



ROTREX

SUPERCHARGERS

Technical Handbook

Revision 1.7

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Revision history

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 - Video tutorials included
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 - Pulley changing procedure updated

Rotrex technology basics

Introduction

This document is a general guide and explains the core knowledge required to successfully create a Rotrex supercharger system and is intended for Rotrex dealers and end users who are completing custom installations. This handbook should be used as a reference when designing, installing, and servicing a Rotrex supercharger system.

For end users who are looking for information and/or guidance on their specific kit, please always contact the company who sold you the Rotrex supercharger/kit or the company from whom you intend to buy the Rotrex supercharger/kit. Rotrex only deals directly with approved dealers and OEM customers.

This document contains important information regarding Rotrex products and services related to the "C" range of superchargers (C15, C30, C38 and C38R product families). It is structured in 5 main sections:

Section 1 - "Rotrex technology basics" – provides essential information on how a Rotrex supercharger works and the benefits it brings to you and your customers.

Section 2 - "Choosing the right Rotrex" – provides a useful guideline to selecting the best Rotrex unit for a particular application.

Section 3 - "Designing and handling interfaces" – Provides a series of guides to design, manufacture and install critical systems interfacing with the Rotrex unit (pulley-belt drive, bracket, ducting and lubrication systems).

Section 4 - "Important notes and info sources" – highlights further key considerations and information resources.

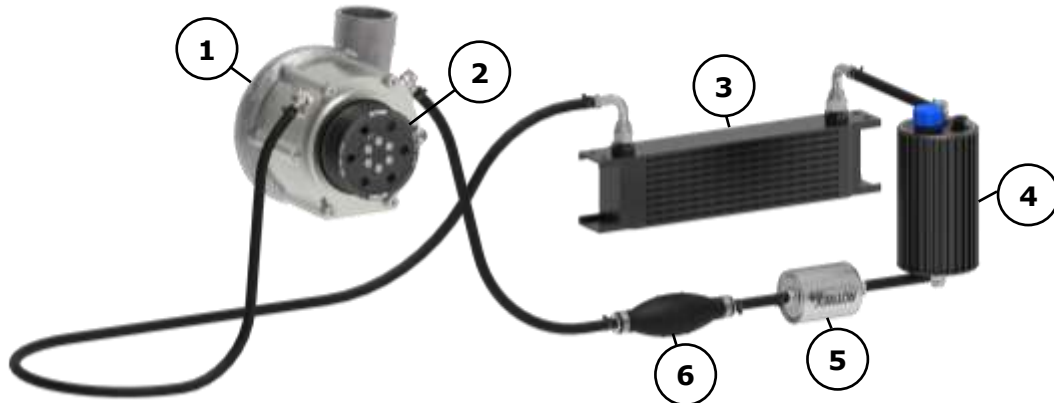
Section 5 - "Support material" – Contains a series of appendices with important drawings, specifications and forms supporting the guidelines.

Following the instructions and recommendations contained in this document is vital for a successful Rotrex installation. Rotrex reserves the right to void warranty if the described requirements aren't followed. Throughout this handbook we have highlighted some of the more common mistakes to make it as easy as possible to successfully develop a new Rotrex application.

Rotrex technology basics

2. Rotrex technology basics

2.1 System overview



The picture above shows a standard Rotrex C-type supercharger system highlighting main components, locations and functions.

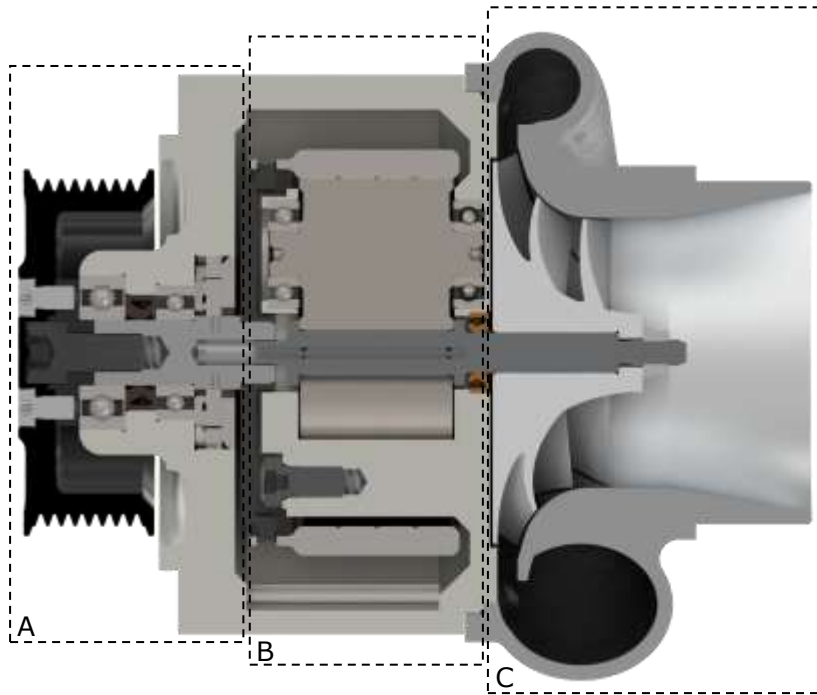
- 1. Supercharger:** Using the highly efficient patented Rotrex planetary traction drive, the input speed from the belt drive is multiplied, spinning the centrifugal compressor impeller at extreme speeds, enabling higher aerodynamic efficiencies than any other centrifugal superchargers on the market.

An integrated dual action oil pump lubricates and cools the traction drive, whilst also circulating the oil through the external oil circuit.

- 2. Pulley:** Connects the supercharger to the crankshaft via a belt. The standard Rotrex pulleys are made to fit PK profile belts, 8PK being the maximum rib count for the C15, C30 and C38 superchargers and 10PK being the maximum rib count for the C38R range. Standard sizes are Ø70-110mm across all ranges apart from the C38R, which is Ø75-110mm.
- 3. Oil cooler:** Cools the traction fluid returning from the supercharger. Rotrex provides oil coolers in 3 sizes, 10, 13 and 16 rows.
- 4. Canister:** Oil reservoir. Its internal design helps to de-foam the traction fluid and vents the oil system through the blue cap. Also acts as a secondary oil cooling element. A sight glass is fitted on the top, which serves as an oil flow confirmation.
- 5. Filter:** Protects the traction drive from any particles using a cellulose and magnetic filter.
- 6. Bulb:** Allows easy priming of the oil system, ensuring correct supply of traction fluid to the supercharger traction drive. It also serves as a one-way valve, ensuring that the traction fluid feed line to the supercharger is always primed with oil.

Rotrex technology basics

2.2 Supercharger internal structure



As the cross-section above shows, the supercharger contains three internal subsystems:

- A. Input & pump:** Connects the pulley drive to the traction drive and powers the dual action vane pump. The dual action vane pump sucks oil from the canister, pumps it into the traction drive, sucks oil from the unit sump and pumps it back out into the canister through the cooler. The oil pump also creates a vacuum in the traction drive housing, prohibiting oil leakage at the high-speed shaft output.
- B. Traction drive:** Multiplies the input speed and powers the centrifugal compressor. The traction drive is covered in detail in section 2.3
- C. Centrifugal compressor:** Provides boost through a high efficiency centrifugal turbo-compressor design. Air is induced, sped up and compressed across the impeller and collected in the compressor housing.

These interdependent subsystems work together, supported by the lubrication circuit, to deliver optimum performance, reliability and low NVH.

