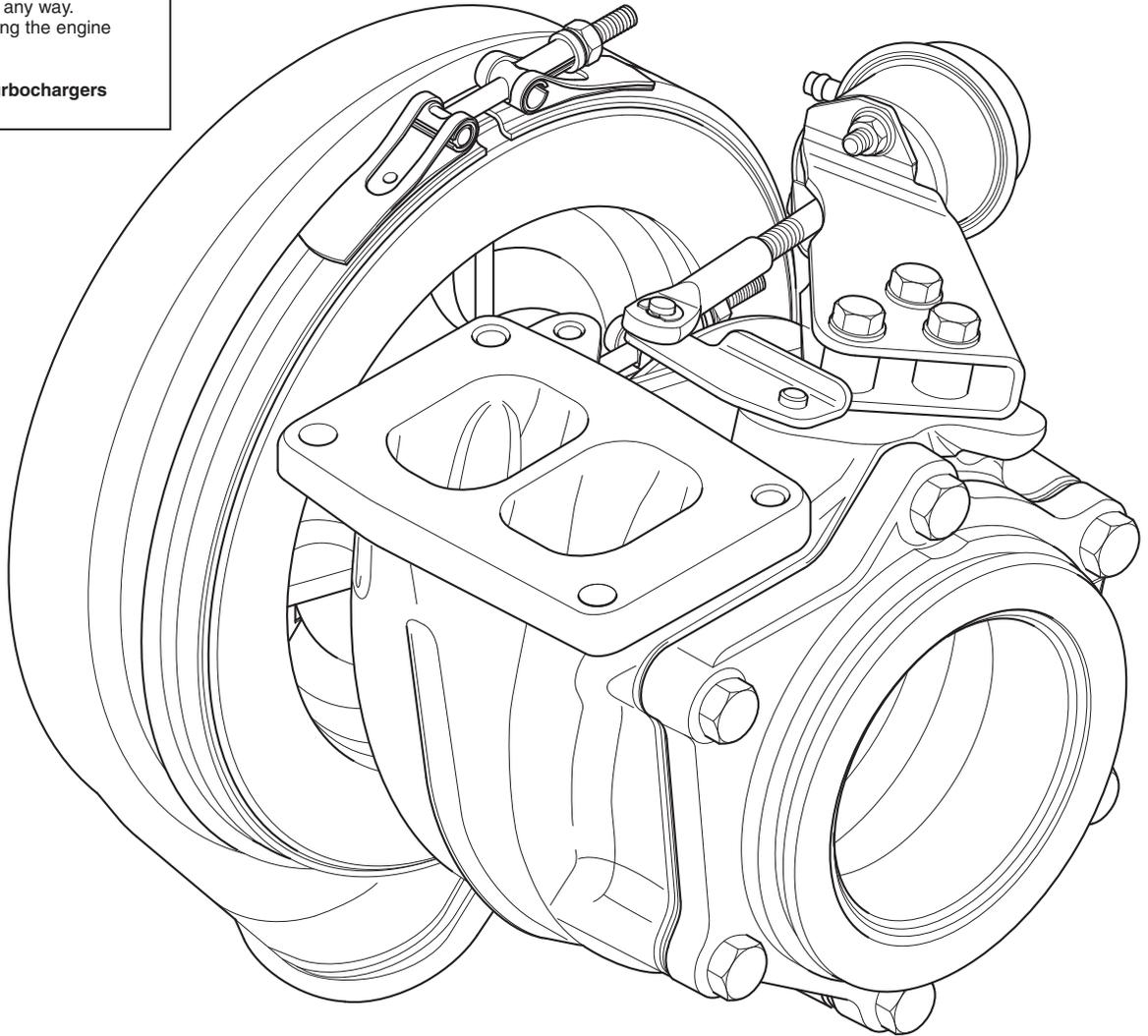


# Holset HE551/M/W

## Service Repair Manual

**WARNING**

-  Turbochargers can be hazardous when not used as specified by the manufacturer. To prevent damage and personal injury:
- Always use the turbocharger part number specified by the engine manufacturer.
  - Use only in applications approved by the engine manufacturer.
  - Do not touch before checking surface temperatures.
  - Do not work on a running turbocharger or engine.
  - Do not modify the turbocharger in any way.
  - Disassemble and re-assemble using the engine manufacturer's instructions.
  - Use only approved spare parts.
- For advice on the safe use of turbochargers contact [www.holset.com](http://www.holset.com)**



## 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 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 Cummins Turbo Technologies 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](http://www.holsetaftermarket.com) so that Cummins Turbo Technologies can update the Service Data 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](http://www.holsetaftermarket.com).



When using the manual on-line this icon will link to Cummins Turbo Technologies'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 Cummins Turbo Technologies 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. Cummins Turbo Technologies 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

Turbocharger surface temperature during operation can achieve 700°C (1300°F). The designated turbochargers weigh from 28 kg to 36.4 kg (62 lb to 80 lb) and some are fitted with external parts that are sensitive to manual handling.

### Warning

Some parts are manufactured in Viton that requires special treatment during repair and service after fire.

### Caution

This turbocharger has been manufactured using piece part and rotor balance processes and **MUST** be check balanced on rebuild.

If you intend to overhaul/repair a rotor balanced turbocharger, ensure that all the rotor parts have co-relation marks prior to disassembly so that they can be reassembled in the same relative positions.

Balance limits for turbocharger rebuild are shown on Cummins Turbo Technologies' Service Data Sheet.

It is important to note that operating a turbocharger with a rotor or core balance level greater than the published limits could cause turbocharger or engine failure. If you are in any doubt regarding the balancing process, please contact an approved Cummins Turbo Technologies agent for assistance.

### Caution

Never remove the wastegate actuator or mounting bracket from the turbine housing, unless the actuator is to be renewed. It is possible to leave the turbine housing, bracket and actuator as an assembly while servicing the turbocharger.

Never adjust the link-rod of an assembled wastegate turbocharger. The link-rods are set by the O.E. supplier to precise limits which must be adhered to.

Always check that the actuator and wastegate mechanism is still in good working order, before proceeding with disassembly of your wastegate turbocharger.

### 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.

### Note

Cummins Turbo Technologies receives many turbocharger returns 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.

## Installation Data

1. Many turbochargers are returned for attention that are no fault found. Before assuming turbocharger is not performing to specification always refer to engine diagnostic system and fault finding chart of this manual to make all recommended health checks.
2. It is important that intake and exhaust systems are fitted in accordance with recommendations of Equipment and Engine manufacturers. It is important not to overload turbocharger by external attachments or forces.
3. The air filter must remove particles greater than  $5\mu\text{m}$  at an efficiency of 95% and be of sufficient capacity to match the air consumption of engine. Recommended filters should always be used with pressure drop indicator. Intake systems must be tightened to values specified by equipment and engine manufacturers to withstand depressions up to 6.3 kPa (0.91 lbf/in<sup>2</sup>).
4. Hose and clip connections of intake manifold system must be tightened to values specified by Equipment and Engine manufacturers to withstand turbocharger pressure ratio.
5. Exhaust system connections must be tightened to values specified by Equipment and Engine manufacturers to be capable of operating at exhaust back pressures of up to 10 kPa (1.5 lbf/in<sup>2</sup>). Subject to an extensive review and formal approval, this limit may be increased to 25 kPa (3.6 lbf/in<sup>2</sup>) 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/in<sup>2</sup>). Experience is available of instantaneous pressures up to 700 kPa (101.5 lbf/in<sup>2</sup>) but any application operating above 450 kPa (65.3 lbf/in<sup>2</sup>) must be referred for approval.
6. Oil should be filtered to  $10\mu\text{m}$  with efficiency of 60% TWA (Time Weighted Average) /  $20\mu\text{m}$  with efficiency of 85% TWA. Efficiency assessed using ISO Standard 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  $95\pm 5^\circ\text{C}$  ( $203\pm 9^\circ\text{F}$ ). It should not exceed  $120^\circ\text{C}$  ( $248^\circ\text{F}$ ) under any operating condition.
9. Any pre-lube oil must be clean and meet minimum CD classification.
10. Orientation of turbine housing, bearing housing and compressor cover is fixed according to application. During installation, do not attempt to rotate these components. Inclined turbocharger installation is not recommended. If an installed angle is necessary, oil inlet centreline must be  $\pm 10$  degrees from vertical and rotor centreline  $\pm 5$  degrees from horizontal.
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 returns into engine under all operating conditions, return connection into engine sump must not be submerged and outlet flange of turbocharger must be 50 mm above maximum oil level of engine sump pan. Crankcase pressure should be limited ideally to 0.8 kPa (0.12 lbf/in<sup>2</sup>) but 1.4 kPa (0.20 lbf/in<sup>2</sup>) can be referred for approval.
12. Crankcase pressure should be limited to 0.8 kPa (0.12 lbf/in<sup>2</sup>). 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/in<sup>2</sup>) must show at oil inlet within 3 - 4 seconds of engine firing to prevent damage to turbocharger bearing system. A flexible supply pipe is recommended. Minimum oil pressure when engine is on load must be 210 kPa (30 lbf/in<sup>2</sup>). Maximum permissible operating pressure is 400 kPa (58 lbf/in<sup>2</sup>) although 600 kPa (88 lbf/in<sup>2</sup>) is permitted during cold start up. Under idling conditions pressure should not fall below 70 kPa (10 lbf/in<sup>2</sup>).
14. Recommended oil flows for the turbochargers are 3 litre/min at idle and 3.5 - 4.5 litre/min above maximum torque speed.
15. Do not use liquid gasket substances or thread sealant as any excess can enter turbocharger oil system to obstruct flow.
16. Recommended coolant flows for turbochargers are 3 litre/min at idle and 10 - 14 litre/min above maximum torque speed.

**Note:** 100 kPa = 1 bar (14.5037 lbf/in<sup>2</sup>=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. Before re-installing flexible pipes always ensure any burnt-on lacquer or other adhered material is removed from internal bores. If in doubt, fit new pipes.
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

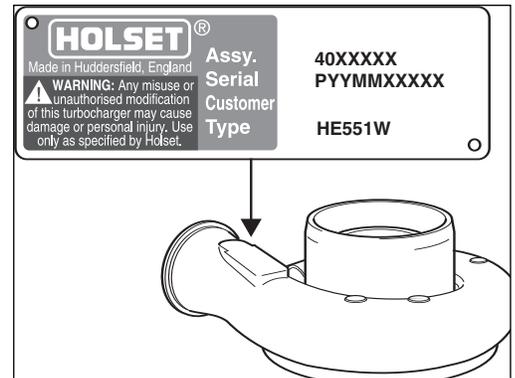
# Turbocharger Identification



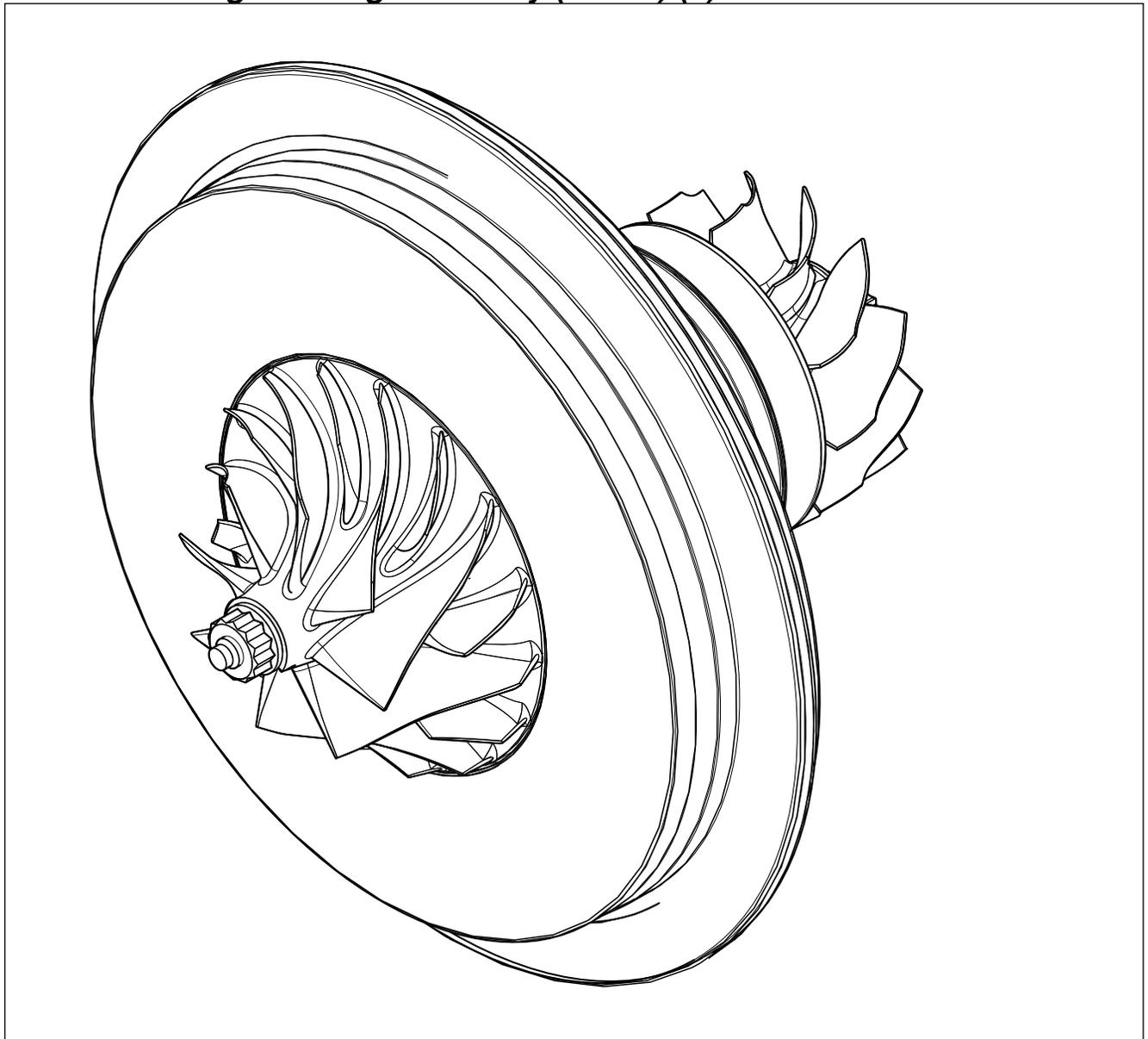
## Dataplate

### Note

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



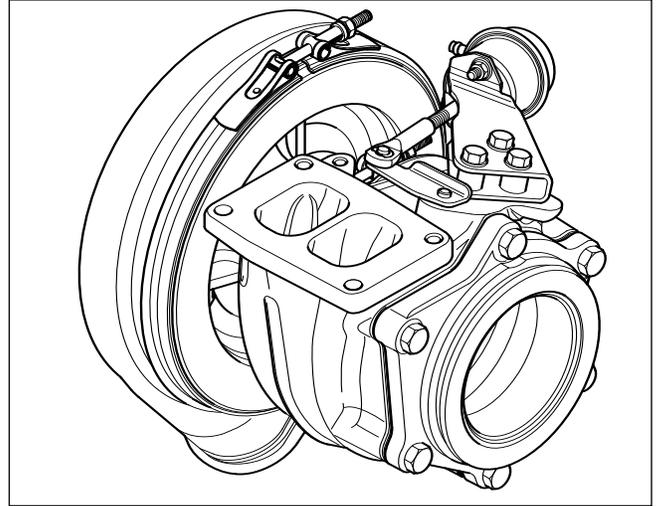
## Center Housing Rotating Assembly (CHRA) (2)



