model 1200 or 2100 veers to the left or right on level ground when it should be travelling in a straight line.</p>	<p>Steering bands are out of adjustment.</p>	<p>Adjust steering bands. See procedure in "Common Adjustments and Repairs".</p>
<p>Foot brake doesn't work on Model 1200.</p>	<p>Steering bands are out of adjustment.</p>	<p>Adjust steering bands. See procedure in "Common Adjustments and Repairs".</p>
<p>Steering levers must be pumped on Model 1200 to steer or stop vehicle.</p>	<p>Steering bands are out of adjustment. Air in hydraulic lines.</p>	<p>Adjust steering bands. See procedure in "Common Adjustments and Repairs". Bleed steering system. See procedure in "Common Adjustments and Repairs".</p>
<p>Model 1200 or 2100 steering requires more effort than normal.</p>	<p>Steering bands or steering drums are worn.</p>	<p>Replace worn steering bands. See procedure in "Common Adjustments and Repairs". If steering drums are badly grooved, they should be replaced. In an emergency, when the vehicle must be back in service before parts can arrive, steering drums can be machined a MAXIMUM OF .020 inch. THIS IS ONLY AN EMERGENCY PROCEDURE AND IS NOT RECOMMENDED BY THIOKOL. New drums should be ordered and installed upon arrival.</p>
<p>No steering response at all on Model 1200 or 2100. No resistance at all on Model 1200 steering levers.</p>	<p>Broken steering linkage.</p>	<p>Inspect linkage. Repair or replace.</p>

SYMPTOM

POSSIBLE CAUSE

REMEDY

<p>Model 2100 turns more easily in one direction than the other.</p>	<p>Malfunctioning flow divider valve.</p>	<p>Inspect flow divider valve. Make sure valve is operating freely and not binding. If valve is binding, loosen mounting bolts slightly until valve functions freely.</p>
<p>Steering levers rock back and forth noticeably during a turn on Model 1200 or 2100.</p>	<p>Steering drums out of round.</p>	<p>Check steering drum face and edge runout with a dial indicator. Face runout should be no greater than .030 inch. Edge runout should be no greater than .060 inch.</p>
<p>Steering is erratic and the pressure seems low in the accessory hydraulic circuit on Model 2100.</p>	<p>Malfunctioning priority valve.</p>	<p>Check valve to make sure it is not binding. If it is binding, loosen valve mounting bolts slightly until it functions freely. Also check the hydraulic pump. A malfunctioning priority valve can sometimes damage the pump.</p>
<p>Model 2100 will only turn in one direction.</p>	<p>Malfunctioning steering actuator valve.  Badly worn steering lever.  Malfunctioning flow divider valve.</p>	<p>Inspect valve and valve mounting position. The valve is mounted in slotted holes and it may have slipped down in the mount, losing contact with the steering lever.  Inspect base of steering lever. In some cases, the steering actuator valve ball wears grooves in the base of the steering lever. Replace badly grooved lever.  Inspect valve. Make sure valve is operating freely and not binding.</p>
<p>Model 1200 will only turn in one direction.</p>	<p>Malfunctioning master cylinder or slave cylinder.</p>	<p>Inspect master cylinder and slave cylinders. Repair leaking cylinders Order repair kits from Thiokol. Slave cylinder part #1219237, kit #KT-1218-1. Master cylinder kit number 1222036.</p>

