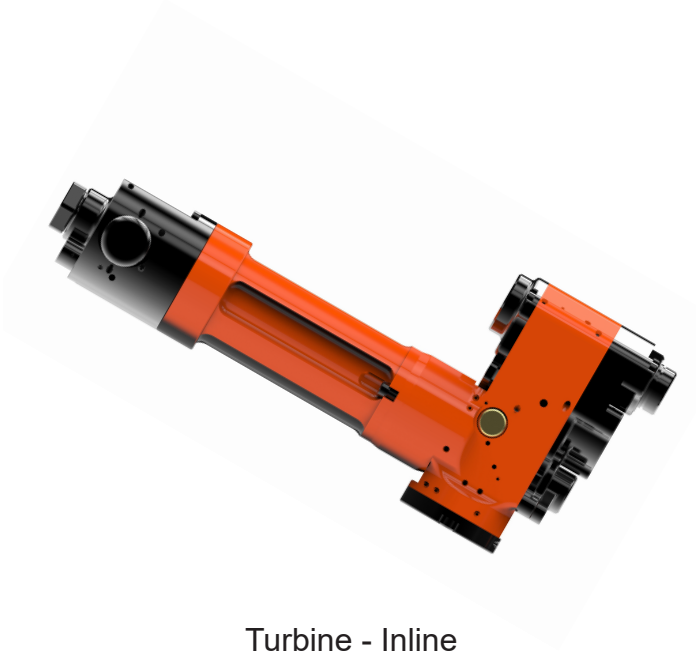
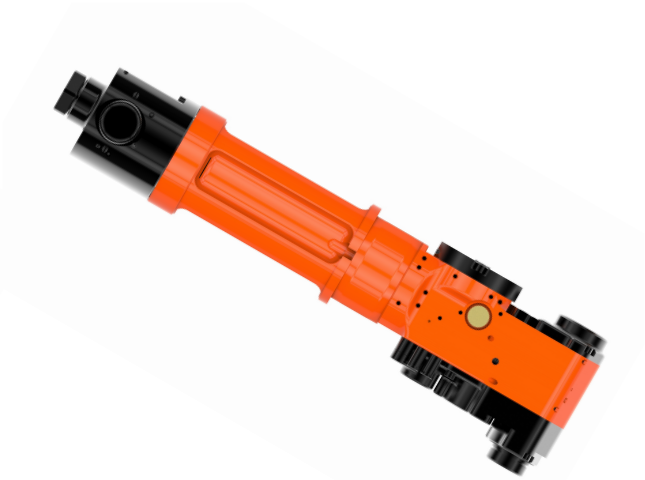
CORVAER

Service and Parts Manual
PL92-5008EN
04/30/2019

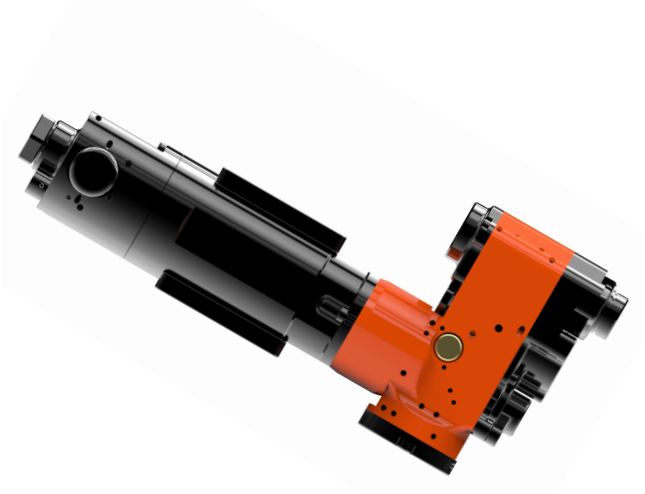
A1 Series
Advanced Drilling



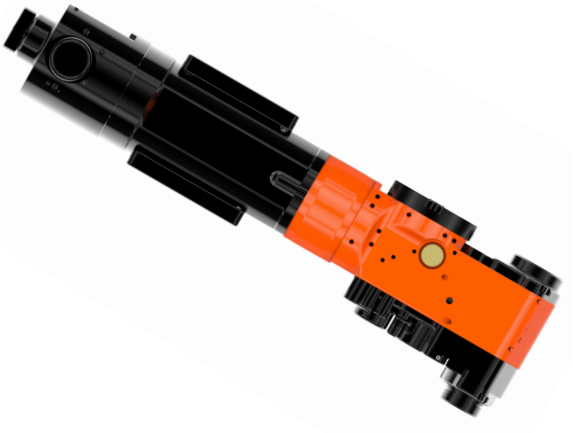
Turbine - Inline



Turbine - Right Angle



Rotary Vane - Inline



Rotary Vane - Right Angle

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The original language of this manual is English.

1 Product Safety Information:

1.1 Intended Use:

WARNING! This positive feed drill is designed for fixtured drilling applications.



This equipment must not be modified in any manner unless approved in writing by Corvaer or Corvaer S.A.S. All safety devices must be properly installed and maintained in good working order.

Any abuse or misuse of this equipment can cause equipment damage, death, or serious injury.

Failure to observe all safety warnings could result in equipment failure or personnel injury.

1.2 General Safety Instructions:

For additional product safety information refer to Corvaer or Corvaer S.A.S. document CE-2009, General Safety Fixtured Drills.

These safety instructions must be accessible to the operator at all times. They must be shown and made available to all personnel involved in the operation of this equipment.



The operator must read and understand the safety instructions contained in this document before operating this equipment.

These safety instructions are not intended to be all inclusive. Study and comply with all applicable Federal, State and local regulations.

Do not remove any labels from this equipment. Replace any label that has been damaged and can not be easily read.

WARNING!



To avoid serious injury, keep hands free from rotating equipment.

Before operating this equipment, coordinate with your workplace safety professional to conduct a hazard assessment of the setup, operation, emergency shut down, start-up, and maintenance of this equipment prior to use. Always use identified safeguards, tooling, and safety procedures identified in the hazard assessment before operating this tool.

1.3 Product Installation:

WARNING! Only qualified and trained personnel should install, adjust, repair or use this equipment.



Do not exceed equipment ratings.

Never attempt to operate this equipment at more than it's rated capacity. Overloading will cause equipment failure and possible personnel injury.

Air Supply:

The positive feed drill A1 type has been designed to be used at 89.9 to 108.8 psi (6.2 to 7.5 bar) dynamic air pressure and a flow rate of 80 cfm (2300 L/min).

In order to get a correct automatic cycle and a maximum output, the minimum dynamic air pressure must not be lower than 89.9 psi (6.2 bar). The minimum inside diameter of the air supply hose must be 7/16" (11mm) to allow sufficient air flow.

CAUTION!

DO NOT LUBRICATE THE TURBINE MOTOR. LUBRICATING THE TURBINE MOTOR WILL CAUSE DAMAGE.

The compressed air must be clean and dry to maintain proper tool performance. Install a filter-regulator-lubricator in the air supply line. Improper lubrication can affect the performance and life of the equipment.

Install the filter-regulator-lubricator at the same height or higher than the work station and a maximum hose length of 16 feet (5 m).

Compressed air quality according to ISO 8573-1: 2010 [2:4:3]:

Recommended oil (rotary vane motors only):

Airlube 533485 (1 US Gallon / 3L)
Airlube 540397 (1 US Quart / 0.9L)

Adjust the inline lubricator to dispense 2 drops of oil per minute at nominal flow.

Recommended grease (gear head and planetary):

Accrolube® High Efficiency Grease with PTFE (manufactured by Accro-Seal)

Any deviation of these instructions could generate abnormal operation on drill cycle of the tool, for which the manufacturer cannot be held responsible.

1.4 Product Operation:

WARNING!



Safety glasses or a face shield must be worn when operating this equipment. Wear hearing protection and other protective equipment, as required by the work environment and drilling application.

If the work environment or drilling application requires the use of protective gloves, avoid contact with the rotating parts of the tool.

Do not wear loose clothing, jewelry or rings and keep long hair away from the tool. Avoid direct skin contact with lubricants, grease or adhesives.

Make certain all personnel in the immediate area of the drilling operation are equipped with the appropriate personal protective equipment before operating the tool.

1.5 Operating Safety Considerations:

WARNING!



- Do not remove any labels and replace any that are damaged or unreadable.
- Do not use this equipment in an explosive environment.
- Disconnect the air supply before performing any service or cutter changes.
- Make sure the air supply line is securely attached to the tool before operating.
- Keep hands away from the ejecting area near the nose unit.
- Use care when handling the sharp cutters.
- Keep clear of all moving parts during the tool's operating cycle.
- Before starting the drilling cycle, make sure the nose piece is securely mounted.
- Before starting the tool, make sure the "STOP" button is working properly.
- Before operating this equipment, run one non-cutting work test cycle.

1.6 Storage Instructions:

This equipment should be stored at temperatures of +40° - +100° F (4° - 38°C) with a maximum relative humidity of 80%.

Note: The electronic cycle counter option contains a battery.

1.7 Disposal:



Observe all local disposal guidelines for all components of this equipment and its packaging.

1.8 Safety Signal Words:

WARNING!



Indicates a potentially hazardous situation which, if not avoided, could result in serious injury or death.

CAUTION!



Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury or property damage

1.9 Safety Maintenance Checklist:

Implement a comprehensive safety maintenance program to provide regular inspection for all phases of tool operation and air supply equipment. Replace worn or damaged parts using only genuine brand replacement parts manufactured by Corvaer or Corvaer S.A.S. The use of parts other than those provided by the manufacturer may result in a drop in output or increased maintenance and may cancel the manufacturer's warranty.

Never lubricate the tool with flammable or volatile liquid, gazoil, aircraft fuel, etc.

Disconnect the air supply before performing any maintenance on this equipment.

Daily:

- Visual inspection of air supply hose and connections.
- If lubrication is used, check the oil tank level and operation.

- Inspect all external tool components.
- Inspect the cutter for cracks or damage.
- Make sure lock screws and drill bushing are securely mounted.
- Inspect the tool for loose fasteners.
- Check the tool for excessive noise or vibration.

Weekly:

- Inspect the air supply hose for damage.
- Make sure the air inlet connection is securely tightened.
- Check the free speed of the tool.
- Make sure all tool fasteners are properly tightened.
- Inspect any guards (if equipped) for damage.

6 Months or sooner if needed:

- Check individual parts and replace as necessary.
- Replace all o-rings, seals and gaskets.

Only qualified and trained personnel should repair this equipment. Refer to the Sales and Service Center listing on the back of this document for authorized Corvaer or Corvaer S.A.S. repair facilities.

1.10 Copyright protection:

Corvaer reserves the right to modify, supplement or improve this document or the product without prior notice. This document may not be reproduced in any way, shape or form, in full or parts thereof, or copied to another natural or machine readable language or to a data carrier, whether electronic, mechanical, optical or otherwise without the express permission of Corvaer.

1.11 EC Declaration of Conformity:

We affirm that this machine is in accordance with the following EC regulations (2006/42/EC). Applied harmonized standards are ISO 12100:2010.

1.12 Noise and Vibration:

Noise: L_{pA} = 73.4 dBA
Noise: L_{WA} = 84.4 dBA
Vibration: < 2.5 m^2/s

2 Product Specifications:

A Series Base Tool Options

Base Tool					Standard Option		Rated Speeds -0/+10%			Feeds	
Code	Base weight lbs	kg	Noise	Configuration	Code	Configuration	Turbine	Vane		ipr	mm/rev
(2)A14V	7.3	3.3	<=85dBA	Right Angle Vane Motor	M	Internal Mitis	3200	3100	760	0.001	0.025
(2)A14T	6.9	3.1	<=82dBA	Right Angle Turbine			2500	2800	670	0.002	0.05
(2)A16V	7.1	3.2	<=85dBA	In Line Vane Motor			1700	2500	600	0.003	0.08
(2)A16T	6.7	3.0	<=82dBA	In Line Turbine			950	2100	510	0.004	0.10
							750	1900	460	0.006	0.15
							600	1700	410	0.007	0.18
							400	1450	350	0.008	0.20
								950	320		
								850	250		

A Series Base Tool Configurations - Refer to Specific Service Parts Section

Gear Head		Speed Specific Parts Rotary Vane							Speed Specific Parts Turbine			
Type	Illustration	Spindle Speed	Planetary Ratio	Assembly	Illustration	Motor Speed	Governor	Illustration	Turbine	Planetary Ratio	Assembly	Illustration
Right Angle	19A and 19B	3100	3.3	642409PT	13	10250	641336	2	3200	3.3	642409PT	13
In Line	20A and 20B	2800	4.1	642410PT	14	11400	641333	2	2500	4.1	642410PT	14
		2500	4.1	642410PT	14	10250	641336	2	1700	6.0	642411PT	14
Mitis	22	2100	4.1	642410PT	14	8700	641335	2	950	10.7	642412PT	15
Non Mitis	23, 24	1900	6.0	642411PT	14	11400	641333	2	750	13.5	642413PT	16
		1700	6.0	642411PT	14	10250	641336	2	600	17.0	642414PT	17
		1450	6.0	642411PT	14	8700	641335	2	400	24.8	642415PT	18
		950	10.7	642412PT	15	10250	641336	2				
		850	13.5	642413PT	16	11400	641333	2				
		760	13.5	642413PT	16	10250	641336	2				
		670	17.01563	642414PT	17	11400	641333	2				
		600	17.01563	642414PT	17	10250	641336	2				
		510	17.01563	642414PT	17	8700	641335	2				
		460	24.75	642415PT	18	11400	641333	2				
Motor		410	24.75	642415PT	18	10250	641336	2				
Type	Illustration	350	24.75	642415PT	18	8700	641335	2				
Turbine	1	320	24.75	642415PT	18	8000	641332	2				
Rotary Vane	2	250	24.75	642415PT	18	6300	641334	2				

2.1 Product Description:

This portable, pneumatic powered machine is designed for drilling, boring or milling in aerospace manufacturing applications. This machine consists of the following components:

- Power supply assembly
- Geared motor unit
- Gear unit assembly for rotation and feed
- Logic components
- Valve
- Spindle screw
- Cutting tool
- Nosepiece
- Various options

3 Maintenance:

General Notes:

Note: Intervals between inspection depend on a number of operation and use factors, most significant of which are:

- the operation frequency of the tool
- number of drilling cycles per use
- drilling torque and thrust required
- cycle time in use
- cleanliness of operation - lubricant/chip cleanup
- quality of air supply

The following recommendations are initial guidelines and should be adapted according to the tool utilization.

For additional information or guidance please contact your local Corvaer representative.

Recommended Minimum Service Intervals *

Schedule	Calendar Time	Cycles V	Run Time/hrs	Action
W1	Daily **	NA	NA	Ensure tool is cleaned - all chips/debris removed
				Visually Inspect air supply hose, all pneumatic connections
				Inspect airline filter, regulator and lubricator for proper lubrication
				Check Air Supply Pressure (90psi dynamic)
				Check spindle stop nuts are securely mounted
				Check all guards are fitted
				Check the tool for excessive vibration/unusual noise
				Visual inspect all external components - Especially inder if fitted for wear
				Check Tool Function - Emergency Stop/Start/Manual Retract/Automatic Retract
				Perform test drill before each shift
W2	3 Months	100,000	500	Check Motor Speed - If Low Clean Inlet Screen and Clean or Change Muffler then check/replace Motor Blades as necessary
				Check for External Air Leaks - Replace O Rings as necessary
				Inspect Fluid Inducer End Seal/Tube for wear/leaks - replace if necessary
				Apply grease to Gear Head
				Check operation of Lubricator
				Check thrust overload setting
W3	6 Months	200,000	2,500	Inspect All O Rings/Seals - Replace as necessary
				Check spindle for wear on threads
W4	1 Year	300,000	7,500	Replace All Bearings/Inspect Gears - refer to spare parts manualfor guidelines
				Check All springs

* Recommended Service Interval is based on 3 possible factors - Calendar Time, Run Time or Run Cycles - the number achieved first should be used to set maintenance schedule

** Alternatively Before or After Each Shift

MITIS™ Service Intervals				
Feed Rate		Stroke Basis (S)		Recommended Service Interval (C)
IPR	mm/rev	inches	mm	Number of Cycles
0.001	0.03	1	25.4	333
0.002	0.05	1	25.4	667
0.003	0.08	1	25.4	1,000
0.004	0.10	1	25.4	1,333
0.005	0.13	1	25.4	1,667
0.006	0.15	1	25.4	2,000
0.007	0.18	1	25.4	2,333
0.008	0.20	1	25.4	2,667
0.009	0.23	1	25.4	3,000
0.010	0.25	1	25.4	3,333

To calculate a User Specific Service interval based on actual stroke.

$$\text{Service Interval (Cycles)} = \frac{\text{Stroke Basis (S)}}{\text{Actual Stroke}} \times \text{Recommended Service Intervals (C)}$$

Note: To service MITIS, access the MITIS components. Remove and inspect for wear and replace as necessary. Reassemble and grease.

4 Service Parts:

Illustration 1: 642452PT Turbine Motor Module

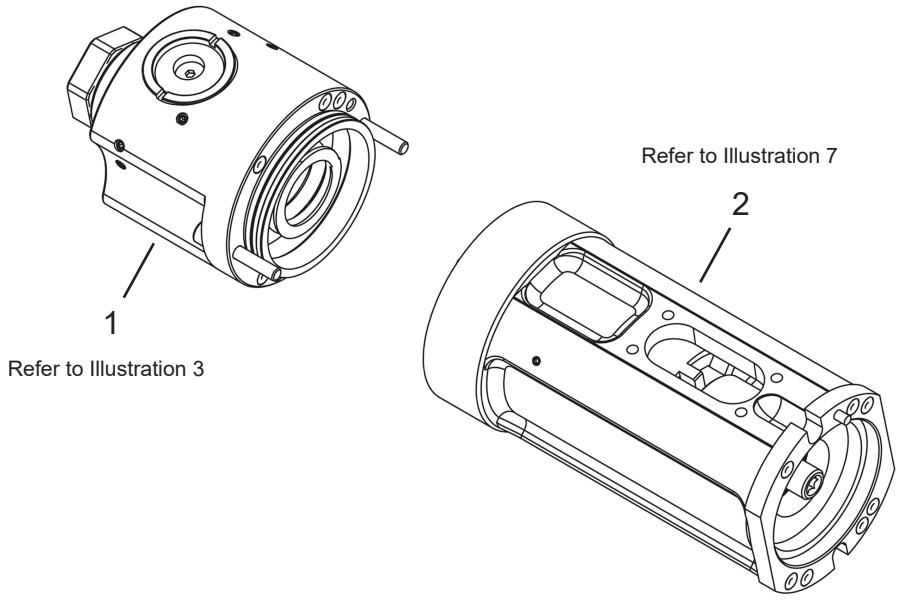


Illustration 2: 642422PT-XX Rotary Vane Motor Module

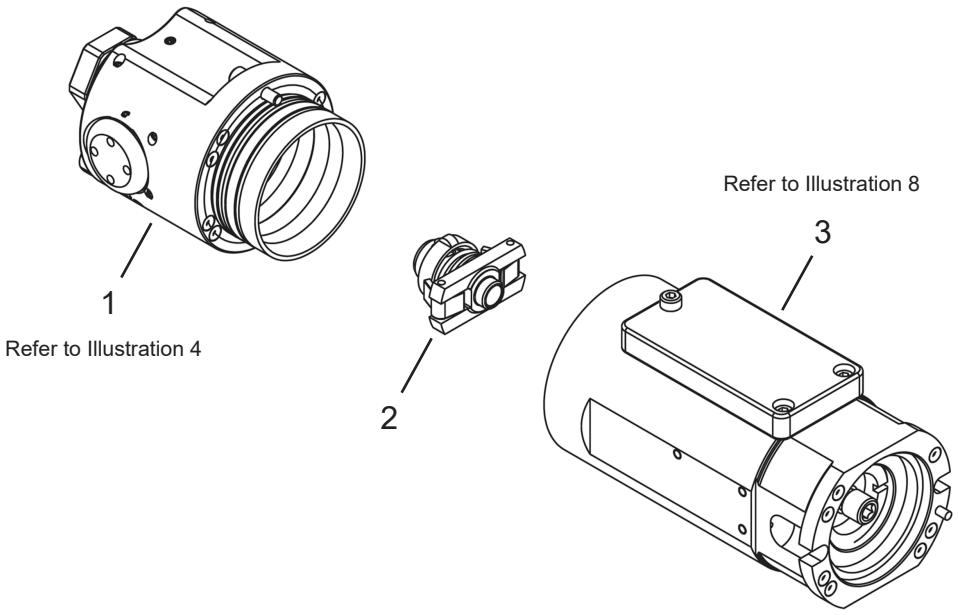


Illustration "1" - 642452PT Turbine Motor Module

Ref	Number	#	X	EN Description
1	642418PT	1		E-Valve Assembly (Refer to Illustration "3")
2	642451PT	1		Motor Assembly (Refer to Illustration "7")

(#) Quantity
(X) Recommended Spare Parts (quantity shown based on 1-5 tools in operation)

Illustration "2" - 642422PT Rotary Vane Motor Module

Ref	Number	#	X	EN Description
1	642419PT	1		E-Valve Assembly (Refer to Illustration "4")
2	Table "2"	1		Governor Assembly
3	642416PT	1		Motor Assembly (Refer to Illustration "8")

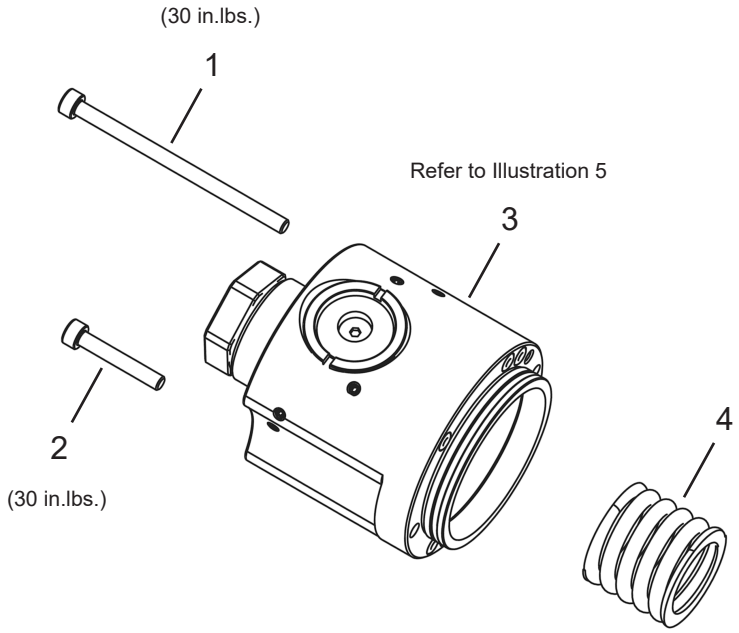
(#) Quantity
(X) Recommended Spare Parts (quantity shown based on 1-5 tools in operation)

Table "2"

Ref.	Description	Motor Speed / Spindle Speed									
		#	8000 / 320	#	11400 / 2800 11400 / 1900 11400 / 850 11400 / 670 11400 / 460	#	6300 / 250	#	8700 / 2100 8700 / 1450 8700 / 510 8700 / 350	#	10250 / 3100 10250 / 2500 10250 / 1700 10250 / 950 10250 / 760 10250 / 600 10250 / 410
2	Governor Assembly	1	641332	1	641333	1	641334	1	641335	1	641336

E-Valve Assembly

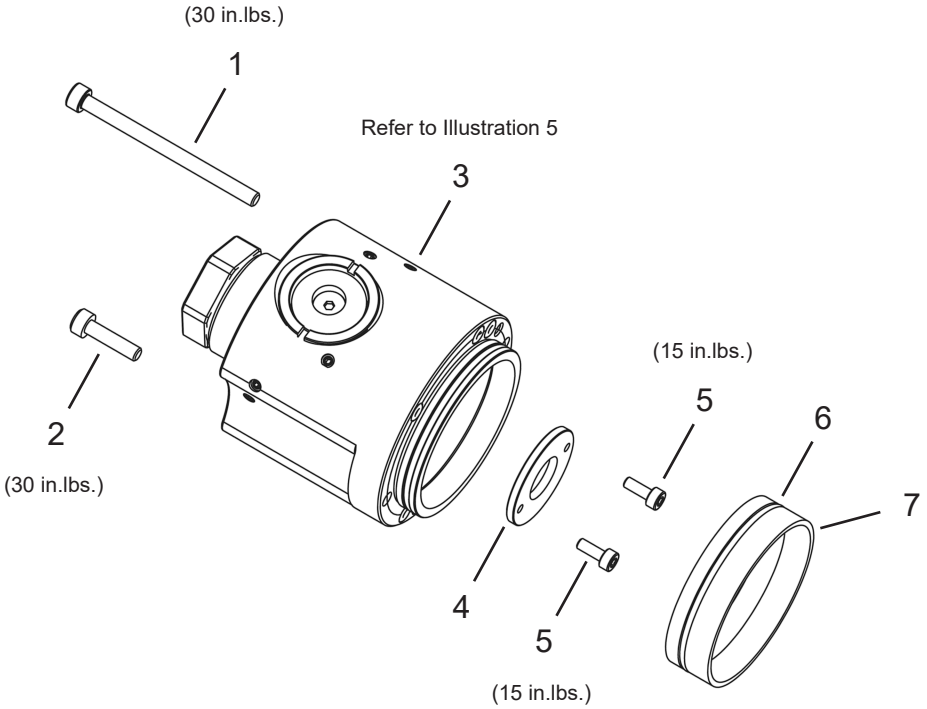
Illustration 3: 642418PT Turbine E-Valve Assembly



WARNING!

