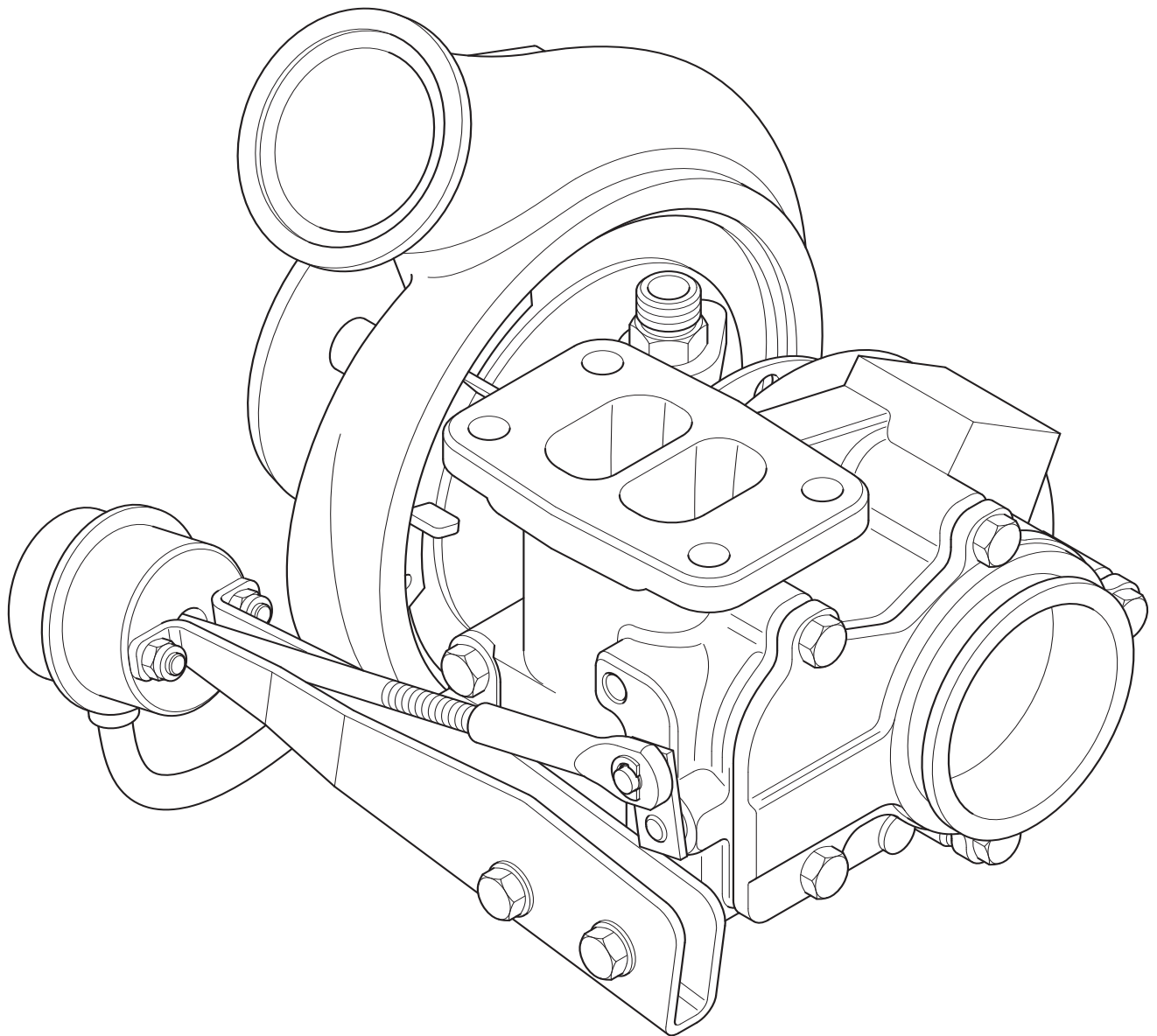


Holset HX30/32/35/38/40/G/W

Service Repair Manual



Foreword

This publication was written to assist with turbocharger installation, maintenance and overhaul. It is not a warranty of any kind expressed or implied.

The specifications and procedures in this manual are based on information in effect at the time of publication. Cummins Turbo Technologies Ltd reserves the right to make any changes at any time without obligation. If differences are found between your turbocharger and the information in this manual, contact your local approved agent.

The latest technology and the highest quality standards are used in the manufacture of Holset Turbochargers. When replacement parts are needed, we recommend using only genuine Holset parts.

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About the Manual

The procedures in this manual were developed to instruct in the correct overhaul of the designated turbochargers for optimum performance and minimum maintenance operation.

How to Use the Manual

The manual is split into sections designed to provide service information in a logical sequence. The manual contains links to help the user navigate between relevant sections. Users who are unfamiliar with navigating in PDF documents are referred to Navigating in PDF documents in the **Adobe® Acrobat® Reader™** help file.

Contents is an interactive page with links to all the sections. It can be accessed from any page in the manual by clicking this icon.

Section 1 defines the layout of the manual, introduces the reader to the operation of the turbocharger and presents important installation guidelines.

Sections 2, 3 and 4 concentrate on Turbocharger Component Identification, Troubleshooting and Diagnosis, Component Testing and Replacement.

Section 5 identifies the Service and Overhaul procedures to be followed in the unlikely event of a major turbocharger malfunction.

Section 6 quantifies build data to ensure the turbocharger will continue to operate to Holset Service standard on completion of overhaul.

Manual sections 1 to 5 where applicable, appear as a self extracting compressed file which is organised according to the steps needed to most easily and correctly maintain the operation of the turbocharger. Users are required to download this file to hard disk. Section 6 has its own file identity and resides at www.holsetaftermarket.com so that service data can be updated as changes occur. The links between manual and service data are active only when the user is connected to the Internet.

Chapter 6 has an expiry date to encourage users to discard outdated saved or printed versions and always access the latest information available at www.holsetaftermarket.com.

When using the manual on-line this icon will link to Holset Aftermarket's website to help find your nearest agent for advice and how to order Holset original parts.

How to Order Holset Original Parts

To make sure of optimum performance, certain items must be discarded during disassembly and replaced with new for re-assembly. These items are indicated in the Service and Overhaul section with the use of a* symbol. All items showing a* are available in a basic overhaul kit.

To get the correct parts for your turbocharger, refer to the 'component identification' section of this manual to help you find the following information:

- 1) Refer to the exploded view and component list to define the major components to be replaced.
- 2) Refer to the turbocharger's dataplate which will be found on the compressor housing or wastegate actuator to define the identifying information about your turbocharger build standard.
- 3) Contact your local agent with component identification nos. and dataplate assembly no., serial no. and turbocharger type.
- 4) With this information, your local agent can provide you with the optimum kit of parts for re-assembling your turbocharger for continued long life operation.

Description and Operation of Turbocharger



General Information

A turbocharger is a mechanical device which uses the engine's exhaust gases to force more air into the engine cylinders. Hot exhaust gas energy is used to turn a turbine wheel and shaft. At the other end of the shaft is the compressor impeller (or compressor wheel), which draws in air and forces it into the engine cylinders.

Supplying increased air mass flow to the engine provides improved engine performance, lower exhaust smoke density, improved operating economy and altitude compensation. The turbocharger has proven to be one of the most beneficial devices for improving engine performance. It performs its job very well, as long as it is properly cared for.

Introduction to Wastegate Turbochargers

The need for wastegated turbochargers

A standard turbocharger can be perfectly matched to only one particular engine condition, eg maximum torque speed or maximum load speed. At this engine speed, the turbocharger supplies the optimum mass of air to give the required air/fuel ratio. At other speeds the air/fuel ratio cannot be held at the optimum hence fuel consumption and emission levels worsen.

Engine emission legislations have forced manufacturers to improve their engine efficiencies, particularly at low speeds where low air/fuel ratios cause high smoke levels.

The Holset integral wastegate turbocharger is a cost effective solution to this problem and for a small increase in complexity, a simple variable flow turbine housing has been achieved.

Integral wastegate turbochargers have been available for passenger cars for many years. Holset has developed such a turbocharger with components designed for extended life equal to that of standard commercial vehicle turbochargers.

The importance of correctly servicing the wastegate actuator mechanism

A wastegate turbocharger requires accurate setting at point of manufacture. It is very important to adhere to setting limits when servicing the turbocharger, as failure to do so could result in turbocharger or engine failure.

Effects of wrong setting

Possible consequences if turbocharger boost pressure is too low:-

- Engine runs fuel rich
- Exhaust temperature increase
- Hydrocarbon levels increase
- High cylinder temperature risks damage to engine pistons
- Fuel consumption increase
- Smoke levels increase
- Risks of failing emissions tests

Possible consequences if turbocharger boost pressure is too high:-

- Engine runs fuel weak (lean)
- Excessive boost overspeeds turbocharger
- Increased cylinder pressure risks damage to engine head gasket, pistons and valves
- Nitrous oxide levels increase
- Turbocharger bearing failure and wheel fatigue problems
- Intercooler load increases causing engine to overheat, risking piston damage



Notes, Cautions and Warnings

Notes, Cautions and Warnings are used in this manual to emphasise important or critical instructions.

Note

Information which is essential to highlight.

Caution

Maintenance or Service procedures which if not strictly followed, will result in damage or destruction of the turbocharger.

Warning

Maintenance or Service procedures which if not correctly followed will result in personal injury or loss of life.

Warning

Some parts are manufactured in fluoroelastomers (eg Viton) or similar that require special treatment in the case of repair and service after fire.

Warning

Turbocharger surface temperature during operation can achieve 700°C (1300°F).

Warning

The designated range of turbochargers weighs up to 15 kg (33 lb) and is fitted with external parts that are sensitive to manual handling.

Caution

Turbochargers manufactured using the 'core balance' process will not have co-relation marks on rotor parts. A core balanced turbocharger MUST be check balanced on rebuild. Where a core balancing machine is not available, it is essential that rotor parts are marked during disassembly so that these parts can be reassembled in the same relative positions.

Operating a turbocharger with rotor or core balance levels greater than published limits could cause turbocharger or engine failure.

Caution

Always check actuator and wastegate mechanism function before proceeding with turbocharger disassembly. Unless wastegate actuator is to be renewed, leave turbine housing, bracket and actuator as an assembly while servicing turbocharger. Never adjust the end link of an assembled wastegate turbocharger. End links are set to precise limits to maintain emissions and performance specifications.



Notes, Cautions and Warnings

Notes, Cautions and Warnings are used in this manual to emphasise important or critical instructions.

Note

Information which is essential to highlight.

Caution

Maintenance or Service procedures which if not strictly followed, will result in damage or destruction of the turbocharger.

Warning

Maintenance or Service procedures which if not correctly followed will result in personal injury or loss of life.

Note

Many turbochargers are returned that are no fault found. Before assuming the turbocharger is not performing to specification always refer to the engine diagnostic system and the troubleshooting diagnostic procedures of this manual.

Note

Holset turbochargers can be remanufactured using recovered parts. Where it is necessary to dispose of components or whole turbochargers, an environmentally responsible process such as recycling should be used, with due regard to local laws.

Installation Data



1. Many turbochargers are returned that are no fault found. Before assuming the turbocharger is not performing to specification always refer to the engine diagnostic system and the fault finding chart of this manual to make all the recommended health checks.
2. It is important that intake and exhaust systems are fitted in accordance with the recommendations of the Equipment and Engine manufacturers. It is important not to overload the turbocharger by external attachments or forces.
3. The air filter must remove particles greater than 5 μm at an efficiency of 95% and be of sufficient capacity to match the air consumption of the engine. Recommended filters should always be used with a pressure drop indicator. Intake systems must be tightened to the values specified by the Equipment and Engine manufacturers to withstand depressions up to 6.3 kPa (0.91 lbf/in²).
4. Hose and clip connections of the intake manifold system must be tightened to the values specified by the Equipment and Engine manufacturers to withstand turbocharger pressure ratio.
5. Exhaust system connections must be tightened to the values specified by Equipment and Engine manufacturers to be capable of operating at exhaust back pressures of up to 10 kPa (1.5 lbf/in²). Subject to extensive review and formal approval, this limit may be increased to 25 kPa (3.6 lbf/in²) if a catalytic convertor is fitted. Exhaust brake applications are permitted to operate at a continuously rated pressure up to 450 kPa (65.3 lbf/in²) back pressure.
6. Oil should be filtered to 10 μm with efficiency of 60% TWA (Time Weighted Average) /20 μm with efficiency of 85% TWA. Efficiency assessed to ISO Standard 16889:1999 (was 4572/SAE J 1858). Always use filters recommended by engine manufacturer.
7. The oil quality must be as specified by the Engine manufacturer and will be a minimum API SE - CD (MIL - L - 2104C) specification. Improved life can be obtained by using super high performance diesel (SHPD) oils, particularly where extended oil drain periods are used.
8. Normal oil temperature is 95+/-5°C (203+/-9°F). It should not exceed 120°C (248°F) under any operating condition.
9. Any pre-lube oil must be clean and meet the minimum CD classification.
10. The orientation of turbine housing, bearing housing and compressor cover is fixed according to application. During installation, do not attempt to rotate these components.
11. Oil return pipes are permitted to decline at an overall angle of not less than 30 degrees below horizontal. All turbocharger applications require a pipe of internal diameter greater than 19 mm which has integrated connectors. To ensure oil drains into the engine under all operating conditions, the return connection into the engine sump must not be submerged and the outlet flange of the turbocharger must be 50 mm above the maximum oil level of the engine sump pan.
12. Crankcase pressure should be limited to 0.8 kPa (0.12 lbf/in²). Pressure above this level should be referred for further evaluation. Closed crankcase ventilation (CCV) systems are known to operate at elevated pressure and all applications must be referred for approval.
13. Oil pressure of 150 kPa (20 lbf/in²) must show at the turbocharger oil inlet within 3 - 4 seconds of engine firing to prevent damage to turbocharger bearing system. A flexible supply pipe is recommended.
14. The minimum oil pressure when the engine is on load must be 210 kPa (30 lbf/in²). Maximum permissible operating pressure is 500 kPa (72 lbf/in²) although 600 kPa (88 lbf/in²) is permitted during cold start up. Under idling conditions pressure should not fall below 70 kPa (10 lbf/in²).
15. Recommended oil flows for the turbochargers are 2 litre/min at idle and 3 litre/min above maximum torque speed.
16. Do not use liquid gasket substances or thread sealant as any excess can enter the turbocharger oil system to obstruct flow.
17. Recommended coolant flows for the turbochargers are 2 litre/min at idle and 7 - 10 litre/min above maximum torque speed.

Note:

100 kPa = 1 bar (14.5037 lbf/in²=psi).

Installation Checklist



1. Always understand why the original turbocharger needs replacing before fitting another unit.
2. Check the turbocharger dataplate to ensure the Part No. is correct for the engine/application.
3. Check the engine exhaust, intake and aftercooler systems are clean and without obstruction i.e. free from oil, gasket pieces, dust/dirt/carbon or foreign objects.
4. Replace the oil and air filters using replacement parts specified by the equipment manufacturer.
5. Change the engine oil using the type specified by the engine manufacturer.
6. Check that the turbocharger oil inlet and drain pipes and connectors are clean, free from obstruction and will not leak under pressure.
7. Check that the coolant pipes of water cooled bearing housing applications and connectors are clean, free from obstruction and will not leak under pressure.
8. To pre-lube the turbocharger bearings, pour some clean engine oil into the oil inlet and rotate the turbocharger rotor assembly by hand.
9. Check that the exhaust manifold flange is flat and undamaged. Mount the turbocharger on the flange and check that the turbine inlet gasket fits properly without obstructing the gas passages.
10. Assemble the air intake and boost outlet connections. Check that the connections are well made and will not leak in use.
11. Check the exhaust system is fitted using the original mounting arrangement provided by the equipment manufacturer. Always re-fit any supports/brackets back in position to ensure the system is correctly supported.
12. Assemble the exhaust system to the turbine housing outlet. Check that the gasket/connection is well made and will not leak in use.
13. Assemble any coolant pipes and check that the connections are well made, without obstruction and will not leak in use.
14. Assemble the turbocharger oil inlet pipe and check that the connection is clean, well made and will not leak in use.
15. Check all clamps and fasteners are correctly tightened to the torque recommended by the equipment manufacturer.
16. Connect the air pipe from the compressor housing/inlet manifold to the wastegate actuator ensuring the pipe bore is clean and dry before fitment.
17. Make any ECU checks recommended by the engine manufacturer.
18. Crank the engine WITHOUT firing until engine oil flows out of the turbocharger drain flange.
19. Assemble the oil drain pipe and check that the connection is well made, without obstruction and will not leak in use.
20. Start the engine and run at idle speed for approximately 1 minute so that the oil supply system is fully operational.
21. Accelerate the engine and check that there are no leaks/obstructions of air/oil/coolant/gas under pressure.
22. Check that no hose or connection deforms under normal operation.
23. Before switching off the engine, leave it running at idle speed for at least 1 minute to cool the turbine.

Symbols



Symbole - Deutsch

In diesem Handbuch werden die folgenden Symbole verwendet, die wesentliche Funktionen hervorheben. Die Symbole haben folgende Bedeutung:



WARNUNG - Unterhaltungs und Wartungsverfahren müssen genau befolgt werden, da ein Nichtbeachten zu Personenschäden oder tödlichen Verletzungen führt.



ACHTUNG - Falls Unterhaltungs und Wartungsverfahren nicht genau beachtet werden, kann der Turbolader dadurch beschädigt oder zerstört werden.



AUSBAU bzw. **ZERLEGEN**.



EINBAU bzw. **ZUSAMMENBAU**.



INSPEKTION erforderlich.



Teil oder Baugruppe **REINIGEN**.



DIMENSION - oder **ZEITMESSUNG**.



Teil oder Baugruppe **ÖLEN**.



WERKZEUGGRÖSSE wird angegeben.



ANZUG auf vorgeschriebenes Drehmoment erforderlich.



Sicherstellen, daß die **AUSWUCHTMARKEN** an der Rotor-Baugruppe richtig ausgerichtet sind.



Elektrische **MESSUNG DURCHFÜHREN**.



Weitere Informationen an anderer Stelle bzw. in anderen Handbüchern.



Schutzkleidung muß immer getragen werden.



Deutet an, daß Teile schwer sein können.



Website-Verzeichnis mit Ihrem nächsten Händler.



Gehe zu Inhalt



Symbols - English

The following group of symbols have been used in this manual to help communicate the intent of the instructions. When one of the symbols appears, it conveys the meaning defined below.



WARNING - Serious personal injury or extensive property damage can result if the warning instructions are not followed.



CAUTION - Minor personal injury can result or a part, an assembly or the engine can be damaged if the caution instructions are not followed.



Indicates a **REMOVAL** or **DISASSEMBLY** step.



Indicates an **INSTALLATION** or **ASSEMBLY** step.



INSPECTION is required.



CLEAN the part or assembly.



PERFORM a mechanical or time **MEASUREMENT**.



LUBRICATE the part or assembly.



Indicates that a **WRENCH** or **TOOL SIZE** will be given.



TIGHTEN to a specific torque.



Ensure that the **BALANCE MARKS** on the rotor assembly are in alignment



PERFORM an electrical **MEASUREMENT**.



Refer to another location in this manual or another publication for additional information.



Please wear protective clothing at all times.



Indicates components may be heavy.



Website access to find your nearest Agent.



Go to contents



Simbolos - Español

Los simbolos siguientes son usados en este manual para clarificar el proceso de las instrucciones. Cuando aparece uno de estos simbolos, su significado se especifica en la parte inferior.



ADVERTENCIA – Procedimientos de Mantenimiento o Servicio que al no seguirse resultarán en daños personales o pérdida de vida.



ATENCION – Procedimientos de Mantenimiento o Servicio que al no seguirse al pie de la letra, resultarán en el daño o la destrucción del turbosobrealimentador.



Indica un paso de **REMOCION o DESMONTAJE**.



Indica un paso de **INSTALACION o MONTAJE**.



Se requiere **INSPECCION**.



LIMPIESE la pieza o el montaje.



Ejecutese una **MEDICION** mecánica o del tiempo.



LUBRIQUESE la pieza o el montaje.



Indica que se dar una **LLAVE DE TUERCAS** o el **TAMAÑO DE HERRAMIENTA**.



APRIETESE hasta un par torsor específico.



Ceriórese de que estén alineadas las marcas de balance en el rotor.



EJECUTESE una **MEDICION** eléctrica.



Para información adicional refiérase a otro emplazamiento de este manual o a otra publicación anterior.



Favor de siempre llevar ropa protectora.



Indica que los componentes pueden ser pesados.



Acceso a Sitio Web para localizar su agente más cercano.



Ir a la tabla de materias



Symboles - Français

Les symboles suivants sont utilisés dans ce manuel pour aider à communiquer le but des instructions. Quand l'un de ces symboles apparaît, il évoque le sens défini ci-dessous:



ATTENTION DANGER - Procédures de maintenance ou d'entretien qui, si elles ne pas observées correctement, auront pour résultat des lésions corporelles ou un décès.



MISE EN GARDE - Procédures de maintenance ou d'entretien qui, si elles ne sont pas observées strictement, auront pour résultat de causer des dégâts au turbocompresseur ou de conduire à sa destruction.



Indique une opération de **DEPOSE**.



Indique une opération de **MONTAGE**.



L'INSPECTION est nécessaire.



NETTOYER la pièce ou l'ensemble.



EFFECTUER une **MESURE** mécanique ou de temps.



GRAISSER la pièce ou l'ensemble.



Indique qu'une **DIMENSION DE CLE** ou **D'OUTIL** sera donnée.



SERRER à un couple spécifique.



S'assurer que les repères d'équilibrage sur l'ensemble de rotor sont alignés.



EFFECTUER une **MEASURE** électrique.



Se reporter à un autre endroit dans ce manuel ou à une autre publication pour obtenir des information plus complètes.



Il faut toujours mettre vêtements de protection.



Indique que les composants peuvent être lourds.



Accès au site Web pour trouver l'agent le plus proche.



Aller au sommaire



Símbolos - Português

Os símbolos a seguir serão utilizados neste manual para facilitar a comunicação das instruções e seu significado está descrito abaixo.



ATENÇÃO - Os procedimentos de Manutenção ou Serviços que não forem seguidos corretamente resultarão em ferimentos pessoais ou riscos de vida.



AVISO - Os procedimentos de Manutenção ou Serviço que não forem rigorosamente seguidos resultarão em danos ou destruição do carregador turbo.



Indica um passo de **DESMONTAGEM**.



Indica um passo de **MONTAGEM**.



Requer inspeção.



LIMPE a peça ou conjunto.



Requer Medição mecânica ou de tempo.



LUBRIFIQUE a peça ou o conjunto.



Indica necessidade de **APERTO**.



TORQUEAR de acordo com o especificado.



Assegure-se de que as **MARCAS DE BALANCEAMENTO** do conjunto eixo-rotor estejam alinhadas.



Requer medição **ELÉTRICA**.



Procure em outra seção deste manual ou em publicação para obter informações adicionais



Por favor, sempre utilize EPI (Equipamento de Proteção Individual)



Indica que os componentes podem estar pesados.



Visite o Website para encontrar o seu Agente mais perto.



Vá para Conteúdo

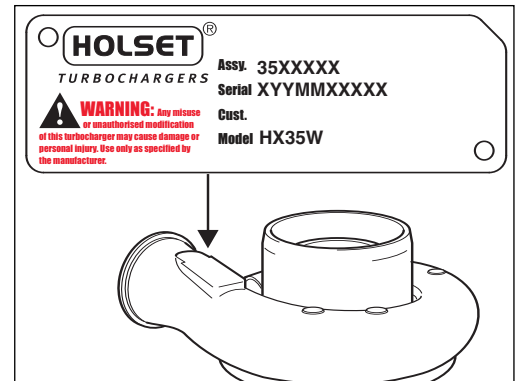
Turbocharger Identification



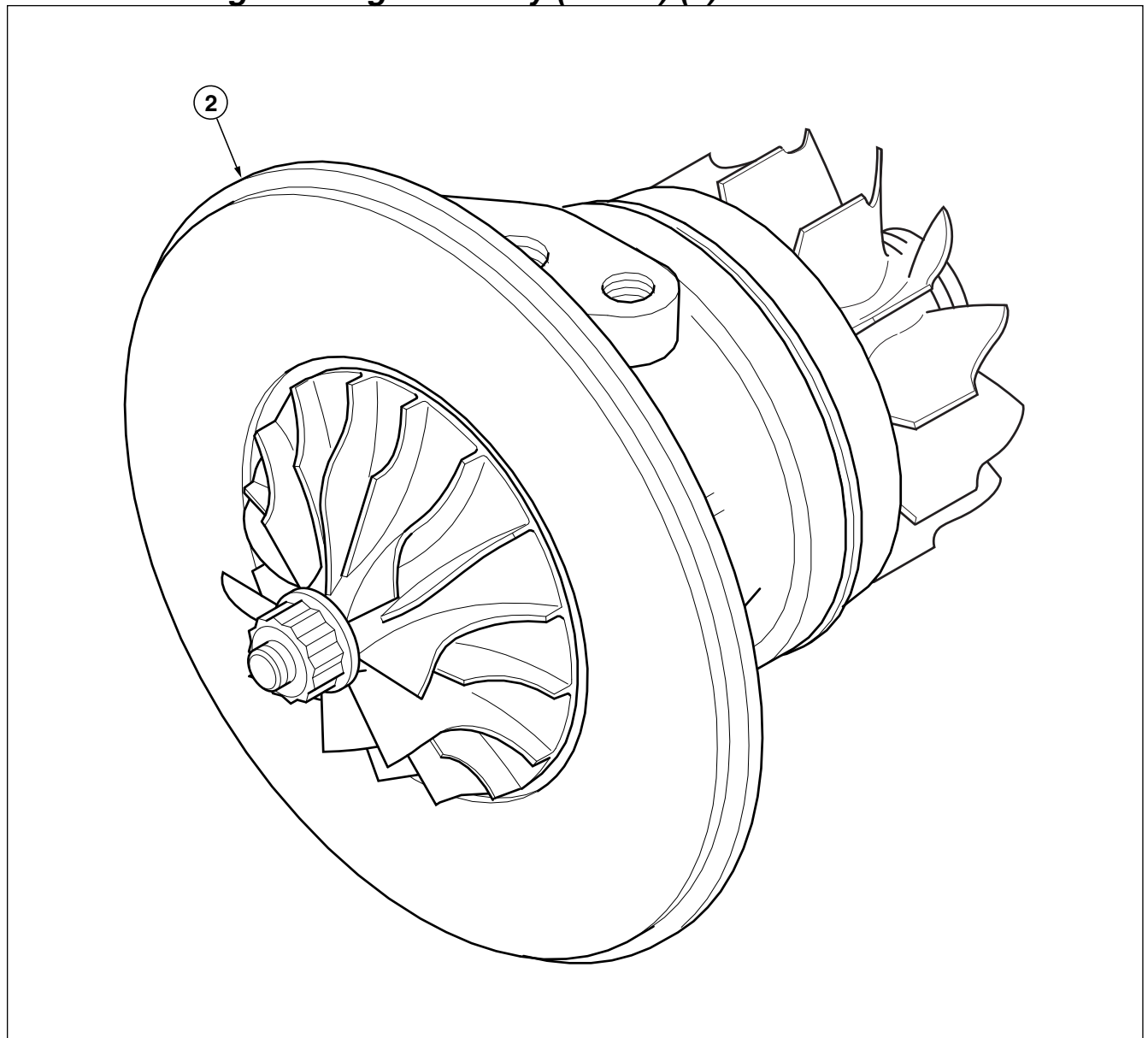
Dataplate

Note

Dataplates will be fitted to the compressor housing (8). The information from the dataplate must be quoted for service and parts support.



