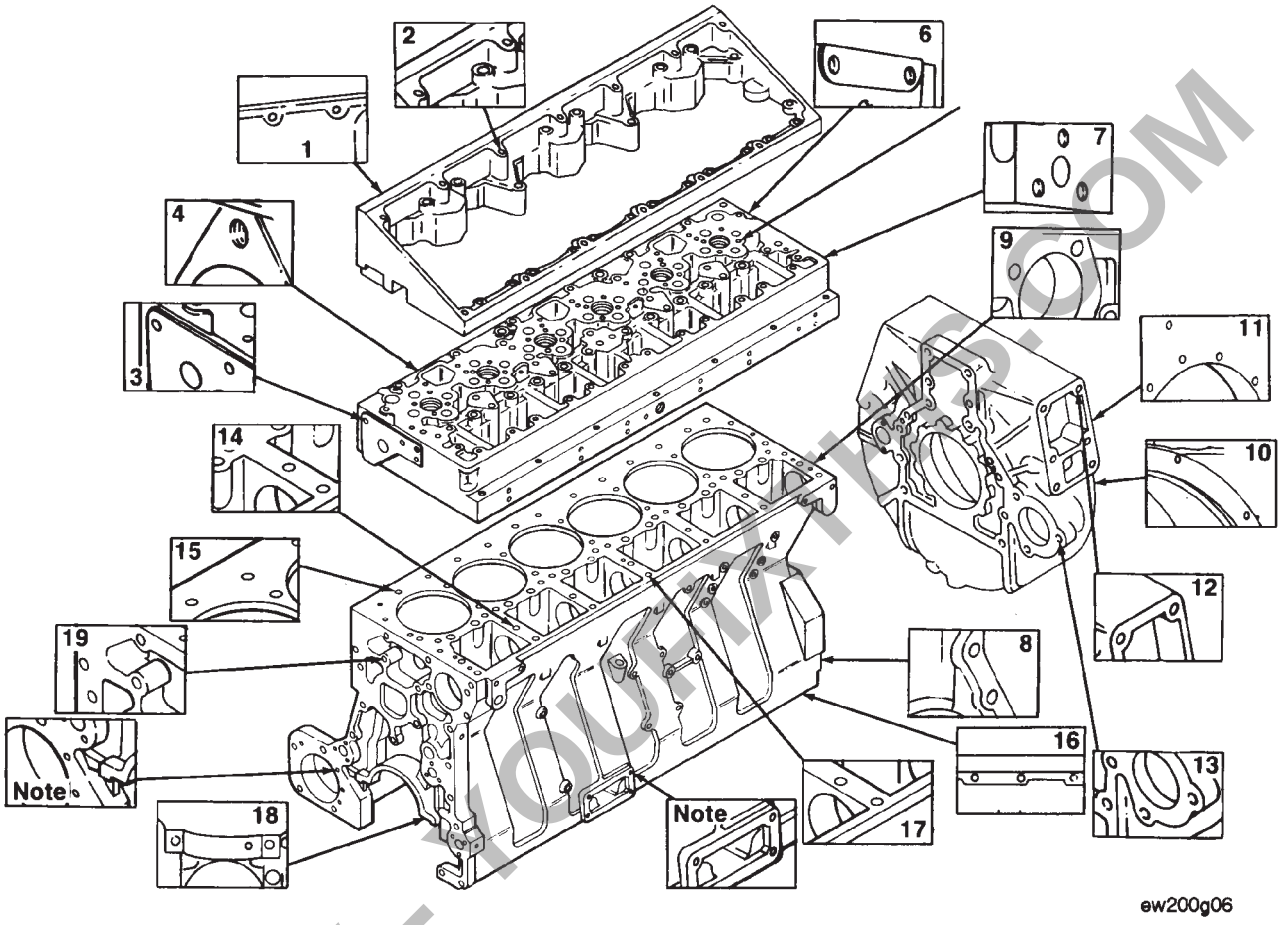
Straight Thread Holes — Exploded



Ref. No.	Mounting Capscrew Thread Location	Thread Size	Ref. No.	Mounting Capscrew Thread Location	Thread Size
1	Aftercooler	M10 x 1.50	11	Rear Crankshaft Seal	M8 x 1.25
2	Rocker Cover	M8 x 1.25	12	*Mounting Pad	M16 x 2.00, M12 x 1.75, 5/8 x 11UNC or 3/4 x 10 UNC
3	Fan Support	M12 x 1.75	13	*Starting Motor Mounting	M16 x 2.00 or 5/8 x 11 UNC
4	Exhaust Manifold	M10 x 1.50	14	Cam Follower Mounting Studs	M10 x 1.50
5	Injector Hold Down Clamps	M8 x 1.25	15	Cylinder Head	M14 x 1.50
6	Lifting Bracket	M12 x 1.75	16	Lubricating Oil Pan	M10 x 1.50
7	Cover Plate	M10 x 1.50	17	Small Cylinder Head	M10 x 1.50
8	Flywheel Housing	M16 x 2.00	18	Main Bearing Cap	M14 x 1.50
9	Camshaft Cover Plate	M10 x 1.50	19	Gear Cover Plate	M10 x 1.50
10	*Transmission	M10 x 1.50 or 7/16 x 14UNC			

* To determine the thread size, inspect the capscrews that were removed.

NOTE: Miscellaneous threaded holes for mounting accessories are M10 x 1.50 thread size.

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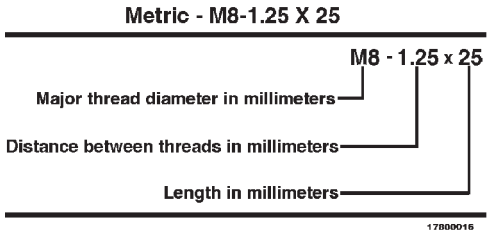
Capscrew Markings and Torque Values

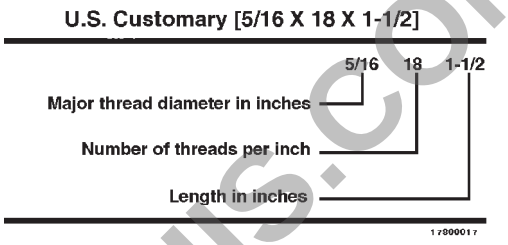
⚠ CAUTION ⚠

When replacing capscrews, always use a capscrew of the same measurement and strength as the capscrew being replaced. Using the wrong capscrews can result in engine damage.

Metric capscrews and nuts are identified by the grade number stamped on the head of the capscrew or on the surface of the nuts. U.S. Customary capscrews are identified by radial lines stamped on the head of the capscrew.