Rotrex technology basics

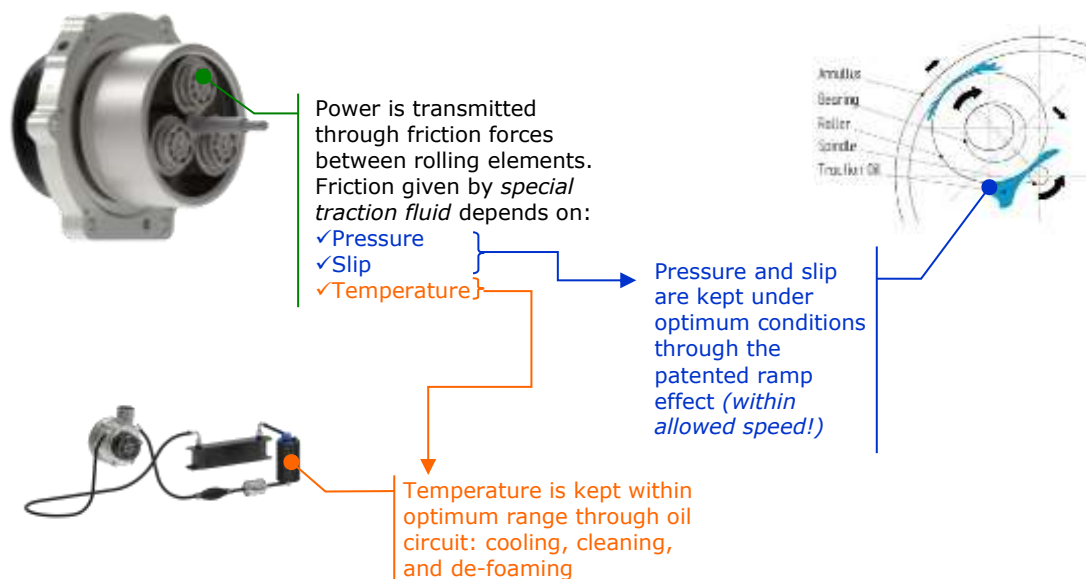
2.3 Traction drive principles and key benefits

A traction drive transmits power through friction forces between rolling elements. High speeds, low noise and high efficiency are just some of the advantages of traction drives over traditional gear transmissions. Contrary to traditional gear transmissions, there is no sliding contact, only rolling elements, which is the key enabler of its unique speed and efficiency capabilities.

The Rotrex patented traction drive uses a steel annulus with a small pre-span to secure contact between the roller planets and the sun shaft with a reasonable force. The ramp or wedge effect increases efficiency and reliability in the transmission by regulating the torque transfer capability on demand through self-adjusting planet geometry. This is a key operational feature since friction is highly dependent on surface pressure, slip and temperature conditions in the traction fluid.

Developed specifically for use in Rotrex superchargers, the special traction fluid momentarily increases viscosity under high surface pressure, enhancing the traction drive performance by securing the optimum friction between rolling elements while cooling and protecting the system from metal-to-metal contact.

The diagram below represents the dynamics explained above.



This unique traction drive delivers the following key benefits:

- Speed capability released up to 240.000 RPM (depending on model)
 - ✓ *Allowing reliable utilization of highly efficient impellers delivering improved boost conditions*
- Great power density (around 20 kW/kg) resulting in unparalleled compactness
 - ✓ *Accelerating application development and simplifying installation = lower costs*
- Low noise and smooth operation
 - ✓ *Improving NVH and customer satisfaction*
- High efficiency
 - ✓ *Causing less heat and requiring less energy*

Choosing the right Rotrex

3. Choosing the right Rotrex

3.1 General guidelines

Supercharger comparison table

Model	Input rotation direction	Pulley dia. [mm]	Air inlet hose dia. [mm]	Air outlet hose dia. [mm]	Max impeller speed [rpm]	Max pressure ratio	Max flow [kg/s]	Power range ¹ [engine kW]	Max adiabatic efficiency [%]
C15-16	CW ³	70-90	60	45	201,500	2.46	0.15	60-125kW (82-170hp)	70
C15-20	CW ³	70-90	60	45	180,000	2.94	0.15	50-120kW (68-163hp)	75
C15-60	CW ³	70-90	60	45	150,000	2.34	0.22	90-175kW (122-238hp)	74
C30-64	CW ³	70-110	60	50	120,000	2.68	0.28	120-235kW (163-320hp)	72
C30-74	CW ³	70-110	60	50	120,000	2.82	0.31	135-255kW (184-347hp)	72
C30-84	CW ³	70-110	76	50	120,000	2.82	0.32	140-265kW (190-360hp)	72
C30-94	CW ³ CCW ²	70-110	76	50	100,000	2.52	0.39	145-320kW (197-435hp)	71
C38-61	CW ³	70-110	76	63	90,000	2.90	0.48	200-410kW (272-557hp)	73
C38-71	CW ³	70-110	76	63	90,000	2.82	0.55	210-455kW (286-620hp)	75
C38-81	CW ³	70-110	76	63	90,000	2.85	0.58	220-485kW (300-660hp)	72
C38-91	CW ³	70-110	76	63	90,000	2.94	0.63	260-530kW (354-720hp)	75
C38-92	CW ³	70-110	89	63	90,000	2.94	0.63	260-530kW (354-720hp)	75
C38R-112	CW ³ CCW ²	75-110	89	63	90,000	3.38	0.84	340-720kW (455-965hp)	75
C38R-122	CW ³	75-110	102	76	90,000	2.82	1.1	460-940kW (616-1240hp)	75

¹ Power output is dependent on engine type, cooling of charge air, cam profile and timing, compression ratio etc. and refers to crank/flywheel hp.

² CCW: **C**ounter **C**lock **W**ise rotation direction seen from the pulley side

³ CW: **C**lock **W**ise rotation direction seen from the pulley side

The amount of air delivered by the supercharger and consequently the boost pressure is determined by the supercharger model and the impeller speed in conjunction with the engine size and speed. The comparison table above shows the working area of each supercharger model within the C-range. For compressor maps please refer to the technical datasheets. If in doubt, please contact your Rotrex dealer.

Regardless of the supercharger type and model, always make sure to run it within its respective operating speed range specified in the technical datasheet. Exceeding these speed values will void warranty.

The optimum supercharger for a given application will depend on many variables of which some are hard to know accurately (e.g., volumetric efficiency or how this will be affected under boost conditions). This can very well be modelled using advanced engine calculation tools and theory. However, using a simple "rule of thumb" along with the information provided here and in the compressor maps will be adequate in many cases.

Choosing the right Rotrex

3.2 Supercharger selection example: boosting 105hp to 150hp

The following example shows the process of supercharger sizing, for a given engine, to provide a more detailed explanation of how to choose the best supercharger for a given application. This example is to be seen as a basic guideline and may vary depending on engine variables.

The key to selecting the right supercharger is to know what air flow and pressure ratio you will be running. With this information you can go through the supercharger compressor maps and choose the right model from there.

Generally speaking, a normal gasoline combustion engine will produce about 120hp for every 0.1 kg/s of air (this figure is highly dependent on engine efficiency and may be considerably higher or lower depending on engine variables). By inserting the expected hp figure of the supercharged engine into the formula below, we now get the expected flow.

$$\text{Flow [kg/s]} = \frac{\text{hp}_{\text{supercharged}}}{1200}$$

Since the target power in this example is 150hp, we have the following flow:

$$\frac{150}{1200} = 0.125 \text{ kg/s}$$

The approximate pressure ratio needed to produce this power on the given engine can be approximated from the formula below. The pressure losses through the filter, pressure pipes, intercooler and intake system including the power to drive the supercharger are approximated to about 15%, thus multiplying by 1.15 in the formula.

$$\text{PR} = \frac{\text{hp}_{\text{supercharged}}}{\text{hp}_{\text{naturally aspirated}}} \times 1.15$$

This is true only when the engine runs under low to moderate boost (up to 0.7 bar \cong PR 1.7) and assuming the air entering the engine has been cooled to a temperature no more than 30°C above ambient temperature. Any other restrictions in the system (i.e., restrictive exhaust system, inlet filter, valve size, ducting etc.) will reduce the expected boosted power output.

Entering the values from this example we have the following PR:

$$\frac{150}{105} \times 1.15 = 1.64$$

After studying the supercharger selection table (above) and flowcharts in the technical datasheets, we can conclude that the C15-60 is a good match with an adiabatic efficiency above 72% at the point of 0.125 kg/s and PR 1.64

Designing and handling interfaces

4. Designing and handling interfaces

4.1 Pulleys and other drive types

Rotrex provides 8 and 10 ribbed PK-type pulleys ranging from Ø70 to Ø110mm in diameter in steps of 5mm (i.e., Ø70, Ø75, Ø80...). Check the technical datasheets for available pulley sizes for specific superchargers. Rotrex highly recommends using standard Rotrex pulleys. If you for some reason need to use a different design, please follow the technical information and specifications on pulley design in Section 6.1 and 6.2. This will ensure a proper coupling and a healthy bearing arrangement. *Not following these specifications voids warranty and may result in permanent damage of the supercharger system and/or other systems in the vehicle/application.*

Repeatedly turning the input shaft on a new unit in the wrong direction (see supercharger selection table, page 9) may result in detachment of the internal thread connection causing supercharger damage.

