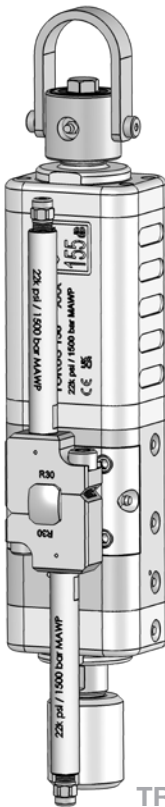
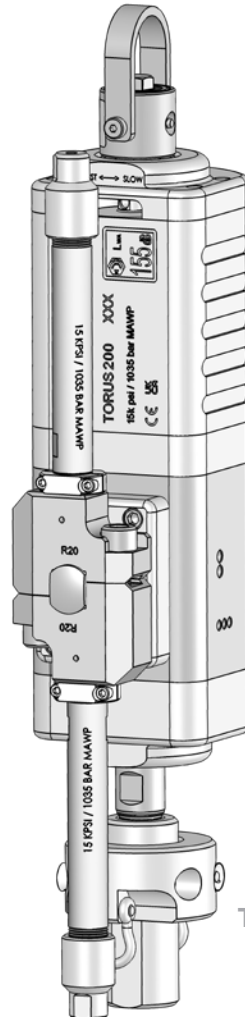


TORUS

3D TANK AND VESSEL CLEANING TOOLS USER MANUAL



TR-130



TR-200

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TERMS AND CONDITIONS AND WARRANTY 30

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sales-eu@stoneagetools.com

This manual must be used in accordance with all applicable national laws. The manual shall be regarded as a part of the machine and shall be kept for reference until the final dismantling of the machine, as defined by applicable national law(s).

Updated manuals can be downloaded at:

<https://www.stoneagetools.com/manuals>

Torus Model Specifications		
	TR-130	TR-200
PRESSURE RANGE	2–22k psi (138–1500 bar)	8–15k psi (550–1035 bar)
FLOW RANGE	10-81 gpm (38-307 l/min)	50-220 gpm (190-830 l/min)
POWER RANGE	30-1000 hp	30-1900 hp
CYCLE TIME	4-24 Minutes	10-88 Minutes
ROTATION SPEED	Adjustable	Adjustable
INLET CONNECTIONS	3/4" NPT, 1" NPT, 3/4 MP, 1 MP, M24	P16 (UP TO 10K PSI MAWP) M16 (UP TO 15K PSI MAWP)
MANIFOLD PORT SIZE	G12	G16
PORT SIZE	1/4" NPT (P4)	3/4" NPT (P12)
NOZZLE TYPE	OCV CARBIDE	OC8
DIAMETER	5.12 in. (130 mm)	8.0 in. (200 mm)
LENGTH	17 in. (432 mm)	22.8 in. (579 mm)
WEIGHT	35 lbs (16 kg)	100 lbs (45kg)
MAXIMUM WATER TEMPERATURE	160°F (70° C)	160°F (70° C)

KEY FEATURES:

- Interchangeable couplings and manifolds- One tool can be adapted to a wide range of pressures and flows, saving the cost of purchasing multiple tools.
- External speed control- If you need to change the speed of rotation while on the job for precise material removal, it is easy to adjust without opening the tool or removing it from the hose.
- Easy access high pressure seals and external grease fittings- Reduced downtime for regular maintenance.
- Field repairable- No need to send to factory means reduced downtime and no freight fees.

EC DECLARATION OF CONFORMITY

Manufacturer: StoneAge Incorporated
466 South Skylane Drive Durango, CO 81303 USA

Authorized Representative: StoneAge Netherlands BV
Reedijk 7Q
3274 KE Heinenoord Netherlands
Bob Van Wordragen, Operations Manager StoneAge NL

Declare that: Torus (TR-130 and TR-200)
are 3D tools designed for tank and vessel cleaning

Are compliant with the following Directives and Standards:

Directive 2006/42/EC (Machinery Directive)

EN ISO 12100:2010 (E) Safety of machinery – General principles for design – Risk assessment and risk reduction

The Technical Files for the Torus 3D Tank and Vessel Cleaning Tools (TR-100 and TR-200) are maintained at:

StoneAge Incorporated, 466 South Skylane Drive, Durango, CO 81303, USA and were compiled by the Engineering Manager. The Technical File is available through the Authorized Representative. This Declaration of Conformity is issued under the exclusive responsibility of StoneAge Incorporated.



StoneAge Incorporated, Durango, CO, USA
Scott Howell, New Product Introduction Manager

12/15/20
Date



UK DECLARATION OF CONFORMITY

Manufacturer: StoneAge Incorporated
466 South Skylane Drive Durango, CO 81303 USA

Authorized Representative: StoneAge UK
Unit 3
Crucible Business Park
Woodbury Lane
Norton
Worcester
Worcestershire, WR5 2DQ
United Kingdom
Steve Ellis, Managing Director StoneAge UK

Declare that: Torus (TR-130 and TR-200)
are 3D tools designed for tank and vessel cleaning

Are compliant with the following Statutory Requirements and Designated Standards:

S.I. 2008 No. 1597 (E) Safety of machinery – General principles for design – Risk assessment and risk reduction
EN ISO 12100:2010 (E) Safety of machinery – General principles for design – Risk assessment and risk reduction

The Technical Files for the Torus 3D Tank and Vessel Cleaning Tools (TR-100 and TR-200) are maintained at:

StoneAge Incorporated, 466 South Skylane Drive, Durango, CO 81303, USA and were compiled by the Engineering Manager. The Technical File is available through the Authorized Representative. This Declaration of Conformity is issued under the exclusive responsibility of StoneAge Incorporated.



StoneAge Incorporated, Durango, CO, USA
Scott Howell, New Product Introduction Manager

12/15/20
Date



**UK
CA**

WARNING AND SAFETY INSTRUCTIONS

DANGER

BOTH THE TR-130 AND TR-200 MODELS OF TORUS CONTAIN SEVERAL HIGH-ENERGY, RARE-EARTH MAGNETS THAT PRODUCE A MAGNETIC FIELD IN EXCESS OF 10 GAUSS. PERSONS WITH A PACEMAKER OR OTHER ELECTRONIC MEDICAL DEVICE MUST USE EXTREME CAUTION WHEN HANDLING, OR IN CLOSE PROXIMITY TO THE TORUS. IT IS RECOMMENDED THAT A MINIMUM DISTANCE OF 6 INCHES (152MM) BE MAINTAINED AT ALL TIMES BETWEEN THE TORUS AND ANY ELECTRONIC MEDICAL DEVICES.

WARNING

Operations with this equipment can be potentially hazardous. Caution must be exercised prior to and during machine and water jet tool use. Please read and follow all of these instructions, in addition to the guidelines in the WJTA Recommended Practices handbook, available online at www.wjta.org. Deviating from safety instructions and recommended practices can lead to severe injury and/or death.

- Do not exceed the maximum operating pressure specified for any component in a system. The immediate work area must be marked off to keep out untrained persons.
- The *Dump Valve* is the most important safety device. Each operator must have and be able to use their own Dump Valves to shut down the water pressure immediately if necessary.
- Inspect the equipment and nozzles for visible signs of deterioration, damage, and improper assembly. Do not operate until repaired. Make sure all threaded connections are tight and free of leaks.
- All operators and persons in close proximity must wear personal protective equipment, including approved protection for body, hands, feet, face, ears, eyes, and air passages. Please refer to the WJTA Recommended Practices, Section 6.
- Water pressure greater than 20,000 psi (1379 bar) can reach 200°F (93°C) and can scald or burn the operator. Always use face shields, water jet resistant armor, and gloves to protect the operator from being burned or cut.
- The use of gloves when handling the tool after operation is recommended as the body at the pulling ring end may reach temperature of up to 160°F.
- Inspect the high pressure hose for damage. Use ONLY hoses intended for waterblast applications and rated for the maximum operating pressure on the job. The high pressure hose should be as large as possible to minimize pressure loss through the hose.

DESCRIPTION OF EQUIPMENT AND INTENDED USE (TR-130):

The Torus TR-130 3D Tool is designed for cleaning tanks, vessels, autoclaves, ducts and reactor interiors. The tool is capable of working pressures up to 22,000 psi (1500 bar) and flow rates of 10 to 80 gpm. The wide range of flow rates is accommodated by the use of four different manifolds: High Flow (R30), Medium Flow (R50), Low Flow (R90) and Extra Low Flow (R150). A maintenance-free magnetic brake is used to control rotation speed. Note that rotation speed may increase as the tool warms up to operating temperature. The complete Torus cleaning cycle varies from about 4 to 30 minutes of operating time depending on rotation speed, which is determined by pressure, flow rate, nozzle diameter, manifold choice and brake setting. A complete cleaning cycle is 92 revolutions of the body. The HP manifold revolves 2.36 times for each body revolution. When used in large vessels, extension arms up to 36 inches long can be used to reduce the jet standoff distance. The Torus can be hung from the high pressure water hose or by the optional pulling ring available for the tool. It is recommended to blow out all internal water passages (nozzles, weep holes, inlet) with compressed air after each use.



TORUS TR-130 OPERATION

OPERATION:

- Before use, confirm that the installed manifold is the one specified for the operating pressure and flow rate. Failure to use the correct manifold will result in an over-speed condition causing permanent component damage, or a condition in which the tool rotates very slowly or not at all.
- The **MANIFOLD AND NOZZLE SELECTION** chart below shows the correct manifold to use for various pressure and flow combinations. Make absolutely certain that the two nozzles being used are of equal size and in good condition, otherwise the Torus may rotate erratically, too fast, or not at all.
- To use the chart, first select the operating pressure row from the left. Move to the right across the table until you read the flow closest to actual. Located directly under the flow rate is the appropriate manifold type, and located at the top of this column is the appropriate nozzle size. If you know the pressure and nozzle size, select the operating pressure row to the left, and read across the nozzle sizes in the top boxes until you get to the nearest nozzle size. The box where these two intersect will give the appropriate flow rate and manifold type.

THIS TABLE SHOWS MANIFOLD AND NOZZLE SIZE SELECTION GUIDELINES FOR **COMMON JETTING** SCENARIOS AND DOES NOT TAKE INTO ACCOUNT HOSE SIZE.

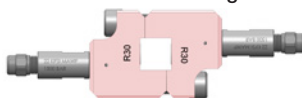
For the most accurate manifold and nozzle selection, use the StoneAge Jetting App:

<http://jetting.stoneagetools.com>

MANIFOLD AND NOZZLE SELECTION CHART																	
OCV Carbide Nozzle Size																	
Nozzle Size		.036	.039	.043	.047	.055	.062	.067	.073	.078	.089	.093	.106	.125	.140	.156	
Pressure & Flow & Manifold Size	2k psi 138 bar	gpm													48	58	
		l/min														182	220
		Manifold														R150	R150
	5k psi 345 bar	gpm							20	24	30	35	44	58			
		l/min							76	91	114	133	167	220			
		Manifold							R150	R150	R90	R90	R90	R90			
	10k psi 690 bar	gpm				12	16	20	24	28	32	42	46	60	66		
		l/min				45	61	76	91	106	121	159	174	230	250		
		Manifold				R150	R150	R150	R90	R90	R90	R50	R50	R50	R30		
	15k psi 1035 bar	gpm		10	11	13	19	23	30	33	37	48	58	70			
		l/min		38	42	49	72	87	114	125	140	182	220	265			
		Manifold		R150	R150	R150	R90	R90	R50	R50	R50	R50	R30	R30			
	20k psi 1380 bar	gpm	11	12	14	17	24	30	34	40	46	60	66				
		l/min	42	45	53	64	91	129	114	151	174	227	250				
		Manifold	R150	R150	R150	R90	R90	R50	R50	R50	R50	R30	R30				

TR130 240-RXX-X MANIFOLD TYPES

There are four manifolds for the Torus; select the proper version for the operating conditions. Different arm lengths are also available.