The following examples indicate how capscrews are identified:

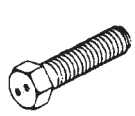
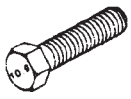
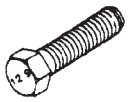




NOTES:

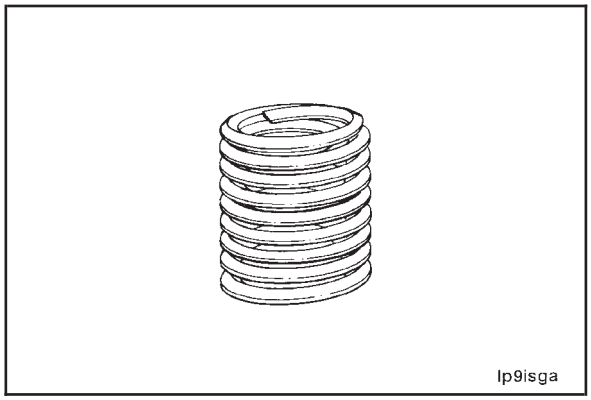
1. **Always** use the torque values listed in the following tables when specific torque values are **not** available.
2. Do **not** use the torque values in place of those specified in other sections of this manual.
3. The torque values in the table are based on the use of lubricated threads.
4. When the ft-lb value is less than 10, convert the ft-lb value to in-lb to obtain a better torque with an in-lb torque wrench. Example: 6 ft-lb equals 72 in-lb.

Capscrew Markings and Torque Values - Metric

Commercial Steel Class	8.8				10.9				12.9			
Capscrew Head Markings												
Body Size Diam.	Torque Cast Iron		Torque Aluminum		Torque Cast Iron		Torque Aluminum		Torque Cast Iron		Torque Aluminum	
mm	N•m	ft-lb	N•m	ft-lb	N•m	ft-lb	N•m	ft-lb	N•m	ft-lb	N•m	ft-lb
6	9	5	7	4	12	9	7	4	14	9	7	4
7	14	9	11	7	18	14	11	7	23	18	11	7
8	25	18	18	14	33	25	18	14	40	29	18	14
10	45	33	30	25	60	45	30	25	70	50	30	25
12	80	60	55	40	105	75	55	40	125	95	55	40
14	125	90	90	65	165	122	90	65	195	145	90	65
16	180	130	140	100	240	175	140	100	290	210	140	100
18	230	170	180	135	320	240	180	135	400	290	180	135

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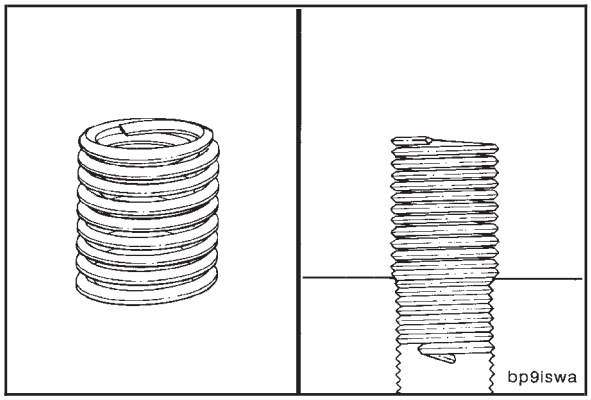
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Coiled Thread Inserts

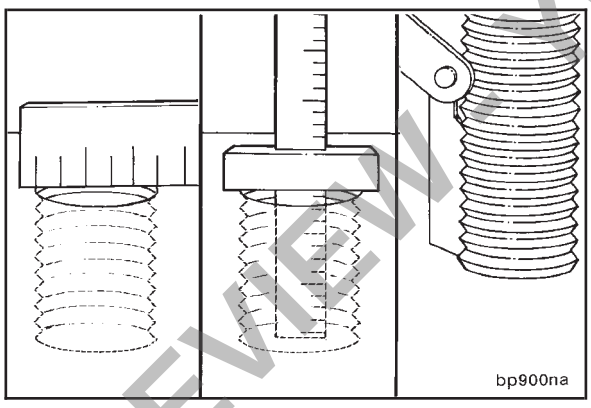
General Information

This repair procedure provides useful information and installation instructions for coiled thread inserts. Coiled thread inserts are a precision wound wire insert for repairing failed or mutilated internal threads.



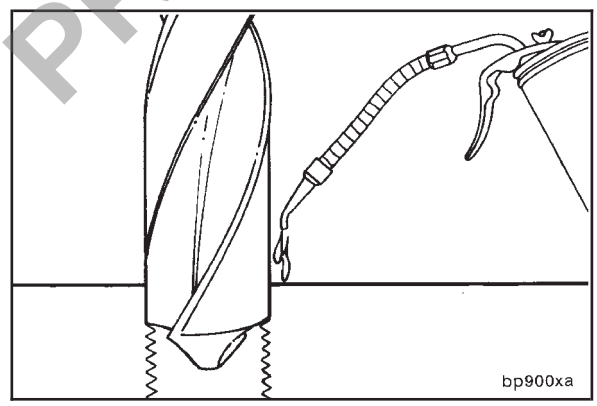
These coils in their free state are designed to be larger in diameter than the tapped hole. After installation, the insert conforms to the outer wall of the tapped hole. This compressed fit holds the insert in place.

NOTE: Inserts are normally made of stainless steel wire. However, other materials are available to meet special installation requirements.



Repair Procedure

Determine the diameter, depth, and pitch of the original threaded hole. Refer to Straight Thread Holes at the front of this section for locations and hole sizes.

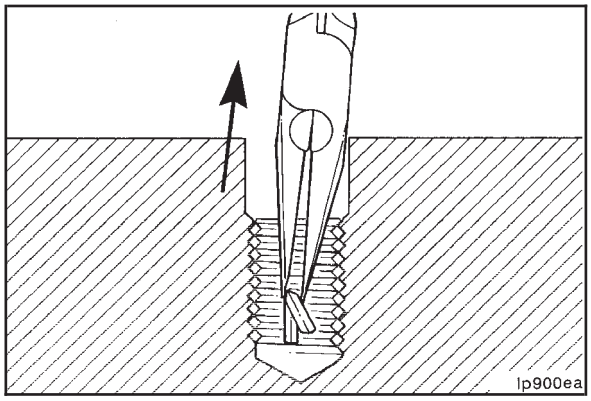


Warning: To avoid possible eye damage, always wear protective goggles when drilling metal.

Use a cutting oil while drilling the capscrew hole to the specified diameter. Refer to the charts in the back of this procedure for drill size diameter specifications. Drill to the bottom of blind capscrew holes.

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Remove the installation tang from the repaired hole.

Coiled Thread Insert Part Numbers — Metric Threads

Thread Size	Thread Length — mm	Heli-Coil Part No.	Perma Thread Part No.
M6 X 1.00	9	1084-6CN-0070	206M-8C-0090
M6 X 1.00	12	1084-6CN-0120	206M-6C-0120
M6 X 1.25	12	1084-8CN-0120	206M-8C-0120
M6 X 1.25	16	1084-8CN-0160	206M-8C-0160
M10 X 1.50	15	1084-10CN-0150	206M-10C-0150
M10 X 1.50	20	1084-10CN-0200	206M-10C-0200
M12 X 1.75	18	1084-12CN-0180	206M-12C-0180
M12 X 1.75	24	1084-12CN-0240	206M-12C-0240
M14 X 2.00	21	1084-14CN-0210	206M-14C-0210
M14 X 2.00	28	1084-14CN-0280	206M-14C-0280
M16 X 2.00	24	1084-16CN-0240	206M-16C-0240
M16 X 2.00	38	1084-16CN-0320	206M-16C-0320