Never use an impact wrench when mounting or changing pulleys. Section 6.3 of this document explains the procedure for mounting and removing pulleys.

In case of any questions or doubt don't hesitate to contact your Rotrex dealer.

Use the formula in the box below to calculate the pulley size for a given application. The target impeller rpm, RPM_i , should be found using a flow map and target values for pressure ratio and air flow. *Do not exceed the maximum allowed supercharger speed.*

Supercharger pulley calculators are available on our website www.rotrex.com/calculators

Pulley size

$$RPM_i = \frac{RPM_{e,max} \times \varnothing Pulley_e \times Ratio_s}{\varnothing Pulley_s}$$

or reorganized for pulley diameter...

$$\varnothing Pulley_s = \frac{RPM_{e,max} \times \varnothing Pulley_e \times Ratio_s}{RPM_i}$$

where subscripts i, e, s denote impeller, engine and supercharger.

Note:

C15 drive ratio:	1:12.67
C30 drive ratio:	1:9.49
C38 drive ratio:	1:7.50
C38R drive ratio:	1:6

Example:

Engine max speed: 7200rpm
 Supercharger: C15-60
 Impeller speed: 142krpm
 Ratio of C15: 12.67:1
 Crank pulley: 123mm

$$\frac{7200 \times 12.67 \times 123}{142000} = 79$$

By rounding up we get the appropriate pulley diameter to be 80mm

Designing and handling interfaces

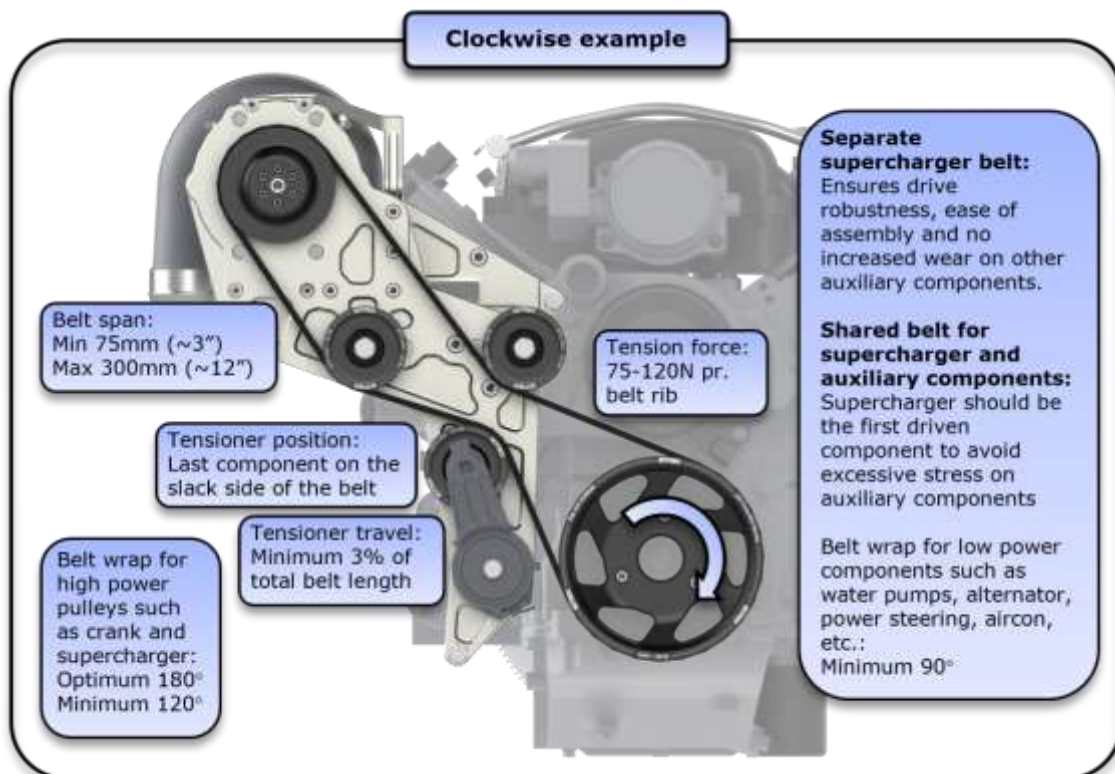
4.2 Belt drives

4.2.1 Belt routing

Due to the apparent simplicity of the belt drive, installers and designers tend to disregard its importance. The single most frequent source of supercharger installation problems can be traced back to the belt drive or design and manufacturing of belt drive components such as brackets, tensioners, pulleys and mounting points. *Paying special attention to the belt drive can improve performance, durability, service life and ease of service significantly.*

These guidelines are rule of thumb only and must be accompanied by extensive testing on multiple installations to get a true picture of the robustness of the belt drive.

It is advisable to run the supercharger from a separate belt and crank pulley. Leaving the vehicle's existing belt drive untouched reduces the risk of wear and failure of the belt and auxiliary components. For twin charger applications we advise to run each supercharger on a separate belt to maximize durability.



Designing and handling interfaces



Although quite rare, there are some engines that rotate counter-clockwise. When choosing a Rotrex supercharger please ensure correct rotational direction of the input, see Section 3.1. By driving the supercharger from the back side of a double-sided belt the rotational direction is reversed. This way it is possible to install clockwise superchargers to counter-clockwise rotating engines.

The same method can be used to install a supercharger in a mirrored position compared to the other front-end components so that a clockwise rotating engine drives a supercharger mounted in a mirrored position from the back side of the belt. This inverts the driving direction twice, resulting in a clockwise rotating engine and a clockwise rotating supercharger.

4.2.2 Belt alignment

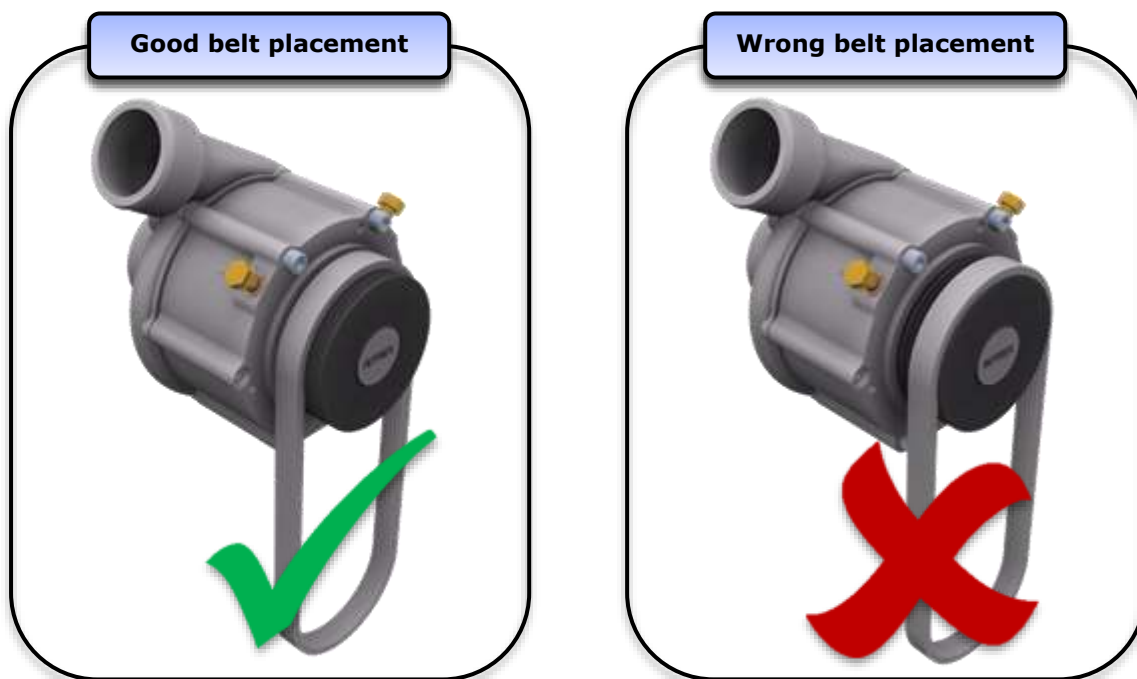
Belt misalignment is a common source of wear, noise and slip problems. Bracket fixing points and tolerances including coatings are a source of belt misalignment issues. The following guidelines will help prevent problems when designing a system.



