



**TRENCHLESS EQUIPMENT SPECIALISTS**

# **OPERATOR'S MANUAL**

## **Multi-Disc Rock Cutters**

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**SERVICE • RELIABILITY • INNOVATION**



# Introduction

This manual contains important safety, operation, and maintenance information for your multi-disc cutters on your Akkerman cutter head. You must read and understand this manual and your tunneling equipment operation manuals before you operate and maintain this equipment. Keep this manual with your equipment at all times. Additional copies of this manual may be purchased from the Akkerman Product Support Department, or downloaded from the Akkerman web site at [www.akkerman.com](http://www.akkerman.com).

The contractor is responsible for the overall safety program on the job site. Use this manual as a part of the safety program.

The use of second rate parts could affect the efficient performance of the multi-disc cutters. ALWAYS use genuine Akkerman parts.

Understand safety signal words, DANGER, WARNING, CAUTION, SAFETY INSTRUCTIONS, and NOTICE. When you see these words in this manual or on safety decals mounted on your equipment, follow the safety message to avoid personal injury and/or property damage.

**▲ DANGER** Indicates an extremely hazardous situation which, if not avoided, WILL result in death or serious injury.

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

**▲ CAUTION** Indicates a potentially hazardous situation, which, if not avoided, MAY result in minor or moderate injury. It may also be used to alert against unsafe practices.

**SAFETY INSTRUCTIONS** Usually consists of individual messages stating procedures or actions that must be followed for the safe operation of a product.

**NOTICE** Identifies potential property damage and important installation, operator, or maintenance information.



## Akkerman Microtunneling Cutter Head With Multi-Disc Cutters

The multi-disc roller cutters mounted on the cutter head, can cut through hard and abrasive rock to the very hard and compacted rock. Optional tungsten carbide inserts are available on the cutters and are typically used in the very hard rock and compacted rock applications. The twin straight disc, triple straight disc, and triple conical disc cutters are used on the cutter head depending on the ground conditions.

If you find any errors with this manual or know of ways to improve procedures, please let us know. Mail your suggestions to: ATTN: Technical Publications  
Akkerman Inc, 58256 266th Street, Brownsdale, MN 55918

Akkerman Inc. reserves the right to improve its product without notice or obligation.

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# Safety

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## BE ALERT FOR SAFETY INFORMATION

When you see this safety alert symbol on your equipment or in this manual, be alert to the possibility of personal injury or property damage.

Read all safety information.

Keep safety decals clean and in good condition.  
Replace missing or damaged safety decals.



**ATTENTION!  
BECOME ALERT!  
YOUR SAFETY IS INVOLVED!**

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## READ OPERATOR'S MANUAL

**⚠️ WARNING** Unsafe operation or maintenance can cause severe injury or death.

Read and understand this Maintenance Manual and your Akkerman equipment Operator's Manual before operating or servicing this equipment.

Any unauthorized modifications will void the warranty.



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## WEAR PROTECTIVE CLOTHING

Wear OSHA approved protective clothing, such as hard hat, gloves, safety goggles, earmuffs or ear plugs, face shield, welding helmet, welding apron, and steel-toed boots, when operating and servicing this equipment.

Wear reasonably close fitting clothing and remove jewelry before working on or near this equipment. This will help prevent the danger of catching them in moving parts or controls.



## WELDING SAFETY

Before welding, read and understand all safety precautions in your welding equipment manuals.

**⚠ WARNING** Electric shock can kill.

Do not touch live electrical parts. Wear dry, flameproof, insulated gloves and clothing to protect your hands, body, and head from work and ground.

Be sure the proper size ground cable is connected to the work piece as close to the work area as possible.

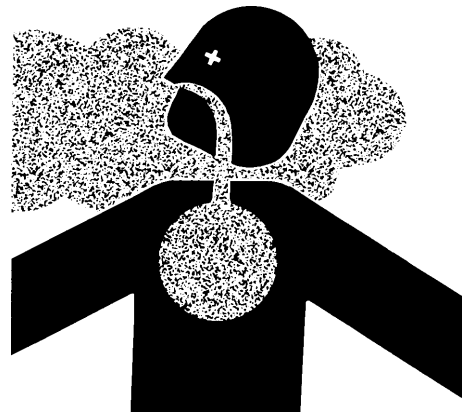
Always ground the power supply by connecting a ground wire between the power supply and an approved electrical ground.

Do not coil or loop cable around parts of the body.

**⚠ WARNING** Breathing fumes and gases can cause serious injury or death.

Keep your head out of fumes.

Use proper ventilation or exhaust fans to remove fumes from breathing zone.



**⚠ WARNING** Arc rays can cause serious injury.

Wear a welding helmet with the correct filter and cover plates to protect your eyes, face, neck, and ears from sparks and rays of the arc.

Warn bystanders not to watch the arc.



## FIRE PREVENTION

**⚠ CAUTION** Fires can cause injury or property damage.

Keep equipment clean. Remove all debris from equipment.

Hot slags or sparks while welding can cause fires. Remove all combustible materials away from work area.

Have a fire extinguisher available at all times. Keep the fire extinguisher fully charged.



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## LOCKOUT POWER BEFORE SERVICING

**⚠ WARNING** Failure to lockout power before servicing can cause severe personal injury or death.

LOCKOUT power before performing any maintenance.



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## PRACTICE SAFE MAINTENANCE

LOCKOUT power before performing any maintenance.

Only trained and qualified personnel should perform any maintenance or repairs.

Keep the area around the equipment clean and dry when performing maintenance.

Do not service the machine while it is in motion.

Replace worn or damaged parts. Remove grease, oil, or debris buildup.



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## REGULARLY CLEAN AND INSPECT EQUIPMENT

Remove any grease, oil, or debris buildup to avoid potential injury or equipment damage.

Inspect equipment for damage. If damaged, repair or replace immediately.



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## BEWARE OF SUSPENDED LOADS

**⚠ WARNING** Suspended loads may fall and cause severe personal injury or death.

If a hydraulic hose from the boom of a crane or excavator breaks, or the chain or cable from the boom breaks, the boom and/or load can fall immediately.

Do not enter area under or around a load.



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## AVOID PINCH POINTS

**⚠ WARNING** Moving parts or the mishandling of parts can cause severe injury.

Keep hands and legs away from moving parts.

Handle parts carefully to avoid crushing and pinch point hazards.

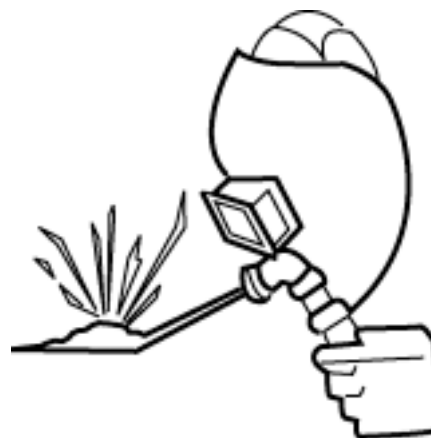


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## UNAUTHORIZED WELDING

**⚠ WARNING** Unauthorized welding can cause structural failure resulting in possible injury or death.

Do not weld on any structural member. Unauthorized welding or repair will void the warranty.



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## KEEP JOB SITE CLEAN AND ORGANIZED

**⚠ WARNING** Tripping can cause serious personal injury.

Be sure to keep job site clean and organized.



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## SLIPPERY WHEN WET

**⚠ WARNING** Slips and falls can cause serious personal injury.

Ensure firm footing in wet or slippery conditions.

Replace skid-resistant material if it is damaged or missing to prevent slips and falls.

Remove any buildup of grease, oil, or debris.



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## NO SMOKING IN TUNNEL

**⚠ WARNING** Smoking in tunnel could cause an explosion if combustible gases are present.

Do not smoke in tunnel.

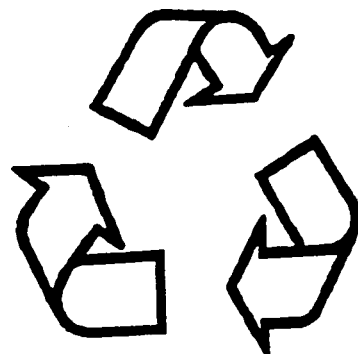


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## RECYCLE WASTE

Follow local, state, federal, and international regulations when recycling or disposing of waste. Waste includes fluids/oil, fuel, filters, coolant, and batteries.

Use leakproof containers when draining fluids/oil. Do not pour waste on the ground, down a drain, or into any water source.





# Pre-Start Inspection

## **⚠ WARNING**

Do not operate this equipment until you read, study, and understand this manual and your other Akkerman tunneling equipment operation manuals. A daily inspection of the equipment must be performed to prevent severe personal injury or death and equipment damage.

The contractor is fully responsible for the safety of all personnel on the job site. Check with the contractor that all site preparation requirements are in place. Be sure to comply with all OSHA regulations, such as: an active safety program is in practice, a confined space permit (if needed) is issued, personal protective equipment is being worn; flammable, combustible, and hazardous materials are properly stored; and a lockout/tagout procedure is in place.

Use the following checklist ✓ as a guide for your MTBM/TBM launch pre-start inspection.

	1. Read and understand this manual and your tunneling equipment operation manuals.
	2. Contractor is responsible for all personnel to wear proper protective equipment on the job site. Replace equipment if defective.
	3. Check cutters for damage.
	4. Purge lithium grease from cutter bearing and replace with clean, fresh lithium grease before each launch. Refer to Section 6, Periodic Maintenance.
	5. Be sure V-shaped portion of the cutter housing is clean.
	6. Visually inspect ALL threaded bolt holes to insure the helical thread insert is in good condition.
	7. Check bolts and lock washers for damage. Be sure to replace with identical hardware.
	8. When reinstalling cutters onto cutter head, make sure the straight cutters and conical triple cutters are in the correct location and orientation.
	9. Be sure bolt keepers are in place and in good condition.
	10. After installing cutters, check that each cutter rotates freely by hand.
	11. Inspect each cutter for leakage. If leakage is found, the cutter must be replaced or repaired.
	12. Remove combustible or flammable materials from equipment. Store materials properly.
	13. Check for loose or missing hardware. Replace damaged or missing hardware.
	14. Check for fluid leaks. Repair leak or replace hoses or components.
	15. Keep job site clean and organized.
	16. Be sure equipment is properly maintained.
	17. Replacement cutters MUST be stored in a cool location and out of direct sunlight.

# Operation

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## OPERATING GUIDELINES

**⚠WARNING** Do not operate this equipment until you read, study, and understand this manual and your other Akkerman tunneling equipment operation manuals. Failure to do so, could result in severe personal injury or death.

1. Before operating, read and understand the Safety, Pre-Start Inspection, and Operation sections.
2. Do not operate, maintain, or repair this equipment while under the influence of alcohol, drugs, or medication.
3. Follow all Federal, State, and Local safety regulations and procedures.
4. Be sure OSHA prescribed safety protective equipment is being worn by all personnel.
5. Be sure the area is safe for operation. Keep worksite clean and orderly.
6. Contact your Akkerman Product Support representative for proper procedures on how to restore equipment for operation.
7. Have a fully charged fire extinguisher on the job site at all times.
8. Before operating, repair equipment problems.
9. Be sure the excavated launch and reception shafts are properly shored or braced to prevent slides or cave-ins.
10. Test air monitoring and ventilation detectors for proper operation. Never enter a tunnel without detectors.
11. Never walk or work under any part of the excavator or crane and suspended loads.
12. Beware of pinch points.
13. Steering corrections should be made gradually in small increments in order to minimize pipe jacking forces and side loads on cutter discs.
14. If this manual is lost, contact your Akkerman Product Support Representative for a new manual or download this manual from the Akkerman web site at [www.akkerman.com](http://www.akkerman.com).

# Lubricants

**NOTICE** Use of inferior lubricants can affect the efficient performance of your multi-disc rock cutters. Always use high quality lubricants as specified in this section. Refer to Section 6, Periodic Maintenance for proper lubrication procedure and maintenance intervals.