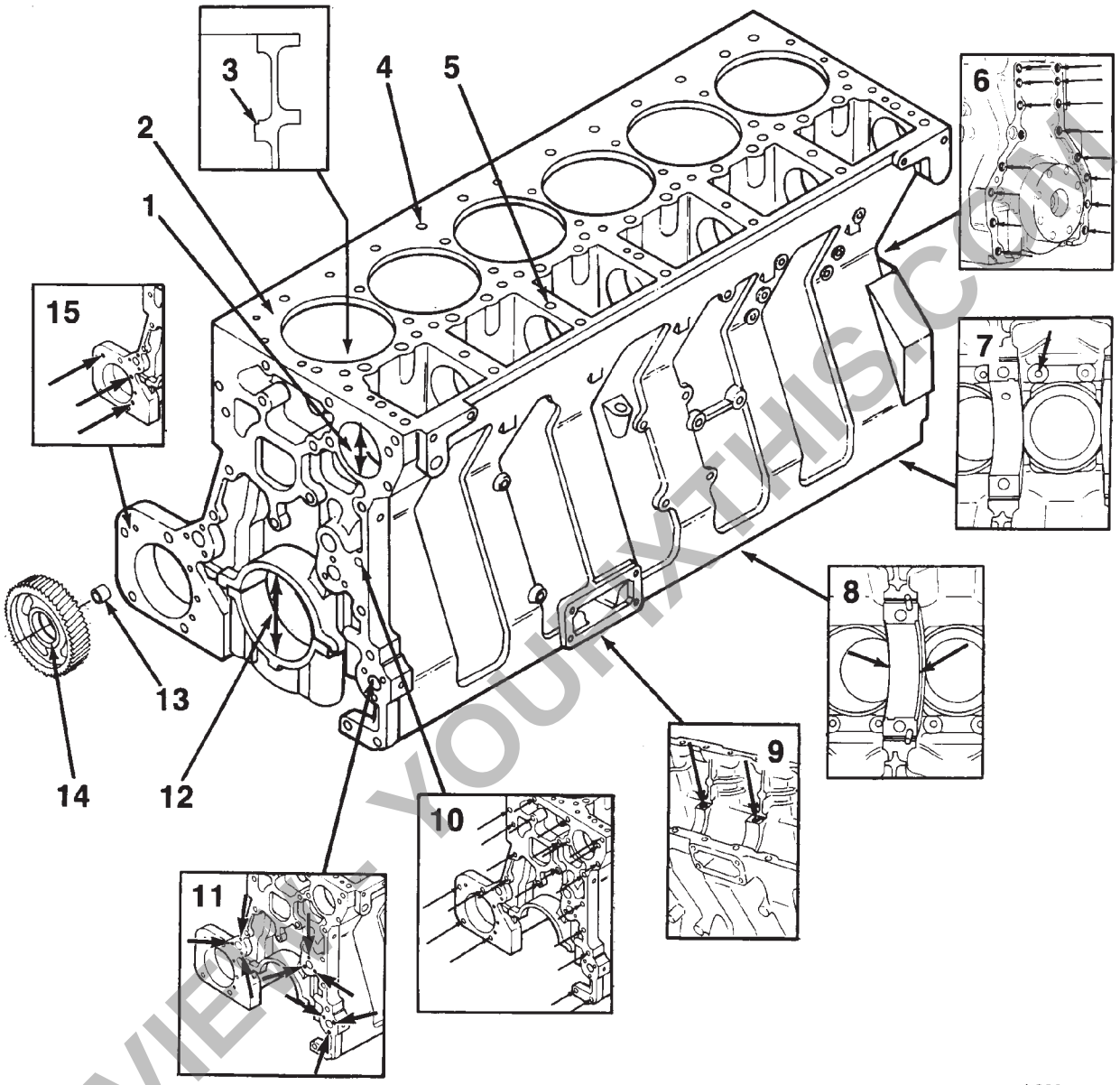
Drill Sizes

Thread Size	Suggested Drill Size — Metric		Suggested Drill Size — Inch	
	Aluminum	Steel	Aluminum	Steel
M6 X 1.00	6.25	6.3	D [0.2460]	1/4 [0.2500]
M8 X 1.25	8.3	8.4	21/64 [0.3281]	Q [0.3320]
M10 X 1.50	10.5	10.5	Z [0.4130]	Z [0.4130]
M12 X 1.75	12.5	12.5	31/64 [0.4844]	1/2 [0.500]
M14 X 2.00	14.5	14.5	37/64 [0.5781]	37/64 [0.5781]
M16 X 2.00	16.5	16.5	21/32 [0.6562]	21/32 [0.6562]

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Cylinder Block — Exploded View



Ref. No.	Description	Ref. No.	Description
1	Camshaft Bore	9	Main Bearing Capscrew Holes
2	Top Deck	10	Gear Plate and Gear Cover Capscrew Holes
3	Cylinder Liner Counterbore	11	Idler Gear Capscrew Holes
4	Cylinder Head Capscrew Hole	12	Main Bearing Bore
5	Cam Follower Stud Hole	13	Idler Shaft Ring Dowel
6	Flywheel Housing Capscrew Holes	14	Idler Gear Bushing
7	Piston Cooling Nozzle Capscrew Hole	15	Lubricating Oil Pump Capscrew Holes
8	Thrust Bearing Surfaces		

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Capscrew Markings and Torque Values - U.S. Customary

SAE Grade Number	5	8
Capscrew Head Markings These are all SAE Grade 5 (3 line)		



Capscrew Body Size	Capscrew Torque - Grade 5 Capscrew				Capscrew Torque - Grade 8 Capscrew			
	Cast Iron		Aluminum		Cast Iron		Aluminum	
	N•m	ft-lb	N•m	ft-lb	N•m	ft-lb	N•m	ft-lb
1/4 - 20	9	7	8	6	15	11	8	6
- 28	12	9	9	7	18	13	9	7
5/16 - 18	20	15	16	12	30	22	16	12
- 24	23	17	19	14	33	24	19	14
3/8 - 16	40	30	25	20	55	40	25	20
- 24	40	30	35	25	60	45	35	25
7/16 - 14	60	45	45	35	90	65	45	35
- 20	65	50	55	40	95	70	55	40
1/2 - 13	95	70	75	55	130	95	75	55
- 20	100	75	80	60	150	110	80	60
9/16 - 12	135	100	110	80	190	140	110	80
- 18	150	110	115	85	210	155	115	85
5/8 - 11	180	135	150	110	255	190	150	110
- 18	210	155	160	120	290	215	160	120
3/4 - 10	325	240	255	190	460	340	255	190
- 16	365	270	285	210	515	380	285	210
7/8 - 9	490	360	380	280	745	550	380	280
- 14	530	390	420	310	825	610	420	310
1 - 8	720	530	570	420	1100	820	570	420
- 14	800	590	650	480	1200	890	650	480

Pipe Plug Torque Values

Size		Torque		Torque	
Thread	Actual Thread O.D.	In Aluminum Components		In Cast Iron or Steel Components	
in	in	N•m	ft-lb	N•m	ft-lb
1/16	0.32	5	45 in-lb	15	10
1/8	0.41	15	10	20	15
1/4	0.54	20	15	25	20
3/8	0.68	25	20	35	25
1/2	0.85	35	25	55	40
3/4	1.05	45	35	75	55
1	1.32	60	45	95	70
1-1/4	1.66	75	55	115	85
1-1/2	1.90	85	65	135	100

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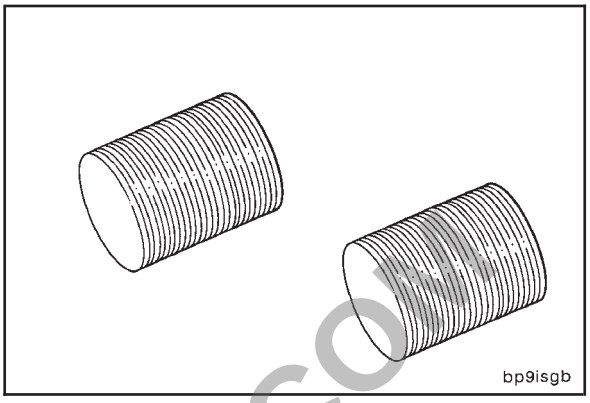
Closed End "Blind" Inserts

General Information

This procedure provides the instructions for installing closed end "blind" inserts.