Designing and handling interfaces

A good rule of thumb to keep in mind is that noise which occurs at idling and low speeds is likely to be due to pulley misalignment. Noise that occurs at high speeds is likely to be due to belt tension problems. To identify or recreate the noise it is important to find the true cause and to cure the problem: Use a spray bottle filled with water to mist the belt lightly. If the noise level recedes for several seconds, then returns louder, a misalignment problem is likely. If the noise immediately increases after the belt is sprayed, slip is likely. Besides noise, belt dust and burnt rubber smell are other typical signs of misalignment, wrong belt tension or other problems in the drive. Note that bracket flex can also be a source of belt misalignment at high speeds and loads.

To avoid bearing problems with the supercharger or any other front-end accessory it is imperative that the belt runs within the specified design window. The maximum allowed belt overhang is defined as; the middle of the belt must run at a maximum of 23mm from the supercharger bracket face. See Section 6.1 for an illustrated specification of the belt overhang limitations.



Designing and handling interfaces

4.2.3 Belt routing fact sheet

Rotrex strongly recommends following below recommended points when designing your supercharger kit:

- If space is available, run the supercharger on its own belt.
- If running on a shared belt, try to place the supercharger as the first driven component in the belt drive.
- To avoid belt slip or excessive belt wear, use a belt with as many ribs as possible. Ideally all ribs available on the supercharger (8-10 ribs). Avoid using toothed belts.
- Have as much wrap as possible on the supercharger and crank pulley. Wrap on the crank pulley is often overlooked.
- Keep the belt as short as possible, avoid belt lengths of more than 2000mm.
- Avoid having unsupported belt lengths of more than 300mm, introduce an idler if necessary.
- Always use a dynamic tensioner to compensate for belt stretch and preferably place it as the last component in the belt drive.
- The dynamic tensioner should have enough travel; 3% belt elongation is not uncommon. Having a high amount of belt wrap on the tensioner will increase the effective travel.
- The pulley ratio between engine and supercharger should preferably be above 1.5 to maintain good lubrication of the supercharger at idle.
- Try to implement adjustment options to allow the end-user to change pulley sizes more easily. This could be several position options for the tensioner or idler pulleys.

Designing and handling interfaces

4.3 Brackets

Section 6.4 of this document provides the critical dimensions needed for the construction of the main bracket. Following these specifications is important to ensuring adequate fixation of the supercharger and pulley/belt at running conditions. In addition, the following guidelines are also important:

- Choose a geometry and material that ensures optimum alignment, stability, and durability.
- Include a minimum of 3 strong fixing points to help prevent excessive vibration and bending during operation.
- Avoid materials that will corrode when mounted onto aluminium.
- Consider possible manufacturing tolerances on engine anchoring points and avoid rough cast surfaces since this can result in considerable belt misalignments that can cause belt slip, noise and even failure.
- Include surface treatments to prevent corrosion and improve aesthetics. Remember that some surface treatments build a considerable layer on top of the material, and this should be accounted for to remain inside the specified dimensional tolerance range.

Designing and handling interfaces

4.4 Lubrication circuit

The Rotrex oil system is an integral part of the design and function of the Rotrex superchargers. Our superchargers have been developed and extensively tested with the specially developed SX150 traction fluid. To maintain the expected level of performance and durability *it is vital that the supercharger is run exclusively with Rotrex SX150 traction fluid.*



The picture shows the Rotrex universal oil set. It contains everything needed (hoses, fittings, filter, cooler and canister) for your application development and commercialization. We strongly recommend using these oil sets as they have gone through extensive testing before approval. Consult your dealer if you need to modify the standard oil set in any way (even if the change seems trivial). *Any deviation from the universal oil set and its standard setup needs to be approved by Rotrex in writing for the supercharger to be covered by warranty.*

To aid in filling the oil system and reduce errors while priming, an overview of the oil capacity of all the Rotrex oil circuit components is given below:

Oil circuit component oil capacities

Supercharger [ml]				Canister [ml, min-max]	Filter [ml]	Bulb [ml]	Cooler [ml]			Hose [ml/m]
C15	C30	C38	C38R				10 rows	13 rows	16 rows	
55	85	100	110	75-150	100	45	200	250	300	50

The oil requirement of your system can be calculated as:

$$Oil_{required} = ml_{supercharger} + ml_{canister} + ml_{filter} + ml_{bulb} + ml_{cooler} + (ml_{hose} \times L_{hose})$$

Example with C15, 10 row cooler and 2m hose:

$$Oil_{required} = 55 + 150 + 100 + 45 + 200 + (50 \times 2) = 650ml$$

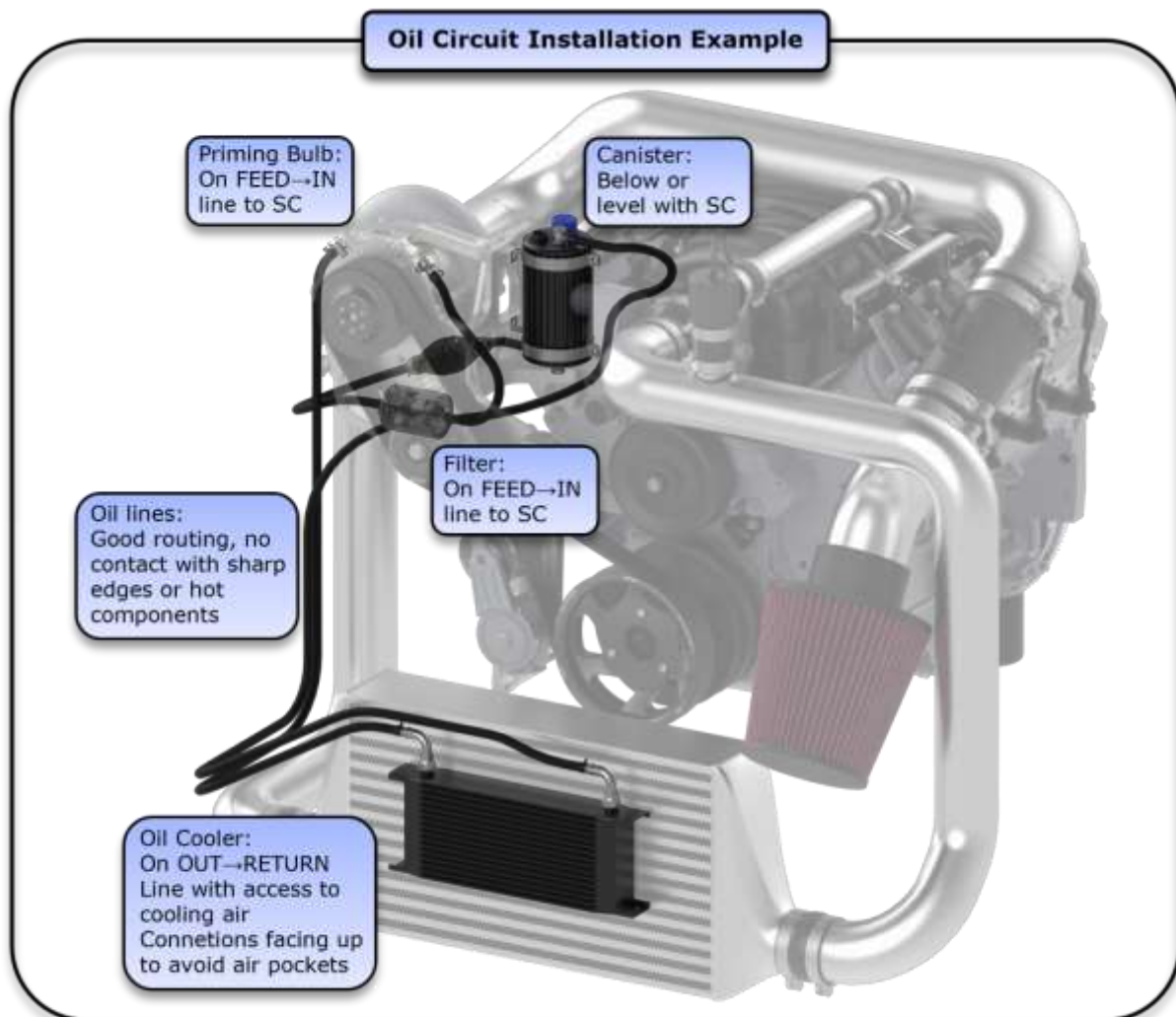
A calculator is available on our website www.rotrex.com/calculators

Designing and handling interfaces

4.4.1 Designing a good lubrication circuit

The lubrication circuit components chosen needs to be able to *ensure that oil temperature at the inlet of the supercharger never exceeds 80°C (176°F) as higher inlet oil temperature will damage the supercharger*. Therefore, it is advised to locate the cooling elements (main cooler and canister) in well-ventilated locations. The oil cooler alone should be able to cool the oil sufficiently.