R30	R50	R90	R150
50-80 gpm (190-303 lpm)	28-55 gpm (106-208 lpm)	16-30 gpm (61-114 lpm)	10-18 gpm (38-68 lpm)

INLET ADAPTERS:

The inlet adapters are all female-female couplings. One end is an O-ring face seal that seals to the inlet shaft. The other end is available in 3/4" NPT, 1" NPT, 3/4" medium pressure or 1" medium pressure.

Coupling Options

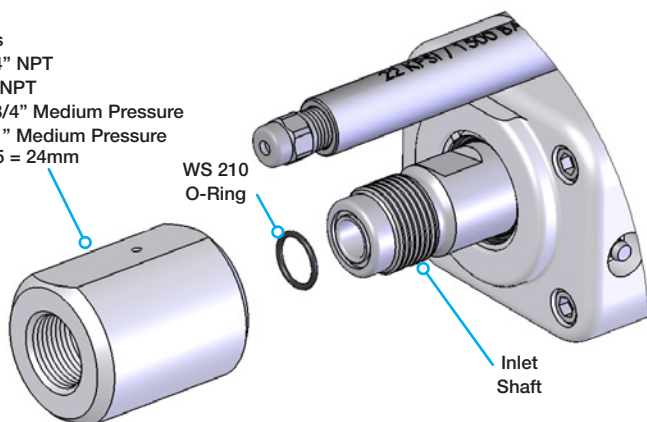
TR 230-P12 = 3/4" NPT

TR 230-P16 = 1" NPT

TR 230-MP12 = 3/4" Medium Pressure

TR 230-MP16 = 1" Medium Pressure

TR 230-M24 x 1.5 = 24mm

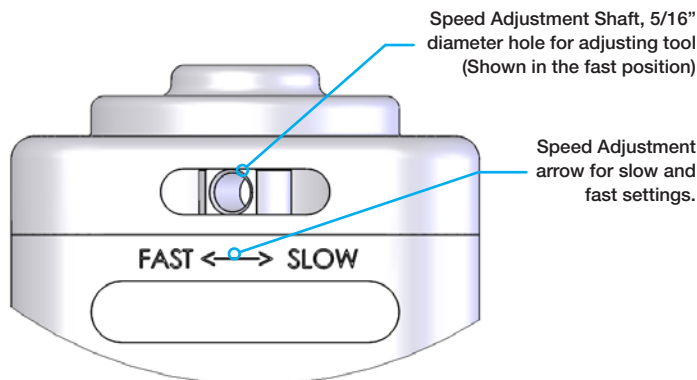


SPEED ADJUSTMENT:

The rotation speed of the Torus may be adjusted using the speed adjustment shaft located at the opposite end from the inlet. The shaft may be set at any location between slow and fast. Any suitable tool may be used to adjust the speed by inserting the tool through the access slot on the housing and into the hole in the shaft. To change from slow to fast, turn the speed adjustment shaft approximately 50° to the left. Marks are engraved on the outside of the body to indicate slow and fast settings. Changing the speed from slow to fast will increase speed by approximately three times (i.e. slow 10 rpm; fast 30 rpm). The rotational speed depends on the torque produced by the operating pressure, flow, manifold version and brake setting. The average operating speed range of the cross-shaft is approximately 8-16 rpm on slow and approximately 25-50 rpm on fast.

NOTICE

Note: It is not necessary to remove the optional Pulling Ring Assembly to access the Speed Adjustment Knob.



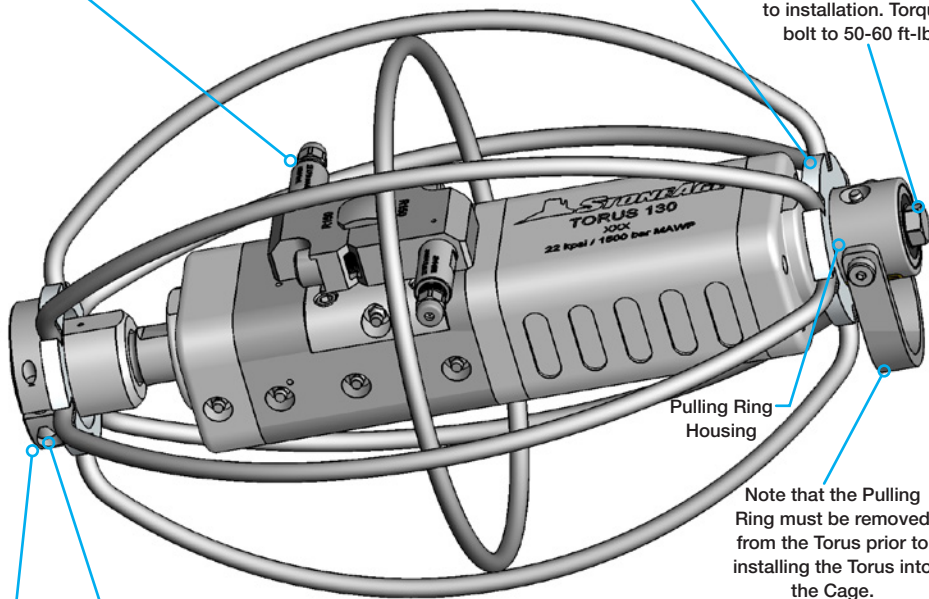
TORUS TR-130 ACCESSORIES

TR130 408-SS CAGE INSTALLATION:

Note that the short 2" nipples must be installed when using the Torus in the cage

Insure that the end plate of the cage is installed as shown over the Pulling Ring Housing with about a 1/8" gap just behind the pulling bail; otherwise the Torus will not rotate correctly during operation.

Apply Blue Loctite 242 (StoneAge part number GP 180) to the pulling ring bolt prior to installation. Torque bolt to 50-60 ft-lbs.



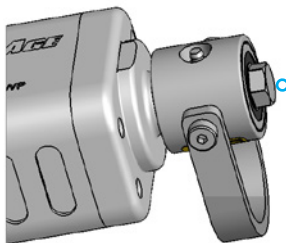
Reference (2) GS 331-04-24 (Socket Head Cap Screw 5/16-24 UNF x 1.0 Long)

It may be necessary to remove the free half of the Clamp Collar on the cage to insert the Torus

Note that the Pulling Ring must be removed from the Torus prior to installing the Torus into the Cage.

HC 090 PULLING RING INSTALLATION:

Apply Blue Loctite® 242 (StoneAge part number GP 180) to the pulling ring bolt prior to installation. Torque bolt to 50-60 ft-lbs.



TORUS TR-130 MAINTENANCE SCHEDULE

Maintenance Item	Frequency	Maintenance Required
High Pressure Seal (See Replacement instructions in this manual)	When water is leaking out of the weep holes closest to the inlet	The Torus has two high pressure seals, one in the inlet shaft, and one in the cross shaft. These seals are identical; they may leak water at low pressure (under 1000 psi) and will leak water continuously at operating pressure during failure. If water is leaking out of the weep holes closest to the inlet, the inlet seal is damaged. If the water is leaking out of the weep holes furthest from the inlet, the cross-shaft seal is damaged and must be replaced.
Lubricant and Storage	Every 100 hours of operation	It is recommended to grease the tool every 100 hours of operation. Any multi-purpose NLGI 2 grease is acceptable. There are five grease fittings located on the outside of the body. No damage will result from over-greasing the tool but the operator will likely see any extra grease leaking out around the shaft seals under operation. It is also recommended to blow out all internal water passages (nozzles, weep holes, inlet) with compressed air after each use to maximize the life of internal components.
Oil Change	When contaminated or after full rebuild	Drain as much used oil out of the housing as possible, let drain a minimum of 10 minutes. Refill housing with 16 oz (1/2 quart) of the following oil: Valvoline Synpower 5W-30 full synthetic engine oil (StoneAge GP 044-S). This specific oil has some beneficial additives for the Torus application and ensures maximum life of the internal components.
Magnetic Brake	Every 500 hours of operation	Inspect brake oil for water contamination. If oil shows no evidence of water intrusion, replace plug, no additional maintenance is required. If the oil is contaminated with water, it should be drained and replaced as specified below. If a major problem is suspected with the magnetic brake assembly, it should be sent to a certified StoneAge repair center for service or replacement.
Magnetic Brake Oil Change	When contaminated or after full rebuild	When contaminated or after full rebuild Drain as much used oil out of the housing as possible, let drain a minimum of 10 minutes. Refill housing with 16 oz (1/2 quart) of the following oil: Valvoline Synpower 5W-30 full synthetic engine oil (StoneAge GP 044-S). This specific oil has some beneficial additives for the Torus application and ensures maximum life of the internal components.
Threaded high pressure connections	Before and/or After each use	To avoid galling, for pipe thread connections use Parker Thread Mate thread sealant (StoneAge part number GP047) and fluorocarbon tape. For all other threaded high pressure connections use anti-seize lubricant alone. StoneAge recommends Swagelok Blue Goop (StoneAge part number GP 043).
Threaded fasteners	When necessary	It is VERY IMPORTANT that all threaded fasteners be reassembled per the following procedure: A) Fasteners labeled with a specific Blue Loctite (GP180) note are to be reassembled and torque as noted. B) All other fasteners are to be reassembled using Blue Goop (GP 043) and torque if specified.

⚠ WARNING

The use of gloves when handling the tool after operation is recommended as the body at the pulling ring end may reach temperatures of up to 160°F depending on operating conditions. Let the tool cool down before disassembling for any maintenance procedures.

TORUS TR-130 MAINTENANCE KITS

TORUS SERVICE

Product training and proper tools are required to service the Torus. If you are uncomfortable performing the service, bring the tool to your authorized dealer.

Take care throughout the entire procedure to keep the internals clean and free from grit, lint, and contamination. Failure to do so could result in premature failure after service.

See the "Maintenance Schedule" page for a list of procedures and oil replacement instructions.

LIST OF TOOLS:

- Pick
- Slot Screwdriver
- Manual Grease Gun
- Hex wrenches;
1/8", 1/4", 3/16", 5/16", 5/32", 2.5mm, and 3mm

LIST OF MATERIALS:

- Clean lint free rags or blue shop towels
- Swagelok Blue Goop Anti-Seize or Equivalent
- Mobil SHC PM 460 Synthetic Grease or equivalent

NOTICE

Do NOT use pneumatic or electric grease gun to lubricate the Torus Assemblies. High grease application rates may lead to grease inadvertently entering the brake assembly causing seal damage and/or rotation problems. StoneAge recommends a manual grease gun be used for lubrication.