SYMPTOM

POSSIBLE CAUSE

REMEDY

<p>Steering is sluggish and unresponsive on Model 2100.</p>	<p>Steering system hydraulic pressure is too low.</p> <p>Hydraulic fluid is contaminated.</p> <p>Priority or flow divider valve malfunction.</p> <p>Slave cylinder malfunction.</p> <p>Improper lubricant in the steering differential.</p>	<p>Attach a pressure gauge to one of the hydraulic lines connected to a steering slave cylinder. Pressure should be 400 psi. If pressure is below specification check hydraulic lines for leaks.</p> <p>Inspect fluid. If contamination is found, flush system.</p> <p>Inspect valves to make sure they are not binding or sticking. If either valve is binding, loosen its mounting bolts slightly until the valve functions freely.</p> <p>Inspect slave cylinders. If they are leaking, repair kits can be ordered from Thiokol. For Model 2100, the part number is 1209050, kit number KT-02-100-017.</p> <p>Conoco DN-600 or equivalent is the recommended oil.</p>
<p>Steering is sluggish and unresponsive on Model 1200.</p>	<p>Brake fluid level is low in master cylinder.</p> <p>Master cylinder leaking.</p> <p>Hydraulic lines leaking.</p> <p>Air in hydraulic lines.</p> <p>Slave cylinders leaking.</p>	<p>Fill to proper level with SAE 70RI heavy-duty brake fluid.</p> <p>Rebuild master cylinder using kit number 1222036 ordered from Thiokol.</p> <p>Inspect lines. Replace leaking lines or faulty fittings.</p> <p>Bleed steering system. See procedure in "Common Adjustments and Repairs".</p> <p>Inspect slave cylinders. If they are leaking, repair kits can be ordered from Thiokol. Part number is 1219237, kit number KT-1218-1.</p>

REMEDY

POSSIBLE CAUSE

SYMPTOM

<p>Differential is losing oil.</p>	<p>Loose bolts on drive unit case lid. Loose bolts on outboard reduction housings. Drive unit breather port is leaking. Drive axle seal is leaking. Pinion seal is leaking. Cracked or broken reduction housing, axle housing or drive unit case.</p>	<p>Tighten bolts to proper torque. Tighten bolts to proper torque. Check weld around port for cracks or separations. Check inside of drive unit lid to make sure crimped end of breather port is open approximately 1/8 inch. Replace seal. Replace seal. Inspect and repair or replace as needed.</p>
<p>Differential is making unusual noise.</p>	<p>Bearing failure on pinion shaft. Bearing failure on outboard reduction gears. Chipped or broken gear teeth in reduction housings, ring or pinion gear, stub shafts or drive unit planetary gears. Backlash has increased due to bearing or spacer failure in drive unit ass'y or pinion ass'y.</p>	<p>Replace bearings and see section on "Checking Bearing Fit". Replace bearings and see section on "Checking Bearing Fit". Disassemble, inspect all gears and replace broken gears. Replace worn parts and correct backlash to specification. See procedure for measuring backlash.</p>

SYMPTOM

POSSIBLE CAUSE

REMEDY

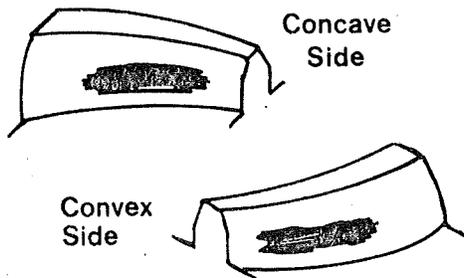
<p>Differential is overheating.</p>	<p>Steering bands are dragging. Driver is steering vehicle improperly Low oil level. Bearing failure. Wrong oil in differential. Broken or chipped teeth on any of the differential gears. Slave cylinder malfunction.</p>	<p>Adjust steering bands. See procedure in "Common Adjustments and Repairs". Read and follow operating instruction for steering vehicle in owner's manual. Add oil to proper level and see "Differential is losing oil" section of Troubleshooting. Inspect all bearings. See procedure for "Checking Bearing Fit". Drain oil and replace with Conoco DN-600 or equivalent. Inspect all gears and replace as needed. Repair slave cylinders using proper kits ordered from Thiokol. Model 1200 part # is 1219237, kit # KT-1218-1. Model 2100 part # is 1209050, kit # KT-02-100-017.</p>
<p>Drive shaft turning, but vehicle doesn't move.</p>	<p>Failure in left or right hand drive train, or sheared gear teeth in the planetary gears, ring and pinion gears, or reduction gears.</p>	<p>Pull steering levers, one at a time. If vehicle doesn't move when right lever is pulled but does move when left lever is pulled, failure is in the left-hand drive train. It could be a broken axle, stub shaft, etc. If the vehicle doesn't move when the left lever is pulled but does move when the right lever is pulled, failure is in the right-hand drive train. If vehicle doesn't move when either lever is pulled, some gear teeth are probably sheared.</p>

# TOOTH CONTACT PATTERNS TELL THE STORY ON DIFFERENTIAL WEAR

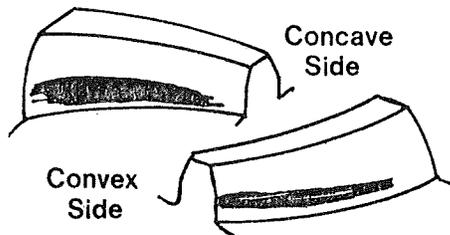
When you're repairing or rebuilding any differential, it's a good idea to look at the contact patterns on the individual teeth of the gears.