The supercharger must be positioned above all oil system components (filter, canister, oil cooler and oil lines) to prevent any potential oil leakage from the supercharger. Remember that the canister needs to be accessible for service and maintenance purposes.



Designing and handling interfaces

When routing the oil lines, care must be taken to prevent kinks, rubbing and cuts on the oil lines since leakage could result in permanent damage of supercharger system and/or other systems in the vehicle. To avoid problems, follow these specifications:

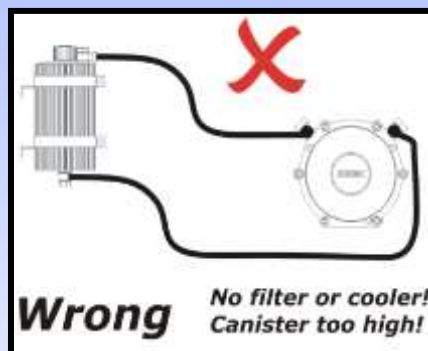
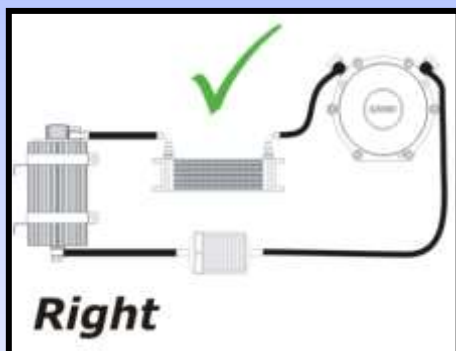
- The oil lines and the oil system components (filter, canister and cooler) must be placed **below** or level with the supercharger shaft.
- Oil lines must be routed in safe distance from the exhaust system or other hot parts to prevent excessive heating of the oil and melting of the oil hoses.
- Make sure there is clearance to other moving parts such as the radiator fans, belts, and pulleys.
- When creating the oil circuit, use only Rotrex standard oil hoses. SX150 traction fluid can dissolve some hose materials.
- Always use hose cutters or a sharp knife when cutting the oil hoses to prevent damage of the hoses during mounting. *If a hose is damaged during assembly, it must be replaced. Using saws, grinders or other abrasive cutters is prohibited.*
- To prevent restricted oil flow only use large radius bends and make sure there are no kinks in the oil lines.
- Engine vibration and movement must be considered when routing the oil lines
- It is important to place the oil cooler where the risk of clogging (debris, stones, sand etc.) can be minimal. If the cooler is clogged it loses function and will overheat the supercharger, leading to failure.
- During assembly it is important to prevent debris and other contamination from entering the oil system.
- Maximum oil system length (including the oil cooler and canister) is 6.0 m.
- Maximum allowable elevation between oil system components is 1.0 m.

Failure to comply with these specifications can compromise the overall reliability and may result in permanent damage of the supercharger and/or other systems in the application.

If the application requires customized oil routing (not using the parts included in the Rotrex package seen in Section 4.4), please contact your Rotrex dealer.

Positioning!

To prevent oil leaks, it is of utmost importance that the oil cooler, oil filter and the oil canister with its cap are placed **below** or **level** with the supercharger shaft.




Designing and handling interfaces

4.4.2 Installation, start-up, and maintenance

Please follow these recommendations when installing the oil circuit.


The original banjo fittings and bolts must be used with the oil canister and supercharger.



Banjo bolt and fitting

For banjo bolts and fittings, always install a copper washer on each side of the banjo.

NOTE Do not re-use copper washers, if the banjo bolt has been tightened.



Hose barb and clamp

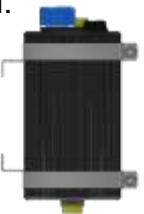
Banjo fittings, oil filter, primer bulb and oil cooler use an Ø8mm hose barb. The oil hose simply slides on and is secured with the provided hose clamps.

IMPORTANT!


Tightening torque of the banjo bolts: **21Nm (15lbft)**

Tightening torque of the oil cooler AN6 fittings: **19Nm (14lbft)**


Carefully follow below installation instructions for a standard Rotrex traction fluid lubrication system. If you purchased your Rotrex supercharger as part of a kit, please follow the steps described in your kit manual provided by your Rotrex dealer.


1.  Install the oil canister in an upright position, with the blue canister cap facing upwards. Use the brackets supplied in the oil set.


Take note of the "feed line" (bottom) and "return line" (top) markings.

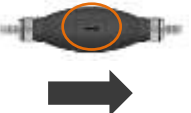
2.  Install the oil cooler in a well-ventilated area in front of other coolers. To prevent air pockets, the fittings on the oil cooler must be facing upwards.

There is no preferred flow direction on the oil cooler.

3.  With a pair of pliers, install a hose clamp on one end of the oil hose. Press a banjo fitting into the hose and secure it with the hose clamp.

4.  With the supercharger properly fitted to the bracket, fit one end of the hose to the oil inlet marked "IN", using the banjo fitting and banjo bolt. Make sure to use a copper washer on each side of the banjo fitting to prevent leaks.

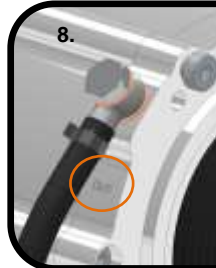
5.  Find a suitable place to install the oil filter along the inlet hose (feed line). **The flow direction arrow must point towards the S/C IN!** Cut the hose, press in the filter and secure it with hose clamps.

6.  Find a suitable place to install the primer bulb along the inlet hose (feed line). **The flow direction arrow must point towards the S/C IN!** Cut the hose, press in the bulb and secure it with hose clamps. Take care to prevent kinks.

Designing and handling interfaces



7. Now, install the oil hose between the filter, bulb and canister "FEED" (bottom) using a banjo fitting, bolt, 2 copper washers and clamp. Make sure to use a copper washer on each side of the banjo fitting. The inlet connects to the feed line.



8. Follow the same procedure for the return line. Connect a hose with a banjo fitting fitted and connect it to the oil outlet on the supercharger clearly marked with the engraved text "OUT". The inlet connects to the feed line.



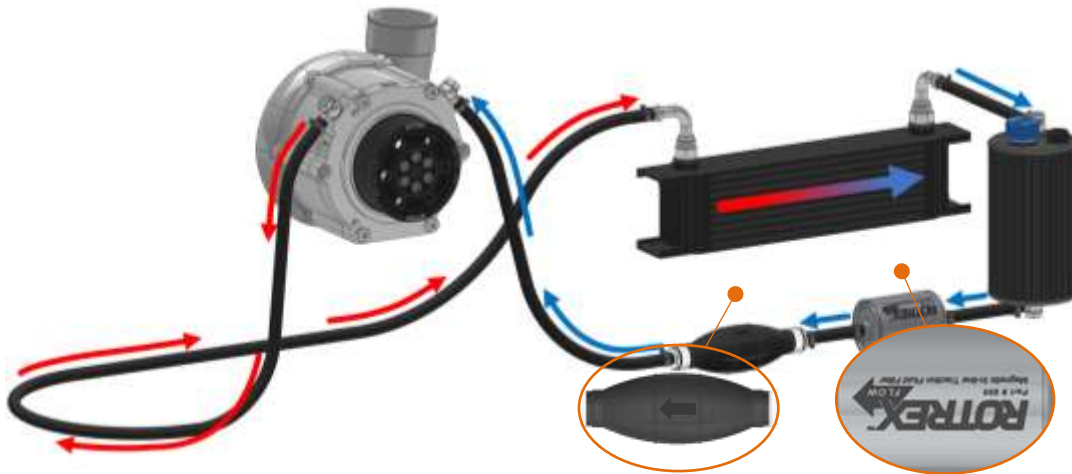
9. Cut the hose to appropriate length and install the hose on one end of the oil cooler hose barbs and secure it with a hose clamp.