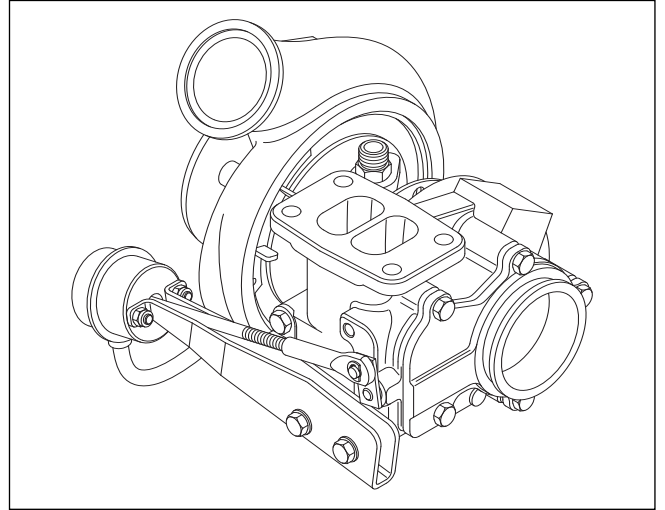
Center Housing Rotating Assembly (CHRA) (2)



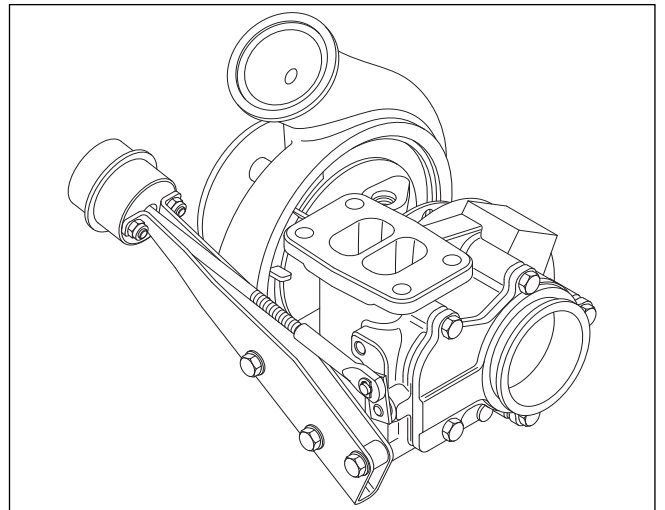


Installation Options

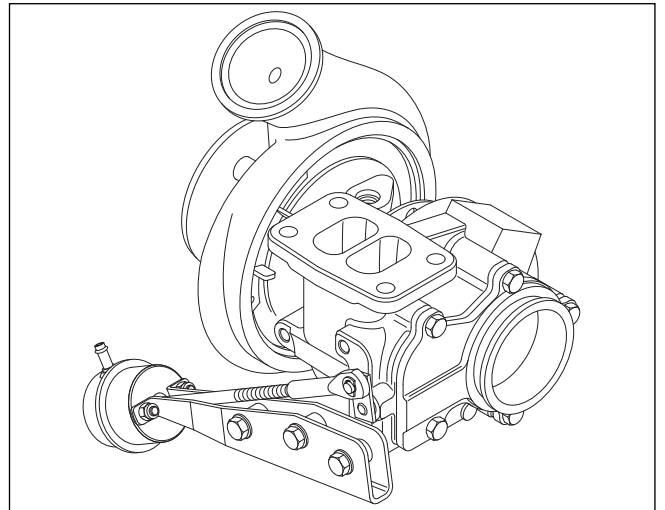
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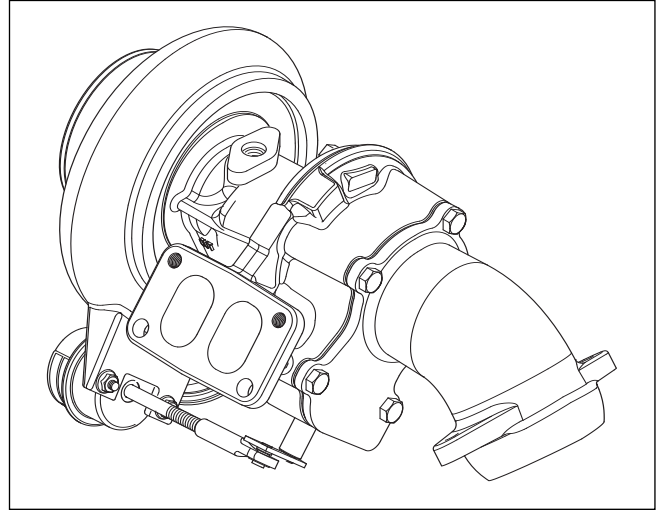
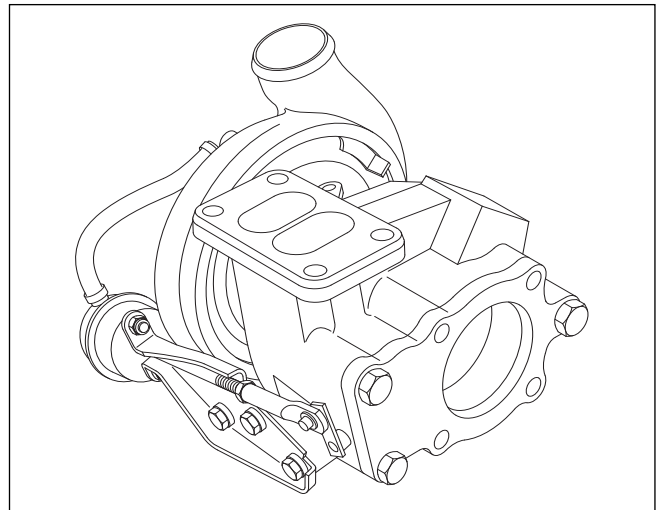
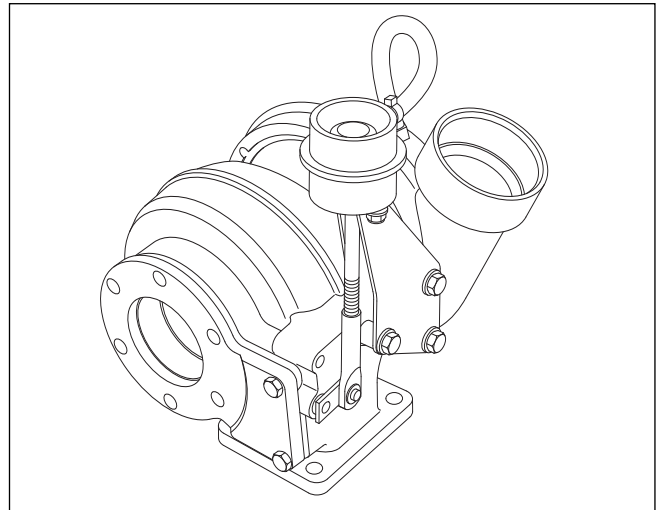


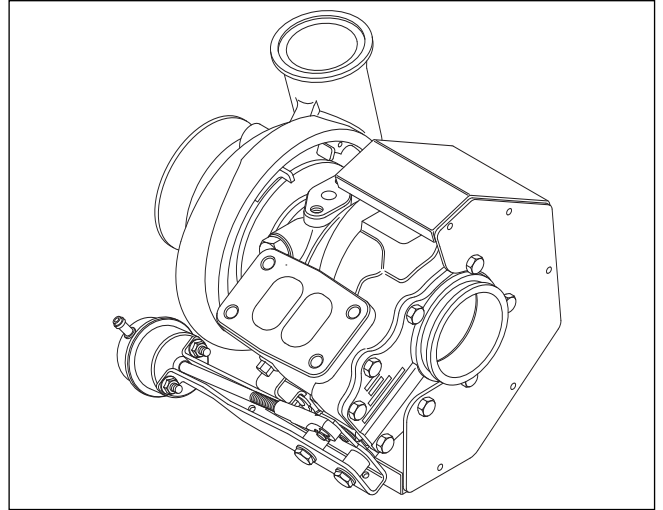
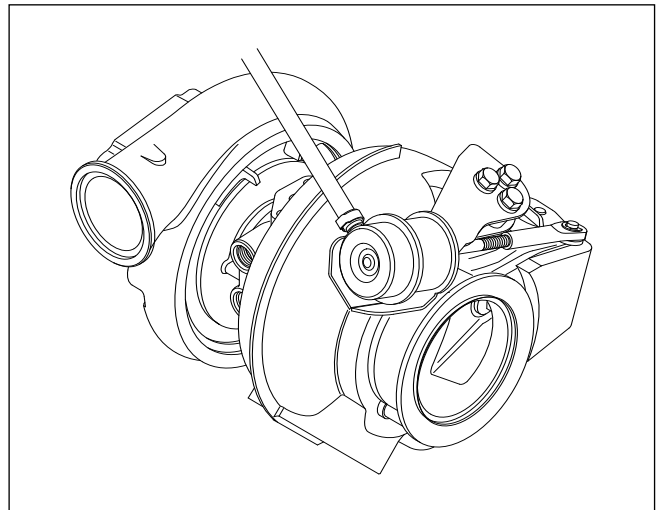
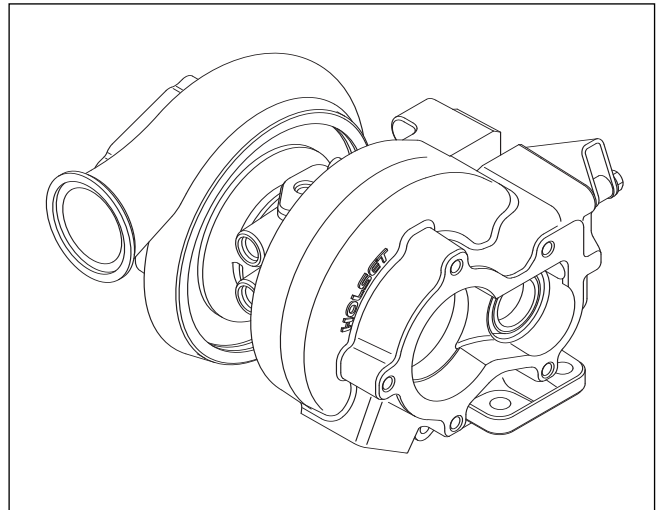
Type B

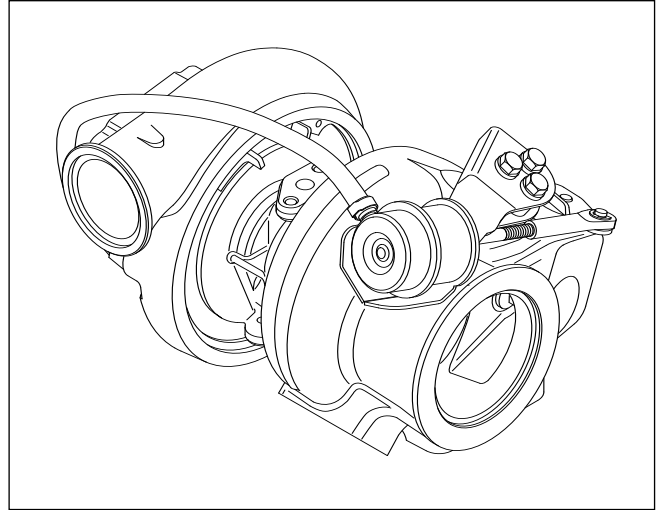
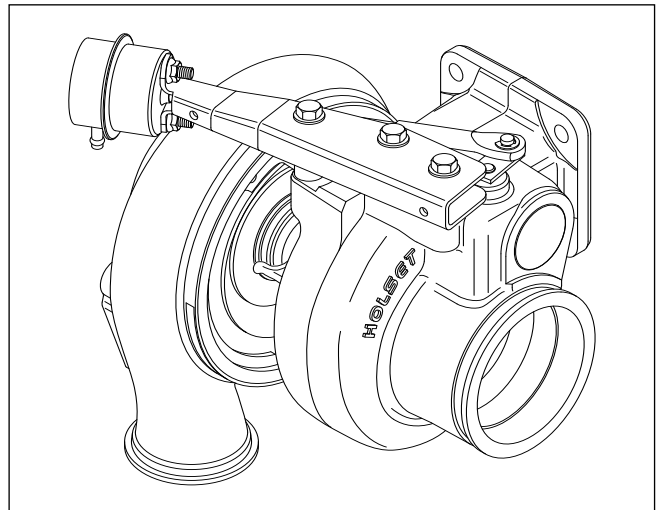
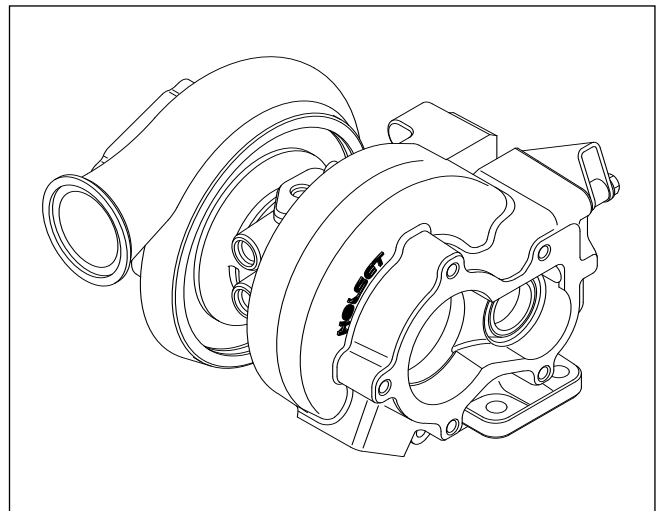


Type C

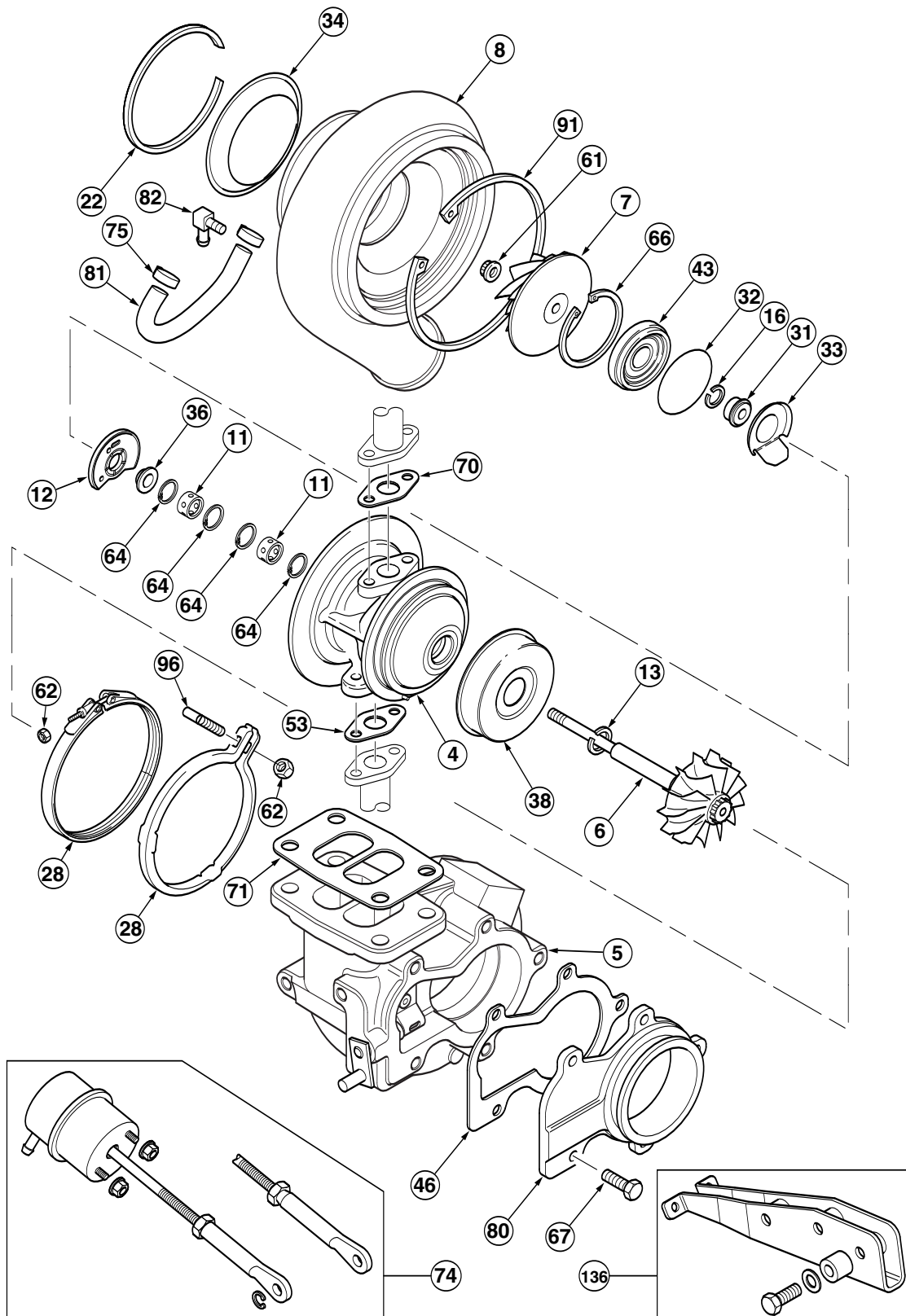


**Type D****Type E****Type F**

**Type G****Type H****Type I**

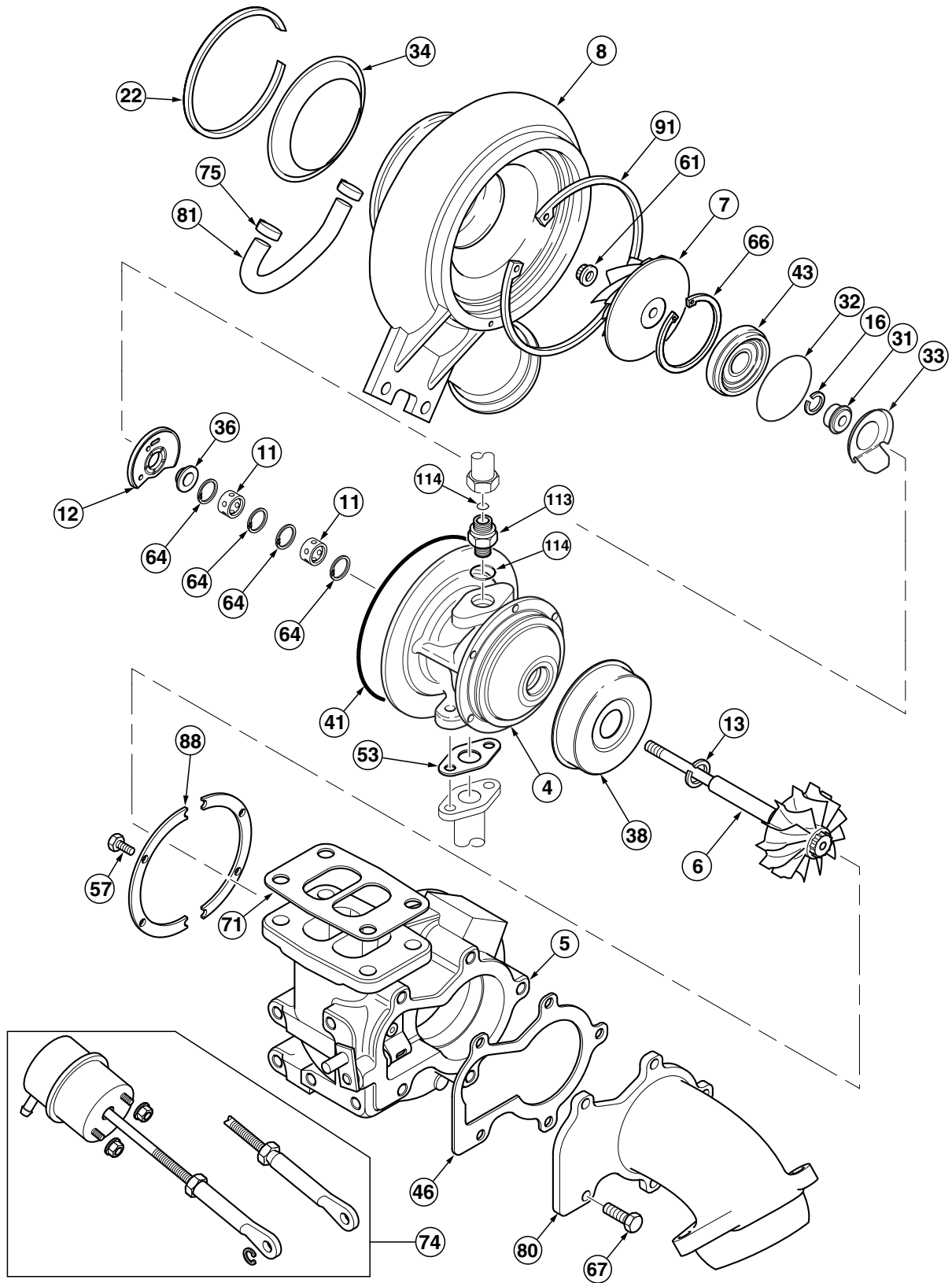
**Type J****Type K****Type L**

Exploded View - HX30/32W

**Note**

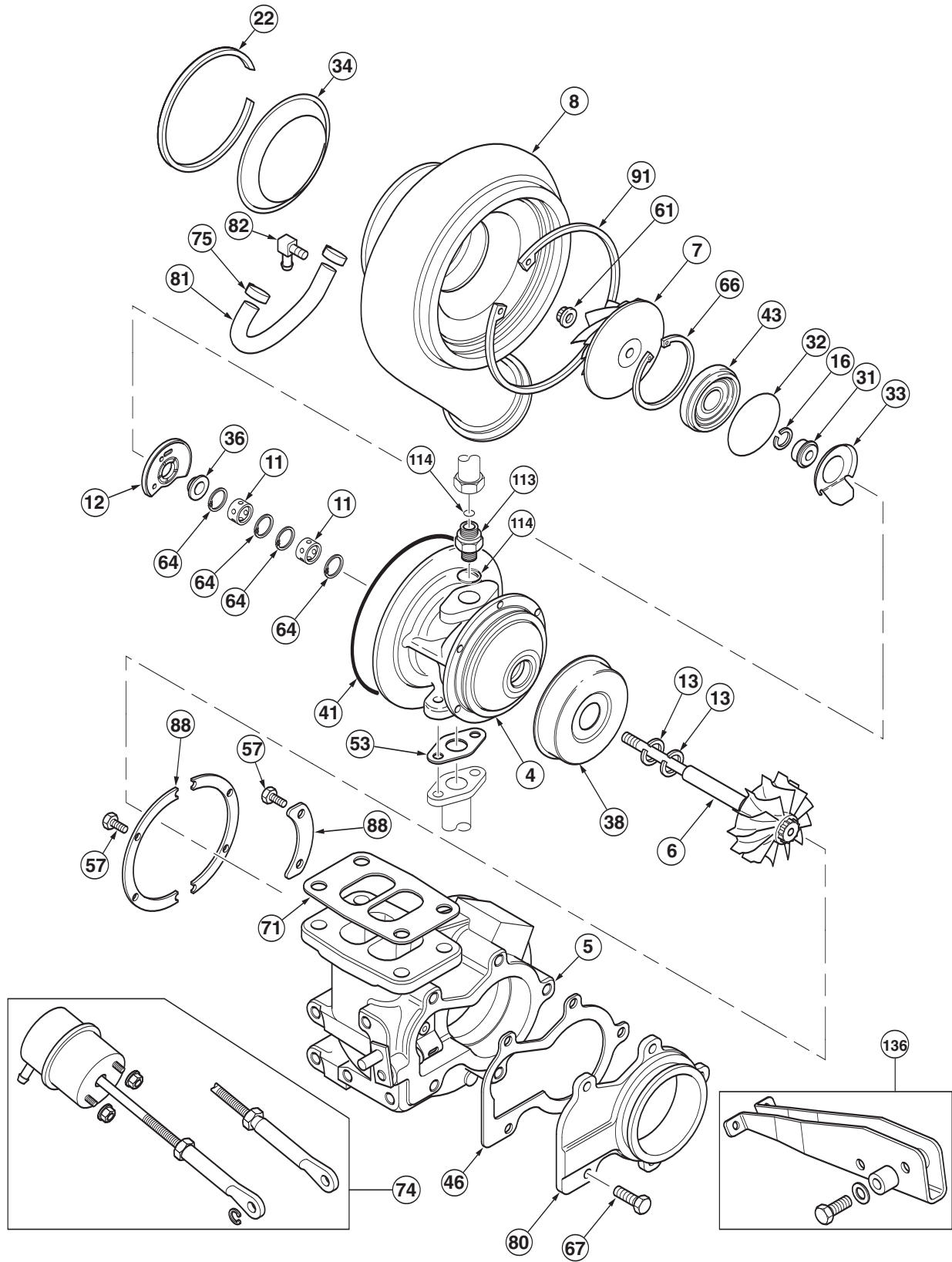
Exploded views represent a generic build standard. Parts may be added or subtracted in specific applications.

Exploded View - HX35W

**Note**

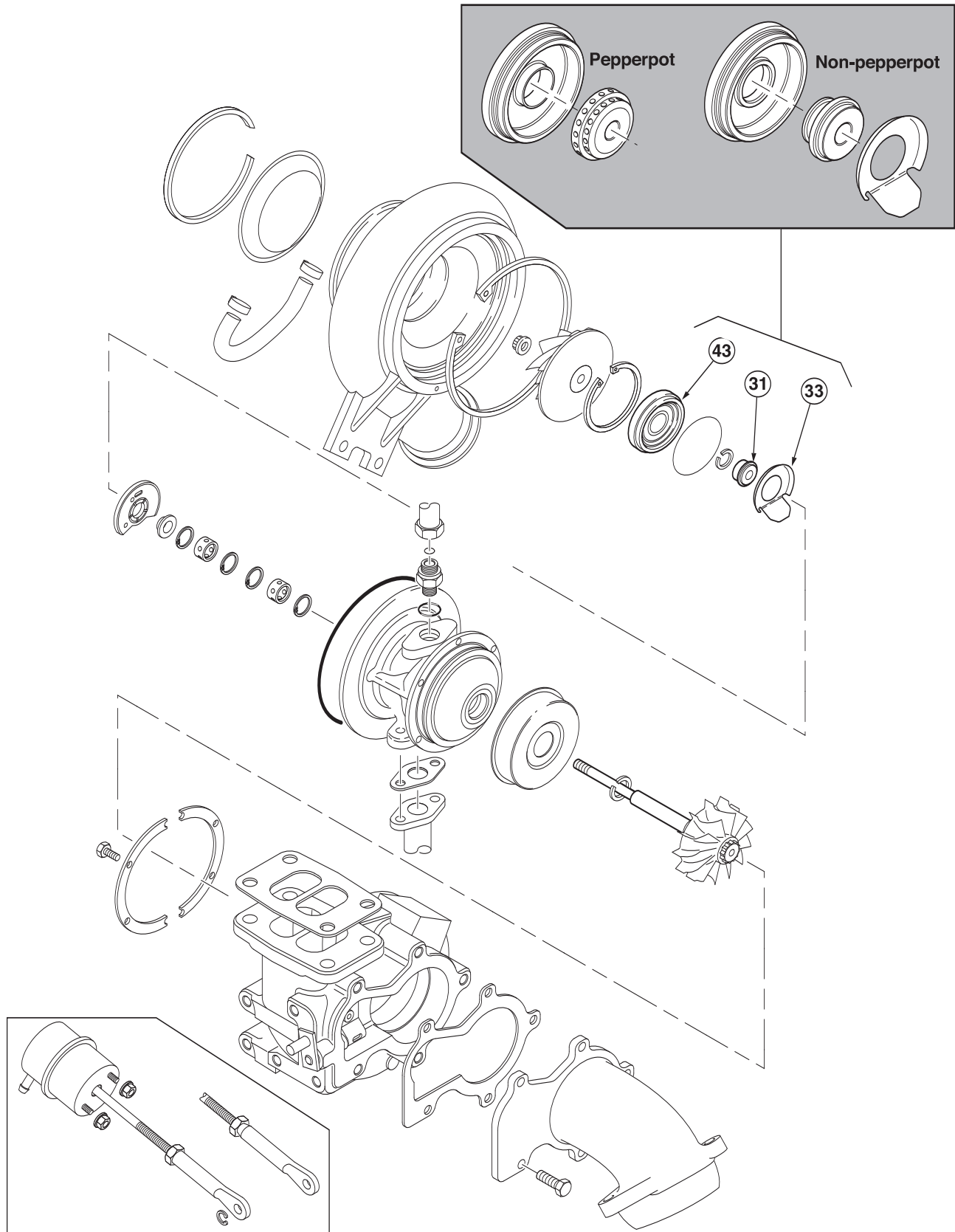
Exploded views represent a generic build standard. Parts may be added or subtracted in specific applications.