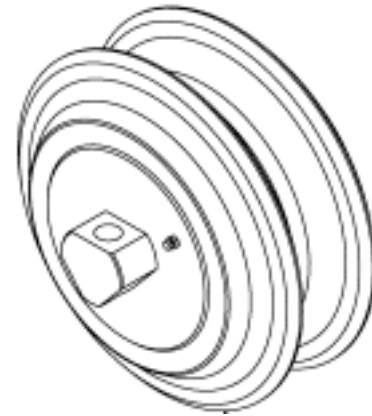
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## GREASE

The cutter bearings are factory lubricated with Paragon® 3000 (NLGI-2) grease.

The Paragon® 3000 grease is a special high temperature, high performance, lithium grease.

Use Paragon® 3000 grease or equivalent when lubricating the multi-disc cutter bearings.



**NOTICE** Grease fitting is used only for lubricating the cutter. The grease fitting **MUST** be replaced with drain plug before mounting cutter to cutter head.

**NOTICE** When the cutters are fully filled with grease, the cutters **MUST** be stored in a cool location, out of direct sunlight, otherwise the grease may expand and damage the seals.

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## STORING LUBRICANTS

Your equipment can operate at maximum performance only if clean lubricants are used. Use clean containers to handle all lubricants.

Lubricants should be stored in an area protected from dust, moisture, and other contaminants.

# Periodic Maintenance

**⚠WARNING** Review the Safety section in this manual before performing maintenance. Failure to do so, could cause severe injury or death.

The requirements for lubrication and maintenance are shown on the maintenance charts in this section. Intervals of maintenance are based on normal operating conditions. If operating under more difficult conditions, use a shorter time interval between maintenance.

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## LOCKOUT POWER BEFORE SERVICING

**⚠WARNING** Severe personal injury or death can result from unexpected machine movement.

LOCKOUT power before attempting to make repairs or adjustments to this equipment, unless otherwise indicated. Proper lockout will prevent accidents and save lives. Performing the lockout will also prevent the equipment from moving unexpectedly.



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## AVOID PINCH POINTS

**⚠WARNING** Moving parts or the mishandling of parts can cause severe injury.

Keep hands and legs away from moving parts.

Handle parts carefully to avoid crushing and pinch point hazards.



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## WELDING SAFETY

Before welding, read and understand your welding equipment operation manual including all safety precautions.

Wear proper gloves, clothing, and welding helmet with the correct filter and cover plates to protect your eyes, face, neck, and ears from sparks and rays of the arc.

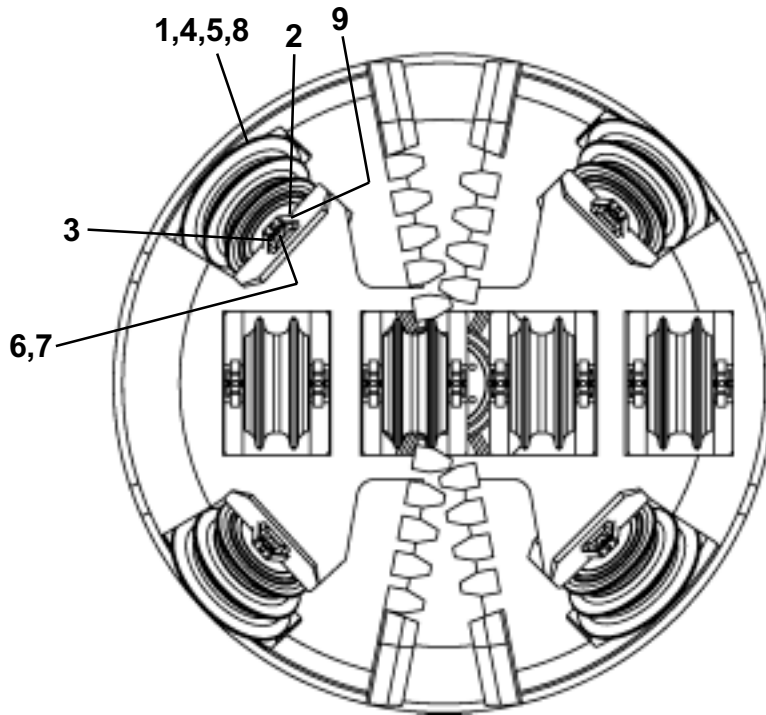
Make sure the welding machine frame is grounded, that neither terminal of the welding generator is bonded to the frame, and that all electrical connections are properly secured. The ground connection must be attached firmly to the work.

Keep welding cables dry and free of oil or grease. Keep cables in good condition.



## MAINTENANCE CHART

Use the item number in the chart to refer to the detailed maintenance procedures later in this section.



### BEFORE EVERY MTBM/TBM\* LAUNCH

ITEM	COMPONENT	SERVICE	REQUIREMENT	MATERIAL
1.	Cutter	Lubricate	See maintenance detail.	Paragon® 3000
2.	Cutter Housing	Clean "V" of Housing		
3.	Threaded Bolt Hole	Check Helical Inserts	Remove foreign material/dirt.	
4.	Cutter	Inspect		
5.	Cutter	Check Cutter Placement	Contact Product Support.	
6.	Retaining Bolts	Install New Hardware		Torque Wrench
7.	Retaining Bolts	Torque	Tighten to 375 ft-lb torque.	
8.	Cutter	Rotate Cutters Freely	Cutters must rotate otherwise requires repair or replacement.	
9.	Bolt Keepers	Weld	Use strap (A04396P) & hex plug (A04397P)	Low Hydrogen Welding Rod

\* MTBM - Micro Tunneling Boring Machine; TBM - Tunnel Boring Machine (conventional)

## BEFORE EVERY MTBM/TBM LAUNCH

### 1. LUBRICATE CUTTERS

BEFORE EVERY LAUNCH, remove and lubricate ALL cutters as follows:

**⚠WARNING** Use faceshield, hand and body protection while cutting off bolt keepers to avoid serious injury.

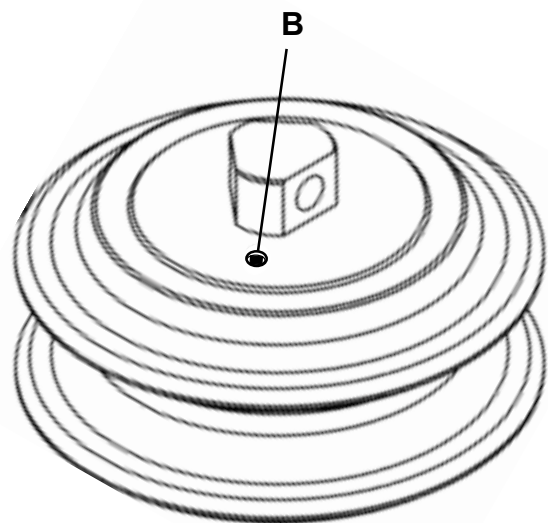
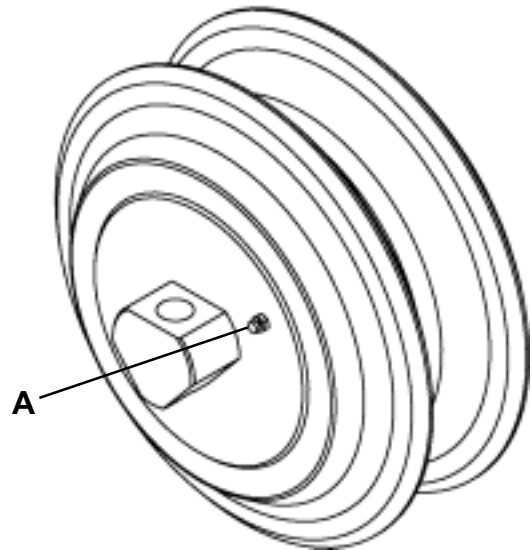
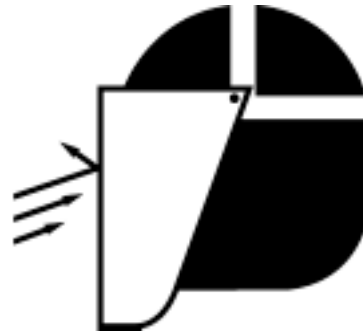
1. Cut and remove all bolt keepers from mounting plates.
2. Carefully remove cutters. Dispose of bolts and lock washers. New hardware must be used when installing new or used cutters.
3. Remove a plug from the drain port and thread a grease fitting (A) into the same port.
4. Remove drain port (s) from the opposite end cap of the cutter.
5. Stand the cutter on its end (shaft vertical) and clamp the shaft in a vice with the grease fitting end pointing down.
6. Pump in grease while rotating the cutter by hand. Continue pumping grease and rotating the cutter until the old grease is removed and the new grease comes through the top drain port (s) (B). This will remove all air so the cutter is completely filled with lubricant.

**NOTICE** All air MUST be removed from bearing cavity. Failure to do so, will cause bearing and cutter failure due to the build up of water, air, and grit in the bearing cavity while under pressure.

7. Replace drain plug (s) in top port (s) (B) by putting an anti-seize lubricant on the threads of the plug and then secure plug to end cap.
8. Remove the cutter from the vise and turn it over so the grease fitting is on top. Clamp the shaft in vice.
9. Remove the grease fitting and immediately apply anti-seize lubricant on the threads of the plug and then secure plug to end cap.

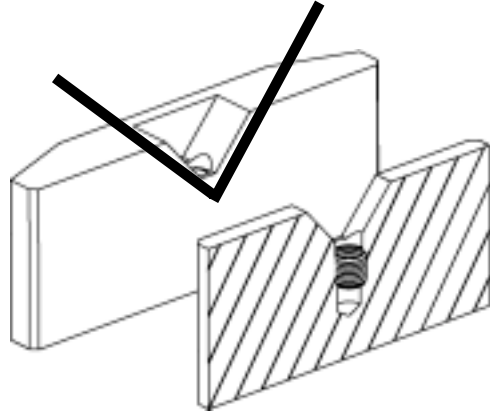
**NOTICE** When the cutters are properly lubricated, they must be stored in a cool location, out of direct sunlight. If the cutters are subjected to heat and sunlight, the grease may expand and damage the seals at one or both ends of the cutter. If any cutter leaks grease from either end, new seals MUST be replaced in the cutter.

**DO NOT USE CUTTERS WITH DAMAGED SEALS.** Irreplaceable damage to the cutter and cutter head could occur. Contact your Akkerman Product Support representative for details on replacing cutter seals.



## 2. CLEAN CUTTER HOUSING

With the cutters removed, clean the V-shaped portion of the cutter housing. Be sure the housing is clean and free of any sharp edges, protrusions and other foreign matter.



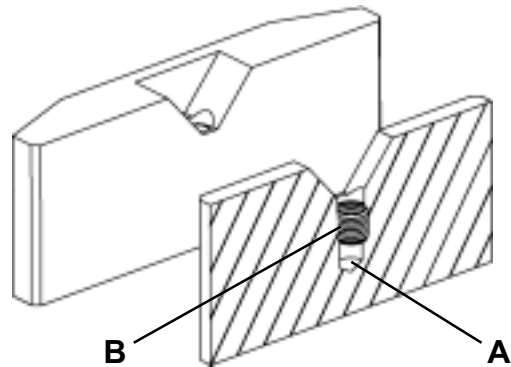
## 3. CHECK & CLEAN THREADED BOLT HOLES

Visually inspect and clean EACH threaded hole (A) in the cutter housings.

Be sure that the helical thread inserts (B) are in good condition.

**NOTICE** Do not chase insert threads with a tap. There must be some resistance while tightening cutter retaining bolts.

Remove debris and any foreign material from ALL bolt holes. Any debris that reduces the depth of the bolt holes can interfere with the proper tightening of the bolts. Improper tightening of the bolts will result in premature wear to the cutter while reducing cutting performance.



#### 4. INSPECT CUTTERS

Visually inspect each cutter thoroughly BEFORE installing. Always keep in mind that it will take significantly more force to penetrate a formation with a blunt cutter than a new cutter.

Check for signs of lubricant leakage from around the cutter end caps (A). If leakage is found, DO NOT install the cutter. The cutter MUST be repaired or replaced before mounting on cutter head.