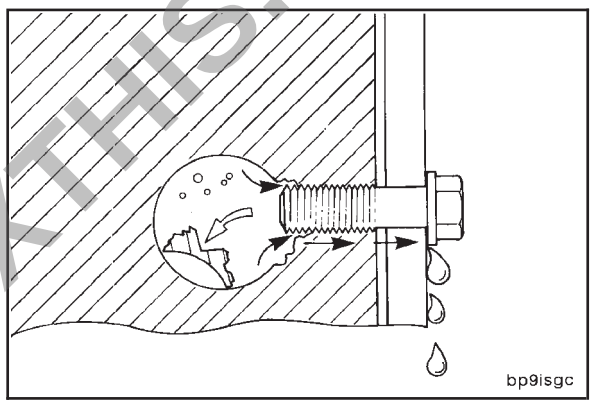
The charts in the back of this procedure lists the two types of blind inserts.

- SAE internal and external threads
- Metric internal with SAE external threads



Closed end inserts are generally used in cases where the bottom or side of a hole has been pierced. They can be used to repair any kind of hole or thread if desired.

NOTE: Closed end inserts **cannot** be used to repair top deck cracks that run into cylinder head capscrew holes.

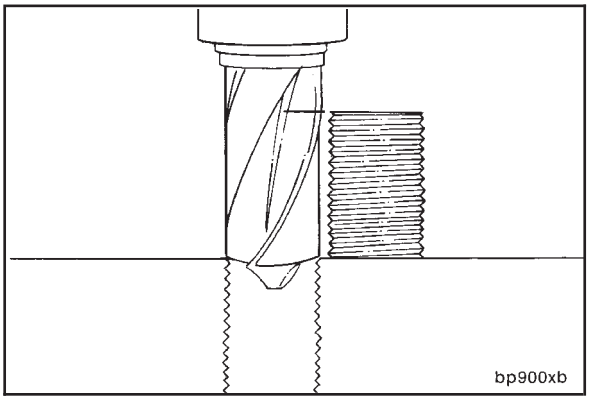


Repair Procedure

Obtain the required reamer or drill size for the hole to be repaired. Refer to the charts at the end of this procedure for size specifications. Install it in the drill.

Set the drill depth by placing the insert to be installed between the top of the hole and the drill chuck.

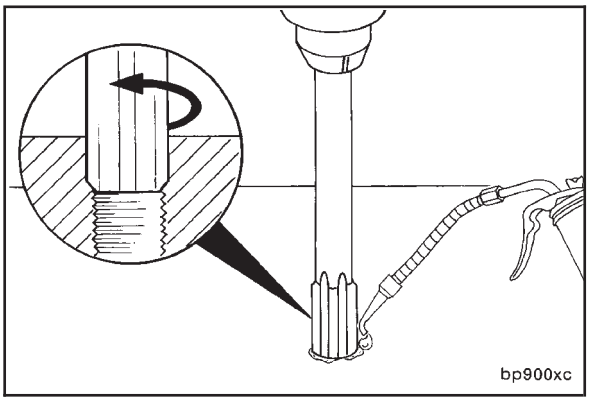
NOTE: If the drill is too long, make a mark on the drill bit to indicate the correct depth.



Warning: To avoid possible eye damage, always wear protective goggles when drilling metal.

Use cutting oil. Drill or ream the hole to the proper depth.

NOTE: In some cases when using a drill, the proper depth will pierce the bottom of the hole.



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Closed End Inserts — SAE Internal and External Threads

Cummins Part No.	Internal Thread (Size It Repairs) Class 2B	External Threads (Tap Size) Class 2B	Tap Drill (Reamer) Dia.-Inch	Nominal Overall Length-Inch
3376437	1/4-20 UNC	3/8-16 UNC	0.332	0.750
3376438	5/16-18 UNC	7/16-14 UNC	0.397	0.930
3376439	3/8-16 UNC	1/2-13 UNC	0.453	1.130
3376440	3/8-24 UNF	1/2-13 UNC	0.453	1.070
3376441	7/16-14 UNC	9/16-12 UNC	0.516	1.150
3376442	7/16-20 UNF	9/16-12 UNC	0.516	1.210
3376443	1/2-13 UNC	5/8-11 UNC	0.578	1.510
3376446	1/2-20 UNF	5/8-11 UNC	0.578	1.190
3376444	5/8-11 UNC	13/16-16 UNC	0.766	1.640
3376445	5/8-18 UNF	13/16-16 UNC	0.766	1.360
3376447	9/16-18 UNF	11/16-11 UNC	0.641	1.180

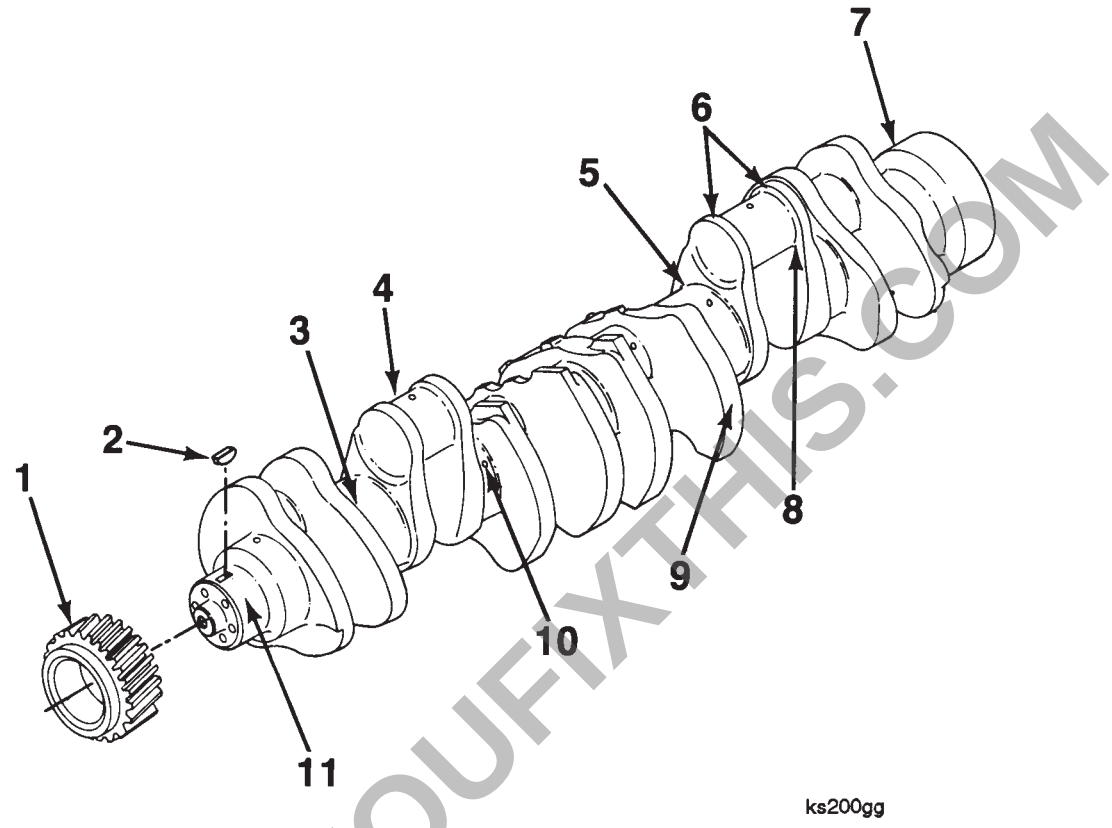
Closed End Inserts — Metric Internal Threads, SAE External Threads (3822709 KIT)