Exploded View - HX35/38/40/G/W

**Note**

Exploded views represent a generic build standard. Parts may be added or subtracted in specific applications.

Exploded View - Non interchangeable components



Note

Exploded views represent a generic build standard. Parts may be added or subtracted in specific applications.

Component List

Item No.	Description	Quantity
1	Repair Kit CHRA (Core)*	1
2	CHRA (Core)	1
4	Bearing Housing	1
5	Turbine Housing	1
6	Assembly, Turbine Wheel	1
7	Compressor Wheel	1
8	Compressor Housing	1
11	Journal Bearing*	2
12	Thrust Bearing*	1
13	Split Ring Seal, Turbine*	1/2
16	Split Ring Seal, Compressor*	1
22	Retaining Ring, Inlet Baffle	1
28	V-band Clamp, Turbine	0/1
31	Oil Slinger	1
32	O-Ring Seal, Bearing Housing*	1
33	Oil Baffle*	0/1
34	Inlet Baffle	1
36	Thrust Collar	1
38	Heat Shield	1
41	O-Ring Seal, Compressor Housing*	0/1
43	Oil Seal Plate	1
46	Gasket, Coverplate	1
53	Gasket, Oil Outlet*	1
57	Bolt, Turbine Housing	0/4/6/8
61	Locknut, Compressor Wheel	1
62	Locknut, V-band*	0/1
64	Retaining Ring, Bearing*	4
66	Insert, Retaining Ring	1
67	Bolt, Coverplate	2/3/5
70	Gasket, Oil Inlet*	0/1
71	Gasket, Turbine Housing*	1

Note

Exploded views may not contain all listed components.

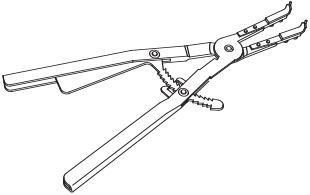
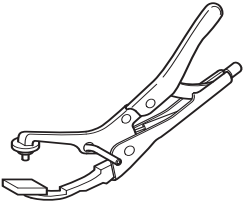
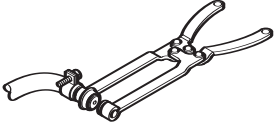
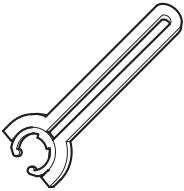
Component List

Item No.	Description	Quantity
80	Coverplate, Wastegate	1
81	Hose	1
82	Elbow, Coupling Hose	0/1
88	Clamp Plate, Turbine housing	0/2/3
91	Retaining Ring, Compresor Cover	1
96	Screw, V-band	0/1
113	Adapter, Oil Inlet	0/1
114	O-Ring Seal, Oil Inlet	0/2
116	Adapter, Oil Drain	0/1
117	O-Ring Seal, Oil Outlet	0/1
136	Bracket Kit	0/1
100	Banjo Connector, Union	0/2
101	Banjo Connector, Screw	0/2
103	Blanking Plug	0/1/2/4
105	Connector Male	0/2/3
65	Sealing Washer	0/4
115	O-Ring Seal, Water	0/4
74	Pre-set Actuator Kit comprising:	1
73	Actuator	1
75	Hose Clamp	2
76	End Link, Assembly	1
77	End Link, Retaining Clip	1
83	Locknut, Actuator	2
128	Jam Nut	0/1

Purchasable Service Tools



The following special tools can be purchased from your local Authorised Repair Location. The use of these tools is recommended and where necessary they are shown in the appropriate service procedure.

Part No.	Tool Description	Tool Illustration
3575186	Circlip Pliers	
4027202	Wastegate Air Feed Adapter	
4027203	Wastegate Air Feed Adapter	
4027204	E-Clip Tool	

Caution

All Service and Maintenance settings are shown in Cummins Turbo Technologies Service Data Sheets. It is essential that these settings are used. Common tools found in mechanic's tool box not included.

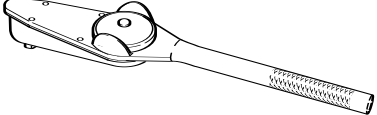
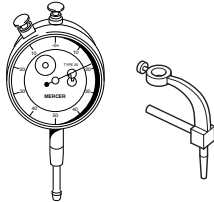
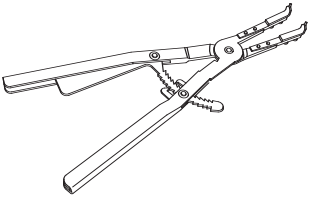
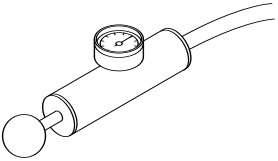
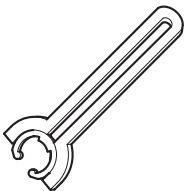
Fault Finding chart

	Engine Running Hot	Poor Transient Response	Smoke	Engine Lacks Power	Black Exhaust Smoke	Blue Exhaust Smoke	High Oil Consumption	Turbocharger Noisy	Cyclic Sound from the Turbocharger	Oil Leak from Compressor Seal	Oil Leak from Turbine Seal
Dirty air cleaner Clean or replace element according to manufacturer's recommendations	●	●	●	●	●	●	●			●	
Restricted compressor intake duct Remove restriction or replace damaged parts as required	●	●	●		●	●	●	●	●	●	
Restricted air duct from compressor to intake manifold Remove restriction or replace damaged parts as required	●	●		●	●			●			
Restricted intake manifold Refer to engine manufacturer's manual and remove restriction	●	●		●	●			●			
Air leak in feed from air cleaner to compressor Replace seals, gaskets or tighten fasteners as required								●			
Air leak in feed from compressor to intake manifold Replace seals, gaskets or tighten fasteners as required	●	●	●	●	●	●	●	●			
Air leak between intake manifold and engine Refer to engine manufacturer's manual and replace gaskets or tighten fasteners as required	●		●	●	●	●	●	●			
Foreign object in exhaust manifold (from engine) Refer to engine manufacturer's manual and remove obstruction				●	●	●	●	●		●	
Restricted exhaust system Remove restriction or replace damaged parts as required	●			●	●					●	
Exhaust manifold cracked, gaskets blown or missing Refer to engine manufacturer's manual and replace gaskets or damaged parts as required		●	●	●	●			●			
Gas leak at turbine inlet/exhaust manifold joint Replace gasket or tighten fasteners as required		●	●	●	●			●			
Gas leak in ducting after turbine outlet Refer to engine manufacturer's manual and repair leak		●						●			
Restricted turbocharger oil drain line Remove restriction or replace damaged parts as required						●	●			●	●
Restricted engine crankcase breather Refer to engine manufacturer's manual, clear restriction						●	●			●	●
Turbocharger bearing housing sludged or coked Change engine oil and oil filter, overhaul or replace turbocharger as required						●	●			●	●
Fuel injection pump or fuel injectors incorrectly set Refer to engine manufacturer's manual and replace or adjust faulty components as required		●	●	●	●						
Engine valve timing incorrect Refer to engine manufacturer's manual for correct settings and adjust as required				●	●						
Worn engine piston rings or liners Refer to engine manufacturer's manual and repair as required				●	●	●	●			●	●
Burnt valves and/or pistons Refer to engine manufacturer's manual and repair as required				●	●	●	●			●	●
Excessive dirt build up on compressor wheel and/or diffuser vanes Clean in accordance with details in the appropriate Holset publication				●	●	●	●	●	●	●	●
Turbocharger damaged Find and correct cause of failure, repair or replace turbocharger as necessary				●	●	●	●	●		●	●
Failed actuator diaphragm Replace using correct Actuator Service Kit	●							●			
Seized wastegate valve (in turbine housing) Free valve in accordance with details in the appropriate Holset publication replace complete turbine housing sub-assembly	●	●									
Leaking actuator hose Replace hose and clips	●							●			
Wastegate mechanism set incorrectly Contact your approved Holset agent for correct setting procedure	●	●	●	●				●			

Service Tools



The following special tools are recommended to perform procedures in this manual. The use of these tools is shown in the appropriate procedure.

Part No.	Tool Description	Tool Illustration
	Torque Wrench	
	Dial Gauge and Dial Gauge Adapter	
3575186	Circlip Pliers	
	Pressure Gauge Regulated Air Supply (Max 3 bar-45 lbf/in ²)	
4027204	E-Clip Tool	

Caution

All Service and Maintenance settings are shown in Cummins Turbo Technologies Service Data Sheets. It is essential that these settings are used. Common tools found in mechanic's tool box not included.

On Engine Checks



Oil Leakage

Warning

Always wear safety glasses.

Warning

Inlet oil is pressurized and outlet oil is hot. Never take service action with engine running. Protect face and hands from hot fluid leakage.

Inlet flange fitting M8 x 1.25

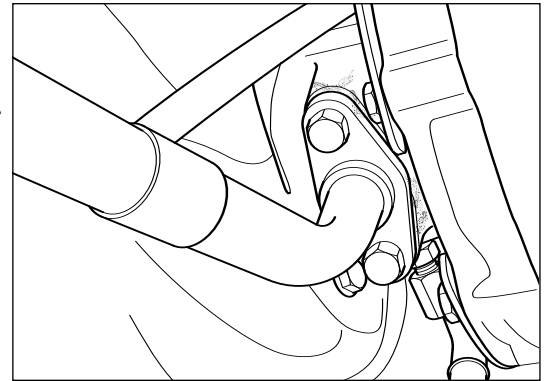
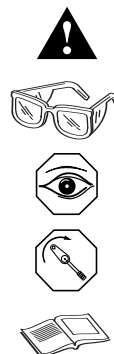
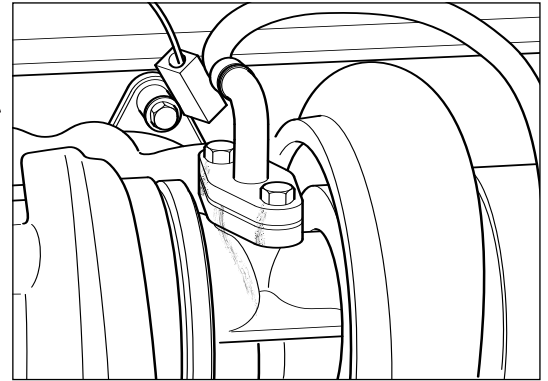
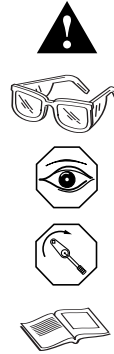
Replacement gaskets and flange fasteners should be fitted without sealant as this can contaminate the oil. Torque tighten to value specified by engine manufacturer.

It is important to avoid kinked pipes during servicing and subsequent operation.

Outlet flange fitting M8 x 1.25

Replacement gaskets and flange fasteners should be fitted without sealant as this can contaminate the oil. Torque tighten fasteners to value specified by engine manufacturer.

All outlet pipes should be free flowing without kinks and sharp bends and decline at an overall angle not less than 30° below horizontal.



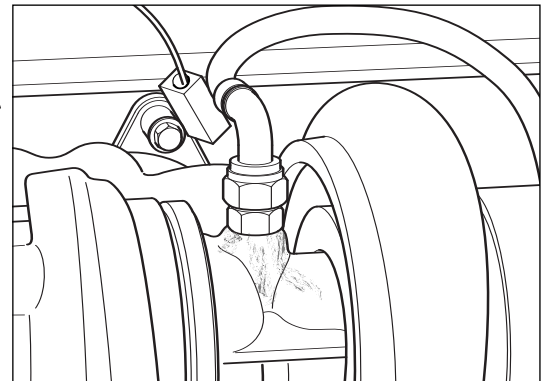
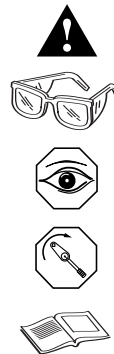
Oil Inlet Adapter Options

Pipe Fitting 11/16-16 UN (19 mm A/F)

Adapter fitting M16 x 1.5 (22 mm A/F)

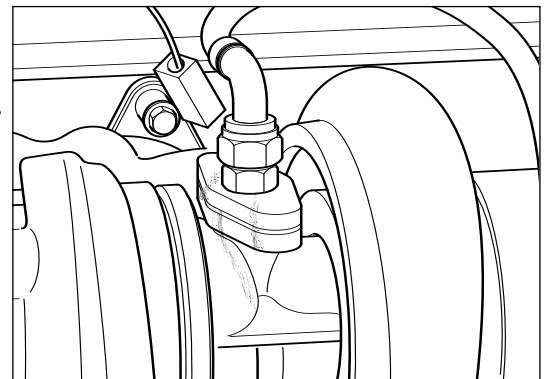
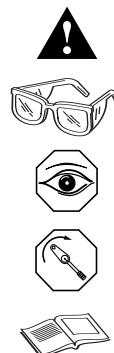
Replacement seals and adapters should be fitted without sealant as this can contaminate the oil. Torque tighten adapter to value shown in [Service Data Sheet](#).

It is important to avoid kinked pipes during servicing and subsequent operation.



Adapter fitting M12 x 1.5

Replacement seals and adapters should be fitted without sealant as this can contaminate the oil. Torque tighten adapter to value specified by engine manufacturer.



Coolant Leakage



Warning

Always wear safety glasses.

M16 x 1.5 (22 mm A/F)

Warning

Water connections may be hot and pressurized. Never take service action with engine running. Protect face and hands from hot fluid leakage.

Repair by replacement of coolant inlet and outlet fittings. Torque tighten adapters to value specified by engine manufacturer or [Service Data Sheet](#).

Caution

Do not use sealant as this may affect performance of o-ring seals.

Where housing threads are damaged remove turbocharger for [Service and Overhaul](#).

Gas Leakage

Turbine housing flange leakage will cause soot formation on flange. Check exhaust manifold to flange seal ensuring fastener torque meets engine manufacturer's recommendation.

Check turbine housing gasket for signs of damage which would cause leakage. Always replace damaged gaskets.

Where gas leak persists, remove turbocharger and refer to [Turbine Housing](#) for removal, checks and refitting instructions.

M8 (13 mm A/F)

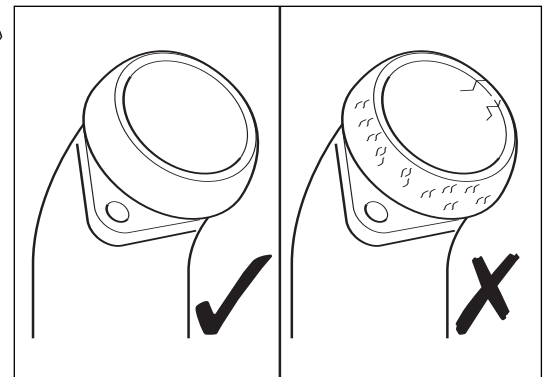
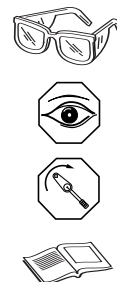
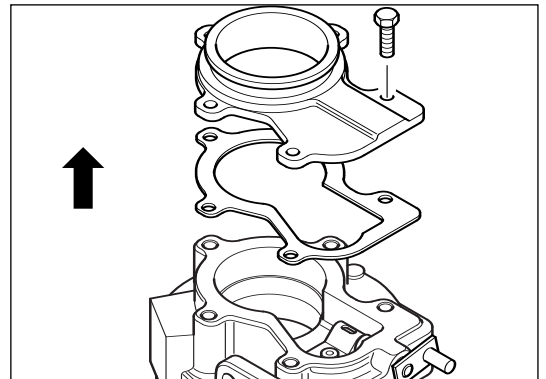
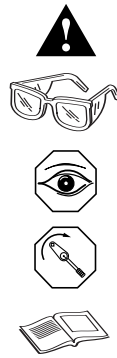
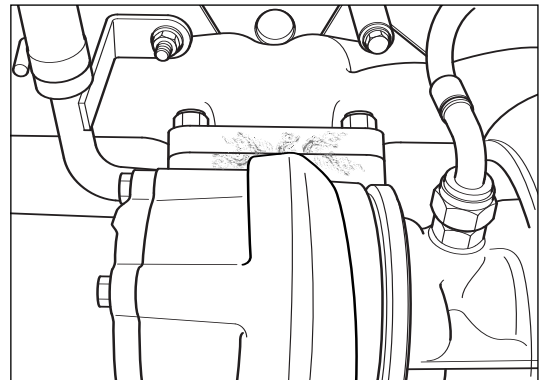
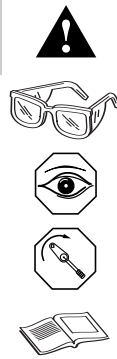
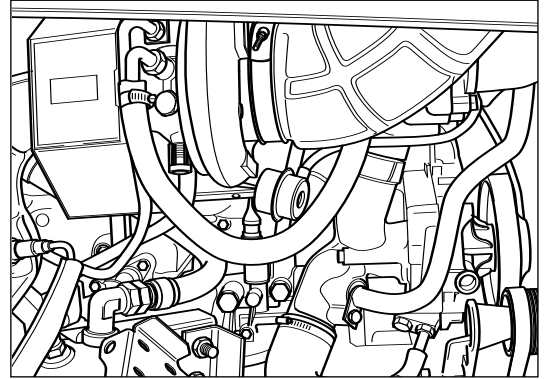
Where practical remove exhaust system pipework to check cover plate gasket condition (where fitted). Check flange sealing face for cracking and distortion.

If exhaust seal is compromised replace gasket/coverplate. Torque coverplate bolts to value specified in [Service Data Sheet](#).

Where turbine housing outlet flange is cracked, remove turbocharger and refer to [Turbine Housings](#) for removal, checks and refitting.

Where practical remove exhaust system pipework to check exhaust system connecting profile for fretting damage.

If sealing is compromised replace cover plate ensuring fastener torque meets engine manufacturer's recommendation.





Air Leakage

Warning

Always wear safety glasses.

Warning

Never attempt to check actuator using air supplied from running engine.

If it is possible to check for wastegate actuator rod movement and air leakage on engine, follow checking procedure described later in

Wastegate Actuator Checks.

Visual Checks

Check for cracked, bent or damaged compressor wheel blades.

Caution

Never attempt to straighten blades.

Where practical, check for cracked, bent or damaged turbine wheel blades.

Caution

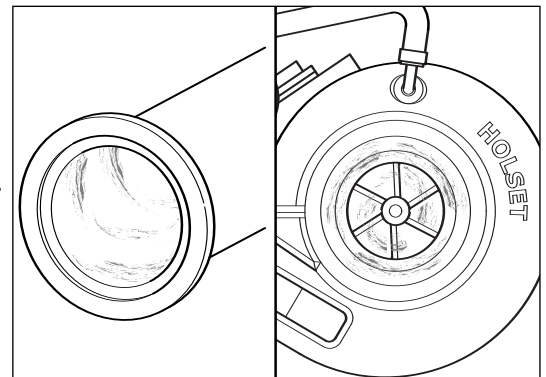
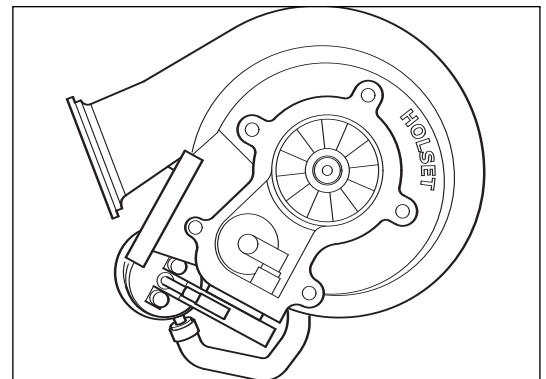
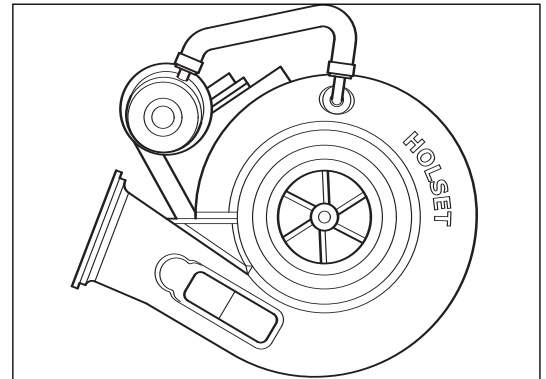
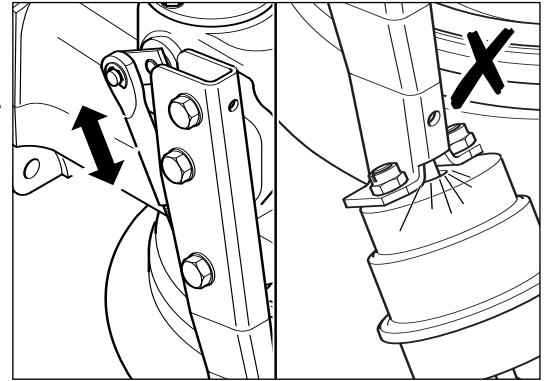
Never attempt to straighten blades.

Closed crankcase ventilation systems have tendency to deposit oil in compressor housing. Where practical remove intake system pipework every 50,000 km (30,000 miles) to check housing, compressor wheel and inlet baffle condition.

Caution

Ambient air ingress after the air filter will damage turbocharger. Never leave compressor inlet open to atmosphere.

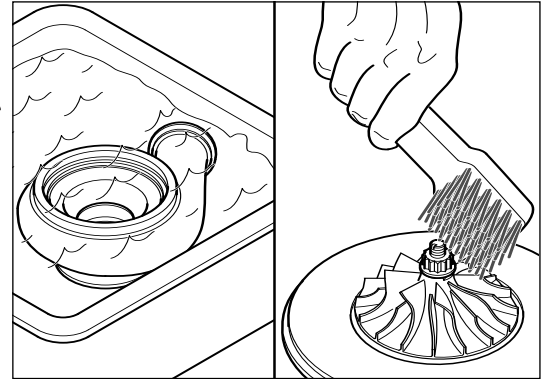
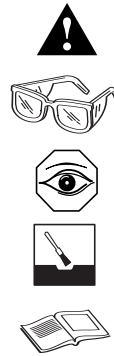
Where fitted, torque tighten CCV pipe fitting to value specified in engine manual. Tighten blanking plug to value specified in ***Service Data Sheet.***



**Warning**

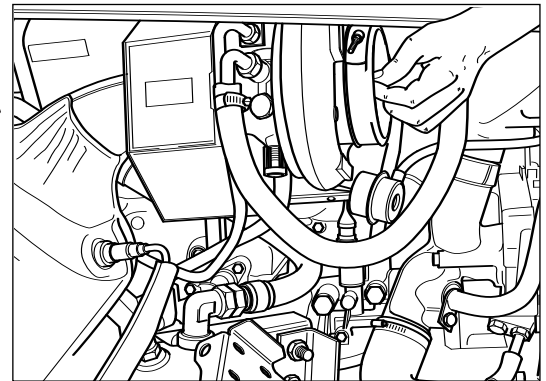
Always wear safety glasses.

Always refer to **Cleaning of Housings** to clean housing. Rotor components can be cleaned using non metallic bristle brush.

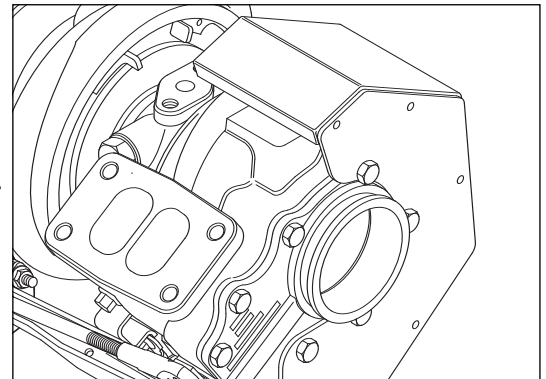


With intake system disconnected from compressor housing, it may be possible to check visually for excess bearing axial and radial clearances.

If in doubt, turbocharger must be removed from engine to check bearing clearance against recommended values shown in **Service Data Sheet**.

**M8 (13 mm A/F)**

Some turbine housings feature heat shield attached through cover plate bolts. Replace cracked or damaged shields. Tighten socket head screws to value specified in **Service Data Sheet**.



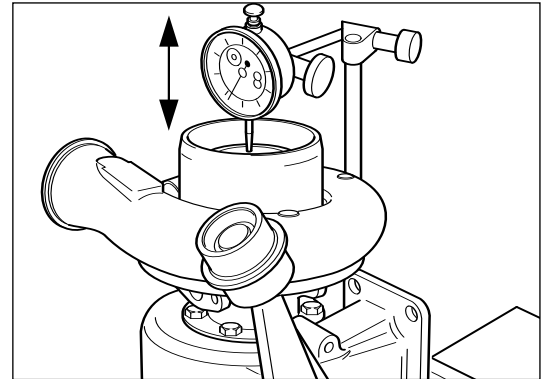
Bearing Clearance



Secure turbine housing and check axial clearance using dial gauge.

Ensure clearance is within MIN/MAX values shown on [Service Data Sheet](#).

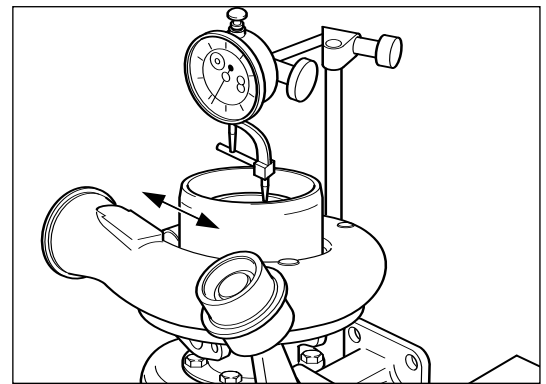
If axial clearance does not meet specification refer to turbocharger [Service and Overhaul](#) to strip and rebuild CHRA (core).



Check radial movement at compressor impeller nose using dial gauge.

Ensure movement is within MIN/MAX TIR (Total Indicator Reading) values shown on [Service Data Sheet](#).

If radial movement does not meet specification refer to turbocharger [Service and Overhaul](#) to strip and rebuild CHRA (core).

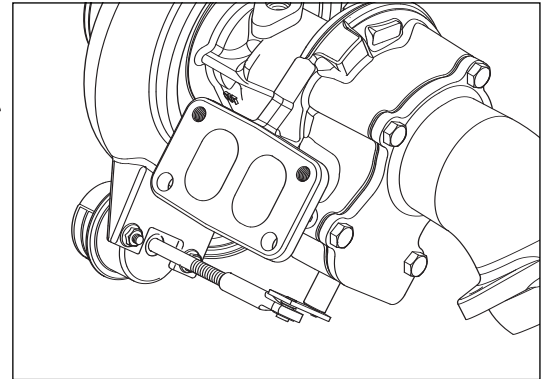


Turbine and Compressor Housings



Note

On turbochargers with compressor mounted wastegate actuators it is necessary to disconnect actuator before removing turbine or compressor housings. Before actuator is disconnected or removed always refer to [Actuator Removal](#).



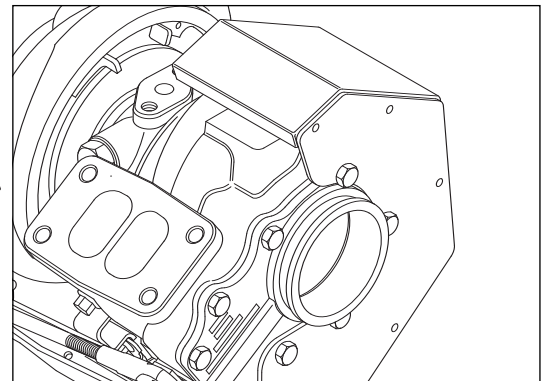
Turbine Housing

Warning

Always wear safety glasses.

M8 (13 mm A/F)

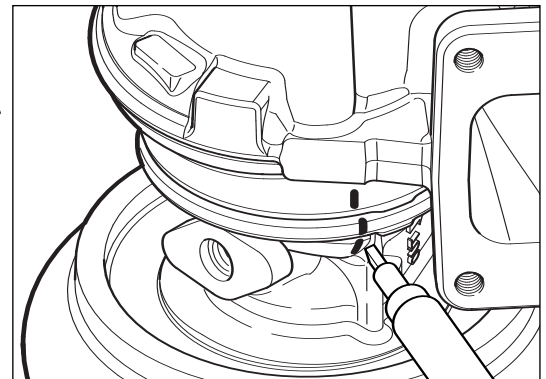
Some turbine housings feature heat shield attached through cover plate bolts. Replace cracked or damaged shields. Tighten socket head screws to value specified in [Service Data Sheet](#).