Shown below are a number of undesirable tooth wear patterns as they appear on the driven gear, along with an explanation of why they formed ... and suggested remedies for their correction.

Of course, the correct tooth contact pattern must be maintained for top performance.



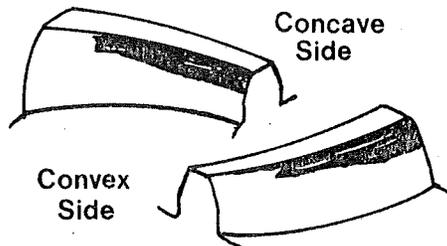
Correct tooth contact patterns will look like this (on the driven gear) with accurate and rigid mounting.



### OUT OF POSITION PATTERNS

**Cause:** Pinion too far from cone center.

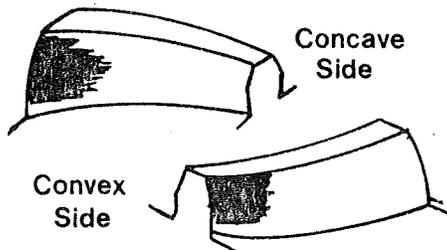
**Remedy:** Move pinion toward cone center.



### OUT OF POSITION PATTERN

**Cause:** Pinion too close to cone center.

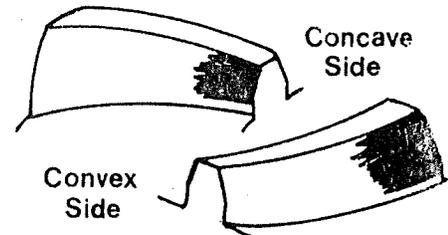
**Remedy:** Move pinion away from cone center.



### CROSS PATTERN

**Cause:** Shafts do not intersect.

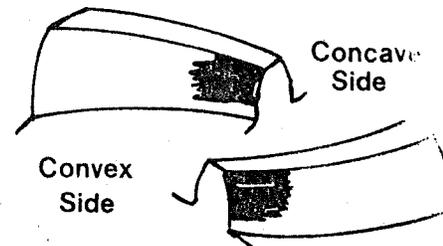
**Remedy:** Line up shafts.



### CROSS PATTERN

**Cause:** Shafts do not intersect.

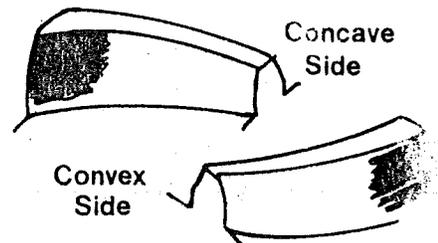
**Remedy:** Line up shafts.



### TOE PATTERN

**Cause:** Shaft angle too large.

**Remedy:** Correct the shaft angle  
crease backlash.



### HEEL PATTERN

**Cause:** Shaft angle too small.

**Remedy:** Correct the shaft angle  
lash.

## SPECIFICATIONS

LUBRICANT TYPE: Conoco DN-600 fluid or equivalent.  
WARNING: SUBSTITUTION OF LESSER QUALITY OIL MAY CAUSE PREMATURE DIFFERENTIAL FAILURE.

LUBRICANT CAPACITY: Approximately 6 gallons

LUBRICATION INTERVAL: Drain and refill every 150 hours of operation and at the beginning of each operating season, if vehicle is only used seasonally. NOTE: Under normal operating conditions, check oil level weekly. Under strenuous operating conditions, check oil level every 2 days.

BACKLASH: .006" to .009" minimum with no more than .008" difference between minimum and maximum backlash. Example: Minimum backlash is found to be .007. Maximum backlash should be no greater than .015 (.007 + .008).

STEERING DRUM RUNOUT: Face maximum .030"  
Edge maximum .060"

FINAL DRIVE GEAR RATIO: 6.14:1 with gasoline engine  
5.44:1 with diesel engine

RING AND PINION GEAR: 6.14 differential has 7-tooth pinion and 43-tooth ring gear.  
5.44 differential has 9-tooth pinion and 49-tooth ring gear.