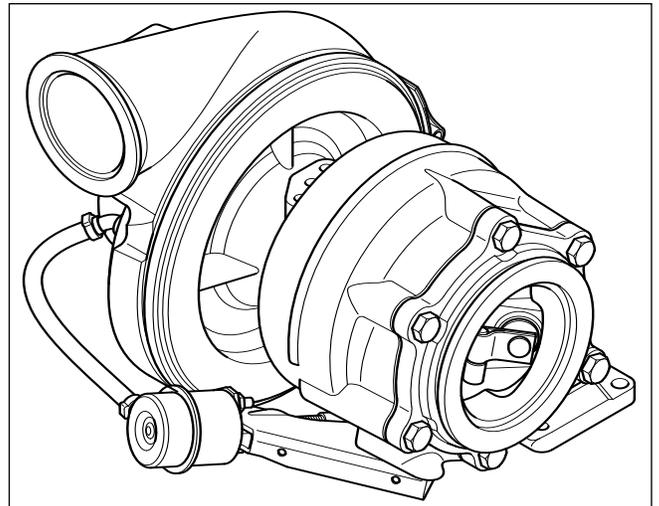


## Installation Options

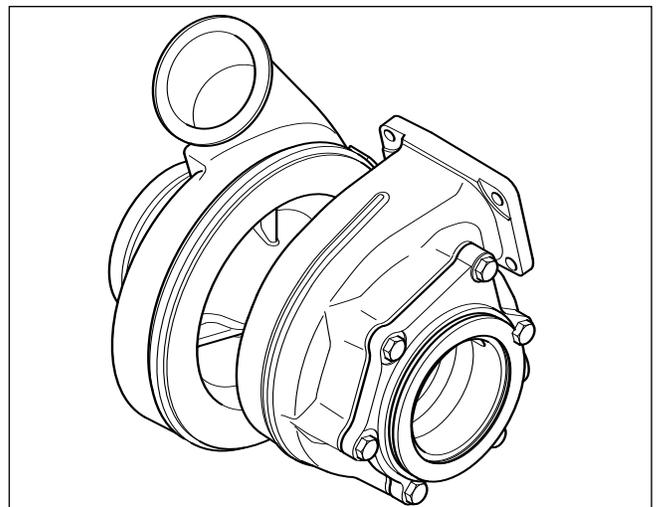
Type A



Type B

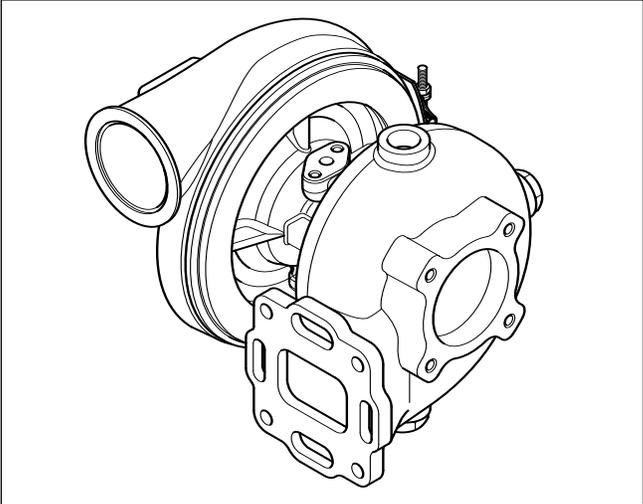


Type C

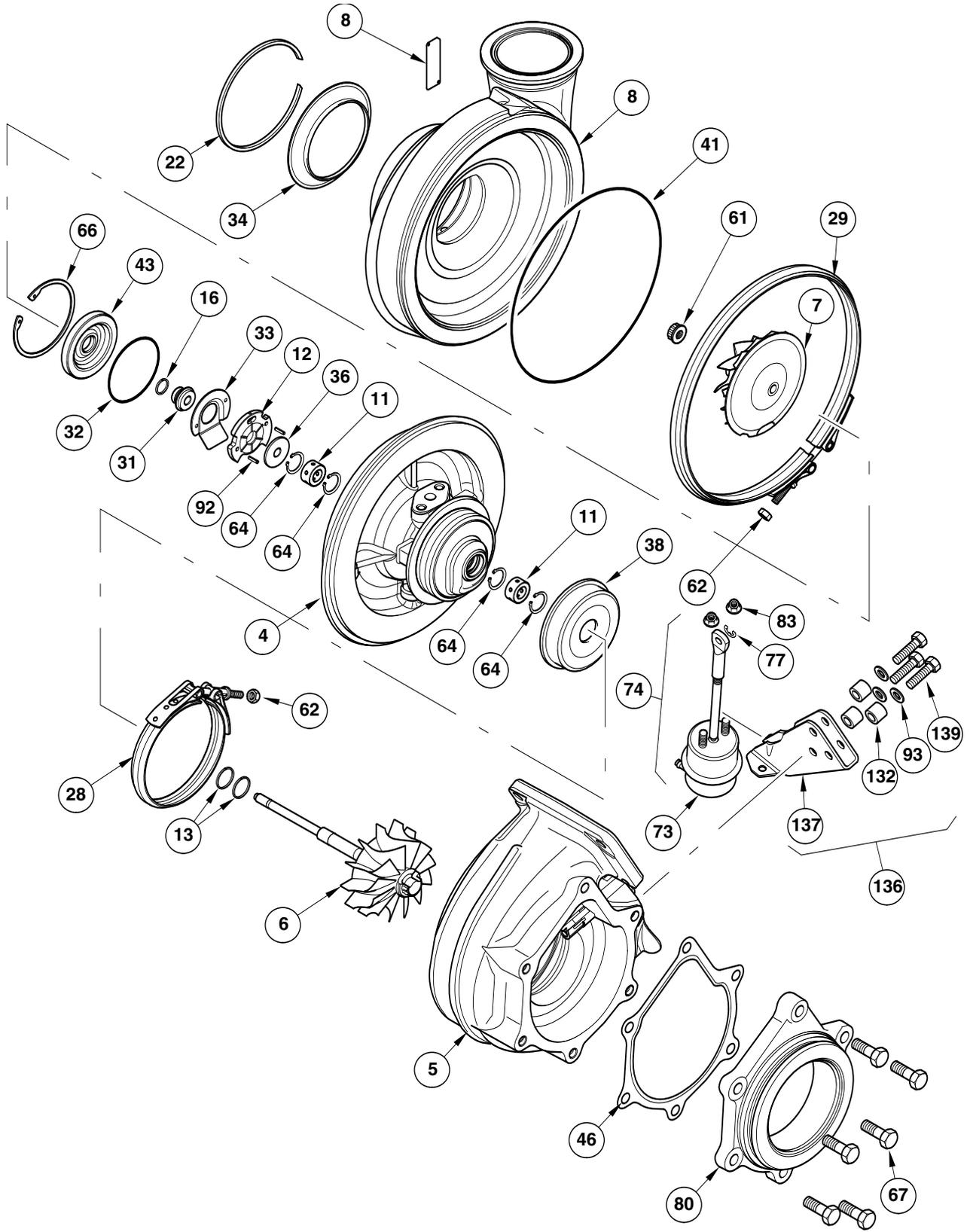


### Installation Options

Type D



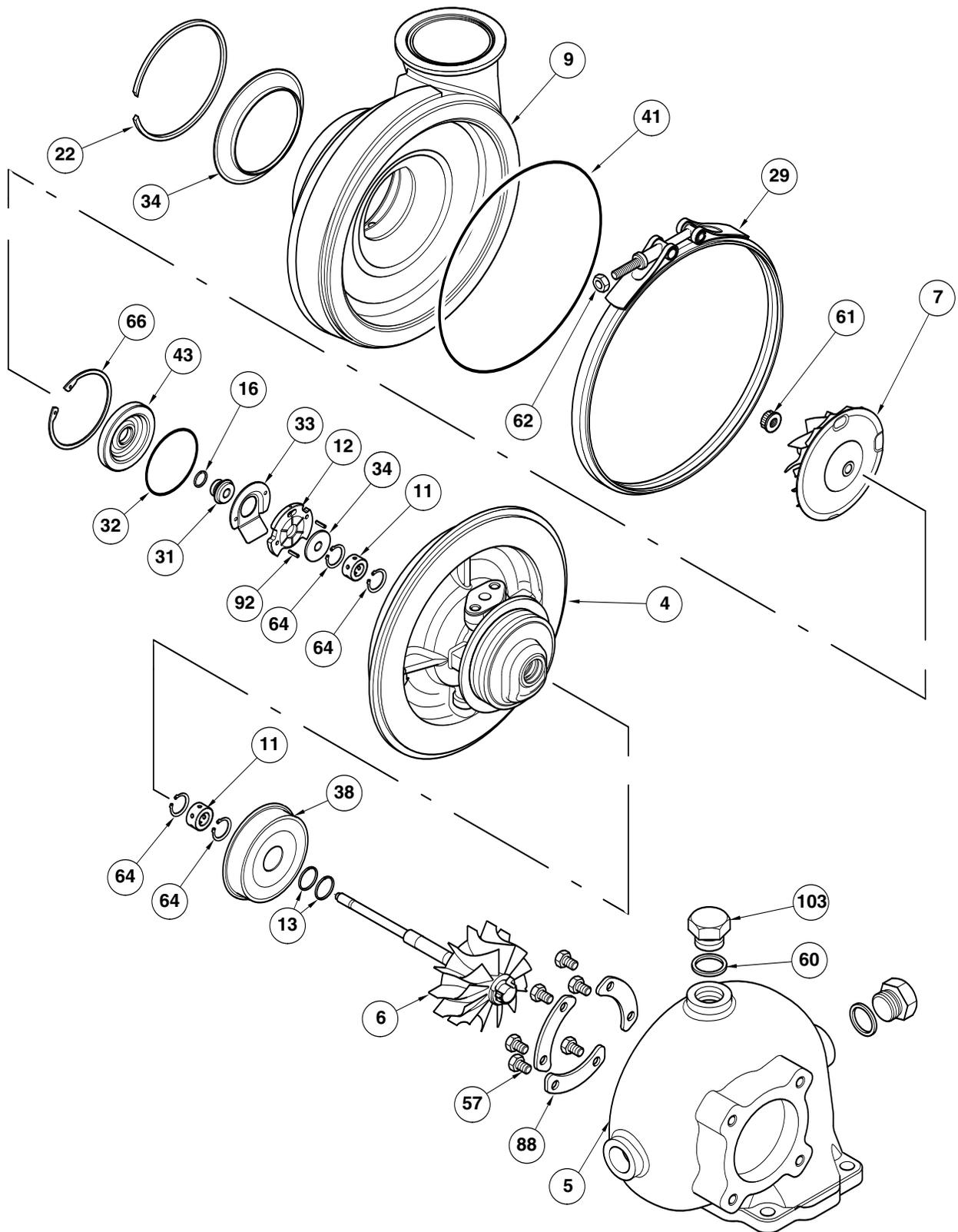
# Exploded View - HX551/W



**Note**

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

# Exploded View - HE551M



## 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*	2
16	Split Ring Seal, Compressor*	1
22	Retaining Ring, Inlet Baffle	1
28	V-band Clamp, Turbine	0/1
29	V-band Clamp, Compressor	1
31	Oil Slinger	1
32	O-Ring Seal, Bearing Housing*	1
33	Oil Baffle*	1
34	Inlet Baffle	1
36	Thrust Collar	1
38	Heat Shield	1
41	O-Ring Seal, Compressor Housing*	1
43	Oil Seal Plate	1
53	Gasket, Oil Outlet*	1
57	Bolt, Turbine Housing	0/6
60	Plain Washer	2
61	Locknut, Compressor Wheel	1
62	Locknut, V-band*	1/2
64	Retaining Ring, Bearing (Snap Ring)*	4
66	Insert, Retaining Ring	1
70	Gasket, Oil Inlet*	1
88	Clamp Plate, Turbine Housing	0/3
103	Blanking Plug	2

## Note

Exploded views may not contain all listed components.

## Component List



Item No.	Description	Quantity
74	Pre-set Actuator Kit comprising	1
73	Actuator	1
76	End Link, Assembly	1
77	End Link, Retaining Clip	1
83	Lock nut, Actuator	2
75	Hose Clamp	2
136	Actuator Bracket Kit comprising	1
137	Actuator Bracket	1
132	Spacer Sleeve	3
93	Washer, Actuator Bracket	3
139	Screw, Actuator Bracket	3
81	Hose	1
82	Elbow, Coupling Hose	1
67	Bolt, Coverplate	3
46	Gasket, Cover Plate	1
80	Coverplate, Wastegate	1

### Note

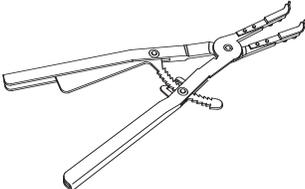
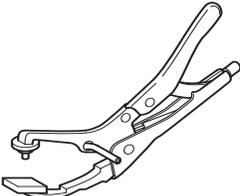
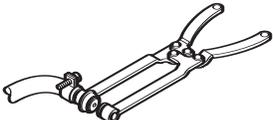
Exploded views may not contain all listed components.

# Purchasable Service Tools



## 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's Service Data Sheet. It is essential that these settings are used. Common tools found in mechanic's tool box not included.

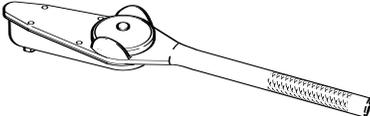
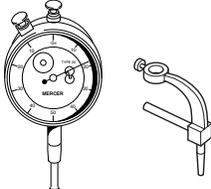
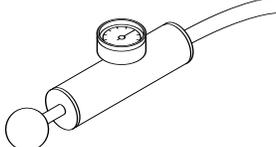
# Fault Finding chart

	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
<b>Dirty air cleaner</b> Clean or replace element according to manufacturer s recommendations	●	●	●	●	●	●	●			●	
<b>Restricted compressor intake duct</b> Remove restriction or replace damaged parts as required	●	●	●		●	●	●	●	●	●	
<b>Restricted air duct from compressor to intake manifold</b> Remove restriction or replace damaged parts as required	●	●		●	●			●			
<b>Restricted intake manifold</b> Refer to engine manufacturer s manual and remove restriction	●	●		●	●			●			
<b>Air leak in feed from air cleaner to compressor</b> Replace seals, gaskets or tighten fasteners as required								●			
<b>Air leak in feed from compressor to intake manifold</b> Replace seals, gaskets or tighten fasteners as required	●	●	●	●	●	●	●	●			
<b>Air leak between intake manifold and engine</b> Refer to engine manufacturer s manual and replace gaskets or tighten fasteners as required	●		●	●	●	●	●	●			
<b>Foreign object in exhaust manifold (from engine)</b> Refer to engine manufacturer s manual and remove obstruction				●	●	●	●	●		●	
<b>Restricted exhaust system</b> Remove restriction or replace damaged parts as required	●			●	●					●	
<b>Exhaust manifold cracked, gaskets blown or missing</b> Refer to engine manufacturer s manual and replace gaskets or damaged parts as required		●	●	●	●			●			
<b>Gas leak at turbine inlet/exhaust manifold joint</b> Replace gasket or tighten fasteners as required		●	●	●	●			●			
<b>Gas leak in ducting after turbine outlet</b> Refer to engine manufacturer s manual and repair leak		●						●			
<b>Restricted turbocharger oil drain line</b> Remove restriction or replace damaged parts as required						●	●			●	●
<b>Restricted engine crankcase breather</b> Refer to engine manufacturer s manual, clear restriction						●	●			●	●
<b>Turbocharger bearing housing sludged or coked</b> Change engine oil and oil filter, overhaul or replace turbocharger as required						●	●			●	●
<b>Fuel injection pump or fuel injectors incorrectly set</b> Refer to engine manufacturer s manual and replace or adjust faulty components as required		●	●	●	●						
<b>Engine valve timing incorrect</b> Refer to engine manufacturer s manual for correct settings and adjust as required				●	●						
<b>Worn engine piston rings or liners</b> Refer to engine manufacturer s manual and repair as required				●	●	●	●			●	●
<b>Burnt valves and/or pistons</b> Refer to engine manufacturer s manual and repair as required				●	●	●	●			●	●
<b>Excessive dirt build up on compressor wheel and/or diffuser vanes</b> Clean in accordance with details in the appropriate Holset publication				●	●	●	●	●	●	●	●
<b>Turbocharger damaged</b> Find and correct cause of failure, repair or replace turbocharger as necessary				●	●	●	●	●		●	●
<b>Failed actuator diaphragm</b> Replace using correct Actuator Service Kit	●							●			
<b>Seized wastegate valve (in turbine housing)</b> Free valve in accordance with details in the appropriate Holset publication replace complete turbine housing sub-assembly	●	●									
<b>Leaking actuator hose</b> Replace hose and clips	●							●			
<b>Wastegate mechanism set incorrectly</b> 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 (Refer to <a href="#">Service Data Sheet</a> for required torque ranges)	
	Dial Gauge and Dial Gauge Adaptor	
	Pressure Gauge Regulated Air Supply (Max 3 bar-45 lbf/in <sup>2</sup> )	
4027204	E-Clip Tool	

### Caution

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

# On Engine Checks



## Oil Leakage

Flange fitting M8 x 1.25

### Warning

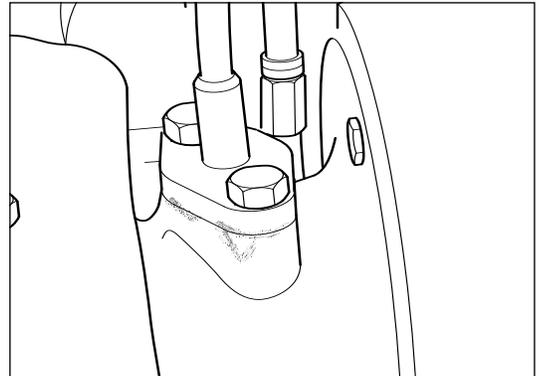
Always wear safety glasses.

### Caution

When replacing parts do not use sealant as this can contaminate the oil.

Torque tighten flange fasteners to value specified by engine manufacturer.

Avoid kinked pipes during servicing and subsequent operation.



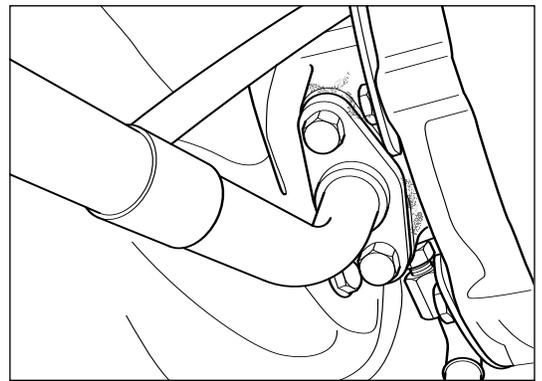
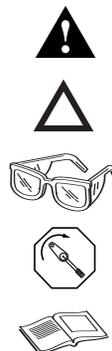
Flange fitting M8 x 1.25

### Warning

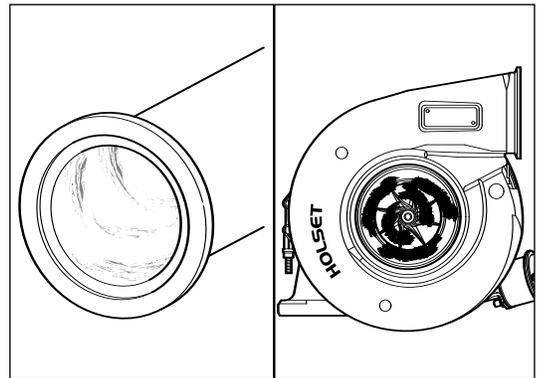
Inlet oil is pressurized and outlet oil is hot. Never take service action with engine running. Protect face and hands from hot fluid leakage.

Torque tighten fasteners to value specified by engine manufacturer.

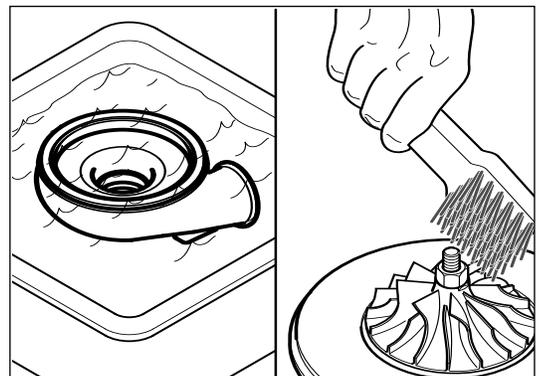
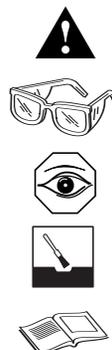
All outlet pipes should be free flowing without kinks and sharp bends and decline at overall angle not less than 30° below horizontal.



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.



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





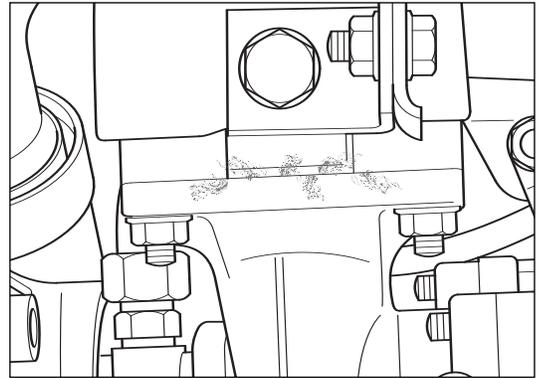
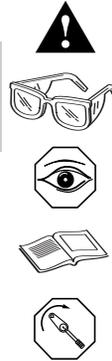
### Gas Leakage

**Warning**

Always wear safety glasses.

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

Cracking of inlet duct requires turbine housing replacement.



**Warning**

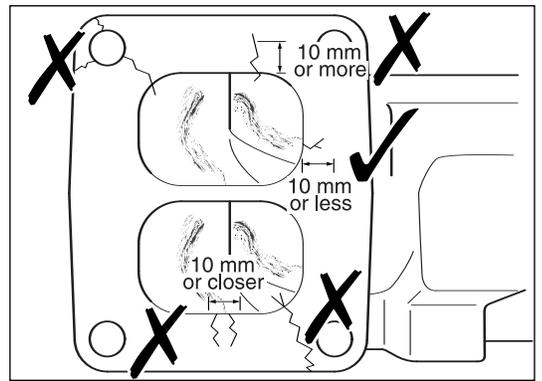
Turbochargers are heavy. Always refer to **Safe Lifting Methods** before removing or refitting

Check flange for cracks and ensure flatness is within 0.1 mm (0.004 in).

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

M10 x 1.5

Check flange threaded holes with a thread gauge.



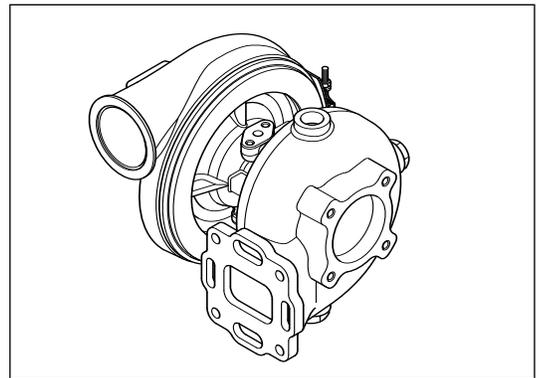
### Coolant Leakage

1 - 12UNF-2B (1 5/16 in A/F)

**Caution**

Turbine housing plugs are fitted with plain washer. Always use parts recommended by engine manufacturer or Cummins Turbo Technologies.

In event of coolant leakage from plug or adapter, retighten to values specified in **Service Data Sheet** or by engine manufacturer. If leak persists change fitting.

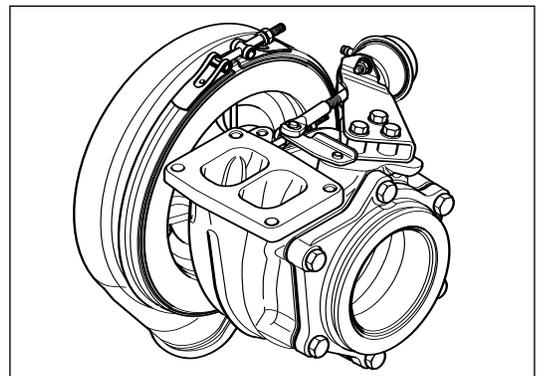
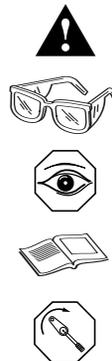


### Visual Checks

Check Marman type connection between turbine outlet to exhaust system for fretting damage. Where fretting damage is visible change cover plate.