Note

Turbine housing options with cover plate can be removed without removing cover plate.

Place compressor inlet on clean flat surface. Mark turbine housing, bearing housing and v-band clamp, (where fitted). This action assists in re-assembly process defining correct component orientation.



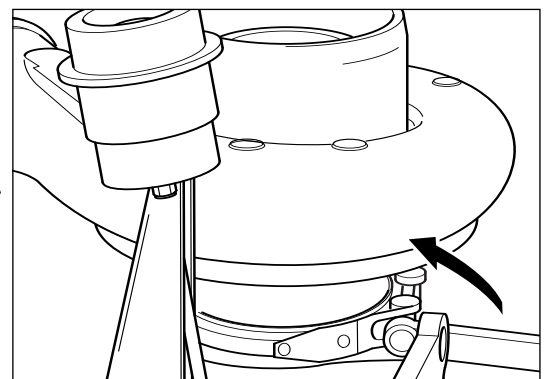
V-band Option

M6 x 1 (10 mm A/F)

Turn turbocharger on to turbine outlet face. Loosen locknut, v-band clamp (62) and discard.

Caution

Locknuts must be replaced every time they are removed to ensure long term clamp loading of v-band.





Clamp Plate Option

Warning

Always wear safety glasses.

M8 x 1.25 (13 mm A/F)

Secure turbine housing flange in vice.

Caution

Take care not to shear clamp plate bolts.

Seized bolts may be freed by spraying with penetrating oil and soaking for twenty minutes or period of time recommended by oil manufacturer.

Loosen and remove bolts and clamp plates.

Caution

Never direct hammer blows on to turbine housing flange.

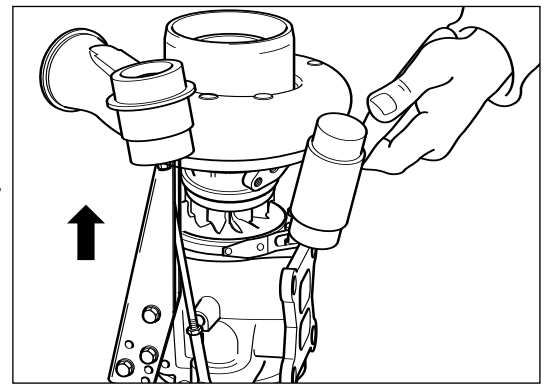
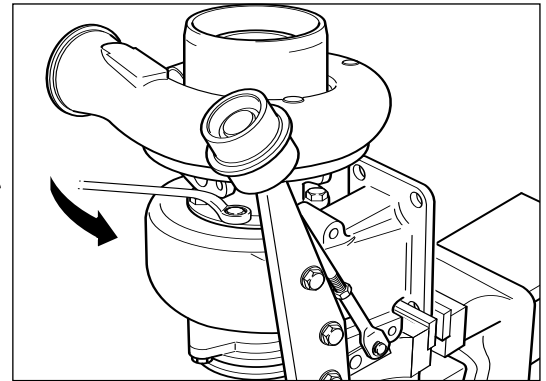
Caution

Turbine blades can be damaged when turbine housing is removed.

Caution

Some turbine housings are pinned to bearing housings. Take care. Do not bend locating pin.

Using soft hammer, tap turbine housing down against soft bench surface. As compressor assembly and v-band (where fitted) come loose, lift out of turbine housing engagement

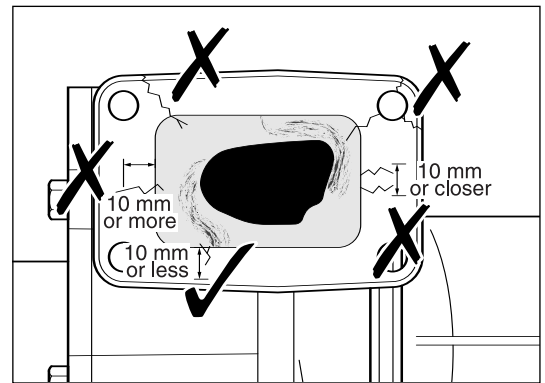




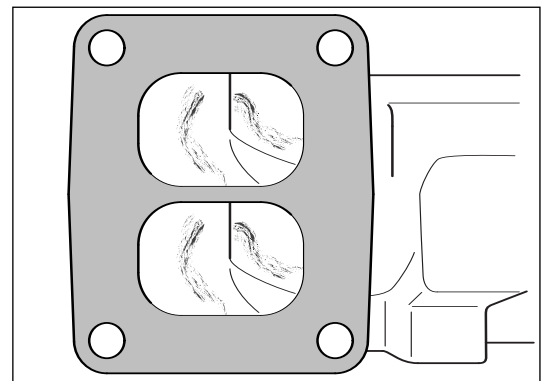
Caution

Turbine housings can exhibit cracking when subject to excessive thermal and mechanical loads.

Cracking of turbine housing inlet flange may require turbine housing replacement. Acceptance and rejection guidelines are shown in this illustration. If exhaust gasket is available, always ensure that any cracks lie within its sealing area.

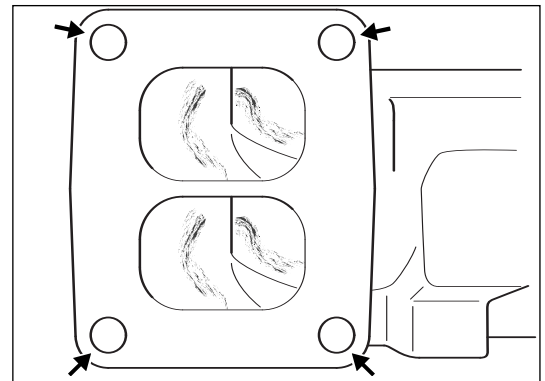


Check turbine housing inlet flange flatness is within 0.1 mm (0.004 in) before retaining component for re-use.



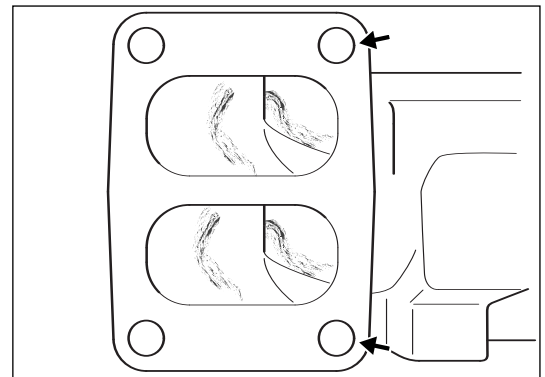
Flange Fasteners

Check fastener hole diameter is not more than 1.5 mm larger than maximum thread diameter of fastener.



M10 x 1.5

Check flange threaded holes with M10 x 1.5 thread gauge.



**Warning**

Always wear safety glasses.

Caution

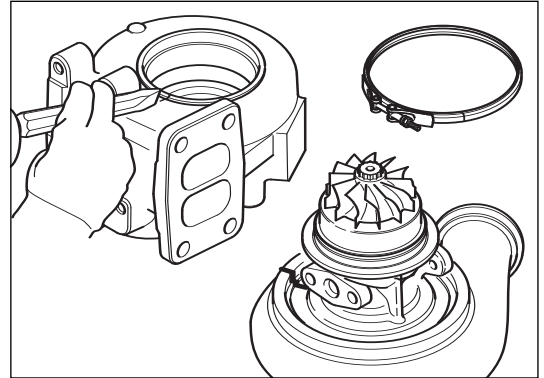
Always clean housing before final inspection and refitting.

Indelible ink marks may be removed by cleaning process. Before cleaning always ensure alignment marks are scribed with metal chisel or scribe.

Refer to **Cleaning of Housings** for recommended cleaning processes.

Where fitted, always remove wastegate actuator before cleaning. Refer to **Actuator Removal**.

Pay particular attention to surfaces close to turbine wheel and bearing housing location.



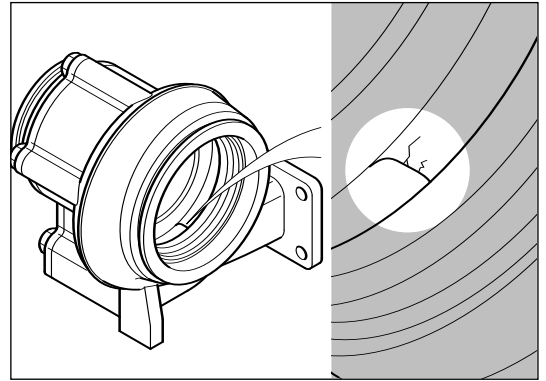
**Warning**

Always wear safety glasses.

Caution

Where crack will cause leakage to atmosphere turbine housing must be replaced.

Cracking of internal wall at entry to turbine wheel (tongue) is an acceptable service condition and turbine housing may be re-used.

**Caution**

Turbine blades can be damaged when turbine housing is refitted.

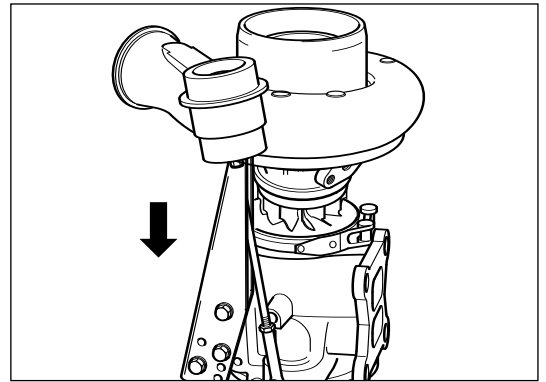
Caution

Some turbine housings are pinned to bearing housing. Take care. Do not bend locating pin.

To reassemble turbine housing (5) position v-band clamp (where fitted) over bearing housing and align component orientation marks.

Apply high temperature anti-seize compound to bearing housing locating bore of turbine housing.

Slide bearing and compressor housing assembly into turbine housing. Use alignment marks to locate assembly in correct orientation with turbine housing. Locate on to locating pin (where fitted).

**V-band Option**

M6 x 1 (10 mm A/F)

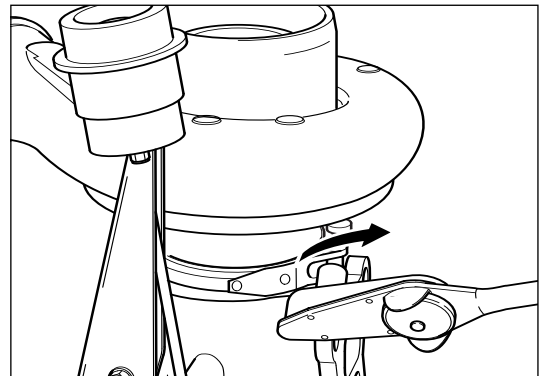
Caution

Ensure v-band locknut is clean and oil free before torque tightening.

Note

There are T- bolt and Hex- bolt versions of v-band clamp but thread detail is common.

Place v-band clamp in correct orientation and torque tighten new locknut (62) to value specified in [Service Data Sheet](#).





Clamp Plate Option

Warning

Always wear safety glasses.

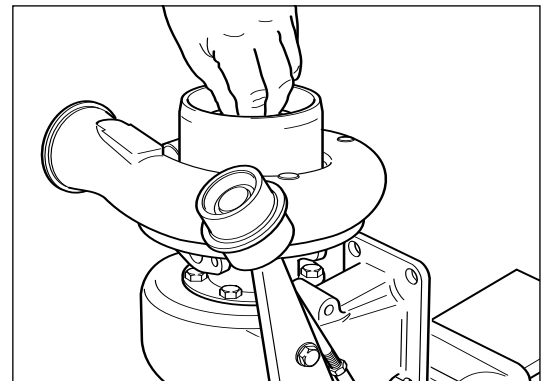
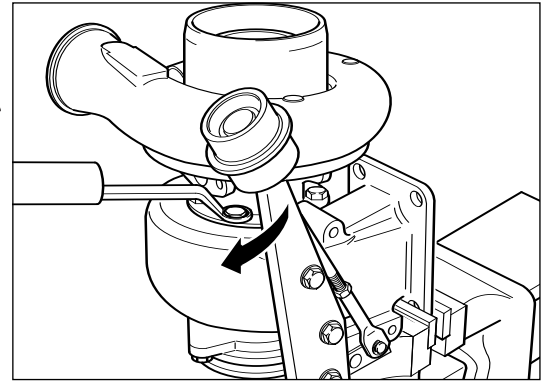
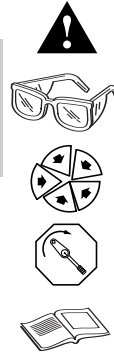
M8 x 1.25 (13 mm A/F)

Secure turbine housing flange in vice.

Install clamp plates and torque tighten bolts to value specified in [Service Data Sheet](#).

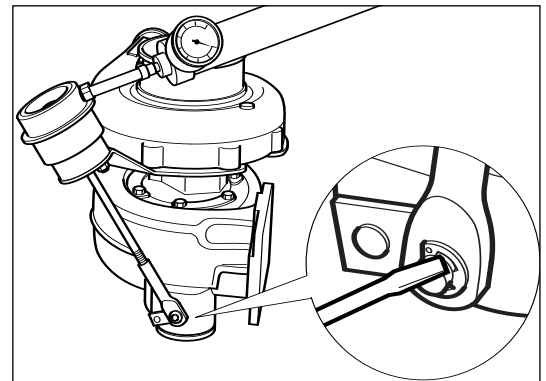
Depending on housing orientation, some clamp plate bolts may have restricted access. In these cases, use suitable torque wrench adapter attached to specially calibrated torque wrench.

Ensure rotor assembly freely rotates.



Caution

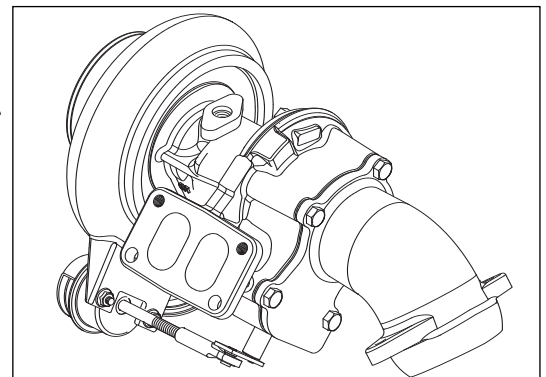
To refit wastegate actuator refer to [Actuator Reassembly](#).



Compressor Housing

Note

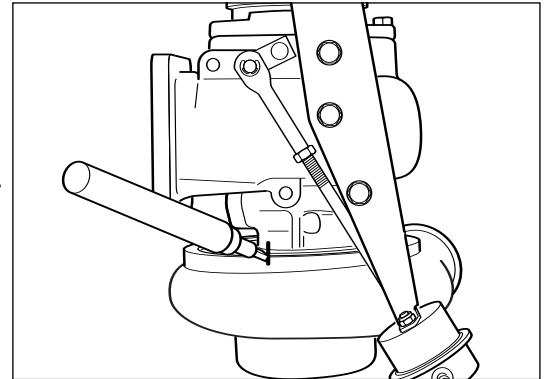
On turbochargers with compressor mounted wastegate actuators it is necessary to disconnect actuator before removing turbine or compressor housings. Before actuator is disconnected or removed always refer to [Actuator Removal](#).



**Warning**

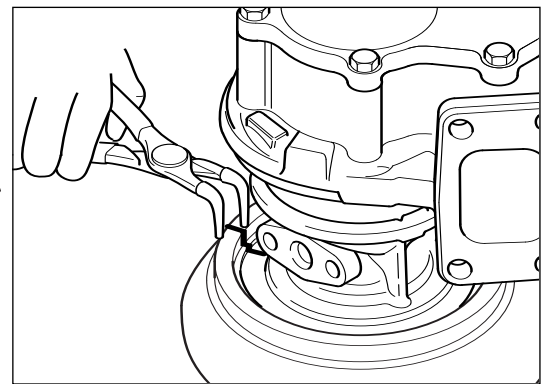
Always wear safety glasses.

Place compressor inlet on clean flat surface. Mark compressor housing, bearing housing and retaining ring to record correct orientation. This action assists in component orientation during reassembly.



Remove compressor cover retaining ring using circlip pliers part no. 3575186.

If circlip is seized in its groove, gently tap one end with leather hammer and drift.

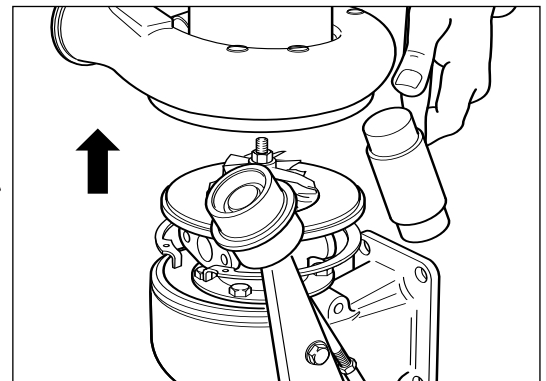
**Caution**

Compressor blades can be damaged when compressor housing is removed.

Caution

Some compressor housings are pinned to bearing housings. Take care. Do not bend locating pin.

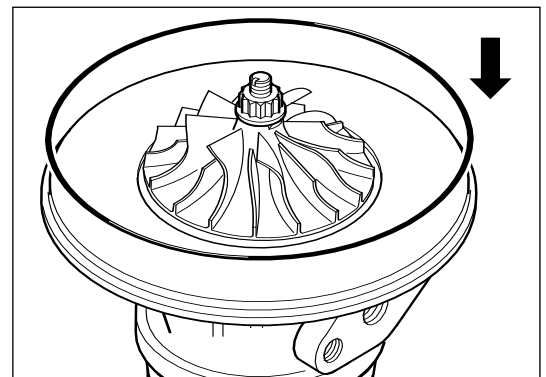
Secure turbine housing flange in vice or ensure turbocharger is stable on work bench. Use soft hammer to tap compressor housing off bearing housing.



On some models, removal of compressor housing will expose an o-ring seal. This seal should be removed and discarded.

Caution

Where seal has been removed, always fit new o-ring seal at this stage.





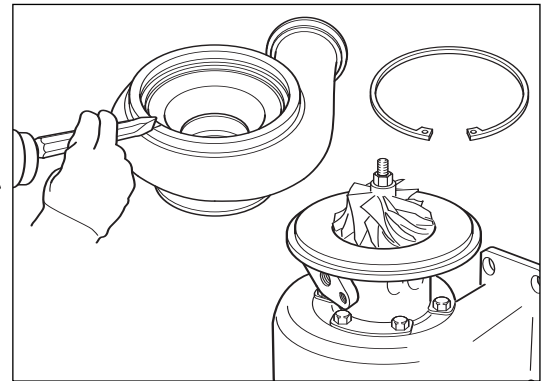
Warning

Always wear safety glasses.

Indelible ink marks may be removed by cleaning process. Before cleaning always ensure alignment marks are scribed with metal chisel or scribe.

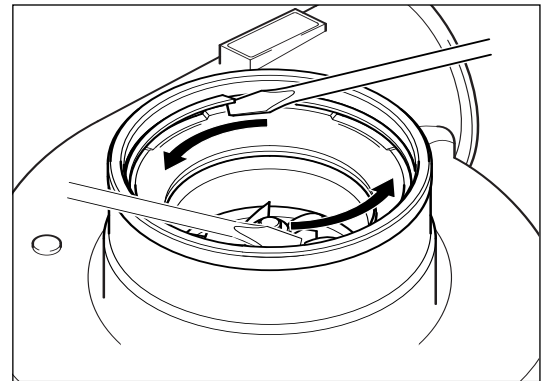
Caution

Always clean housing before final inspection and reassembly.



To clean compressor housings fitted with an inlet baffle it is necessary to remove baffle. Refer to [Inlet Baffle Option](#).

Refer to [Cleaning of Housings](#) for recommended cleaning processes. Where fitted, always remove wastegate actuator before cleaning. Refer to [Actuator Removal](#).



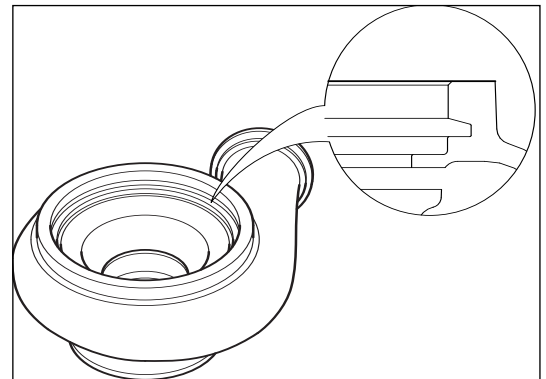
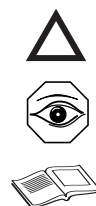
Inspect internal profile of compressor housing for scoring damage due to possible contact with compressor wheel. Check compressor housing retaining ring groove is free from deposits and is not worn.

Move to [Cleaning of Housings](#) if deposits remain.

Replace with new if profile damage is visible.

Caution

Good groove and abutment face condition are critical to integrity of compressor housing to bearing housing joint.



**Warning**

Always wear safety glasses.

Where fitted, lubricate new o-ring seal (41*) with clean engine oil and insert into bearing housing groove.

Locate core assembly into compressor housing. Use alignment marks to locate assembly in correct orientation with compressor housing. Ensure location pin (where fitted) aligns with mating hole.

Press assembly into position taking care not to trap o-ring or bend pin.

Caution

Compressor blades can be damaged when compressor housing is installed.

Caution

Take care. Do not bend roll pin during assembly.

Locate retaining ring over CHRA. Using circlip pliers, part no. 3575186, fit retaining ring.

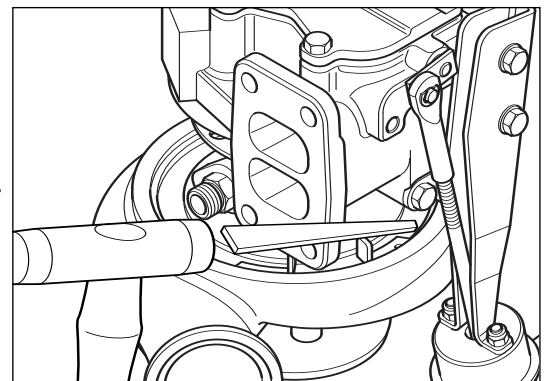
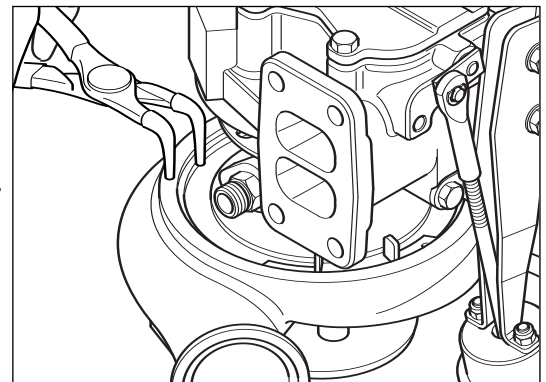
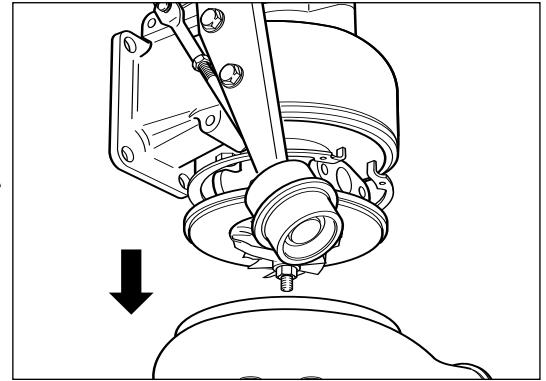
Caution

Retaining ring must be fitted with chamfered face upwards away from compressor housing.

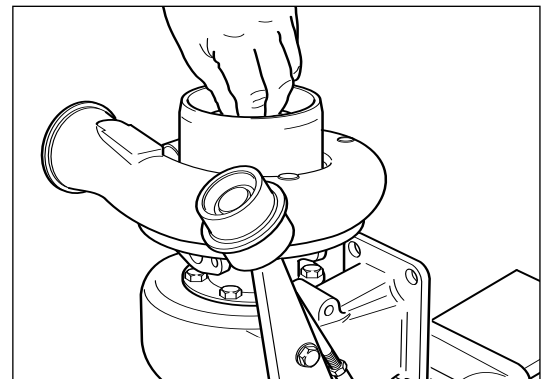
Tap ends of retaining ring lightly with hammer and drift to ensure that ring is properly located into its groove.

Caution

Ensure that drift does not damage bearing housing.



Ensure rotor assembly freely rotates.

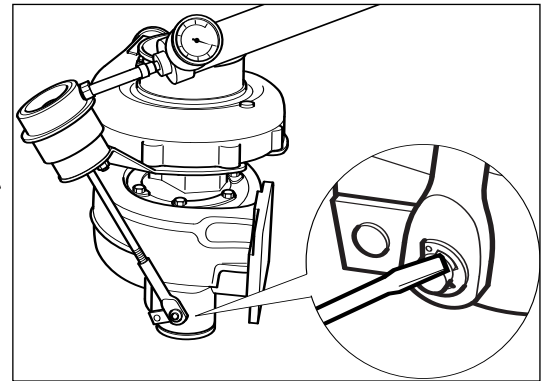


**Warning**

Always wear safety glasses.

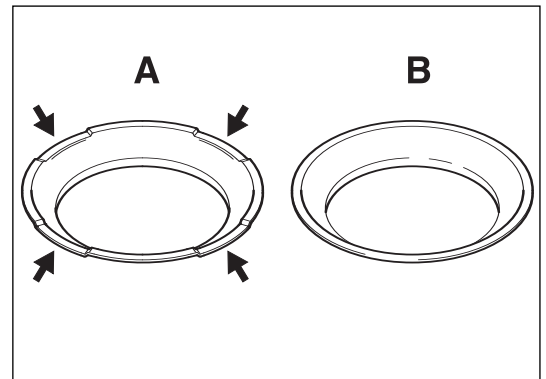
Caution

To refit wastegate actuator refer to **Actuator Reassembly**.

**Inlet Baffle Option**

To clean compressor housings fitted with inlet baffle it is necessary to remove baffle.

Inlet baffle (A) is old type; inlet baffle (B) is new type. Baffle (B) has been improved and no longer incorporates four stepped areas. This gives new baffle increased service life.

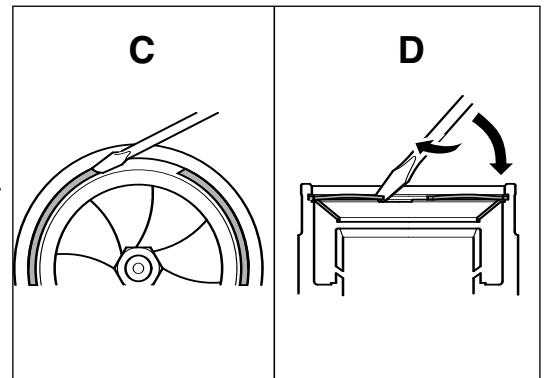
**Caution**

Always fit new type of baffle (B) on re-assembly.

Caution

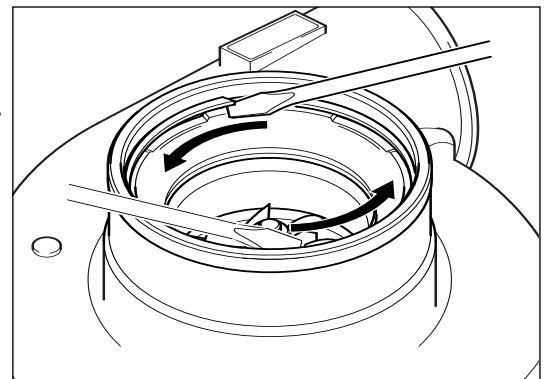
When removing inlet baffle retaining ring, be careful not to damage compressor wheel with screw driver. Use rag or rubber bung to protect wheel.

Using flat screw driver, carefully apply force in area shown (C) as retaining ring starts to move, force screwdriver under ring as shown in (D).



Push screwdriver in anti-clockwise (counter-clockwise) direction to force retaining ring out of groove. Remove retaining ring.