Cummins Part No.	Internal Threads (Size It Repairs)	External Threads (Tap Size) Class 2B	Tap Drill (Reamer) Dia.-Inch	Nominal Overall Length — Inch
3822698	M 6X 1.0-6H	3/8-16 UNC	0.3125	0.75
3822699	M 8X 1.25-6H	1/2-13 UNC	0.421	0.94
3822700	M 10X 1.50-6H	9/16-12 UNC	0.484	1.12
3822701	M 12X 1.25-6H	5/8-18 UNF	0.578	1.37
3822702	M 12X 1.50-6H	5/8-18 UNF	0.578	1.37
3822703	M 12X 1.75-6H	5/8-18 UNF	0.578	1.37
3822704	M 14X 2.00-6H	3/4-16 UNF	0.687	1.50
3822705	M 16X 1.50-6H	7/8-14 UNF	0.812	1.75
3822706	M 16X 2 00-6H	7/8-14 UNF	0.812	1.75

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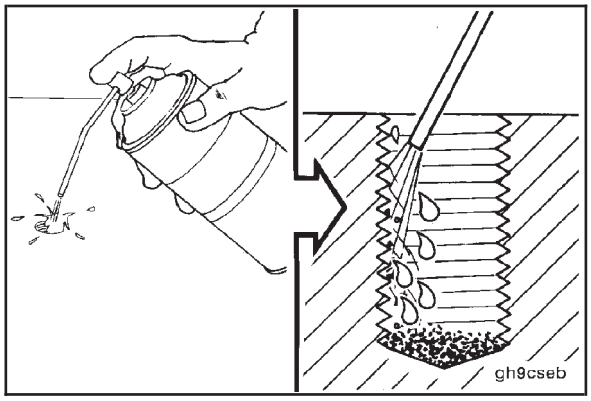
Crankshaft — Exploded View



Ref. No.	Description	Ref. No.	Description
1	Crankshaft Gear	7	Rear Oil Seal Flange Diameter
2	Woodruff Key	8	Bearing Fillet Sidewall
3	Main Bearing Journal	9	Counterweight Area
4	Connecting Rod Bearing Journal	10	Oil Drillings
5	Bearing Journal Fillets	11	Gear Journal Diameter
6	Crankshaft Webs		

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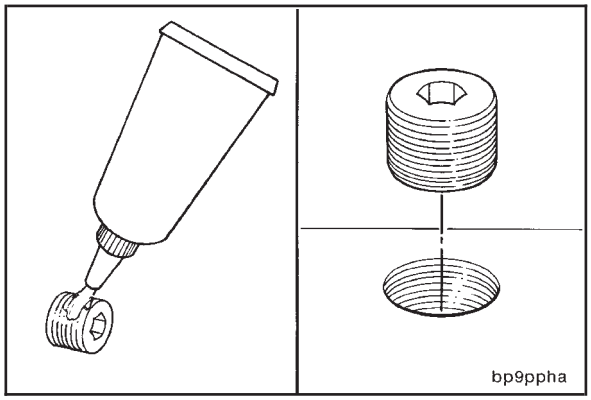
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Warning: When using compressed air to dry capscrew holes, always wear safety glasses or a face shield to protect the eyes. Personal injury can result.

Use a spray cleaner to clean the threads.

Dry with compressed air.



Coat the pipe plug with pipe sealant, Part No. 3375066, and install it in the hole.

Tighten the pipe plug to the torque specified in the chart at the end of this procedure.

Oversize (Copper Plated) Pipe Plugs — Torque Values

Size (NPT)	Torque Value Aluminum N•m	ft-lb	Steel/Cast Iron N•m	ft-lb
1/8-27	9	85 in-lb	20	15
1/4-18	20	15	25	20
3/8-18	25	20	35	25
1/2-14	35	25	55	40
3/4-14	45	35	75	55
1-11 1/2	60	45	95	70

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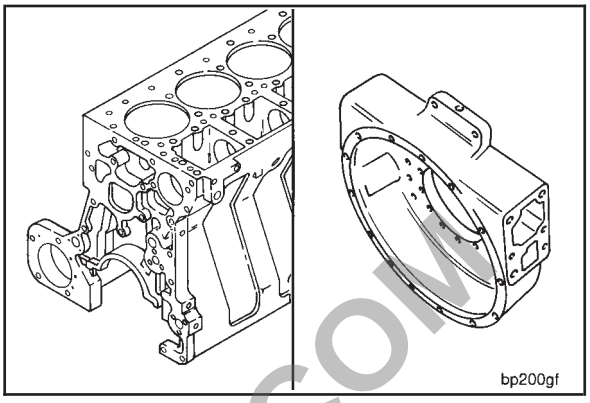
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Keylock Open End Thread Inserts

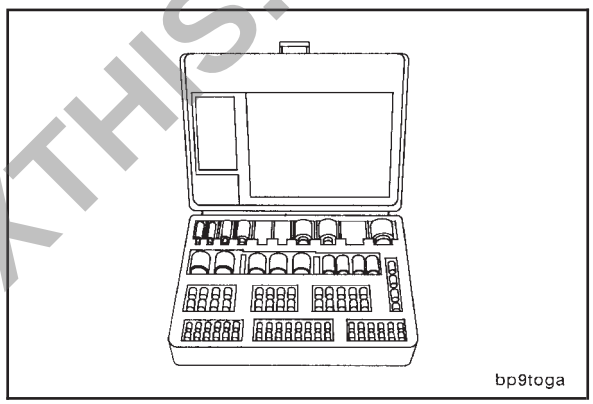
General Information

This procedure provides guidelines for using keylock inserts.

Keylock inserts can be used to repair threads in cast iron, steel and aluminum components.

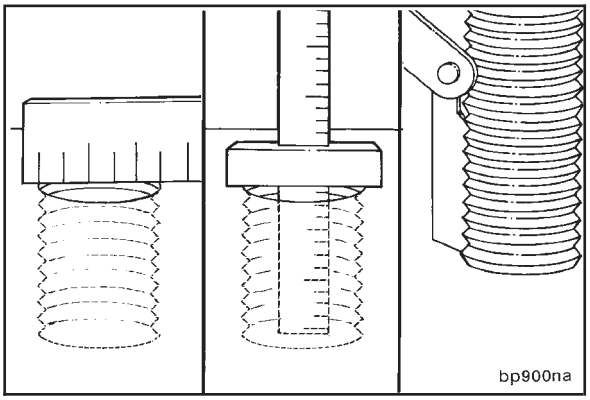


Thread repair kit, Part No. 3375021, contains keylock inserts. The inserts are internally and externally threaded metallic cylinders which have captive locking keys. The keys prevent the insert from rotating after it has been installed.