TORUS TR-130 SERVICE AND OVERHAUL KIT PARTS

TR130 600 –SERVICE KIT

TR130 610 –OVERHAUL KIT

GP 043 BLUE GOOP, 2 OZ	1	BJ 007 Bearing, Angle Contact, BECBY	2
GP 180 Loctite, 242 Blue .5ml Bottle	1	BR 196 Retaining Ring, HD External 1.188	1
HC 012-TO H.P. Seal Assembly	2	CJ 009 Bearing	1
MJ 011-C Carbide Seat (Coated)	2	GP 043 Blue Goop, 2 oz	1
PL 556 Torus Family User Manual	1	GP 180 Loctite, 242 Blue .5ml Bottle	1
SA 059 O-Ring, G12	2	GP 805 Container, Round Hinged Lid Plastic 1¼	2
TR 245 HP Seal, Manifold	2	HC 012-TO H.P. Seal Assembly	2
WS 210 O-Ring	1	MJ 008 O-Ring	1
		MJ 011-C Carbide Seat (Coated)	2
		PL 556 Torus Family User Manual	1
		PTL 078 Retaining Ring, SS	1
		SA 059 O-Ring, G12	2
		SG 009 Ball Bearing	1
		TR 134 Seal	2
		TR 136 Bearing, Needle Roller	2
		TR 138 Retaining Ring, SS Spiral Int .968	2
		TR 245 HP Seal, Manifold	2
		TR130 105 O-Ring	4
		TR130 113 Seal	2
		TR130 114 Retaining Ring, SS Spiral Int 1.56	2
		TR130 230 Bearing, Ball	2
		TR130 233 O-Ring	2
		TR130 234 Retaining Ring, SS External 17mm	2
		WS 029 Seal, Large	1
		WS 210 O-Ring	1

Part Diagram Color Code Key

TR130 600 = Replacement part is available in this kit
Service Kit

TR130 610 = Replacement part is available in this kit
Overhaul Kit

MOBIL® is a registered trademark of the Exxon Mobil Corporation.

Blue Goop® is a registered trademark of the Swagelok.

Loctite® is a registered trademark of the Henkel Corporation.

Threadmate™ is a trademark of the Parker Hannifin Corporation.

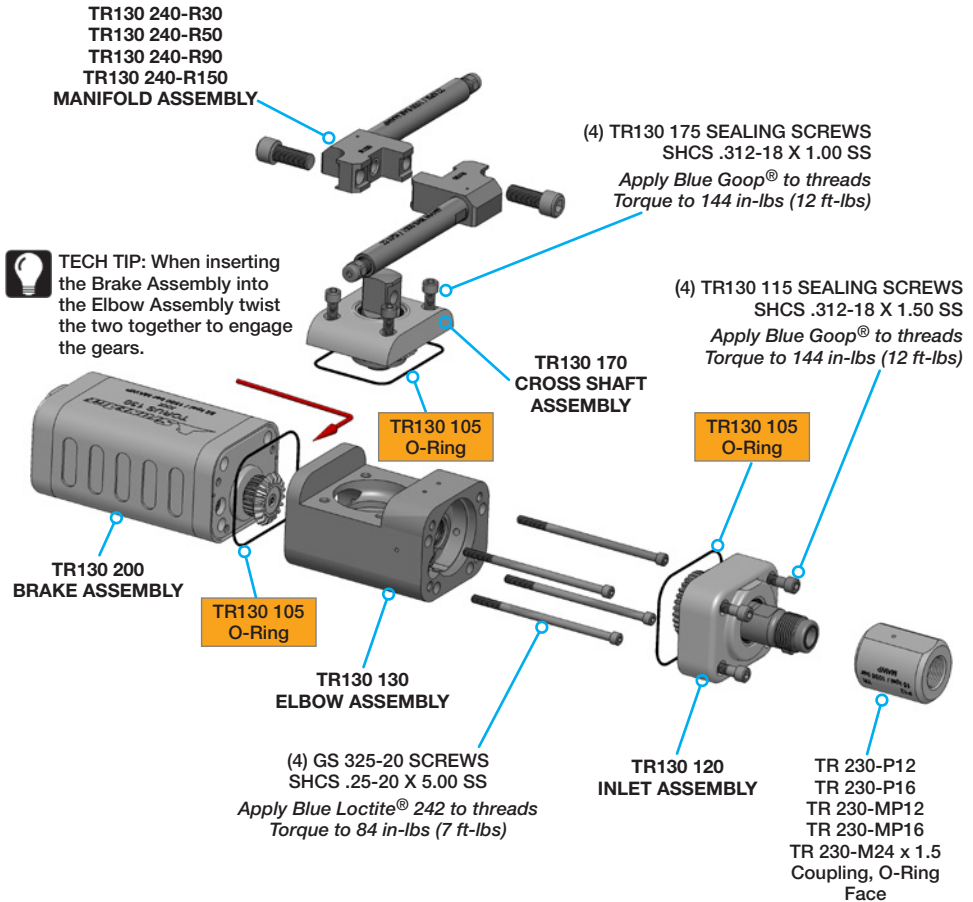
TR-130 ASSEMBLY

Sub-Assemblies of the TR-130 shown in **BOLD CAPITAL** labels and have additional part break downs in the following pages.

Part Diagram Color Code Key

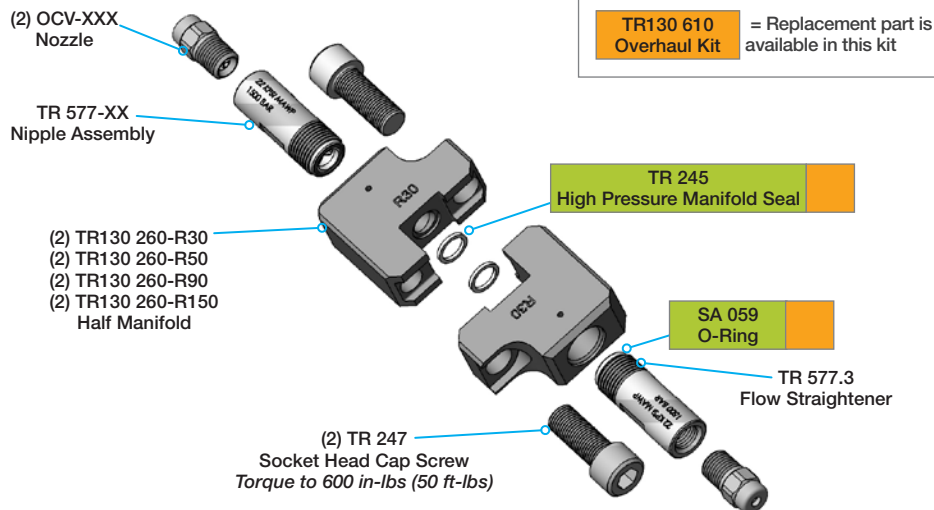
TR130 600 Service Kit = Replacement part is available in this kit