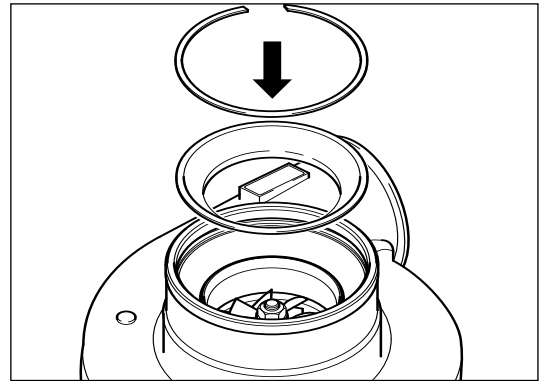
Remove inlet baffle.



**Warning**

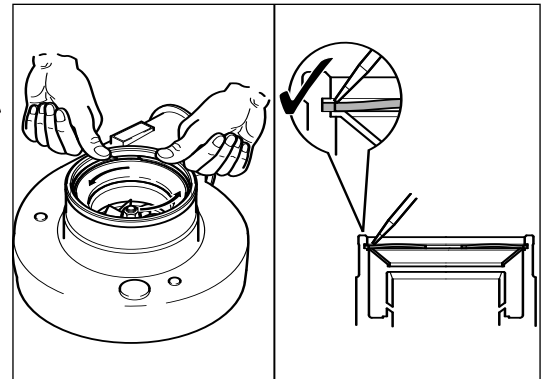
Always wear safety glasses.

Following cleaning of compressor housing, locate new type of inlet baffle onto location ledge of compressor housing inlet.



Hold one end of retaining ring in position in its compressor cover groove. Press remainder of retaining ring into position using free hand.

Use flat screw driver to make sure retaining ring is correctly seated in groove.



Cleaning of Housings



Warning

Always wear safety glasses.

Visually inspect parts to detect signs of burning and other conditions in order to obtain as much information as possible before washing.

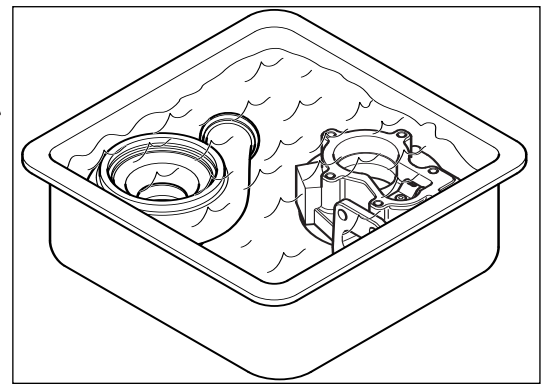
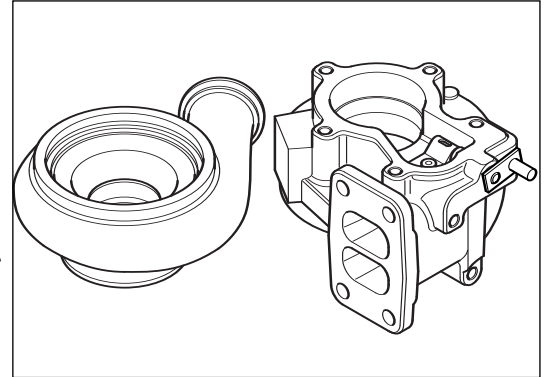
Caution

Housing surfaces adjacent to turbine and compressor wheels must be clean, smooth and free from deposits.

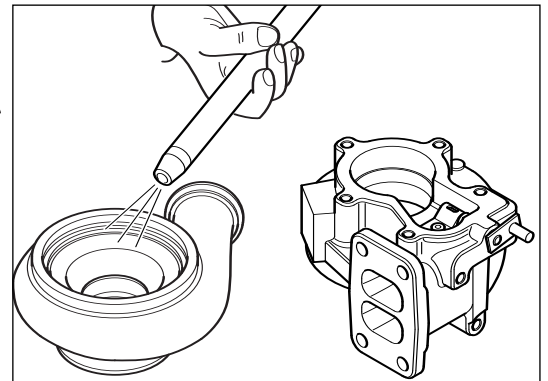
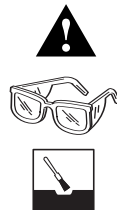
Caution

Always remove wastegate actuator before cleaning.

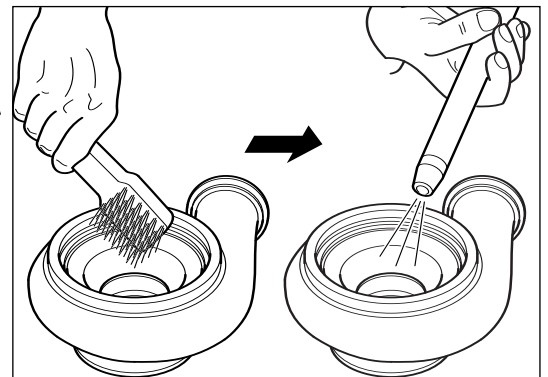
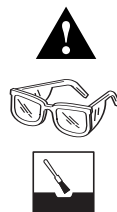
Soak housings in non-corrosive low flash point metal cleaner to loosen deposits.



Dry components using compressed air.



Scale like deposits, if any, must be removed by using non metallic bristle brush. After removing deposits, re-wash and dry components.



**Warning**

Always wear safety glasses.

It is permissible to bead blast turbine housing if chemical and brush cleaning is not effective.

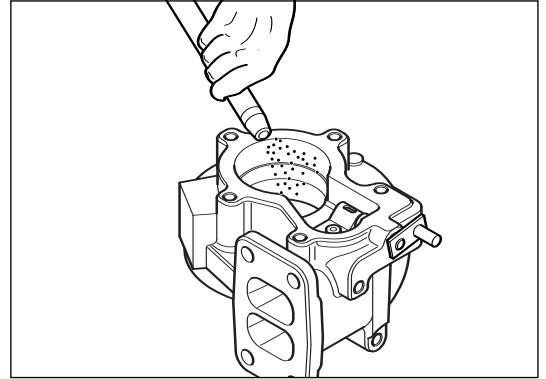
Warning

Do not bead blast Aluminium and Cast Iron components together.

Caution

Do not direct bead spray on to wastegate valve spindle as beads can penetrate spindle bore, leading to spindle seizure.

After removing deposits, re-wash and dry components.



Wastegate Actuator Checks



Warning

Always wear safety glasses.

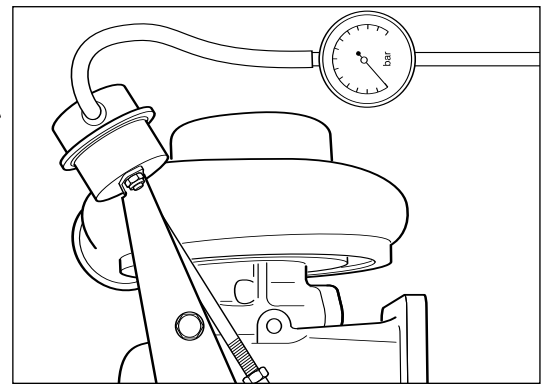
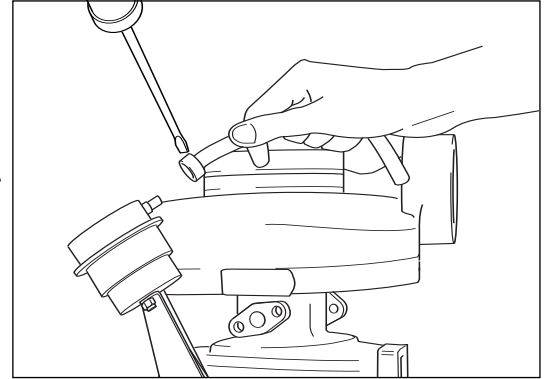
Caution

Do not remove turbocharger from engine unless an actuator check is impractical due to space or access limitations or where an on-engine check has shown problem exists.

Place turbocharger on suitable workbench. Use small flat screwdriver to remove hose clip. Pull flexible hose from actuator spigot.

Discard hose clips (75).

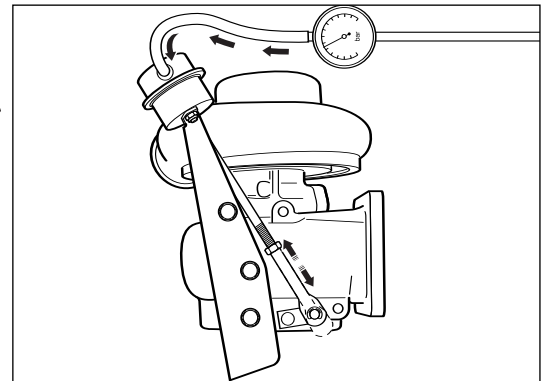
Connect and secure hose from regulated compressed air supply to actuator spigot.



Warning

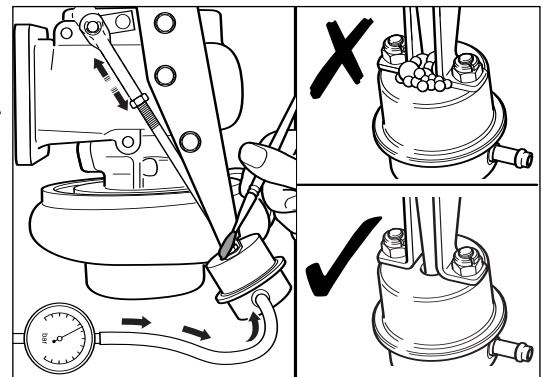
Avoid touching wastegate rod end area as finger injury may result from sudden movement of assembly when air pressure is applied.

Carefully apply pressure to actuator from regulated compressed air supply (Max 3 bar, 45 lbf/in²) and check for actuator movement.



Seized Actuator Check

If rod does not move check wastegate actuator for air leaks. If no air leak is found and rod does not move, check valve mechanism for seizure according to procedure in [Wastegate Mechanism Check](#).



Actuator Removal



Warning

Always wear safety glasses.

Caution

Do not adjust end link. This setting is critical to actuator performance.

Caution

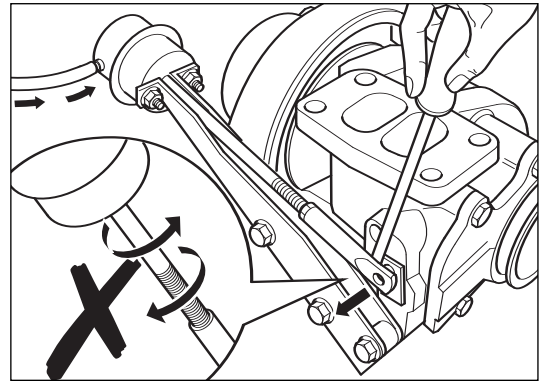
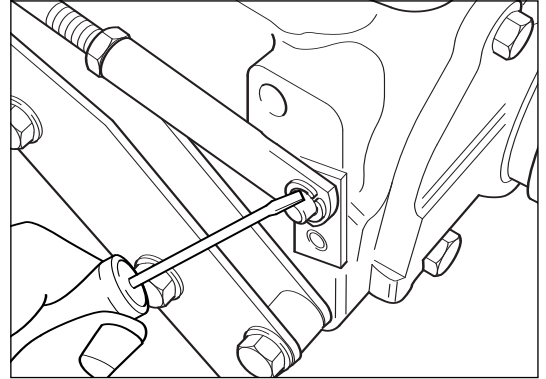
Do not rotate actuator rod relative to actuator as this can damage actuator internal components

Use small flat screwdriver to remove end link retaining clip.

Warning

Rod may retract very quickly when freed from crank lever. Keep fingers away from mechanism.

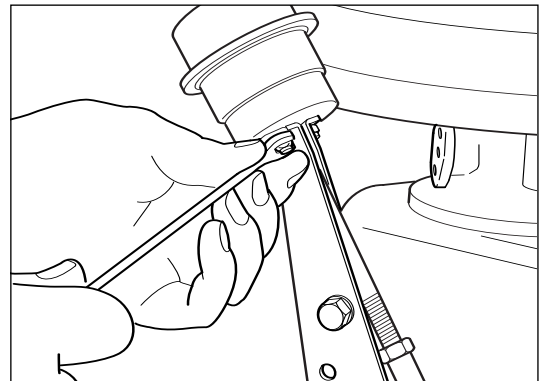
Gently apply small amount of air to actuator and when/if rod end moves, carefully slide link end off valve crank lever. If actuator rod does not move, screw driver may be required to force link end off crank lever.



M6 x 1 (10 mm A/F)

1/4 - 28 UNF2B (7/16 in A/F)

Remove actuator lock nuts.

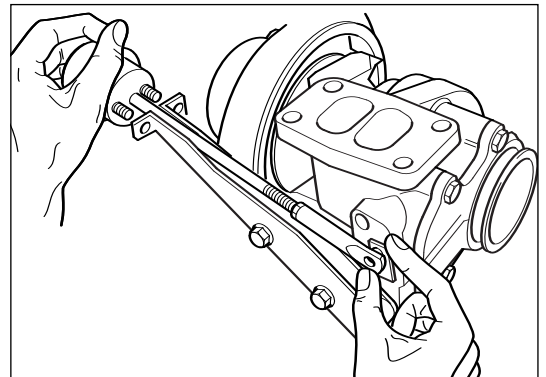


After removal of hose clip and hose, lift actuator away from bracket until studs clear location holes.

Discard hose clips (75).

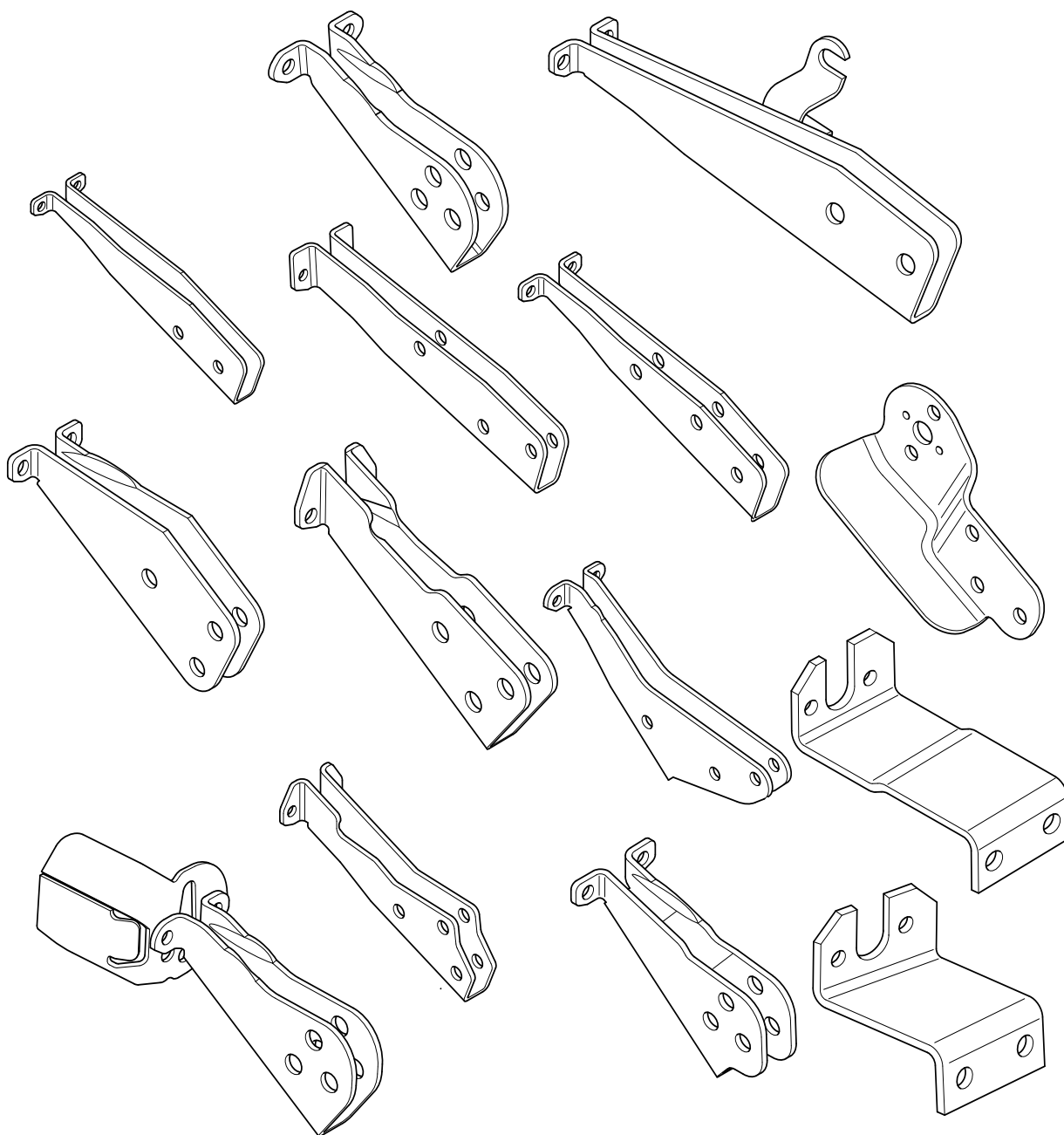
Note

Compressor mounted actuators are removed using same four process steps.



Actuator Bracket Removal and Replacement

Turbine Mounted Actuator Bracket Options

**Note**

It is important to quote correct turbocharger assembly number, serial number and type from dataplate when ordering replacement bracket kit (136).



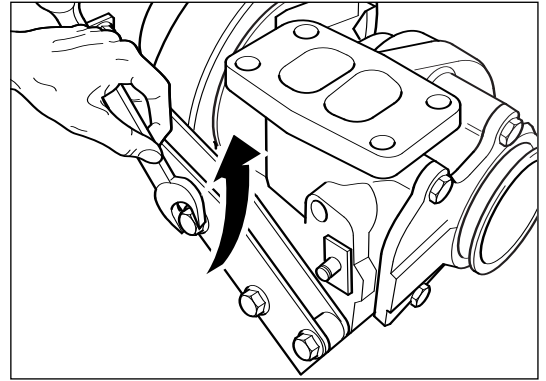
Turbine Mounted Actuator

M8 (13 mm A/F)

Warning

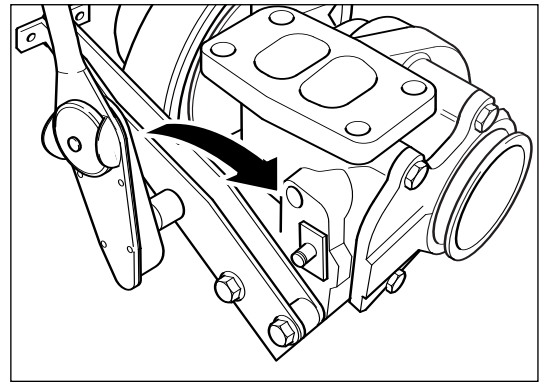
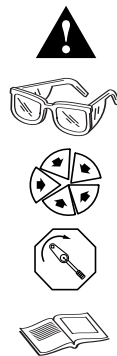
Always wear safety glasses.

Remove setscrews and retain with mounting spacers (where fitted) and bracket



Replace bracket by inserting setscrews into bracket and correctly positioned spacers (where fitted).

Locate setscrews into threaded holes in turbine housing and torque tighten to value specified in [Service Data Sheet](#).



Wastegate Mechanism Check



Warning

Always wear safety glasses.

Rotate crank lever on cross shaft by hand. If arm moves smoothly with small resistance, re-check for movement of disassembled actuator rod.

Apply an air pressure of 3 bar, 45 lbf/in² to actuator. If rod does not move, replace actuator with a pre-set replacement kit (74) by reference to **Actuator Replacement**.

If the crank lever is seized or moves loosely, turbine housing will require replacement. However, it may be possible to free seized crank lever.

M8 (13 mm A/F)

Caution

Take care not to shear coverplate bolts.

Remove cover plate option.

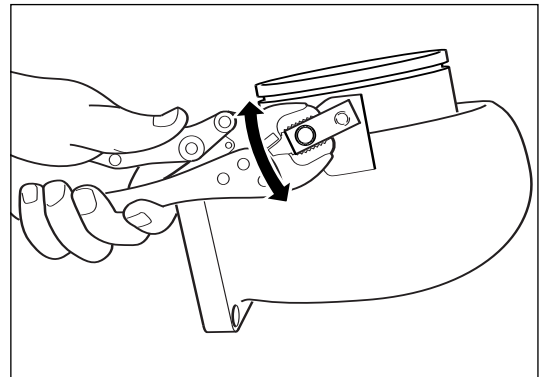
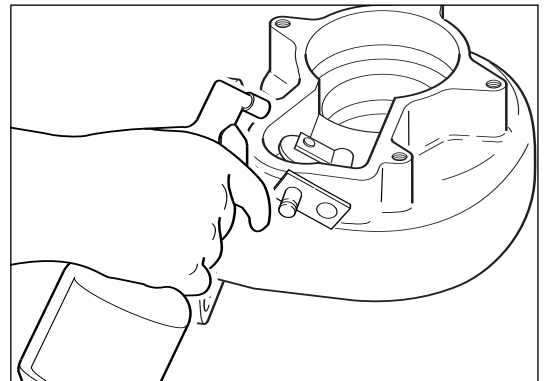
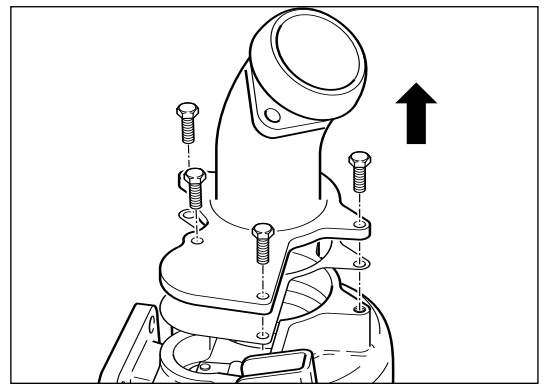
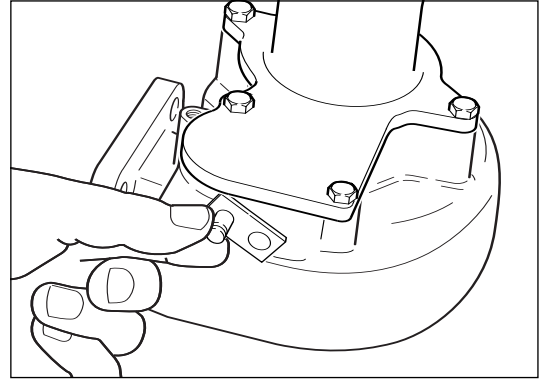
Seized bolts may be freed by spraying with penetrating oil and soaking for 20 minutes or period of time recommended by oil manufacturer.

Soak wastegate valve and lever mechanism in penetrating oil.

Caution

Extra care must be taken when attempting to free valve mechanism. Any damage will result in replacement of turbine housing.

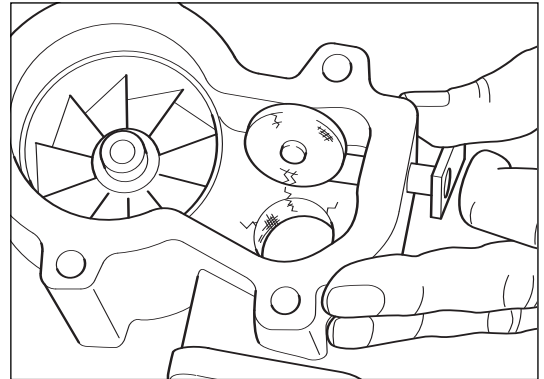
Clamp pair of quality mole (vice) grips to lever and gently apply pressure to rotate crank lever in an arc. If this process does not free valve mechanism, new turbine housing must be fitted.



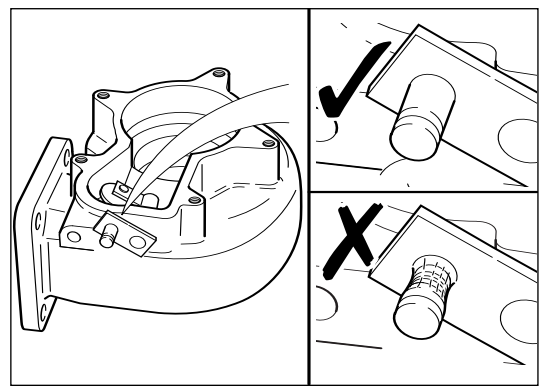

Caution

If wastegate valve mechanism shows any fault, it must be replaced. Using damaged turbine housings will lead to inferior performance of turbocharger, and risk of irreparable damage to both turbocharger and engine.

Radial cracks can occur around valve seat when turbocharger has been abused or overheated.



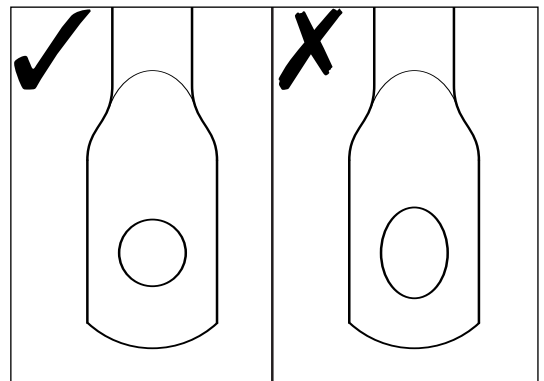
Crank journal can be worn by partial seizure of valve mechanism. Scoring may be caused by arduous local environmental conditions.



Same failure conditions can also lead to elongation of rod end bore which locates on crank journal. This must not exceed 0.50 mm (0.020 in).

Caution

If actuator shows any fault, it must be replaced.



Wastegate Actuator Replacement



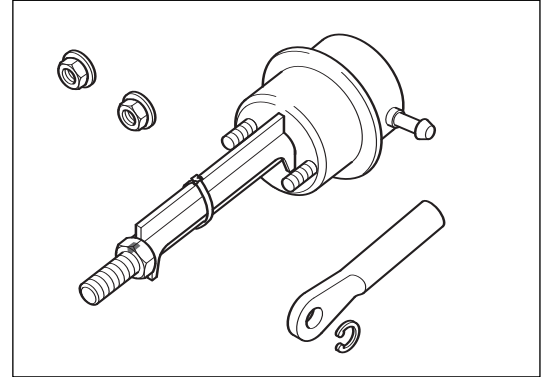
Turbine Mounted Actuator

Caution

Contact your local approved agent for correct replacement actuator kit. It is important to quote correct turbocharger assembly number, serial number and type from dataplate to ensure supply of correct pre-set actuator.

Note

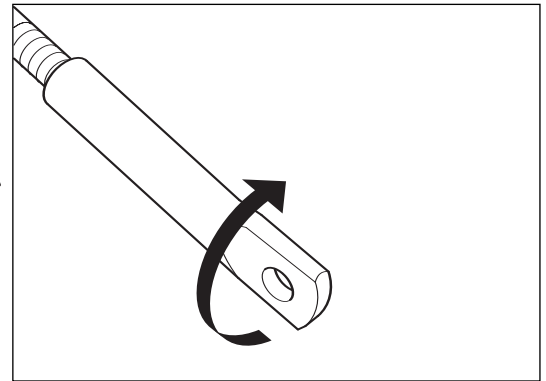
When refitting existing actuator, end link will be locked in correct setting.



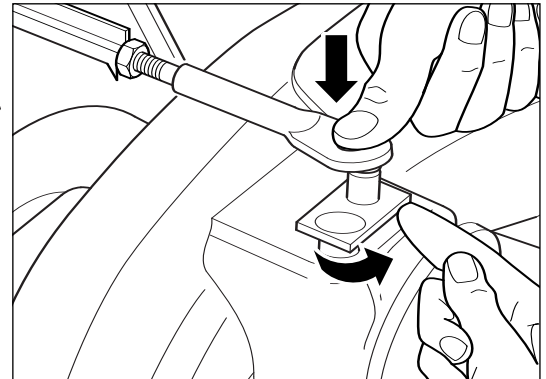
Thread new end link several turns on to shaft of new pre-set actuator assembly.

Warning

Always wear safety glasses.



Hold actuator assembly with spine of spacer piece upright. Rotate wastegate valve crank lever to close valve (pushed towards compressor end). Fit end link over crank journal.



Note

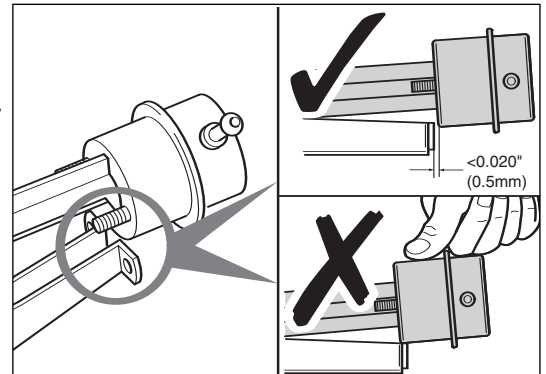
Do not fit mounting studs into bracket mounting holes at this stage.