M10 x 1.5 (17 mm A/F)

Tighten cover plate bolts to value specified in **Service Data Sheet**

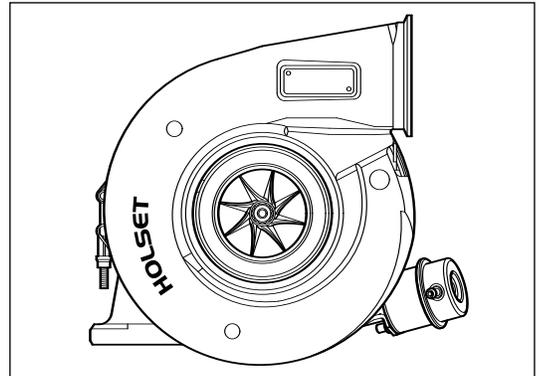




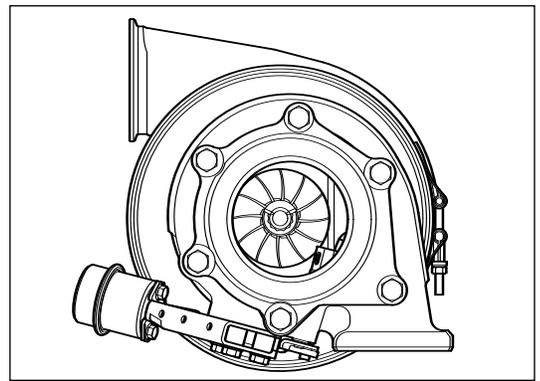
Check for cracked, bent or damaged compressor wheel blades.

**Caution**

Never attempt to straighten blades.



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

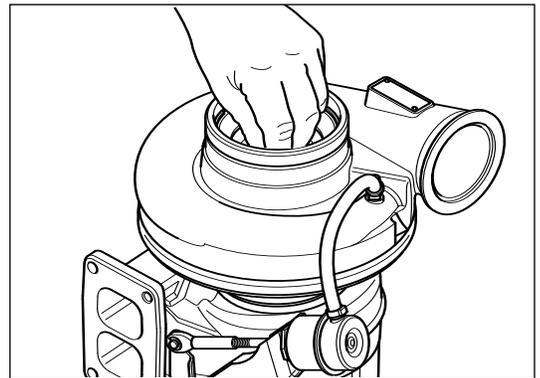


**Warning**

Always wear safety glasses.

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

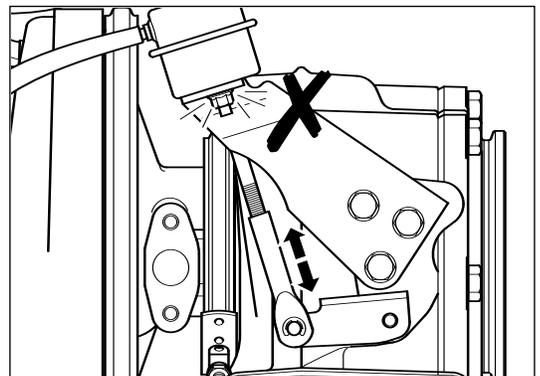
If in doubt, turbocharger must be removed from engine to check **Bearing Clearance** against recommended values shown in **Service Data Sheet**.



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**.

**Warning**

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



**Warning** 

Always wear safety glasses.

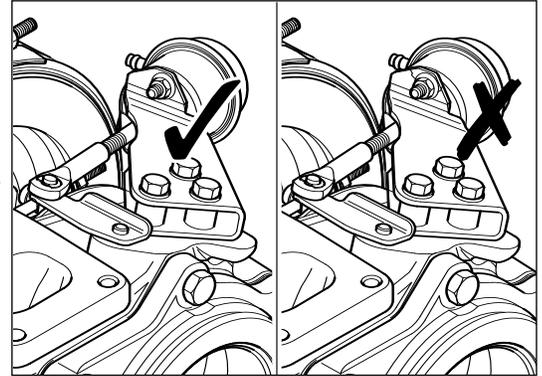
Inspect wastegate bracket for cracks at actuator fastener locations.

**Caution** 

Always replace cracked actuator bracket.

**Note**

It is important to quote actuator bracket part number and turbocharger type when ordering replacement bracket kit (136).



## Safe Lifting Methods



The designated turbochargers weigh up to 28 kg to 36.4 kg (62 lb to 80 lb) and include sensors, electrical wiring and connectors which are sensitive to handling.

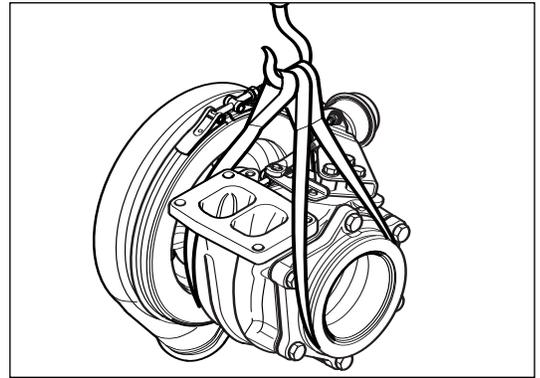
Always use mechanical lifting method or seek assistance.

### Mechanical Handling

#### Warning

This turbocharger is not fitted with lifting eye.  
Always seek assistance when lifting.

Always support weight of turbocharger during removal and refitting using sling and mechanical hoist system of correct load rating.

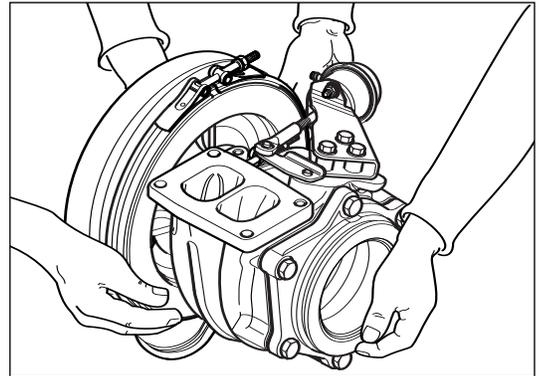


### Manual Handling

When mechanical lifting system is available always seek assistance to support weight of turbocharger.

#### Warning

Turbochargers are heavy. Always use two-man safe manual lifting method when removing or refitting.



## Bearing Clearance



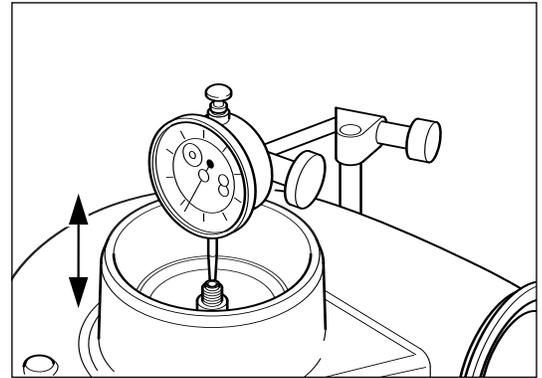
Secure turbine housing and check axial clearance using dial gauge.

Ensure clearance is within MIN/MA<sub>v</sub> 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).

### Warning

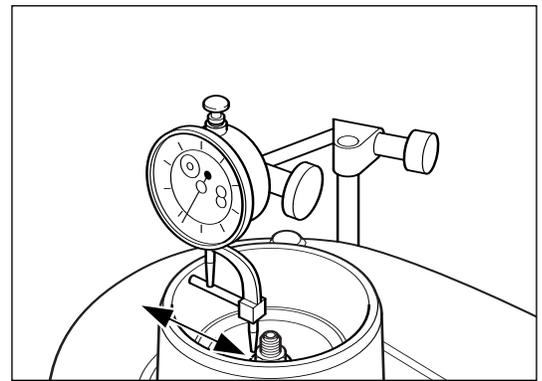
Turbochargers are heavy. Always refer to [Safe Lifting Methods](#) before removing or refitting.



Check radial movement at compressor impeller nose using dial gauge.

Ensure movement is within MIN/MA<sub>v</sub> 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).

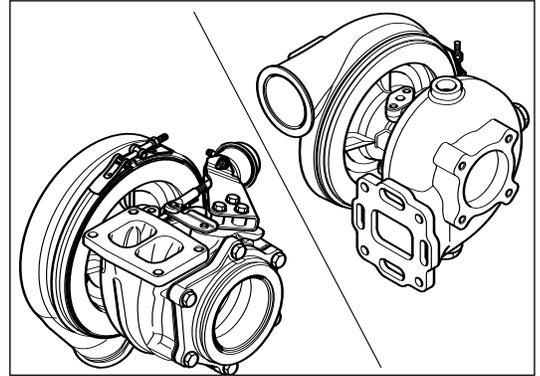


# Turbine and Compressor Housings



Some turbocharger specifications are not fitted with a wastegate.

Where it is necessary to remove actuator before commencing planned actions on turbine or compressor housing, refer to [Actuator Removal](#) for more details.



## Turbine Housing

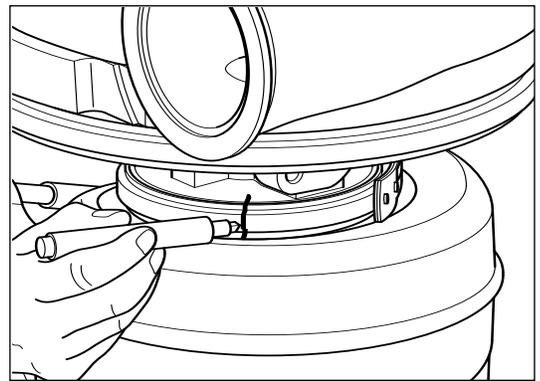
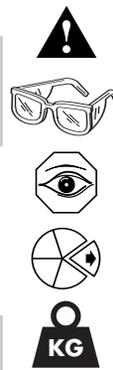
### Warning

Always wear safety glasses.

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

### Warning

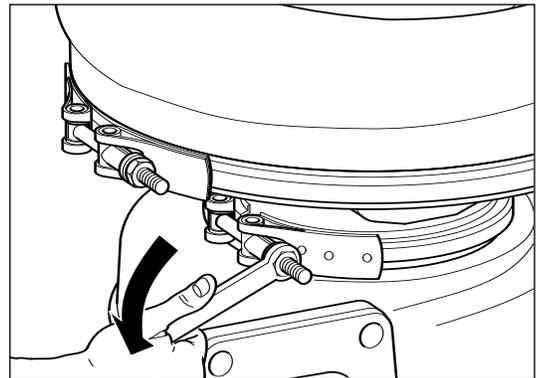
Turbochargers are heavy. Always refer to [Safe Lifting Methods](#) before removing or refitting.



## V-band Option

1/4 UNF 28 tpi (7/16 in A/F)

Loosen locknut, V-band clamp (62) and discard.



## Clamp Plate Option

M8 x 1.25 (13 mm A/F)

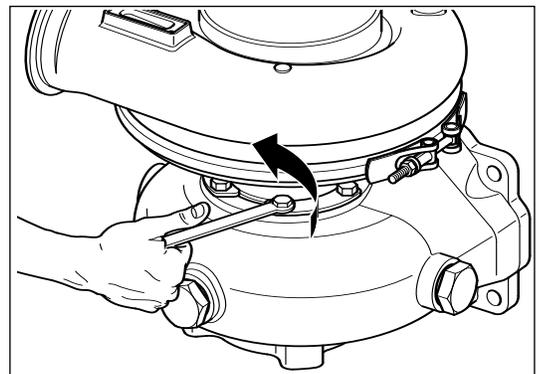
Secure turbine housing flange in vice.

### 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 a period of time recommended by oil manufacturer.

Loosen and remove six bolts and three clamp plates.





**Warning** ⚠

Always wear safety glasses.

To separate turbine housing and bearing housing, use soft metal hammer on two opposing areas of turbine housing at 180 degrees.

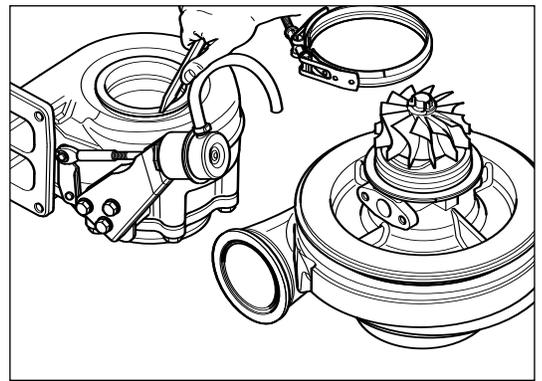
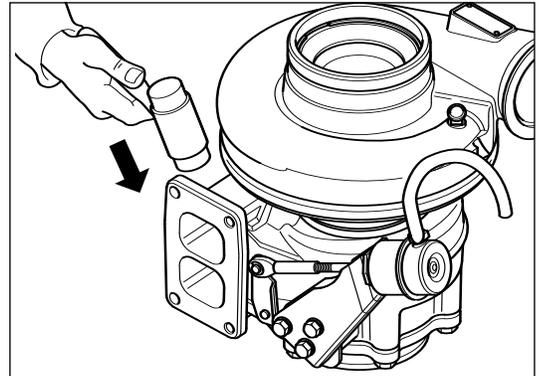
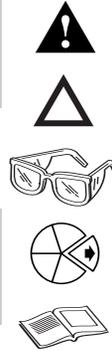
**Caution** ⚠

Do not apply hammer to turbine housing flange.

Wastegate mounting is not affected by this disassembly process.

Always remove wastegate actuator before cleaning turbine housing. Refer to **Actuator Removal** for details.

Pen marker lines may be removed by cleaning processes. Once housing is removed strike or score pen marks on housings and v-band.

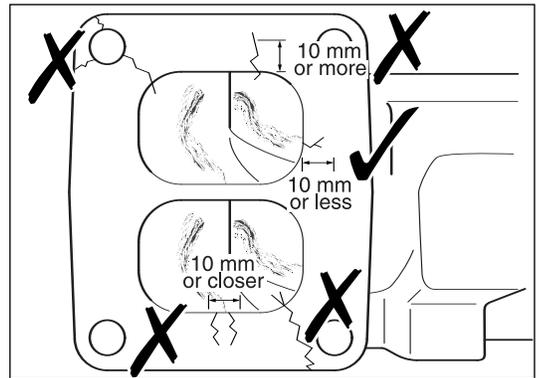


**Caution** ⚠

Turbine housings can exhibit cracking when subject to excessive thermal and mechanical loads. Cracking of turbine housing inlet duct requires turbine housing replacement.

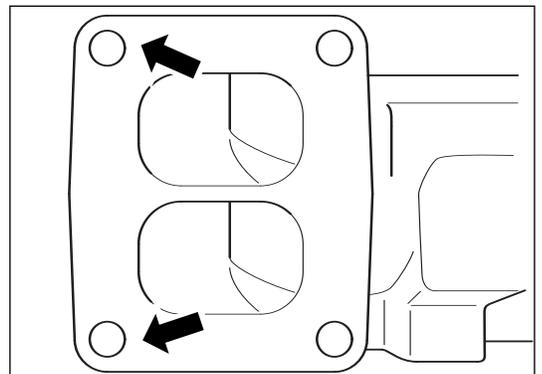
Acceptance and rejection guidelines are shown in these illustrations. If exhaust gasket is available, always ensure that any cracks lie within sealing area.

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 the max. thread diameter of the fastener.

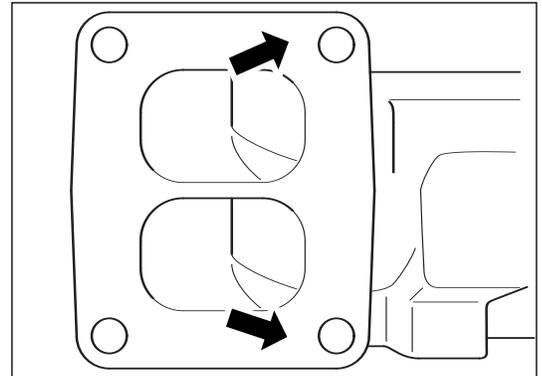


**Warning**

Always wear safety glasses.

M10 x 1.5

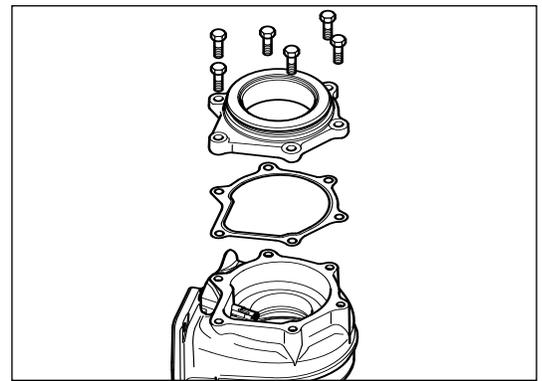
Check flange threaded holes with an M10 x 1.5 thread gauge.



M10 x 1.5 (17 mm A/F)

Remove cover plate to check gasket condition. Check flange sealing face for cracking and distortion. If exhaust seal is compromised replace gasket/coverplate. Where turbine housing flange is cracked, replace turbine housing.

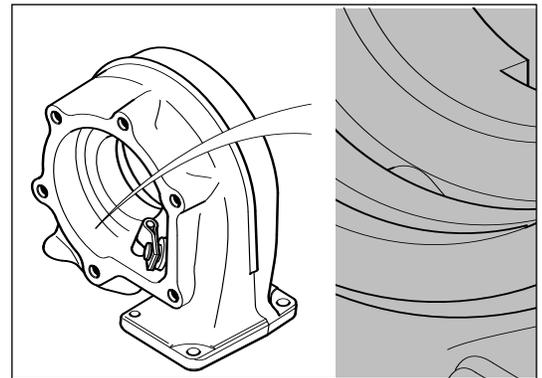
When refitting cover plate and gasket, torque coverplate bolts to the value specified in the [Service Data Sheet](#).

**Caution**

Where crack will cause leakage to atmosphere turbine housing must be replaced. Cracking of inlet duct requires housing replacement.

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

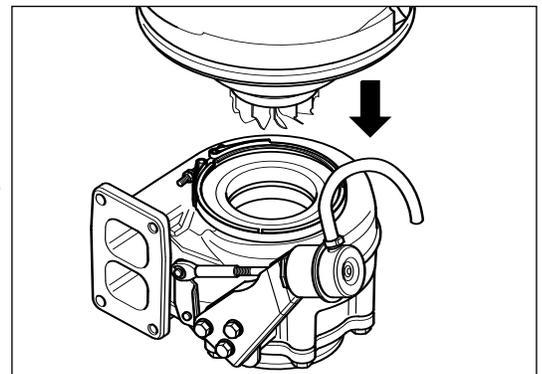
Always clean turbine housing before re-assembly paying particular attention to surfaces close to turbine wheel and bearing housing location. Refer to [Cleaning of Housings](#) for details.



To replace turbine housing position V-band clamp (where fitted) over bearing housing and align marks applied during disassembly.

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

Carefully insert core assembly into turbine housing. Use alignment mark to locate housing assembly in correct orientation with turbine housing.

**Caution**

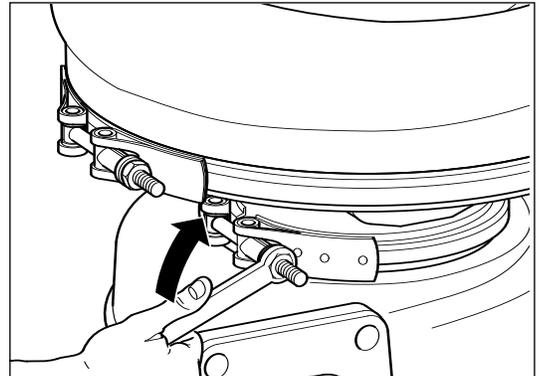
Turbine blades can be damaged when installing in



**V-band Option**

1/4 UNF 28 tpi (7/16 in)

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



**Clamp Plate Option**

M8 x 1.25 (13 mm A/F)

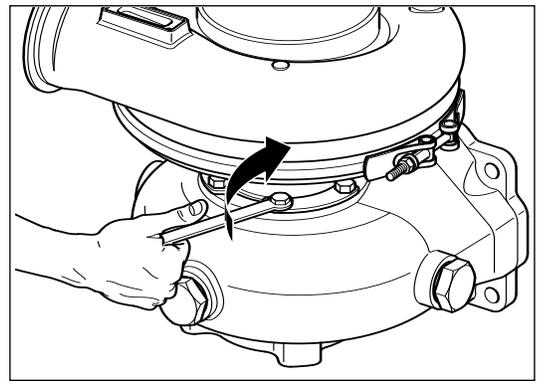
**Warning**

Always wear safety glasses.

Secure turbine housing flange in vice.