TR130 610 Overhaul Kit = Replacement part is available in this kit

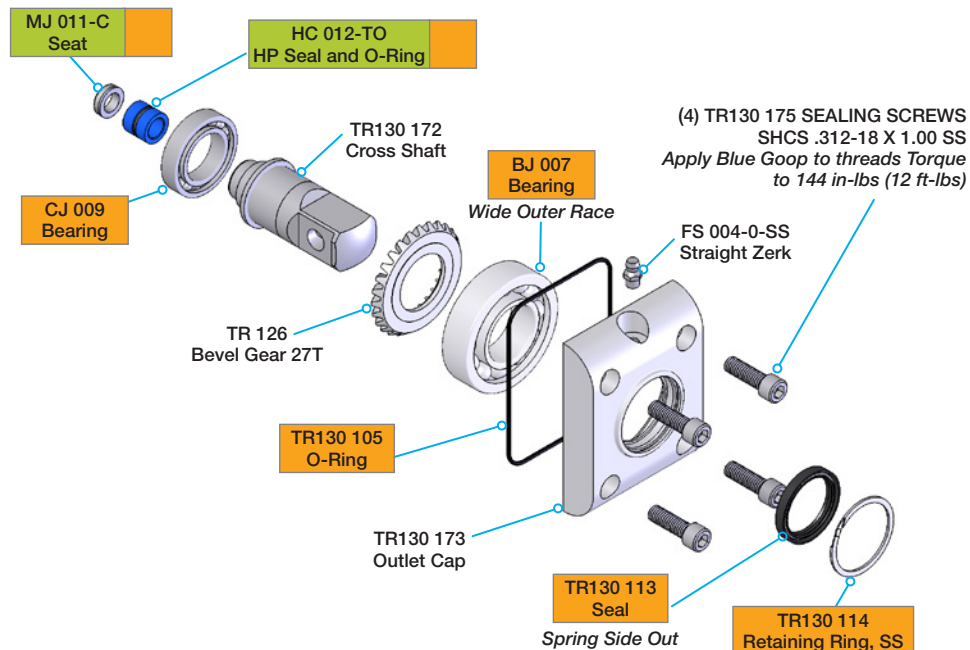


TORUS TR-130 MAINTENANCE

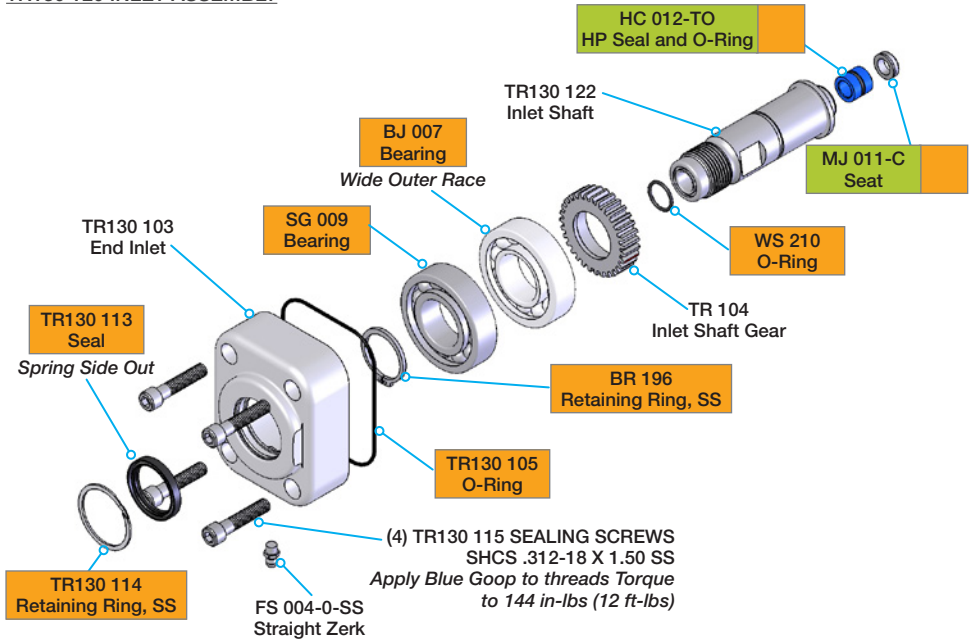
TR130 240-RXX-X MANIFOLD ASSEMBLY



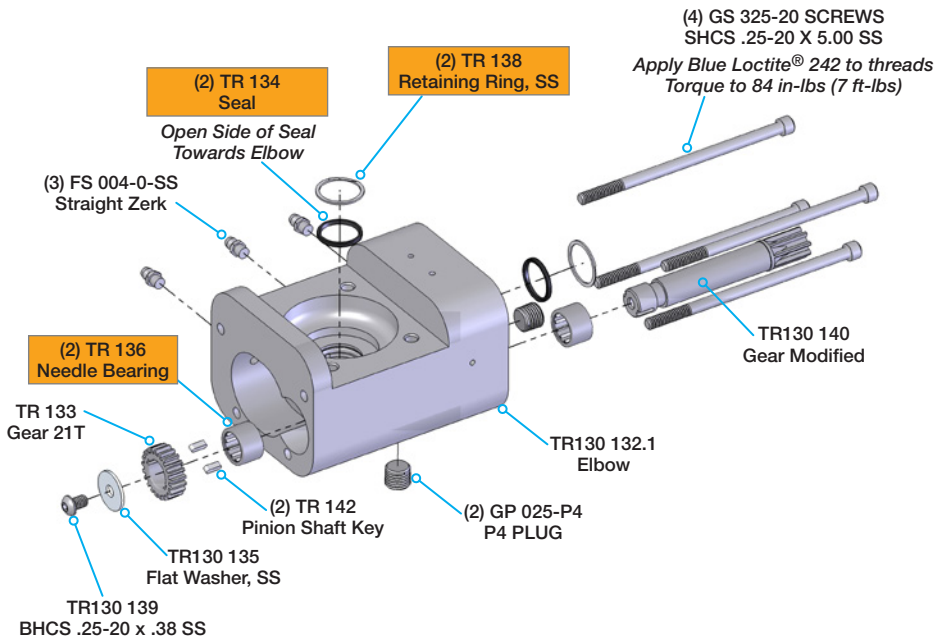
TR130 170 CROSS SHAFT ASSEMBLY



TR130 120 INLET ASSEMBLY

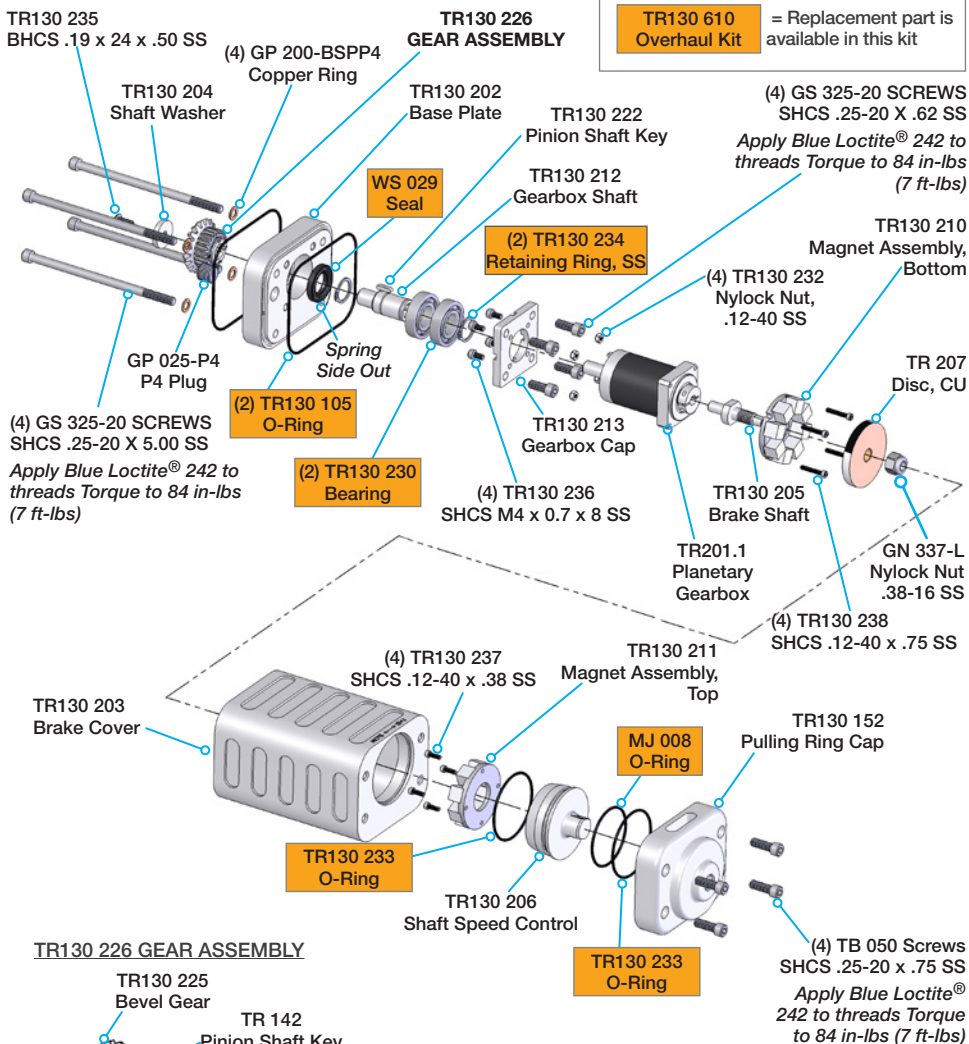


TR130 130 ELBOW ASSEMBLY

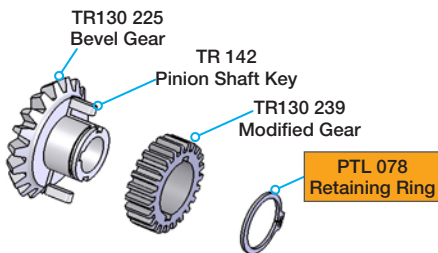


TORUS TR-130 MAINTENANCE

TR130 200 BRAKE ASSEMBLY



TR130 226 GEAR ASSEMBLY



TR-130 HIGH PRESSURE SEAL MAINTENANCE

The Torus has 2 high pressure seals. These seals may leak at tap pressure, but should seal at pressures above 1000 psi.

TO ACCESS THE SHAFT SEAL IN THE TR130 120 INLET ASSEMBLY:

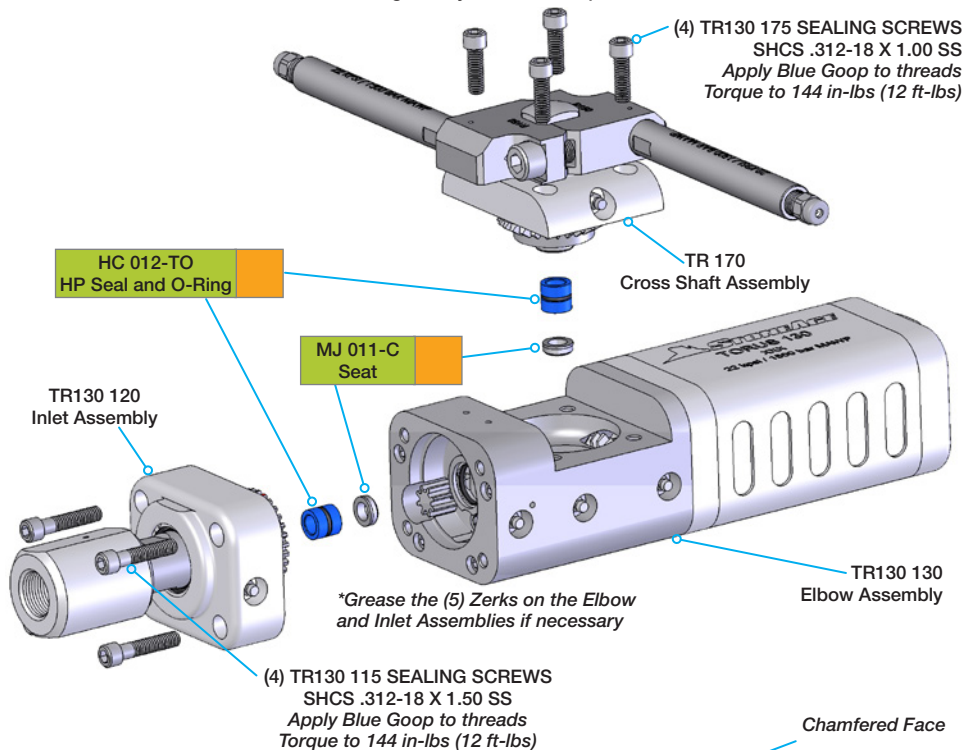
1. Remove the (4) Sealing Socket Head Cap Screws holding the Inlet Assembly (TR130 120) to the Elbow Assembly. The Inlet Assembly may then be slid out of the Elbow Assembly to gain access to the Seal. The Seal is located in the end of the Inlet Shaft. No more disassembly is required.

TO ACCESS THE CROSS SHAFT SEAL:

1. Rotate the Half Manifolds as necessary to gain access to the (4) Sealing Socket Head Cap Screws that hold the Cross Shaft Assembly (TR130 170) to the Elbow Assembly and remove them. Lift the Cross Shaft Assembly out of the Main Elbow. The Seal is located in the end of the Cross Shaft. No more disassembly is required.

⚠ CAUTION

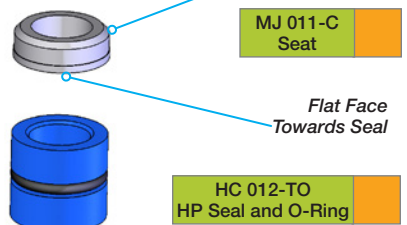
The use of gloves when handling the tool after operation is recommended as the body at the pulling ring end may reach temperatures of up to 160°F depending on operating conditions. Let the tool cool down before disassembling for any maintenance procedures.



TO MAINTAIN H.P. SEAT & SEAL:

1. Remove the Carbide Seat (MJ 011-C) and the H.P. Seal (HC 012-TO). Inspect the Seat for chips on edges. Replace if damaged. Inspect the related face of the Elbow Assembly for dings or pits. If damaged, it must be faced or replaced, otherwise the Seal will leak.

2. Apply grease to new H.P. Seal and install into bore. Place the Seat on the Seal with the flat side against the Seal. The chamfered side should face towards the Elbow Assembly.



TORUS TR-130 GENERAL FASTENER INSTALLATION

TR-130 FASTENER ASSEMBLY INSTRUCTIONS

- (4) TB 050 Screws
SHCS .25-20 x .75 SS

Apply Blue Loctite® 242 to threads
Torque to 84 in-lbs (7 ft-lbs)

- (4) GP 200-BSPP4 Copper Ring

- (4) GS 325-20 SCREWS
SHCS .25-20 X 5.00 SS

Apply Blue Loctite® 242 to threads
Torque to 84 in-lbs (7 ft-lbs)

- (4) TR130 175 SEALING SCREWS
SHCS .312-18 X 1.00 SS

Apply Blue Goop to threads
Torque to 144 in-lbs (12 ft-lbs)

- (4) GS 325-20 SCREWS
SHCS .25-20 X 5.00 SS

Apply Blue Loctite® 242 to threads
Torque to 84 in-lbs (7 ft-lbs)

- (4) TR130 115 SEALING SCREWS
SHCS .312-18 X 1.50 SS

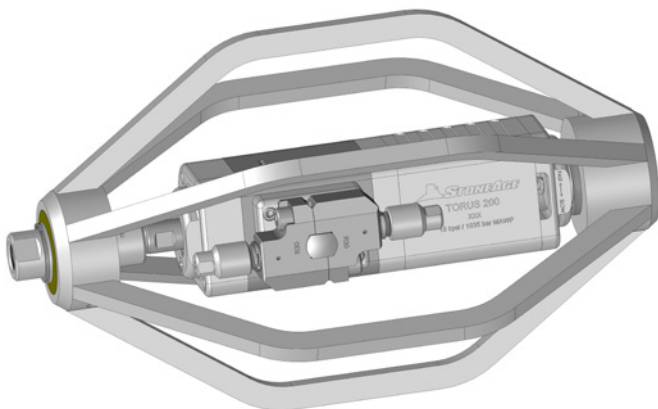
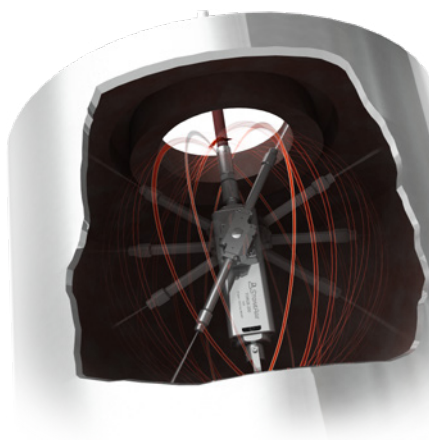
Apply Blue Goop to threads
Torque to 144 in-lbs (12 ft-lbs)

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TORUS TR-200 DESCRIPTION AND INTENDED USE

DESCRIPTION OF EQUIPMENT AND INTENDED USE (TR-200):

The Torus TR-200 3D Tool is designed for cleaning tanks, vessels, autoclaves, ducts and reactor interiors. The tool is capable of working pressures up to 15,000 psi (1035 bar) and flow rates of 50 to 220 gpm. The wide range of flow rates is accommodated by the use of seven different manifolds; each is engraved with its corresponding offset (i.e. R30). A maintenance-free magnetic brake is used to control rotation speed. Note that rotation speed may increase as the tool warms up to operating temperature. The complete Torus cleaning cycle varies from about 10 to 88 minutes of operating time depending on rotation speed, which is determined by pressure, flow rate, nozzle diameter, manifold choice and brake setting. A uniform jet pattern is achieved after 440 revolutions of the manifold shaft (136 revolutions of the body) and is recommended for most applications. The tool can continue to run, thus generating a finer jet pattern. A complete cleaning cycle is 1426 revolutions of the manifold shaft (441 revolutions of the body). The HP manifold shaft revolves 3.23 times for each body revolution. When used in large vessels, extension arms up to 36 inches long can be used to reduce the jet standoff distance. The Torus can be hung from the high pressure water hose or by the optional pulling ring available for the tool. It is recommended to blow out all internal water passages (nozzles, weep holes, inlet) with compressed air after each use.