Attempt to slide the actuator over its retaining bracket. If actuator fouls on bracket or there is significant clearance between bracket and actuator base, actuator rod length requires adjustment.

Caution

Do not apply force to push actuator on to mounting face of bracket.

Rod length setting is correct if, by rotating end link clockwise by a half turn, actuator body fouls on bracket.



**Warning**

Always wear safety glasses.

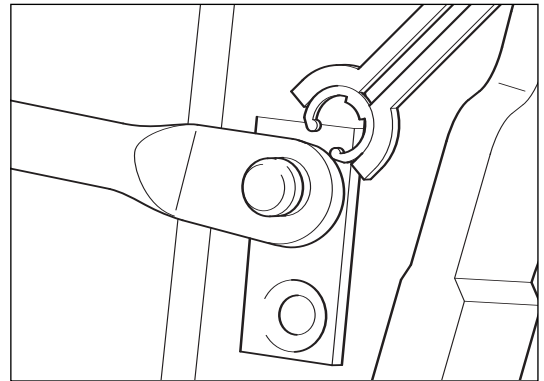
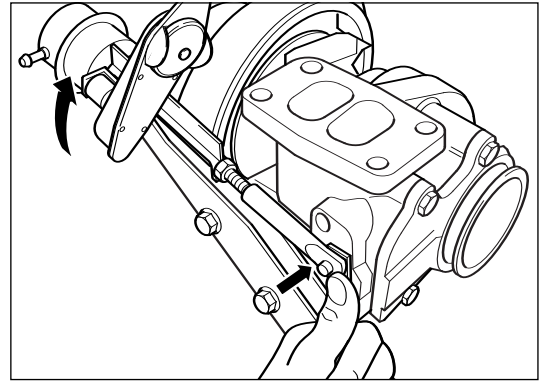
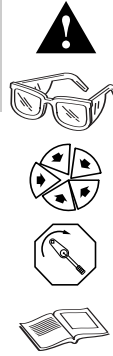
1/4 - 28 UNF 2B (7/16 in A/F)
M6 (10 mm A/F)

Remove actuator assembly from crank lever ensuring that end-link does not rotate. Fit actuator mounting studs into holes (or slots) in the bracket. Fit both actuator mounting nuts and torque tighten to value shown in [Service Data Sheet](#).

Note

Ensure actuator is refitted in correct orientation recorded during actuator removal.

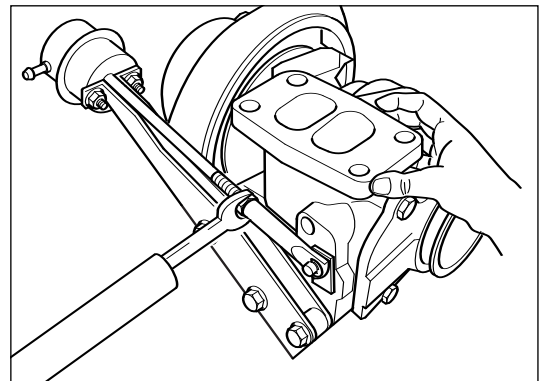
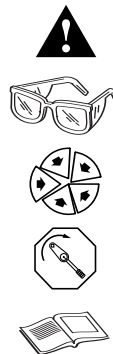
Re-fit end link to crank journal. Fit new e-clip (77) using special tool Part No. 4027204 to retain end link.



5/16 - 24 UNF 2B (1/2 in A/F)

Loosen spacer piece by turning jam nut anti-clockwise (counterclockwise). Remove and discard tie-wrap and spacer piece.

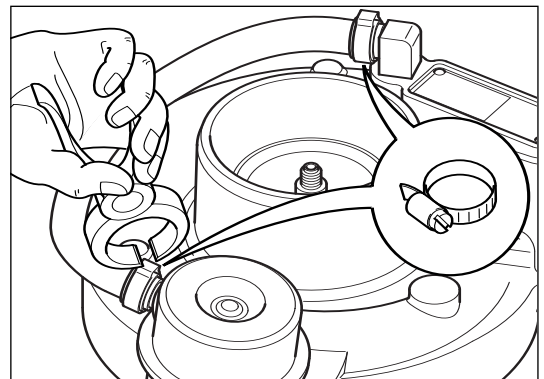
Continue turning jam-nut in same direction, and tighten against end link. Torque jam nut to value shown in [Service Data Sheet](#).

**Caution**

Before mounting turbocharger on engine, check for full and free wastegate movement, previously described in [Wastegate Actuator Checks](#).

Refit air supply hose with new clips (75). Clips should be crimped closed using piners. Crimp gap will vary due to spring back and hose type but will not be less than 0.6 mm (0.0025 in).

Suitable alternative hose clamps can be used.

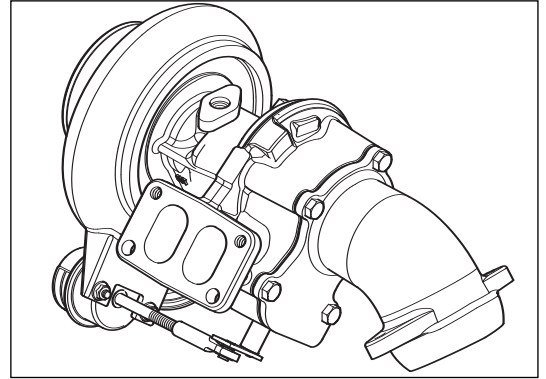




Compressor Mounted Actuator

Note

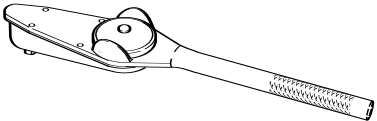
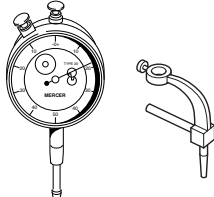
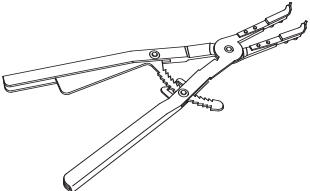
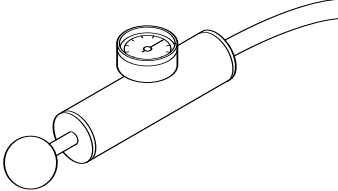
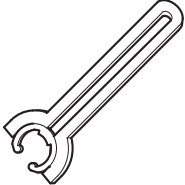
Compressor mounted actuators are fitted using same seven process steps.



Service Tools



The following special tools are recommended to perform procedures in this manual. The use of these tools is shown in the appropriate procedure. These tools can be purchased from your local Authorised Repair Location.

Part No.	Tool Description	Tool Illustration
	Torque Wrench	
	Dial Gauge and Dial Gauge Adapter	
3575186	Circlip Pliers	
	Pressure Gauge Regulated Air Supply (Max 3 bar-45 lbf/in ²)	
4027204	E-Clip Tool	

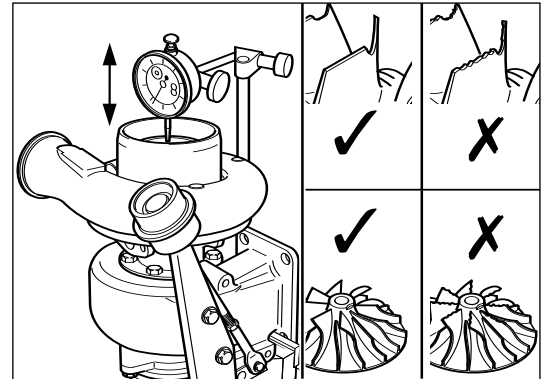
Caution

All Service and Maintenance settings are shown in Cummins Turbo Technologies' Service Data Sheet. It is essential that these settings are used. Common tools found in mechanic's tool box not included.

Disassembly

Note

Before disassembly, check for turbine and compressor blade damage. Measure bearing radial movement and axial clearance to ensure CHRA (core) is within MIN/MAX shown on [Service Data Sheet](#).

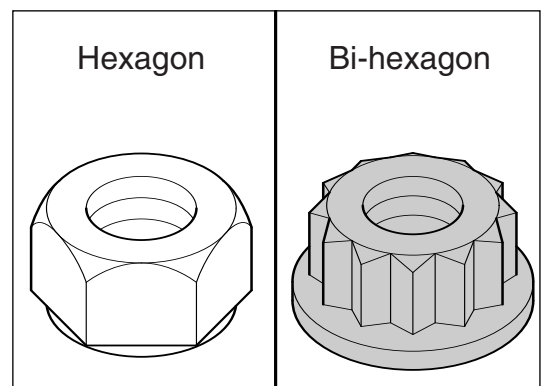


Compressor Wheel Locknut Options (61)

Designated turbochargers are fitted with alternative hexagon and bi-hexagon compressor wheel locknuts.

Hexagon nut indicates rotor balance during original manufacture.

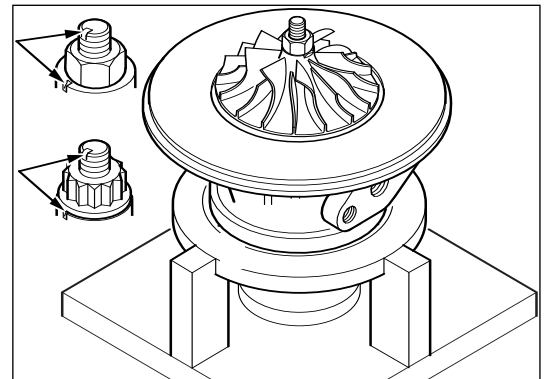
Bi-hexagon nut indicates core balance during original manufacture. This original build standard will not feature alignment marks of shaft and compressor wheel.



Where no alignment marks exist always mark shaft and compressor wheel prior to disassembly of CHRA (core).

Caution

Rotor balance **MUST** always be checked before re-assembly.



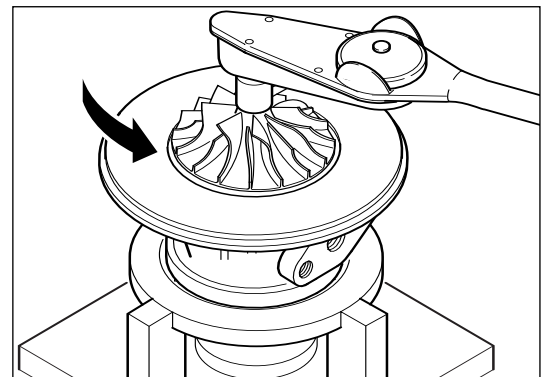
Hexagon M7 LH (13 mm A/F)

Bi-hexagon M7 LH (10 mm A/F)

Bi-hexagon nut has lower tightening torque than hexagon option. Always refer to [Service Data Sheet](#) for correct torque value.

Caution

Correct torque tightening is critical to turbocharger life. Never under- or over-torque compressor locknut.



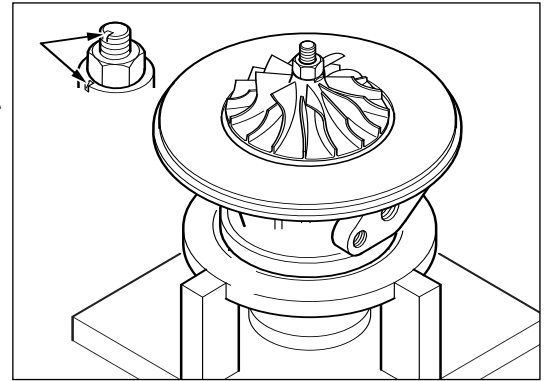


Locate CHRA (2) on to 14 mm (HX30/32W) or 19 mm (HX35/38/40/G/W) 12 point socket located in suitable fixture or vice.

Caution

Always ensure shaft and compressor wheel have alignment marks before disassembly of CHRA.

If no marks exist scribe shaft and compressor wheel before removing compressor wheel lock nut. Washing process may remove indelible ink so a file mark on shaft and scribe line on compressor wheel nose is recommended.



Warning

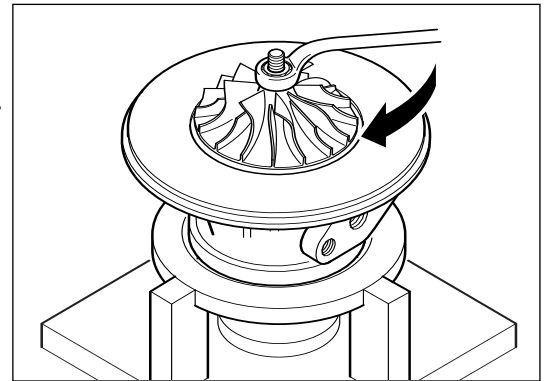
Always wear safety glasses.

M7 LH (10mm A/F)

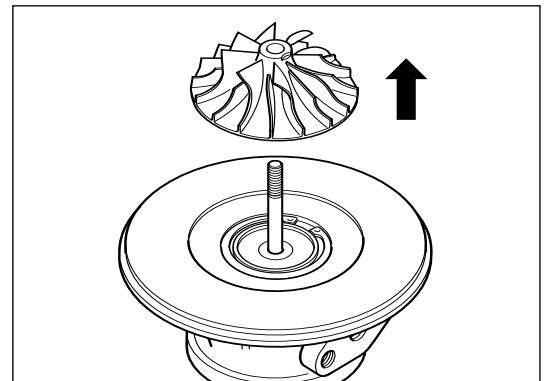
Remove compressor wheel locknut (61).

Note

Left hand thread.

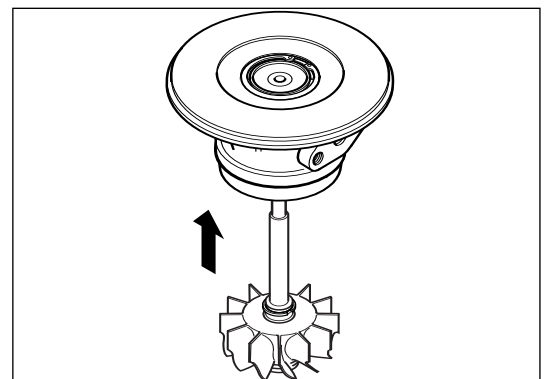


Remove compressor wheel (7).



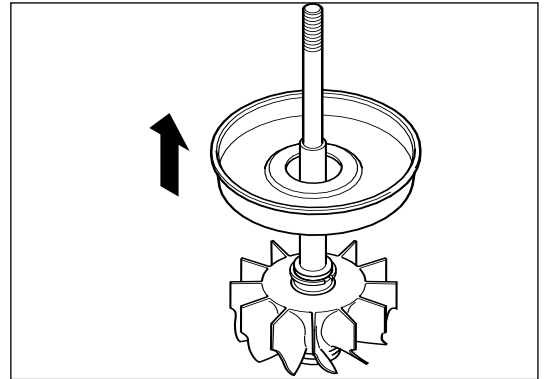
Remove remaining CHRA from fixture and gently slide bearing housing (4) off turbine wheel assembly (6).

It is permissible to tap protruding turbine shaft gently with soft hammer if split ring seal/s are stuck in their bore.





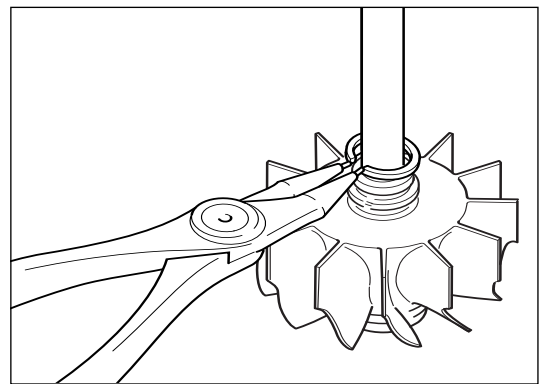
Remove heat shield (38).



Warning

Always wear safety glasses.

Carefully remove turbine split ring seal / seals (13)*.

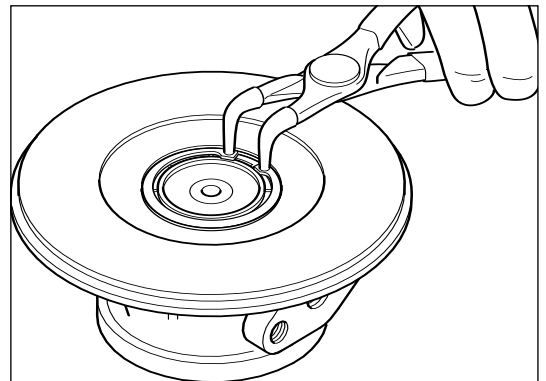


Caution

Care should be taken not to score turbine wheel shaft assembly.

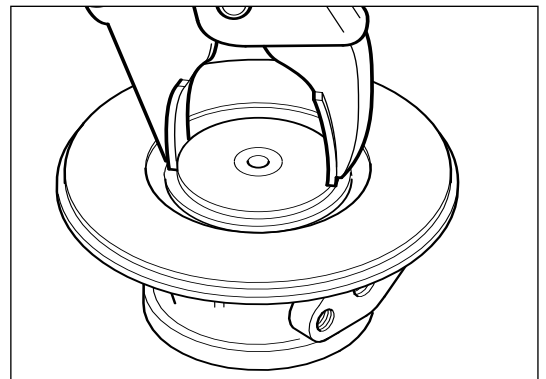
With bearing housing (4) on flat clean surface, use suitable circlip pliers to remove retaining ring insert (66).

It is practical to use free hand to contain disassembled ring whilst releasing pliers.



Remove oil seal plate (43) using mole (vice) grips.

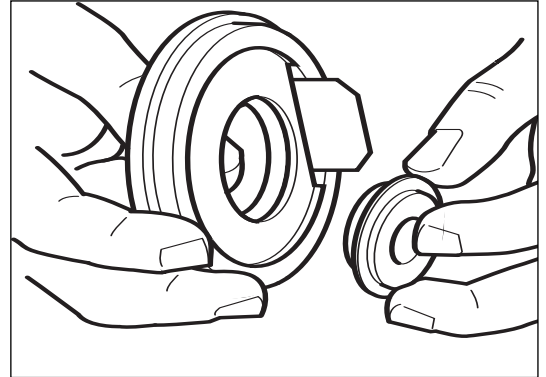
If oil seal plate is stuck in its location, it is permitted to use two screw drivers under exposed lip to lever out seal plate.



**Warning**

Always wear safety glasses.

Remove oil slinger (31).

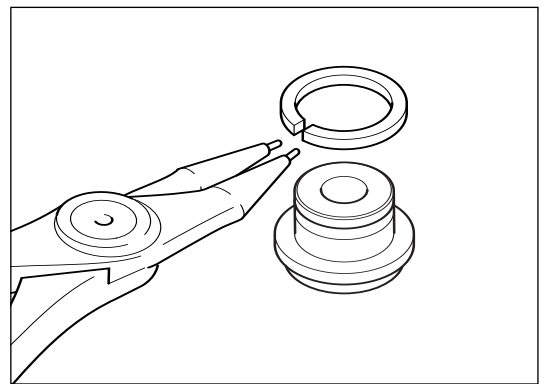
**Caution**

There are two oil slinger designs which are not interchangeable except as an oil seal plate subassembly. One of the designs does not feature an oil baffle. Ensure oil seal plate, oil slinger and baffle, where fitted, are stored together to prevent errors during reassembly.

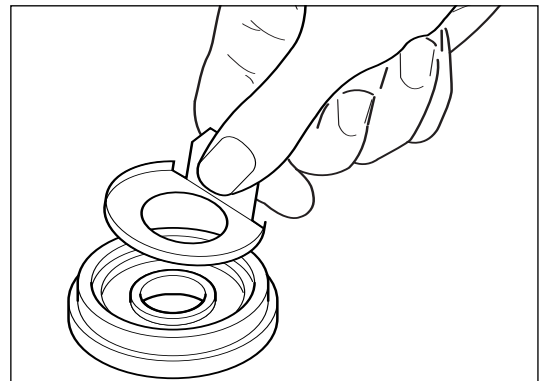
Caution

Always quote correct turbocharger assembly number, serial number and type from dataplate to ensure supply of correct oil seal plate and/or oil slinger.

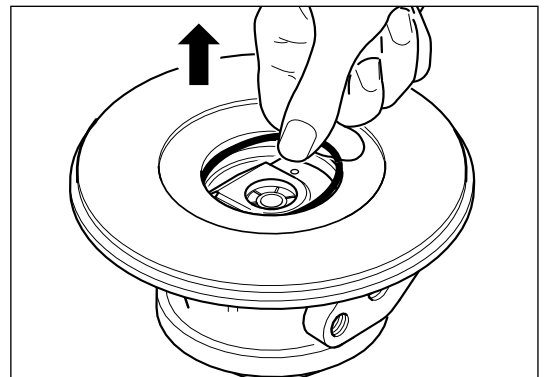
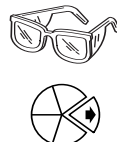
Using piston ring expander pliers remove and discard compressor split ring seal (16)* from oil slinger.



Remove oil baffle(33)* where fitted.



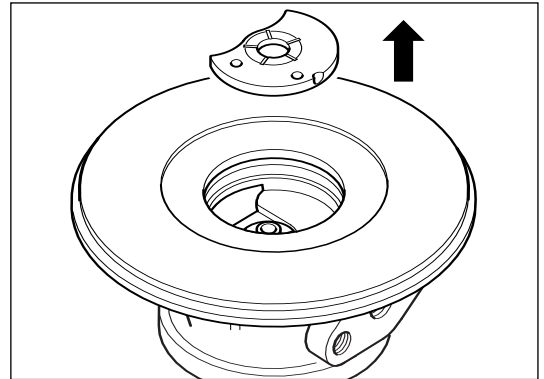
Remove and discard bearing housing o-ring seal (32)*.



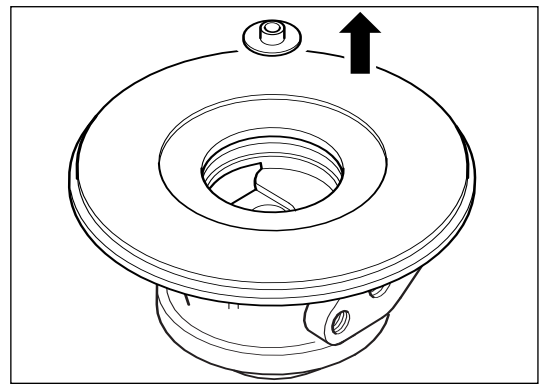
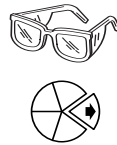
**Warning**

Always wear safety glasses.

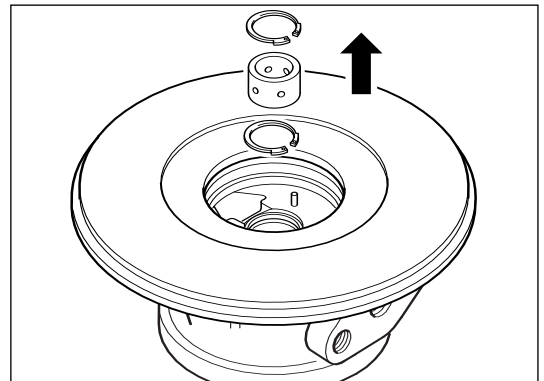
Remove thrust bearing (12)* from its pin locations and discard.



Remove thrust collar (36).

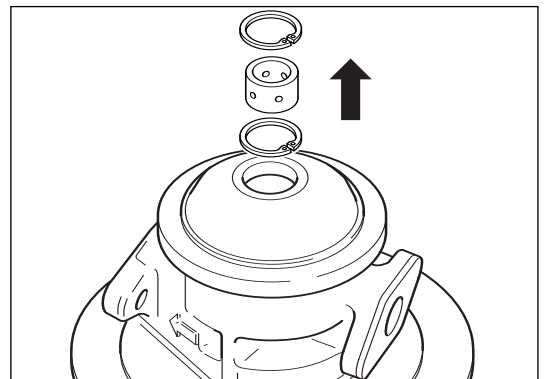


Using suitable circlip pliers, remove two circlips (64)* and journal bearing (11)* from compressor end and discard.

**Caution**

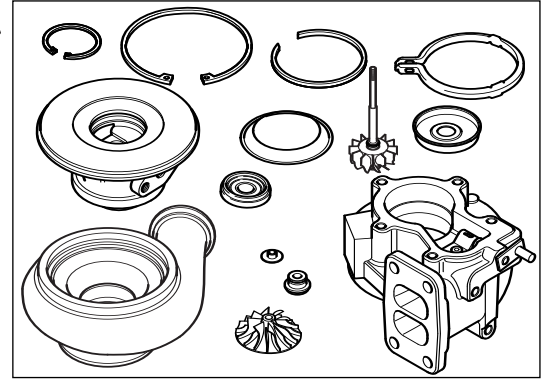
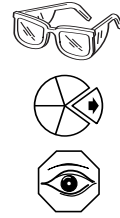
Some turbochargers are now fitted with grooved journal bearings. It is important to quote correct turbocharger assembly number, serial number and type from dataplate to ensure supply of correct bearing kit.

Turn bearing housing over and repeat process of retaining ring (64)* and bearing (11)* removal at turbine end.



Component Cleaning

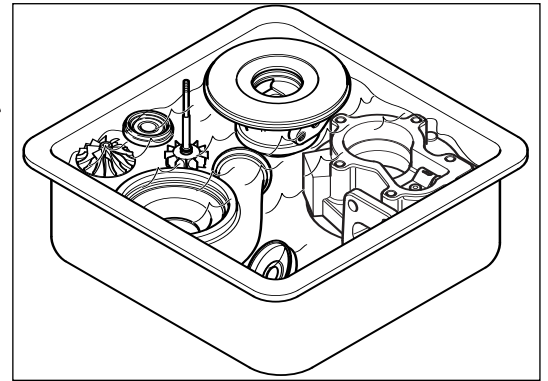
Visually inspect all parts to detect signs of burning and other fault conditions in order to obtain as much information as possible before washing.



Warning

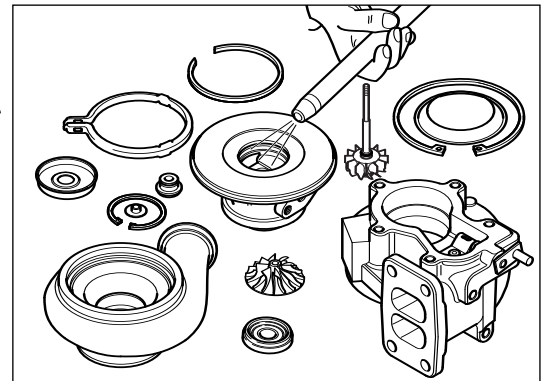
Always wear safety glasses.

Soak components in non-corrosive low flash point metal cleaner to loosen deposits.

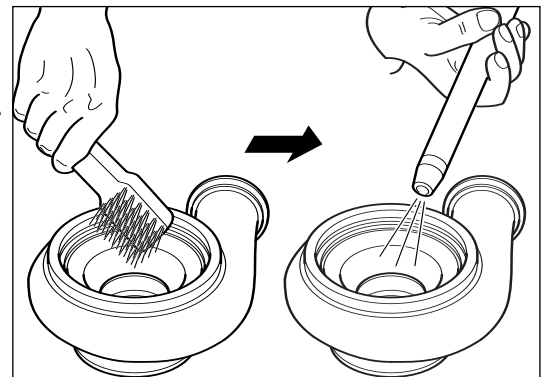


Dry components using compressed air.

Protect sliding surfaces of cleaned parts against corrosion by applying clean engine oil.



Scale like deposits, if any, must be removed by using non metallic bristle brush. After loosening deposits with brush, wash and dry components as above.



**Warning**

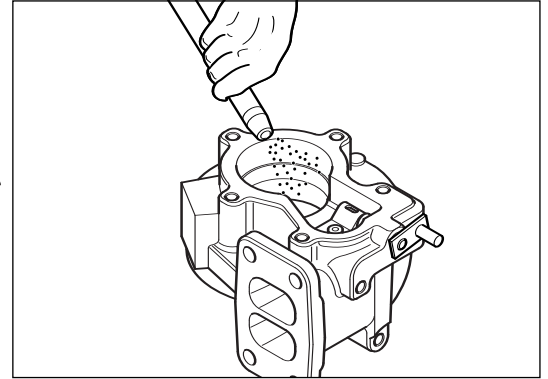
Always wear safety glasses.