Be sure ALL drain plugs (B) are securely in place. The drain plugs are located on both cutter end caps.

Inspect cutter shaft (C) (both ends) for damage. If damaged, contact your Akkerman Product Support representative.

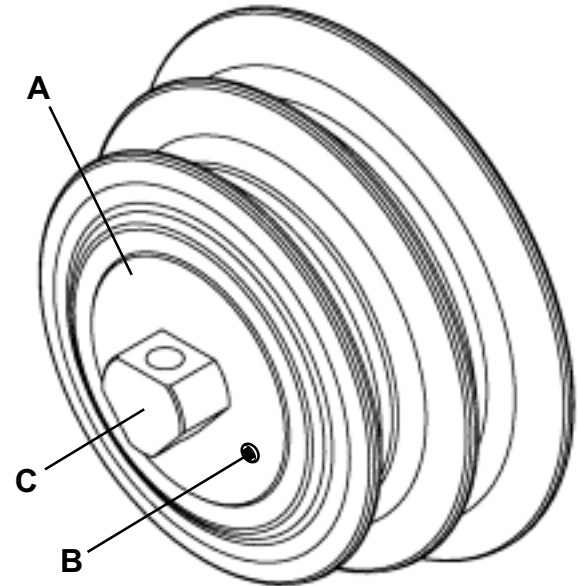
##### CUTTER WEAR

If any flat spots are visible on the cutter, this is an indication that the cutter is skidding, and is most likely a result of a damaged bearing. Install a new cutter to replace any cutter with flat spots.

For the 280mm to 320mm size cutter, typically no more than 3/4 in. (19mm) of diameter wear is acceptable until considerable ground experience is achieved.

In cutters with tungsten carbide inserts (TCI), any cutters with cracked carbides or cracks in the base metal of the cutter, must be replaced with a new cutter.

If the carbide insert has turned into the base metal of the cutter, the cutter should be replaced with new, otherwise unplanned cutter failure will result.



#### 5. CHECK CUTTER PLACEMENT

**NOTICE** Pinch points! Moving parts or the mishandling of parts can cause serious injury. Handle parts carefully to avoid crushing and pinch point hazards.

Make sure when replacing the cutters on the cutter head, that the correct style of cutter (twin or triple, straight or conical cutters) is in the proper location and orientation.

If necessary, contact your Akkerman Product Support representative for a drawing for the proper cutter layout for your cutter head.

If the twin and triple cutters are not properly located and oriented, damage will result to your cutters, cutter head, and tunnel boring machine.



## 6. INSTALL NEW RETAINING HARDWARE

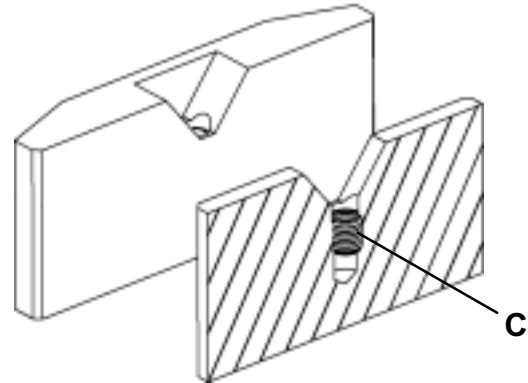
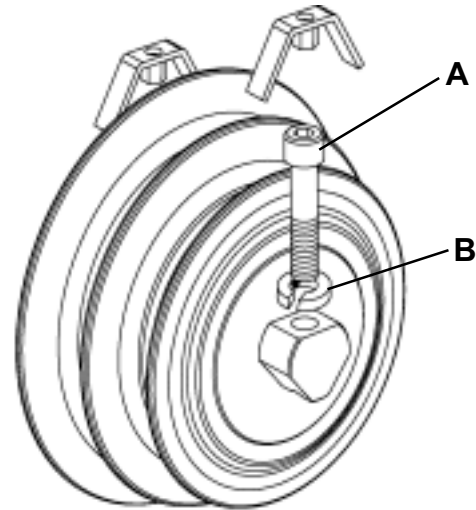
When installing cutters, ALWAYS replace with new cutter retaining bolts (A) and lock washers (B).

When replacing hardware, replace only with IDENTICAL size and grade. Contact your Akkerman Product Support representative for proper hardware.

The bolts must reach through the lock washer and shaft of cutter with at least one and one-half times the bolt diameter to engage the threads of the helical thread inserts (C).

To tighten hardware, refer to "7. Tighten Retaining Bolts" below.

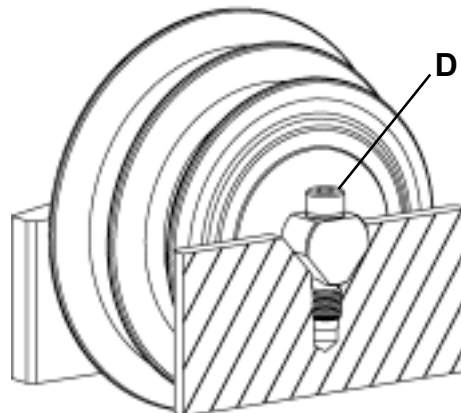
**NOTICE** Do not chase insert threads with a tap. There must be some resistance while tightening cutter retaining bolts.



## 7. TIGHTEN RETAINING BOLTS

When securing the cutters in place, tighten all retaining bolts (D) to 375 ft-lb (508 N·m) torque with a calibrated torque wrench.

**NOTICE** It is helpful to mark each bolt after tightening, so any bolts that have not been tightened, are clearly at a visible glance.



## 8. ROTATE CUTTERS

After the cutter retaining bolts are properly torqued, be sure the cutters rotate freely by hand.

It is normal to take some effort in rotating the cutters to overcome the bearing pre-load and friction in the seals.

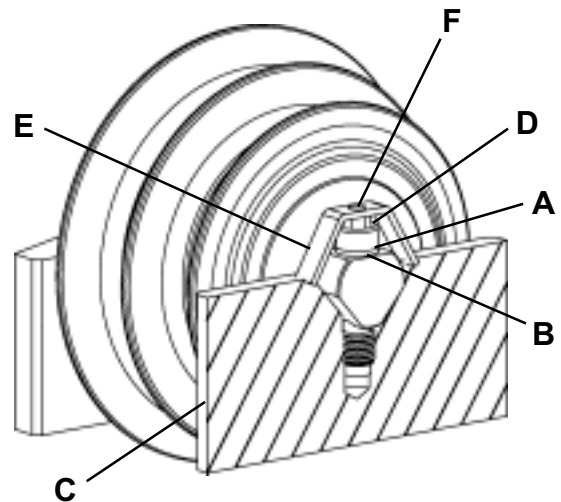
If the cutter cannot be turned by hand, it may be wedged against debris behind the cutter or part of the cutter head structure. If after removing the debris and the cutter still does not rotate, the cutter must be repaired or replaced.



## 9. APPLY BOLT KEEPERS

Once the cutters are installed and the retaining bolts properly tightened, bolt keepers must be welded in place to prevent the bolts from working loose while mining.

1. With the bolt (A) and lock washer (B) properly tightened into mounting plate (C), place bolt retainer hex plug (D) (PN A04397P) into socket head of bolt.
2. Place bolt retainer strap (E) (PN A04396P) over bolt/hex plug, aligning hole (F) of strap over hex plug.



### NOTICE

To avoid premature damage to bearing and cutter:

- **DO NOT** attach welding ground cable to cutter.
- **DO NOT** flash any arcs against cutter hub.
- **Hold a shield between cutter and work while attaching bolt keepers to keep weld spatter from hitting cutters.**
- **Apply stitch welds using low-hydrogen welding rods.**
- **DO NOT** weld on cutter surfaces. Otherwise cracks will develop.

3. Using a low-hydrogen welding rod, stitch weld strap to mounting plate.
4. Stitch weld hex plug to strap.
5. Continue steps 1 through 4 for other side of cutter and all other cutters.

# Storage

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## PREPARING FOR STORAGE

1. Repair worn or damaged parts.
2. Wash all equipment thoroughly.
3. Repaint equipment where necessary.
4. Inspect each cutter for leaks. If leaks appear, the cutter must be repaired or replaced.
5. Check to be sure each cutter rotates freely by hand. If not, the cutter must be repaired or replaced.
6. Store machine and replacement under cover and out of the weather in a ventilated area. Always store cutters away from heat and out of direct sunlight.
7. If machine and cutters will be stored for a long period of time, it is recommended that the cutter lubricant be removed and replaced with fresh lubricant.

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## REMOVING FROM STORAGE

1. Clean equipment thoroughly.
2. Inspect cutters for leaks. Repair or replace as necessary.
3. Check to be sure each cutter rotates freely by hand. If not, the cutter must be repaired or replaced.
4. If the cutter head or cutters have been stored for a long period of time, the lubricant in the cutters must be replaced with fresh lubricant.
5. Perform the cutter maintenance as described in Section 6, Periodic Maintenance.
6. Be sure to keep all replacement cutters under cover and out of the weather in a ventilated area. Always store cutters away from heat and out of direct sunlight.
7. Review this Operator's Manual and your Akkerman tunneling equipment operation manuals before operating the equipment.

# Troubleshooting

<b>Problem</b>	<b>Cause</b>	<b>Solution</b>
Cutter discs have flat spots on the cutting surface.	Bearing is worn or damaged.	Replace bearing and/or cutter. Contact your Akkerman Product Support Representative for bearing replacement.
There is end play or slack between the shaft and outer hub, or a loose or rough feel when turning the cutter in its mount.	Retaining bolts were not properly tightened before welding bolt keepers to mounting plate.	Check for cutter damage. Tighten bolts to 375 ft-lb. Weld bolt keepers.
	Bearing is worn or damaged.	Replace bearing. Contact your Akkerman Product Support Representative for bearing replacement.
Cutter will not turn.	Bearing is worn or damaged.	Replace bearing. Contact your Akkerman Product Support Representative for bearing replacement.
Traces of leakage from the seal area.	Faulty seal.	Replace seal. Contact your Akkerman Product Support Representative for seal replacement.
No lubrication is visible through the drain plug.	Drain plug is missing.	Fully lubricate the cutter and replace drain plug.
	Faulty seal.	Replace seal. Contact your Akkerman Product Support Representative for seal replacement.
The retaining bolts cannot be tightened.	Debris in cutter housing or bolt hole.	Remove debris and replace retaining bolts and lockwashers with new.
Newly lubricated cutters are leaking.	Grease in cutter expanded and ruptured the duo-cone seals at one or both end caps.	Cutters must be stored in a cool location, out of direct sunlight. Contact your Akkerman Product Support Representative for repair.

# Specifications

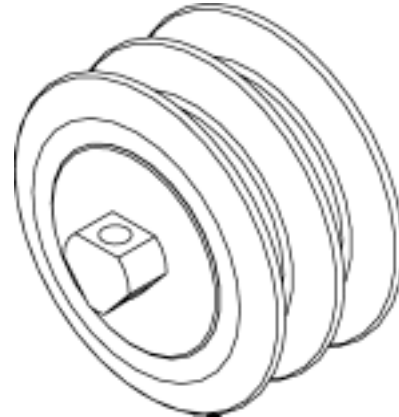
**Triple Disc Conical Cutter**



Cutter Diameter: 320 - 250 mm

Cutter Discs Available With:  
Harden Steel or  
Tungsten Carbide Inserts

**Triple Disc Straight Cutter**



Cutter Diameter: 250 mm or 280 mm

Cutter Discs Available With:  
Harden Steel or  
Tungsten Carbide Inserts

**Twin Disc Straight Cutter**



Cutter Diameter: 250 mm or 280 mm

Cutter Discs Available With:  
Harden Steel or  
Tungsten Carbide Inserts

Akkerman Inc. reserves the right to improve its products without notice or obligation.

## TORQUE CHART

Use these torque values as a guideline when tightening hardware unless otherwise specified in this manual.