REDUCTION SYSTEM GEAR RATIO: 2.40:1 standard  
1.83:1 optional

REDUCTION SYSTEM GEARS: 2.40 ratio has 15-tooth pinion and 36-tooth driven gear.  
1.83 ratio has 18-tooth pinion and 33-tooth driven gear.

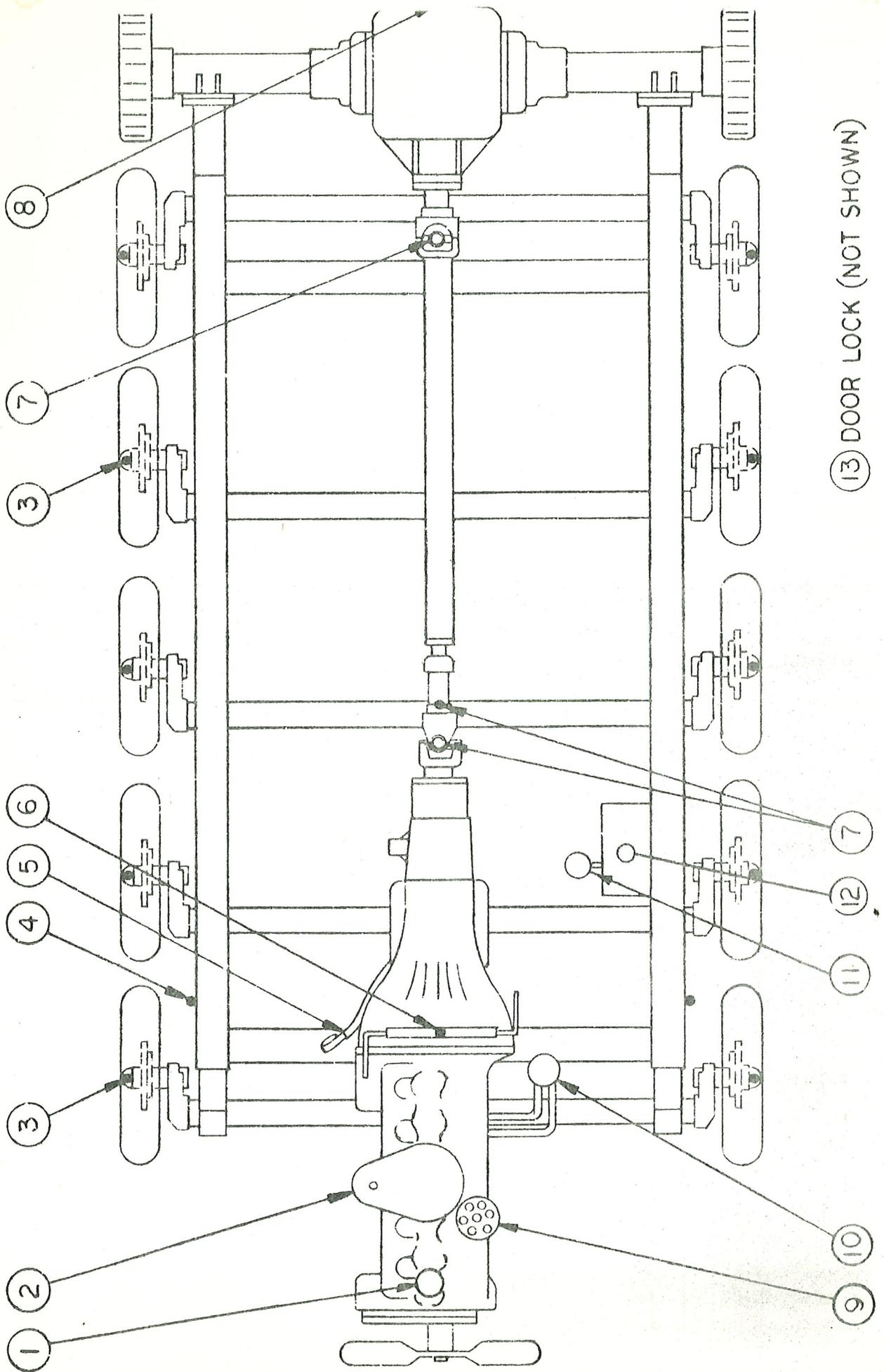
## SECTION IV

### STANDARD TOOLS

#### GENERAL

Standard tools supplied with the vehicle include two (2) track jacks and a wheel lug wrench. These tools are basic to the peculiarities of the machine, such as track adjustment, track removal and wheel removal.