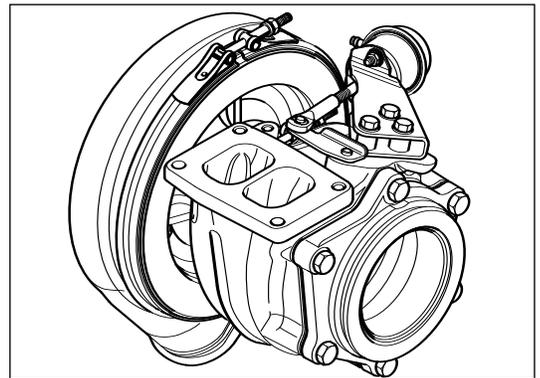
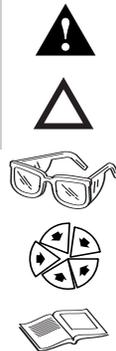
Install three clamp plates and torque tighten six bolts to value specified in [Service Data Sheet](#).

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



**Caution**

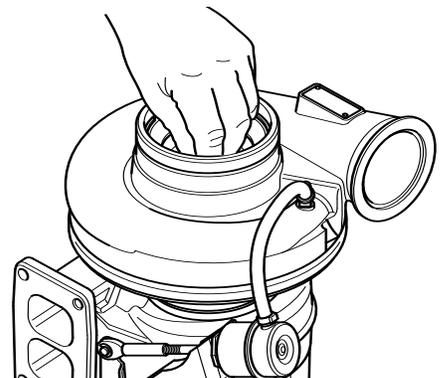
Refer to [Actuator Replacement](#) when attaching end link to valve mechanism.



Ensure rotor assembly freely rotates.

**Warning**

Turbochargers are heavy. Always refer to [Safe Lifting Methods](#) before removing or refitting.





## Compressor Housing

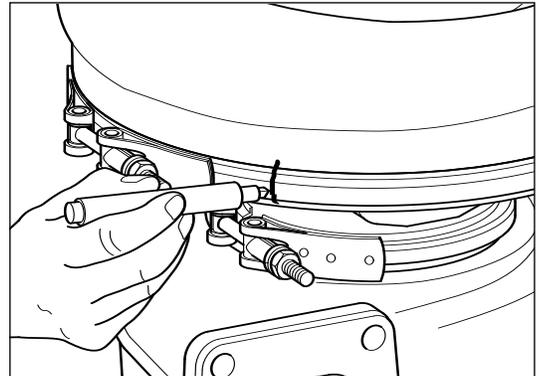
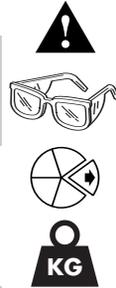
### Warning

Always wear safety glasses.

Place turbine outlet on clean flat surface. Mark compressor housing, bearing housing and V-band clamp to record correct orientation. This action assists in housing orientation during re-assembly.

### Warning

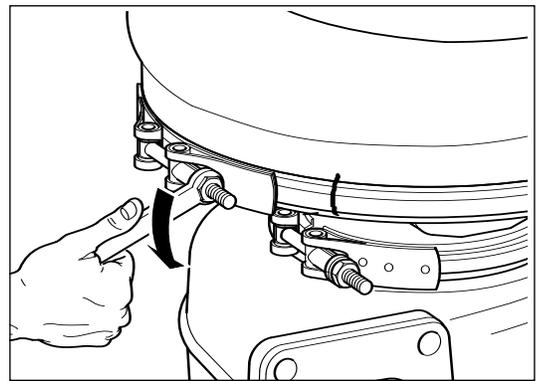
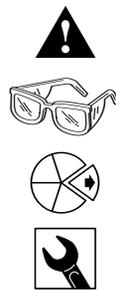
Turbochargers are heavy. Always refer to [Safe Lifting Methods](#) before removing or refitting.



## V-band Option

1/4 UNF 28 tpi (7/16 A/F)

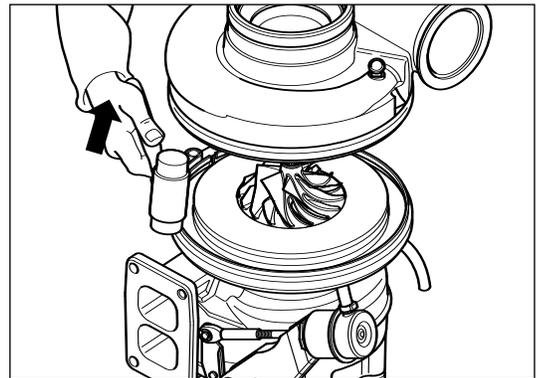
Loosen and remove compressor end V-band locknut (62) and discard.



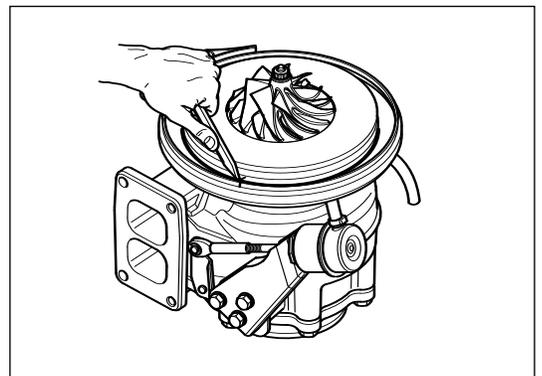
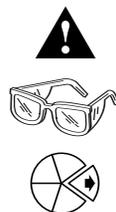
### Caution

Compressor blades can be damaged when compressor housing is removed.

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



Pen marker lines may be removed by cleaning processes. Once housing is removed strike or score pen marks on housings and v-band.





**Warning** ⚠

Always wear safety glasses.

**Warning** ⚠

If there is any possibility that o-ring seal has been subject to fire, always wear neoprene gloves when handling.

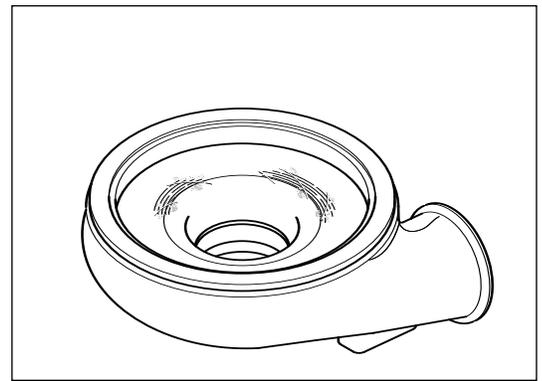
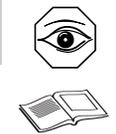
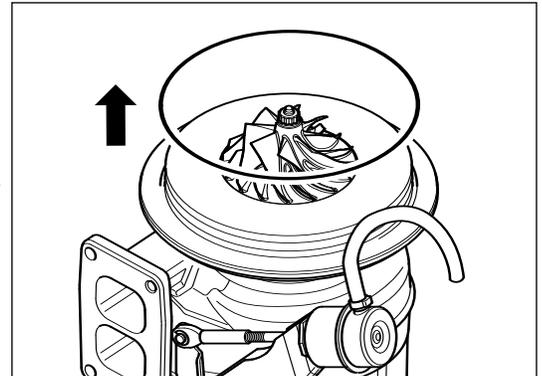
Bearing housing to compressor housing joint is fitted with o-ring seal, compressor (41). This seal should be removed and discarded at this stage.

**Caution** ⚠

Always fit new seal on re-assembly.

Inspect internal profile of compressor housing for scoring damage due to possible contact with compressor wheel. Move to [Cleaning of Housings](#) if deposits remain.

Replace with new if profile damage is visible.



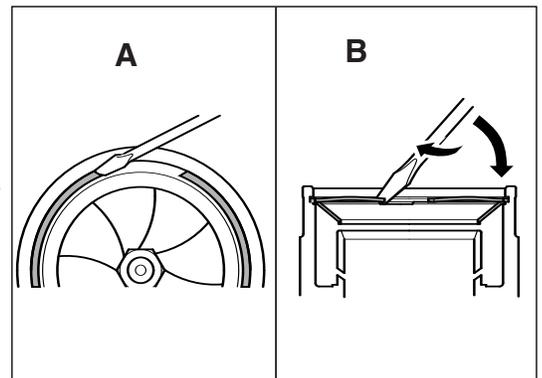
**Inlet Baffle**

To clean compressor housing remove inlet baffle.

**Caution** ⚠

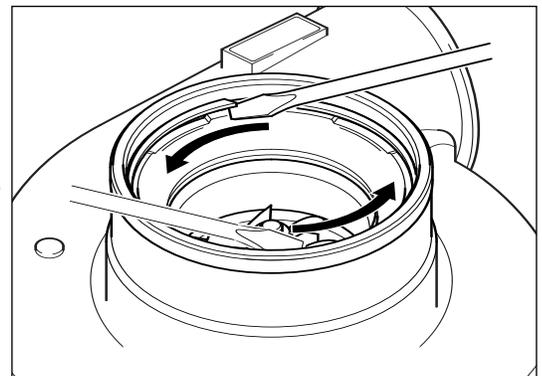
When removing inlet baffle retaining ring, be careful not to damage compressor wheel with screw driver. Use rag or rubber bung to protect wheel.

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



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

Remove inlet baffle.

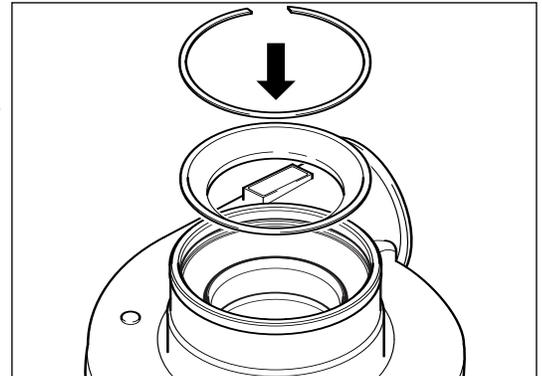




**Warning** ⚠

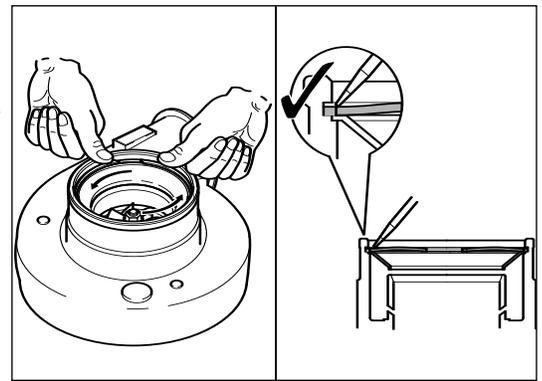
Always wear safety glasses.

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



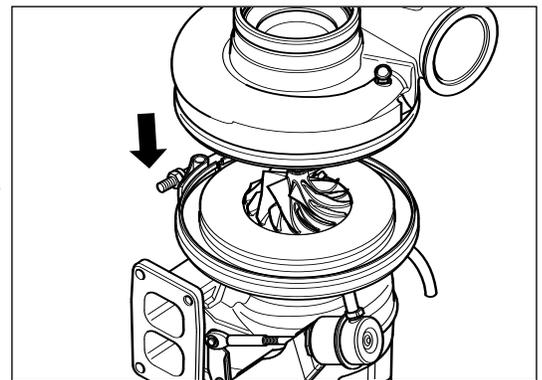
Hold one end of retaining ring in position in compressor housing groove. Press remainder of retaining ring into position using free hand.

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



To refit compressor housing, place core assembly on clean surface. Lubricate new o-ring seal (41) with clean engine oil and install into retaining groove. Loosely fit V-band clamp in correct orientation using alignment marks made during disassembly.

Carefully locate the compressor housing over the compressor wheel again using alignment marks to achieve correct orientation.

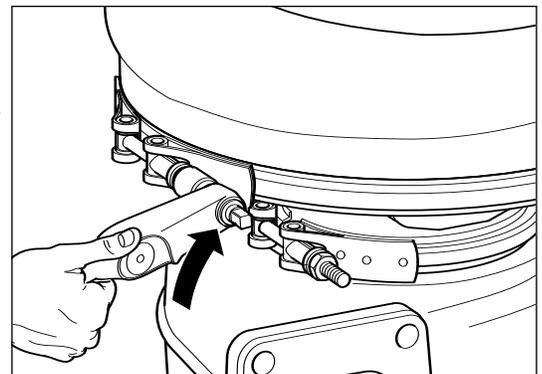
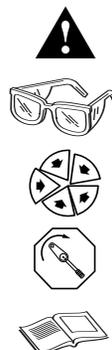


**Caution** ⚠

The compressor wheel blades can be damaged when housing is installed.

1/4 UNF 28 tpi (7/16 A/F)

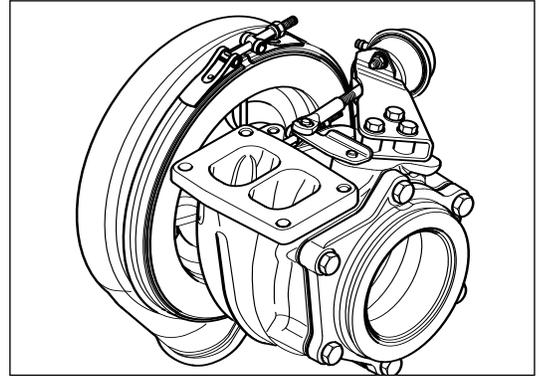
Place V-band clamp in position and torque tighten new locknut (62) to value specified in **Service Data Sheet**.





**Caution** 

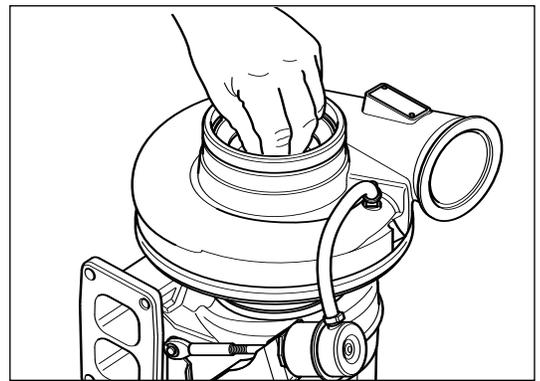
Refer to **Actuator Replacement** when refitting actuator.



Ensure rotor assembly freely rotates.

**Warning** 

Turbochargers are heavy. Always refer to **Safe Lifting Methods** before removing or refitting.



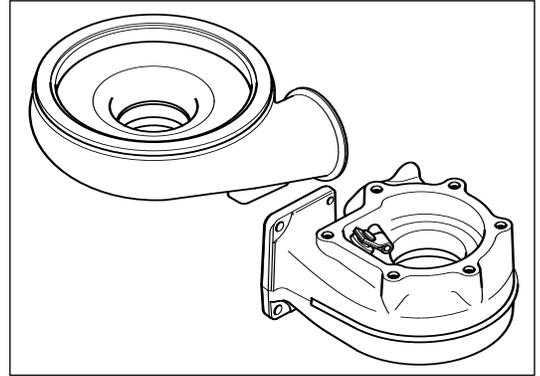
## Cleaning of Housings



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

### Caution

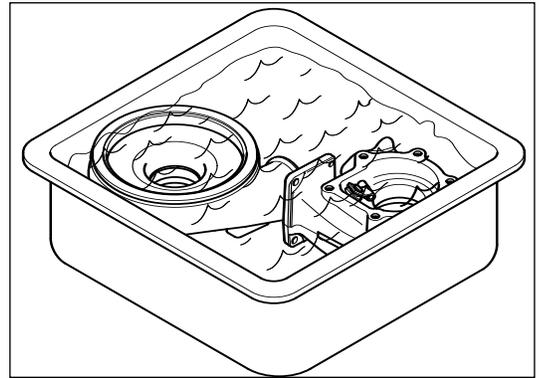
Housing surfaces adjacent to turbine and compressor wheels must be clean, smooth and free from deposits.



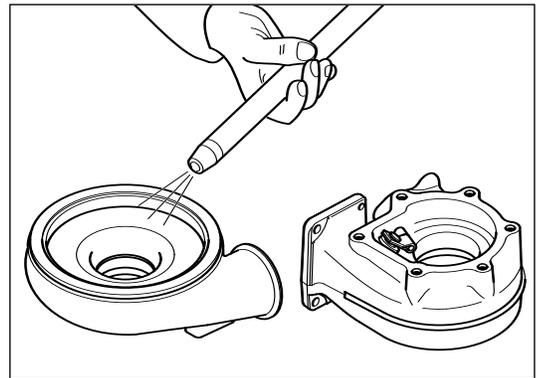
### Warning

Always wear safety glasses.

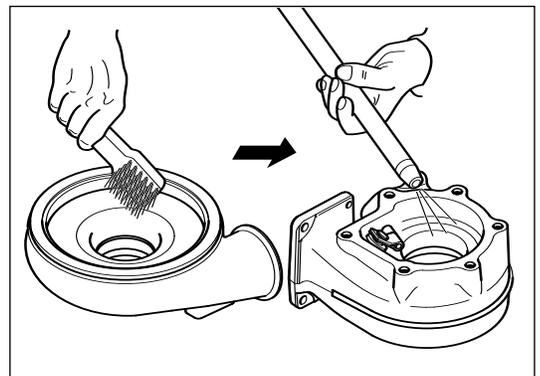
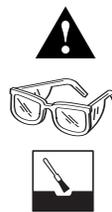
Soak housings in non-corrosive low flash point metal cleaner to loosen deposits.



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**

Prevent bead spray impinging directly on clamp plate and turbine flange threads by masking or plugging.

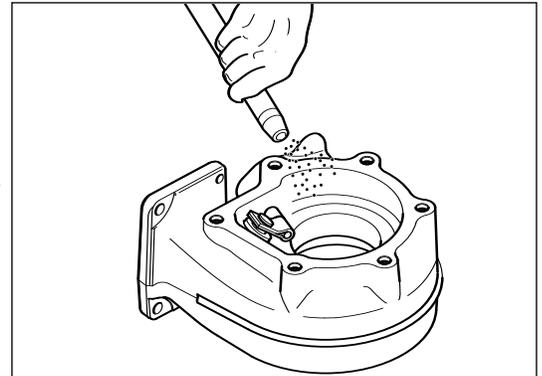
**Caution**

Prevent bead spray impinging directly on wastegate valve spindle as beads can penetrate spindle bore, leading to spindle seizure.

After removing deposits, re-wash and dry components.

**Caution**

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



## Wastegate Actuator Checks



### Warning

Always wear safety glasses.

### Warning

Turbochargers are heavy. Always refer to [Safe Lifting Methods](#) before removing or refitting.

Place turbocharger on suitable workbench. Using small flat screwdriver, carefully remove hose clip. Pull flexible hose from actuator air inlet fitting.

Discard hose clips (75).

### Caution

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

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

### Note

Closed crankcase ventilation (CCV) systems can cause engine oil ingress into wastegate actuator. On removal of hose, oil may seep out of actuator. Ensure actuator is drained of residual oil before making checks.

### Warning

Ensure hose is securely fastened to air inlet fitting using appropriate hose clip and clamp load.