Lubricated Coarse UNC Threads Grade 8 Fasteners			Lubricated Fine UNF Threads Grade 8 Fasteners		
Bolt Size	Torque		Bolt Size	Torque	
	ft. lbs.	(N·m)		ft. lbs.	(N·m)
1/4 - 20	10	(14)	1/4 - 28	11	(15)
5/16 - 18	20	(27)	5/16 - 24	22	(30)
3/8 - 16	35	(47)	3/8 - 24	39	(53)
7/16 - 14	56	(76)	7/16 - 20	62	(84)
1/2 - 13	85	(115)	1/2 - 20	96	(130)
9/16 - 12	123	(167)	9/16 - 18	137	(186)
5/8 - 11	170	(231)	5/8 - 18	192	(260)
3/4 - 10	301	(408)	3/4 - 16	336	(456)
7/8 - 9	450	(610)	7/8 - 14	500	(678)
1 - 8	680	(922)	1 - 12	740	(1003)
1-1/8 - 7	960	(1302)	1-1/8 - 12	1030	(1397)
1-1/4 - 7	1360	(1844)	1-1/4 - 12	1500	(2034)
1-1/2 - 6	2360	(3200)	1-1/2 - 12	2660	(3607)

Lubricated Threads Metric Class 12.9 Fasteners			Dry Threads Metric Class 12.9 Fasteners		
Bolt Size	Torque		Bolt Size	Torque	
	ft. lbs.	(N·m)		ft. lbs.	(N·m)
M6	11.5	(15)	M6	14.5	(19)
M8	28	(37)	M8	35	(47)
M10	55	(75)	M10	70	(95)
M12	95	(130)	M12	120	(165)
M14	150	(205)	M14	190	(260)
M16	240	(320)	M16	300	(400)
M18	325	(440)	M18	410	(560)
M20	460	(625)	M20	580	(800)
M22	625	(850)	M22	800	(1075)

# Material Safety Data Sheets

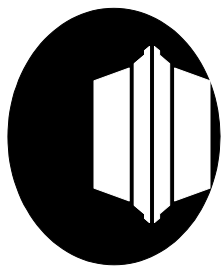
The Federal Occupational, Safety, and Health Administration (OSHA) Standard 29 CFR 1910.1200, require that specific material safety data sheets (MSDS) be available to employees before operating this equipment. This may include information on substances contained in this equipment such as antifreeze, brake fluid, battery acid, hydraulic fluid and gear lubricant.

Akkerman Inc. will provide, at no cost, MSDS which apply to its product line. Simply contact your Akkerman Product Support representative for a copy.

To ensure a prompt response to your MSDS request, include your return address (including zip or postal code) and the equipment's model numbers and serial numbers with your request.

# Warranty

Akkerman Inc. warrants that all equipment manufactured by it be free from defects due to workmanship or material under normal use and service for a period of 90 days. This warranty does not apply to normal wear items such as cutter teeth, cutter discs, etc. Akkerman Inc. does not warrant the fitness of its equipment for a particular purpose or application.



## **MAINTENANCE MANUAL**

**SECTION A: General information**

**SECTION B: External inspection**

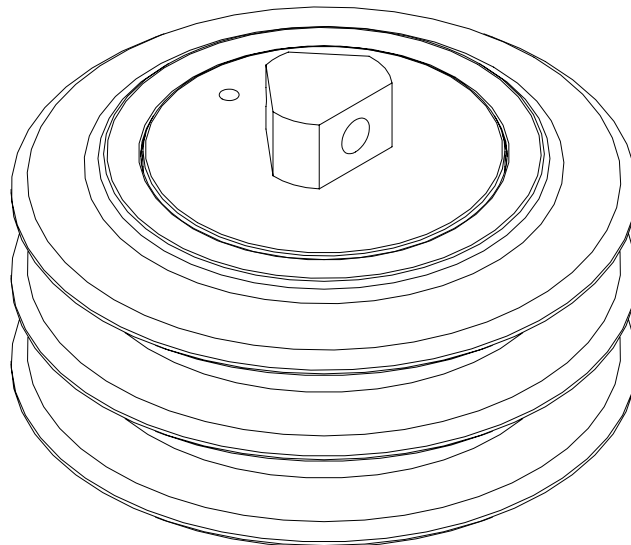
**SECTION C: Disassembly & internal inspection procedure**

**SECTION D: Assembly & final inspection procedure**

### **SECTION A: GENERAL INFORMATION**

This manual contains instructions for inspection, re-ringing, and rebuilding of PALMIER Straight disc cutters.

We recommend that cutter rebuilding personnel keep accurate cutter records.



#### **0020.110.87 STRAIGHT CUTTERS**

The manual describes the use of suitable Tools for cutter maintenance. Some of these Tools are "commercial parts" easily sourced on the market. Others are "special", and can be obtained from PALMIERI.

## SECTION B: CUTTER DISASSEMBLY AND INTERNAL INSPECTION PROCEDURE

**-B1- Clean cutter assembly.**

**-B2- Remove the tab:**

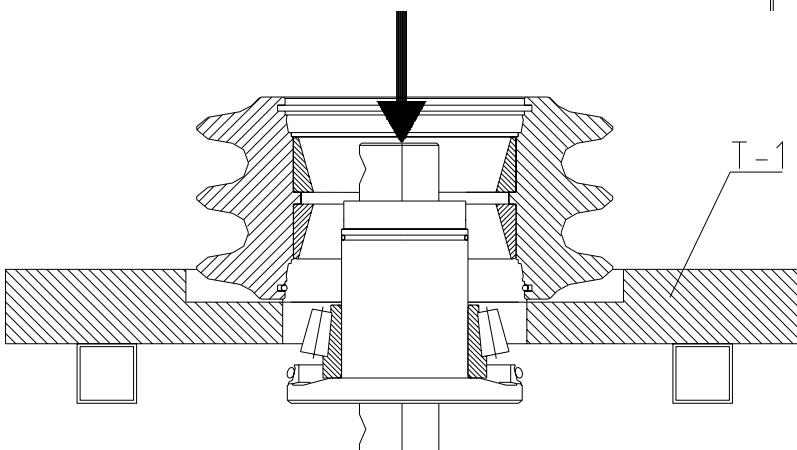
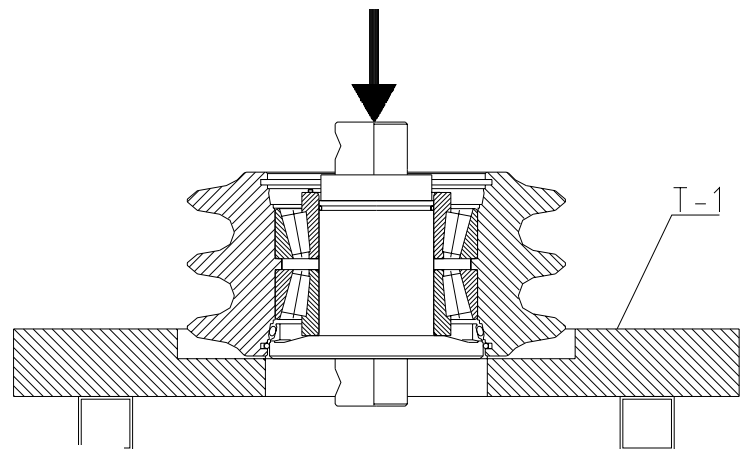
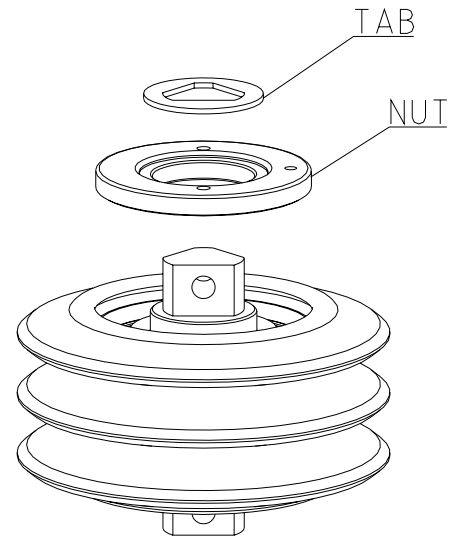
Carefully grind through the weld holding the tab (pos.10) to the nut (pos.3). removing as little material as possible from either the tab or nut.

**-B3- Unscrew nut (pos.3) by using the Tool T-10**

Be sure that outside diameter of shaft end is clean, smooth and free of any Burrs or sharp edges.  
Remove and discard "O" ring (pos.6) from nut (pos.3).

**-B4- Press out shaft:**

Place the cutter assembly onto Tool T-1 and use press to push shaft (pos.2).  
Remove hub and bearing cones.



**-B5- Remove and inspect seals:**

Remove seal sets from cutter assembly.

Discard the rubber torics. Inspect the seal faces for any scratches.

The metal seal rings must be free of nicks, burrs, or scratches.

Discard the rings if inspection shows that seals are bad.

**SEE APPENDIX 4 for SEAL SET INSPECTION PROCEDURE.**

**We always suggest to effect an inner revision, with replacement of complete sealing system.**

**-B6- Inspect both bearing cones:**

Deformations of the roller cage, or flat spots, flaking, brinelling, or cracking is cause to discard and replace cone (s).

**-B7- Inspect the bearing cups:**

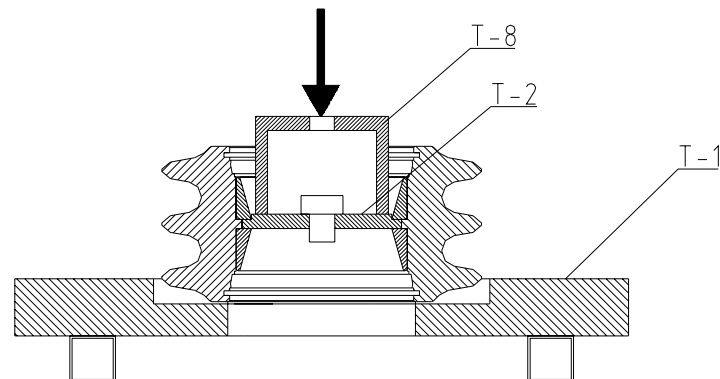
If one or both cups require replacement, place hub on Tool T-1.

Insert Tool T-2 and Tool T-8 and press out bearing cup (s).

Inspect the hub bores for nicks, burrs, etc. and clean as required.

Inspect the web in the hub where the cups bottom against.

Any sign of deformation or cracking will require hub replacement.



**-B8- Inspect the hub interior:**

Inspect the toric areas of the hub. Clean and deburr as required.

Remove and discard seal rings (pos.8A-8B) from hub.

**-B9- Inspect shaft:**

Remove and discard “O” rings (pos.7) from shaft

If shaft has any scratches, nicks, galling, or gauges that cannot be removed by minor polishing, the shaft must be replaced.

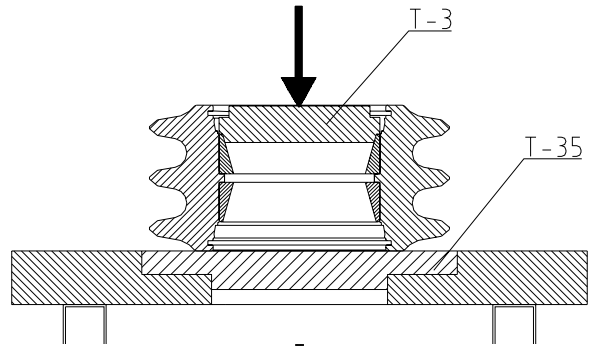
## SECTION E: CUTTER ASSEMBLY AND FINAL INSPECTION

**-C1- Clean all parts:**

To get the best cutter performance, carefully clean all components.  
Make sure all parts are fully cleaned and washed with oil free solvent, deburred,  
sharp edges removed, and fully inspected.

**-C2- Install bearing cups into hub:**

If cups were removed, install cups using  
cup installation Tool T-3 .  
Press the cups into hub.  
Use 40 tons pressure to insure proper setting.