Repair Procedure

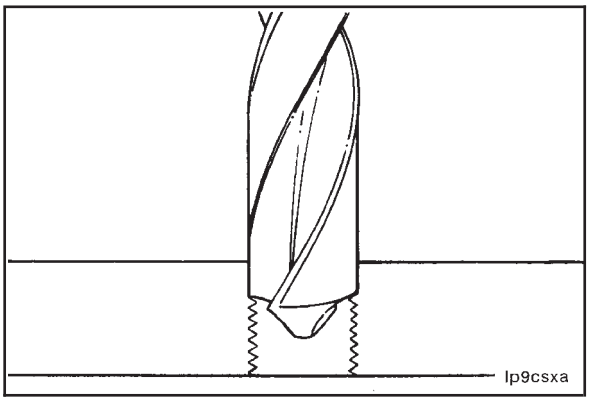
Determine the diameter, depth, and pitch of the original threaded hole. Refer to Straight Thread Holes at the front of this seciton for locations and hole sizes.



Warning: To avoid possible eye damage, always wear protective goggles when drilling metal.

Use cutting oil. Drill the hole to the specified diameter. Refer to the charts in the back of this procedure for drill size diameter specifications. Drill to the bottom of blind holes.

NOTE: The drill **must** be in proper alignment when drilling the capscrew hole.



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Keylock Thread Inserts — Unified Threads

Cummins Part No.	Internal Thread Size Class 2B	Tap Drill Size-Inch	Tap Size-Inch Class 2B	Installation Tool Part No.	Min. Tap Depth-Inch	C'sink Dia.-Inch	Overall Length-Inch
3375141	1/4-20	0.332	3/8-16	3375142	0.43	0.385	0.37
3375022	5/16-18	0.397	7/16-14	3375023	0.50	0.447	0.43
3375430	5/16-18 (Heavy Duty)	0.453	1/2-13	3375026	0.56	0.510	0.43
3375024	3/8-16	0.453	1/2-13	3375026	0.56	0.510	0.50
3375025	3/8-24	0.453	1/2-13	3375026	0.56	0.510	0.50
3375027	7/16-14	0.516	9/16-12	3375029	0.62	0.572	0.56
3375028	7/16-20	0.516	9/16-12	3375029	0.62	0.572	0.56
3375030	1/2-13	0.578	5/8-11	3375032	0.68	0.635	0.62
3375031	1/2-20	0.578	5/8-11	3375032	0.68	0.635	0.62
3375143	5/8-11	0.766	13/16-16	3375034	0.87	0.822	0.81
3375033	5/8-18	0.766	13/16-16	3375034	0.87	0.822	0.81
3375035	3/4-16	1.062	1 1/8-12	3375036	1.18	1.145	1.12
3375037	1-18	1.312	1 3/8-12	3375038	1.56	1.395	1.37

Keylock Thread Inserts — Tridair Keenserts — Unified Threads

Part No.	Internal Thread Size Class 2B	External Thread Size Class 2A	Length Inch	Tap Drill Dia.	C"sink Dia.	Tap Size Class 2B	Insert Tool Part No.
RKKA 1/4-20	1/4-20	3/8-16	0.37	"Q"	0.38	3/8-16	TRKA 1/4
RKKA 5/16-18	5/16-18	7/16-14	0.43	"X"	0.44	7/16-14	TRKA 5/16
RKK 5/16-18 (Heavy Duty)	5/16-18	1/2-13	0.43	29/64	0.51	1/2-13	TRK 5/16
RKKA 3/8-16	3/8-16	1/2-13	0.50	29/64	0.51	1/2-13	TRKA3/8
RKKA 3/8-24	3/8-24	1/2-13	0.50	29/64	0.51	1/2-13	TRKA3/8
RKKA 7/16-14	7/16-14	9/16-12	0.56	33/64	0.57	9/16-12	TRKA7/16
RKKA 7/16-20	7/16-20	9/16-12	0.56	33/64	0.57	9/16-12	TRKA7/16
RKKA 1/2-13	1/2-13	5/8-11	0.62	37/64	0.63	5/8-11	TRKA1/2
RKKA 1/2-20	1/2-20	5/8-11	0.62	37/64	0.63	5/8-11	TRKA1/2
RKK 5/8-11	5/8-11	7/8-14	0.87	53/64	0.88	7/8-14	TRK5/8
RKK 5/8-18	5/8-18	7/8-14	0.87	53/64	0.88	7/8-14	TRK5/8
RKK 3/4-10	3/4-10	1 1/8-12	1.12	1 1/16	1.14	1 1/8-12	TRK3/4
RKK 3/4-16	3/4-16	1 1/8-12	1.12	1 1/16	1.14	1 1/8-12	TRK3/4

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General Safety Instructions

Important Safety Notice

⚠ WARNING ⚠

Improper practices or carelessness can cause burns, cuts, mutilation, asphyxiation or other bodily injury or death.

Read and understand all of the safety precautions and warnings before performing any repair. This list contains the general safety precautions that **must** be followed to provide personal safety. Special safety precautions are included in the procedures when they apply.

- Make sure the work area surrounding the product is dry, well lit, ventilated; free from clutter, loose tools, parts, ignition sources and hazardous substances. Be aware of hazardous conditions that can exist.
- **Always** wear protective glasses and protective shoes when working.
- Rotating parts can cause cuts, mutilation or strangulation.
- Do **not** wear loose-fitting or torn clothing. Remove all jewelry when working.
- Disconnect the battery (negative [-] cable first) and discharge any capacitors before beginning any repair work. Disconnect the air starting motor if equipped to prevent accidental engine starting. Put a ‘‘Do **Not** Operate’’ tag in the operator’s compartment or on the controls.
- Use ONLY the proper engine barring techniques for manually rotating the engine. Do **not** attempt to rotate the crankshaft by pulling or prying on the fan. This practice can cause serious personal injury, property damage, or damage to the fan blade(s) causing premature fan failure.
- If an engine has been operating and the coolant is hot, allow the engine to cool before you slowly loosen the filler cap and relieve the pressure from the cooling system.
- Do **not** work on anything that is supported ONLY by lifting jacks or a hoist. **Always** use blocks or proper stands to support the product before performing any service work.
- Relieve all pressure in the air, oil, and the cooling systems before any lines, fittings, or related items are removed or disconnected. Be alert for possible pressure when disconnecting any device from a system that utilizes pressure. Do **not** check for pressure leaks with your hand. High pressure oil or fuel can cause personal injury.
- To prevent suffocation and frostbite, wear protective clothing and ONLY disconnect liquid refrigerant (freon) lines in a well ventilated area. To protect the environment, liquid refrigerant systems **must** be properly emptied and filled using equipment that prevents the release of refrigerant gas (fluorocarbons) into the atmosphere. Federal law requires capture and recycling refrigerant.
- To avoid personal injury, use a hoist or get assistance when lifting components that weigh 23 kg [50 lb] or more. Make sure all lifting devices such as chains, hooks, or slings are in good condition and are of the correct capacity. Make sure hooks are positioned correctly. **Always** use a spreader bar when necessary. The lifting hooks **must not** be side-loaded.
- Corrosion inhibitor, a component of SCA and lubricating oil, contains alkali. Do **not** get the substance in your eyes. Avoid prolonged or repeated contact with skin. Do **not** swallow internally. In case of contact, immediately wash skin with soap and water. In case of contact, immediately flood eyes with large amounts of water for a minimum of 15 minutes. IMMEDIATELY CALL A PHYSICIAN. KEEP OUT OF REACH OF CHILDREN.
- Naptha and Methyl Ethyl Ketone (MEK) are flammable materials and **must** be used with caution. Follow the manufacturer’s instructions to provide complete safety when using these materials. KEEP OUT OF REACH OF CHILDREN.
- To avoid burns, be alert for hot parts on products that have just been turned OFF, and hot fluids in lines, tubes, and compartments.
- **Always** use tools that are in good condition. Make sure you understand how to use them before performing any service work. Use ONLY genuine Cummins or Cummins ReCon® replacement parts.
- **Always** use the same fastener part number (or equivalent) when replacing fasteners. Do **not** use a fastener of lessor quality if replacements are necessary.
- Do **not** perform any repair when fatigued or after consuming alcohol or drugs that can impair your functioning.
- Some state and federal agencies in the United States of America have determined that used engine oil can be carcinogenic and can cause reproductive toxicity. Avoid inhalation of vapors, ingestion, and prolonged contact with used engine oil.