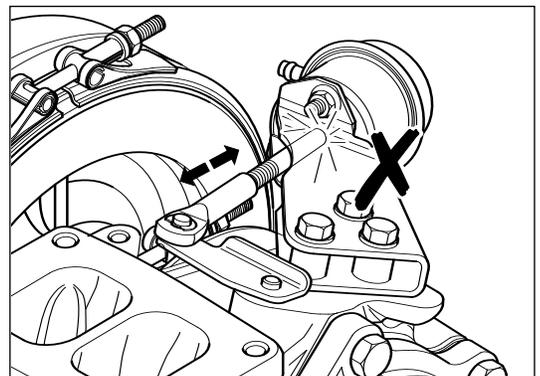
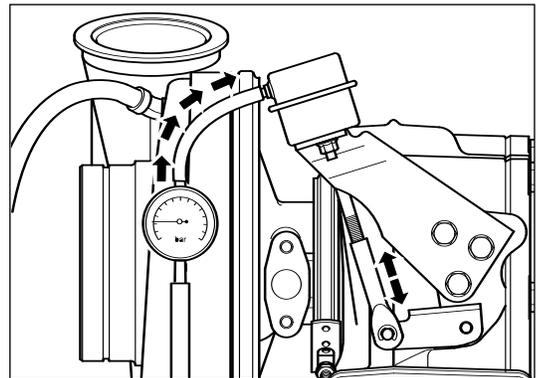
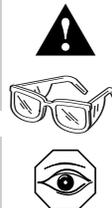
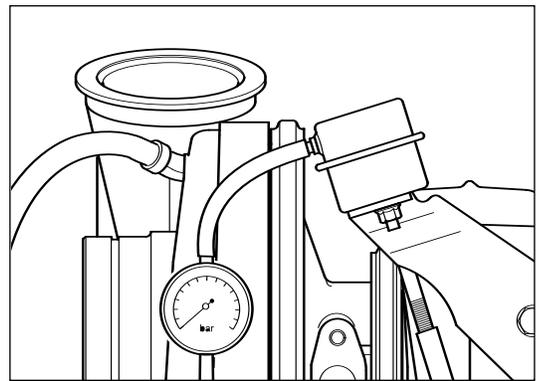
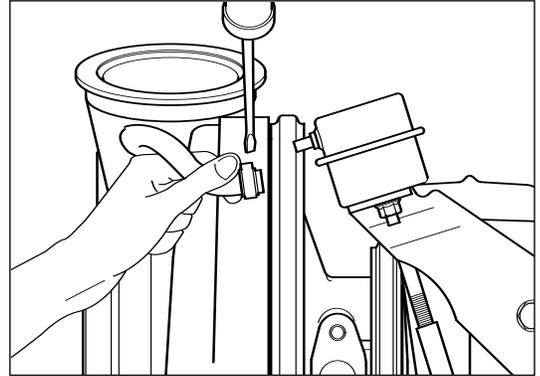
### Warning

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

Carefully apply pressure from regulated compressed air supply (Max 3 bar, 45 lbf/in<sup>2</sup>) and check for actuator movement.

### Seized Actuator Check

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



# Actuator Removal



## Warning

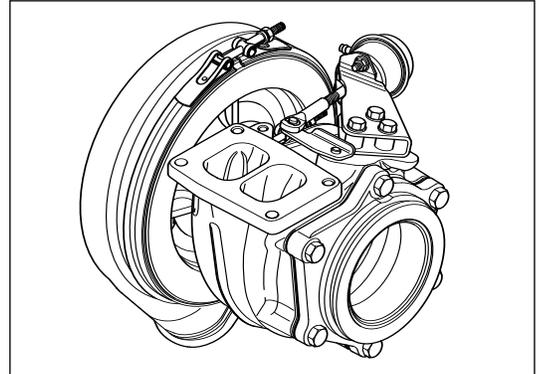
Always wear safety glasses.

## Note

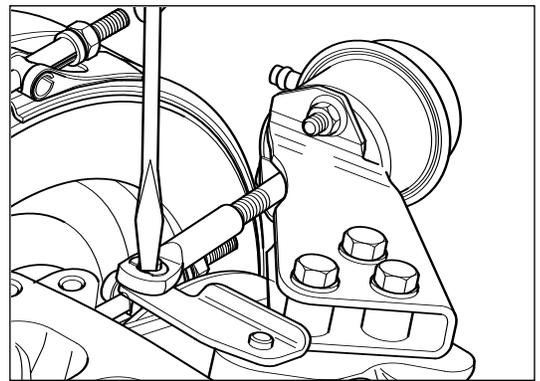
Before removing actuator, record orientation of air inlet fitting.

## Caution

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



Using small flat screwdriver carefully remove e-clip (77) from crank journal and discard.



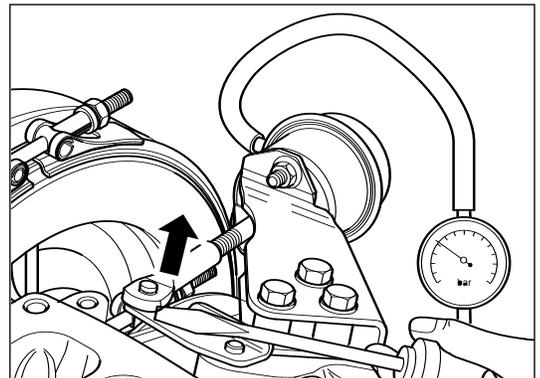
## Warning

Actuator rod may retract very quickly when freed from lever arm. Keep fingers away from mechanism.

## Warning

Ensure hose is securely fastened to air inlet fitting using appropriate hose clip and clamp load.

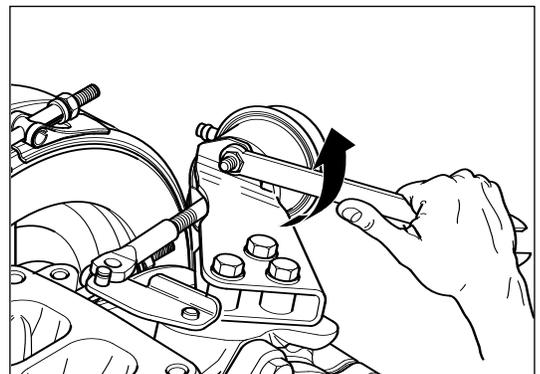
Remove hose clip from actuator. Disconnect hose from air inlet fitting and connect air supply (Max 3 bar, 45 lbf/in<sup>2</sup>). Apply small amount of air pressure to actuator until end link moves to release actuator pre-load. Carefully slide end link off crank journal. If actuator rod does not move, screw driver may be required to prise end link off crank journal.



Remove air pressure from actuator.

1/4 UNF 28 tpi (7/16 in A/F)

Remove two actuator mounting nuts and remove actuator.



# Actuator Bracket Removal and Replacement



M8 (13 mm A/F)

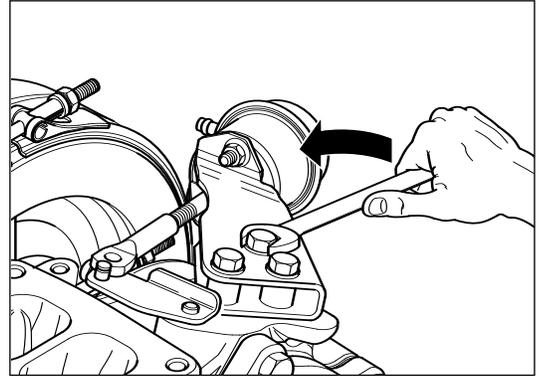
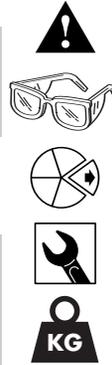
## Warning

Always wear safety glasses.

Remove three setscrews, washers, mounting spacers and retain with bracket.

## Warning

Turbochargers are heavy. Always refer to [Safe Lifting Methods](#) before removing or refitting.

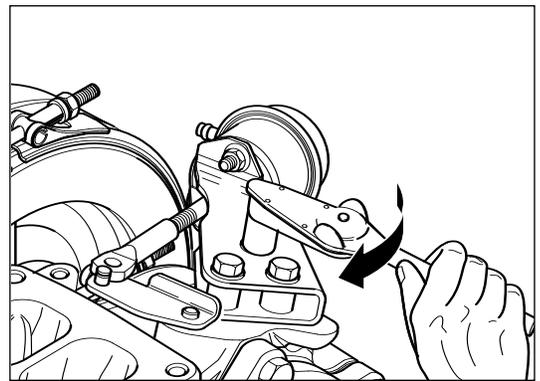
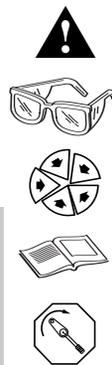


Refit bracket by assembling setscrews with washers and inserting into bracket and correctly positioned spacers.

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

## Note

It is important to quote actuator bracket part number and turbocharger type when ordering replacement bracket kit (136)



## Wastegate Mechanism Check



### Warning

Always wear safety glasses.

### Warning

Turbochargers are heavy. Always refer to [Safe Lifting Methods](#) before removing or refitting.

Place turbocharger on compressor housing end face. Carefully move crank journal up and down. If lever moves freely by hand, then re-check for movement of actuator rod. Refer to [Wastegate Actuator Checks](#).

If lever is seized, turbine housing will require replacement. However, it may be possible to free lever.

Access to wastegate valve from exhaust outlet is limited but, with care, soaking with penetrating oil is possible.

### Caution

Wastegate mechanism checks can be completed without removing cover plate. If cover plate must be removed take care not to shear cover plate bolts.

### Caution

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

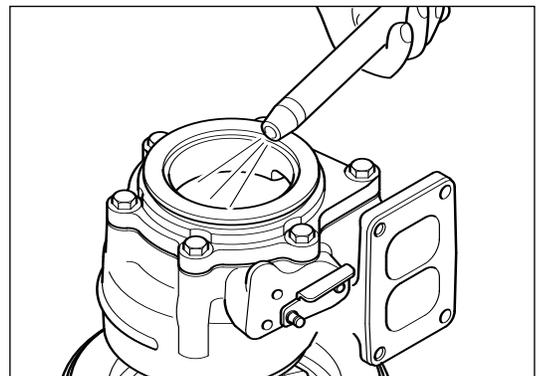
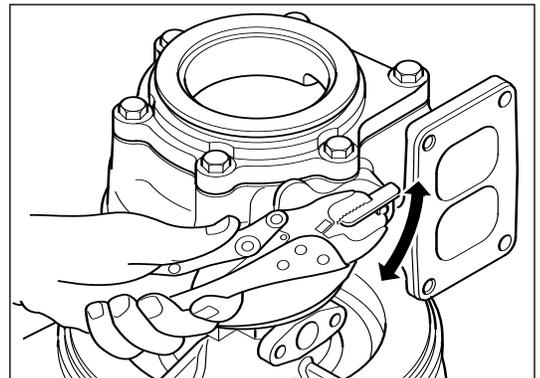
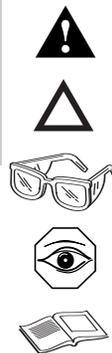
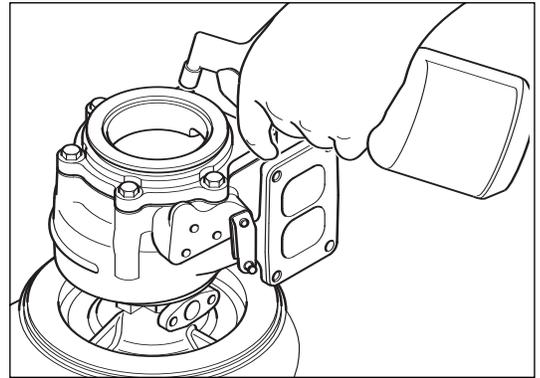
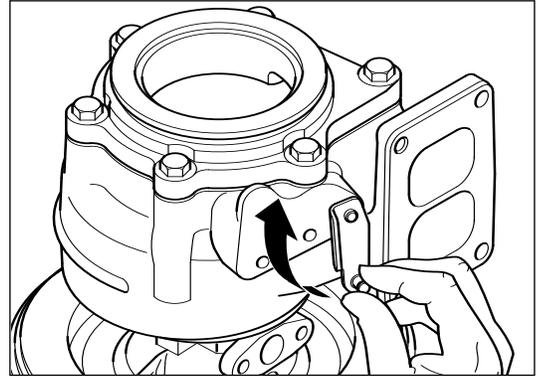
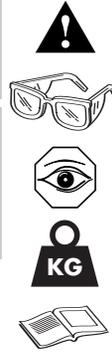
Clamp pair of mole (vice) grips to lever and gently apply pressure to rotate lever.

If this process does not free valve mechanism, new turbine housing must be fitted. Refer to [Turbine and Compressor Housing](#).

Radial cracks can occur around valve seat when turbocharger has been abused or overheated. It is possible to inspect for cracks using a torch. Check that rivet attaching valve to linkage is not loose.

### 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.



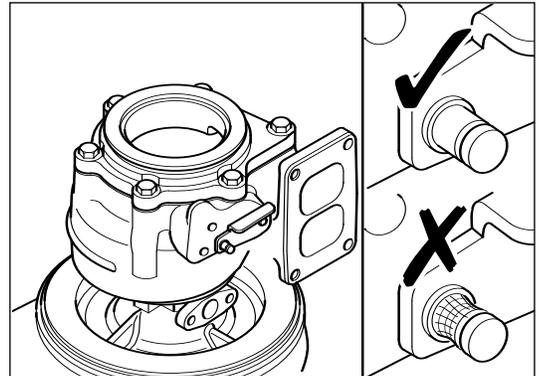


**Warning** ⚠

Always wear safety glasses.

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

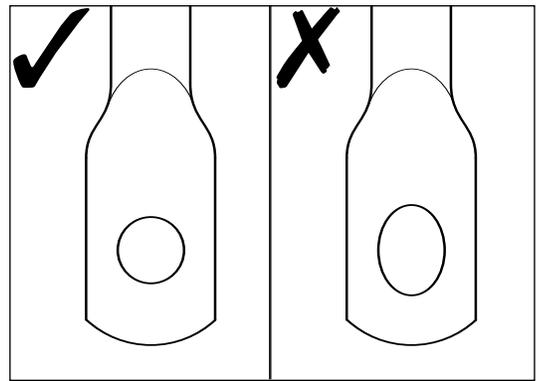
If loaded section of crank journal is worn by more than 0.013 mm (0.005 in) replace turbine housing.



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

**Caution** ⚠

If wastegate shows any fault, it must be replaced.

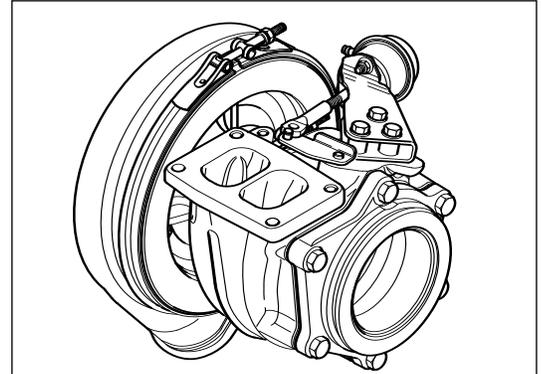


# Actuator Replacement



## Warning

Turbochargers are heavy. Always refer to **Safe Lifting Methods** before removing or refitting.



## Caution

Contact nearest approved agent for correct replacement actuator kit. Always quote turbocharger assembly number, serial number and type from dataplate to ensure supply of correct pre-set actuator.

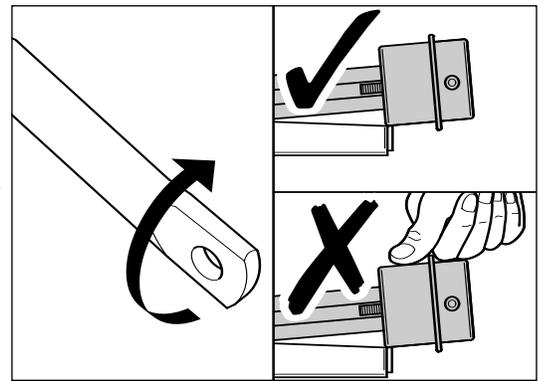
## Note

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

## Warning

Always wear safety glasses.

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

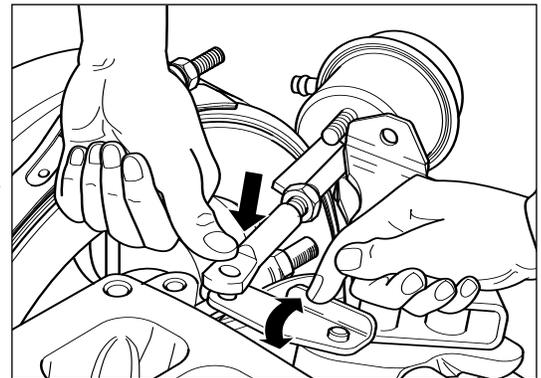


## Caution

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

## Note

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

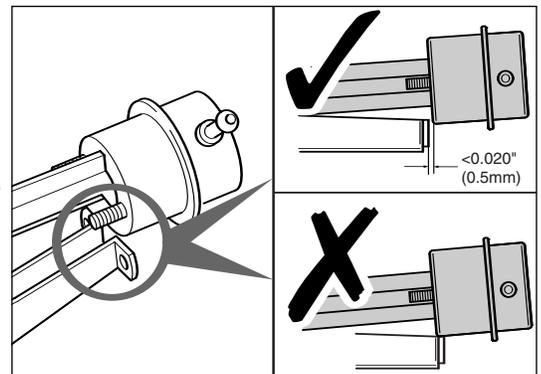


Hold actuator assembly with spine of spacer piece facing away from bracket. With wastegate valve held closed fit end link over crank journal.

## Note

Ensure orientation of actuator air inlet fitting is as recorded during actuator removal.

To adjust length of actuator assembly, remove from turbocharger, rotate end link and re-fit until underside of actuator will just fit over bracket mounting lugs with less than 0.5 mm (0.020 in) gap. If actuator fouls on bracket or there is significant clearance end link must be adjusted.



Setting is correct if, by rotating end-link clockwise by extra half-turn, actuator body will foul on bracket.

**Warning**

Always wear safety glasses.

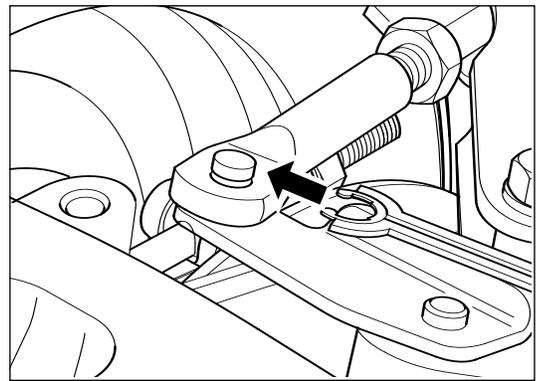
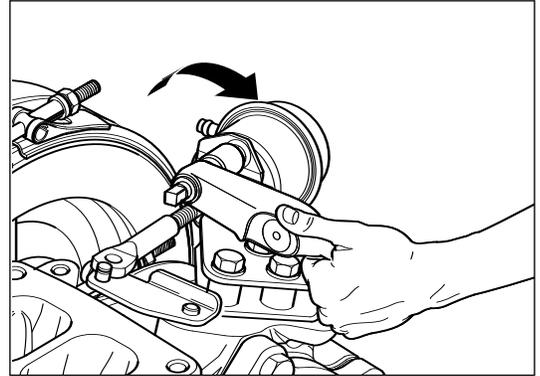
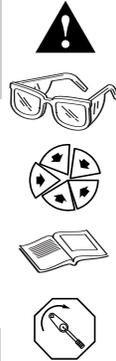
M6 x 1.0 (10 mm A/F)

Remove actuator assembly from crank journal ensuring that end link does not rotate relative to rod. Fit actuator mounting studs in holes in bracket, fit both actuator mounting nuts, and torque to value shown in [Service Data Sheet](#).

**Note**

Correct actuator orientation will have been recorded during actuator removal.

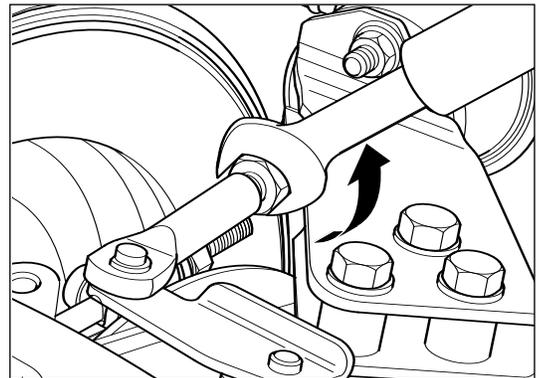
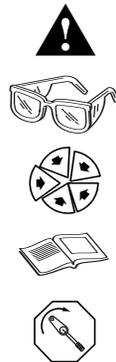
Re-fit end link to crank journal. Fit new e-clip (77) using special tool Part No. 4027204.



M6 x 1.0 (10 mm A/F)

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

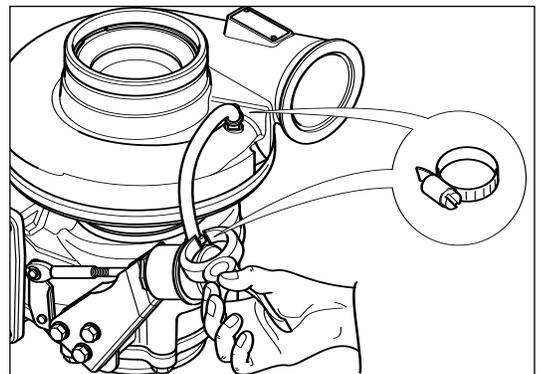
Continue turning jam-nut in same direction, and tighten against end link. Torque jam-nut to value shown in [Service Data Sheet](#).