OPERATION:

- Before use, confirm that the installed manifold is one specified for the operating pressure and flow rate. Failure to use the correct manifold will result in an over-speed condition causing permanent component damage, or a condition in which the tool rotates very slowly or not at all.
- The **MANIFOLD AND NOZZLE SELECTION** chart below shows the correct manifold to use for various pressure and flow combinations. Make absolutely certain that the two nozzles being used are of equal size and in good condition, otherwise the Torus may rotate erratically, too fast, or not at all.
- To use the chart, first select the operating pressure row from the left. Move to the right across the table until you read the flow closest to actual. Located directly under the flow rate is the appropriate manifold type, and located at the top of this column is the appropriate nozzle size. If you know the pressure and nozzle size, select the operating pressure row to the left, and read across the nozzle sizes in the top boxes until you get to the nearest nozzle size. The box where these two intersect will give the appropriate flow rate and manifold type.

THIS TABLE SHOWS MANIFOLD AND NOZZLE SIZE SELECTION GUIDELINES FOR COMMON JETTING SCENARIOS AND DOES NOT TAKE INTO ACCOUNT HOSE SIZE.

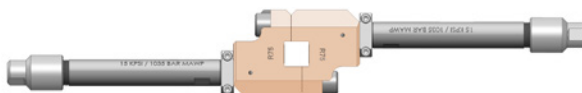
For the most accurate manifold and nozzle selection, use the StoneAge Jetting App:

<http://jetting.stoneagetools.com>

MANIFOLD AND NOZZLE SELECTION CHART												
OCV Carbide Nozzle Size												
Nozzle Size		.085	.095	.105	.125	.145	.165	.175	.190	.200	.215	
Pressure & Flow & Manifold Size	8k psi 552 bar	gpm				76	100	130	146	172	190	218
		l/min				288	379	492	553	651	719	825
		Manifold				R75	R60	R45	R35	R30	R25	R20
	10k psi 690 bar	gpm			60	84	112	146	164	192	212	
		l/min			227	318	424	553	621	727	803	
		Manifold			R75	R60	R45	R35	R30	R25	R20	
	12k psi 827 bar	gpm		52	66	92	124	160	178	210		
		l/min		197	250	348	469	606	674	795		
		Manifold		R75	R60	R45	R35	R30	R25	R20		
	15k psi 1035 bar	gpm	48	60	72	102	138	178	200			
		l/min	182	227	273	386	522	674	757			
		Manifold	R75	R60	R45	R35	R30	R25	R20			

TR200 240-RXX-X MANIFOLD

There are seven manifolds for the Torus; select the proper version for the operating conditions. Different arm lengths are also available.

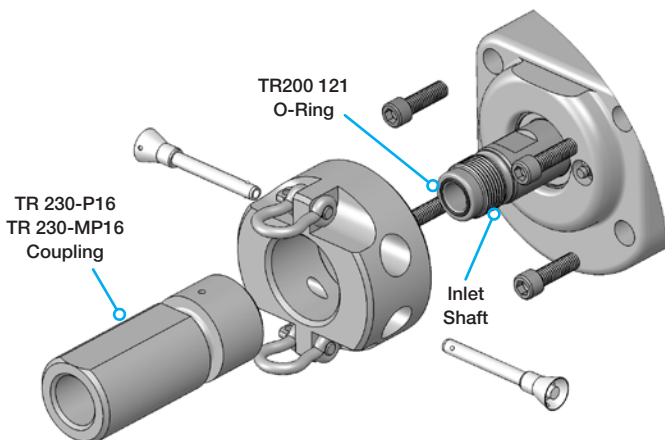


R75	R60	R45	R35	R30	R25	R20
48-76 gpm (182-288 lpm)	60-100 gpm (227-379 lpm)	72-130 gpm (273-492 lpm)	102-146 gpm (386-553 lpm)	138-172 gpm (522-651 lpm)	178-190 gpm (674-719 lpm)	200-218 gpm (757-825 lpm)

TORUS TR-200 OPERATION

INLET ADAPTERS:

The inlet adapters are all female-female couplings. One end is an O-ring face seal that seals to the inlet shaft. The other end is available in 1" NPT or 1" medium pressure.

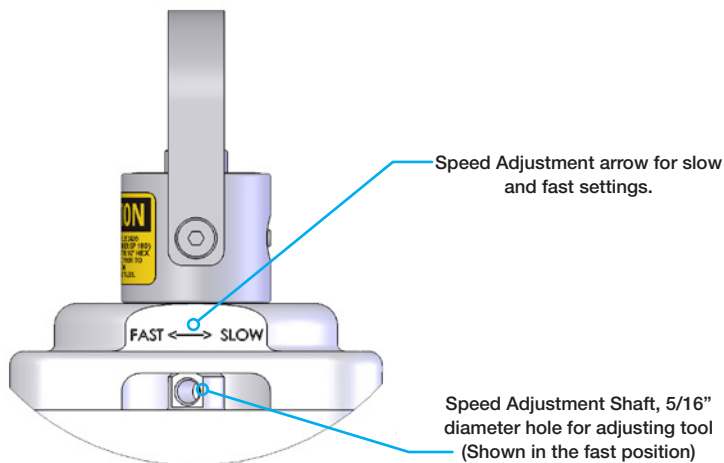


SPEED ADJUSTMENT:

The rotation speed of the Torus may be adjusted using the speed adjustment shaft located at the opposite end from the inlet. The shaft may be set at any location between slow and fast. Any suitable tool may be used to adjust the speed by inserting the tool through the access slot on the housing and into the hole in the shaft. To change from slow to fast, turn the speed adjustment shaft approximately 50° to the left. Marks are engraved on the outside of the body to indicate slow and fast settings. Changing the speed from slow to fast will increase speed by approximately three times for the TR-130 and six times for the TR-200 (i.e. slow 5 rpm; fast 30 rpm). The rotational speed depends on the torque produced by the operating pressure, flow, manifold version and brake setting. The average operating speed range of the cross-shaft is approximately 5-8 rpm on slow and approximately 30-45 rpm on fast.

NOTICE

Note: It is not necessary to remove the optional Pulling Ring Assembly to access the Speed Adjustment Knob.



Maintenance Item	Frequency	Maintenance Required
High Pressure Seal (See Replacement instructions in this manual)	When water is leaking out of the weep holes closest to the inlet	The Torus has two high pressure seals, one in the inlet shaft, and one in the cross shaft. These seals are identical; they may leak water at low pressure (under 1000 psi) and will leak water continuously at operating pressure during failure. If water is leaking out of the weep holes closest to the inlet, the inlet seal is damaged. If the water is leaking out of the weep holes furthest from the inlet, the cross-shaft seal is damaged and must be replaced.
Lubricant and Storage	Every 100 hours of operation	It is recommended to grease the tool every 100 hours of operation. Any multi-purpose NLGI 2 grease is acceptable. There are five grease fittings located on the outside of the body. No damage will result from over-greasing the tool but the operator will likely see any extra grease leaking out around the shaft seals under operation. It is also recommended to blow out all internal water passages (nozzles, weep holes, inlet) with compressed air after each use to maximize the life of internal components.
Oil Change	When contaminated or after full rebuild	Drain as much used oil out of the housing as possible, let drain a minimum of 10 minutes. Refill housing with 16 oz (1/2 quart) of the following oil: Valvoline Synpower 5W-30 full synthetic engine oil (StoneAge GP 044-S). This specific oil has some beneficial additives for the Torus application and ensures maximum life of the internal components.
Magnetic Brake	Every 500 hours of operation	Inspect brake oil for water contamination. If oil shows no evidence of water intrusion, replace plug, no additional maintenance is required. If the oil is contaminated with water, it should be drained and replaced as specified below. If a major problem is suspected with the magnetic brake assembly, it should be sent to a certified StoneAge repair center for service or replacement.
Magnetic Brake Oil Change	When contaminated or after full rebuild	When contaminated or after full rebuild Drain as much used oil out of the housing as possible, let drain a minimum of 10 minutes. Refill housing with 16 oz (1/2 quart) of the following oil: Valvoline Synpower 5W-30 full synthetic engine oil (StoneAge GP 044-S). This specific oil has some beneficial additives for the Torus application and ensures maximum life of the internal components.
Threaded high pressure connections	Before and/or After each use	To avoid galling, for pipe thread connections use Parker Thread Mate thread sealant (StoneAge part number GP047) and fluorocarbon tape. For all other threaded high pressure connections use anti-seize lubricant alone. StoneAge recommends Swagelok Blue Goop (StoneAge part number GP 043).
Threaded fasteners	When necessary	It is VERY IMPORTANT that all threaded fasteners be reassembled per the following procedure: A) Fasteners labeled with a specific Blue Loctite (GP180) note are to be reassembled and torque as noted. B) All other fasteners are to be reassembled using Blue Goop (GP 043) and torque if specified.

WARNING

The use of gloves when handling the tool after operation is recommended as the body at the pulling ring end may reach temperatures of up to 160°F depending on operating conditions. Let the tool cool down before disassembling for any maintenance procedures.

TORUS TR-200 MAINTENANCE KITS

TORUS SERVICE

Product training and proper tools are required to service the Torus. If you are uncomfortable performing the service, bring the tool to your authorized dealer.

Take care throughout the entire procedure to keep the internals clean and free from grit, lint, and contamination. Failure to do so could result in premature failure after service.

See the "Maintenance Schedule" page for a list of procedures and oil replacement instructions.

LIST OF TOOLS:

- Pick
- Slot Screwdriver
- Manual Grease Gun
- Hex wrenches

LIST OF MATERIALS:

- Clean lint free rags or blue shop towels
- Swagelok Blue Goop Anti-Seize or Equivalent
- Mobil SHC PM 460 Synthetic Grease or equivalent

NOTICE

Do NOT use pneumatic or electric grease gun to lubricate the Torus Assemblies. High grease application rates may lead to grease inadvertently entering the brake assembly causing seal damage and/or rotation problems. StoneAge recommends a manual grease gun be used for lubrication.