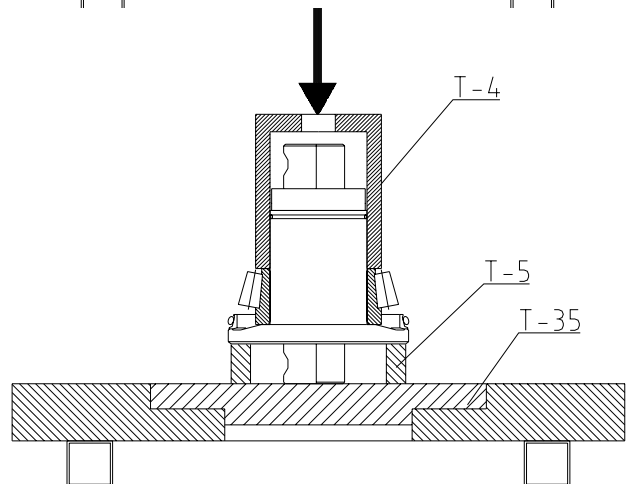


**-C3- Install the seal sets in hub.**

**SEE APPENDIX4**

**-C4- Assemble shaft and bearing cone**

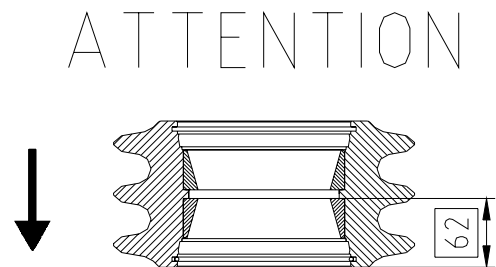
Place shaft onto Tool T-5.  
Lube shaft with never-seize and press  
bearing cone onto shaft with Tool T-4.  
Press till cone bottoms against shaft  
Seat cone with 80 bars pressure.



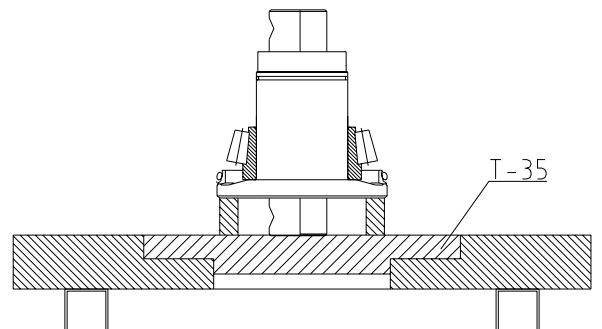
**-C5- Install two seal rings (pos.8A-8B)**  
(Teflon +square rubber ring) on hub,  
on side where ring shoulder is located.

**-C6- Install hub**

Place hub assembly on the bearing cone  
being assured it is on the right versus  
(see figure).

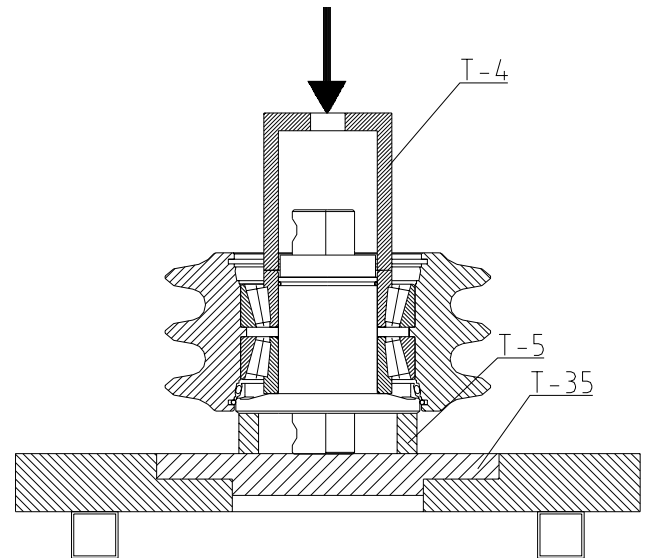


**-C7- Install one o-ring (POS. 7) with oil**  
and install onto shaft.



**-C8- Install bearing cone**

Press the other bearing cone onto shaft until it just begins to seat with bearing cup. Care must be taken to not press second cone on too far as this will overload the bearings causing the cutter to lock-up.



**-C9-** Lubricate and install o-ring (pos.6) into groove on nut (pos.3)

**-C10-** Install nut onto shaft by using of Tool T-10.

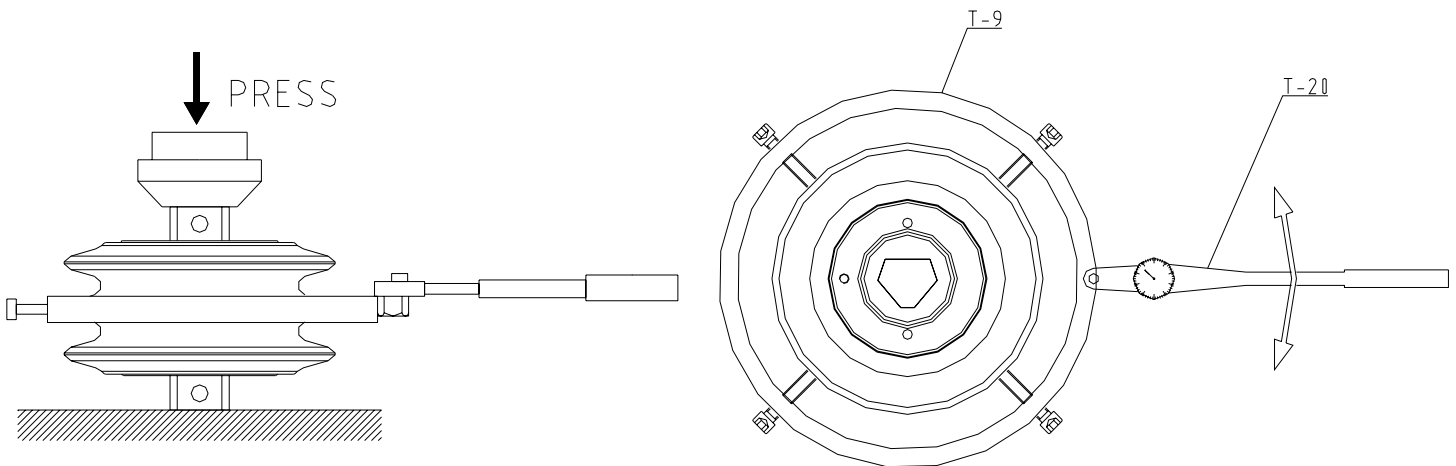
**-C11- Test Drag Torque:**

SEE APPENDIX 2

To keep cutter shaft and supports from rotating, place cutter under press with approximately 50 bars load.

Mount Tool T-9 with Tool T-20 on hub and tighten the nut (pos.3) with Tool T-10 until the specified value of torque is reached.

Recommended TRUE Torque range 20-40 Nm.



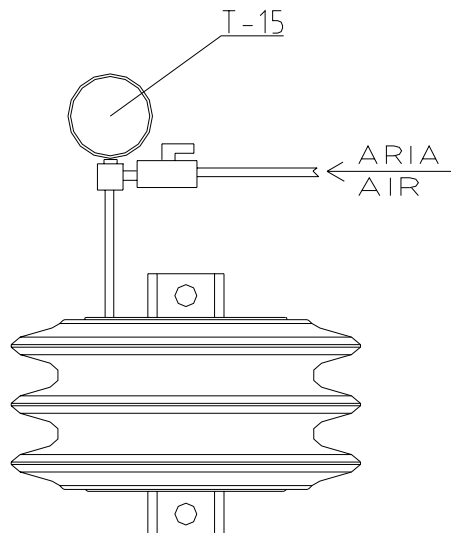
**-C12- Cutter pressure test:**

Install one pipe plugs (pos.9) with Teflon tape in shaft.

Install Seal Test Tool T-14 in remaining hole and apply 1.5 Bar for 30 minutes.

In case pressure drop down 0,8 bar for specified time, locate leak and repair.

If pressure test is OK, remove pressure test fixture and proceed.

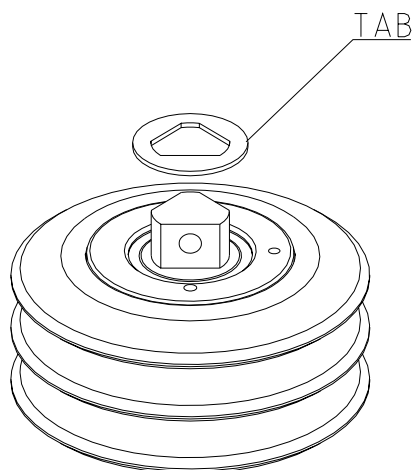


**-C13-** Remove Tool T-14 and the pipe plug from nut and fill up the cutter with grease.  
Use Tool T-18. Install two pipe plugs (pos.9) with tape.

**Palmieri highly recommends the use of approved grease for the application.  
Paragon® 3000**

**-C14- Install tab:**

Place the tab (POS.10) between the nut (POS.3) and the shaft  
Weld along interface of the tab and nut.



**-C15-** Make sure that the cutter serial number is clearly legible. Restamp if required.



## **APPENDIX 1** **SPECIAL TOOLS**

**T-1-PRESS PLATFORM**  
**T-2-DISASSEMBLY PLATE FOR BEARING CUP**  
**T-3-ASEMBLY PLATE FOR THE BEARING CUP**  
**T-4-ASSEMBLY PIPE FOR BEARING CONE**  
**T-5-ADAPTER SHAFT**  
**T-8-PRESSING PIPE FOR BEARING CUP**  
**T-9-RING FOR MEASURING TORQUE**  
**T-10-NUT ASSEMBLY/DISASSEMBLY TOOL**  
**T-14-SEAL TEST TOOL**  
**T-15-SEAL SETS INSTALLATION TOOL**  
**T-18-GREASE PUMP**  
**T-20-TORQUE WRENCH**  
**T-35-BASE**

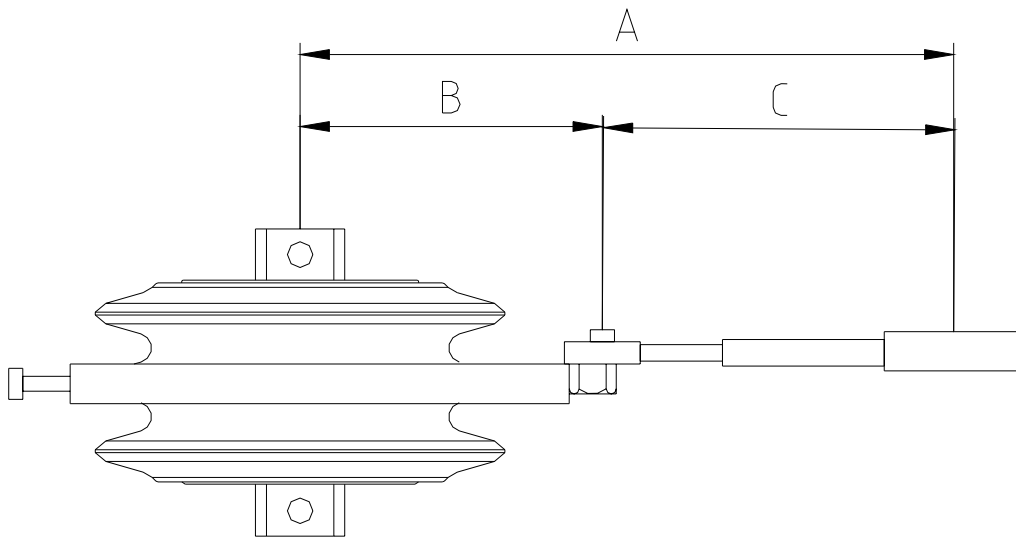
## APPENDIX 2

### CHECK ROTATIONAL TRUE TORQUE

Recommended TRUE DRAG TORQUE value must be within 20-40Nm.

All assemblies, whether new or rebuilt, must satisfy above minimum torque requirements.

A higher torque than that specified above might be desirable in some ground conditions.



$$\text{WRENCH TORQUE} = \left( \frac{\text{TRUE TORQUE}}{A} \right) \times C$$

$$\text{TRUE TORQUE} = \left( \frac{\text{WRENCH TORQUE}}{C} \right) \times A$$

## APPENDIX 4

### DUO-CONE SEALS INSTALLATION

#### HOW TO GET MAXIMUM LIFE FROM YOUR SEALS

Proper handling and installation of Duo-Cone Seals is vital to obtain maximum life and positive sealing protection afforded by these precision lapped units.