**Caution**

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

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

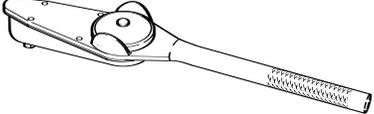
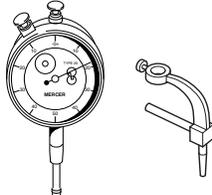
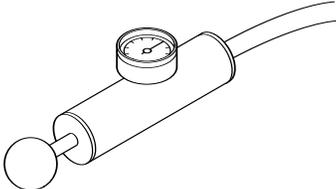
Suitable alternative hose clamps can be used.



## 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 (Refer to <a href="#">Service Data Sheet</a> for required torque ranges)	
	Dial Gauge and Dial Gauge Adaptor	
	Pressure Gauge Regulated Air Supply (Max 3 bar-45 lbf/in <sup>2</sup> )	
4027204	E-Clip Tool	

### Caution

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

# Disassembly

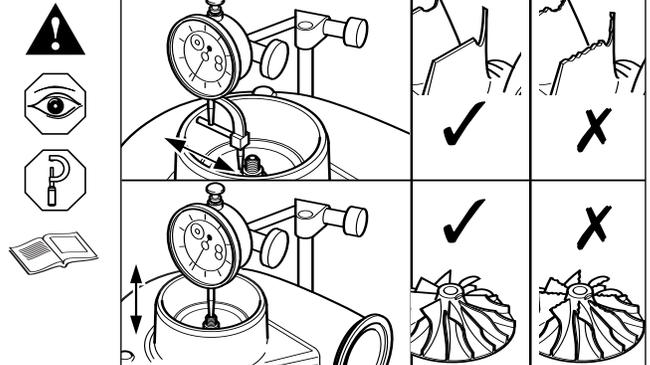


**Warning**

Always wear safety glasses.

**Note**

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

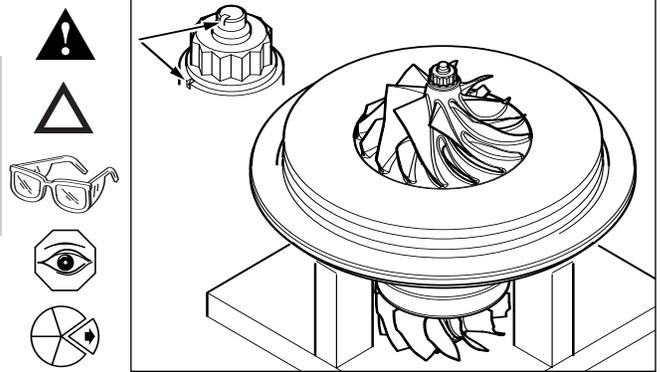


Locate CHRA (2) on to 19 mm 12 point socket located in suitable fixture.

**Caution**

Always make sure turbine wheel 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.

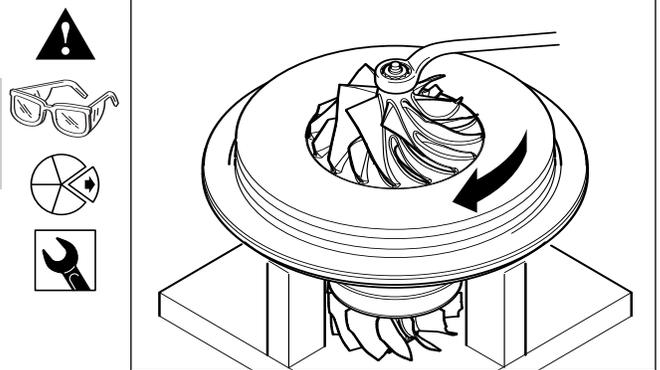


M8 x 1.25 LH (15 mm multipoint)

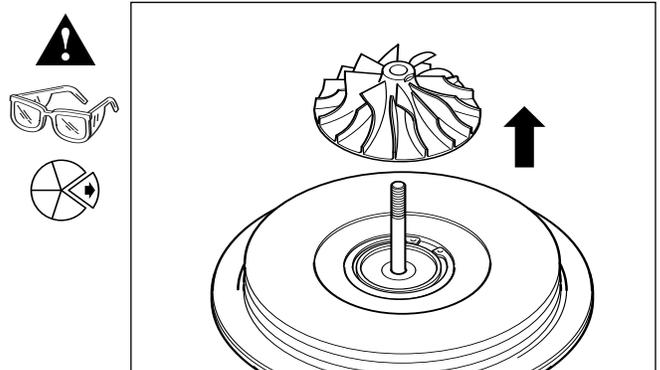
Remove locknut, compressor wheel (61).

**Note**

Left hand thread.



Remove compressor wheel (7).



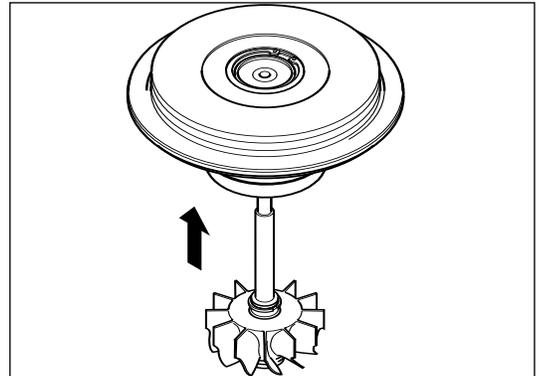


**Warning**

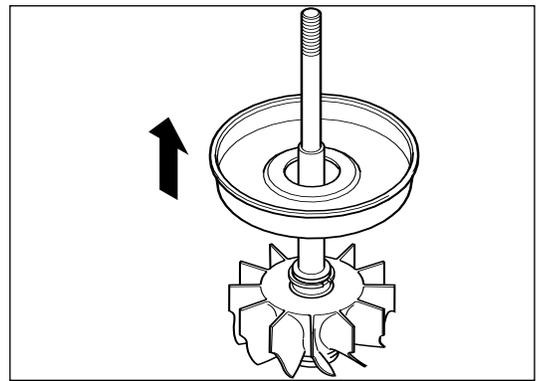
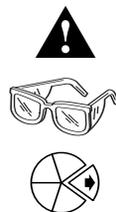
Always wear safety glasses.

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.



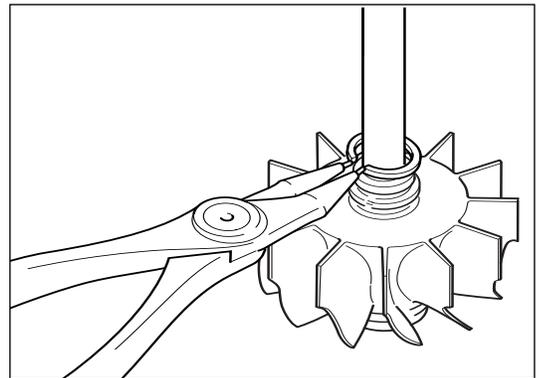
Remove heat shield (38).



Carefully remove turbine split ring seals (13)\* and discard.

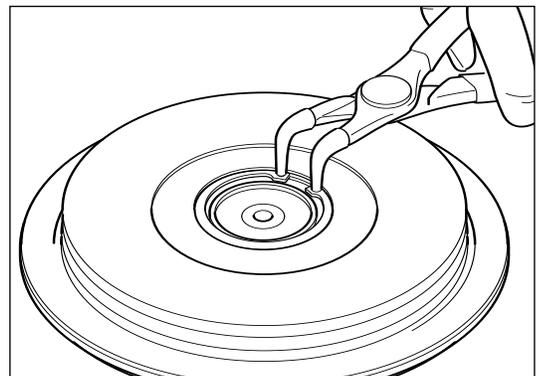
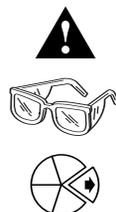
**Caution**

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 (66).

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

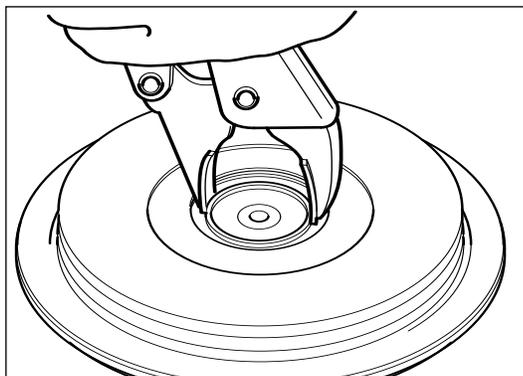




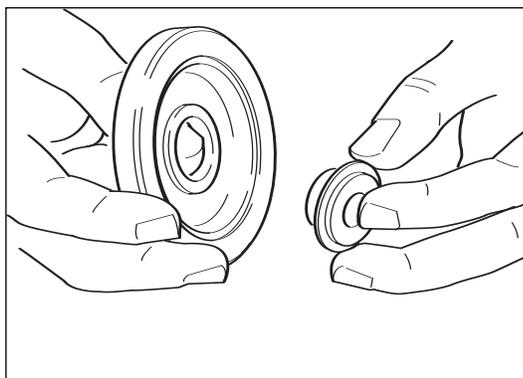
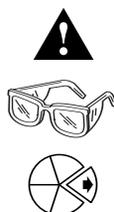
**Warning**

Always wear safety glasses.

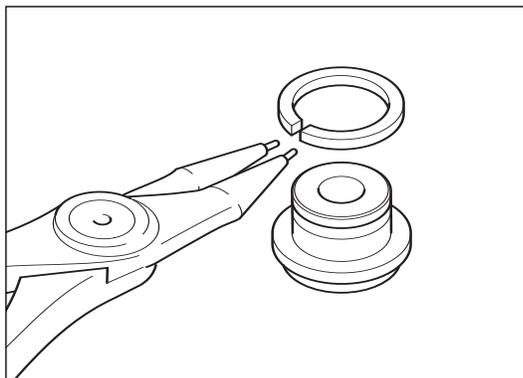
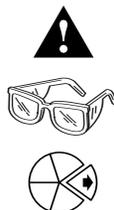
Remove oil seal plate (43) using mole (vice) grips.  
 If oil seal plate is stuck in its location, it is permitted to use two screw drivers under exposed lip to prise out seal plate.



Remove oil slinger (31).



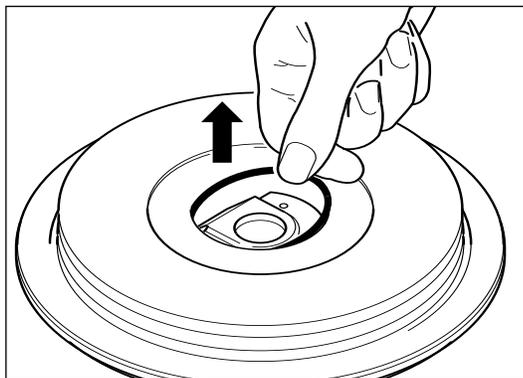
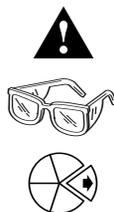
Using piston ring expander pliers remove and discard split ring seal, compressor (16)\* from oil slinger.



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

**Warning**

If there is any possibility that o-ring seal has been subject to fire, always wear neoprene gloves when handling.

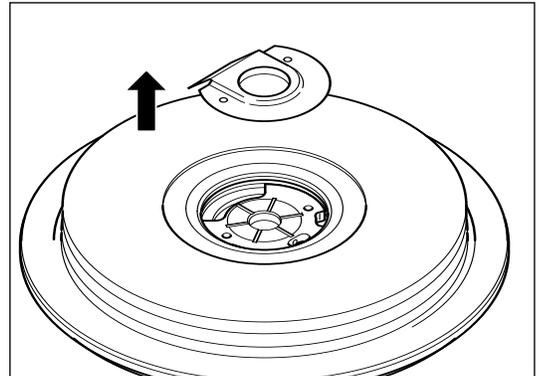




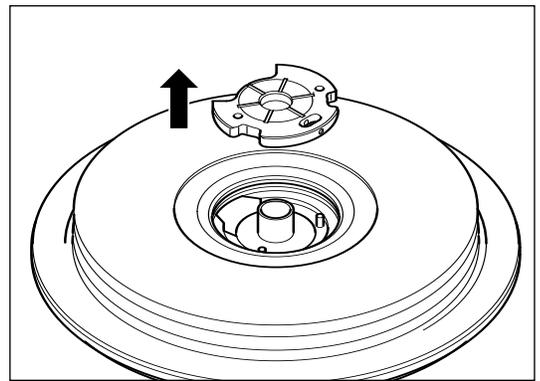
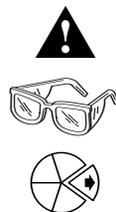
**Warning**

Always wear safety glasses.

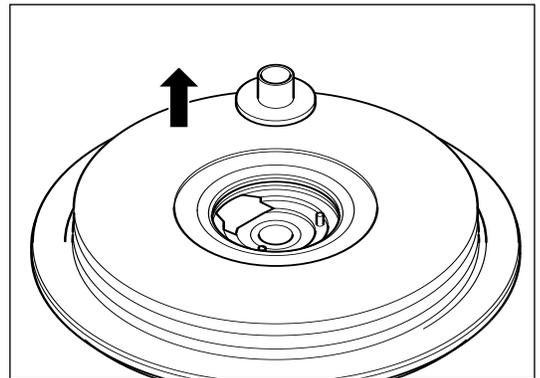
Remove oil baffle (33)\* and discard.



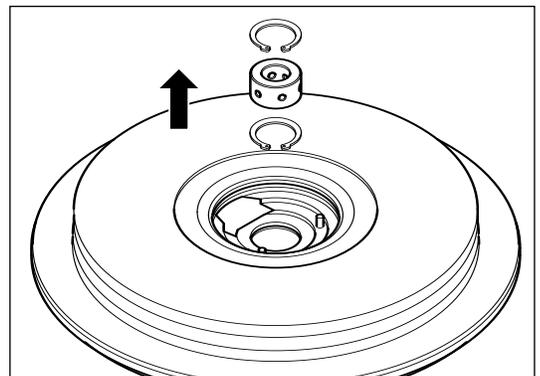
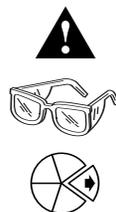
Remove thrust bearing (12)\* from its pin locations and discard.



Remove thrust collar (36).



Use suitable circlip pliers to remove two circlips (64)\* and journal bearing (11)\* from compressor end and discard.

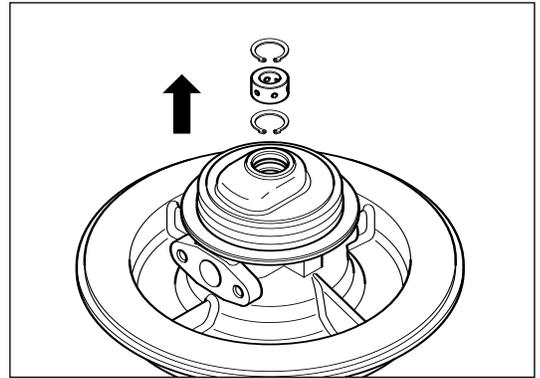




**Warning** 

Always wear safety glasses.

Turn bearing housing over and repeat process of bearing removal at turbine end.



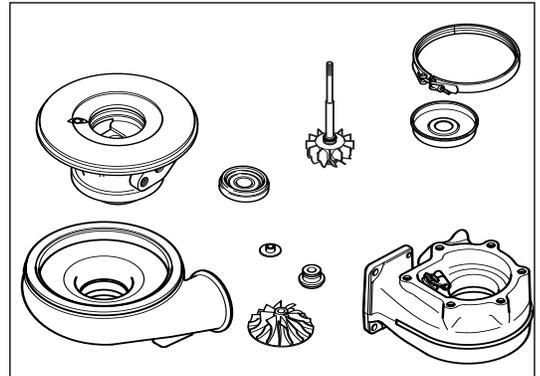
# Component Cleaning



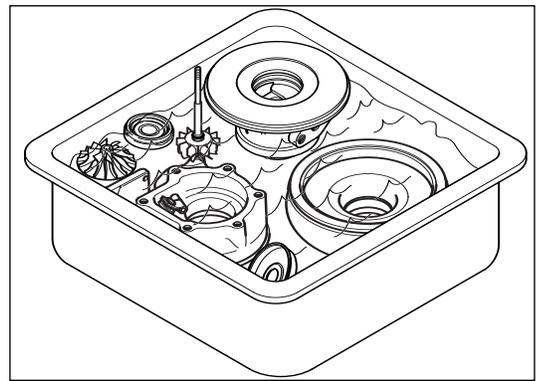
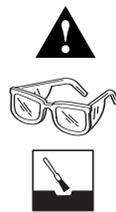
## Warning

Always wear safety glasses.

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

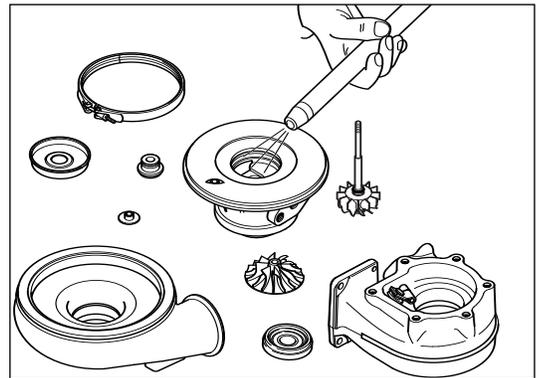


Soak components in non-corrosive low flash point metal cleaner to loosen deposits.



Dry components using compressed air.

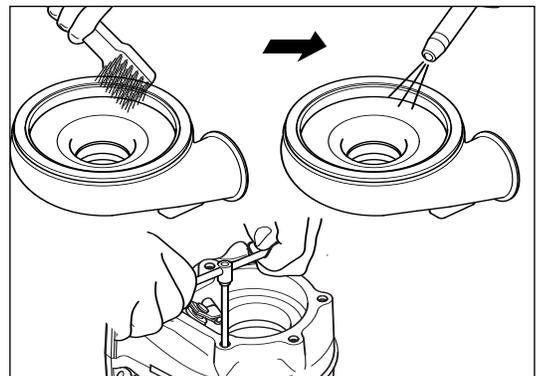
Protect sliding surfaces of cleaned parts against corrosion by applying clean engine oil.



M6 x 1.25

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

Clamp plate threads can be cleaned using specified thread tap.





**Warning** ⚠

Always wear safety glasses.

Flange M10 x 1.5 - Clamp 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.

Oil fittings M16 x 1.5 - M8 x 1.25

It is important that oil chamber of bearing housing is free of carbon before re-assembly. 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** ⚠

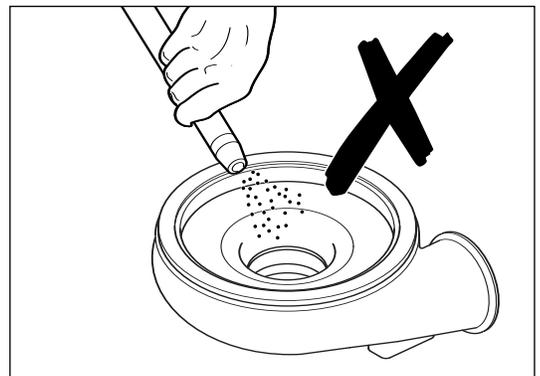
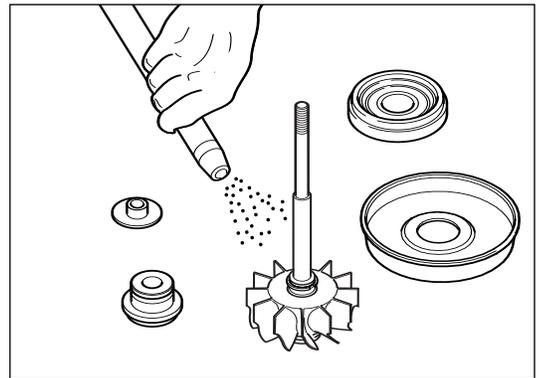
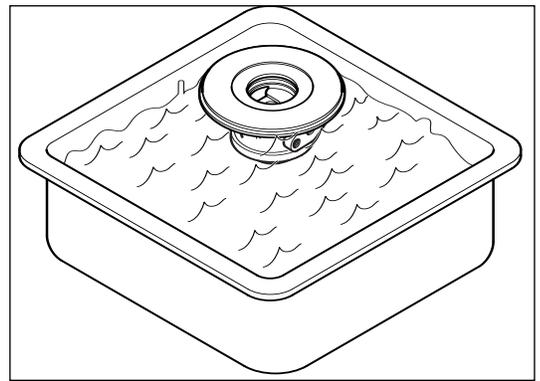
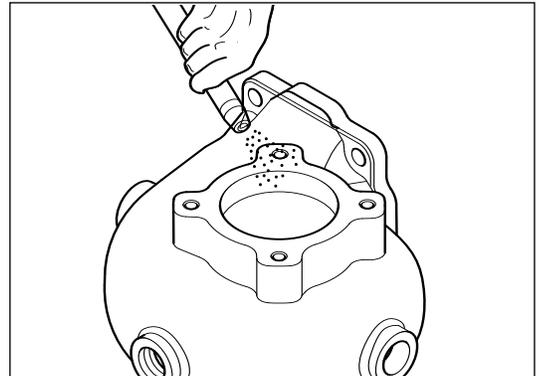
Blasting specific areas for long periods of time may affect component balance. Protect thread of turbine wheel assembly.