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About The Manual

The procedures in this manual were developed for a shop environment. A Group System has been used to subdivide the instructions by major components and systems. Refer to the Section Contents for the various groups. Wrench sizes and shop tooling are identified in the procedure when needed.

This publication provides general repair information, cylinder block repair, and cylinder head repair. Subsequent versions of the manual will include alternative repairs for additional components as they are developed.

The contents of this manual are based on information in effect at the time of publication and are subject to change without notice.

How to Use the Manual

This manual is divided in the same group system used for Cummins' engine shop manual. Each group is organized in a way that all mechanics, both those who are and are not familiar with the L10 or M11 engine models can reference the manual. Refer to the Table of Contents at the front of the manual to determine the group that details the desired information.

Each group contains the following in sequence:

- Section contents at the beginning of each group to quickly aid in locating the information desired.
- Service tools list with recommended tools needed to rebuild the components.
- General information to aid in repairing the component.
- Step-by-step rebuild instructions for cleaning, inspection and salvage of the component.
- Symbols which represent the action outlined in the instructions. The definitions of the symbols, listed in four languages (English, Spanish, French and German), appear on pages i-4 through i-7.

Topics will be listed alphabetically on the Section Contents page. All procedures are described using the text-symbol-picture (TSP) format.

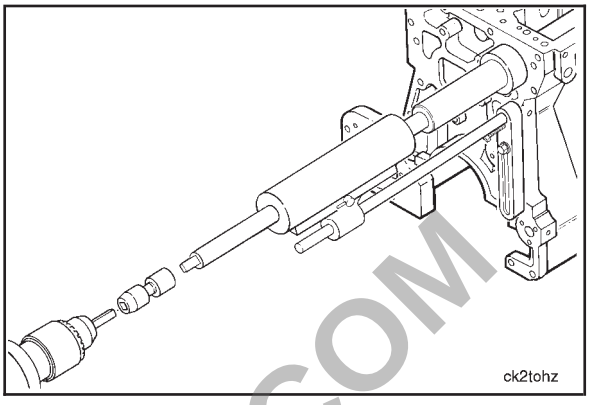
Both metric and U.S. customary values are used in this manual. The metric value is listed first, followed by the U.S. customary in brackets. An example is 60°C [140°F].

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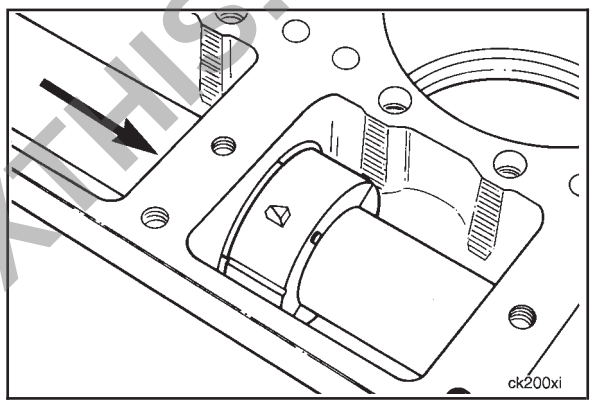
Install the swivel joint, Part No. ST-1277-27, into the chuck of a heavy duty 1/2 inch 450 to 500 RPM drill motor.

Attach the drill motor and swivel joint to the drive unit.

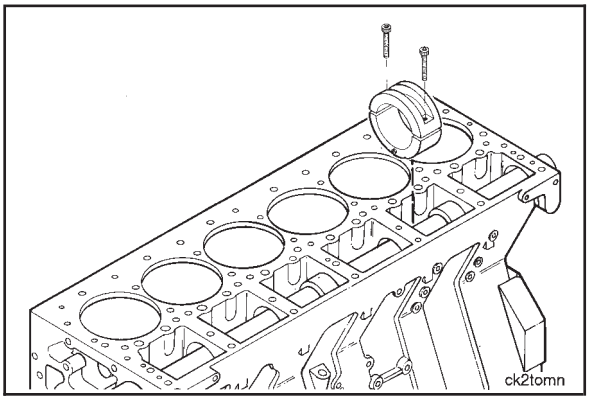


Caution: Do not force the cut. Allow the drive unit to control the feed speed to prevent damage to the cutter assembly.

Use cutting oil. Cut the camshaft bore completely through.

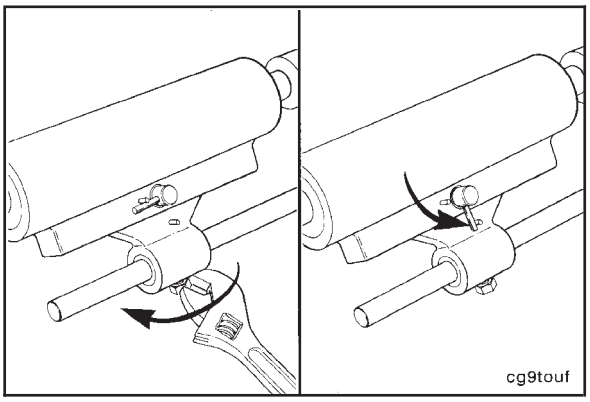


Remove the cutting tool holder.



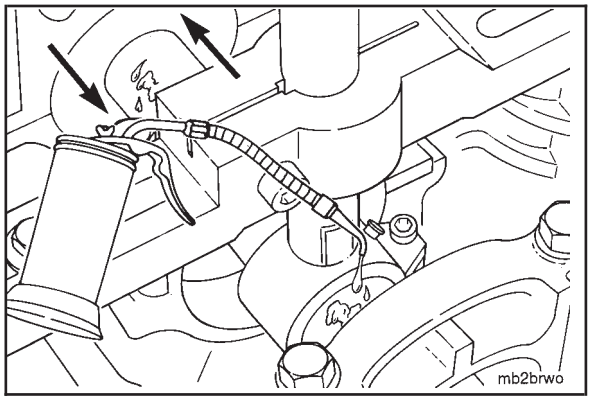
Loosen the thumb screw.