The E-Valve assembly is under spring load, remove carefully. The correct length screw must be used to allow spring tension release without the screws becoming detached from the motor housing.

Illustration 4: 642419PT Rotary Vane E-Valve Assembly



E-Valve Assembly

Illustration "3" - 642418PT Turbine E-Valve Assembly

Ref	Number	#	X	EN Description
1	94234213	1		Socket Head Cap Screw (M4 x 65mm)
2	542940-57	1		Socket Head Cap Screw (M4 x 25mm)
3	642420PT	1		Safety Body Assembly (Refer to Illustration "5")
4	634587PT	1	1	Compression Spring

(#) Quantity
(X) Recommended Spare Parts (quantity shown based on 1-5 tools in operation)

Illustration "4" - 642419PT Rotary Vane E-Valve Assembly

Ref	Number	#	X	EN Description
1	94234211	1		Socket Head Cap Screw (M4 x 55mm)
2	94234195	1		Socket Head Cap Screw (M4 x 16mm)
3	642420PT	1		Safety Body Assembly (Refer to Illustration "5")
4	90226942	1		Governor Wear Ring
5	94234140	2		Socket Head Cap Screw (M3 x 8mm)
6	91816167	1	3	O-Ring
7	634646PT	1		Spacer

(#) Quantity
(X) Recommended Spare Parts (quantity shown based on 1-5 tools in operation)

Safety Body Assembly

Illustration 5: 642420PT Safety Body Assembly

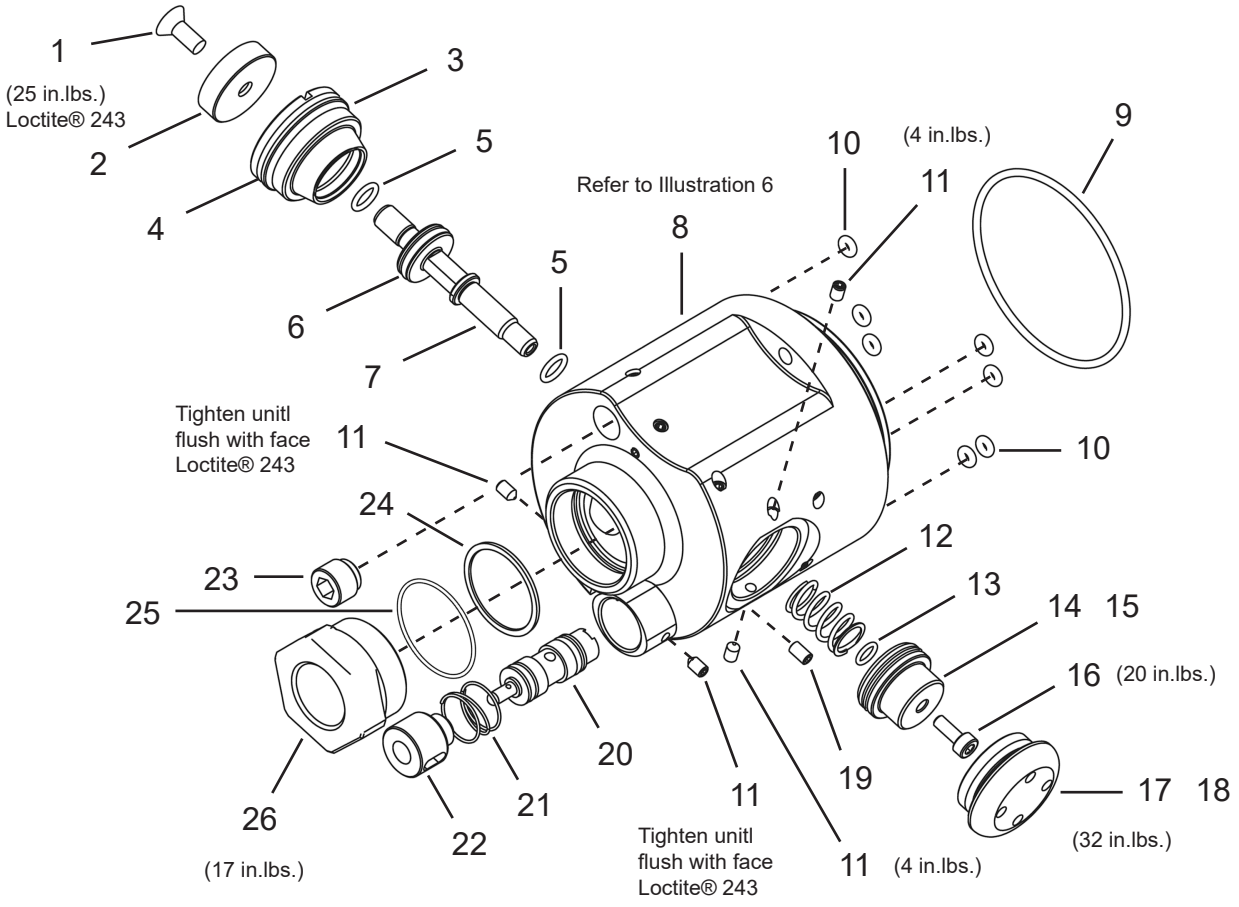
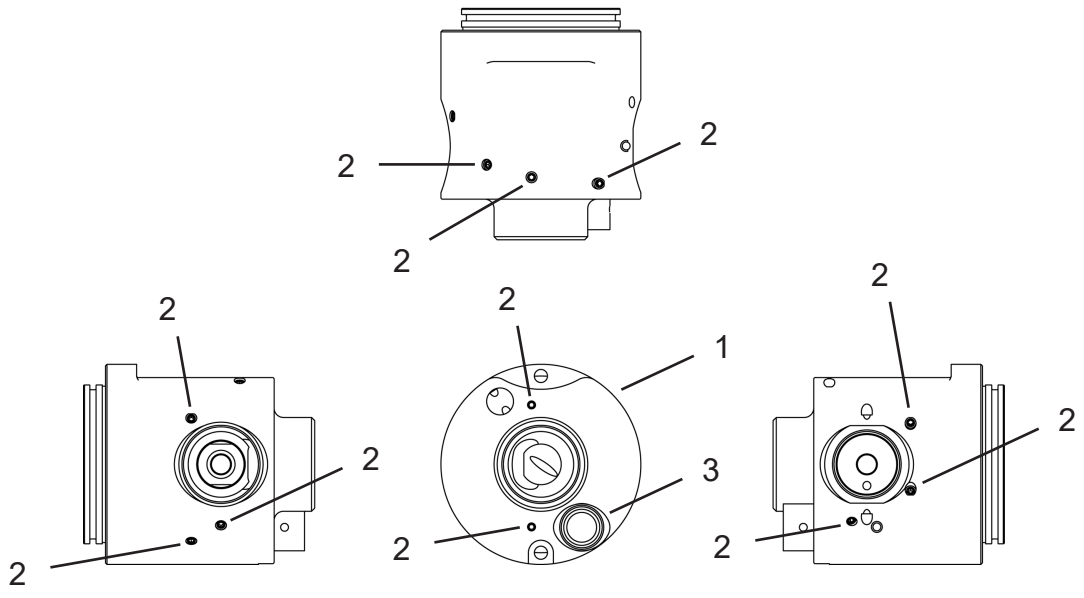


Illustration 6: 642421PT Safety Body



Safety Body Assembly

Illustration "5" - 642420PT Safety Body Assembly

Ref	Number	#	X	EN Description
1	542940-25	1	1	Flat Head Screw (M4 x 0.7 x 8mm)
2	634640PT	1		Emergency Stop Button
3	90225692PT	1		Safety Valve Guide
4	91815721PT	1	3	O-Ring
5	91815155	2	6	O-Ring
6	91815351PT	1	3	O-Ring
7	93815041PT	1		Slide Valve
8	642421PT	1		Safety Body (Refer to Illustration "6")
9	91816167	1	3	O-Ring
10	91815045	7	21	O-Ring
11	94221100	4		Set Screw
12	93430952PT	1	3	Compression Spring
13	91815104	1	3	O-Ring
14	90231106	1	3	O-Ring
15	93050111PT	1		Piston
16	94234140	1		Socket Head Cap Screw (M3 x 8mm)
17	91815677	1	3	O-Ring
18	90225691PT	1		Safety Valve Cap
19	94224005	1		Set Screw
20	531226	1		Poppet Valve
21	634645PT	1	3	Compression Spring
22	642384PT	1		Start Button
23	90255216	1		Plug (Assemble flush to surface)
24	93800005	1	3	Screen
25	847445	1	3	O-Ring
26	90810863PT	1		Inlet Adapter

(#) Quantity
(X) Recommended Spare Parts (quantity shown based on 1-5 tools in operation)

Illustration "6" - 642421PT Safety Body Assembly

Ref	Number	#	X	EN Description
1	634641PT	1		Safety Body
2	634323PT	11	11	Set Screw (M3 x 3mm)
3	634642PT	1		Differential Piston

(#) Quantity
(X) Recommended Spare Parts (quantity shown based on 1-5 tools in operation)

Motor Assembly

Illustration 7: 642451PT Turbine Motor Assembly

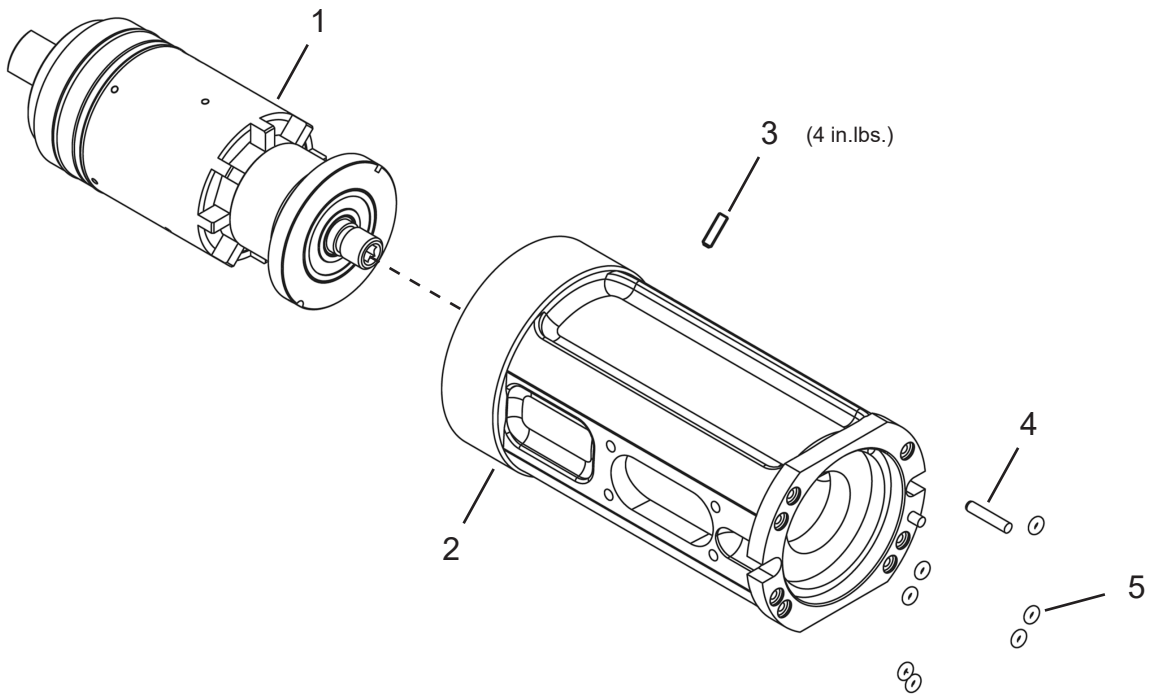


Illustration 8: 642416PT Rotary Vane Motor Assembly

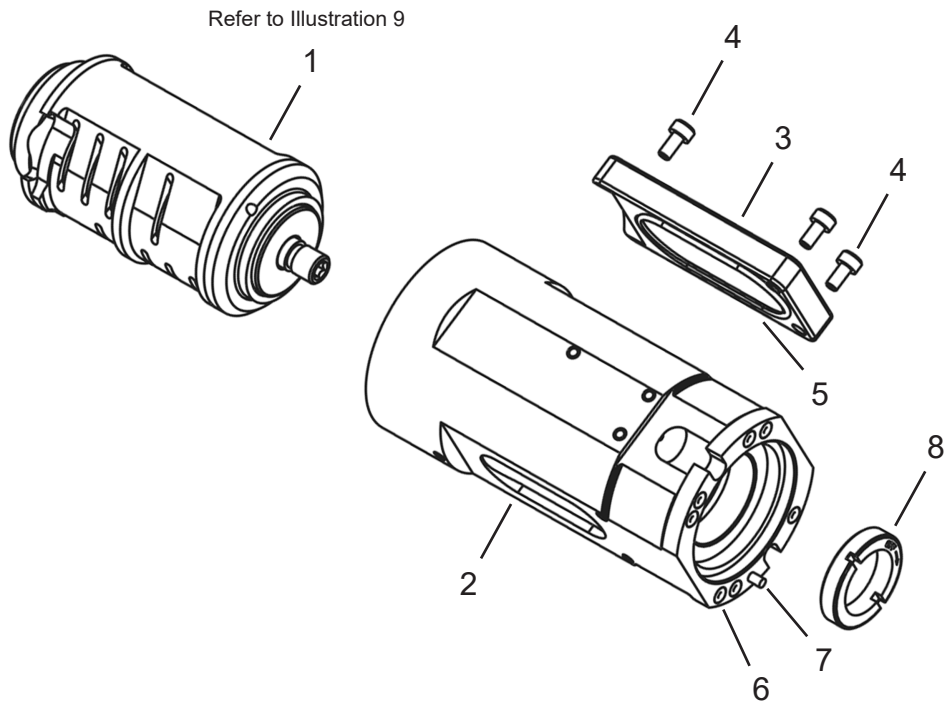


Illustration "7" - 642451PT Turbine Motor Assembly

Ref	Number	#	X	EN
				Description
1	642435PT	1		Turbine Motor Assembly
2	642450PT	1		Turbine Motor Housing
3	634880PT	1	2	Set Screw (M3 x 10mm)
4	91216105	1		Pin
5	91815045	7	21	O-Ring

(#) Quantity
(X) Recommended Spare Parts (quantity shown based on 1-5 tools in operation)

Illustration "8" - 642416PT Vane Motor Assembly

Ref	Number	#	X	EN
				Description
1	642417PT	1		Vane Motor (Refet to Illustration "9")
2	642426PT	1		Vane Motor Housing
3	634636PT	1		Cover Plate
4	542940-47	3	6	Socket Head Cap Screw (M4 x .07 x 8mm)
5	91816120	1	3	Cover Plate Seal
6	91815045	7	21	O-Ring
7	634339PT	2		Pin
8	90810836	1		Nut

(#) Quantity
(X) Recommended Spare Parts (quantity shown based on 1-5 tools in operation)

Rotary Vane Motor & Turbine Exhaust Kit

Illustration 9: 642417PT Rotary Vane Motor

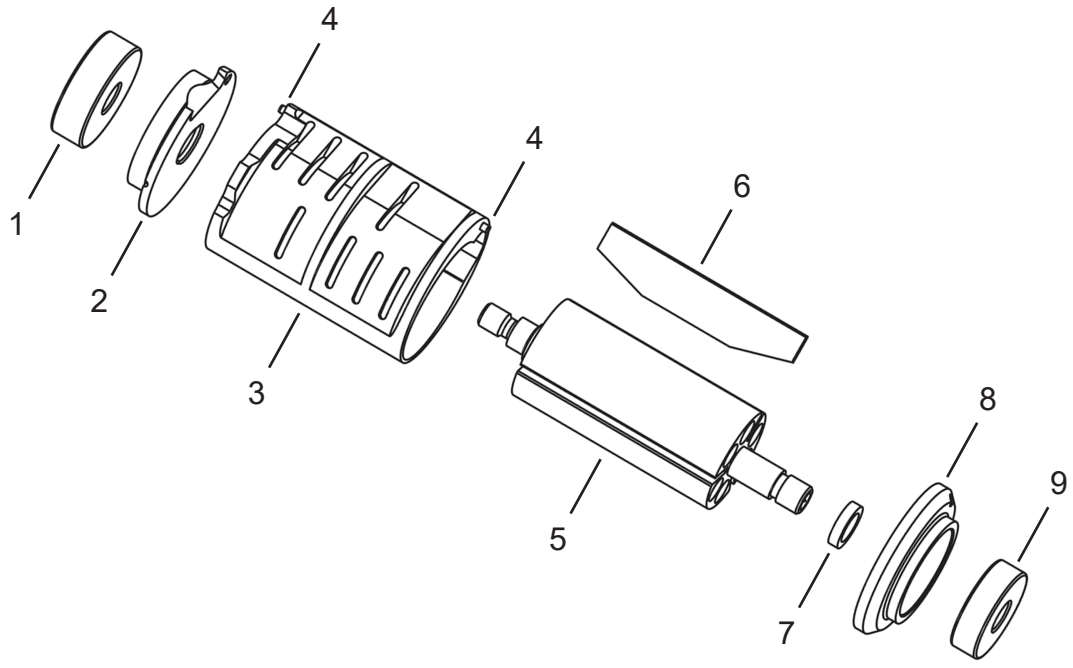


Illustration 10: 642539PT Turbine Exhaust Kit

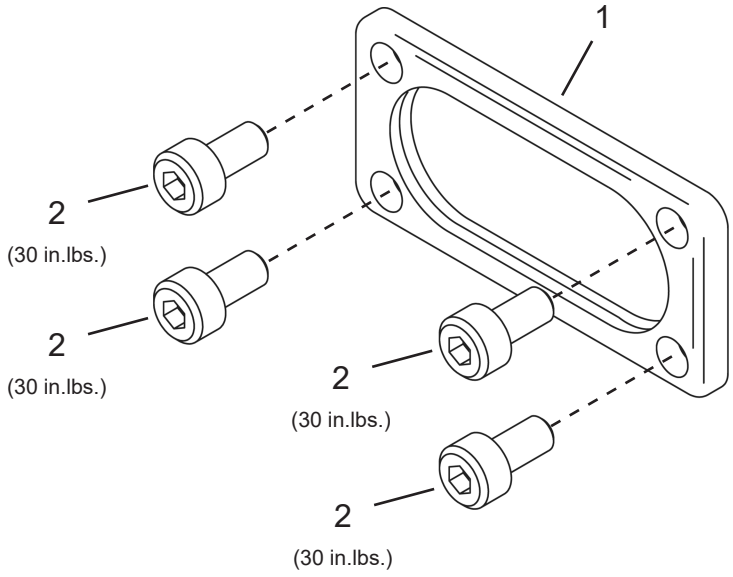


Illustration "9" - 642417PT Vane Motor Assembly

Ref	Number	#	X	EN Description
1	864522	1	2	Ball Bearing
2	634572PT	1		Rear Bearing Plate
3	642428PT	1		Cylinder (includes Ref. 4)
4	619154	2		Cylinder Pin
5	634583PT	1		Rotor
6	382520	3	9	Rotor Blade
7	865417	1	1	Rotor Collar
8	634571PT	1		Front Bearing Plate
9	842870	1	2	Ball Bearing

(#) Quantity
(X) Recommended Spare Parts (quantity shown based on 1-5 tools in operation)

Illustration "10" - 642539PT Turbine Exhaust Kit

Ref	Number	#	X	EN Description
1	634849PT	1		Outlet Cover
2	542940-47	4		Socket Head Cap Screw

(#) Quantity
(X) Recommended Spare Parts (quantity shown based on 1-5 tools in operation)

Rotary Vane Muffler Cover Assembly

Illustration 11: 642523PT Rotary Vane Muffler Cover Assembly (Low Noise)