It is recommended that anyone responsible for the driving or care of these vehicles equip themselves with ordinary mechanic's tools as may be necessary for general trouble shooting in the field.



(13) DOOR LOCK (NOT SHOWN)

SECTION V

LUBRICATION INSTRUCTIONS

LUBRICATION POINT	LUBRICANT	INTERVAL/INSTRUCTIONS
1. Engine	Use SAE 10W-40 oil for operating conditions to -20 degrees F. At temperatures below -20 degrees F., use Conoco DN-600 fluid.	Change oil supplied with engine after first 50 hours of operation. Thereafter, change oil every 100 hours of operation or at shorter intervals when vehicle is used at temperatures below 0 degrees F.
2. Oil bath air cleaner	Use SAE 10W-40 engine oil.	Drain and refill every engine oil change. Wash filter assembly in solvent every third or fourth oil change. Service air cleaner more frequently under severe dust conditions.
3. Wheel bearings	Use all temperature grease conforming to Mil-G-10924A or Conoco DN-600 grease.	Clean and repack bearings once a year. Hubs are also equipped with grease fittings. Flush grease through hubs frequently, depending on vehicle use and operating conditions. Flush bearings daily when operating in mud, silt, water.
4. Track adjusting cylinders.	Use all temperature grease conforming to Mil-G-10924A or Conoco DN-600 grease.	As required.
5. Automatic transmission	Use Ford Type F automatic transmission fluid or equivalent.	Check oil level frequently. This system is not filtered. If fluid is contaminated, drain and replace.
6. Throttle linkage	Use all temperature grease conforming to Mil-G-10924A or Conoco DN-600 grease.	As required.

LUBRICATION INSTRUCTIONS

LUBRICATION POINT	LUBRICANT	INTERVAL/INSTRUCTIONS
7. Drive shaft universal joints, sleeve yoke miscellaneous grease fittings.	All temperature grease conforming to Mil-G-10924A or Conoco DN-600 grease.	Service grease fittings every 50 hours.
8. Steering differential.	Use Conoco DN-600 fluid.	Drain and refill oil in steering differential after first 25 hours of operation. Thereafter, check oil level weekly and change oil every 150 hours of operation.
9. Distributor (cam and bushing).	Distributor cam: Use a high melting point, non-fiber cam grease. Distributor bushing: Use engine oil, SAE 10W-40.	Apply a thin film to cam as required. Apply 5-10 drops to bushing at each oil change.
10. Oil filter.	Use Fram PH7 oil filter.	Change filter with each oil change.
11. Hydraulic filter.	Use Thiokol #1228205-1 or Gresen Part #1553.	Change every 100 hours of operation.
12. Hydraulic tank.	Use Conoco DN-600 fluid, or Automatic Transmission Fluid or any grade hydraulic oil.	As required.
13. Door locks.	Use stick wax.	As required.

## SECTION VI

### SOME THINGS THE VEHICLE OPERATOR SHOULD KNOW

The following is a list of items which should be brought specifically to the attention of the vehicle operator. They will help the customer realize expected performance and operational safety of the vehicle.

1. Unlike some tracked vehicles, the Model 1200 does not use a clutch brake system in the steering differential. This means that power is always maintained to both tracks, even during a tight turn, with the outer track running at approximately twice the speed of the inner track. Excessive force on the steering levers will not tighten the turning radius of the vehicle.
2. Tracks should not be run any tighter than necessary. Tight tracks will rob available horsepower as well as decrease the life expectancy of track parts. Run tracks as loose as possible while still maintaining track retention and sufficient track and sprocket engagement.
3. Avoid over-speeding the engine. Engine life will be increased if the operating RPM's are kept below the engine manufacturer's suggested maximum. When descending steep grades, use low gear and/or check the engine's speed by applying the steering levers simultaneously. The hand brake may also be used to slow the vehicle.
4. Correct vehicle speed to terrain conditions. Eliminate track throwing and excessive loads on the vehicle by slowing down when negotiating sharp turns. Consider the effects of striking hidden objects, such as stumps and rocks.
5. When operating on very steep grades, special care should be taken to insure that engine oil pressure is always maintained. Keeping an eye on the oil pressure gauge can prevent serious and costly repairs. Loss of oil pressure can occur on steep grades if the oil is not maintained at or near the "full" mark.
6. Be sure windshield wipers are free before turning them on. Wipers frozen to the windshield can cause overheating and failure of wiper motors. Also, avoid running the wipers when the windshield is dry.