Special attention is given during manufacturing and shipping to help ensure absolute cleanliness. To obtain maximum service, cleanliness during installation and while filling with oil must be the rule.

#### REMOVE ALL PROTECTIVE COATING

If necessary, remove all oil and any protective coating from seal ring (2) and from the seat (4) with a cleaning solvent.

#### ELIMINATE ROUGHNESS IN SEAT AREA

Check retaining lip (3) for rough tool marks or nicks. Smooth any nicks and re-clean.

#### EXERCISE CARE WITH TORIC

The rubber toric (1) should be seated uniformly on the seal ring (2). Be sure that the toric is not twisted and that it rests uniformly against the retaining lip.

#### TOOLS HELP PROTECT RINGS DURING INSTALLATION

Simple installer tools are available. The lip on the installer tool (5) exerts uniform pressure on the rubber seal ring and provides protection to the seal face. Press the rubber ring into the seat making certain it is straight in the bore and inside the retaining lip.

Dimension (x) must be uniform around the circumference of the seal.

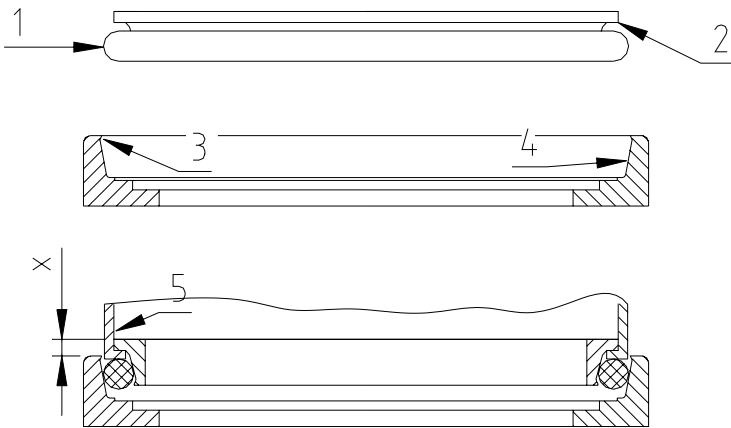
If an installer tool is not used, press with fingers on the rubber ring only, seating the ring inside the lip. Do not use a screwdriver or any sharp instrument to seat the ring.

#### WIPE SEAL FACES CLEAN

Before final assembly, wipe the seal faces to remove any foreign material. Place a few drops of light oil on a cleaning tissue and completely coat the sealing faces of seals to assure corrosion protection and initial lubrication.

#### ALWAYS USE MATED SEAL RINGS

Duo-Cone Seal Rings should always be installed in pairs; that is, two new rings or two rings that have previously run together. Never assemble one new ring and one used ring, or two used rings that have not previously run together. New torics should always be used.



1. Rubber sealing ring or toric
2. Metal seal ring
3. Seal retaining lip
4. Seal set
5. Installer tool

#### CLEAN ALL SURFACE BEFORE INSTALLATION

Before installing Duo Cone Seals, thoroughly remove all dirt or rust accumulated on the seal sets and other parts of the assembly.

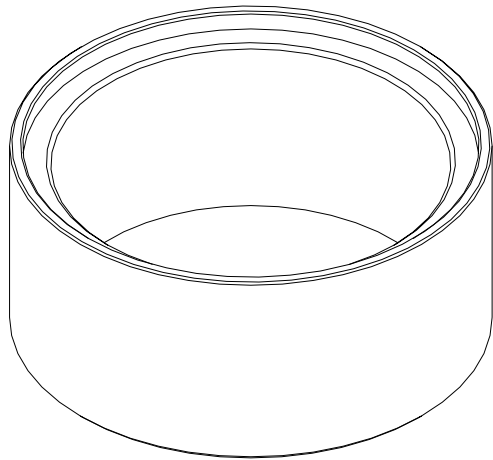
#### AVOID CARELESS HANDLING

Handle all parts with care to avoid damaging critical areas. The sealing face of seal ring (2) must not be nicked or scratched.



## APPENDIX 4 INSTALLER TOOLS

Seals can be pressed into their seats by hand, applying finger pressure to the rubber torics to seat them inside the retaining lips. However, it is recommended that these inexpensive installer tools be used to simplify seal installation and to protect the seal faces during assembly. Depending upon the volume of seals used, only one or two installer tools for each size of seal are needed.

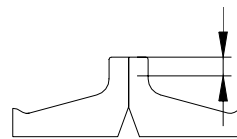


When the installer tool is placed on the metal seal ring, hand pressure is applied to push the rubber toric into its seat. The toric must be seated uniformly in relation to both seal ring and seat. Dipping the seal assembly into a shallow pan of shop solvent, noninjurious to the rubber toric, will facilitate assembly by reducing friction between toric and seat. The quick-evaporating solvent will not leave an oily residue or cause corrosion of the metal parts.

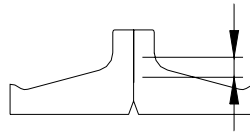
The seals use a one-piece installer tool which snaps around the seal ring.



### INSPECTION FOR SEAL WEAR

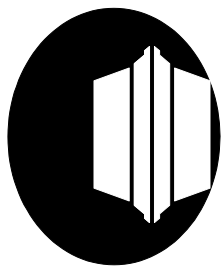


A narrow polished band indicates the seal interfaces. On a new seal, this contact band is at the outer perimeter.



As the seal wears, this polished band will move toward the inner diameter. Remaining wear life can be estimated based on a linear relationship of service hours (or meters of tunnel bored) vs. contact band position.





**PALMIERI** SPA

# MAINTENANCE MANUAL

**SECTION A: General information**

**SECTION B: External inspection**

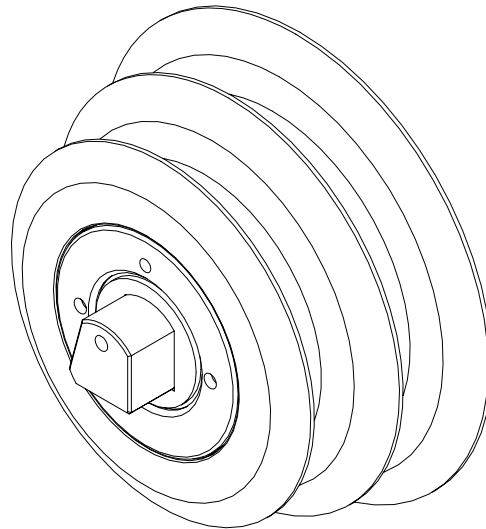
**SECTION C: Disassembly & internal inspection procedure**

**SECTION D: Assembly & final inspection procedure**

## SECTION A: GENERAL INFORMATION

This manual contains instructions for inspection, re-ringing, and rebuilding of PALMIERI Triple Conical disc cutters.

We recommend that cutter rebuilding personnel keep accurate cutter records.



**0020-111-87**  
**CONICAL CUTTERS**  
**GAGE POSITION**  
**FRONT LOAD MOUNT**

The manual describes the use of suitable Tools for cutter maintenance. Some of these Tools are "commercial parts" easily sourced on the market. Others are "special", and can be obtained from PALMIERI.



## SECTION B: CUTTER DISASSEMBLY AND INTERNAL INSPECTION PROCEDURE

**-B1- Clean cutter assembly.**

**-B2- Remove the tab:**

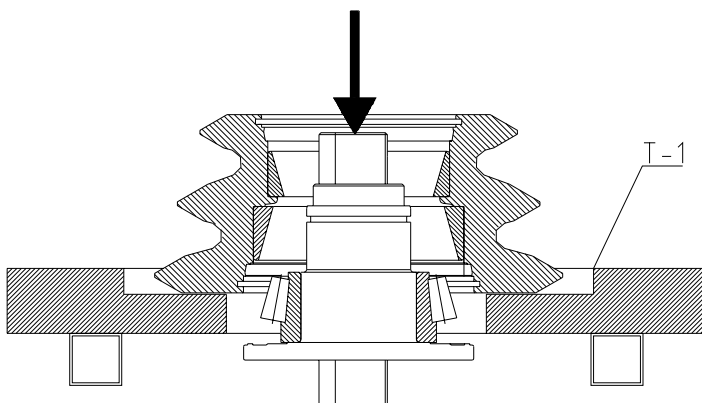
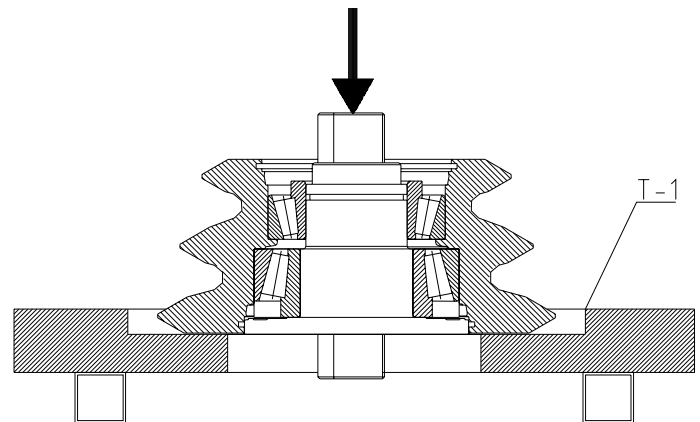
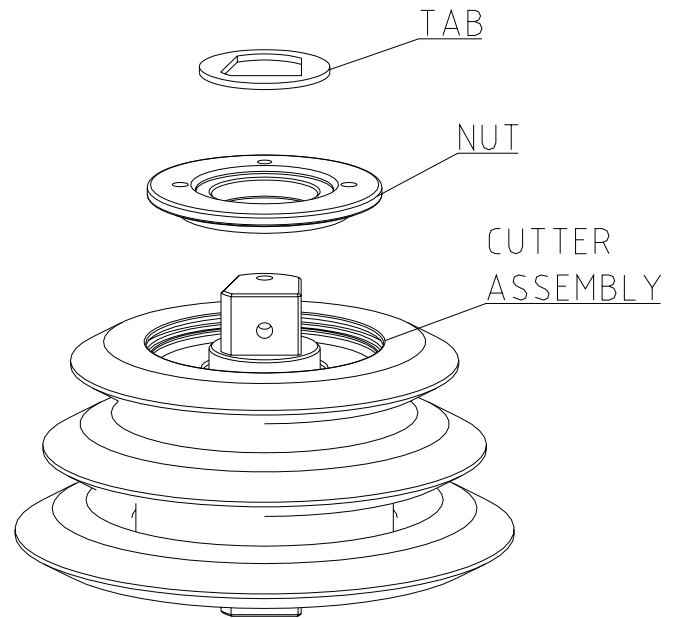
Carefully grind through the weld holding the tab (pos.15) to the nut(pos.3). removing as little material as possible from either the tab or nut.

**-B3- Unscrew nut (pos.3) by using the Tool T-10**

Be sure that outside diameter of shaft end is clean, smooth and free of any Burrs or sharp edges.  
Remove and discard "O" rings (pos.9) from nut (pos.3).

**-B4- Press out shaft:**

Place the cutter assembly onto Tool T-1 and use press to push shaft (pos.2).  
Remove hub and bearing cone



**-B5- Remove and inspect seals:**

Remove seal sets from cutter assembly.

Discard the rubber torics. Inspect the seal faces for any scratches.

The metal seal rings must be free of nicks, burrs, or scratches.

Discard the rings if inspection shows that seals are bad.

**SEE APPENDIX4 for SEAL SET INSPECTION PROCEDURE.**

If they are acceptable for re-use, clean and band the two rings together.

**We always suggest to effect an inner revision, with replacement of complete sealing system.**

**-B6- Inspect both bearing cones:**

Deformations of the roller cage, or flat spots, flaking, brinelling, or cracking is cause to discard and replace cone (s).

**-B7- Inspect the bearing cups:**

Place hub on press platform large side up.