**Caution** ⚠

Always clean components with compressed air after blasting.

**Caution** ⚠

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



# Inspection and Testing



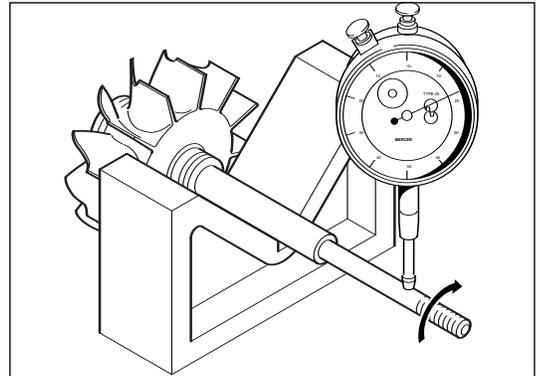
## Major Components

### Assembly Turbine Wheel

Place assembly, turbine wheel (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

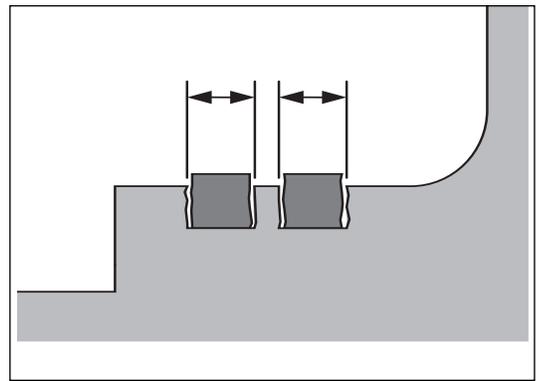
Do not attempt to straighten the turbine shaft.



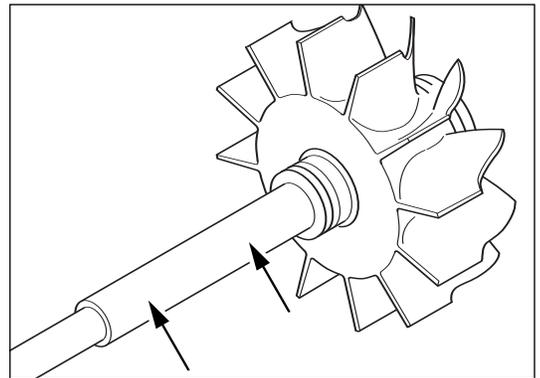
Inspect split ring seal, turbine (13)\* groove walls for wear. If either groove width exceeds recommended maximum of 1.69 mm (.067 in) replace assembly.

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

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



Inspect bearing journals for excessive scratches and wear. Where scratching is excessive or where either journal diameter is less than recommended minimum of 12.19 mm (0.48 in) replace assembly.

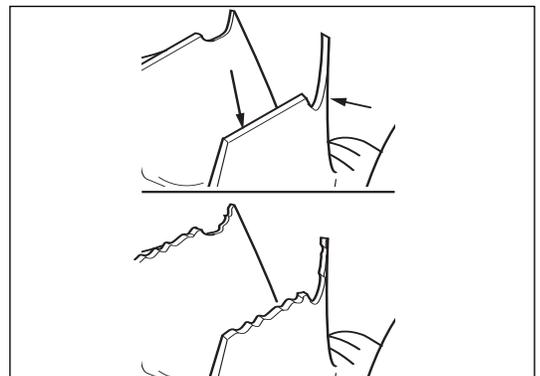


Inspect for cracked, bent or damaged blades.

#### Caution

Never attempt to straighten blades.

Replace with new if any damage found.





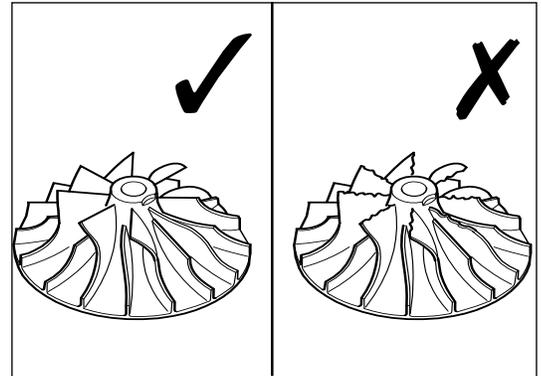
### Compressor Wheel

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

#### Caution

Do not attempt to straighten blades.

Replace with new if any damage found.

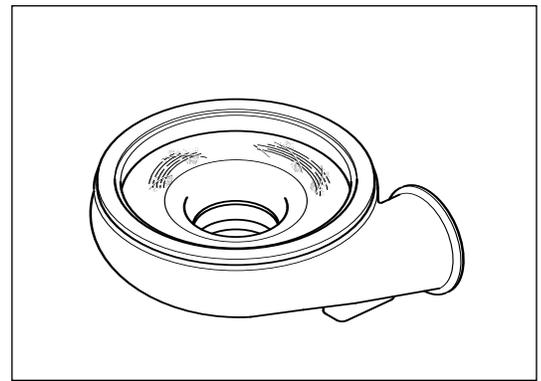


### Compressor Housing

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.



### Turbine Housing

Clamp plates M8 x 1.25 (13 mm A/F)  
Turbine housing flange M10 x 1.5

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 clamp plate threaded holes with specified thread gauge.

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. Where studs have been removed check flange threaded holes with specified thread gauge.

Check exhaust outlet sealing face for cracking and distortion.

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

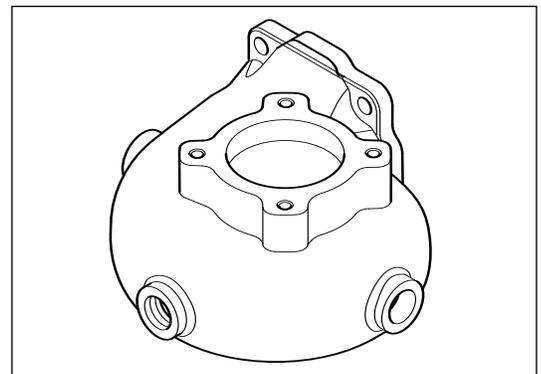
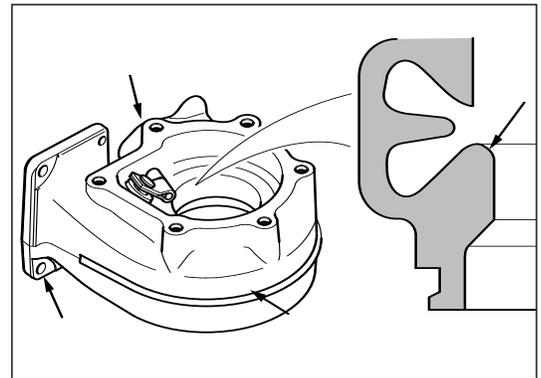
### Water Cooled Turbine Housing

Clamp plates M8 x 1.25 (13 mm A/F)

Blanking Plugs 1 - 12UNF-2B (1 5/16 in A/F)

Check clamp plate and blanking plug thread holes with specified thread gauges.

Replace with new where threads are damaged





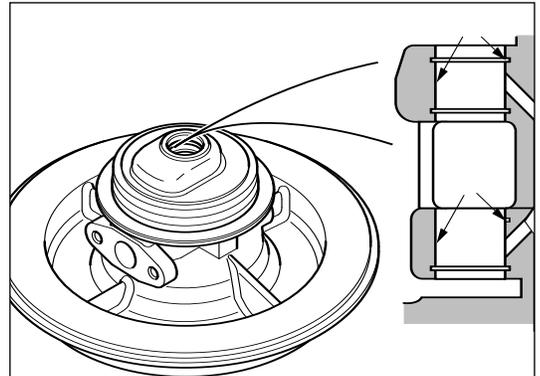
### Bearing Housings

Oil Flanges M8 x 1.25

Inspect journal bearing bores for wear and score marks. Replace bearing housing (4) if a bore diameter exceeds a maximum of 22.27 mm (0.877 in) or when bore scratching is severe.

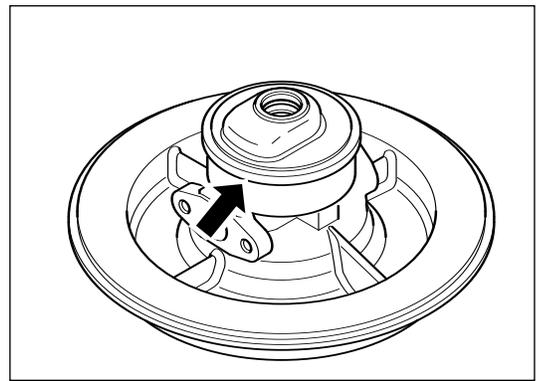
Ensure groove locations for retaining rings, bearing (64) are free from deposits and do not exceed width of 1.25 mm (0.049 in).

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

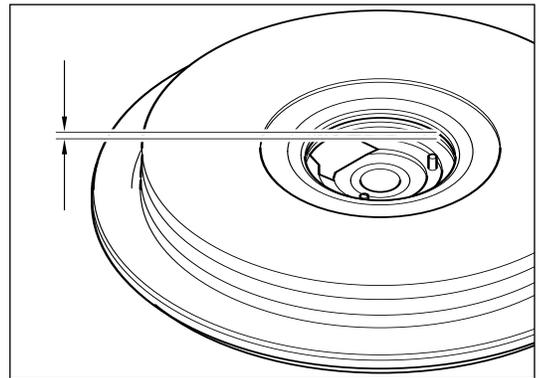


#### Caution

Bearing housing clamp plate interface with the water cooled turbine housing can corrode in high temperature operation. Bearing housings showing corrosion damage must be replaced.



Check oil seal plate, retaining ring groove does not exceed a maximum width dimension of: 2.2 mm (0.087 in).



### Small Components

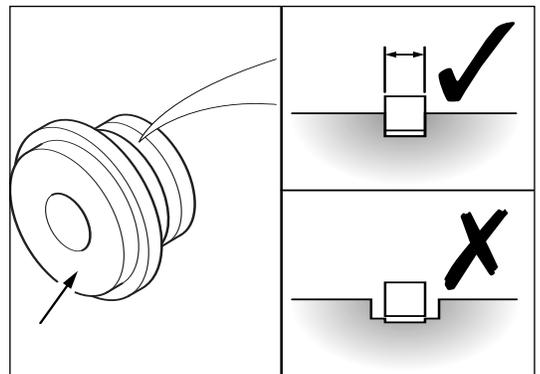
#### Oil Slinger

Inspect and replace oil slinger (31) if piston ring groove walls are scored or damaged or if groove width exceeds maximum of 1.68 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 split ring seal, compressor (16).

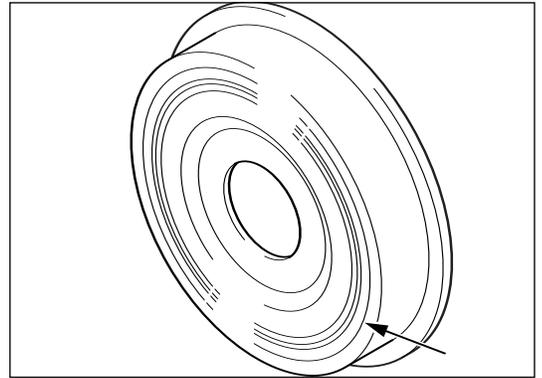
If free gap of ring is less than 2.0 mm (0.08 in) replace split ring seal, compressor (16) \*.





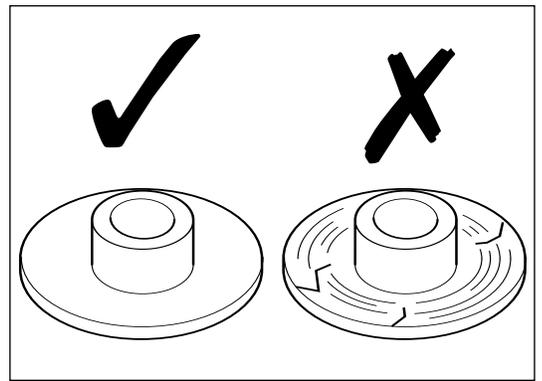
### Heat Shield

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



### Thrust Collar

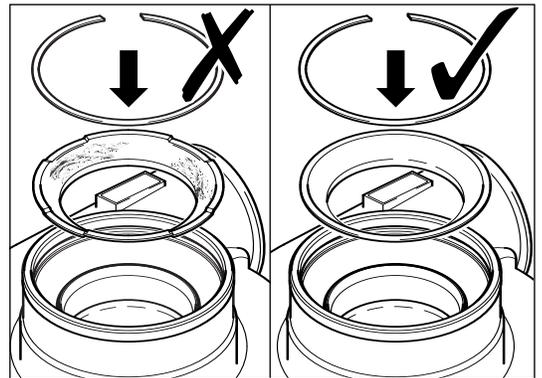
Check and replace if thrust collar (36) is scored on thrust face or if any cracks are visible.



### Compressor Inlet Baffle Option

Check baffle for debris entrapment damage.

Refer to [Turbine and Compressor Housings](#) for re-fitting instructions.



# Reassembly

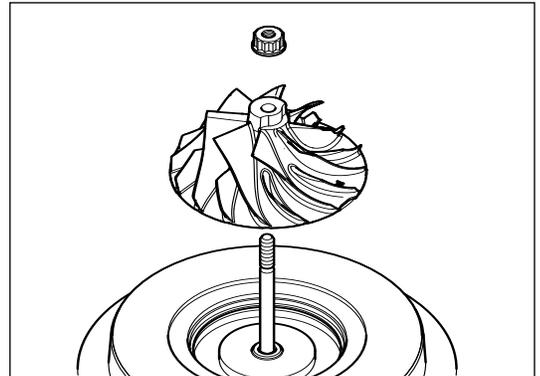


## Rotor Balance

### Caution

This turbocharger may have been manufactured using 'separately piece part balanced' process. Rotor balance **MUST** always be checked on re-build.

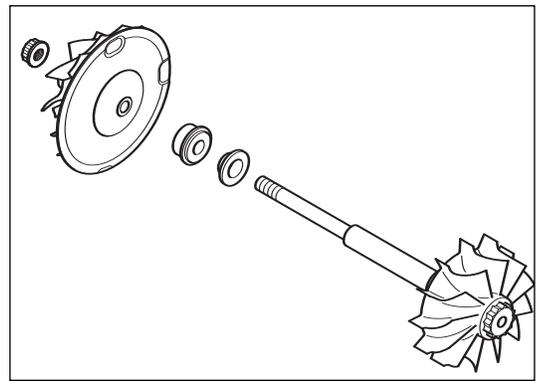
Turbocharger should always have co-relation marks on end of turbine shaft and impeller nose if it has been disassembled according to process defined in **Disassembly**. Thrust collar and oil slinger will not have co-relation marks.



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.



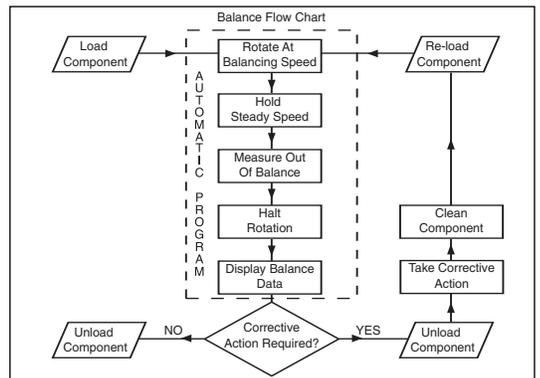
Balance process requires purpose built rig and compliance with rig procedure.

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

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

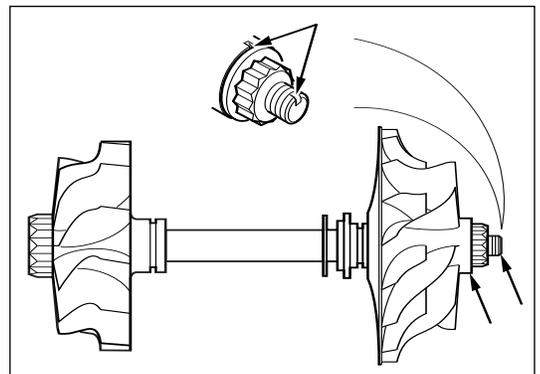
### Caution

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.





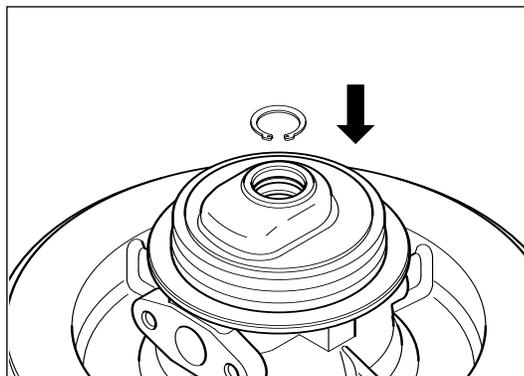
## Turbocharger Reassembly

### Warning

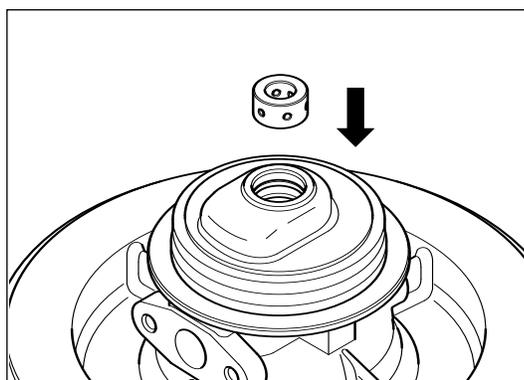
Always wear safety glasses.

Place bearing housing compressor mating face on clean surface.

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

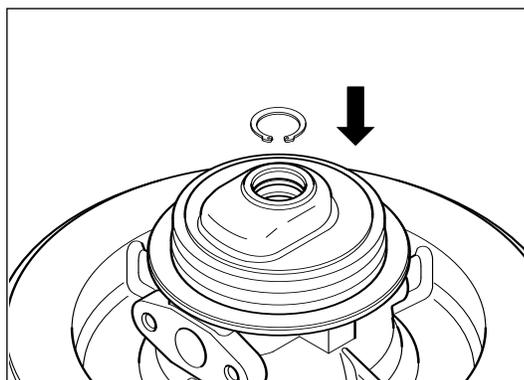


Lubricate journal bearing (11)\* with clean engine oil and install.

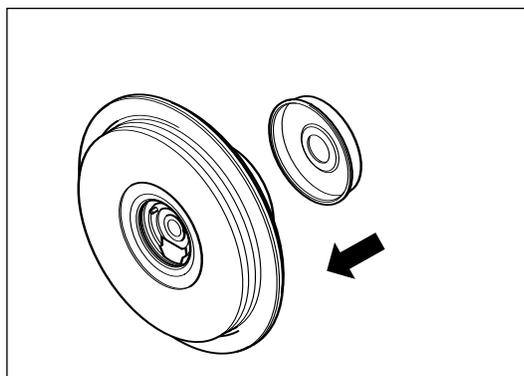


Fit outer retaining ring (64)\*.