7. Do not direct hot air from the defrosters directly onto a cold windshield. Localized heat on a cold windshield causes thermal stresses which will crack the glass. If the engine coolant system is hot when turning on the defrosters, care should be taken to diffuse the air until the windshield has absorbed some heat. Starting with defrosters on the "low" setting will help. Most trouble is caused by starting the engine on cold mornings and then turning on the defrosters after the engine is fully warm. Turn defrosters on when the engine is first started and let the windshield warm up gradually.
8. Care should always be taken to assure that the vehicle is in good operational condition when making long trips. Regular maintenance procedures must be followed. Check-listing the vehicle condition daily will save costly repairs and assure safety to the operator and passengers. Special attention should be given to tire inflation and track condition. Always carry some spare belting for emergency repairs.
9. This vehicle has been designed for traversing marginal terrain which will support only low pressure vehicles. In rough terrain, where rocks and stumps are present, care should be taken to avoid damaging tracks, chassis tub or steering differential outboard reduction housings. Severe impacts can be experienced even at relatively slow speeds.

#### Safe Slope Operation

The vehicles made by Thiokol are special-purpose working vehicles. They do not perform and cannot be driven in the same manner as an automobile or truck. Every vehicle operator should become familiar with the capabilities and limitations of his vehicle. This can only be accomplished through practice and experience.

Any vehicle will encounter difficulty if it is driven on a slope which is too steep. The drivability and control of a Thiokol vehicle on a given slope is a function of the vehicle design, the implements on the vehicle, the snow conditions and the degree of slope.

The following list outlines some of the things a vehicle operator should know before operating a Thiokol vehicle on snow-covered slopes.

1. You will lose traction in loose snow sooner than in packed snow on a given slope.

2. You will lose traction on very hard snow sooner than on packed snow.
3. The vehicle may slip sideways on loose snow on a slope that it can normally traverse if the snow is packed.
4. On very hard snow or ice, vehicle tracks should be equipped with ice caulks. CAUTION: ICE CAULKS WILL NOT COMPLETELY PREVENT LOSS OF TRACTION ON ALL SLOPES. ICY SLOPES SHOULD ALWAYS BE APPROACHED WITH CAUTION.
5. If you cannot climb it, you cannot traverse it. You may not be able to traverse some slopes that you can climb.
6. If you should lose traction while working a slope, turn up or down the slope and apply power. Applying the brakes will not stop a vehicle in a slide. You can regain control by speeding up. KEEP THE TRACKS TURNING.
7. In an emergency, use the blade as a brake. Drop the blade and push forward on the blade "tee" handle or blade valve handle.
8. In an emergency and if the vehicle is so equipped, drop the groomer "U" blade and use it as a brake.
9. Some vehicles are equipped with foot brakes. Check the foot brake everytime you start driving the vehicle to make sure the brake is functioning properly.
10. Always check the backup steering system before operating a vehicle.
11. Always park the vehicle in a traverse slope position. Never park the vehicle so that it is headed uphill or downhill. When parking, always apply the drive line brake and put the automatic transmission in "Park."
12. Do not attempt to get out of the vehicle when it is headed uphill or downhill.
13. Do not leave the vehicle unattended on a slope.
14. Do not put an automatic transmission in "Neutral" on any slope.
15. Wet snow on wet, grassy slopes can slide under a vehicle. This is important to remember during early season and preseason grooming.

16. Remember: Implements on the machine will cut down its sidehill and climbing ability.

PRACTICE EMERGENCY PROCEDURES UNTIL THEY ARE AUTOMATIC. YOU CAN BECOME AN EXPERT DRIVER ONLY BY PRACTICING IN YOUR SKI AREA, BY KNOWING YOUR VEHICLE AND BY KNOWING YOUR SLOPES.