Install tools T-A2 and T8 on the hub and press out bearing cup (POS.5)

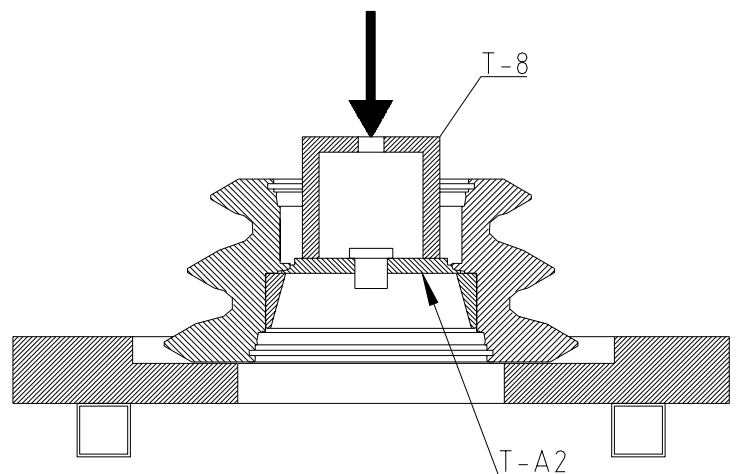
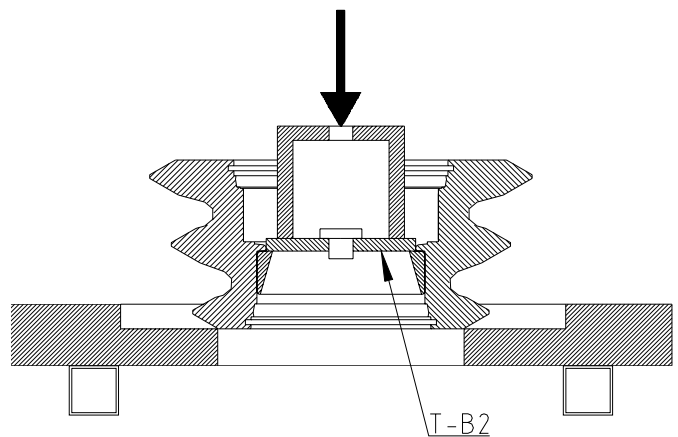
Turn over hub as it is set down on the press platform, install tool T-B2 and tool T8,

then press out bearing cup (POS.6).

Inspect the hub bores for nicks, burrs, etc. and clean as required.

Inspect the web in the hub where the cups bottom against.

Any sign of deformation or cracking will require hub replacement.



**-B8- Inspect the hub interior:**

Inspect the toric areas of the hub. Clean and deburr as required.

Remove and discard seal rings (pos.12-13 & pos.10-11) from hub.

**-B9- Inspect shaft:**

Remove and discard “O” rings (pos.8) from shaft

If shaft has any scratches, nicks, galling, or gauges that cannot be removed by minor polishing, the shaft must be replaced.

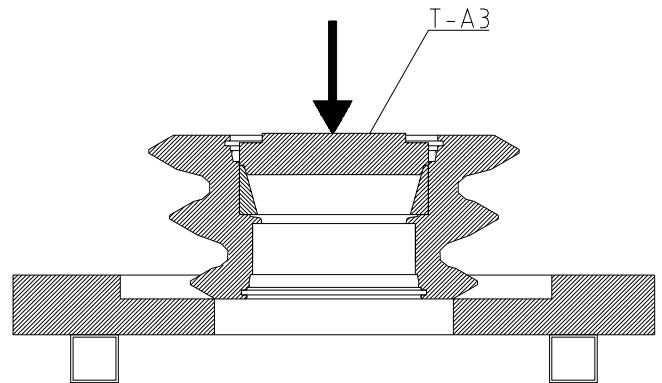
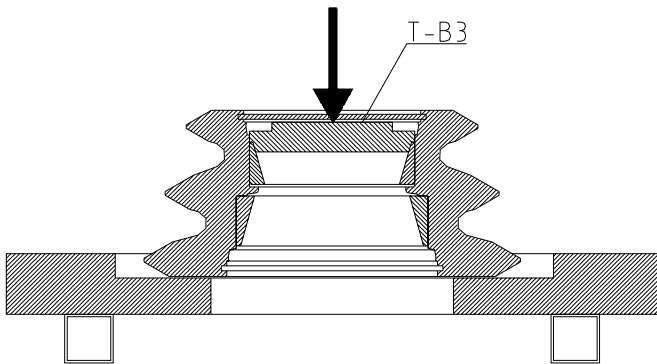
## SECTION E: CUTTER ASSEMBLY AND FINAL INSPECTION

### -C1- Clean all parts:

To get the best cutter performance, carefully clean all components.  
Make sure all parts are fully cleaned and washed with oil free solvent, deburred,  
sharp edges removed, and fully inspected.

### -C2- Install bearing cups into hub:

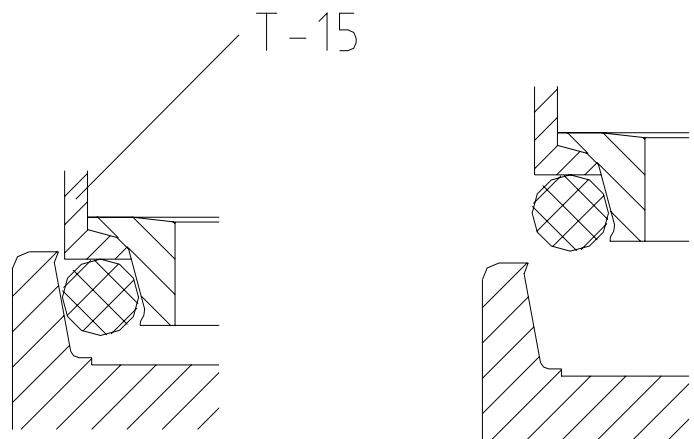
If cups were removed, install cups using  
cup installation Tool T-A3 and T-B3  
Press the cups into hub.  
Use 40 tons pressure to insure proper setting.



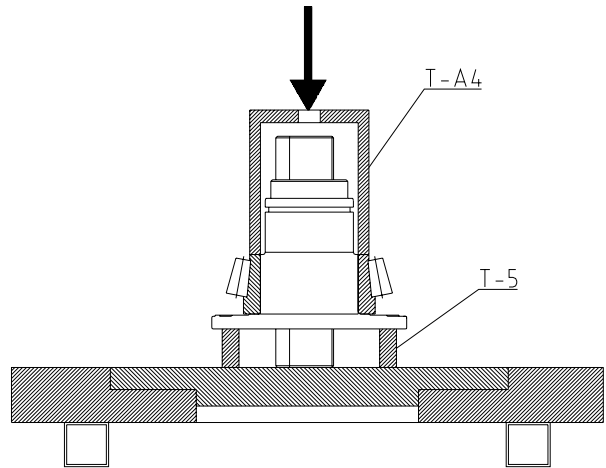
### -C3- Install the seal sets in hub. SEE APPENDIX 4

Use tool T-A15 for seal set (pos.6)

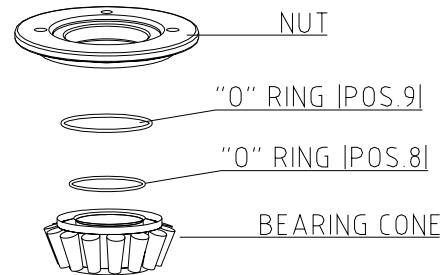
Use tool T-B15 for seal set (pos.7)



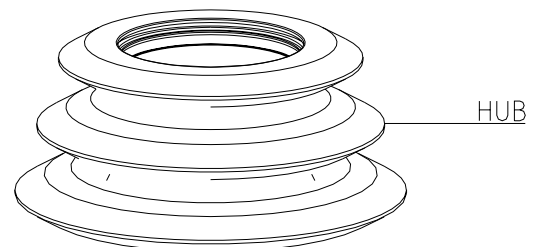
- C4- **Assemble shaft and bearing cone**  
Place shaft onto Tool T-5.  
Lube shaft with never-seize and press bearing cone onto shaft with Tool T-4.  
Press till cone bottoms against shaft  
Seat cone with 80 bars pressure.



- C5- **Install two seal rings (POS.12-13)**  
(Teflon +square rubber ring) on hub,  
on side where ring shoulder is located.

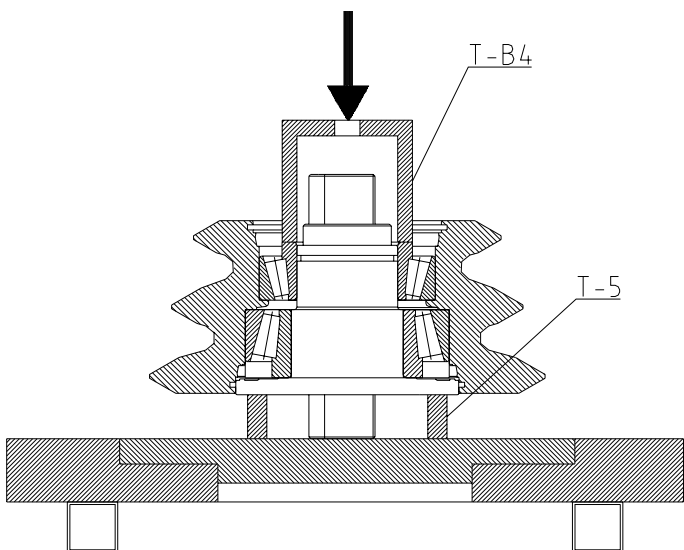
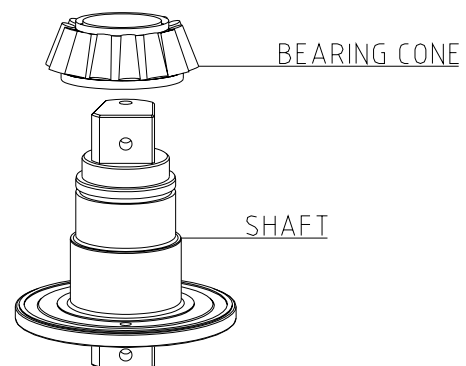


- C6- **Install hub**  
Place hub assembly onto bearing cone.



- C7- Install one o-ring (POS. 8) with oil and install onto shaft.

- C8- **Install bearing cone (pos.4).**  
Press the other bearing cone onto shaft until it just begins to seat with bearing cup.  
Care must be taken to not press second cone on too far as this will overload the bearings causing the cutter to lock-up.



-C9- Lubricate and install o-ring (pos.9) into groove on nut (pos.3)

-C10- Install nut onto shaft by using of Tool T-10.

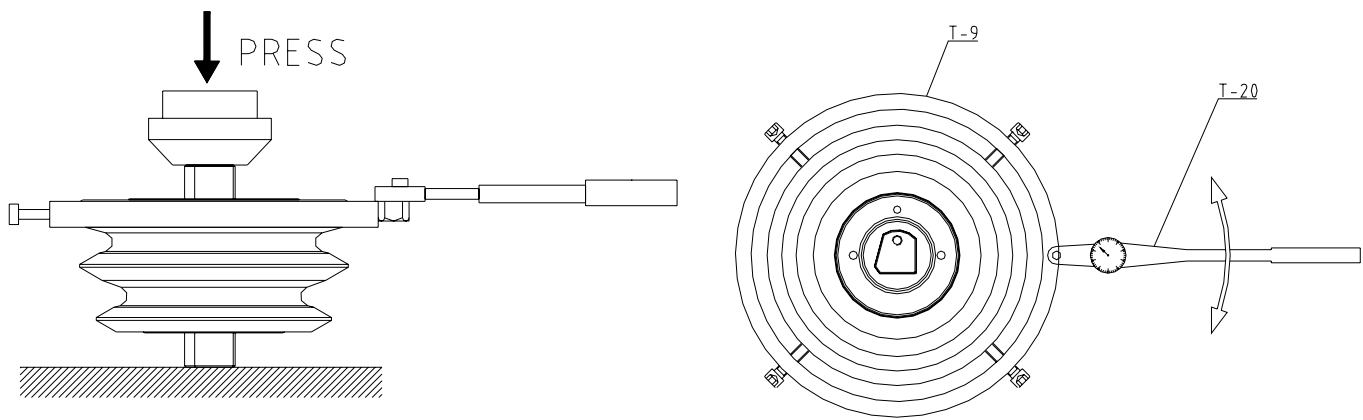
**-C11- Test Drag Torque:**

SEE APPENDIX 2

To keep cutter shaft and supports from rotating, place cutter under press with approximately 50 bars load.