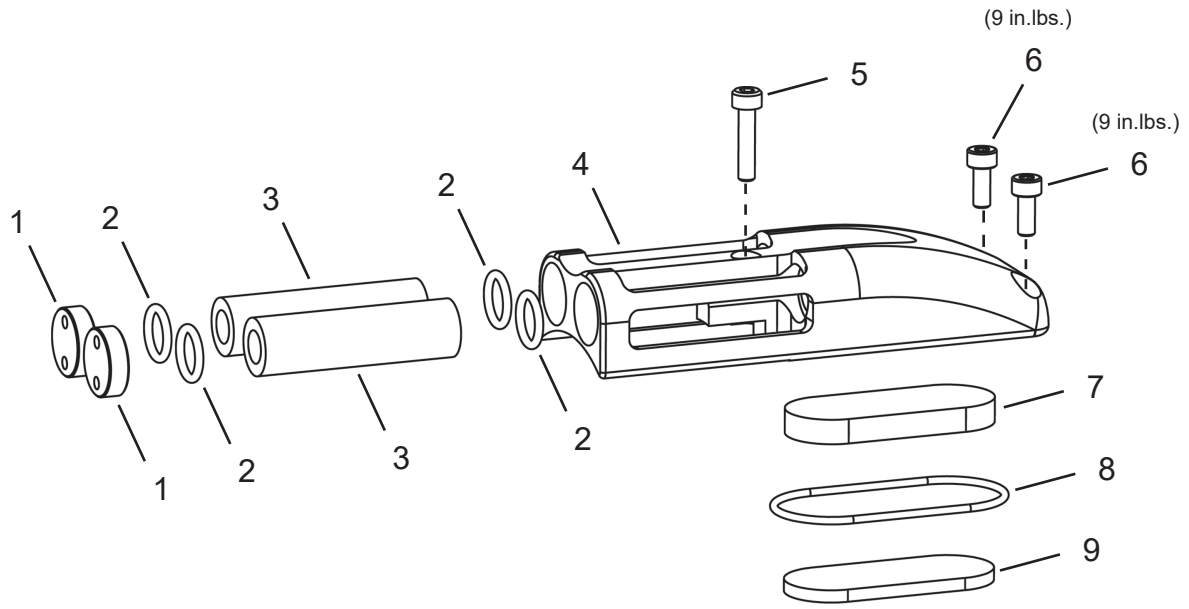
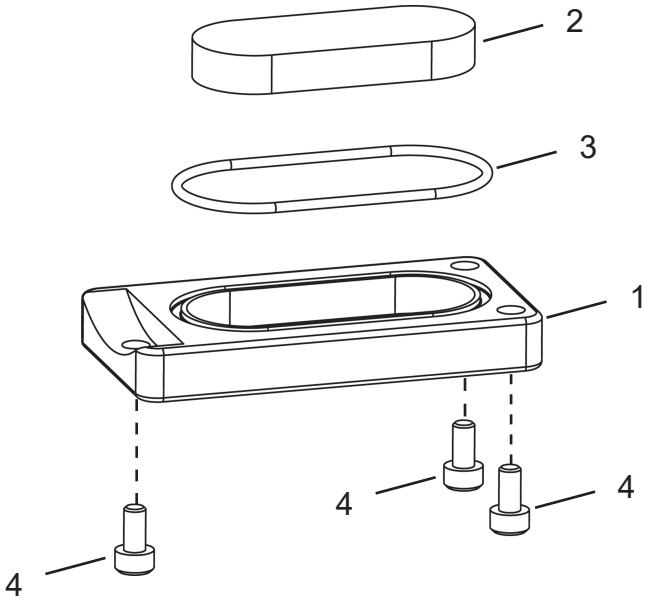


Illustration 12: 642524PT Rotary Vane Muffler Cover Assembly (High Power)



Rotary Vane Muffler Cover Assembly

Illustration "11" - 642523PT Muffler Cover Assembly (Low Noise) - Vane Motor

Ref	Number	#	X	EN Description
1	90255986	2		Plug (3/8")
2	91815310	4	12	O-Ring
3	93615931	2	6	Noise Reducer
4	90474023	1		Muffler Cover Case
5	634356PT	1		Screw
6	94234185	2		Screw
7	93615941PT	1	3	Filter
8	91816120	1	3	O-Ring
9	93615930	1	3	Muffler

(#) Quantity
(X) Recommended Spare Parts (quantity shown based on 1-5 tools in operation)

Illustration "12" - 642524PT Muffler Cover Assembly (High Power) - Vane Motor

Ref	Number	#	X	EN Description
1	634637PT	1		Muffler Cover
2	634649PT	1	3	Muffler
3	91816120	1	3	O-Ring
4	542940-47	3		Screw

(#) Quantity
(X) Recommended Spare Parts (quantity shown based on 1-5 tools in operation)

Single Stage Gearing

Illustration 13: 642408PT (2.79 ratio) Single Stage Gearing Assembly
642409PT (3.3 ratio) Single Stage Gearing Assembly

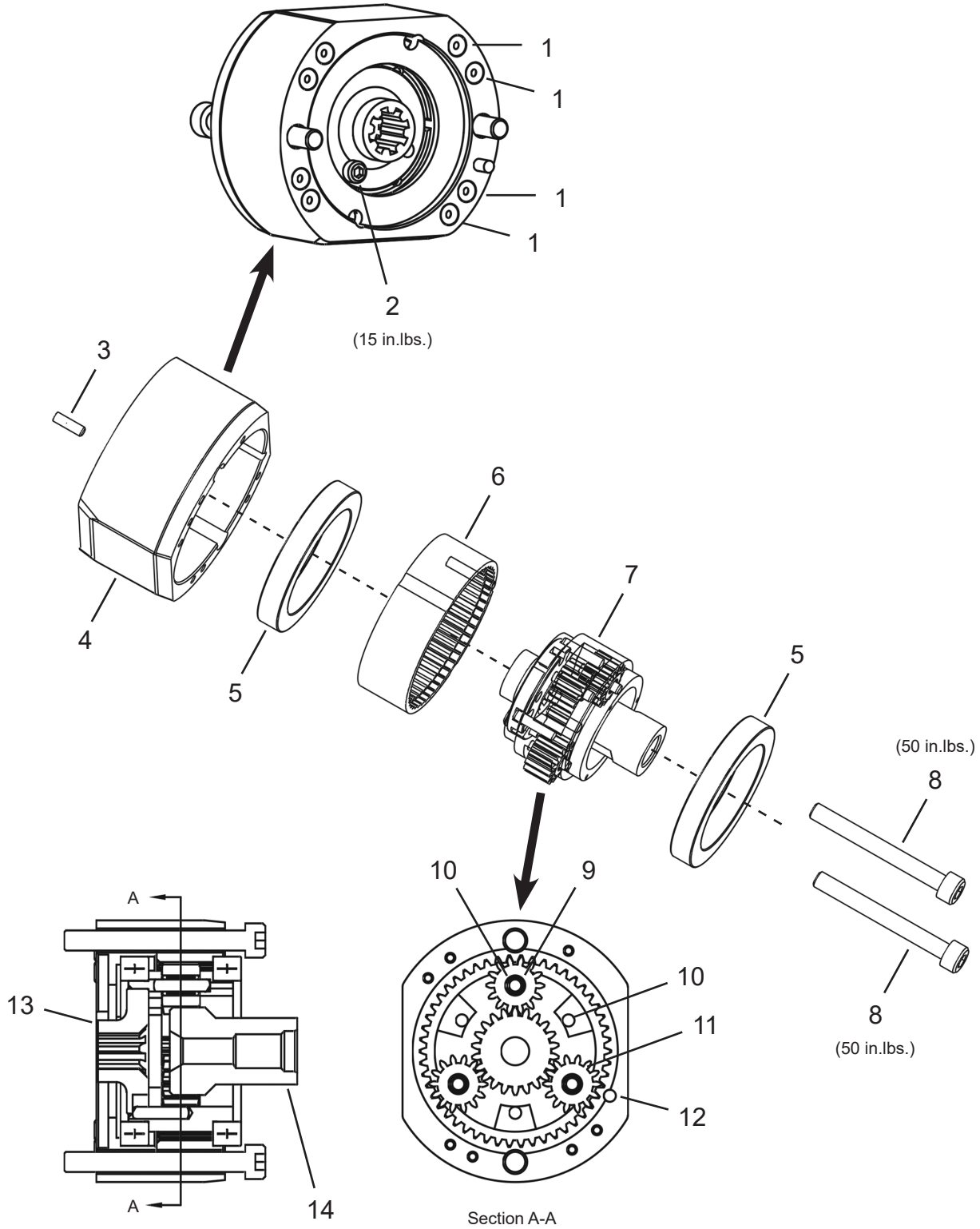


Illustration "13" - 642408PT and 642409PT Gearing

Ref	Number	#	X	EN Description
1	91815045	8	24	O-Ring
2	634345PT	1		Socket Head Cap Screw (M3 x 8mm)
3	634339PT	1		Pin
4	634575PT	1		Planetary Housing
5	93450775	2	4	Ball Bearing
6	90515063PT	1		Ring Gear
7	Table "13"	1		Gear Cage
8	542940-54	2		Socket Head Cap Screw (M5 x 45mm)
9	90405005	3	6	Planetary Gear Needle Bearing
10	91216103	6	12	Planetary Gear Pin
11	Table "13"	3	6	Planetary Gear
12	91216105	1		Dowel Pin
13	634577PT	1		Adapter
14	Table "13"	1	2	Pinion Gear

(#) Quantity
(X) Recommended Spare Parts (quantity shown based on 1-5 tools in operation)

Table "13"

Ref.	Description	Gearing Assembly Number			
		#	642408PT	#	642409PT
7	Gear Cage	1	90404039PT	1	90404040PT
11	Planetary Gear	3	93030983PT (11T)	3	93030993PT (14T)
15	Pinion Gear	1	634661PT	1	634662PT

(T) Teeth

Single Stage Gearing

Illustration 14: 642410PT (4.1 ratio) Single Stage Gearing Assembly
642411PT (6.0 ratio) Single Stage Gearing Assembly

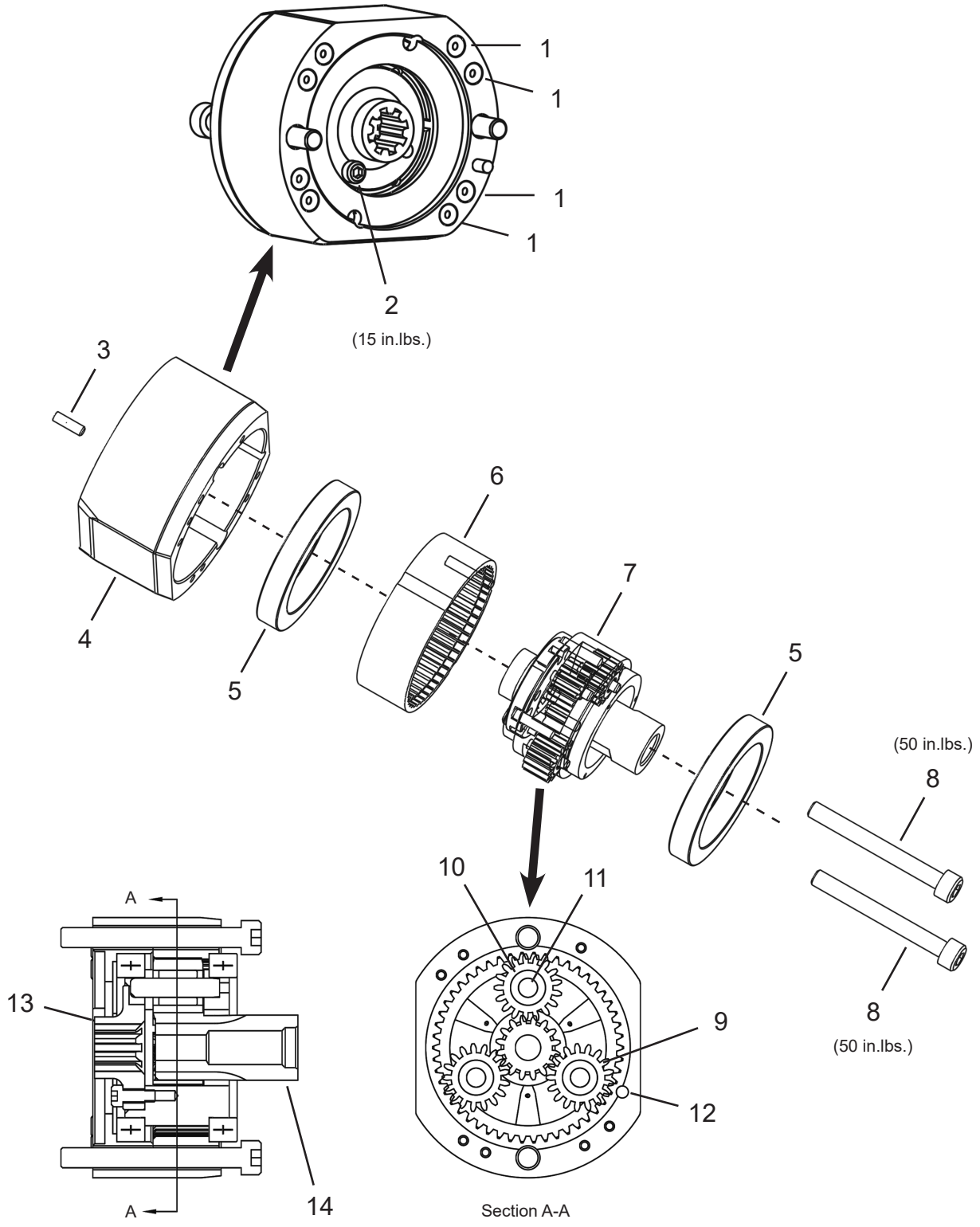


Illustration "14" - 642410PT and 642411PT Gearing

Ref	Number	#	X	EN Description
1	91815045	8	24	O-Ring
2	634345PT	1		Socket Head Cap Screw (M3 x 8mm)
3	634339PT	1		Pin
4	634575PT	1		Planetary Housing
5	93450775	2	4	Ball Bearing
6	90515063PT	1		Ring Gear
7	Table "14"	1		Gear Cage
8	542940-54	2		Socket Head Cap Screw (M5 x 45mm)
9	Table "14"	3	6	Planetary Gear (includes Ref. 10)
10	844774	3	6	Planetary Gear Needle Bearing
11	202075PT	3	6	Planetary Gear Pin
12	91216105	1		Dowel Pin
13	634577PT	1		Adapter
14	Table "14"	1	2	Pinion Gear

(#) Quantity
(X) Recommended Spare Parts (quantity shown based on 1-5 tools in operation)

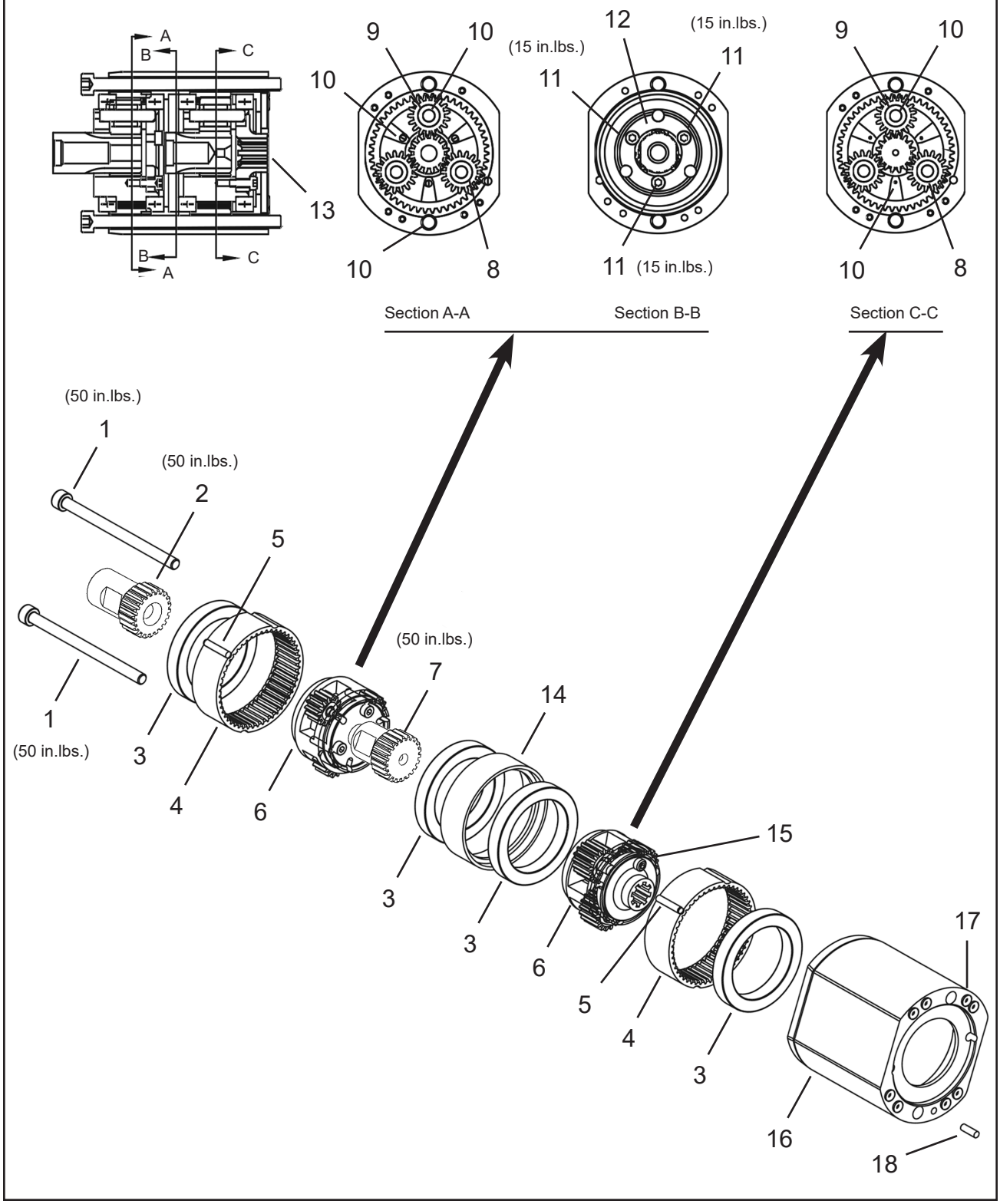
Table "14"

Ref.	Description	Gearing Assembly Number			
		#	642410PT	#	642411PT
7	Gear Cage	1	90404036PT	1	90404038PT
9	Planetary Gear	3	633789PT	3	93030982PT
14	Pinion Gear	1	634663PT	1	93030829PT

(T) Teeth

Double Stage Gearing

Illustration 15: 642412PT (10.7 ratio) Double Stage Gearing Assembly



Double Stage Gearing

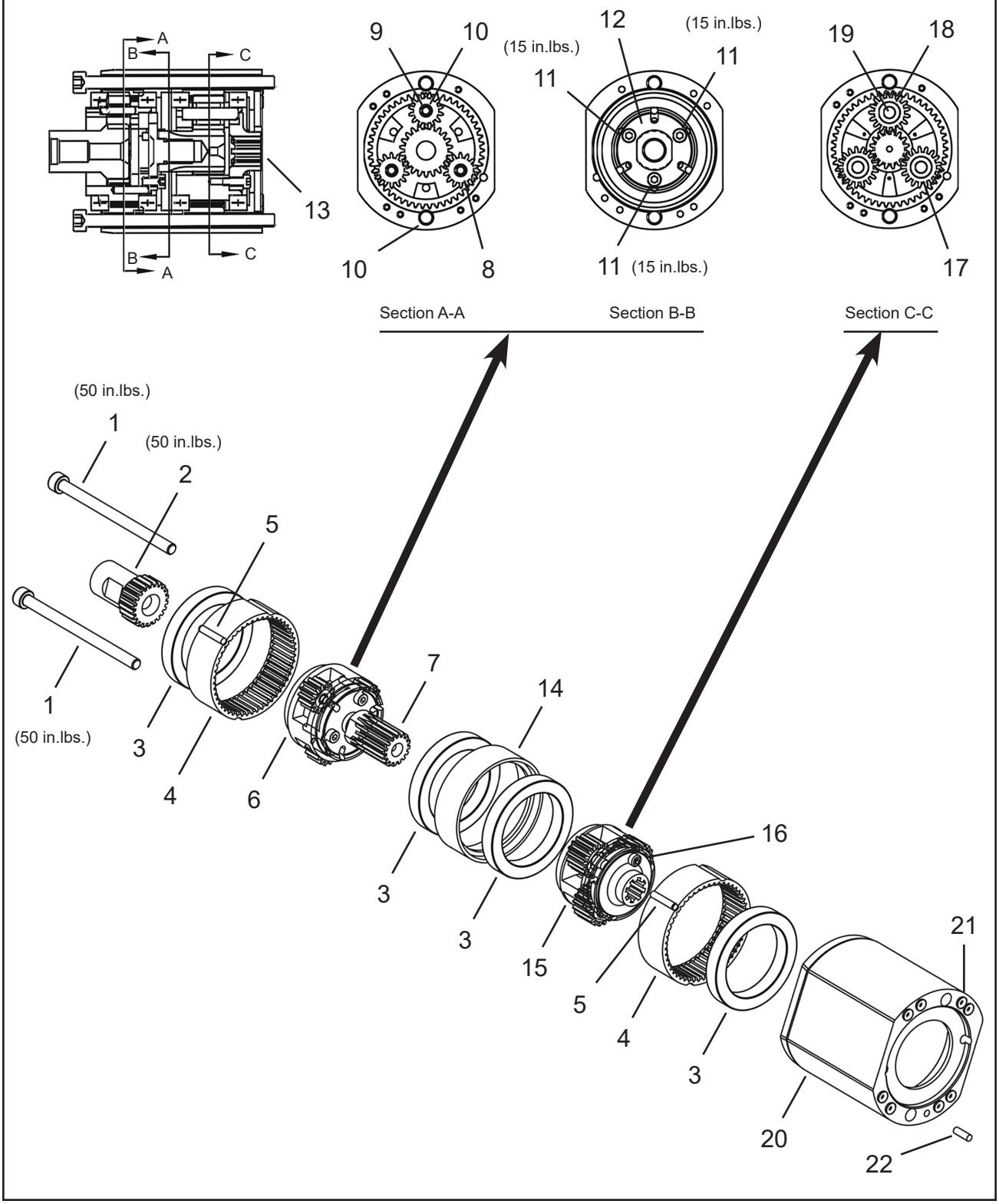
Illustration "15" - 642412PT Gearing

Ref	Number	#	X	EN Description
1	94234297PT	2		Socket Head Cap Screw (M5 x 75mm)
2	634662PT	1	2	Pinion Gear
3	93450775	4	8	Ball Bearing
4	90515063PT	2		Ring Gear
5	91216105	2		Pin
6	90404040PT	2		Planetary Gear Cage
7	93030833PT	1	2	Pinion Gear
8	93030993PT	6	12	Planetary Gear
9	90405005	6	12	Planetary Gear Needle Bearing
10	91216103	6	12	Planetary Gear Pin
11	94234135	3	6	Screw
12	90000052PT	1		Coupling
13	634577PT	1		Adapter
14	90835939PT	1		Gear Spacer
15	634345PT	1	2	Screw
16	634576PT	1		Gear Housing
17	91815045	8	24	O-Ring
18	634339PT	1		Pin