Move the directional lever on the drive unit to the "Open" position and back the boring bar out until there is enough clearance to measure the bore that was just cut.

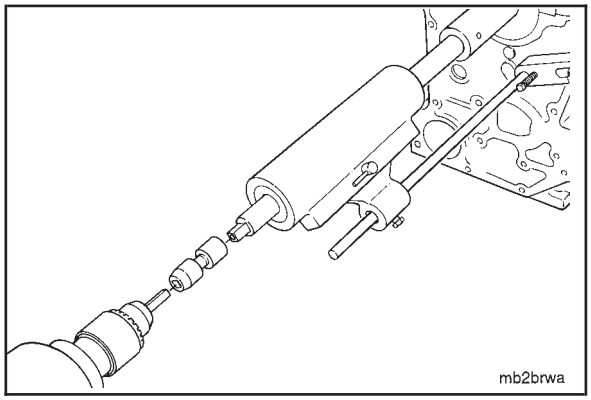


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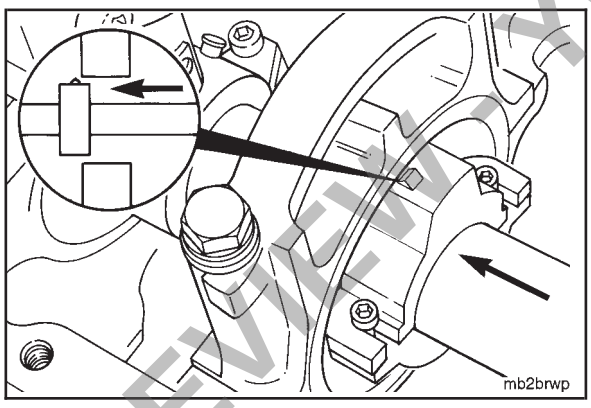


Use clean 15W-40 oil to lubricate the boring bar, centering rings and bearing bar.



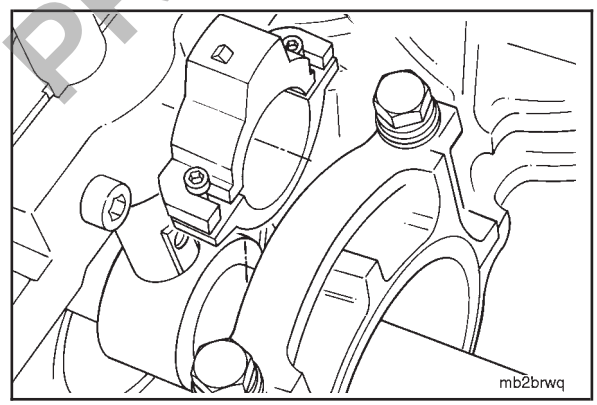
Install the swivel joint, Part No. ST-1177-27, into the chuck of a heavy duty 1/2 inch right hand, 450 to 500 RPM drill.

Attach the swivel joint to the drive unit.



Cut the main bearing bore completely through.

NOTE: Use cutting oil. Do **not** force the cut. Allow the drive unit to control the feed speed.



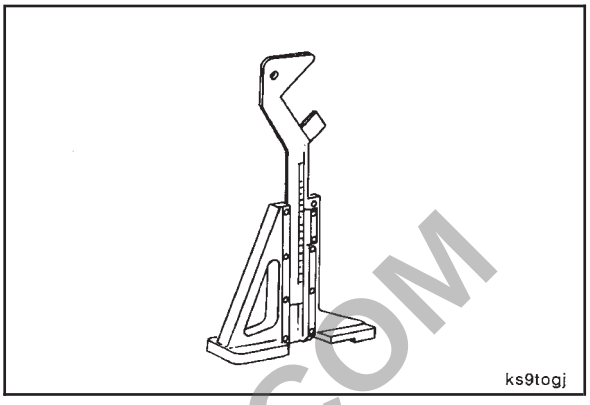
Remove the cutting tool holder.

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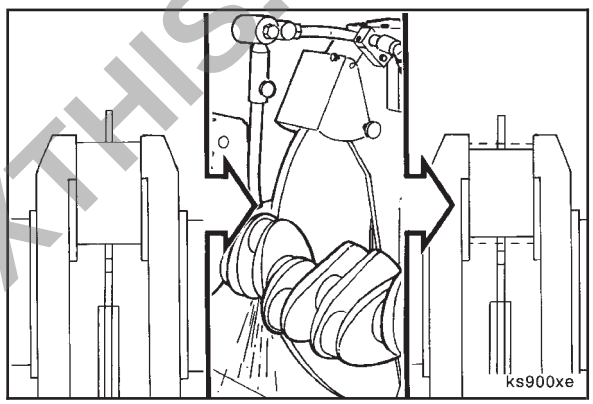
Adjust the size indicating gauge to the specified rod bearing journal diameter.

NOTE: The size indicating gauge is commonly known as an Arnold Gauge.

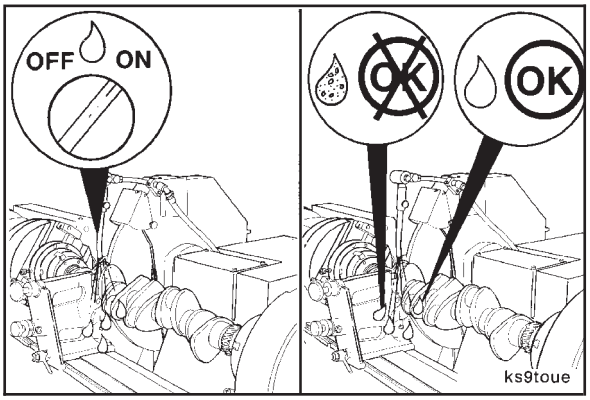


Install the size indicating gauge around the rod bearing journal to be ground.

NOTE: The size indicating gauge will allow the operator to monitor the amount of material being removed from the rod bearing journal during the grinding operation.

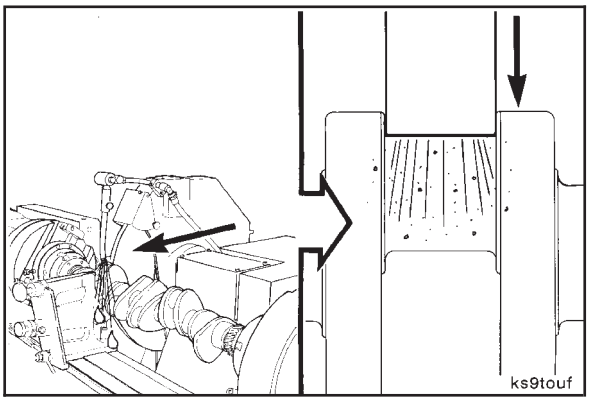


Turn the coolant "ON". Adjust the coolant flow to minimize the amount of air trapped in the liquid. A smooth continuous flow is preferred.



Very carefully bring the grinding wheel towards the rod bearing journal.

NOTE: Keep the grinding wheel centered so that it starts to spark on both sides of the rod bearing journal at the same time.



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