TORUS TR-200 SERVICE AND OVERHAUL KIT PARTS

TR200 600 –SERVICE KIT

BJ 072 O-Ring	2
GP 043 BLUE GOOP, 2 OZ	1
PL 556 Torus Family User Manual	1
SM 011 Carbide Seat	2
SM 012-O H.P. Seal, & O-Ring	2
TR200 121 O-Ring	1
TR200 245 HP Seal, Manifold	2

TR200 610 –OVERHAUL KIT

BJ 008 O-Ring	1
BJ 072 O-Ring	2
CY 015 Seal	2
GP 043 Blue Goop, 2 oz	1
GP 180 Loctite, 242 Blue .5ml Bottle	1
MJ 007 Ball Bearing	1
PL 556 Torus Family User Manual	1
PTL 078 Retaining Ring, SS	1
RJ 040-K O-Ring	2
SG 007 Large Seal	1
SM 009 Bearing, 6307 JEM	1
SM 011 Carbide Seat	2
SM 012-O H.P. Seal, & O-Ring	2
TR200 007 Bearing	2
TR200 038 Retaining Ring, SS Internal Inv 1.5	2
TR200 105 O-Ring	3
TR200 116 Retaining Ring, SS External 1.375	2
TR200 118 Retaining Ring, SS HD Internal 1.81	2
TR200 121 O-Ring	1
TR200 136 Bearing Needle Roller	2
TR200 175 O-Ring Inlet End	1
TR200 213 O-Ring Inlet	1
TR200 224 Retaining Ring, SS External 1.00	1
TR200 245 H.P. Seal, Manifold	2

Part Diagram Color Code Key

TR200 600 Service Kit = Replacement part is available in this kit

TR200 610 Overhaul Kit = Replacement part is available in this kit

MOBIL® is a registered trademark of the Exxon Mobil Corporation.

Blue Goop® is a registered trademark of the Swagelok.

Loctite® is a registered trademark of the Henkel Corporation.

Threadmate™ is a trademark of the Parker Hannifin Corporation.

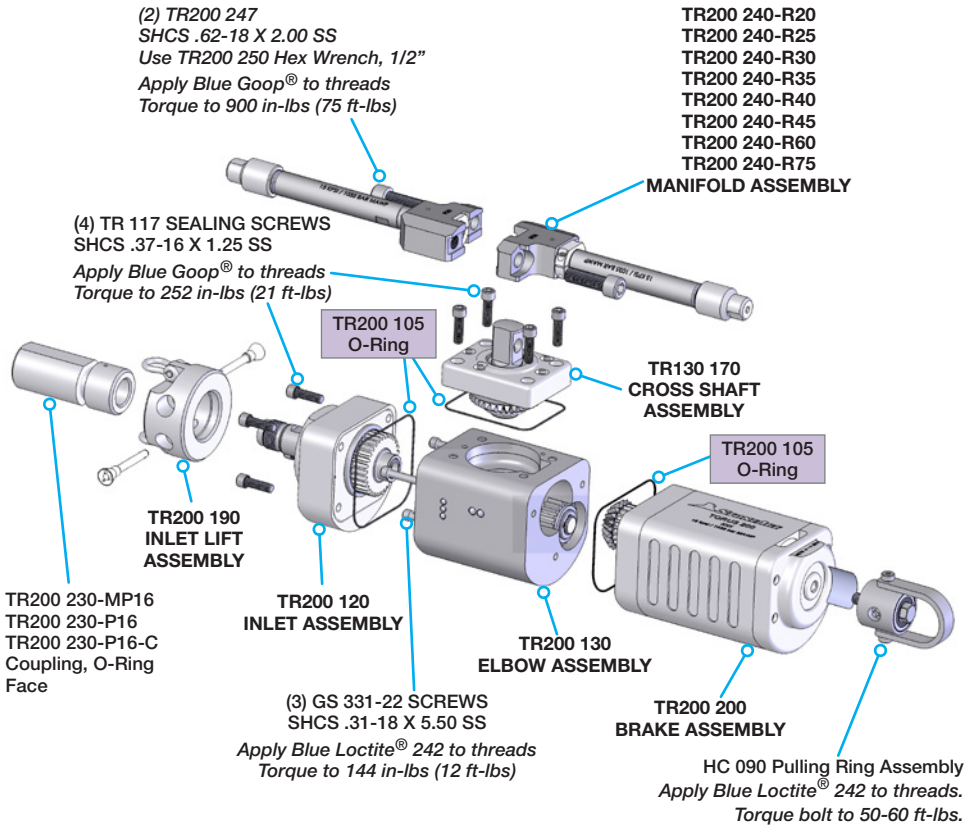
TR-200 ASSEMBLY

Sub-Assemblies of the TR-200 shown in **BOLD CAPITAL** labels and have additional part break downs in the following pages.

Part Diagram Color Code Key

TR200 600 Service Kit = Replacement part is available in this kit

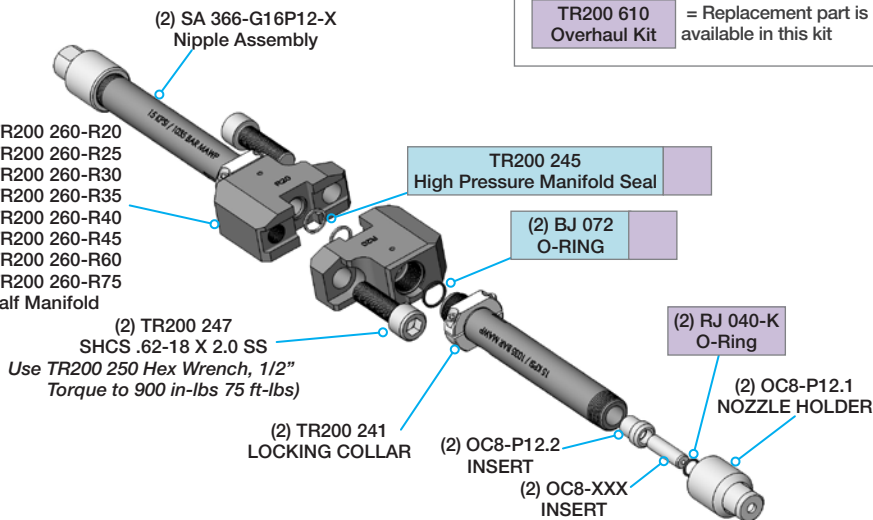
TR200 610 Overhaul Kit = Replacement part is available in this kit



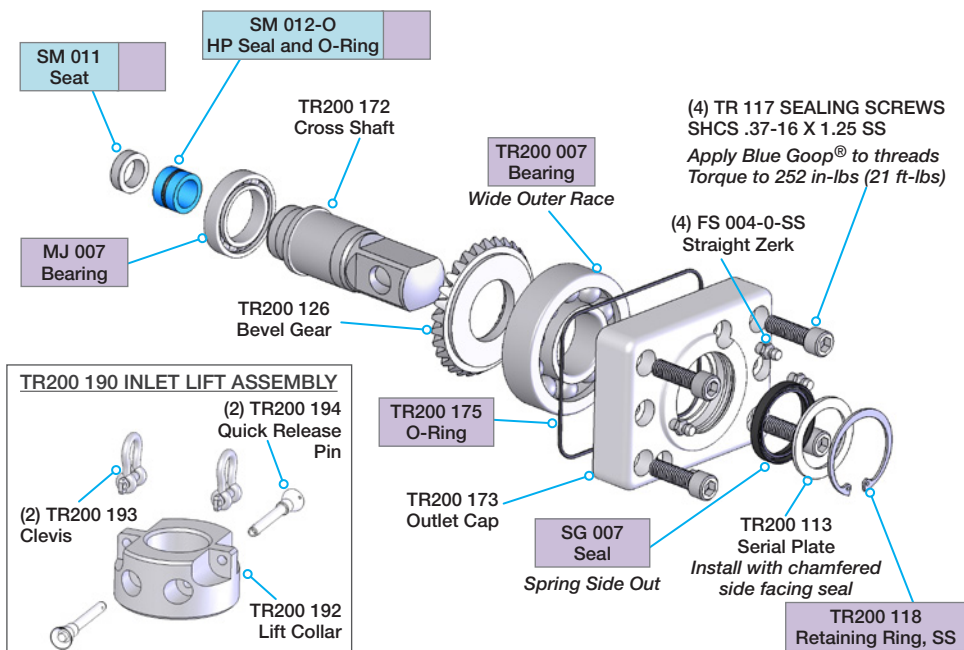
TECH TIP: When inserting the Brake Assembly into the Elbow Assembly twist the two together to engage the gears.