(#) Quantity
(X) Recommended Spare Parts (quantity shown based on 1-5 tools in operation)
(T) Teeth

Double Stage Gearing

Illustration 16: 642413PT (13.5 ratio) Double Stage Gearing Assembly



Double Stage Gearing

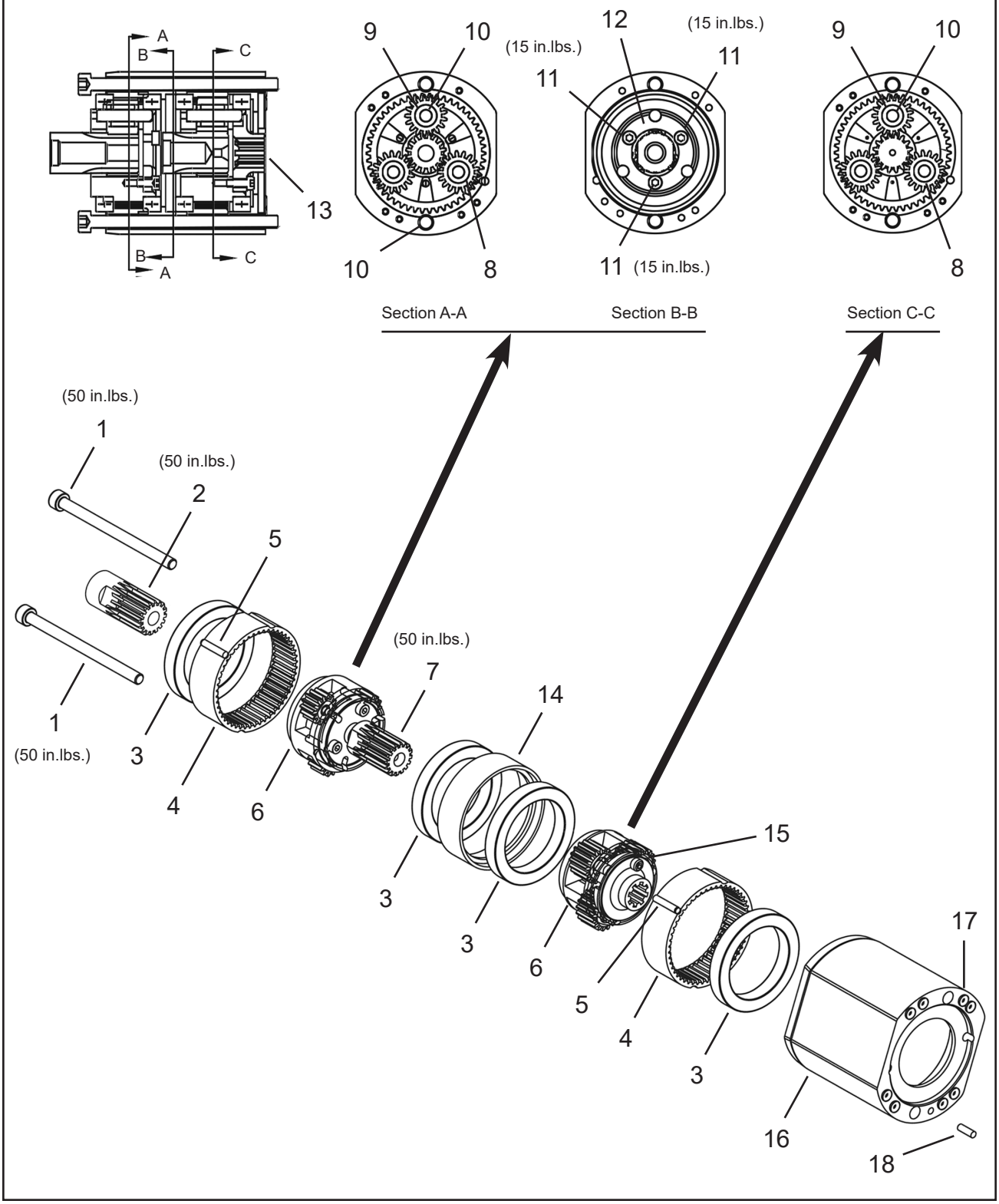
Illustration "16" - 642413PT Gearing

Ref	Number	#	X	EN Description
1	94234297PT	2		Socket Head Cap Screw (M5 x 75mm)
2	634662PT	1	2	Pinion Gear
3	93450775	4	8	Ball Bearing
4	90515063PT	2		Ring Gear
5	91216105	2		Pin
6	90404040PT	1		Planetary Gear Cage
7	93030828PT	1	2	Pinion Gear
8	93030993PT	3	6	Planetary Gear (14T)
9	90405005	3	6	Planetary Gear Needle Bearing
10	91216103	6	12	Planetary Gear Pin
11	94234135	3	6	Screw
12	90000052PT	1		Coupling
13	634577PT	1		Adapter
14	90835939PT	1		Gear Spacer
15	90404036PT	1		Planetary Gear Cage
16	634345PT	1	2	Screw
17	633789PT	3	6	Planetary Gear (includes Ref. 18)
18	844774	3	6	Planetary Gear Needle Bearing
19	202075PT	3	6	Planetary Gear Pin
20	634576PT	1		Gear Housing
21	91815045	8	24	O-Ring
22	634339PT	1		Pin

(#) Quantity
(X) Recommended Spare Parts (quantity shown based on 1-5 tools in operation)
(T) Teeth

Double Stage Gearing

Illustration 17: 642414PT (17.0 ratio) Double Stage Gearing Assembly



Double Stage Gearing

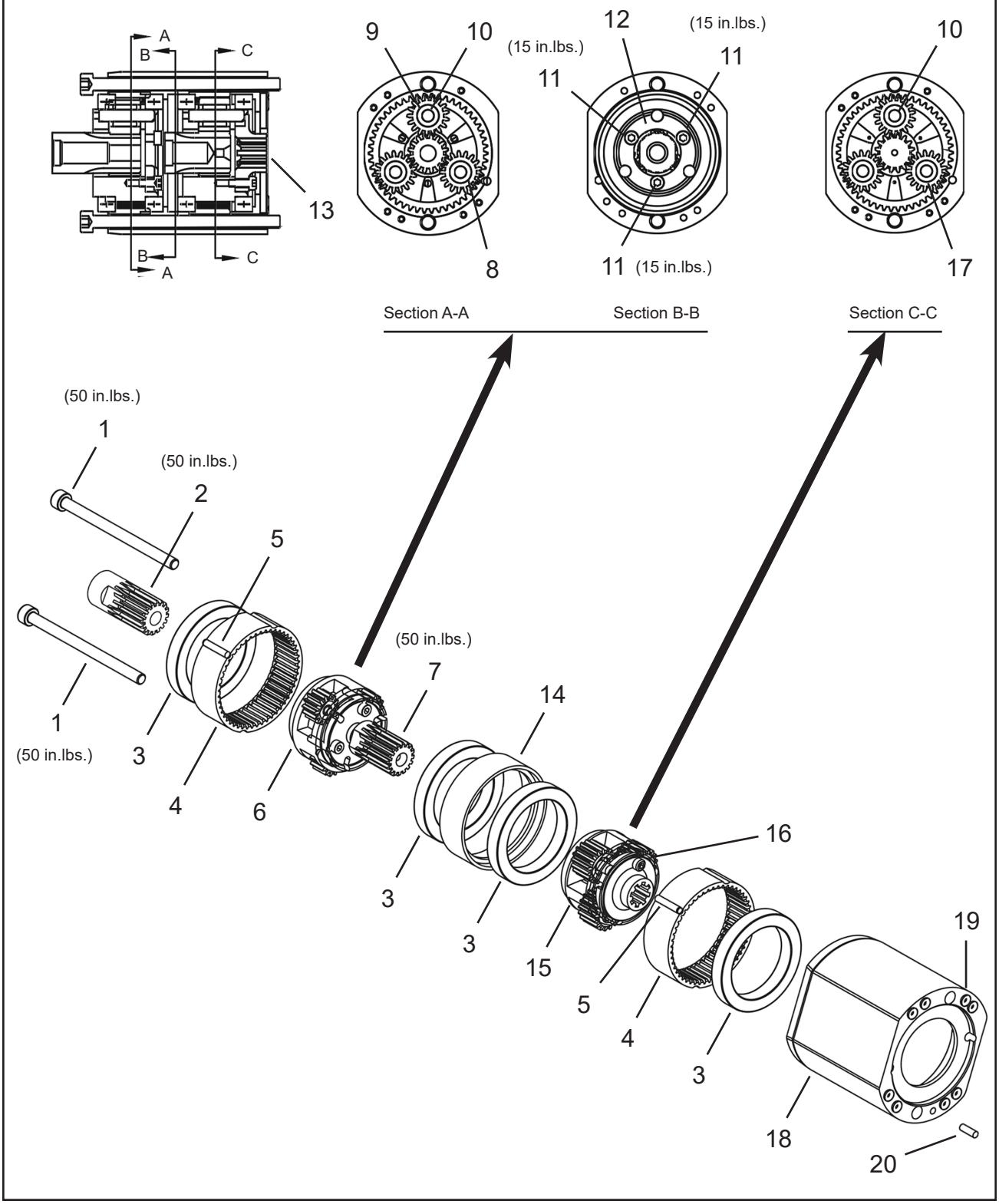
Illustration "17" - 642414PT Gearing

Ref	Number	#	X	EN Description
1	94234297PT	2		Socket Head Cap Screw (M5 x 75mm)
2	634663PT	1	2	Pinion Gear
3	93450775	4	8	Ball Bearing
4	90515063PT	2		Ring Gear
5	91216105	2		Pin
6	90404036PT	2		Planetary Gear Cage
7	93030828PT	1	2	Pinion Gear
8	633789PT	6	12	Planetary Gear (includes Ref. 9)
9	844774	6	12	Planetary Gear Needle Bearing
10	202075PT	6	12	Planetary Gear Pin
11	94234135	3	6	Screw
12	90000050PT	1		Coupling
13	634577PT	1		Adapter
14	90835939PT	1		Gear Spacer
15	634345PT	1	2	Screw
16	634576PT	1		Gear Housing
17	91815045	8	24	O-Ring
18	634339PT	1		Pin

(#) Quantity
(X) Recommended Spare Parts (quantity shown based on 1-5 tools in operation)
(T) Teeth

Double Stage Gearing

Illustration 18: 642415PT (24.8 ratio) Double Stage Gearing Assembly



Double Stage Gearing

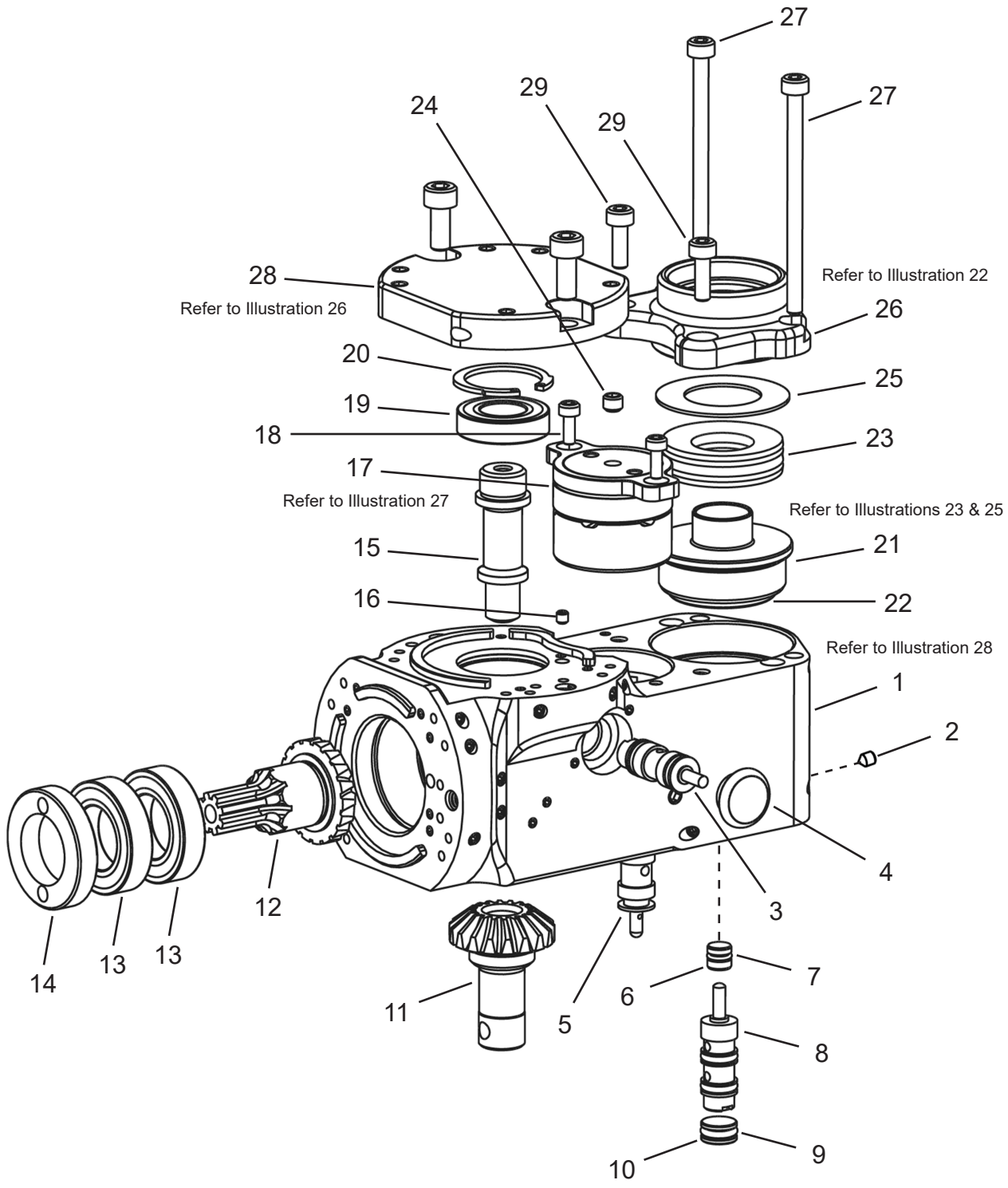
Illustration "18" - 642415PT Gearing

Ref	Number	#	X	EN Description
1	94234297PT	2		Socket Head Cap Screw (M5 x 75mm)
2	634663PT	1	2	Pinion Gear
3	93450775	4	8	Ball Bearing
4	90515063PT	2		Ring Gear
5	91216105	2		Pin
6	90404036PT	1		Planetary Gear Cage
7	93030826PT	1	2	Pinion Gear
8	633789PT	3	6	Planetary Gear (includes Ref. 9)
9	844774	3	6	Planetary Gear Needle Bearing
10	202075PT	6	12	Planetary Gear Pin
11	94234135	3	6	Screw
12	90000056PT	1		Coupling
13	634577PT	1		Adapter
14	90835939PT	1		Gear Spacer
15	90404038PT	1		Planetary Gear Cage
16	634345PT	1	2	Screw
17	93030982PT	3	6	Planetary Gear
18	634576PT	1		Gear Housing
19	91815045	8	24	O-Ring
20	634339PT	1		Pin

(#) Quantity
(X) Recommended Spare Parts (quantity shown based on 1-5 tools in operation)
(T) Teeth

Gear Head Assembly - Right Angle

Illustration 19A: Right Angle Gear Head Assembly



Gear Head Assembly - Right Angle

Illustration "19A" - Right Angle Gear Head Assembly

Ref	Number	#	X	EN Description
1	642379PT	1		Primary Housing (Refer to Illustration "28")
2	634399PT	1		Set Screw
3	1110715	1		Valve (2-Way)
4	537140	1	1	Start Button
5	531226	1		Valve (3-Way)
6	634602PT	1		Clippard Piston
7	91815104	1	3	O-Ring
8	634628PT	1		Valve (Mavo-3C)
9	844305	1	3	O-Ring
10	634620PT	1		Valve Plug
--	642389PT	1		Right Angle Gearing Assembly (includes Ref. 11-15)
11	634512PT	1		Spiral Bevel Gear
12	634511PT	1		Spiral Bevel Pinion Gear
13	634556PT	2	4	Ball Bearing
14	634600PT	1		Bearing Clamp Nut
15	634623PT	1		Bevel Gear Shaft
16	634323PT	1		Set Screw
17	642392PT	1		Clutch Assembly (Refer to Illustration "27")
18	634345PT	2		Screw (Clutch Assembly)
19	634557PT	1	2	Ball Bearing
20	634627PT	1	2	Retaining Ring (Internal)
21	642391PT	1		Spindle Thrust Kit - Non-MITIS (Refer to Illustration "25")
	642390PT	1		Spindle Thrust Kit - MITIS (Refer to Illustration "23")
22	Table "19A"	1		MITIS Cam Kit
23	634539PT	4	4	Belleville Spring Washers
24	634534PT	1		Set Screw
25	634563PT	1		Belleville Wear Spacer
26	642396PT	1		Thrust Pack Cap Assembly (Refer to Illustration "22")
27	542940-50	2		Screw (Thrust Pack Cap)
28	642407PT	1		Gear Head Cover (Refer to Illustration "26")
29	542940-48	2		Screw (Thrust Pack Cap)
30	642557PT	1		Output Bevel Gear Shim Kit (includes the following shims) (not shown)
	634919PT-001	2		Shim (.001")
	634919PT-003	1		Shim (.003")
	634919PT-005	1		Shim (.005")
	634919PT-007	1		Shim (.007")
	634919PT-009	1		Shim (.009")
	634919PT-010	1		Shim (.010")
31	642558PT	1		Input Bevel Gear Shim Kit (includes the following shims) (not shown)
	634920PT-001	2		Shim (.001")
	634920PT-003	1		Shim (.003")
	634920PT-005	1		Shim (.005")
	634920PT-007	1		Shim (.007")

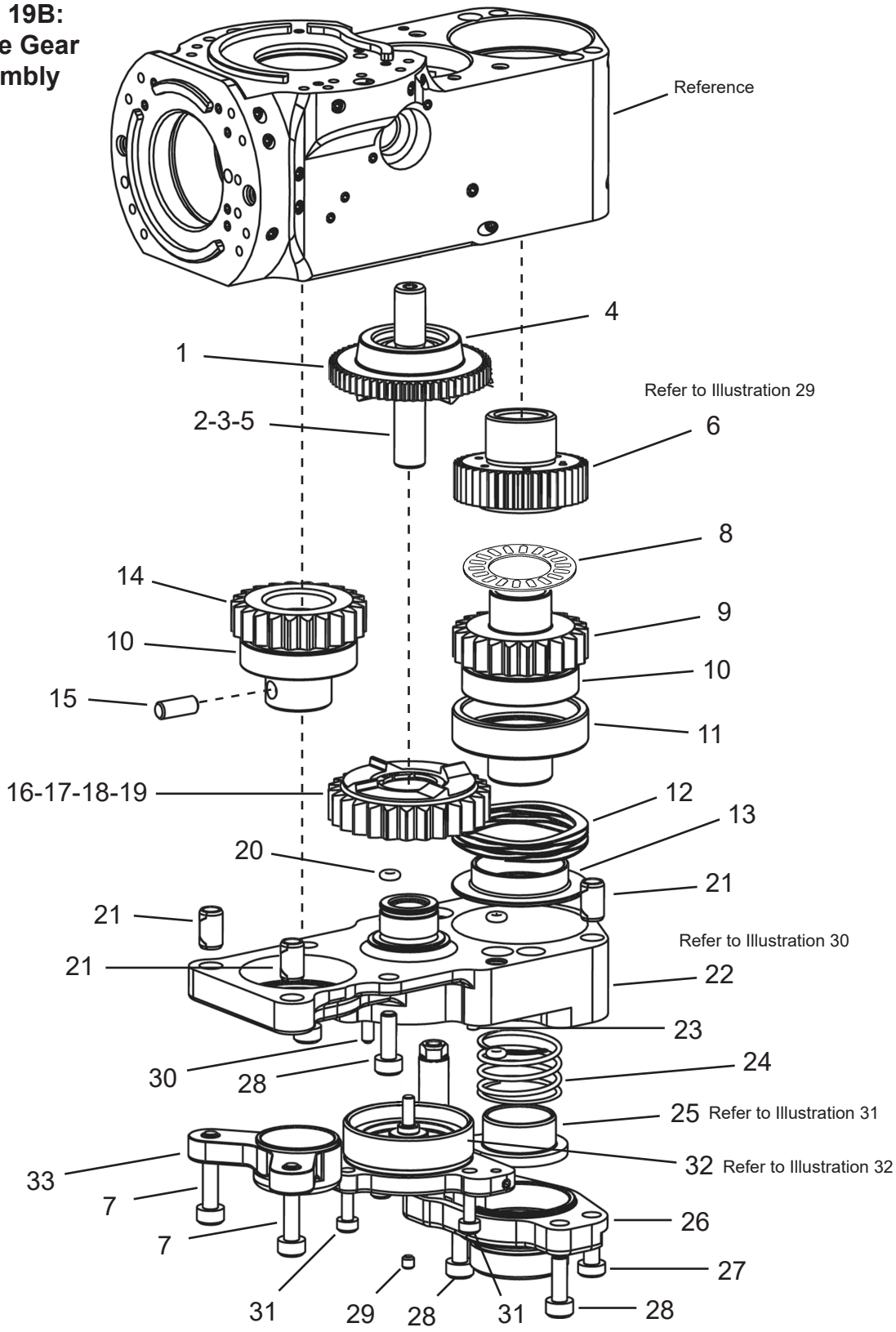
(#) Quantity
(X) Recommended Spare Parts (quantity shown based on 1-5 tools in operation)

Table "19A"

MITIS Cam Kits		
3 Roller Cam	5 Roller Cam	Cam Amplitude
92050240PT	92050246PT	0.10
92050241PT	92050247PT	0.15
92050242PT	92050248PT	0.20
92050243PT	92050249PT	0.25
92050244PT	92050250PT	0.30
92050245PT	92050251PT	0.35