Make sure to tighten the AN6 hose barbs correctly on the oil cooler.



10. Lastly, install the oil hose between the other end of the oil cooler and canister "RETURN" (top) using a banjo fitting, bolt, 2 copper washers and clamp. Make sure to use a copper washer on each side of the banjo fitting.

Below illustration is a **clockwise** supercharger installation with the complete lubrication system installed. Please note the oil flow direction marked with blue and red arrows; oil flowing from the canister through the filter into the compressor oil inlet and outlet flowing through the cooler before entering the oil canister at the top.



To ensure proper function of the internal dual action oil pump, the flat surface of the supercharger must be installed facing downwards and horizontal within $\pm 15^\circ$. Mounting the supercharger outside this tolerance will prevent the scavenge side of the pump to work properly and jeopardizes the traction drive. ***Not following this specification voids warranty and may result in permanent damage of the supercharger system and/or other systems in the vehicle.***




Designing and handling interfaces

4.4.3 Initial startup and priming


IMPORTANT!


Priming of your new Rotrex supercharger is the **single most important part** of a successful Rotrex supercharger installation. Incorrect priming will lead to dry running of the high-speed planetary traction drive and will cause irreversible damage.

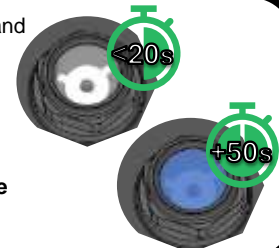
1.  With the blue canister cap removed, fill up the oil canister with SX150 traction fluid, to just below the threaded hole. Use the one-time-use funnel to fill up the canister without spilling.
Canister volume ~400ml

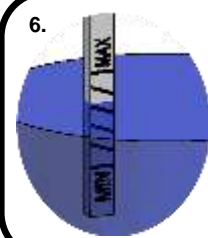
2.  Carefully squeeze the primer bulb by hand to prime the feed line. The bulb slowly expands after each squeeze. When the bulb becomes firm, give it one more squeeze.
Typically, 7-10 squeezes in total are required.

3.  Refill the oil canister with SX150 traction fluid. Take care not to overfill the lubrication system. **Typically, 400-650ml is enough.** The correct amount of traction fluid can be calculated on our website (QR code or) www.rotrex.com/calculators

3.  Turn on the engine and let it idle, while paying attention to the oil level in the canister by looking into the fill hole. **Be ready to top up with more SX150 traction fluid to avoid air pockets in the oil feed line.** The oil level should be below half full.

5.  After **20-50 seconds** the oil will return from the supercharger and the flow indicator on the oil canister will turn blue, confirming oil flow. If the above time is exceeded, check the installation and restart the priming procedure from step 1.
Depending on engine idle speed and pulley ratio, the indicator may pulsate or be partially blue. This is ok. Above 3.000rpm it must be solid blue.



6.  Check the correct oil level by following the procedure on page 20. Overfilling of the system is not harmful to the Rotrex supercharger but will cause oil spilling.

7.  Use the QR-code to be redirected to our website where you can calculate the total lubrication system volume depending on the supercharger model, cooler size and total hose length.
www.rotrex.com/calculators

Warning: Not following the priming and start-up procedures will cause damage to the supercharger and the oil system!

Designing and handling interfaces

4.4.4 Oil level checking and maintenance

MAINTAIN YOUR SYSTEM!

The oil and filter change interval of the Rotrex supercharger is **80,000 km / 50,000 miles** or every **two years**, whichever comes first.

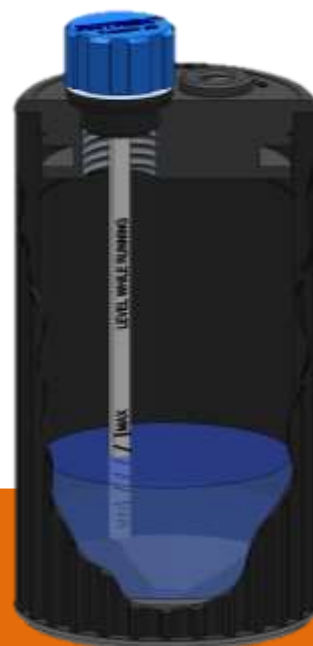
Always keep the oil level between minimum and maximum.

Overfilling the Rotrex supercharger may cause oil leaks from the top of the canister, and too little oil may cause severe damage to the unit.

Check the oil level using the procedure described below:

1. Start the engine and let it idle
2. Remove the dipstick and wipe it clean
3. Check the oil level using the dipstick with its thread fully engaged as shown on the picture

The correct oil level is between the "MIN" and "MAX" marking of the dipstick


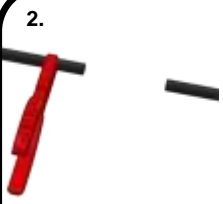




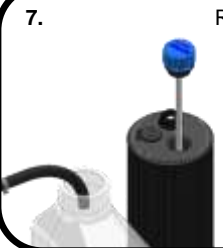
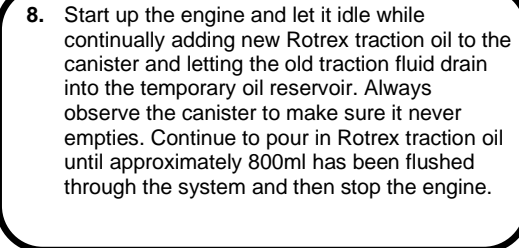




IMPORTANT!

The procedure above is the correct and only way to check the oil level. Checking the oil level with the engine turned off does not give a correct reading.

Designing and handling interfaces

The recommended maintenance procedure and frequency is to *change oil and filter every 80,000 km (50,000 miles) or two years, whichever comes first. Please see below procedure for correct oil and filter replacement.*

<p>1.  To avoid traction oil spilling into the engine compartment, use brake hose pliers to clamp the oil hose as close to the oil filter as possible on the oil canister side (filter inlet).</p>	<p>2.  Slide away the two hose clamps on the oil filter and remove the oil filter.</p>
<p>3.  Mount the new oil filter. Make sure to mount the filter in the correct direction according to the arrows on the filter indicating the correct oil flow direction. Slide the two oil hose clamps back to the correct position.</p>	<p>4.  Remove the brake hose pliers.</p>
<p>5.  Clean all the oil hose connections on the oil canister to prevent any debris or dirt from entering the oil circuit.</p>	<p>6.  Remove the top banjo bolt and sealing washers on the canister. Remove the hose and let the old oil flow into a temporary open oil reservoir (min. capacity 1 liter).</p>
<p>7.  Remove the canister cap.</p>	<p>8.  Start up the engine and let it idle while continually adding new Rotrex traction oil to the canister and letting the old traction fluid drain into the temporary oil reservoir. Always observe the canister to make sure it never empties. Continue to pour in Rotrex traction oil until approximately 800ml has been flushed through the system and then stop the engine.</p>
<p>9.  Remount the canister's oil inlet hose and remember to replace the copper washers with new ones.</p>	<p>10.  Top up the canister and check the oil level as per the procedure on page 21.</p>

Please note: the above procedure is a general Rotrex procedure that may not apply to your specific installation. Contact your Rotrex dealer for more detailed information about your installation.