Exhaust Flange M10 x 1.5 - Cover Plate M8 x 1.25

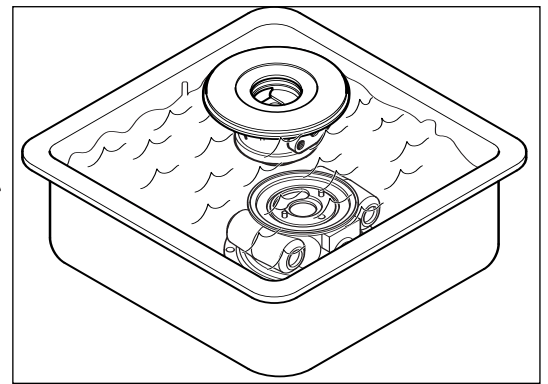
Warning

Do not bead blast Aluminium and Cast Iron components together.

It is permissible to bead blast turbine housing if chemical and brush cleaning is not effective.

**Caution**

Housing surfaces adjacent to turbine and compressor wheels must be clean, smooth and free from deposits. Always protect threads during bead blasting and clean with specified thread tap after blasting.

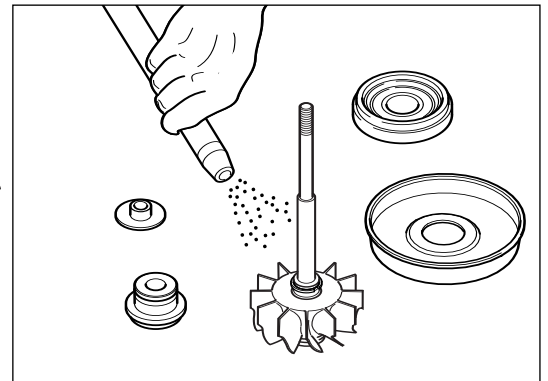
**Caution**

Do not direct bead spray on to wastegate valve spindle as beads can penetrate spindle bore, leading to spindle seizure.

Oil fittings M16 X 1.5 - M14 x 1.5 - M8 x 1.25

Coolant fittings M16 x 1.5

It is important that oil chamber of bearing housing is free of carbon before re-building. If heavy deposits persist after repeat washing replace bearing housing (4).

**Caution**

Do not bead blast bearing housing as this may damage critical bearing surfaces.

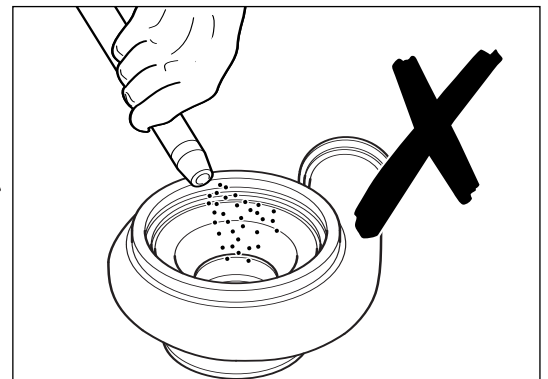
It is permissible to bead blast steel rotating parts.

Caution

Blasting specific areas for long periods of time may affect component balance. Protect thread of turbine wheel assembly.

Caution

Always clean components with compressed air after blasting.

**Caution**

Do not bead blast Aluminium compressor housing as this may damage critical surfaces.

Inspection and Testing

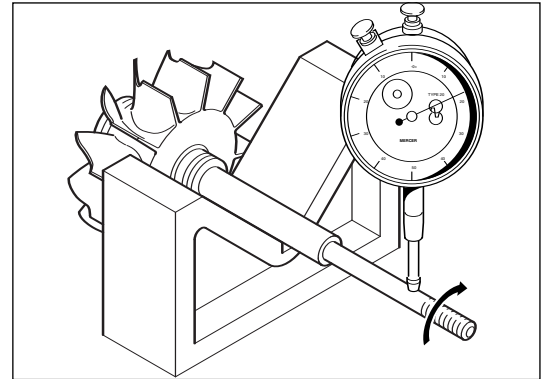
Major Components

Assembly Turbine Wheel

Place turbine wheel assembly (6) on vee block. Position dial gauge on turned surface of shaft at threaded end. Check dial gauge reading. Where shaft bend is greater than recommended maximum of 0.025 mm (0.001 in) replace assembly.

Caution

Do not attempt to straighten turbine shaft.



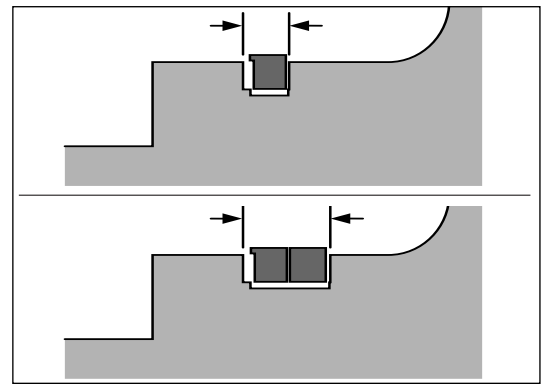
Inspect split ring seal, turbine (13)* groove walls for wear. If groove width exceeds recommended maximum replace assembly.

Single ring seal 1.69 mm (0.067 in)

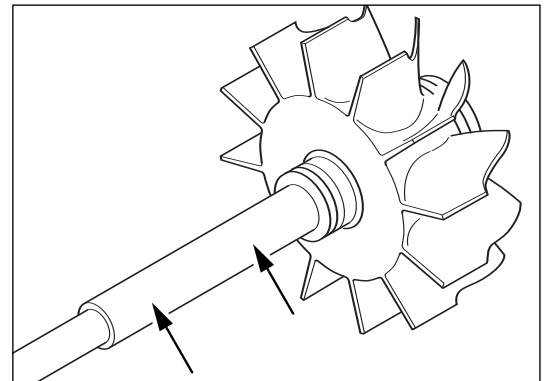
Dual ring seal 3.55 mm (0.140 in)

If wear step on ring face exceeds 0.102 mm (0.004 in) replace split ring seal, turbine.

If free gap of ring is less than 2.0 mm (0.08 in) replace split ring seal, turbine.



Inspect bearing journals for excessive scratches and wear. Where scratching is excessive or where either journal diameter is less than recommended minimum of 10.97 mm (0.43 in) replace assembly.

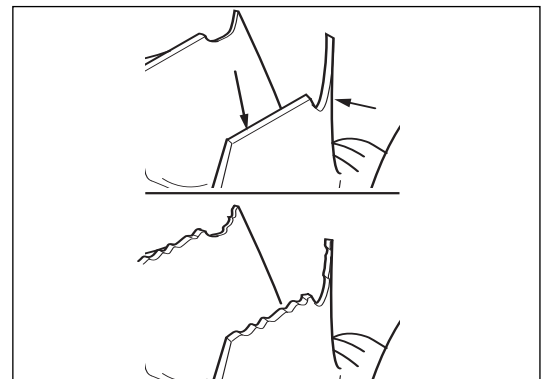


Inspect for cracked, bent or damaged blades.

Caution

Never attempt to straighten blades.

Replace with new if any damage found.





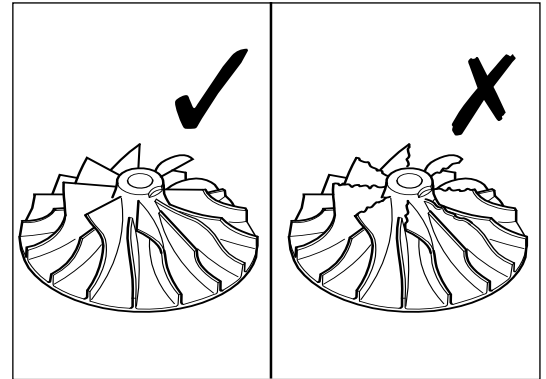
Compressor Wheel

Inspect compressor wheel (7), for cracked, bent or damaged blades.

Caution

Do not attempt to straighten blades.

Replace with new if any damage found.

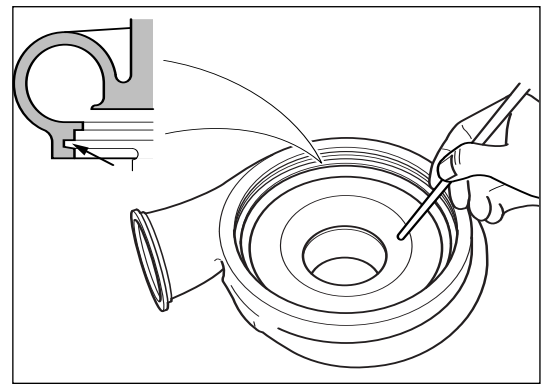


Compressor Housing

Inspect internal profile of compressor housing (8), for scoring damage due to possible contact with compressor wheel.

Return to **Component Cleaning** if deposits remain.

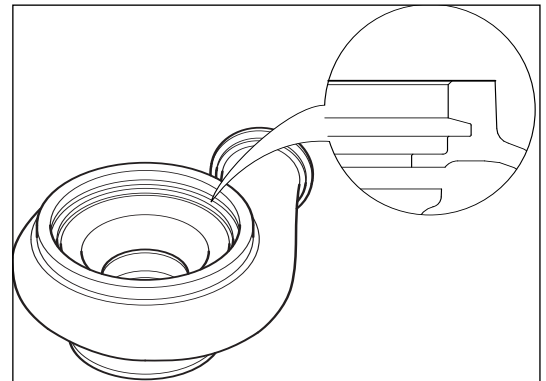
Replace with new if profile damage is visible.



Ensure position of compressor housing retaining ring groove has not been compromised by wear.

Caution

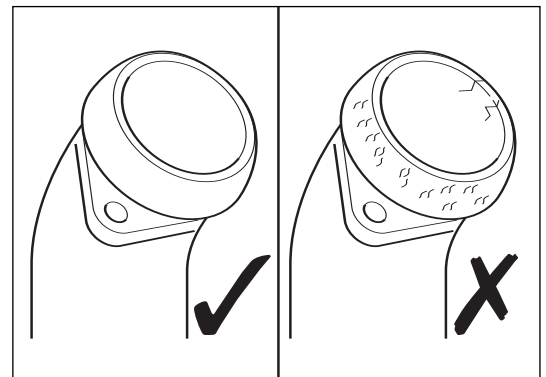
Good groove and abutment face condition are critical to integrity of compressor housing to bearing housing joint.



Turbine Housing

Check exhaust system connecting profile for fretting damage.

If sealing is compromised replace cover plate, if available.



**Warning**

Always wear safety glasses.

M8 (13 mm A/F)

Caution

Take care not to shear coverplate bolts.

Remove cover plate option. Seized bolts may be freed by spraying with penetrating oil and soaking for 20 minutes or period of time recommended by oil manufacturer.

Check cover plate gasket condition. Check flange sealing face for cracking and distortion.

If exhaust sealing is compromised replace gasket/coverplate. Where turbine housing flange is cracked, safely dispose of housing

Inspect turbine housing (5) profile for damage caused by possible contact with rotor. Inspect outer and internal walls for cracks or flaking caused by overheating.

Check turbine housing inlet flange flatness is within 0.1 mm (0.004 in). Check fastener hole diameter is not more than 1.5 mm larger than max. thread diameter of fastener.

Replace with new if any of above features are non compliant.

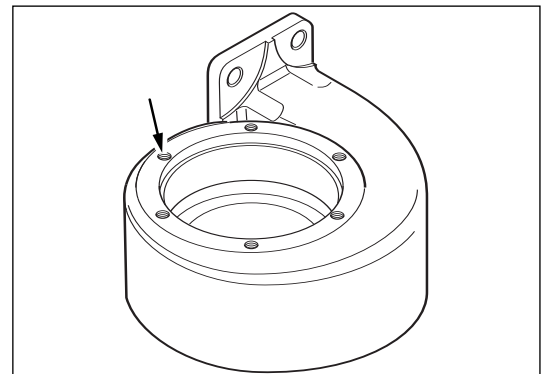
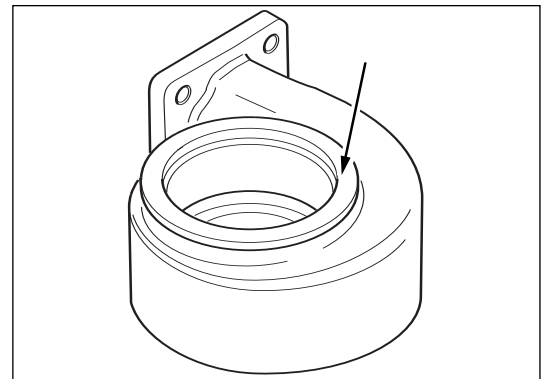
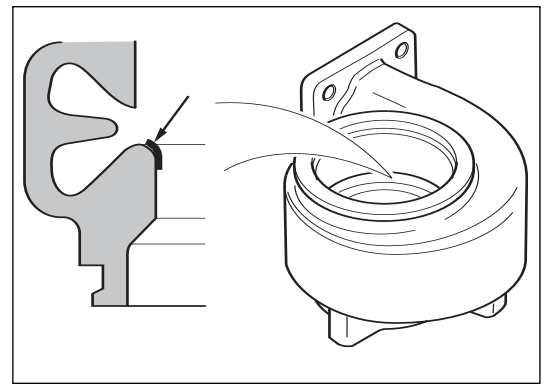
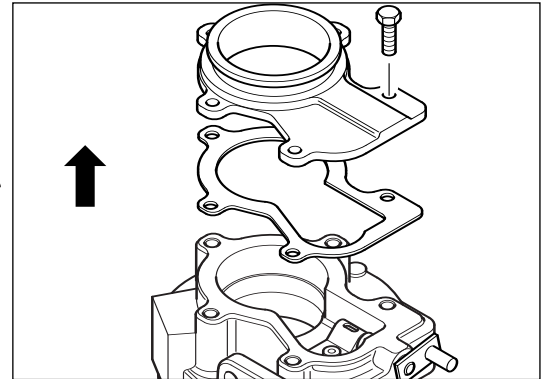
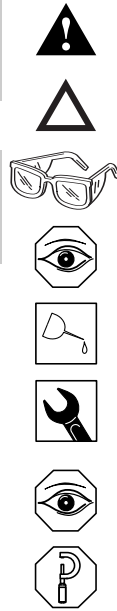
V Band

Check v-band flange for fretting damage. Turbine housings showing damage must be replaced

Clamp Plate

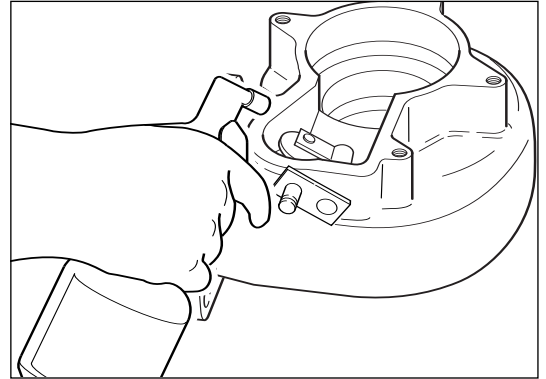
M8 X 1.25

Check clamp plate threaded holes with specified thread gauge. Replace turbine housing if threads are damaged.

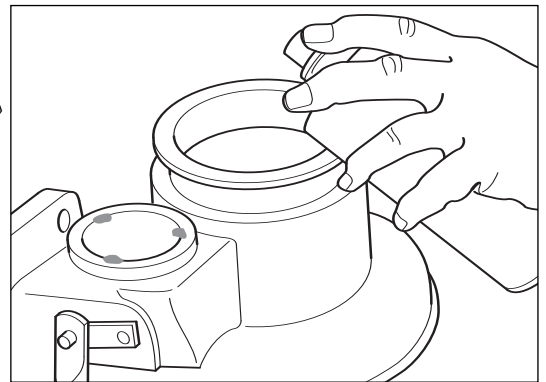
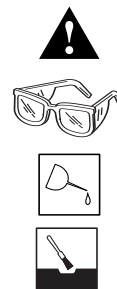




After washing, wastegate valve mechanism may remain seized or stiff to operate. If so, soak mechanism in penetrating oil for approximately 20 minutes or period of time recommended by oil manufacturer.



Some turbine housing options do not have open access to the wastegate valve but, with care, soaking with penetrating oil may still be possible.

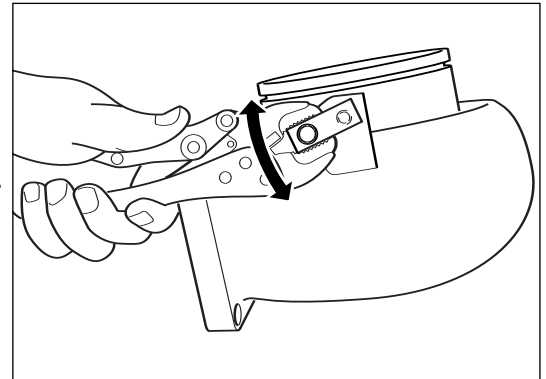


**Caution**

Extra care must be taken when attempting to free valve mechanism. Any damage will result in replacement of turbine housing.

Clamp pair of quality mole (vice) grips to lever and gently apply pressure to rotate crank lever in an arc.

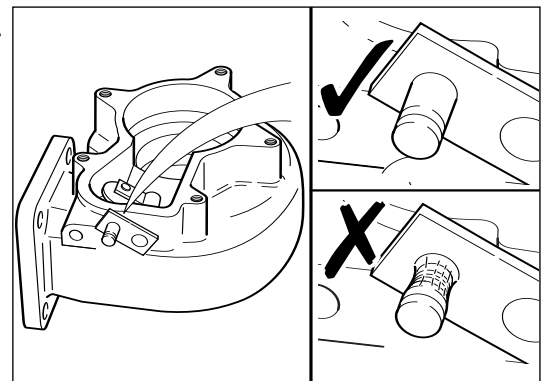
If this process does not free valve mechanism, new turbine housing must be fitted.



Check wastegate valve assembly for evidence of rubbing or cracking. Replace with new turbine housing if damage is visible.

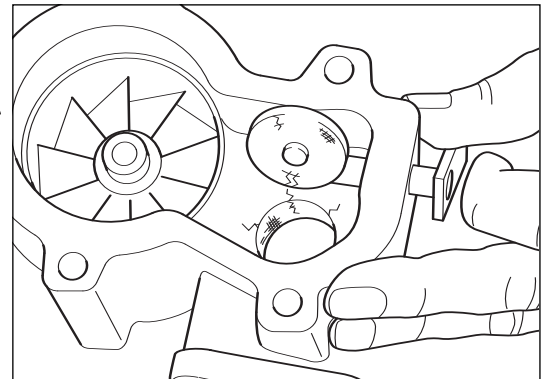
Check actuator crank lever for evidence of fretting damage, wear or cracking.

Check actuator crank lever for cracking and or misalignment due to mechanical damage.

**Caution**

If wastegate valve mechanism shows any fault, it must be replaced. Using damaged turbine housings will lead to inferior performance of turbocharger, and risk of irreparable damage to both turbocharger and engine.

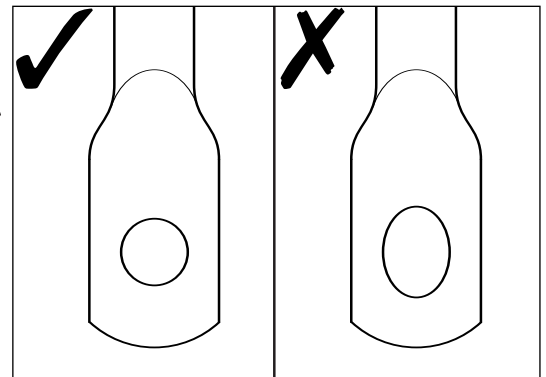
Radial cracks can occur around valve seat when turbocharger has been abused or overheated.



Inspect actuator rod end bore which locates on crank journal for elongation. Ovalisation must not exceed 0.50 mm (0.020 in).

Caution

If actuator shows any fault, it must be replaced.



Air and Water Cooled Bearing Housings

Oil Flanges M8 x 1.25 - Oil Adapter M12 and M16 x 1.5

Inspect journal bearing bores for wear and score marks. Replace bearing housing (4) if bore diameter exceeds maximum of 15.88 mm (0.625 in) or when bore scratching is severe.

Ensure groove locations for retaining rings, bearing (64) are free from deposits and do not exceed width of 0.82 mm (0.032 in).

Check that oil cavity is free from carbon and any entrained debris that may be result of failure. Ensure oil port threads are clean then check with appropriate thread gauge.

Caution

Bearing housing clamp plate interface can corrode in high temperature operation. Bearing housings showing corrosion or v band fretting damage must be replaced.

Water Cooled Bearing Housing

M16 x 1.5

Ensure all coolant port threads are clean then check with appropriate thread gauge.

Check oil seal plate retaining ring groove does not exceed maximum width dimension of: 2 mm (0.079 in).

Small Components

Oil Slinger and Oil Seal Plate

Caution

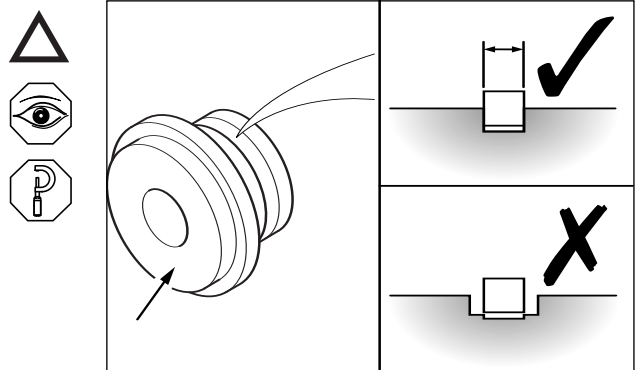
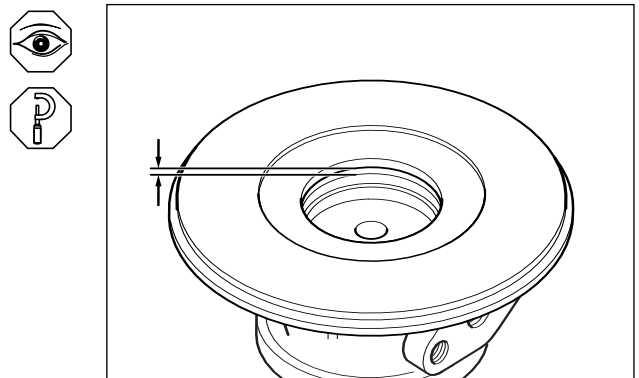
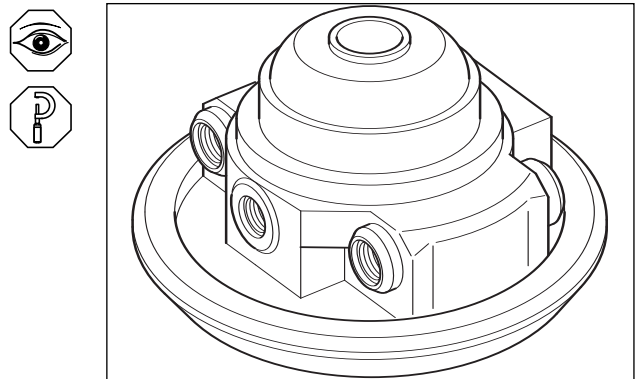
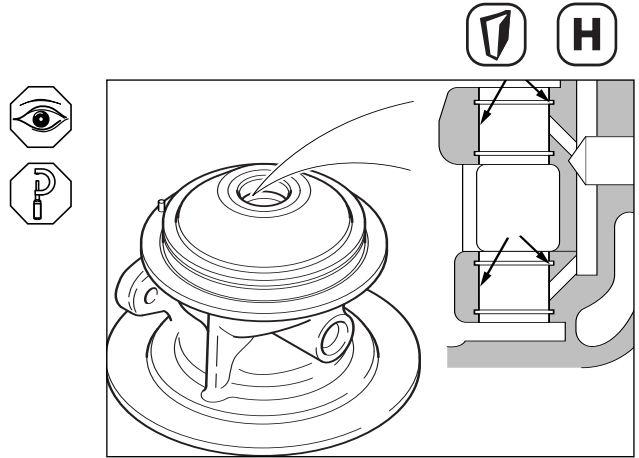
There are two oil slinger designs which are not interchangeable except as an oil seal plate subassembly.

Inspect and replace oil slinger (31) if compressor split ring seal (16)* groove walls are scored or damaged or if groove width exceeds maximum of 1.67 mm (0.066 in).

Check for signs of rubbing and scoring on thrust surface and replace where damage is severe.

If ring faces show any signs of wear replace compressor split ring seal (16)*.

If free gap of ring is less than 2.0 mm (0.08 in) replace compressor split ring seal (16)*.



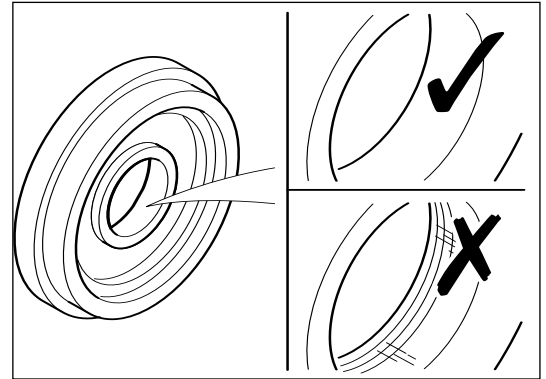


Inspect seal bore of oil seal plate (43) and replace if scored or damaged.

Slinger with multiple radial holes has annular groove which fits on to spigot extension of oil seal plate. This design does not feature an oil baffle.

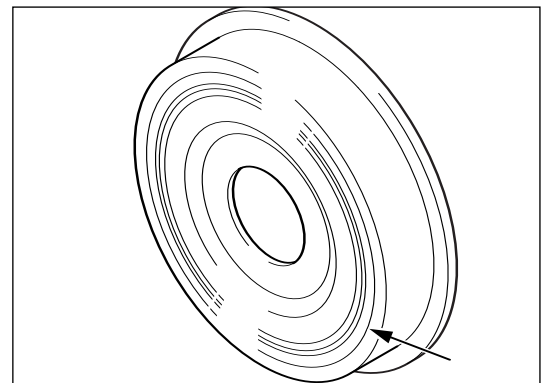
Slinger with no radial holes does not have groove and oil seal plate has no spigot extension. An oil baffle is required.

Refer to [Exploded view](#).



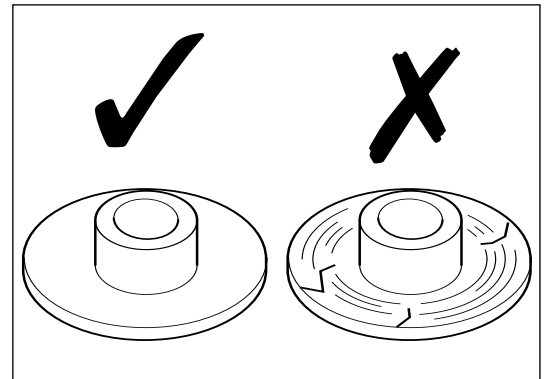
Heat Shield

Check and replace if heat shield (38) is distorted or if signs of rubbing or cracking are visible.



Thrust Collar

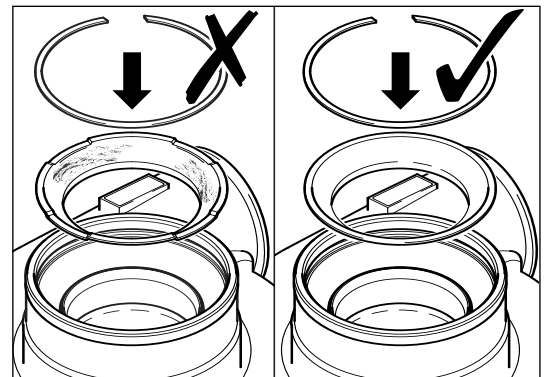
Check and replace if thrust collar (36) is scored on thrust face or if any cracks are visible.



Compressor Inlet Baffle Option

Check baffle for debris entrainment damage. Always fit new type inlet baffle on reassembly.

Refer to [Inlet Baffle](#) for re-fitting instructions.