Gear Head Assembly - Right Angle

Illustration 19B: Right Angle Gear Head Assembly



Gear Head Assembly - Right Angle

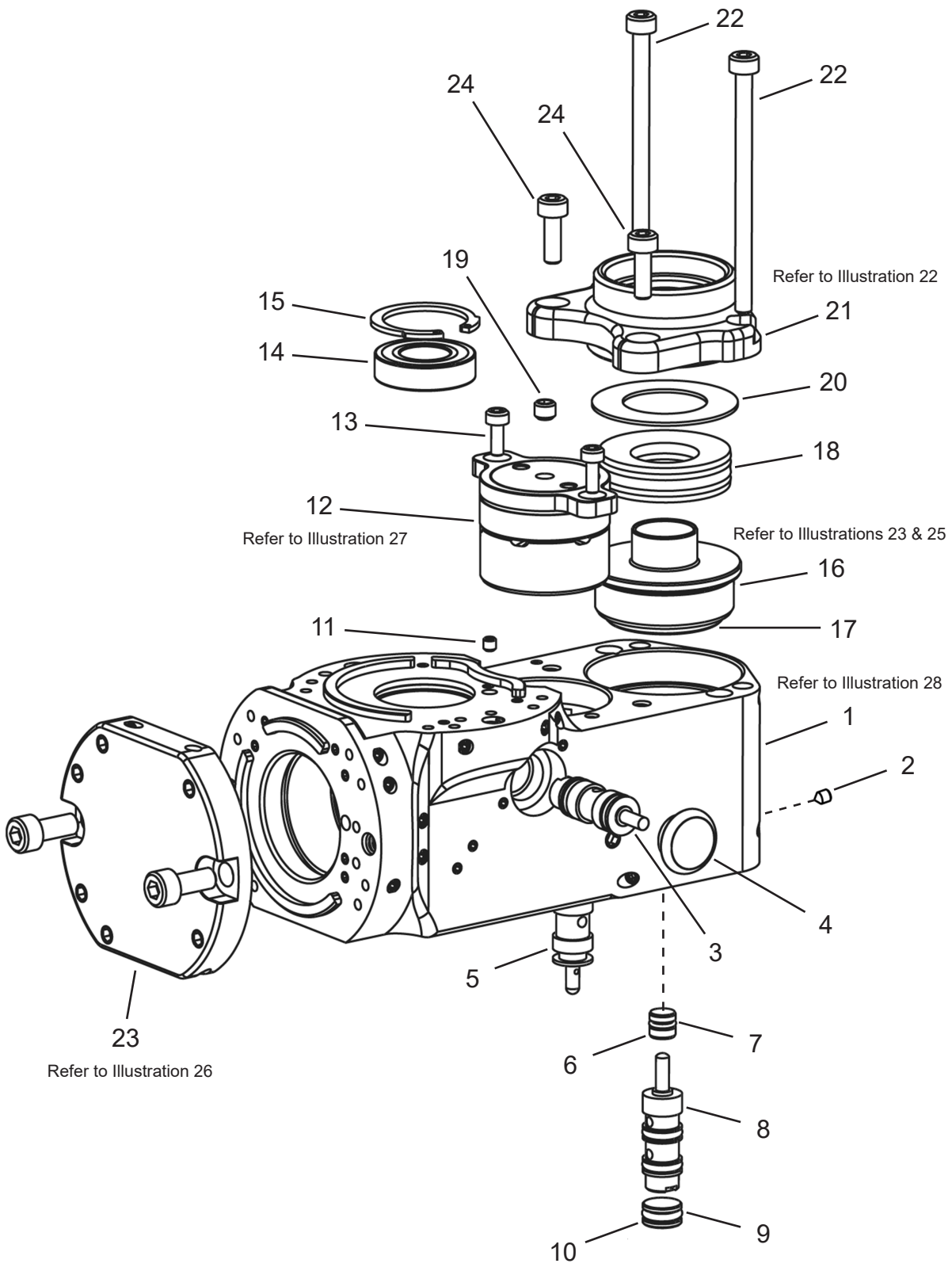
Illustration "19B" - Right Angle Gear Head Assembly

Ref	Number	#	X	EN Description
1	634884PT	1		Differential Feed Gear
2	634887PT	1		Differential Feed Gear Shaft
3	634885PT	1		Lock Nut
4	634554PT	1	2	Ball Bearing
5	634886PT	1		Differential Shaft Nut
6	642395PT-XX	1		Spindle Feed Gear (Refer to Illustration "29")
7	542940-49	2		Screw (Shear Pin Cover)
8	634565PT	1	2	Needle Bearing
9	634590PT	1		Spindle Drive Gear
10	634556PT	2	4	Ball Bearing
11	634605PT	1		Front Stop Guide Spacer
12	634536PT	1		Wave Spring
13	634604PT	1		Spindle Lift Ring
14	634592PT	1		Input Drive Gear
15	634613PT	1		Shear Pin (17.0mm x 4.47mm)
	634614PT	1		Shear Pin (11.5mm x 4.47mm)
16	634864PT	1		Intermediate Drive Gear
17	634888PT	1		Intermediate Drive Gear Nut
18	634555PT	1	2	Ball Bearing
19	634548PT	1	2	Snap Ring (Internal)
20	91815045	4	12	O-Ring
21	634532PT	4		Pin
22	642545PT	1		Secondary Housing (Refer to Illustration "30")
23	634339PT	1		Pin
24	634538PT	1	3	Spring
25	642394PT	1		Shut Off Arm Assembly (Refer to Illustration "31")
26	634610PT	1		Spindle Nose Adapter
27	542940-47	2		Screw (Spindle Nose Adapter)
28	542940-48	4		Screw (Spindle Nose Adapter and Secondary Housing)
29	634323PT	1		Set Screw
30	634340PT	1		Pin
31	94234150	3		Screw (Differential Piston Housing)
32	642533PT	1		Differential Piston Housing (Refer to Illustration "32")
33	634599PT	1		Shear Pin Cover

(#) Quantity
(X) Recommended Spare Parts (quantity shown based on 1-5 tools in operation)

Gear Head Assembly - Inline

Illustration 20A: Inline Gear Head Assembly



Gear Head Assembly - Inline

Illustration "20A" - Inline Gear Head Assembly

Ref	Number	#	X	EN Description
1	642379PT	1		Primary Housing (Refer to Illustration "28")
2	634399PT	1		Set Screw
3	1110715	1		Valve (2-Way)
4	537140	1	1	Start Button
5	531226	1		Valve (3-Way)
6	634602PT	1		Clippard Piston
7	91815104	1	3	O-Ring
8	634628PT	1		Valve (Mavo-3C)
9	844305	1	3	O-Ring
10	634620PT	1		Valve Plug
11	634323PT	1		Set Screw
12	642392PT	1		Clutch Assembly (Refer to Illustration "27")
13	634345PT	2		Screw (Clutch Assembly)
14	634557PT	1	2	Ball Bearing
15	634627PT	1	2	Retaining Ring (Internal)
16	642391PT	1		Spindle Thrust Kit - Non-MITIS (Refer to Illustration "25")
	642390PT	1		Spindle Thrust Kit - MITIS (Refer to Illustration "23")
17	Table "20A"	1		MITIS Cam Kit
18	634539PT	4	4	Belleville Spring Washers
19	634534PT	1		Set Screw
20	634563PT	1		Belleville Wear Spacer
21	642396PT	1		Thrust Pack Cap Assembly (Refer to Illustration "22")
22	542940-50	2		Screw (Thrust Pack Cap)
23	642407PT	1		Gear Head Cover (Refer to Illustration "26")
24	542940-48	2		Screw (Thrust Pack Cap)

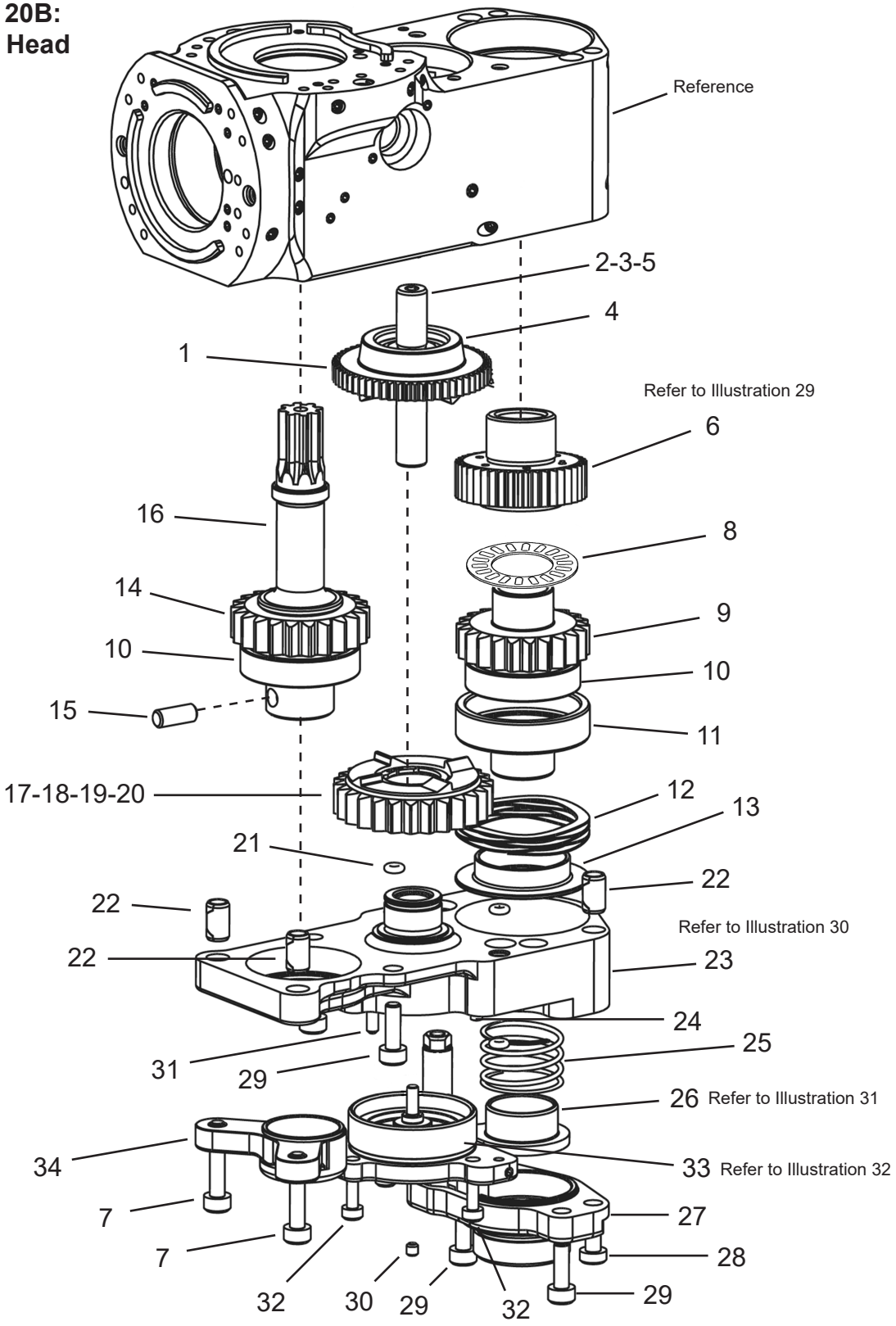
(#) Quantity
(X) Recommended Spare Parts (quantity shown based on 1-5 tools in operation)

Table "20A"

MITIS Cam Kits		
3 Roller Cam	5 Roller Cam	Cam Amplitude
92050240PT	92050246PT	0.10
92050241PT	92050247PT	0.15
92050242PT	92050248PT	0.20
92050243PT	92050249PT	0.25
92050244PT	92050250PT	0.30
92050245PT	92050251PT	0.35

Gear Head Assembly - Inline

Illustration 20B: Inline Gear Head Assembly



Gear Head Assembly - Inline

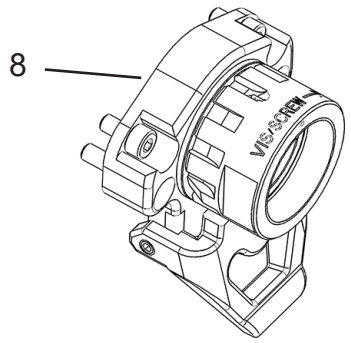
Illustration "20B" - Inline Gear Head Assembly

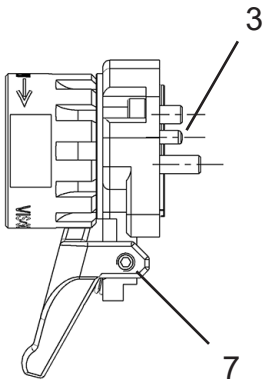
Ref	Number	#	X	EN Description
1	634884PT	1		Differential Feed Gear
2	634887PT	1		Differential Feed Gear Shaft
3	634885PT	1		Lock Nut
4	634554PT	1	2	Ball Bearing
5	634886PT	1		Differential Shaft Nut
6	642395PT-XX	1		Spindle Feed Gear (Refer to Illustration "29")
7	542940-49	2		Screw (Shear Pin Cover)
8	634565PT	1	2	Needle Bearing
9	634590PT	1		Spindle Drive Gear
10	634556PT	2	4	Ball Bearing
11	634605PT	1		Front Stop Guide Spacer
12	634536PT	1		Wave Spring
13	634604PT	1		Spindle Lift Ring
14	634592PT	1		Input Drive Gear
15	634613PT	1		Shear Pin (17.0mm x 4.47mm)
	634614PT	1		Shear Pin (11.5mm x 4.47mm)
16	634510PT	1		Inline Drive Shaft
17	634867PT	1		Intermediate Drive Gear
18	634888PT	1		Intermediate Drive Gear Nut
19	634555PT	1	2	Ball Bearing
20	634548PT	1	2	Snap Ring (Internal)
21	91815045	4	12	O-Ring
22	634532PT	4		Pin
23	642545PT	1		Secondary Housing (Refer to Illustration "30")
24	634339PT	2		Pin
25	634538PT	1	3	Spring
26	642394PT	1		Shut Off Arm Assembly (Refer to Illustration "31")
27	634610PT	1		Spindle Nose Adapter
28	542940-47	2		Screw (Spindle Nose Adapter)
29	542940-48	4		Screw (Spindle Nose Adapter and Secondary Housing)
30	634323PT	1		Set Screw
31	634340PT	1		Pin
32	94234150	3		Screw (Differential Piston Housing)
33	642533PT	1		Differential Piston Housing (Refer to Illustration "32")
34	634599PT	1		Shear Pin Cover

(#) Quantity
(X) Recommended Spare Parts (quantity shown based on 1-5 tools in operation)

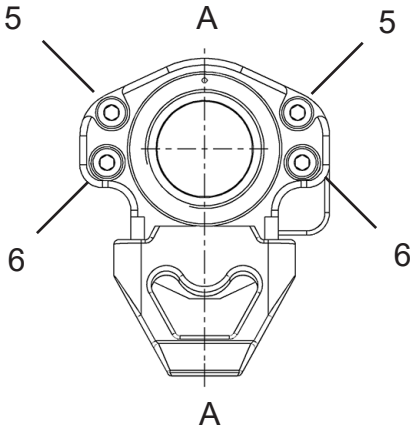
Gear Head Assembly - Inline

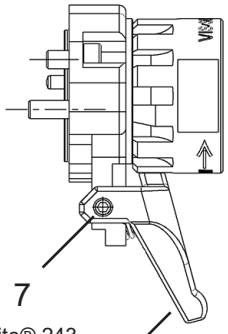
Illustration 21: 22008919PT Indexer Assembly



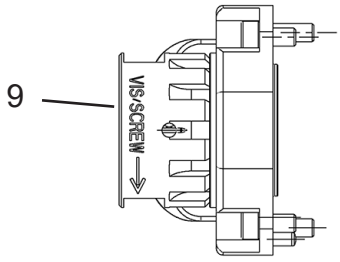


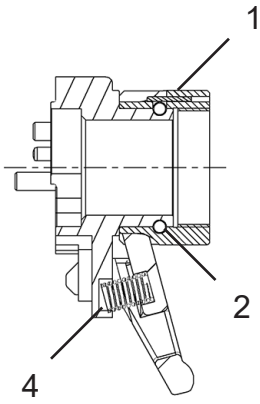
Loctite® 243





Loctite® 243





Use a center punch on the axis of the pin after assembly.

Section A-A

Gear Head Assembly - Inline

Illustration "21" - 22008919PT Indexer Assembly

Ref	Number	#	X	EN Description
1	90010015	1	2	Pin
2	90245140	27	27	Steel Ball
3	91216095	1		Cylinder Pin
4	93430115	1	3	Spring
5	94234180	2		Screw (M4 x 8)
6	94234190	2		Screw (M4 x 12)
7	94235933	2		Screw (M4 x 8)
8	90005912PT	1		Adapter
9	90830934PT	1		Nose End Cap
10	92205928PT	1		Lever

(#) Quantity
(X) Recommended Spare Parts (quantity shown based on 1-5 tools in operation)

Thrust Cap Pack & Spindle Thrust Kit

Illustration 22: 642396PT Thrust Pack Cap Assembly

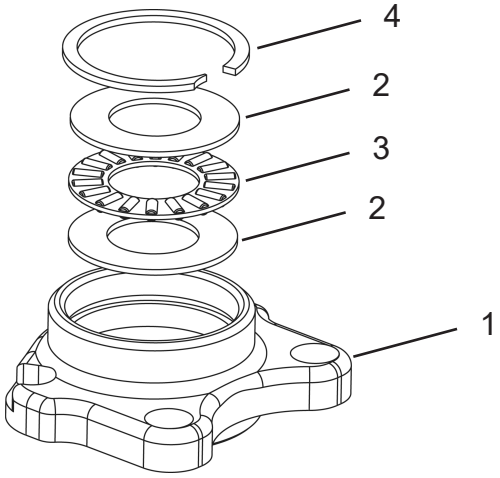


Illustration 23: 642390PT Spindle Thrust Kit (MITIS)

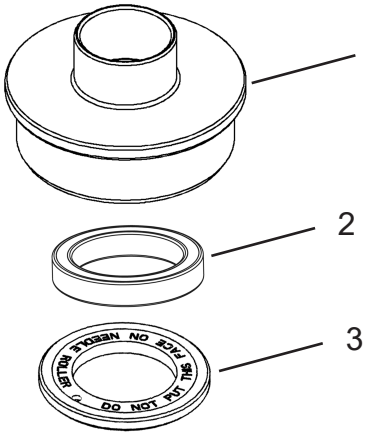
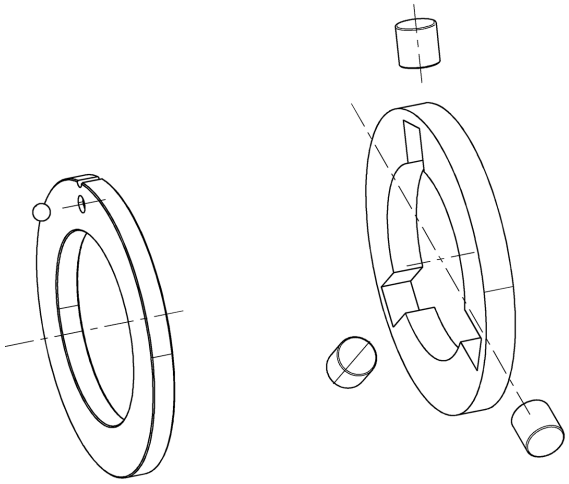


Illustration 24: MITIS Kit



Thrust Cap Pack & Spindle Thrust Kit

Illustration "22" - 642396PT Thrust Pack Cap Assembly

Ref	Number	#	X	EN Description
1	634603PT	1		Rear Cap
2	634561PT	2		Back Stop Bearing Washer
3	634562PT	1	2	Needle Bearing
4	634549PT	1	1	Snap Ring

(#) Quantity
(X) Recommended Spare Parts (quantity shown based on 1-5 tools in operation)

Illustration "23" - 642390PT Spindle Thrust Kit - MITIS

Ref	Number	#	X	EN Description
1	634755PT	1		Spindle Thrust Cap
2	634756PT	1	2	Ball Bearing
3	634619PT	1		Feed Gear Spacdr

(#) Quantity
(X) Recommended Spare Parts (quantity shown based on 1-5 tools in operation)

Mitis Kits	Description	Frequency	Amplitude/mm
92050245PT	KIT MITIS CAME 3 / 0,35 /	1.5/spindle feed rev	0.35
92050244PT	KIT MITIS CAME 3 / 0,30 /	1.5/spindle feed rev	0.3
92050243PT	KIT MITIS CAME 3 / 0,25 /	1.5/spindle feed rev	0.25
92050242PT	KIT MITIS CAME 3 / 0,20 /	1.5/spindle feed rev	0.2
92050241PT	KIT MITIS CAME 3 / 0,15 /	1.5/spindle feed rev	0.15
92050240PT	KIT MITIS CAME 3 / 0,10 /	1.5/spindle feed rev	0.1
92050251PT	KIT MITIS CAME 5 / 0,35 /	2.5/spindle feed rev	0.35
92050250PT	KIT MITIS CAME 5 / 0,30 /	2.5/spindle feed rev	0.3
92050249PT	KIT MITIS CAME 5 / 0,25 /	2.5/spindle feed rev	0.25
92050248PT	KIT MITIS CAME 5 / 0,20 /	2.5/spindle feed rev	0.2
92050247PT	KIT MITIS CAME 5 / 0,15 /	2.5/spindle feed rev	0.15
92050246PT	KIT MITIS CAME 5 / 0,10 /	2.5/spindle feed rev	0.1

Thrust Cap Pack & Spindle Thrust Kit

Illustration 25: 642391PT Spindle Thrust Kit (Non-MITIS)

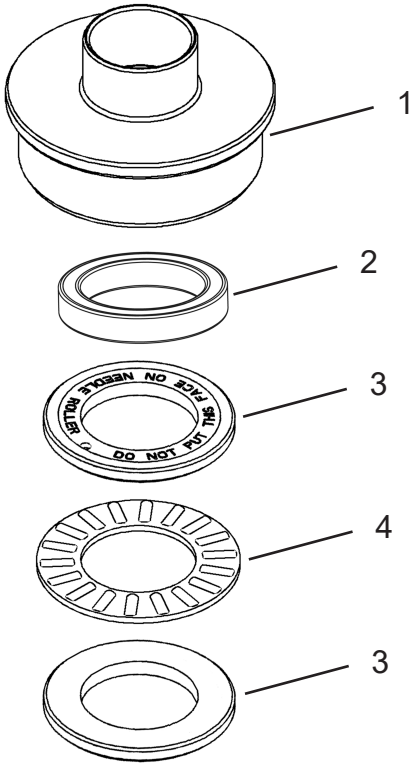
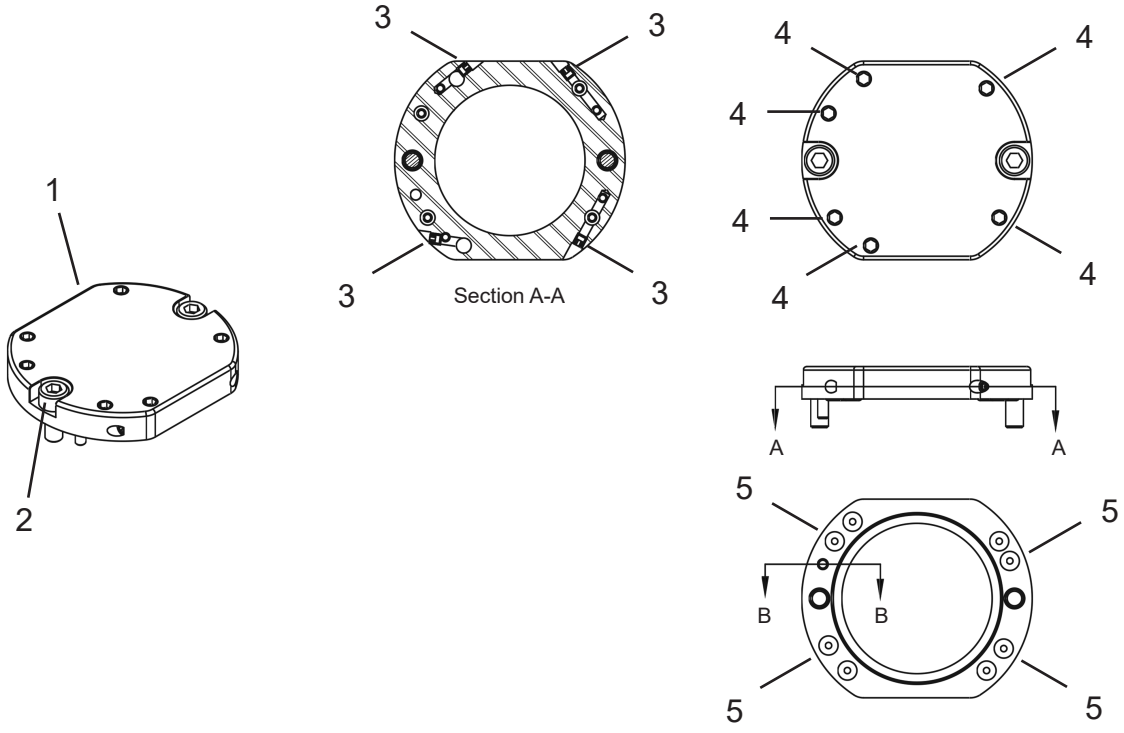