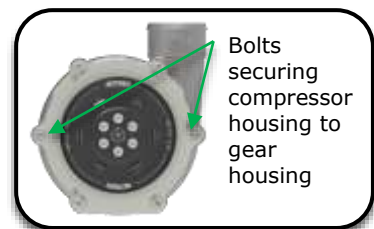
Designing and handling interfaces

4.5 Air ducting

4.5.1 Compressor house adjustment

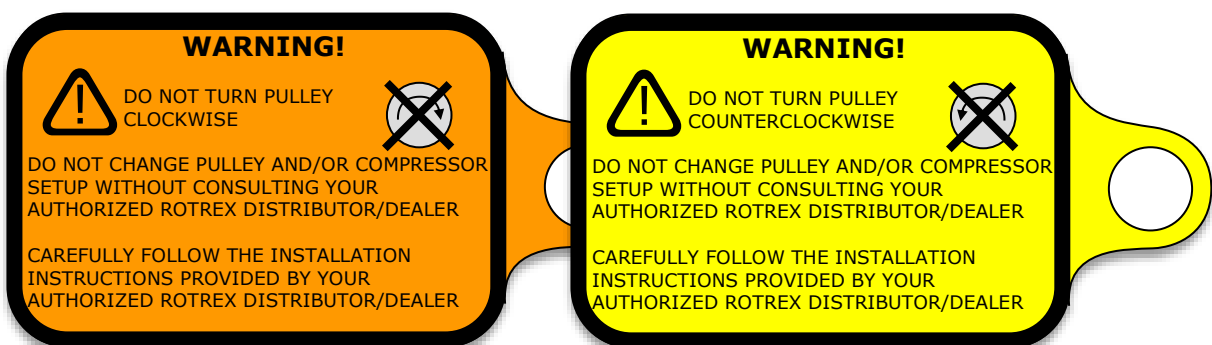
Rotrex can deliver superchargers with 6 different air outlet positions following your order specifications. It is possible to change the pre-set outlet direction carefully applying the following procedure:

- A. First identify the desired outlet direction of the compressor housing respecting the $\pm 15^\circ$ to horizontal specified in Section 4.4.2
- B. Loosen the two large counter-bore bolts securing the compressor housing to the gear housing. Do this carefully and only a couple of turns on each screw at a time – making sure the compressor housing does not come off at an angle damaging the impeller
- C. With the bolts completely removed, the compressor housing can be rotated by hand while still on the gear housing. Again, pay attention not to damage the impeller during this operation
- D. With the compressor outlet at the desired location fit the two bolts and tighten to the torque stated in the respective datasheet. Tightening of the two large counter-bore bolts must be done incrementally, turning each bolt a couple of turns – making sure the compressor housing is not mounted at an angle; damaging the impeller



Not following this procedure may result in impeller imbalance and ultimately cause permanent damage of supercharger system and/or other systems in the vehicle.

The supercharger should be delivered to the end user or installer with a pre-set outlet direction. To support this, every Rotrex unit includes a warning label as shown below.

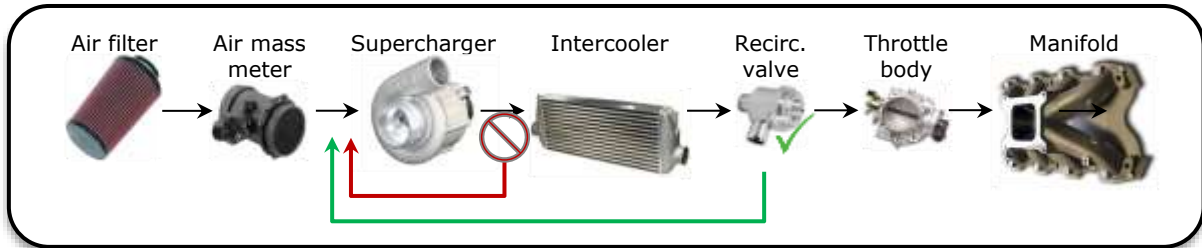


In case of any question or doubt don't hesitate to contact your Rotrex dealer.

Designing and handling interfaces

4.5.2 Ducting

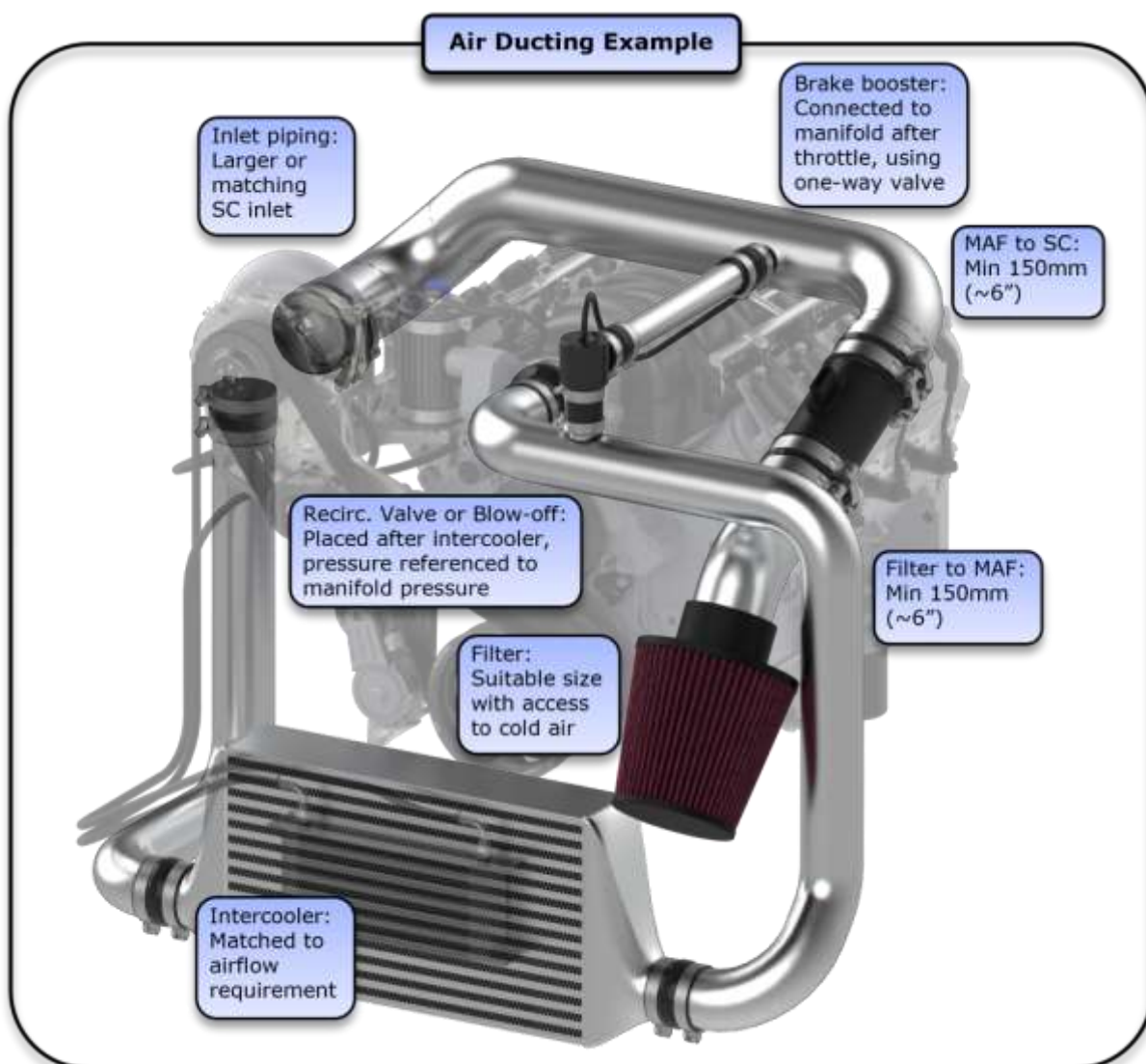
Proper attention to air ducting is core to a healthy forced induction system. The following section should help in the understanding of the main aspects involved in designing a ducting system for a supercharger installation.



A blow-off-valve (BOV) or recirculation valve is optional but recommended in most applications to prevent surge under deceleration. It is critical to use an appropriate size for the specific installation and install it correctly. Surge can occur when the supercharger increases pressure ratio at low air flow (left border of the flow map, see technical datasheets). Under surge, air flow through the compressor can no longer be maintained and momentary backflow occurs resulting in a characteristic chirping sound. Surge can be caused by a blocked inlet air stream, such as a throttle valve or a clogged air filter. *Continuous operation in surge will cause damage to the supercharger.* To prevent surge, it is necessary to relieve the system from excessive pressure through re-circulation or blow-off. A BOV will prevent surge by allowing air to circulate from outlet to inlet of the supercharger under vacuum conditions. In case re-circulation is directed to the inlet of the supercharger, *it is very important that the re-circulation valve is positioned after an intercooler*, to avoid excessive heat soak of the supercharger. Under cruise and/or urban driving with an incorrectly mounted re-circulation valve, the inlet temperature of the supercharger can easily exceed 200°C. *Incorrectly placed re-circulation valve will cause damage to the supercharger and voids warranty.* If an intercooler is not installed, excessive pressure must be relieved through blow-off.