Reassembly

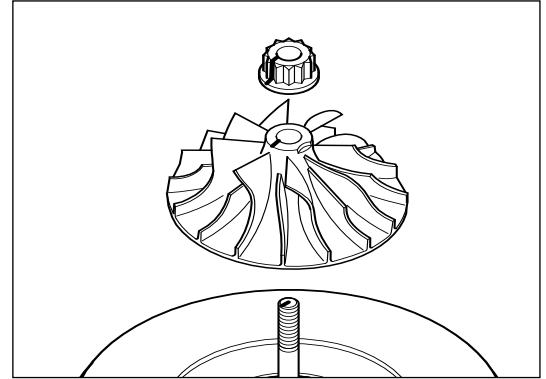


Rotor Balance

Caution

This turbocharger may have been manufactured using core balance process. Rotor balance **MUST** always be checked on re-build.

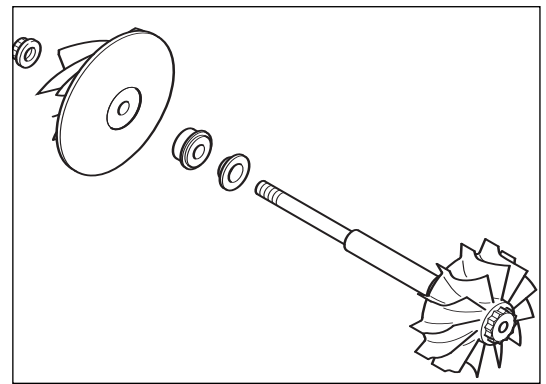
Turbocharger should always have co-relation marks on end of turbine shaft and impeller nose if it has been disassembled according to process defined in **Disassembly**. Thrust collar and oil slinger will not have co-relation marks.



Components that should be included in rotor balance are:

- Turbine wheel and shaft
- Thrust collar
- Oil slinger
- Compressor wheel
- Nut

Balance is achieved by relative rotation of components as indicated by balance machine output.



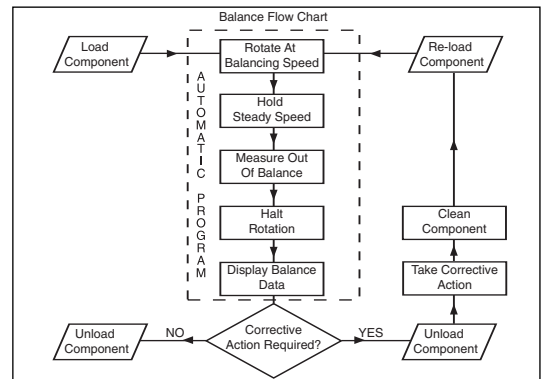
Balance process requires purpose built rig and compliance with rig procedure.

Rotor balance limits appear in **Service Data Sheet**.

On achieving balance, parts should be permanently marked for subsequent re-alignment during reassembly.

Caution

Only use genuine Holset compressor wheels and assembly turbine wheels which are individually check balanced for long life and quiet operation.

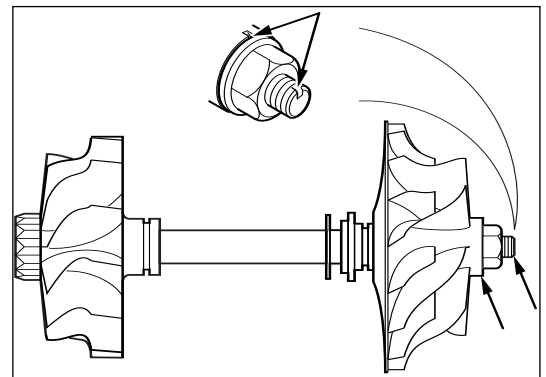


Caution

Always make sure balance marks on rotor assembly are in alignment when rebuilding turbocharger.

Caution

Both 6 and 12 point nuts have been used on this range of turbochargers. Ensure correct tightening torque specified in **Service Data Sheet** is used.





Turbocharger Reassembly

Warning

Always wear safety glasses.

Caution

Original circlips must be fitted with bevelled edge facing journal bearing. Premature failure will result from incorrect fitting. New circlips in bearing kit will not have bevel feature and can be fitted in either orientation.

Caution

Some turbochargers are now fitted with grooved journal bearings. It is important to quote correct turbocharger assembly number, serial number and type from the dataplate to ensure supply of correct bearing kit.

Place bearing housing compressor mating face on clean surface.

Fit inner turbine end retaining ring, bearing (64)* using suitable circlip pliers.

Lubricate journal bearing (11)* with clean engine oil and install.

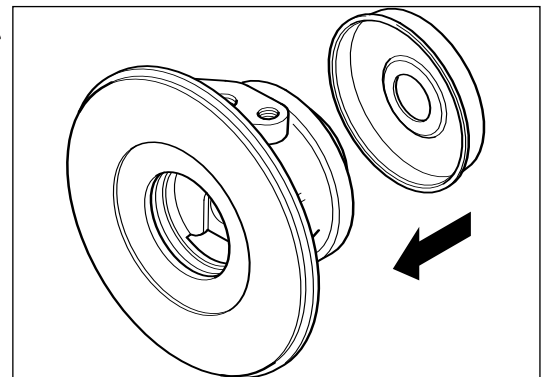
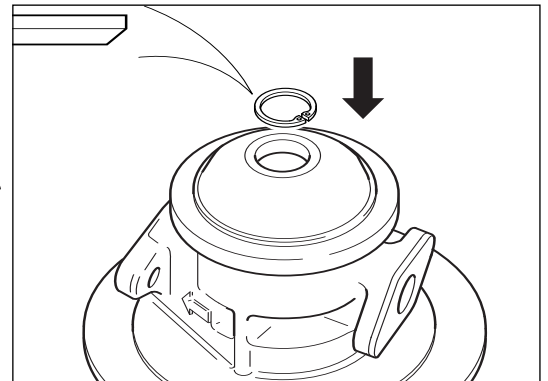
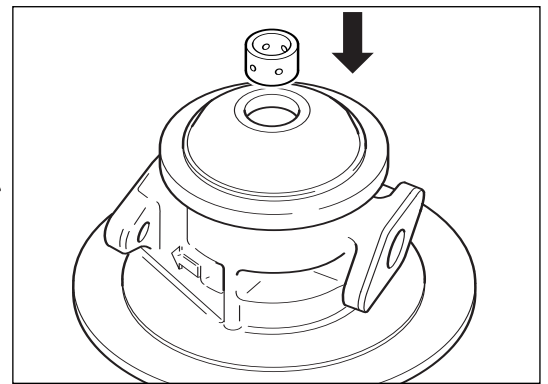
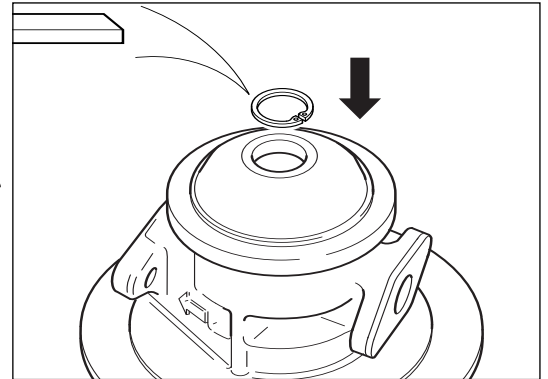
Fit outer retaining ring (64)*.

Caution

If retaining ring features bevelled edge always face bevel towards bearing.

Turn bearing housing over and repeat retaining ring (64)* and journal bearing (11)* installation process at compressor end.

Install heat shield (38).



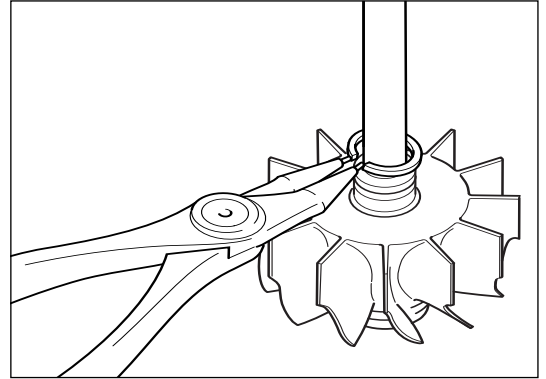
**Warning**

Always wear safety glasses.

Install new turbine split ring seal / seals(13)* to turbine wheel assembly (6).

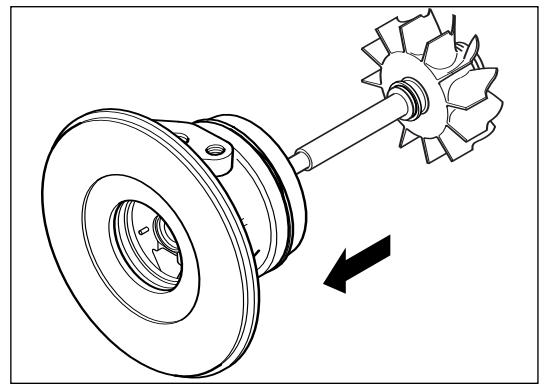
Caution

Some applications contain dual ring seals. It is clear from groove width dimension whether single or dual split ring seals are required.

**Caution**

Align dual split ring seals (13) so gaps are positioned 180° apart. Gently press down on turbine wheel - slight rotation of wheel will assist in properly locating split ring seals.

Lubricate shaft with clean engine oil and insert into journal bearings. Positively locate seal ring (13)* into position and ensure turbine wheel assembly rotates freely.



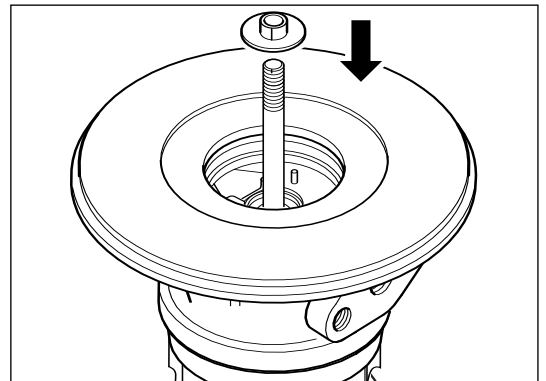
Place assembly on clean flat surface supporting turbine wheel assembly (6) in suitable fixture.

Ensure all thrust contact faces are clean.

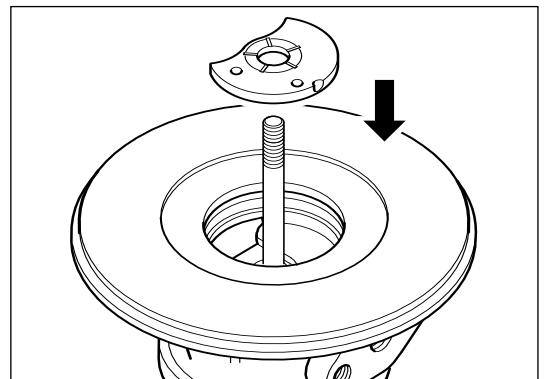
Insert thrust collar.

Caution

Align balance mark on thrust collar with that on shaft, if applicable.



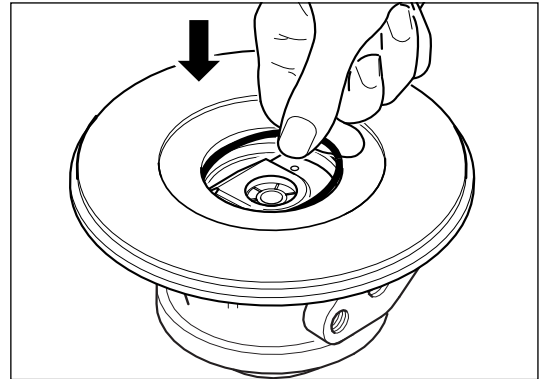
Apply clean engine oil to installed thrust collar (36) and insert thrust bearing (12)*.



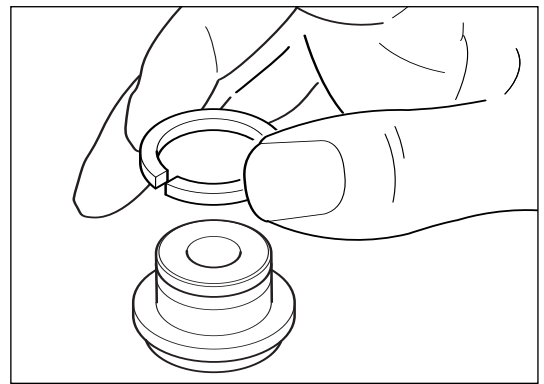
**Warning**

Always wear safety glasses.

Apply small amount of engine oil to bearing housing o-ring seal (32)* and insert.



Install new split ring seal (16)* to oil slinger (31).



Install oil slinger (31) into oil seal plate (43).

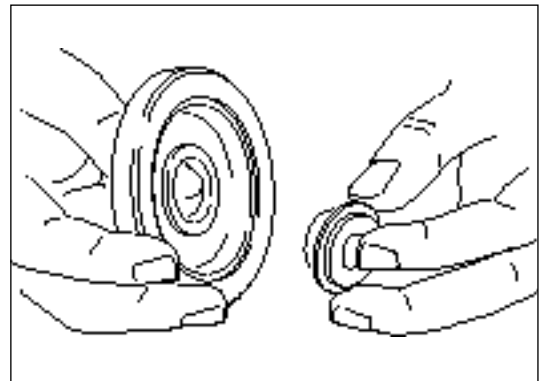
Caution

There are two oil slinger designs which are not interchangeable except as an oil seal plate subassembly.

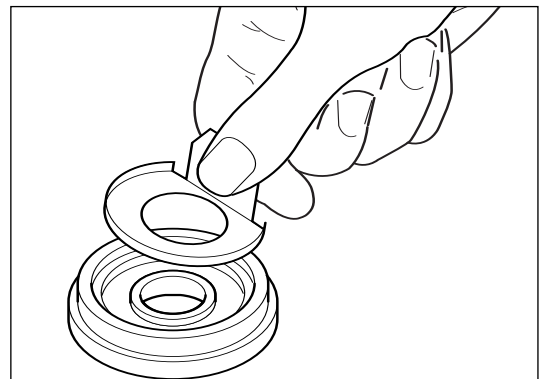
Slinger with multiple radial holes has annular groove which fits on to spigot extension of oil seal plate. This design does not feature an oil baffle.

Slinger with no radial holes does not have groove and oil seal plate has no spigot extension. An oil baffle is required.

Refer to [Exploded View](#)



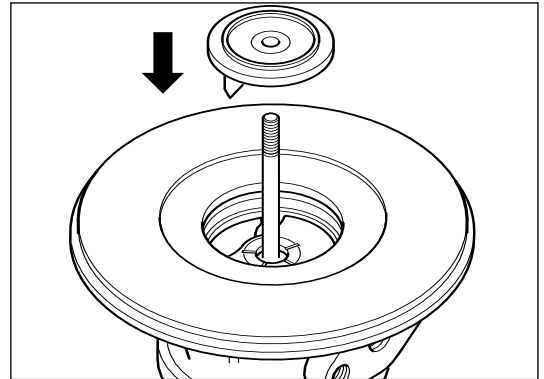
Install oil baffle (33)*, where fitted, into oil seal plate (43).



**Warning**

Always wear safety glasses.

Align tongue of oil baffle, where fitted, with aperture in bearing housing and install seal plate assembly.

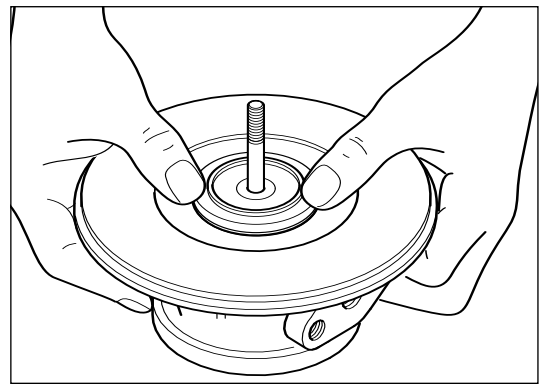


Transfer assembly from fixture locating on turbine wheel nose to one locating on bearing housing.

Install oil seal plate (43) into bearing housing (4).

Caution

Align balance mark on oil slinger with that on shaft, if applicable.

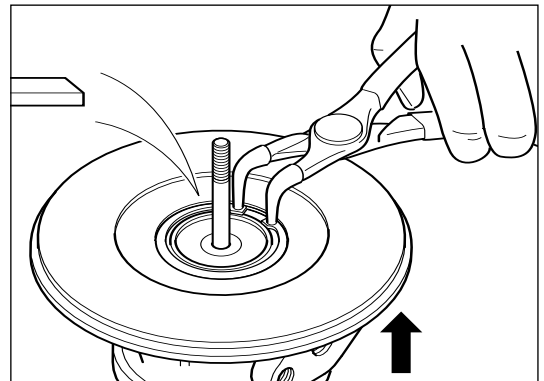


Locate part built CHRA on to 14 mm (HX30/32W) or 19 mm (HX35/38/40/G/W) 12 point socket located in suitable fixture or vice.

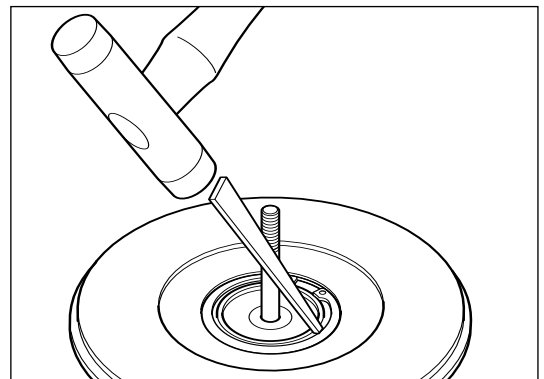
Use suitable circlip pliers to install insert, retaining ring (66). It may be necessary to lift bearing housing to its upper clearance limit to fully expose circlip groove.

Caution

Retaining ring must be fitted with chamfered face upwards away from oil seal plate.



Use soft hammer and drift to ensure retaining ring (66) is properly located.



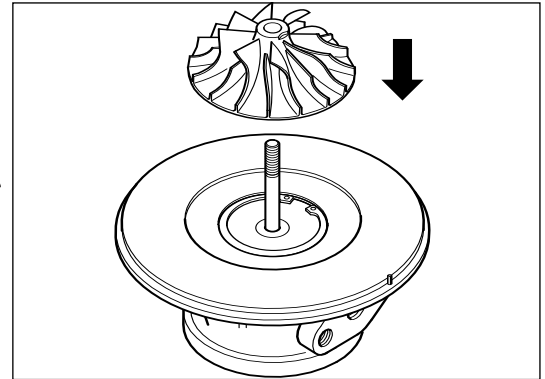
**Warning**

Always wear safety glasses.

Install compressor wheel (7).

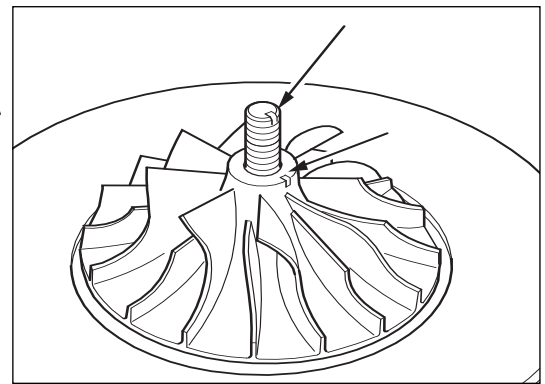
Caution

Before installation ensure compressor wheel is clean and back face is free from oil. After installation smear light oil to shaft thread and compressor wheel clamp face.



Align balance marks scribed on shaft and compressor wheel.

Brush thread and clamp face of locknut with an anti-seize compound to avoid loss of alignment during torque tightening.



M7 LH (10 or 13 mm A/F)

Install locknut, compressor wheel (61) and tighten to torque value defined in **Service Data Sheet**.

Caution

Hand tighten and correct any excessive/unusual torque characteristic before torque tightening.

Caution

Ensure that balance marks remain aligned on compressor wheel and shaft throughout torque tightening sequence.

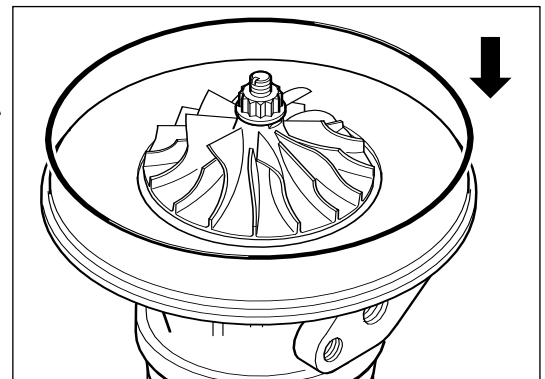
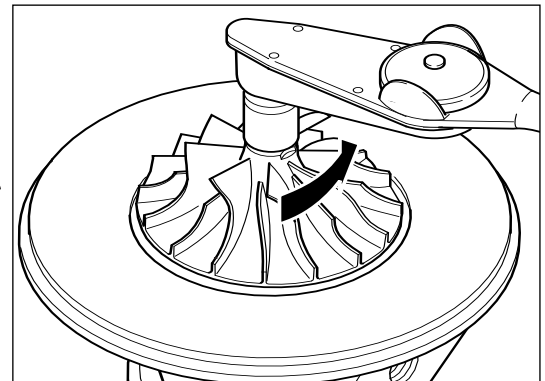
Caution

Both 6 and 12 point nuts have been used on this range of turbochargers. Ensure correct tightening torque specified in **Service Data Sheet** is used.

Note

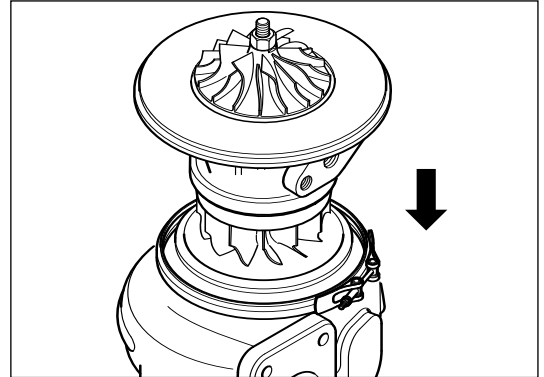
Left hand thread.

Lubricate o-ring seal (41) with clean engine oil and install into retaining groove

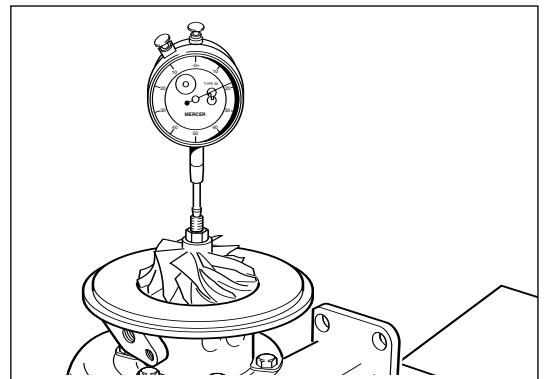




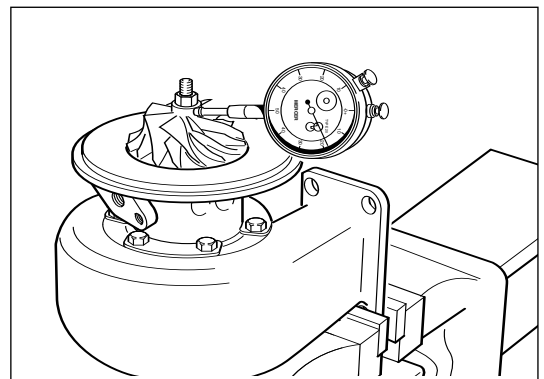
Refer to ***Turbine and Compressor Housings*** to reassemble turbine housing.



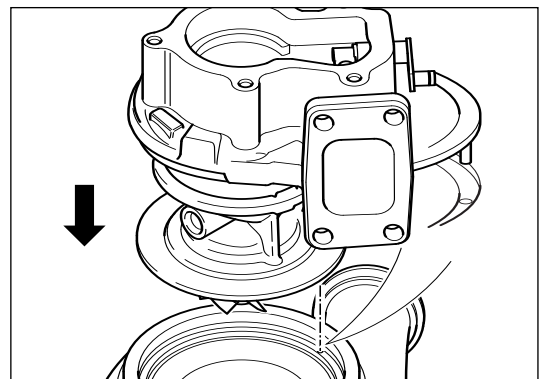
Check thrust clearance using dial gauge. Ensure clearance is within MIN/MAX values shown on ***Service Data Sheet***.



Check compressor end radial movement using dial gauge. Ensure clearance lies within MIN/MAX TIR (Total Indicator Reading) values shown on ***Service Data Sheet***.



Refer to ***Turbine and Compressor Housings*** to reassemble compressor housing.



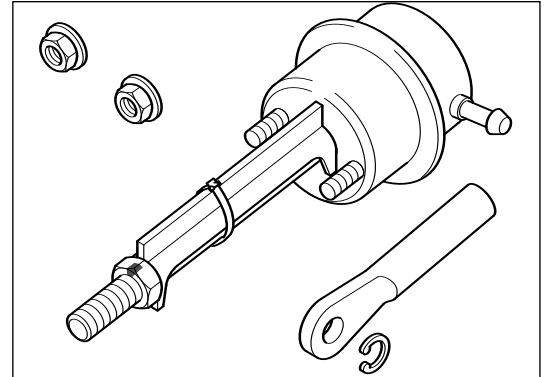


Pre-set Wastegate Actuator Reassembly

Caution

Contact your local approved dealer for correct replacement actuator kit (74). It is important to quote the correct turbocharger assembly number, serial number and type to ensure supply of correct pre-set actuator.

Refer to [Wastegate Actuator Replacement](#) to reassemble existing or new actuator.

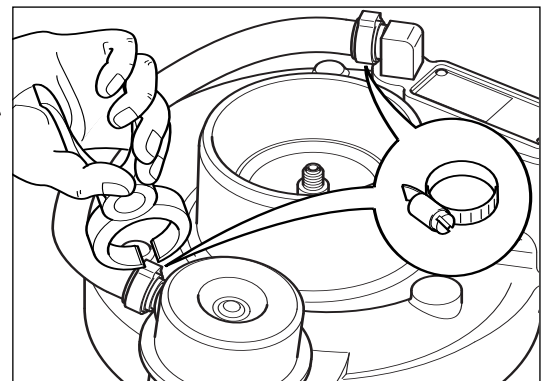


Warning

Always wear safety glasses.

On hose fed actuator options, refit air supply hose with new hose clips (75). Clips should be crimped closed using pinners. Crimp gap will vary due to spring back and hose type but will not be less than 0.6 mm (0.025 in).

Suitable alternative hose clamps can be used.

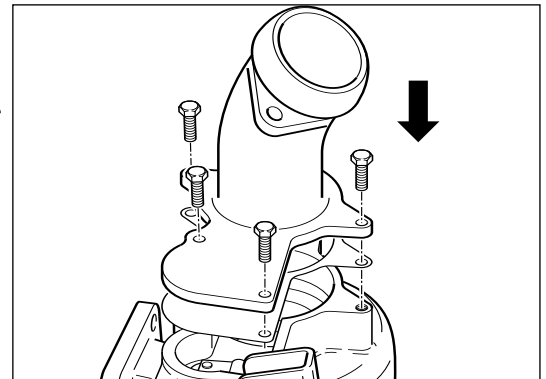


Caution

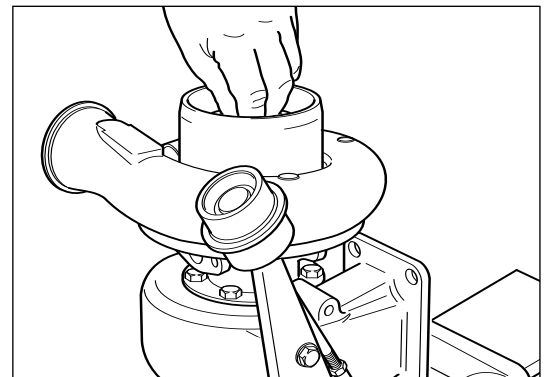
Before mounting turbocharger on engine, check for full and free wastegate movement.

M8 (13 mm A/F)

Replace cover plate (option) (80) and tighten cover plate bolts (67) to torque value specified in [Service Data Sheet](#).



Ensure rotor assembly freely rotates.





Holset HX30/32/35/38/40/G/W

Service Repair Manual

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