TORUS TR-200 MAINTENANCE

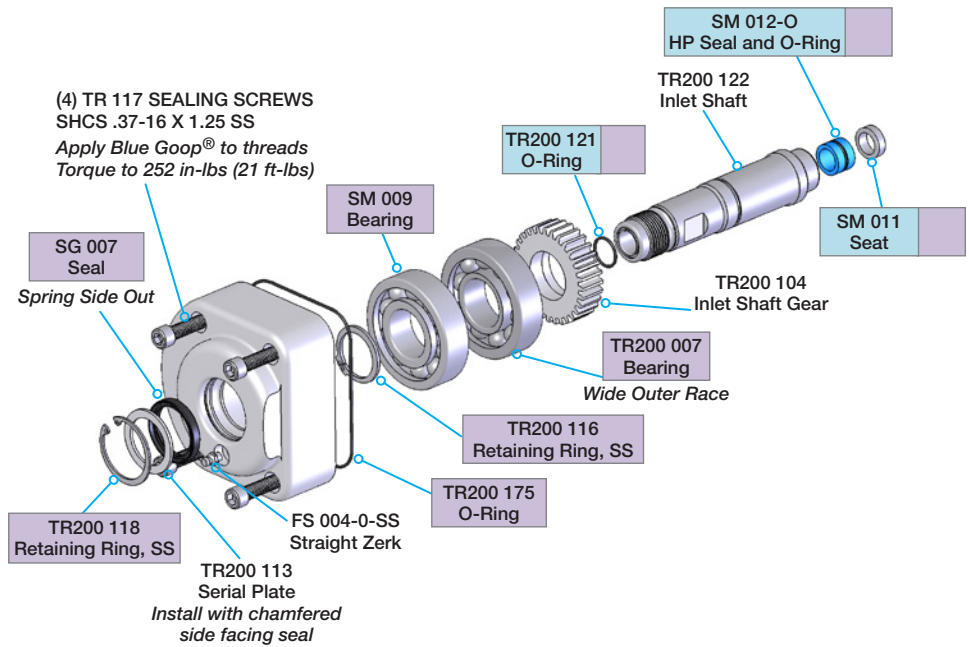
TR200 240-RXX-X MANIFOLD ASSEMBLY



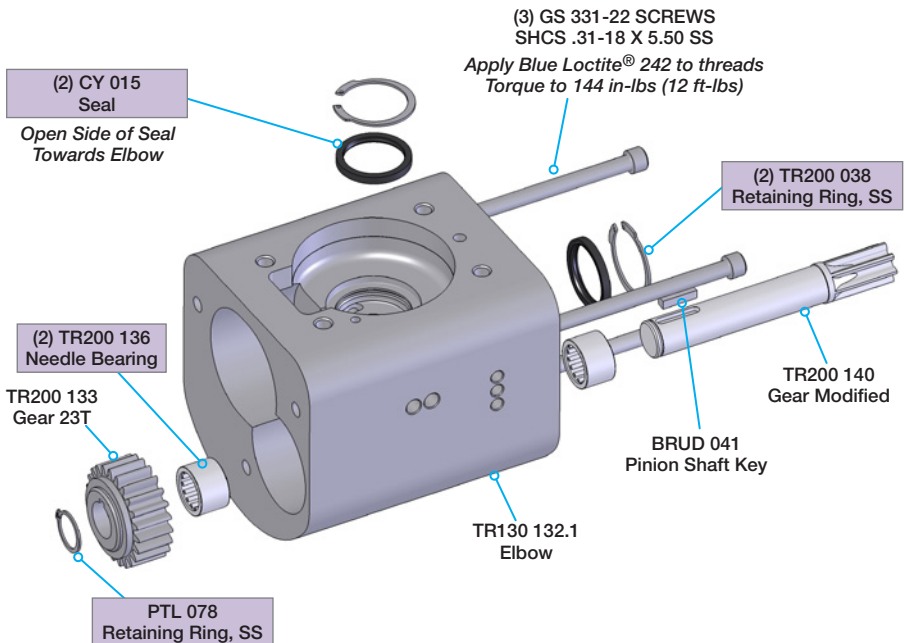
TR200 170 CROSS SHAFT ASSEMBLY



TR200 120 INLET ASSEMBLY

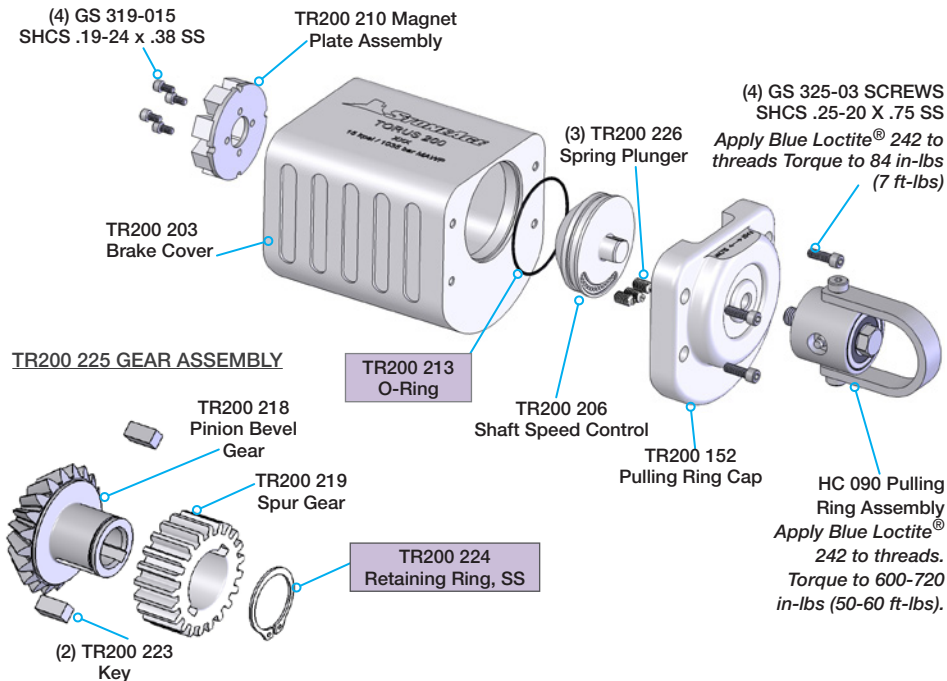
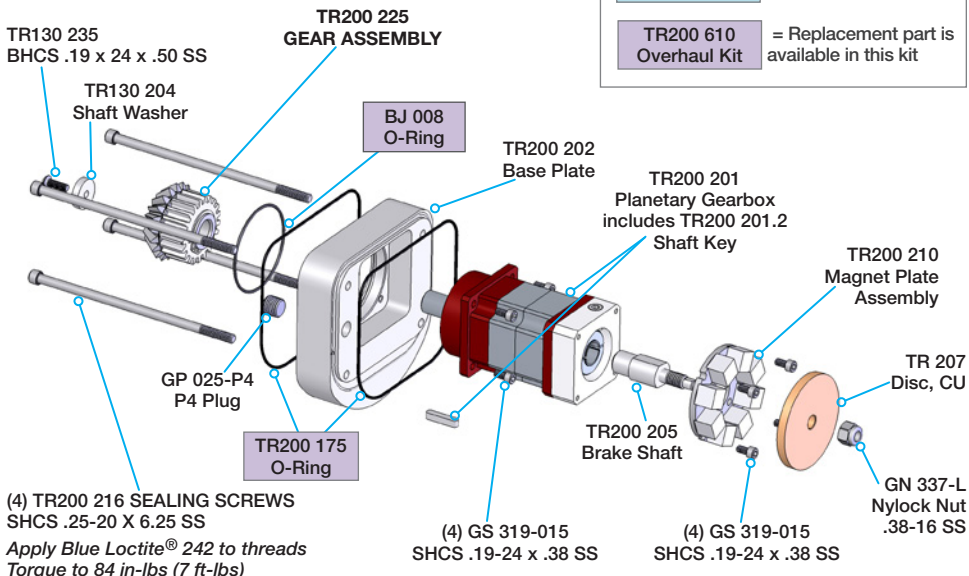


TR200 130 ELBOW ASSEMBLY



TORUS TR-200 MAINTENANCE

TR200 200 BRAKE ASSEMBLY



TR-200 HIGH PRESSURE SEAL MAINTENANCE

The Torus has 2 high pressure seals. These seals may leak at tap pressure, but should seal at pressures above 1000 psi.

TO ACCESS THE SHAFT SEAL IN THE TR200 120 INLET ASSEMBLY:

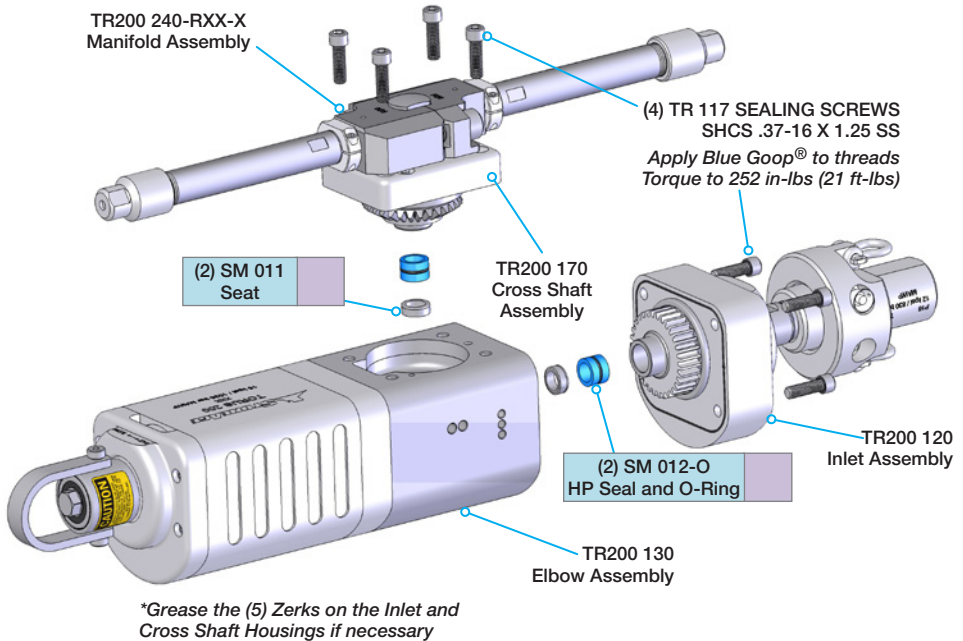
1. Remove the (4) Sealing Socket Head Cap Screws holding the Inlet Assembly (TR200 120) to the Elbow Assembly. The Inlet Assembly may then be slid out of the Elbow Assembly to gain access to the Seal. The Seal is located in the end of the Inlet Shaft. No more disassembly is required.

TO ACCESS THE CROSS SHAFT SEAL:

1. Rotate the Half Manifolds as necessary to gain access to the (4) Sealing Socket Head Cap Screws that hold the Cross Shaft Assembly (TR200 170) to the Elbow Assembly and remove them. Lift the Cross Shaft Assembly out of the Main Elbow. The Seal is located in the end of the Cross Shaft. No more disassembly is required.

⚠ WARNING

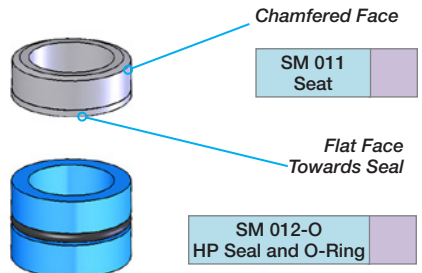
The use of gloves when handling the tool after operation is recommended as the body at the pulling ring end may reach temperatures of up to 160°F depending on operating conditions. Let the tool cool down before disassembling for any maintenance procedures.



TO MAINTAIN H.P. SEAT & SEAL:

1. Remove the Carbide Seat (SM 011) and the H.P. Seal (SM 012-O). Inspect the Seat for chips on edges. Replace if damaged. Inspect the related face of the Elbow Assembly for dings or pits. If damaged, it must be faced or replaced, otherwise the Seal will leak.

2. Apply grease to new H.P. Seal and install into bore. Place the Seat on the Seal with the flat side against the Seal. The chamfered side should face towards the Elbow Assembly.



TORUS TR-200 GENERAL FASTENER INSTALLATION

TR-200 FASTENER ASSEMBLY INSTRUCTIONS

- (4) GS 325-03 SCREWS
SHCS .25-20 X .75 SS

Apply Blue Loctite® 242 to threads
Torque to 84 in-lbs (7 ft-lbs)

- (4) TR200 216 SEALING SCREWS
SHCS .25-20 x 6.25 SS

Apply Blue Goop® to threads
Torque to 144 in-lbs (12 ft-lbs)

- (4) TR 117 SEALING SCREWS
SHCS .37-16 X 1.25 SS

Apply Blue Goop® to threads
Torque to 252 in-lbs (21 ft-lbs)

- (3) GS 331-22 SCREWS
SHCS .31-18 X 5.50 SS

Apply Blue Loctite® 242 to threads
Torque to 144 in-lbs (12 ft-lbs)

- (4) TR 117 SEALING SCREWS
SHCS .37-16 X 1.25 SS

Apply Blue Goop® to threads
Torque to 252 in-lbs (21 ft-lbs)

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TERMS AND CONDITIONS AND WARRANTY INFORMATION

1. Acceptance of Terms and Conditions. Receipt of these Terms and Conditions of Sale ("Terms and Conditions") shall operate as the acceptance by StoneAge, Inc. ("Seller") of the order submitted by the purchaser ("Buyer"). Such acceptance is made expressly conditional on assent by Buyer to these Terms and Conditions. Such assent shall be deemed to have been given unless written notice of objection to any of these Terms and Conditions (including inconsistencies between Buyer's purchase order and this acceptance) is given by Buyer to Seller promptly on receipt hereof.

Seller desires to provide Buyer with prompt and efficient service. However, to individually negotiate the terms of each sales contract would substantially impair Seller's ability to provide such service. Accordingly, the product(s) furnished by Seller are sold only according to the terms and conditions stated herein and with the terms and conditions stated in any effective StoneAge Dealer Agreement or StoneAge Reseller Agreement, if applicable. Notwithstanding any terms and conditions on Buyer's order, Seller's performance of any contract is expressly made conditional on Buyer's agreement to these Terms and Conditions unless otherwise specifically agreed to in writing by Seller. In the absence of such agreement, commencement of performance, shipment and/or delivery shall be for Buyer's convenience only and shall not be deemed or construed to be an acceptance of Buyer's terms and conditions.