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



Install heat shield (38).

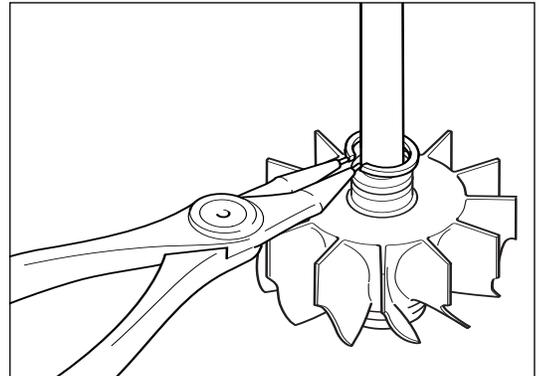




**Warning**

Always wear safety glasses.

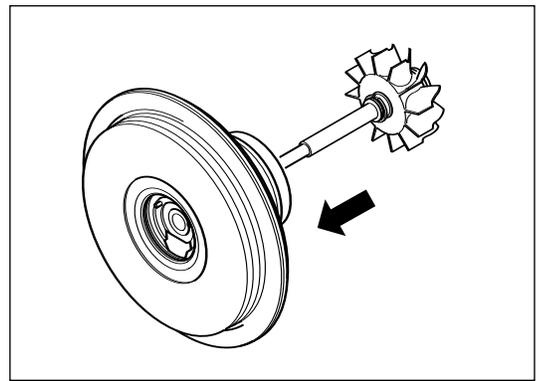
Using expander pliers, install new twin turbine split ring seals (13)\* to turbine wheel assembly (6).



**Caution**

Align twin split ring seals 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 split ring seals (13)\* into position and ensure turbine wheel assembly rotates freely.



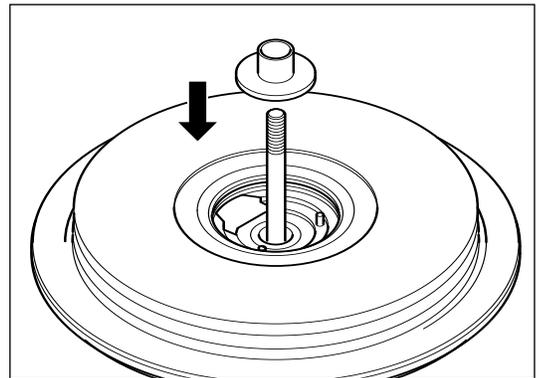
Support turbine wheel assembly in 19 mm 12 point socket located in suitable fixture.

Ensure all thrust contact faces are clean.

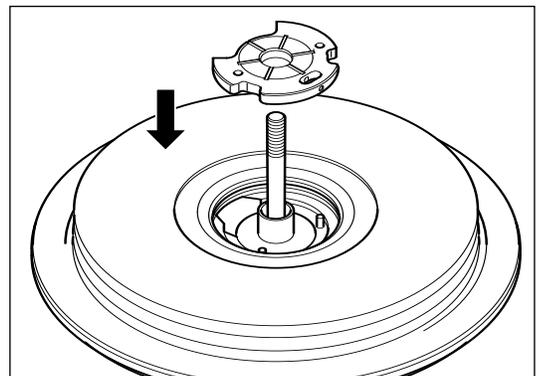
Insert thrust collar.

**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)\* on to location pins.

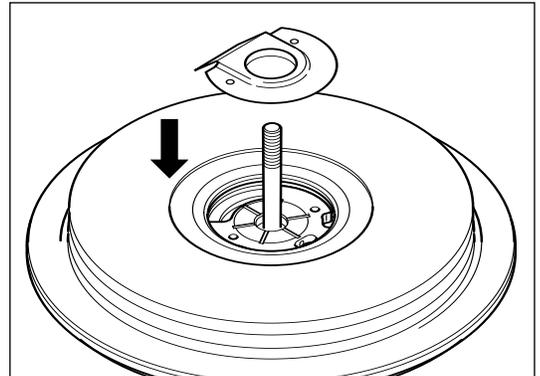




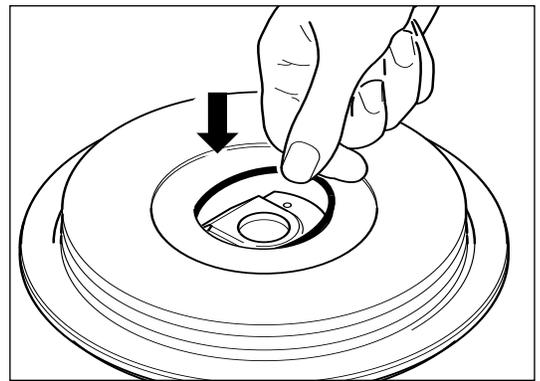
**Warning**

Always wear safety glasses.

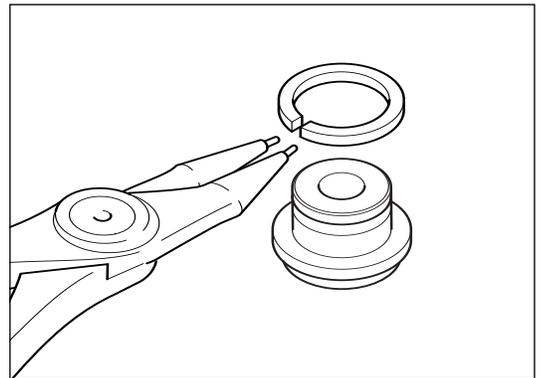
Install oil baffle (33)\*.



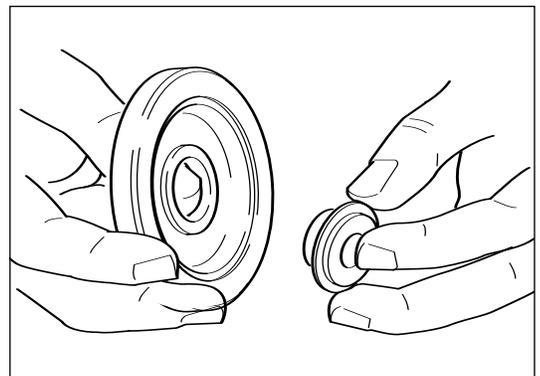
Apply small amount of engine oil to bearing housing o-ring seal (32)\* and insert.



Install new compressor split ring seal (13)\* to oil slinger (31).



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





**Warning** ⚠

Always wear safety glasses.

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

**Caution** ⚠

Do not rest turbocharger on turbine wheel. Always use suitable assembly fixture.

Install oil seal plate (43) with slinger (31) into bearing housing (4).

**Caution** ⚠

Align balance marks on oil slinger and shaft.

Gently tap the oil seal plate (43) with soft hammer to seat in position.

**Caution** ⚠

Ensure that o-ring is not cut during oil seal plate insertion.

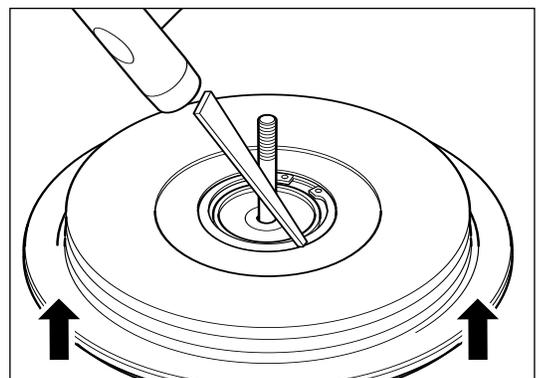
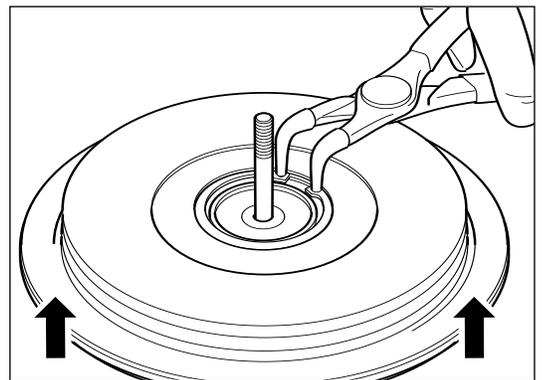
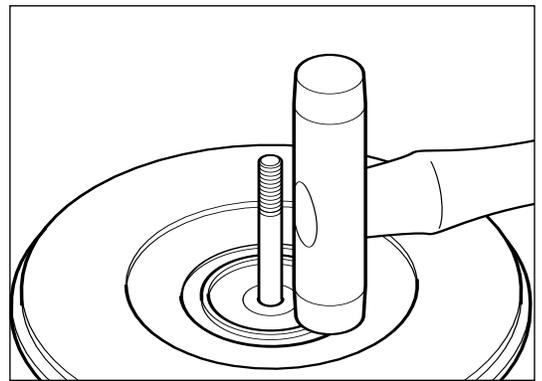
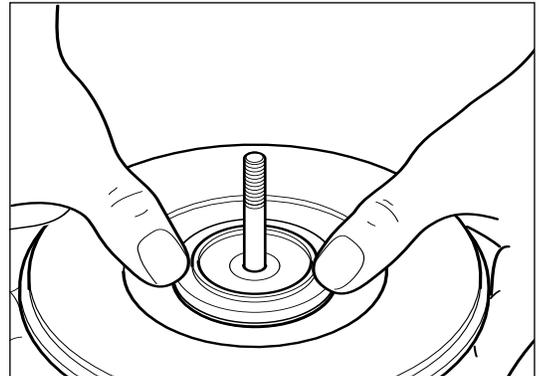
Relocate part built CHRA on to 19 mm 12 point socket in suitable fixture or vice.

Use suitable circlip pliers to install 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.





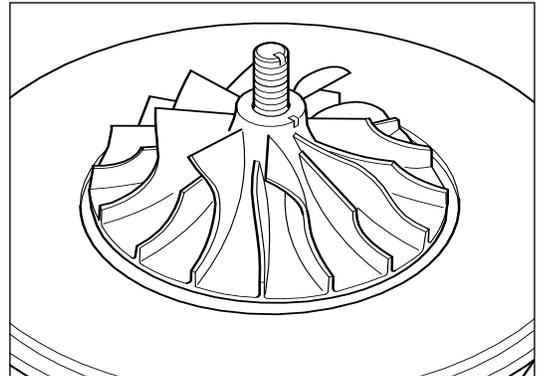
**Warning** ⚠

Always wear safety glasses.

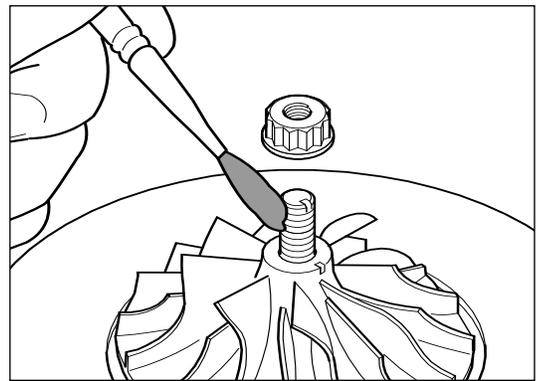
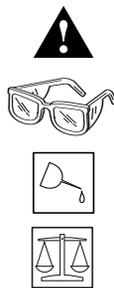
Install compressor wheel (7).

**Caution** ⚠

Align balance marks scribed on shaft and compressor wheel.



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



M8 x 1.25 LH (15 mm multipoint)

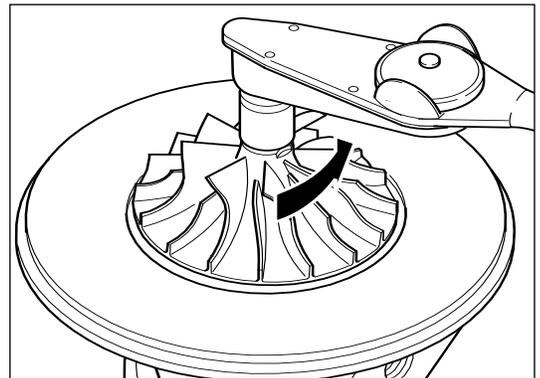
Install compressor wheel locknut (61) and tighten to torque value defined in **Service Data Sheet**.

**Caution** ⚠

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

**Note**

Left hand thread.

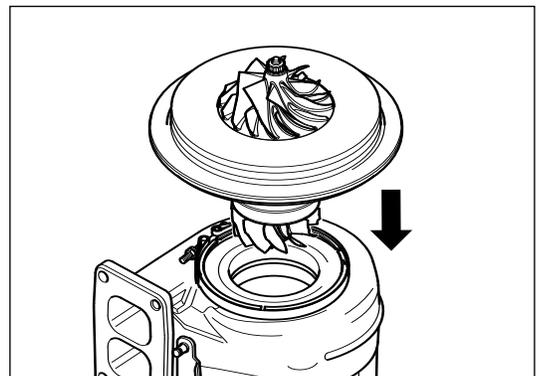


**Turbine housing: V-band option**

Place turbine housing (5) on clean surface. Place V-band clamp (28) loosely into position on turbine housing. Carefully slide CHRA (2) assembly into turbine housing.

**Caution** ⚠

Turbine wheel blades can be easily damaged when CHRA (core) is installed.





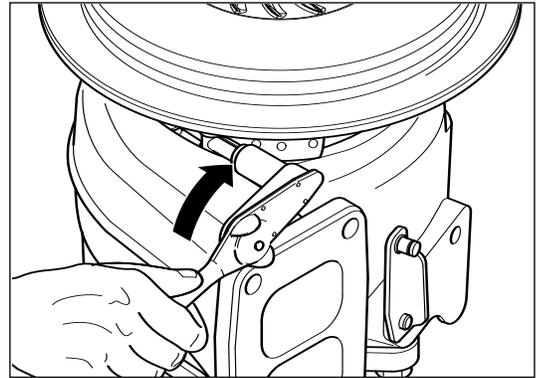
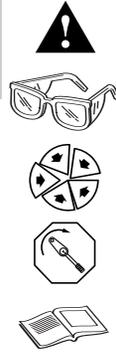
### Warning

Always wear safety glasses.

1/4UNF 28tpi (7/16 in)

Place V-band clamp, turbine (28) in position and torque tighten new locknut V-band (62)\* to value specified in [Service Data Sheet](#).

Ensure rotor assembly freely rotates.



### Clamp Plate Option

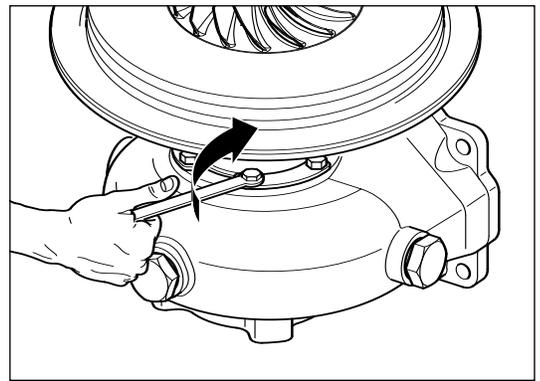
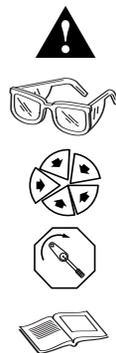
M8 x 1.25 (13 mm)

Secure turbine housing flange in vice.

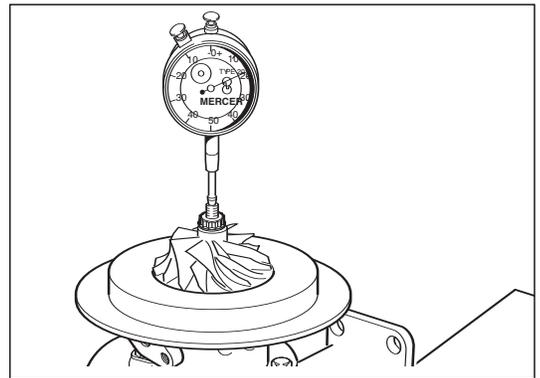
Locate C.H.R.A. into turbine housing (5).

Install three clamp plates (88) and torque tighten six bolts (57) to value specified in [Service Data Sheet](#).

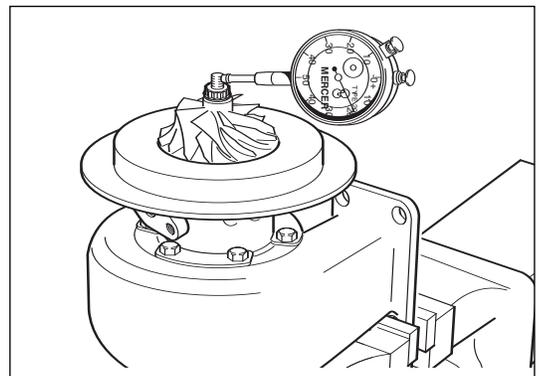
Depending on housing orientation, some clamp plate bolts may have restricted access. In these cases, use suitable torque wrench adapter attached to specially calibrated torque wrench.



Check thrust clearance using dial gauge. Ensure clearance is within MIN/MA<sub>V</sub> values shown on [Service Data Sheet](#).



Check compressor end radial movement using dial gauge. Ensure clearance lies within MIN/MA<sub>V</sub> TIR (Total Indicator Reading) values shown on [Service Data Sheet](#).





### Compressor Housing

**Warning**

Always wear safety glasses.

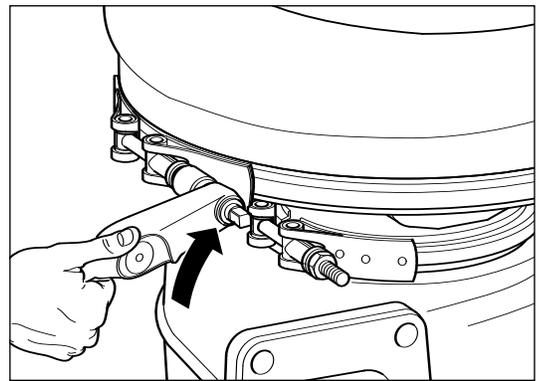
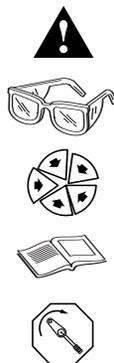
**Caution**

Compressor wheel blades can be easily damaged when CHRA (core) is installed.

Place turbine and bearing housing assembly on clean surface. Lubricate o-ring seal with clean engine oil and install into retaining groove. Loosely fit v-band clamp. Carefully locate compressor housing over compressor wheel.

1/4 UNF 28 tpi (7/16 A/F)

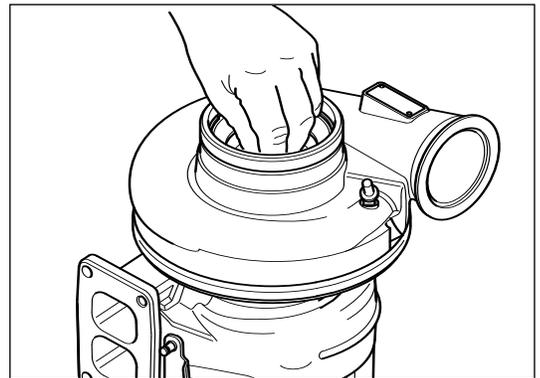
Place compressor v-band clamp (29) in position and torque tighten new locknut (62) to value specified in [Service Data Sheet](#).



Ensure rotor assembly freely rotates.

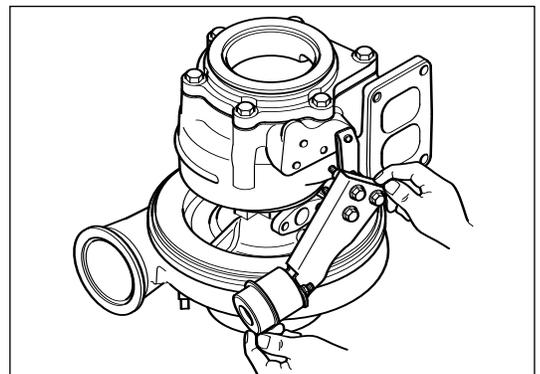
**Warning**

Turbochargers are heavy. Always refer to [Safe Lifting Methods](#) before removing or refitting.



### Pre-set Wastegate Actuator Re-assembly

Refer to [Actuator Replacement](#) for installation procedures.





# Holset HE551/M/W

## Service Repair Manual

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