Illustration 26: 642407PT Gear Head Cover Assembly (Non-MITIS)



Thrust Cap Pack & Spindle Thrust Kit

Illustration "25" - 642391PT Spindle Thrust Kit - Non-MITIS

Ref	Number	#	X	EN Description
1	634596PT	1		Spindle Thrust Cap
2	634558PT	1	2	Ball Bearing
3	634617PT	2		Spindle Feed Gear Spacer
4	634564PT	1	2	Needle Bearing

(#) Quantity
(X) Recommended Spare Parts (quantity shown based on 1-5 tools in operation)

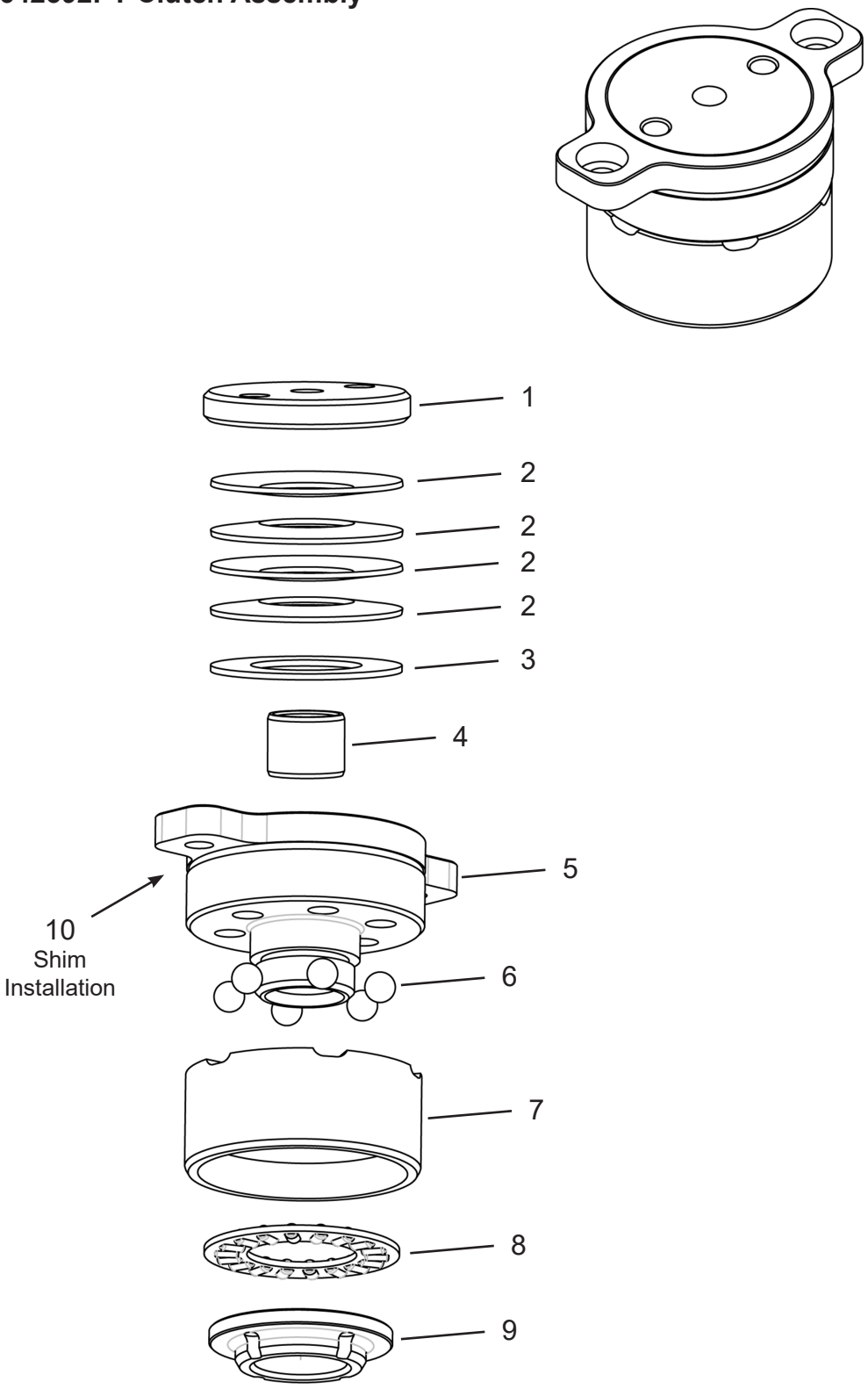
Illustration "26" - 642407PT Gear Head Cover Assembly

Ref	Number	#	X	EN Description
1	634574PT	1		Gear Head Cover
2	542940-51	2		Screw
3	634323PT	4		Set Screw
4	634534PT	6		Set Screw
5	91815045	8	24	O-Ring

(#) Quantity
(X) Recommended Spare Parts (quantity shown based on 1-5 tools in operation)

Clutch Assembly

Illustration 27: 642392PT Clutch Assembly



Clutch Assembly

Illustration "27" - 642392PT Clutch Assembly

Ref	Number	#	X	EN Description
1	634598PT	1		Clutch Ball Spring Nut
2	634542PT	4	4	Belleville Spring Washer
3	634560PT	1		Belleville Wear Spacer
4	634552PT	1	2	Bushing
5	634594PT	1		Ball Clutch Housing
6	842274	6	12	Steel Ball
7	634597PT	1		Ball Clutch Cup
8	634559PT	1	2	Needle Bearing
9	634606PT	1		Ball Clutch Nut
10	642559PT	1		Clutch Shim Kit (includes the following shims) (not shown)
	634922PT-05	2		Shim (0.5mm) - see Table "25"
	634922PT-10	2		Shim (1.0mm) - see Table "25"
	634922PT-15	2		Shim (1.5mm) - see Table "25"
	634922PT-20	2		Shim (2.0mm) - see Table "25"

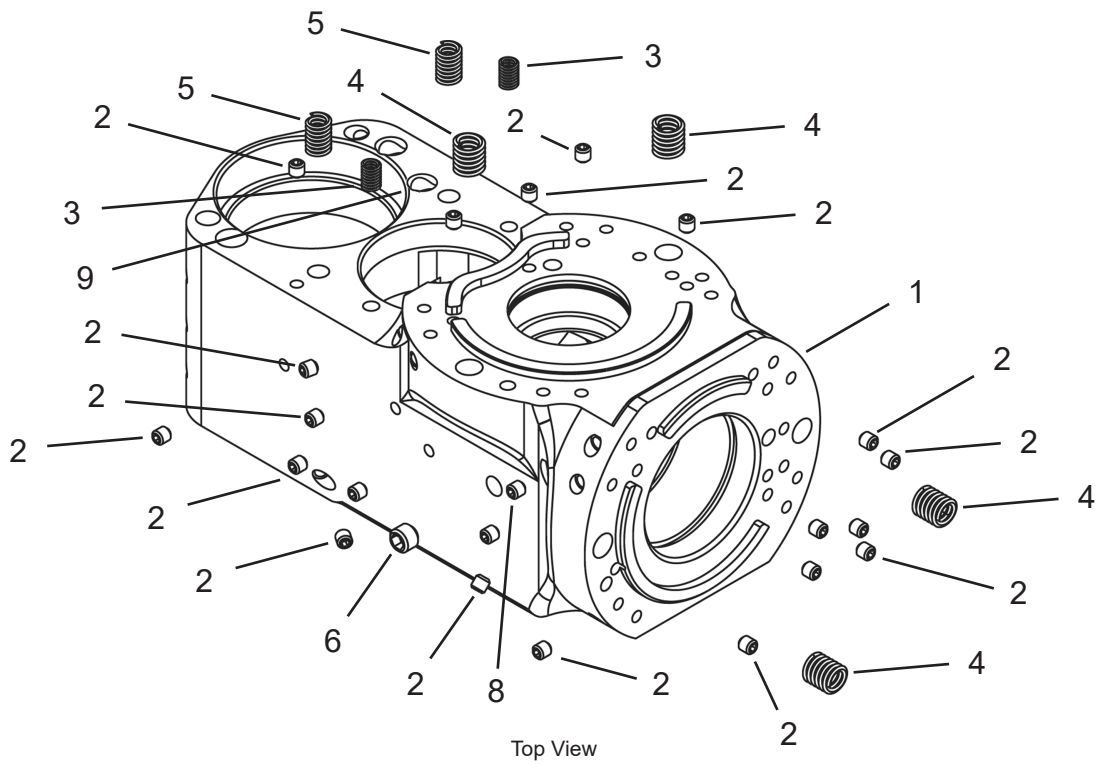
(#) Quantity
(X) Recommended Spare Parts (quantity shown based on 1-5 tools in operation)

Table "27"

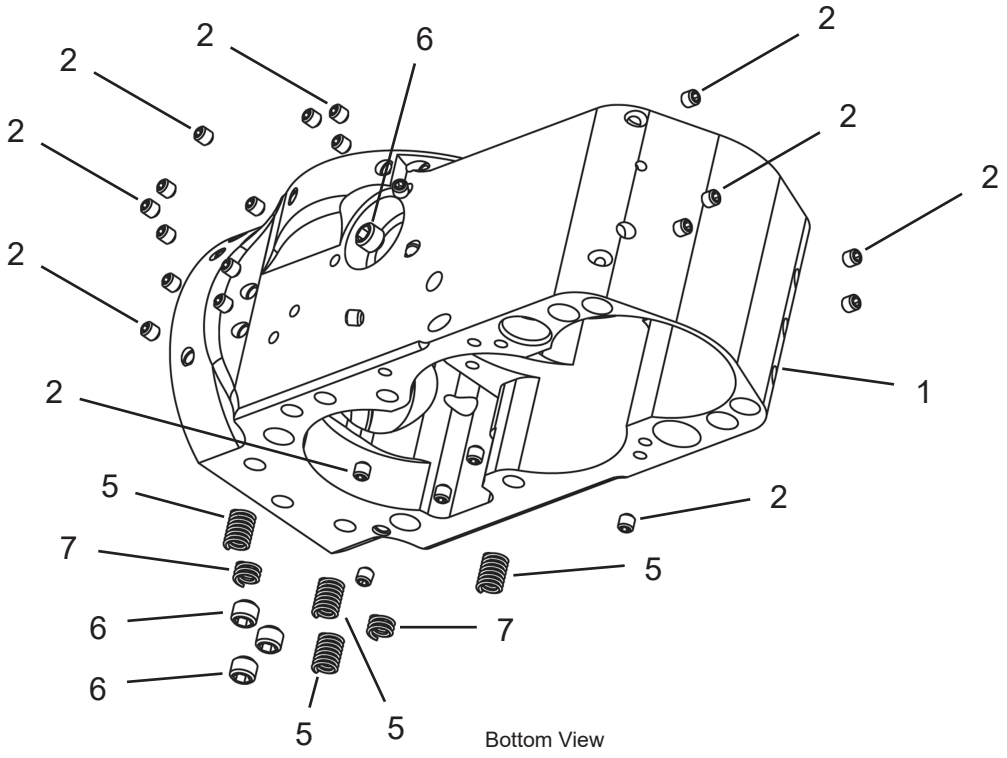
Clutch Shimming Guide			
Measured Dimension		Shim Thickness	Shim To Use
Up To	Including		
2.6	2.11	None	None
2.1	1.61	0.5	634922PT-05
1.6	1.11	1.0	634922PT-10
1.1	0.61	1.5	634922PT-15
0.6	0.11	2.0	634922PT-20

Primary Housing Assembly

Illustration 28: 642379PT Primary Housing Assembly



Top View



Bottom View

Primary Housing Assembly

Illustration "28" - 642379PT Primary Housing Assembly

Ref	Number	#	X	EN Description
1	634506PT	1		Primary Housing
2	634323PT	46	10	Set Screw
3	634326PT	2		Heli-Coil (M3 x 6mm)
4	634327PT	4		Heli-Coil (M5 x 7mm)
5	634325PT	6		Heli-Coil (M4 x 8mm)
6	634534PT	5	5	Set Screw
7	634608PT	2		Heli-Coil (M4 x 4mm)
8	634829PT	1	2	Set Screw
9	634927PT	1		Pin

(#) Quantity
(X) Recommended Spare Parts (quantity shown based on 1-5 tools in operation)

Spindle Feed Gear & Secondary Housing

Illustration 29: 642395PT-XX-XX Spindle Feed Gear Assembly

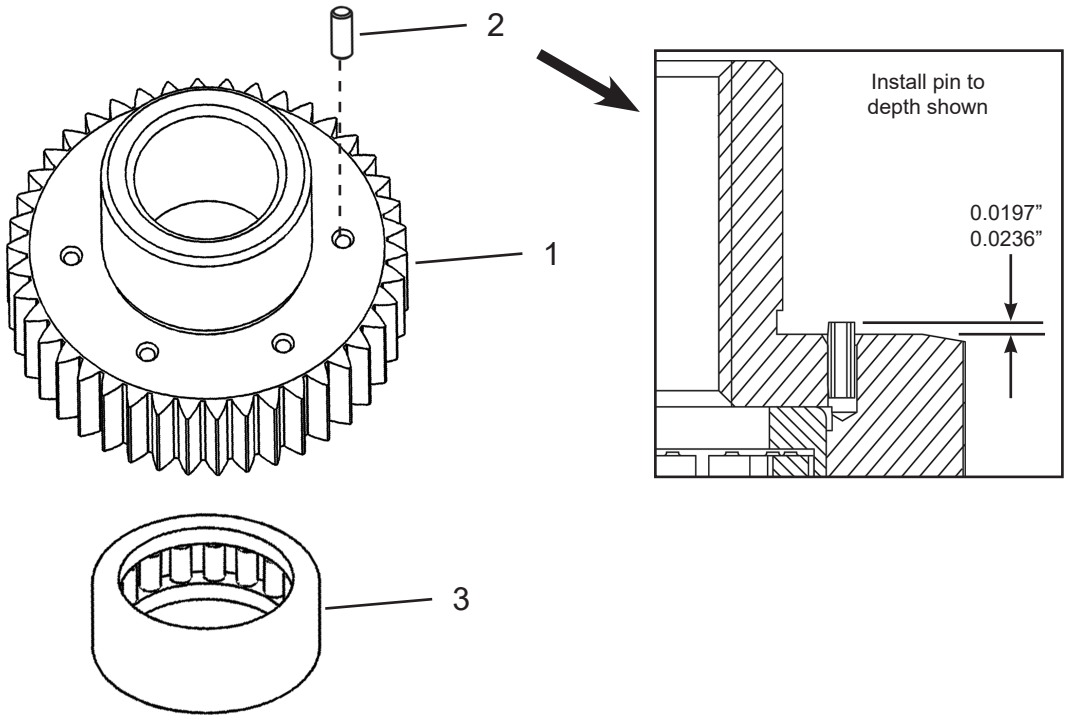
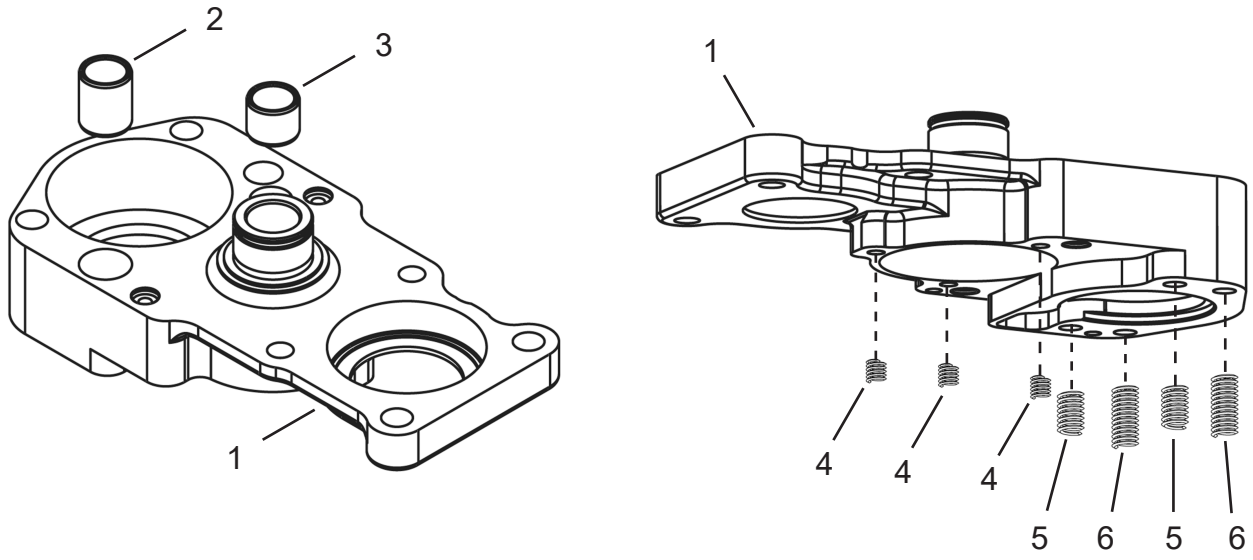


Illustration 30: 642545PT Secondary Housing Assembly



Top View

Bottom View

Spindle Feed Gear & Secondary Housing

Illustration "29" - 642395PT-XX Spindle Feed Gear Assembly

Ref	Number	#	X	EN Description
1	642395PT-10-03	1		Spindle Feed Gear (Feed Rate: ipr = 0.001, mm/rev = 0.03)
	642395PT-20-03	1		Spindle Feed Gear (Feed Rate: ipr = 0.002, mm/rev = 0.05)
	642395PT-30-03	1		Spindle Feed Gear (Feed Rate: ipr = 0.003, mm/rev = 0.08)
	642395PT-40-03	1		Spindle Feed Gear (Feed Rate: ipr = 0.004, mm/rev = 0.10)
	642395PT-60-03	1		Spindle Feed Gear (Feed Rate: ipr = 0.006, mm/rev = 0.15)
	642395PT-70-03	1		Spindle Feed Gear (Feed Rate: ipr = 0.007, mm/rev = 0.18)
	642395PT-80-03	1		Spindle Feed Gear (Feed Rate: ipr = 0.008, mm/rev = 0.20)
2	634668PT	1	2	Roll Pin
3	634535PT	1	2	Needle Bearing

(#) Quantity
(X) Recommended Spare Parts (quantity shown based on 1-5 tools in operation)

Illustration "30" - 642545PT Secondary Housing Assembly

Ref	Number	#	X	EN Description
1	634889PT	1		Secondary Housing
2	634553PT	1		Bushing
3	634552PT	1		Bushing
4	634652PT	3		Heli-Coil (M3 x 4.5mm)
5	634325PT	2		Heli-Coil (M4 x 8mm)
6	634651PT	2		Heli-Coil (M4 x 12mm)

(#) Quantity
(X) Recommended Spare Parts (quantity shown based on 1-5 tools in operation)

Shutoff Arm & Differential Piston Housing

Illustration 31: 642394PT Shutoff Arm Assembly

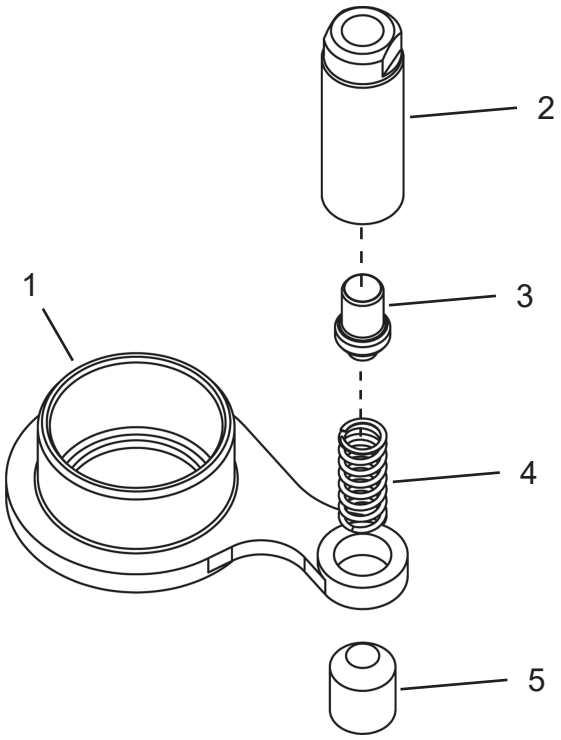
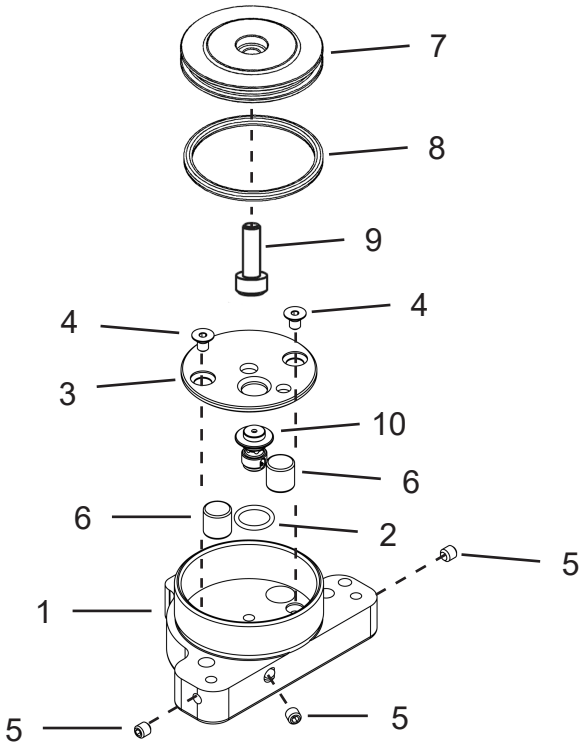


Illustration 32: 642533PT Differential Piston Housing Assembly



Shutoff Arm & Differential Piston Housing

Illustration "31" - 642394PT Shutoff Arm Assembly

Ref	Number	#	X	EN Description
1	634618PT	1		Wing Plate
2	634616PT	1		Clippard Pushrod Guide
3	634615PT	1		Clippard Pushrod
4	634533PT	1	3	Spring
5	634531PT	1		Set Screw

(#) Quantity
(X) Recommended Spare Parts (quantity shown based on 1-5 tools in operation)

Illustration "32" - 642533PT Differential Piston Housing Assembly

Ref	Number	#	X	EN Description
1	634864PT	1		Differential Piston Housing
2	634895PT	1	3	O-Ring
3	634893PT	1		Magnet Pull Plate
4	634650PT	2		Screw
5	634323PT	3		Set Screw
6	633727PT	2		Magnet
7	642526PT	1		Differential Piston (includes Ref. 8-9)
8	634530PT	1	3	Quad Seal
9	542940-56	1		Screw
10	642541PT	1		Valve Assembly

(#) Quantity
(X) Recommended Spare Parts (quantity shown based on 1-5 tools in operation)

5 Assembly Instructions:

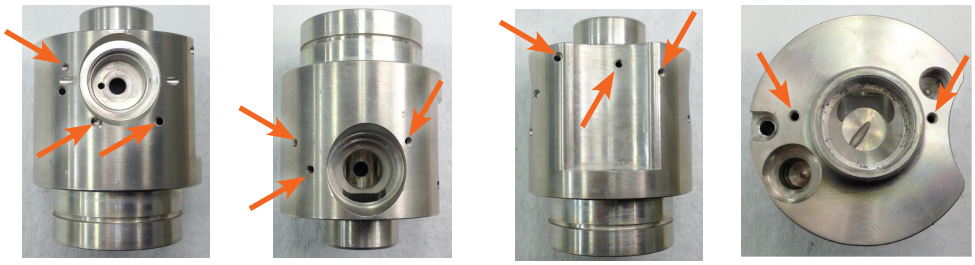
5.1 E-Valve Assembly: 642418PT (Turbine) and 642419PT (Rotary Vane)

The same safety body assembly (642420PT) is used in both the turbine and rotary vane versions.