2. Payment/Prices. Unless other arrangements have been made in writing between Seller and Buyer, payment for the product(s) shall be made upon receipt of invoice. The prices shown on the face hereof are those currently in effect. Prices invoiced shall be per pricelist in effect at the time of shipment. Prices are subject to increase for inclusion of any and all taxes which are applicable and which arise from the sale, delivery or use of the product(s), and the collection of which Seller is or may be responsible to provide to any governmental authority, unless acceptable exemption certificates are provided by Buyer in accordance with applicable law. Buyer shall pay all charges for transportation and delivery and all excise, order, occupation, use or similar taxes, duties, levies, charges or surcharges applicable to the product(s) being purchased, whether now in effect or hereafter imposed by any governmental authority, foreign or domestic.

3. Warranty. SELLER MAKES NO WARRANTIES OR REPRESENTATIONS AS TO THE PERFORMANCE OF ANY PRODUCT EXCEPT AS SET FORTH IN THE STONEAGE LIMITED WARRANTY PROVIDED WITH THE PRODUCT.

4. Delivery. Seller is not obligated to make delivery by a specified date, but will always use its best efforts to make delivery within the time requested. The proposed shipment date is an estimate. Seller will notify Buyer promptly of any material delay and will specify the revised delivery date as soon as practicable. UNDER NO CIRCUMSTANCES SHALL SELLER HAVE ANY LIABILITY WHATSOEVER FOR LOSS OF USE OR FOR ANY DIRECT OR CONSEQUENTIAL DAMAGES RESULTING FROM DELAY REGARDLESS OF THE REASON(S).

All product(s) will be shipped F.O.B. point of origin, unless specifically agreed otherwise, and Buyer shall pay all shipping costs and insurance costs from that point. Seller, in its sole discretion, will determine and arrange the means and manner of transportation of the product(s). Buyer shall bear all risk of loss commencing with the shipment or distribution of the product(s) from Seller's warehouse. Order shortages or errors must be reported within fifteen (15) business days from receipt of shipment to secure adjustment. No product(s) may be returned without securing written approval from Seller.

5. Modification. These Terms and Conditions are intended by Seller and Buyer to constitute a final, complete and exclusive expression of agreement relating to the subject matter hereof and cannot be supplemented or amended without Seller's prior written approval.

6. Omission. Seller's waiver of any breach or Seller's failure to enforce any of these Terms and Conditions at any time, shall not in any way affect, limit or waive Seller's right thereafter to enforce and compel strict compliance with every term and condition hereof.

7. Severability. If any provision of these Terms and Conditions is held to be invalid or unenforceable, such invalidity or unenforceability shall not affect the validity or enforceability of the other portions hereof.

8. Disputes. Seller and Buyer shall attempt in good faith to promptly resolve any dispute arising under these Terms and Conditions by negotiations between representatives who have authority to settle the controversy. If unsuccessful, Seller and Buyer shall further attempt in good faith to settle the dispute by nonbinding third-party mediation, with fees and expenses of such mediation apportioned equally to each side. Any dispute not so resolved by negotiation or mediation may then be submitted to a court of competent jurisdiction in accordance with the terms hereof. These procedures are the exclusive procedures for the resolution of all such disputes between the Seller and Buyer.

TERMS AND CONDITIONS AND WARRANTY INFORMATION

9. Governing Law. All sales, agreements for sale, offers to sell, proposals, acknowledgments and contracts of sale, including, but not limited to, purchase orders accepted by Seller, shall be considered a contract under the laws of the State of Colorado and the rights and duties of all persons, and the construction and effect of all provisions hereof shall be governed by and construed according to the laws of such state.

10. Jurisdiction and Venue. Seller and Buyer agree that the state or federal courts located within the City and County of Denver, Colorado shall have sole and exclusive jurisdiction over any litigation concerning any dispute arising under these Terms and Conditions not otherwise resolved pursuant to Section 9 as well as any alleged defects of any Products or damages sustained as a result of such alleged defects. Seller and Buyer further agree that should any litigation be commenced in connection with such a dispute, it shall only be commenced in such courts. Seller and Buyer agree to the exclusive jurisdiction of such courts and neither will raise any objection to the jurisdiction and venue of such courts, including as a result of inconvenience.

11. Attorney's Fees. If any litigation is commenced between Seller and Buyer, or their personal representatives, concerning any provision hereof, the party prevailing in the litigation shall be entitled, in addition to such other relief that is granted, to a reasonable sum as and for their attorneys' fees and costs in such litigation or mediation.

STONEAGE TRADEMARK LIST

View the list of StoneAge's trademarks and service marks and learn how the trademarks should be used. Use of StoneAge trademarks may be prohibited, unless expressly authorized.

<http://www.StoneAgetools.com/trademark-list/>

STONEAGE PATENT DATA

View the list of StoneAge's current U.S. patent numbers and descriptions.

<http://www.sapatents.com>

STONEAGE TERMS AND WARRANTY

View StoneAge's Terms and Warranty Conditions online.

<http://www.stoneagetools.com/terms>

<http://www.stoneagetools.com/warranty>

TERMS AND CONDITIONS AND WARRANTY INFORMATION

WARRANTY:

Warranties set forth herein extend only to End-Users, meaning customers acquiring, or that have previously acquired, a product manufactured by StoneAge ("Product") for their own use and not for resale, either directly from StoneAge Inc. ("StoneAge") or from a StoneAge Authorized Dealer or Reseller ("Dealer"). No warranty of any kind or nature is made by StoneAge beyond those expressly stated herein.

1. LIMITED WARRANTY PERIOD. Subject to the limitations and conditions hereinafter set forth, StoneAge warrants its Product to be free from defects in workmanship and material for a period of one (1) year from the date of purchase by the End-User, provided that the end of the limited warranty period shall not be later than eighteen (18) months from the date of shipment of the Product to the Dealer or the End-User by StoneAge ("Limited Warranty Period"). All replacement parts which are furnished under this Limited Warranty and properly installed shall be warranted to the same extent as the original Product under this Limited Warranty if, and only if, the original parts were found to be defective within the original Limited Warranty Period covering the original Product. Replacement parts are warranted for the remainder of the original Limited Warranty Period. This Limited Warranty does not cover any component part of any Product not manufactured by StoneAge. Any such component part is subject exclusively to the component manufacturer's warranty terms and conditions.

2. LIMITED WARRANTY COVERAGE. StoneAge's sole obligation under this Limited Warranty shall be, at StoneAge's option and upon StoneAge's inspection, to repair, replace or issue a credit for any Product which is determined by StoneAge to be defective in material or workmanship. StoneAge reserves the right to examine the alleged defective Product to determine whether this Limited Warranty is applicable, and final determination of limited warranty coverage lies solely with StoneAge. No statement or recommendation made by a StoneAge representative, Dealer or agent to End-User shall constitute a warranty by StoneAge or a waiver or modification to any of the provisions hereof or create any liability for StoneAge.

3. WARRANTY SERVICE PROVIDERS. Service and repair of the Product is to be performed only by StoneAge authorized service representatives, including Dealers who are authorized repair centers, with StoneAge approved parts. Information about StoneAge authorized service representatives can be obtained through the StoneAge website at www.stoneagetools.com/service. Unauthorized service, repair or modification of the Product or use of parts not approved by StoneAge will void this Limited Warranty. StoneAge reserves the right to change or improve the material and design of the Product at any time without notice to End-User, and StoneAge is not obligated to make the same improvements during warranty service to any Product previously manufactured.

4. WARRANTY EXCLUSIONS. This Limited Warranty does not cover, and StoneAge shall not be responsible for the following, or damage caused by the following: (1) any Product that has been altered or modified in any way not approved by StoneAge in advance in writing; (2) any Product that has been operated under more severe conditions or beyond the rated capacity specified for that Product; (3) depreciation or damage caused by normal wear and tear, failure to follow operation or installation instructions, misuse, negligence or lack of proper protection during storage; (4) exposure to fire, moisture, water intrusion, electrical stress, insects, explosions, extraordinary weather and/or environmental conditions including, but not limited to lightning, natural disasters, storms, windstorms, hail, earthquakes, acts of God or any other force majeure event; (5) damage to any Product caused by any attempt to repair, replace, or service the Product by persons other than StoneAge authorized service representatives; (6) costs of normal maintenance parts and services; (7) damage sustained during unloading, shipment or transit of the Product; or (8) failure to perform the recommended periodic maintenance procedures listed in the Operator's Manual accompanying the Product.

5. REQUIRED WARRANTY PROCEDURES. To be eligible for warranty service, the End-User must: (1) report the Product defect to the entity where the Product was purchased (i.e. StoneAge or the Dealer) within the Limited Warranty Period specified in this Limited Warranty; (2) submit the original invoice to establish ownership and date of purchase; and (3) make the Product available to a StoneAge authorized service representative for inspection to determine eligibility for coverage under this Limited Warranty. This Limited Warranty shall not extend to any person or entity who fails to provide proof of original purchase from StoneAge or a Dealer. No Product may be returned for credit or adjustment without prior written permission from StoneAge.

6. DISCLAIMER OF IMPLIED WARRANTIES AND OTHER REMEDIES. EXCEPT AS EXPRESSLY STATED HEREIN (AND TO THE FULLEST EXTENT ALLOWED UNDER APPLICABLE LAW), STONEAGE HEREBY DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION ALL IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, AND ANY AND ALL WARRANTIES, REPRESENTATIONS OR PROMISES AS TO THE QUALITY, PERFORMANCE OR FREEDOM FROM DEFECT OF THE PRODUCT COVERED BY THIS LIMITED WARRANTY. STONEAGE FURTHER DISCLAIMS ALL IMPLIED INDEMNITIES.

TERMS AND CONDITIONS AND WARRANTY INFORMATION

7. LIMITATION OF LIABILITY. End-User specifically acknowledges that the Product may be operated at high speeds and/or pressures, and that as such it may be inherently dangerous if not used correctly. End-User shall familiarize itself with all operation materials provided by StoneAge and shall at all times use and require its agents, employees and contractors to use all necessary and appropriate safety devices, guards and proper safe operating procedures. In no event shall StoneAge be responsible for any injuries to persons or property caused directly or indirectly by the operation of the Product if End-User or any agent, employee, or contractor of End-User: (1) fails to use all necessary and appropriate safety devices, guards and proper safe operating procedures; (2) fails to maintain in good working order such safety devices and guards; (3) alters or modifies the Product in any way not approved by StoneAge in advance in writing; (4) allows the Product to be operated under more severe conditions or beyond the rated capacity specified for the Product; or (5) otherwise negligently operates the Product. End-User shall indemnify and hold StoneAge harmless from any and all liability or obligation incurred by or against StoneAge, including costs and attorneys' fees, to or by any person so injured.

TO THE FULL EXTENT ALLOWED BY APPLICABLE LAW, STONEAGE SHALL NOT BE LIABLE FOR ANY INDIRECT, SPECIAL, INCIDENTAL, CONSEQUENTIAL, OR PUNITIVE DAMAGES (INCLUDING WITHOUT LIMITATION, LOSS OF PROFITS, LOSS OF GOODWILL, DIMINUTION OF VALUE, WORK STOPPAGE, INTERRUPTION OF BUSINESS, RENTAL OF SUBSTITUTE PRODUCT, OR OTHER COMMERCIAL LOSS EVEN TO THE EXTENT SUCH DAMAGES WOULD CONSTITUTE DIRECT DAMAGES), WITH RESPECT TO THE COVERED STONEAGE PRODUCT, OR OTHERWISE IN CONNECTION WITH THIS LIMITED WARRANTY, REGARDLESS OF WHETHER STONEAGE HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

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YOU, THE END-USER, UNDERSTAND AND EXPRESSLY AGREE THAT THE FOREGOING LIMITATIONS ON LIABILITY ARE PART OF THE CONSIDERATION IN THE PRICE OF THE STONEAGE PRODUCT YOU PURCHASED.

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