Mount Tool T-9 with Tool T-20 on hub and tighten the nut (pos.3) with Tool T-10 until the specified value of torque is reached.

Recommended TRUE Torque range 15-40 Nm.



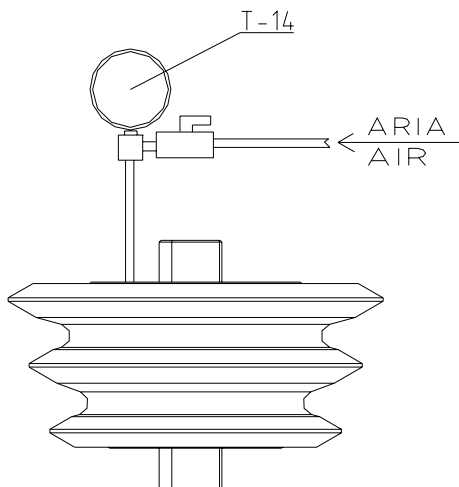
**-C12- Cutter pressure test:**

Install one pipe plugs (pos.14) with Teflon tape in shaft.

Install Seal Test Tool T-14 in remaining hole and apply 1.5 Bar for 30 minutes.

In case pressure drop down 0,8 bar for specified time, locate leak and repair.

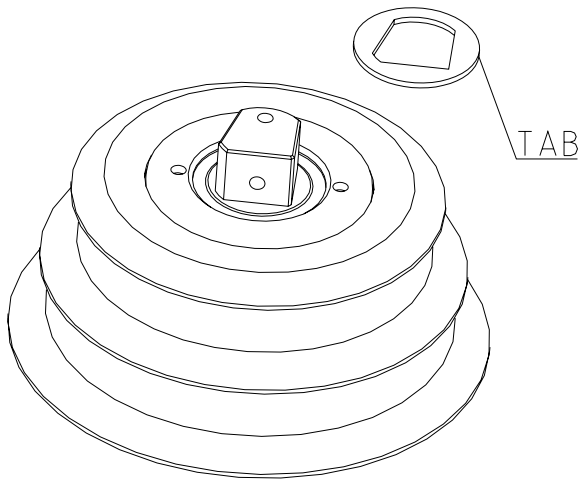
If pressure test is OK, remove pressure test fixture and proceed.



- C13- Remove Tool T-14 and the pipe plug from nut and fill up the cutter with grease.  
Use Tool T-18. Install two pipe plugs (pos.14) with tape.

**Palmieri highly recommends the use of approved grease for the application:  
Paragon® 3000**

- C14- **Install tab:**  
Place the tab (POS.15) between the nut (POS.3) and the shaft  
Weld along interface of the tab and nut.



- C15- Make sure that the cutter serial number is clearly legible. Restamp if required.

## **APPENDIX 1**

### **SPECIAL TOOLS**

**T-1-PRESS PLATFORM**

**T-A2-DISASSEMBLY PLATE FOR BEARING CUP (POS.5)**

**T-B2-DISASSEMBLY PLATE FOR BEARING CUP (POS.4)**

**T-A3-ASEMBLY PLATE FOR THE BEARING CUP (POS.5)**

**T-B3-ASEMBLY PLATE FOR THE BEARING CUP (POS.4)**

**T-A4-ASSEMBLY PIPE FOR BEARING CONE (POS.5)**

**T-B4-ASSEMBLY PIPE FOR BEARING CONE (POS.4)**

**T-5-ADAPTER SHAFT**

**T-8-PRESSING PIPE FOR BEARING CUP**

**T-9-RING FOR MEASURING TORQUE**

**T-10-NUT ASSEMBLY/DISASSEMBLY TOOL**

**T-14-SEAL TEST TOOL**

**T-A15-SEAL SETS INSTALLATION TOOL (POS.6)**

**T-A15-SEAL SETS INSTALLATION TOOL (POS.6)**

**T-18-GREASE PUMP**

**T-20-TORQUE WRENCH**

**T-30-CUTTER LIFTING TOOL**

**T-35-BASE**

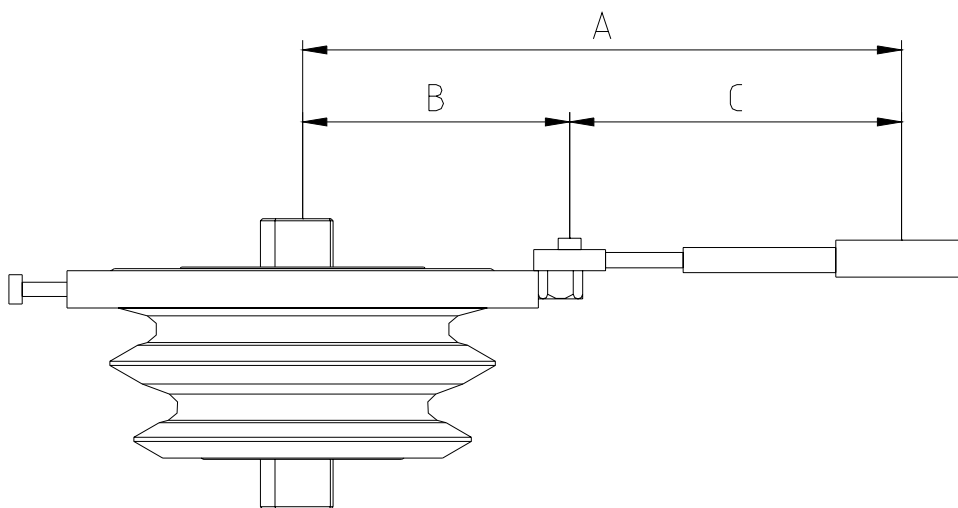
## APPENDIX 2

### CHECK ROTATIONAL TRUE TORQUE

Recommended TRUE DRAG TORQUE value must be within 15-40 Nm.

All assemblies, whether new or rebuilt, must satisfy above minimum torque requirements.

A higher torque than that specified above might be desirable in some ground conditions.



$$\text{WRENCH TORQUE} = \left( \frac{\text{TRUE TORQUE}}{A} \right) \times C$$

$$\text{TRUE TORQUE} = \left( \frac{\text{WRENCH TORQUE}}{C} \right) \times A$$

## APPENDIX 4

### DUO-CONE SEALS INSTALLATION

#### HOW TO GET MAXIMUM LIFE FROM YOUR SEALS

Proper handling and installation of Duo-Cone Seals is vital to obtain maximum life and positive sealing protection afforded by these precision lapped units.

Special attention is given during manufacturing and shipping to help ensure absolute cleanliness. To obtain maximum service, cleanliness during installation and while filling with oil must be the rule.

#### EXERCISE CARE WITH TORIC

The rubber toric (1) should be seated uniformly on the seal ring (2). Be sure that the toric is not twisted and that it rests uniformly against the retaining lip.

#### TOOLS HELP PROTECT RINGS DURING INSTALLATION

Simple installer tools are available. The lip on the installer tool (5) exerts uniform pressure on the rubber seal ring and provides protection to the seal face. Press the rubber ring into the seat making certain it is straight in the bore and inside the retaining lip.

Dimension (x) must be uniform around the circumference of the seal.

If an installer tool is not used, press with fingers on the rubber ring only, seating the ring inside the lip. Do not use a screwdriver or any sharp instrument to seat the ring.

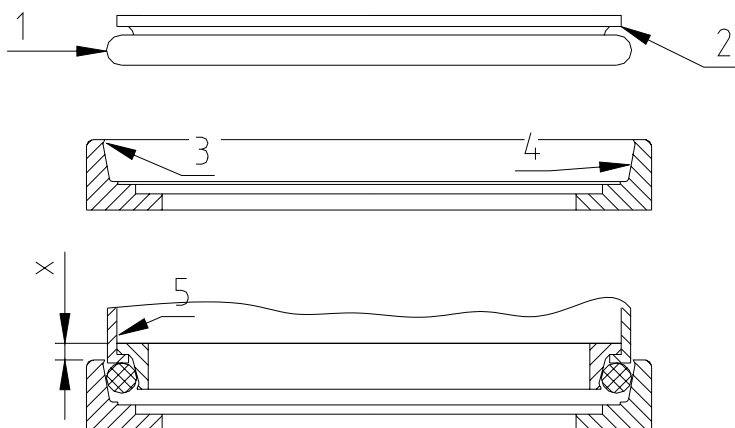
#### WIPE SEAL FACES CLEAN

Before final assembly, wipe the seal faces to remove any foreign material. Place a few drops of light oil on a cleaning tissue and completely coat the sealing faces of seals to assure corrosion protection and initial lubrication.

#### ALWAYS USE MATED SEAL RINGS

Duo-Cone Seal Rings should always be installed in pairs; that is, two new rings or two rings that have previously run together. Never assemble one new ring and one used ring, or two used rings that have not previously run together.

New torics should always be used.



1. Rubber sealing ring or toric
2. Metal seal ring
3. Seal retaining lip
4. Seal set
5. Installer tool

#### CLEAN ALL SURFACE BEFORE INSTALLATION

Before installing Duo Cone Seals, thoroughly remove all dirt or rust accumulated on the seal sets and other parts of the assembly.

#### AVOID CARELESS HANDLING

Handle all parts with care to avoid damaging critical areas. The sealing face of seal ring (2) must not be nicked or scratched.

#### REMOVE ALL PROTECTIVE COATING

If necessary, remove all oil and any protective coating from seal ring (2) and from the seat (4) with a cleaning solvent.

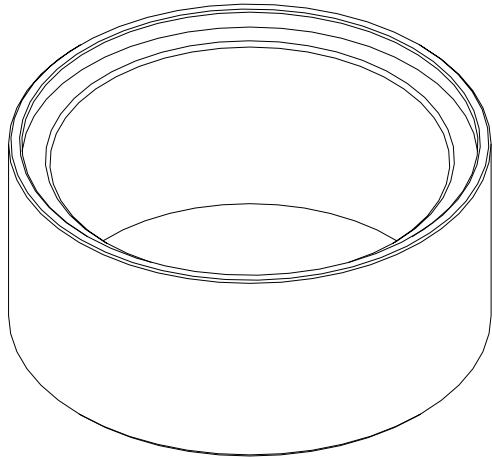
#### ELIMINATE ROUGHNESS IN SEAT AREA

Check retaining lip (3) for rough tool marks or nicks. Smooth any nicks and re-clean.



## APPENDIX 4 INSTALLER TOOLS

Seals can be pressed into their seats by hand, applying finger pressure to the rubber torics to seat them inside the retaining lips. However, it is recommended that these inexpensive installer tools be used to simplify seal installation and to protect the seal faces during assembly. Depending upon the volume of seals used, only one or two installer tools for each size of seal are needed.



When the installer tool is placed on the metal seal ring, hand pressure is applied to push the rubber toric into its seat. The toric must be seated uniformly in relation to both seal ring and seat.

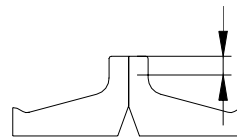


Dipping the seal assembly into a shallow pan of shop solvent, noninjurious to the rubber toric, will facilitate assembly by reducing friction between toric and seat. The quick-evaporating solvent will not leave an oily residue or cause corrosion of the metal parts.

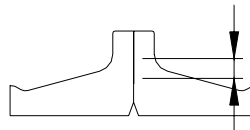
The seals use a one-piece installer tool which snaps around the seal ring,



### INSPECTION FOR SEAL WEAR



A narrow polished band indicates the seal interfaces. On a new seal, this contact band is at the outer perimeter.



As the seal wears, this polished band will move toward the inner diameter. Remaining wear life can be estimated based on a linear relationship of service hours (or meters of tunnel bored) vs. contact band position.



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