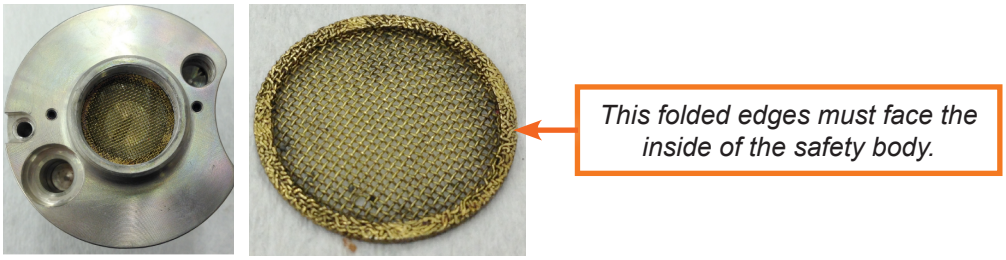
Refer to the following illustrations for detailed parts listing.

642418PT Turbine E-Valve Assembly: Illustration 3
642419PT Rotary Vane E-Valve Assembly: Illustration 4
642420PT Safety Body Assembly: Illustrations 5 and 6

1. Using a 1.5mm Allen key, assemble the eleven (11) set screws (634323PT) into the safety body (642421PT) as shown. Install each set screw just below flush with the outer surface.



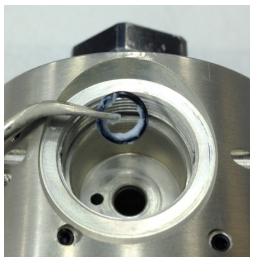
2. Install the screen (9380005) into the safety body. Make certain the folded edge of the screen is facing the interior of the safety body.



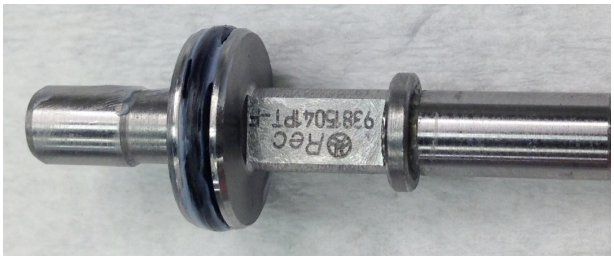
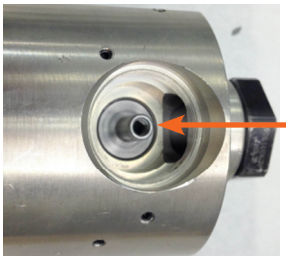
3. Apply O-Ring Lube to o-ring (847445) and assemble it onto the inlet adapter (90810863PT). Apply Loctite® 545 to the inlet adapter threads and install it into the safety body. Tighten the inlet adapter.



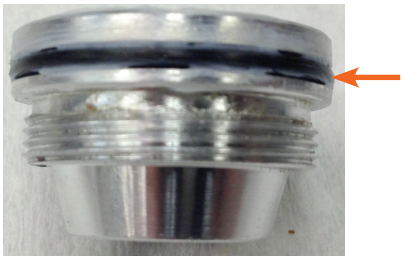
4. Apply O-Ring Lube to o-ring (91815155) and install it into the safety body. Make sure the o-ring is seated in the undercut of the safety body hole.



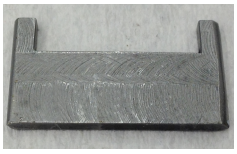
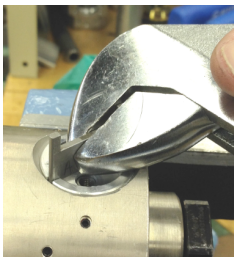
5. Apply O-Ring Lube to o-ring (91815351PT) and assemble it onto the slide valve (93815041PT). Install the slide valve into the safety body. Insert the slide valve into the safety body until it is flush with the surface of the hole.

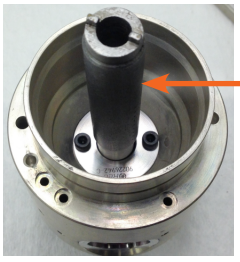
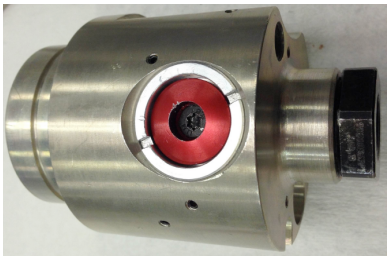
6. Apply O-Ring Lube to the small o-ring (91815155) and install it in the undercut of the hole inside the safety valve guide (90225692PT). Apply O-Ring Lube to the large o-ring (91815721PT) and assemble it into the o-ring groove on the outside diamteter of the safety valve guide.

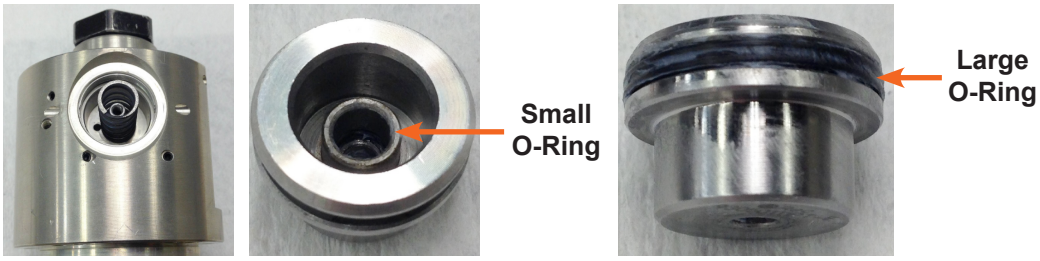
7. Thread the safety valve guide assembly into the safety body. Using assembly fixture (TF-634900), tighten the safety valve guide.


TF-634900



8. Install the emergency stop button (634640PT) into the safety valve guide. When assembled, the flat side of the button must face down, into the safety valve guide. Secure the button to the slide valve using a flat head screw (542940-25) with Loctite® 243. During installation of the screw, use assembly fixture (AT0740) and an Allan key to secure the slide valve while tightening the screw to 30 in. lbs. torque.


AT0740 Fixture


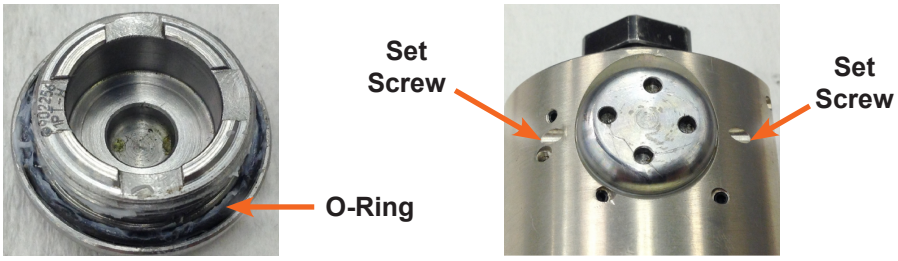
9. Place the compression spring (93430952PT) into the safety body over the open end of the slide valve. Apply O-Ring Lube to the small o-ring (91815104) and install it in the undercut of the hole in the center of the piston (93050111PT). Apply O-Ring Lube to the large o-ring (90231106) and assemble it into the o-ring groove on the outside diamteter of the piston.



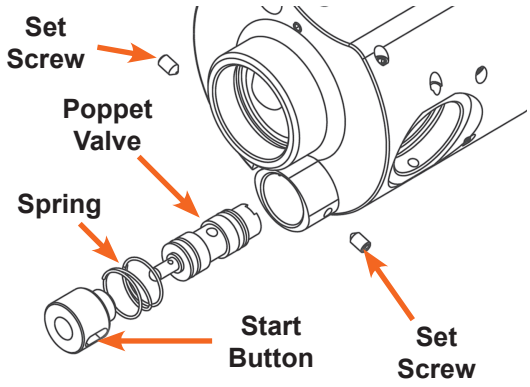
10. Install the piston assembly into the safety body and over the compression spring. Secure the piston to the slide valve using a socket head screw (94234140) with Loctite® 243 and tighten the screw to 15 in. lbs. torque.



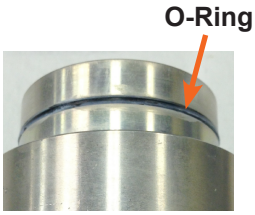
11. Apply O-Ring Lube to o-ring (91815677) and assemble it into the o-ring groove on the outside diameter of the safety valve cap (90225691PT). Thread the safety valve cap assembly into the safety body. Using assembly fixture (TF-634899), tighten the safety valve cap. Using a 1.5mm Allen key, install and tighten two (2) set screws (94221100) to secure the safety valve cap.

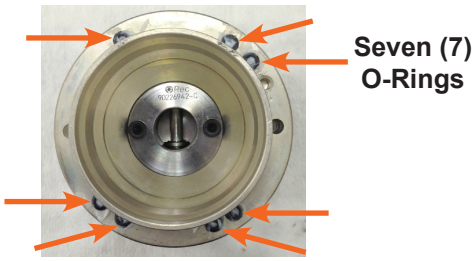


12. Install the poppet valve (531226), spring (634645PT) and start button (642384PT) into the safety body assembly. Hold the button in and use a 1.5mm Allen key to install and tighten two (2) set screws (94221100) to secure the start button. Tighten the set screws to 32 in-lbf (3.66 Nm) The set screws must fit into the grooves in the side of the start button to allow button movement.



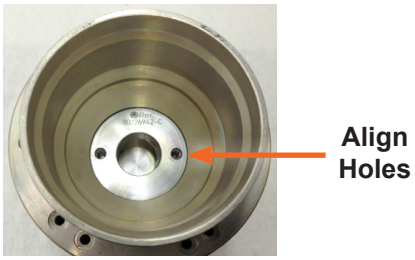
13. Apply O-Ring Lube to o-ring (91816167) and assemble it into the o-ring groove on the outside diameter at the rear of the safety body. Apply O-Ring Lube to seven (7) o-rings (91815045) and install them into the o-ring grooves in the rear face of the safety body.

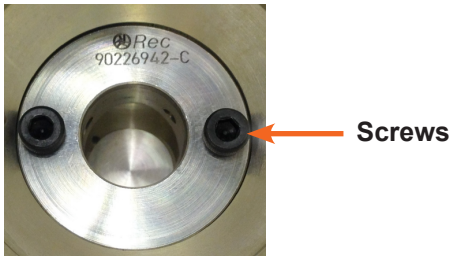




642419PT Rotary Vane E-Valve Assembly:

Assemble the governor wear ring (90226942) into the safety body assembly. Make sure the screw holes in the wear ring align with the screw holes in the safety body assembly. Using a 2.5mm Allen key, install and tighten the two (2) screws (94234140) to 15 in-lbf (1.7 Nm) torque, securing the governor wear plate.



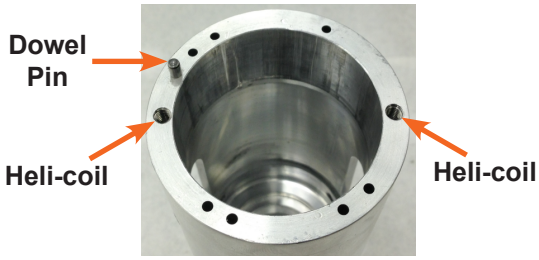


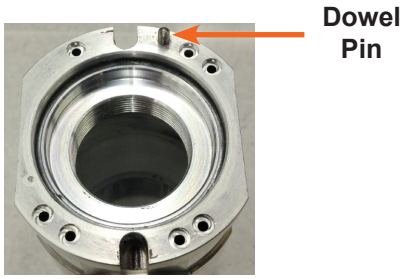
5.2 642416PT Rotary Vane Motor Assembly:

Refer to the following illustrations for detailed parts listing.

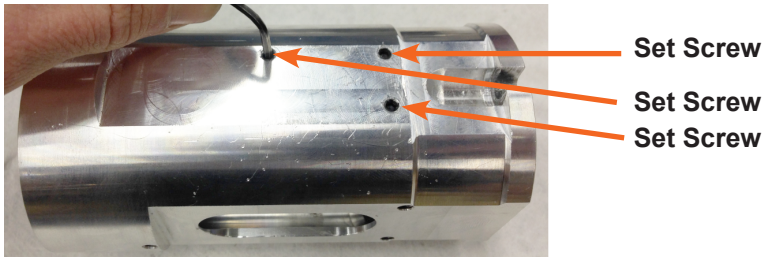
642416PT Rotary Vane Motor Assembly: Illustration 8
642417PT Rotary Vane Motor: Illustration 9

1. Using an M4 Heli-coil tool, install two (2) heli-coils (634325PT) into the motor housing (642426PT). Using a hammer, tap a dowel pin (634339PT) into each end of the motor housing.

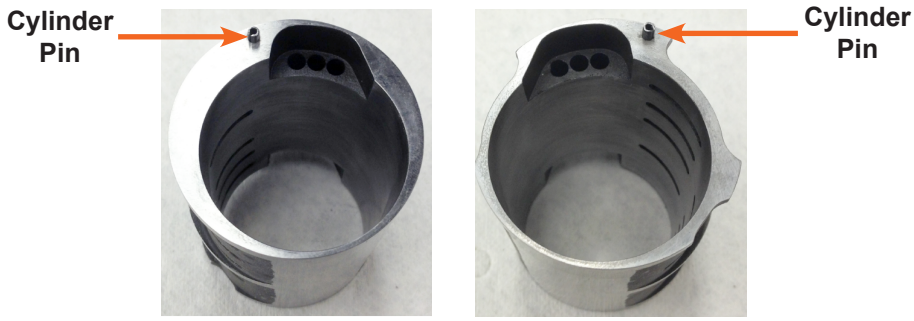




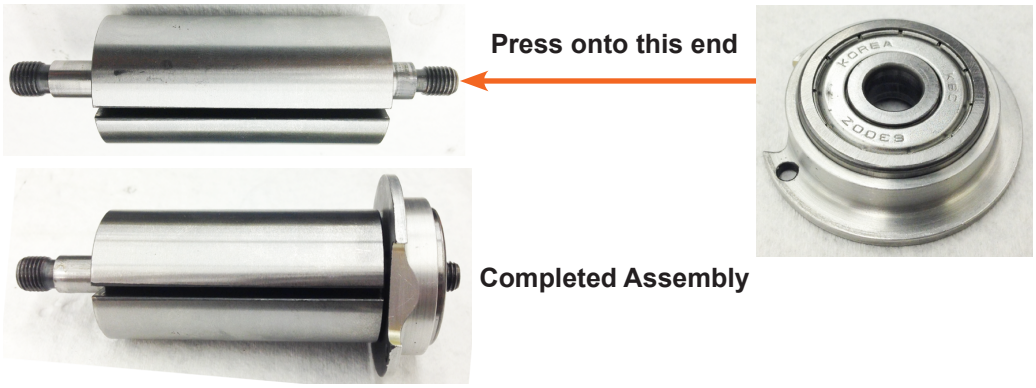
2. Using a 2mm Allen key, install three (3) set screws (634669PT) into the motor housing.



3. Install a cylinder pin (619154) into each end of the cylinder (642428PT).



4. Assemble a ball bearing (864522) into the rear bearing plate (634572PT). It may be necessary to use an Arbor Press to fully insert the bearing. Use an Arbor Press to install the rear bearing plate assembly onto the rotor (634583PT). *Note: Press the rear bearing plate assembly onto the shortest end of the rotor, which has a 5/16"-24 thread.*



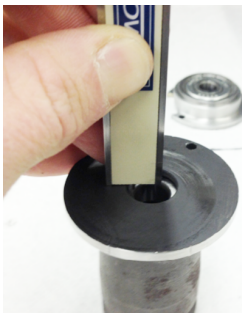
5. Insert the rotor assembly into the cylinder (642428PT). The opening on the bearing plate must align with the opening in the cylinder. Make sure the cylinder pin is inserted into the rear bearing plate hole as shown. Install the three (3) rotor blades (382520) into the rotor slots. Assemble the rotor blades with the flat edge facing away from the rotor.



6. Assemble a ball bearing (842870) into the front bearing plate (634571PT). It may be necessary to use an Arbor Press to fully insert the bearing.



7. Position the front bearing plate assembly so the inner race is clear. Using a depth mic, measure the distance from the face of the front bearing plate to the inner race of the bearing. This measurement will determine the required rotor collar. The rotor collar should be this distance + .002".





Depth = 0.123



0.123 + 0.002 = 0.125 (864492)

Rotor Collar	
Part No.	**Width**
864487	0.120
864488	0.121
864489	0.122
864490	0.123
847525	0.124
864492	0.125
864493	0.126
865416	0.127
865417	0.128
202076	0.129
202187	0.130
202188	0.131

8. Install the selected rotor collar into the front bearing plate. Make sure the chamfered edge of the rotor collar faces away from the ball bearing.



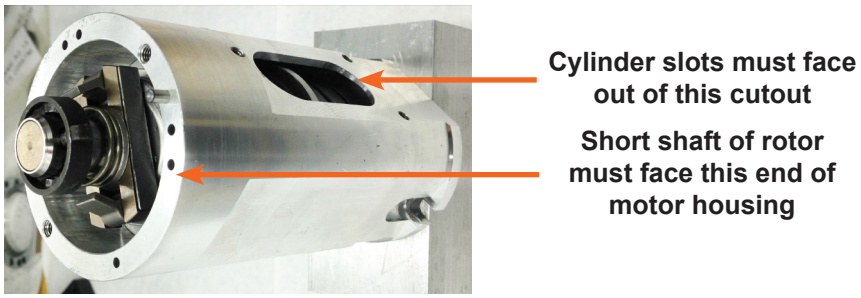


Chamfered surface installed away from the ball baring

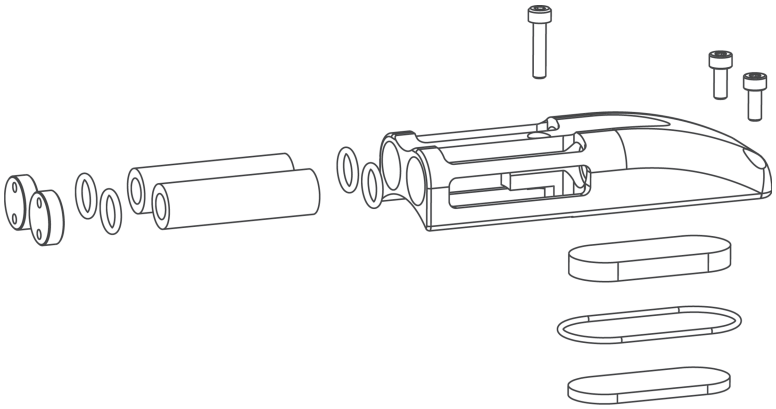
9. Install the front bearing plate onto the rotor with the flat surface facing the rotor. Make certain the clinder pin aligns with the pin hole in the front bearing plate. Use an Arbor Press to press the front bearing plate fully onto the rotor.Install a cylinder pin (619154) into each end of the cylinder (642428PT).



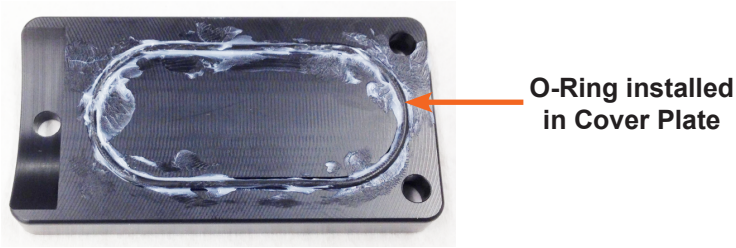
10. Insert the rotary vane motor subassembly into the motor housing. Position the motor so the short shaft of the rotor is facing the end of the housing without threads on the inside diameter. The slots of the cylinder must face the cutout in the side of the motor housing.



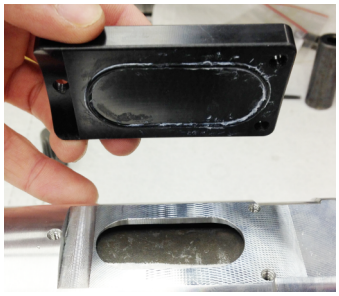
11. Assemble the low noise muffler (642523PT) and assemble it to the motor housing.

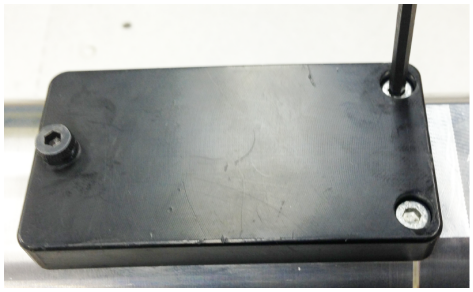


12. Apply O-ring Lube to o-ring (91816120), to hold it in place, then install it into the o-ring groove on the surface of the cover plate (634636PT).

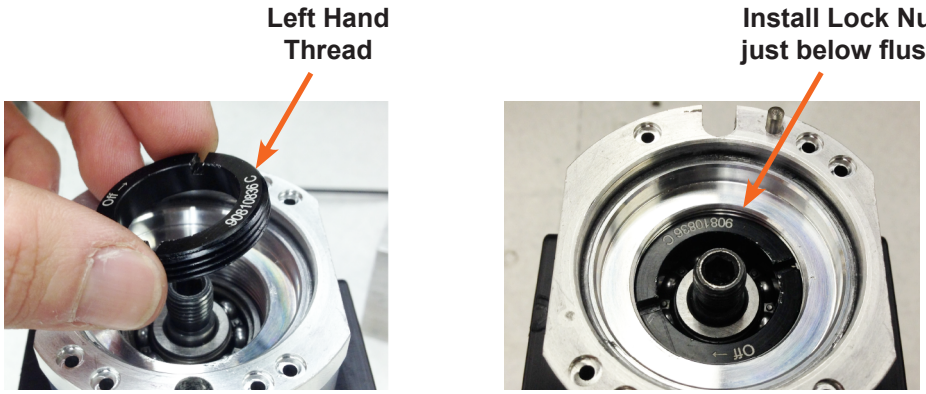


13. The cover plate assembly goes over the cutout of the motor housing where the slots in the motor assembly are not visible. Secure the cover plate assembly to the motor housing using three (3) screws (542940-47) and tighten to 30 in. lbs. torque.





14. Install the lock nut (90810836) into the motor housing by turning counter-clockwise (left hand thread). Install the lock nut just below flush until the final tool assembly when the E-Valve assembly is installed on the motor housing.

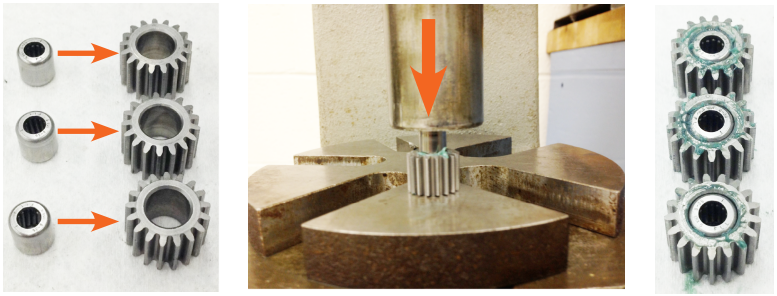


5.3 Single Stage Gearing Assembly (642408PT, 642409PT, 642410PT, 642411PT):

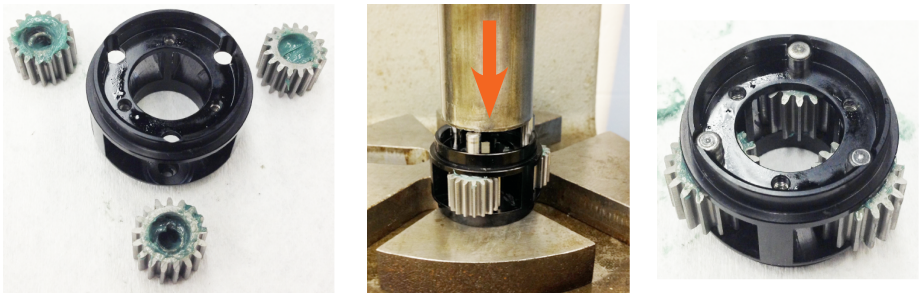
Refer to the following illustrations for detailed parts listing.

642408PT Single Stage Gearing Assembly: Illustration 13
642409PT Single Stage Gearing Assembly: Illustration 13
642410PT Single Stage Gearing Assembly: Illustration 14
642411PT Single Stage Gearing Assembly: Illustration 14

1. Apply Accrolube to the inside diameter of each planetary gear. Using an Arbor Press, install a planetary gear needle bearing into each of the three (3) planetary gears. Apply Accrolube to the inside diameter of each needle bearing after assemble.

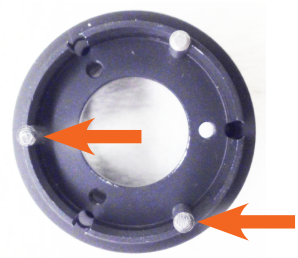


2. Install each planetary gear assembly into the gear cage and secure in position with a planetary gear pin. Use an Arbor Press to fully insert the pins into the gear cage until they bottom out. Apply Accrolube to each planetary gear after assembly.

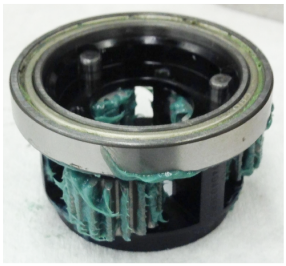


Assembly Instructions

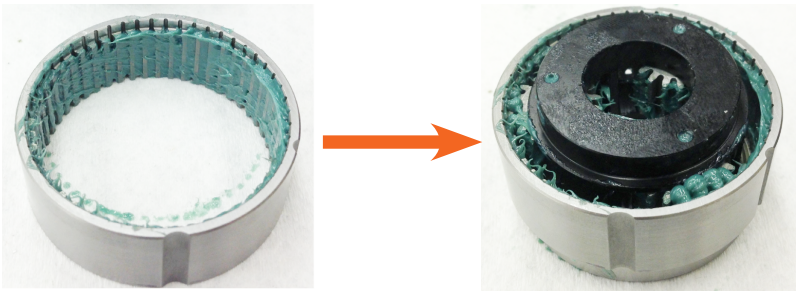
3. Install the remaining three dowel pins into the gear cage. Use an Arbor Press to fully insert the pins into the gear cage. *Note: The pins will not be flush with the face of the gear cage after installation.*



4. Assemble a ball bearing onto the end of the gear cage where the pins are visible. If necessary, use an Arbor Press to fully seat the bearing on the gear cage.



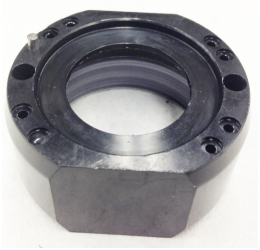
5. Apply Accrolube to the teeth of the ring gear. Install it on the gear cage with the lip cutout in the ring gear teeth positioned away from the ball bearing.



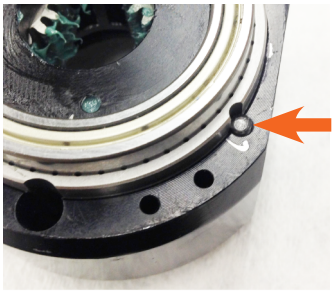
6. Install the second ball bearing onto the other end of the gear cage. If necessary, use an Arbor Press to fully seat the bearing on the gear cage.

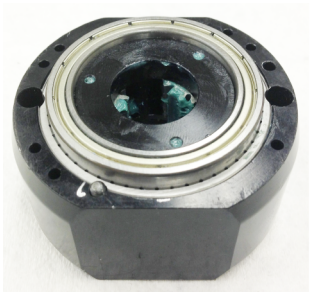


7. Install a dowell pin (634339PT) into the planetary housing (634575PT). Us an Arbor Press to fully insert the dowel pin into the planetary housing



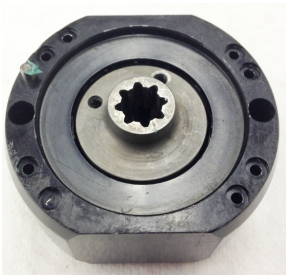
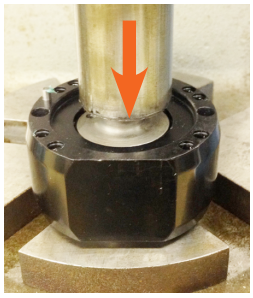
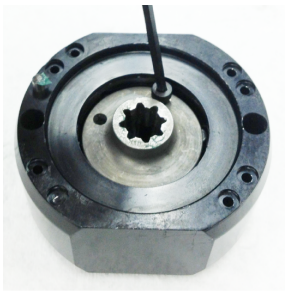
8. Insert the gear cage assembly into the planetary housing. Make sure to align the pin notch on the outside of the ring gear with the pin (634339PT) previously installed on the planetary housing. Use an Arbor Press to complete the installation of the gear cage assembly into the





planetary housing.

9. Install the inline drive adapter onto the planetary housing assembly. Align the pin notches in the inline drive adapter with the pins in the gear cage. Use an Arbor Press to complete the assembly of the inline drive adapter. Using a 2.5mm Allen key, install the screw (634345PT) to secure the inline drive adapter.

5.4 Double Stage Gearing Assembly (642412PT, 642413PT, 642414PT, 642415PT):

Refer to the following illustrations for detailed parts listing.

642412PT Double Stage Gearing Assembly: Illustration 15
642413PT Double Stage Gearing Assembly: Illustration 16
642414PT Double Stage Gearing Assembly: Illustration 17
642415PT Double Stage Gearing Assembly: Illustration 18

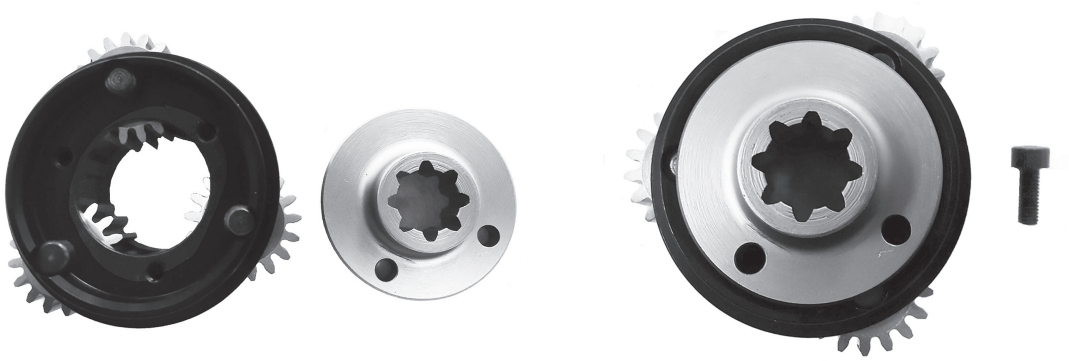
Lower Gear Cage Assembly *(part numbers vary between gearing assemblies but the assembly process is the same)*

1. Install three (3) planetary gears, with bearings (if applicable), into the lower planetary gear cage and secure with three (3) planetary gear pins.

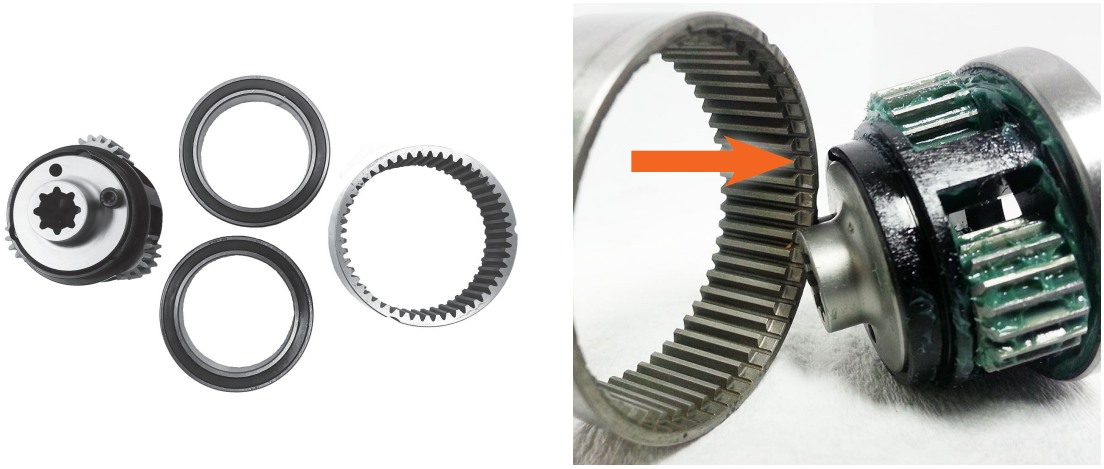




2. Install the drive adapter (634577PT) onto the planetary gear cage assembly. Make certain the pins in the gear cage are aligned with the slots in the adapter. Using a 3mm Allen Key, install the screw (634345PT) to secure the adapter to the gear cage assembly. Tighten the screw to 32 in-lbf (3.7 Nm) Torque.



3. Install a ball bearing (93450775) onto the bottom of the gear cage assembly. Apply gear grease to the gear cage assembly and install it into the ring gear (90515063PT). ***IMPORTANT: MAKE SURE THE BEARING SEAT IN THE RING GEAR TEETH ENGAGES PROPERLY WITH THE BALL BEARING ON THE GEAR CAGE ASSEMBLY.***



4. Assemble the other ball bearing (93450775) onto the top of the gear cage and ring gear assembly. After assembly, there will be an open space between the bottom of the ball bearing and the ring gear.

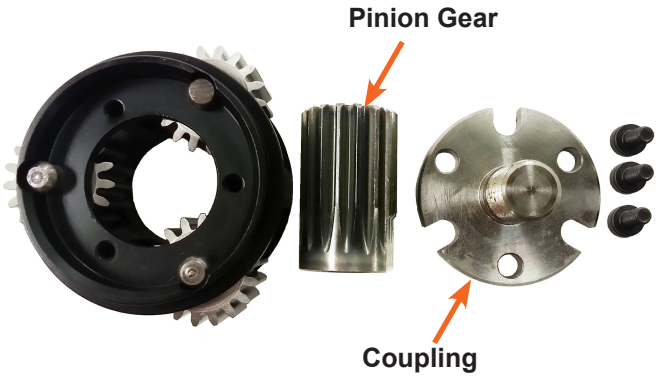


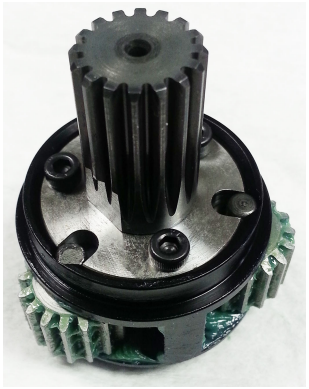
Upper Gear Cage Assembly *(part numbers vary between gearing assemblies but the assembly process is the same)*

1. Install three (3) planetary gears, with bearings (if applicable), into the upper planetary gear cage and secure with three (3) planetary gear pins



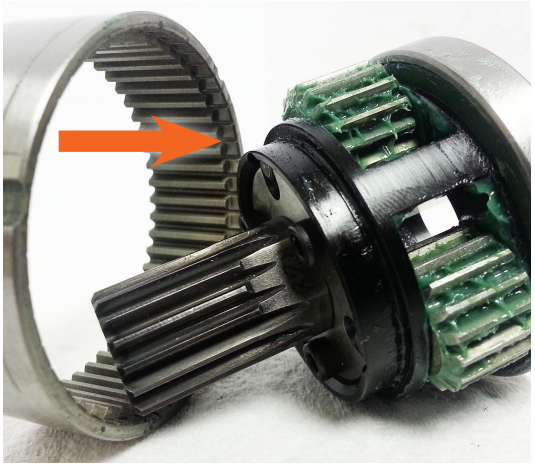
2. Assemble the pinion gear to the coupling and tighten. Assemble the coupling and pinion gear assembly to the upper gear cage assembly. Make sure to align the slots of the coupling with the planetary gear pins for proper fit. Using a 3mm Allen Key, install three (3) screws (94234135) to secure the coupling assembly to the gear cage assembly.





3. Install a ball bearing (93450775) onto the bottom of the gear cage assembly. Apply gear grease to the gear cage assembly and install it into the ring gear (90515063PT). ***IMPORTANT: MAKE SURE THE BEARING SEAT IN THE RING GEAR TEETH ENGAGES PROPERLY WITH THE BALL BEARING ON THE GEAR CAGE ASSEMBLY.***



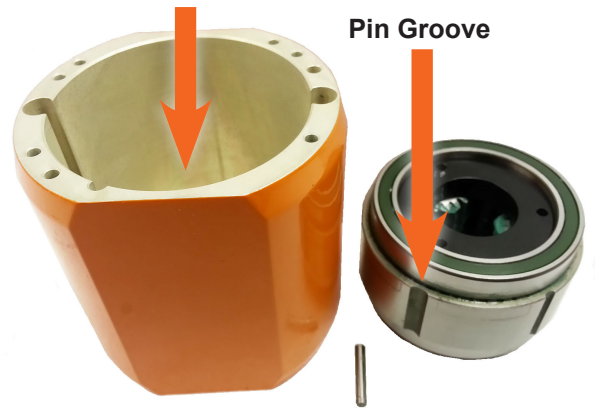


4. Assemble the other ball bearing (93450775) onto the top of the gear cage and ring gear assembly. After assembly, there will be an open space between the bottom of the ball bearing and the ring gear.



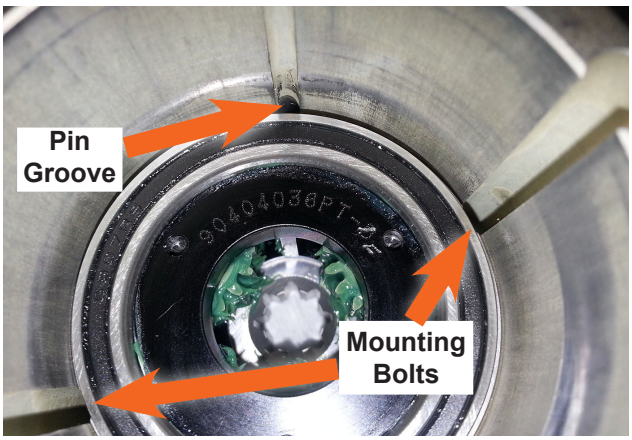
Gear Housing Assembly *(part numbers vary between gearing assemblies but the assembly process is the same)*

1. Position the lower gear cage assembly so the drive adapter is installed towards the front of the gear housing (634576PT) and install the lower gear cage assembly into the gear housing. *Note: Make sure the pin groove in the side of the ring gear is aligned with the pin groove in the gear housing. The two large holes in the gear housing are for the gear head mounting bolts.*

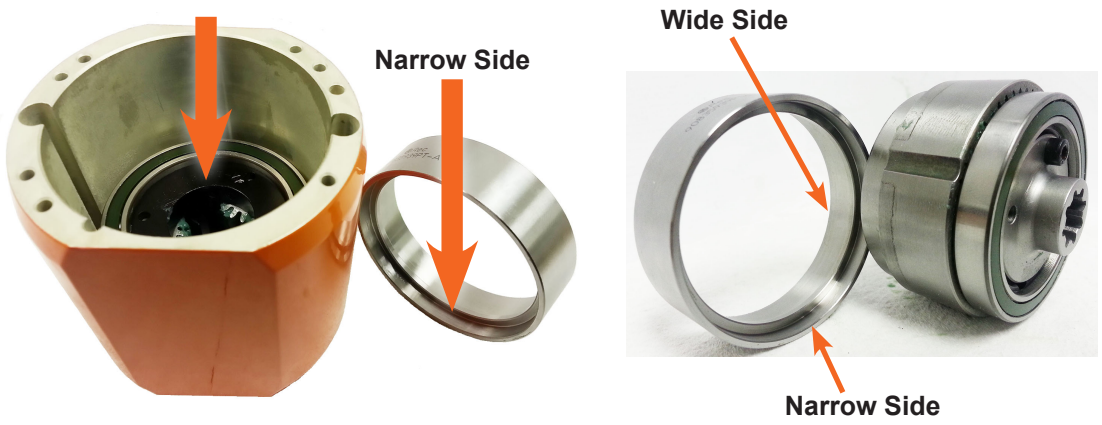




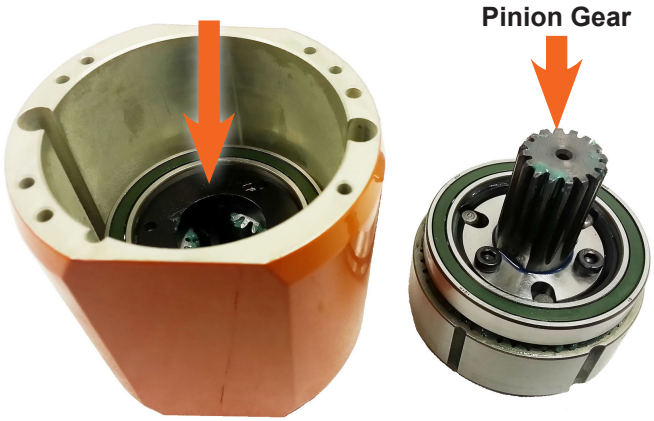
2. Install the dowel pin (91216105) into the aligned pin groove of the gear housing and ring gear on the lower gear cage. *The two large holes in the gear housing are for the gear head mounting bolts.*



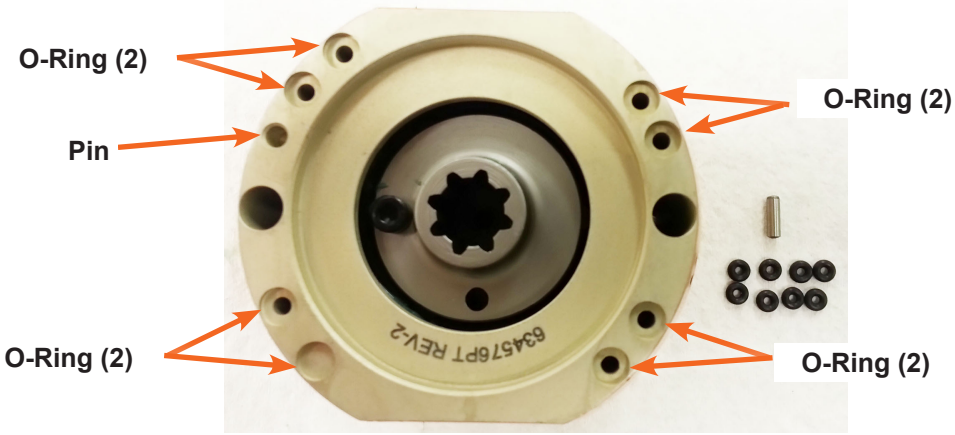
3. Install the gear spacer (90835939PT) onto the lower gear cage assembly in the gear housing. ***ASSEMBLY NOTE: THE NARROW SIDE OF THE SPACER MUST BE ASSEMBLED TO THE LOWER GEAR CAGE ASSEMBLY.***



4. Insert the upper gear cage assembly, pinion gear first, into the gear housing and onto the gear spacer. The pinion gear must mesh fully with the lower gear cage assembly.



5. Install the eight (8) o-rings (91815045) into the counterbored holes in the face of the gear housing. Install the pin (634339PT) into the face of the gear housing, as indicated.



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