The crankcase ventilation system (Positive Crank Ventilation PCV) is to be connected to the inlet of the supercharger to prevent pressurizing the crankcase. If the vehicle is equipped with an air mass meter (AMM), the crankcase ventilation must be connected downstream of the AMM to prevent oil vapours from corrupting the signal of the AMM.

Designing and handling interfaces



It is recommended to have at least 150mm unrestricted flow before and after the air mass meter to avoid problems with the readings caused by turbulent flow from recirculation valves and other ducting that may cause turbulent air flow.

Inlet restrictors are considered a constructive change of the supercharger unit and influences its characteristics. Incorrectly designed inlet restrictors can also create dynamic forces applied directly to the rotating impeller wheel and may cause damage to the supercharger and/or reduce lifetime. *Using custom inlet restrictors voids warranty.* In case it is deemed mandatory for the success of the application/project, please contact Rotrex directly for assistance.

Check if other systems such as carbon canister and EGR need to be adjusted to work properly under boost.

Designing and handling interfaces

It is imperative that there is an air filter on the inlet of the supercharger. If this is neglected, there is a risk of damage to the supercharger from objects being sucked into the inlet and damaging the host. *Not using an air filter which can remove particles larger than 20 microns voids warranty.* An open filter arrangement will in some cases give induction noise from the impeller. To prevent induction noises, use a closed filter box as seen on most OE applications.

It is important to position the throttle body downstream (after the supercharger) to avoid excessive vacuum, potentially collapsing hoses and damaging the supercharger. *Positioning the throttle body upstream (before the supercharger) voids warranty.*

To maintain air cleanliness, it is important to position the air filter where external clogging can be prevented. The air filter should be mounted where it cannot be covered or sprayed with water and mud. If the air filter gets clogged, the air flow is restricted and will cause a pressure drop, resulting in temporary loss of pressure and air flow. The filter used for the application must be able to last the oil-maintenance interval found in Section 4.4.2.

Do not make unnecessary sharp bends in the air ducting as bends will cause pressure drop resulting in loss of output. *Using a minimum of bends in the inlet and outlet hoses will significantly increase the adiabatic efficiency of the supercharger and increase the success rate for reaching the desired point of operation.* Also, some applications require various sensors which could potentially interfere with the air flow and decrease the adiabatic efficiency.

All air ducting on the inlet side of the supercharger must be of a material that does not collapse and restrict the airflow under vacuum. A Partially blocked air filter will result in significant vacuum which can cause surge or easily collapse a soft hose. Rotrex urges the customer to minimize the use of soft materials in the entire air ducting system.

Rotrex also recommends hose diameters for both inlet and outlet to match the supercharger compressor housings inlet and outlet diameters. For specific diameters see section 3.1. If the inlet ducting, disregarding our recommendations, requires many bends, sensors or narrow pipe diameters, extensive application testing is required.

Hoses, pipes, filters, valves etc. must be fastened with proper clamps to prevent air leakages in the system. To ensure correct tightening torque, use the recommended specifications delivered by the clamp manufacturer. Also, Rotrex recommends contacting the clamp manufacturer to help choose the optimal clamps for the application.

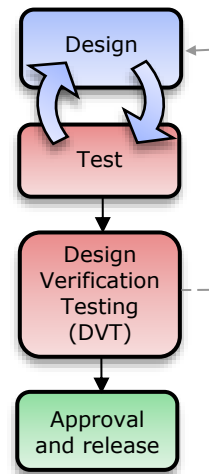
Important notes and info sources

5. Important notes and info sources

5.1 Testing and verification

Once the application design process has come to the prototype phase it is necessary to thoroughly test it before releasing it to verify the system is working as expected and to rectify unforeseen issues. As the diagram to the right indicates, it is important to separate iterative development testing and verification testing. Iterative development testing is all the “trial and error” testing done during the design process and verification testing is the test program designed to verify that the final design complies with minimum performance and reliability target levels.

The intensity and strictness of the testing and verification process will depend on a wide variety of factors (i.e., experience, system complexity, cost-benefit criteria, resource constraints, etc.) and therefore the best advice here is to apply common sense and follow a conservative approach. Shortcuts never pay.



Rotrex recommends taking the following steps during the testing phase:

- A. Verify proper oil conditions: the exact amount of oil needed depends on the components of the oil circuit chosen. Determine the appropriate oil amount needed for the application during the testing phase. Remember to use the correct oil level check procedure described in section 4.4.2 of this document. Adjust oil accordingly and document the amount needed since this information will be very important to include in your application documentation (refer to section 5.2). Once oil flow and level are verified, it is necessary to check that the oil remains below the maximum temperature during harsh climate and operating conditions. Dedicated desert/hot climate testing is highly recommended. Rotrex recommends installing a monitoring/logging system of the oil canister temperature during all testing, placing the sensor as far down in the canister as possible. The temperature values measured must not exceed 80°C (176°F) under any condition
- B. Verify vehicle performance: check that the vehicle performs as desired on the dyno and in the field and double-check that the supercharger is running within the allowed speed range. Keep a close eye on electronic control performance over time and under different variables such as fuel grades and altitude. Rotrex recommends building a monitoring/logging system into the test vehicles to make sure the most important parameters are well within acceptable values. To ensure performance uniformity, perform tests under the most typical configuration variations (i.e., common modifications such as air filters, exhaust system changes etc.)
- C. Belt routing and tension: despite all efforts to get a good routing during the design phase you may need to make adjustments. A proper belt drive is very important to prevent issues such as boost loss due to belt slippage, short belt drive life and noise. During the test phase mentioned above you can check for evidence of misalignment or wrong tension by listening, smelling, and watching the supercharger operate at different points. Burned rubber smell, belt “dust”, belt oscillation and unstable boost are typical signs of a problem. Excessive belt tension and misalignment can eventually cause a failure in the belt and/or supercharger pulley

Important notes and info sources

- D. Installation, safety, and maintenance: it is important to check that your application is "user friendly" and safe to use, both for the installer and for the final user. Remember to document installation procedures since every step should be included in your application documentation (refer to section 5.2)

As mentioned in section 2, the iterative process will be shorter and more effective if you involve your Rotrex dealer as early as possible. The feedback provided and the guidelines given in the previous sections will help you deal with eventual difficulties.

At some point during the iteration process you will find a design you are satisfied with. Only then should you begin the Design Verification Testing phase (DVT). The DVT is a program designed to prove that the final design fulfils minimum quality requirements. *Rotrex recommends running the final application on more than one vehicle for a minimum of 25000 km (15000 miles) per vehicle under harsh driving conditions (city and highway) monitoring vehicle performance, traction fluid conditions (mainly temperatures and level) and belt drive conditions constantly and thoroughly – as well as other engine parameters affected by supercharging.* Perform dyno tests to monitor performance variations across vehicles and environments during the DVT phase. If a problem is identified during this phase, you should go back to the design phase and take corrective actions. Again, follow a conservative approach and common sense... shortcuts never pay and can harm profitability and reputation severely.

5.2 Installer and end user documentation

A good application contains clear thorough instructions to ensure installers and end users know how to handle, install, and maintain the system properly. This documentation is an important instrument to increase customer satisfaction, reduce claims and avoid negligent use or intentional system abuse.

In every Rotrex supercharger, a supercharger setup and maintenance instructions leaflet is included (a copy can be downloaded from www.rotrex.com). This leaflet is intended to guide installers and end users on the main requirements and considerations needed to ensure the integrity of the supercharger. However, *the responsibility to provide clear and thorough documentation and information about your application is in your hands* since Rotrex cannot control the design, manufacture, and distribution of your application. Consider the supercharger setup and maintenance leaflet only as a small complement to your documentation and information package.

Important notes and info sources

5.3 Claim handling

If you have a problem with a Rotrex supercharger always consult your Rotrex dealer, where you purchased your supercharger.

- Do not disassemble your Rotrex supercharger as this will void warranty.
- If asked to return the claimed unit then always return it with the entire pulley system attached at the time of failure (pulley, pulley ring, sprocket, or jackshaft)
- Always make sure the entire oil system is replaced before installing a new supercharger

5.4 Important information sources

Rotrex website - www.rotrex.com - provides up to date information about the latest installations within the official dealer network and other interesting news. You will also find the latest technical information such as technical datasheets and the setup and maintenance instructions leaflet.

Important notes and info sources

6. Support material

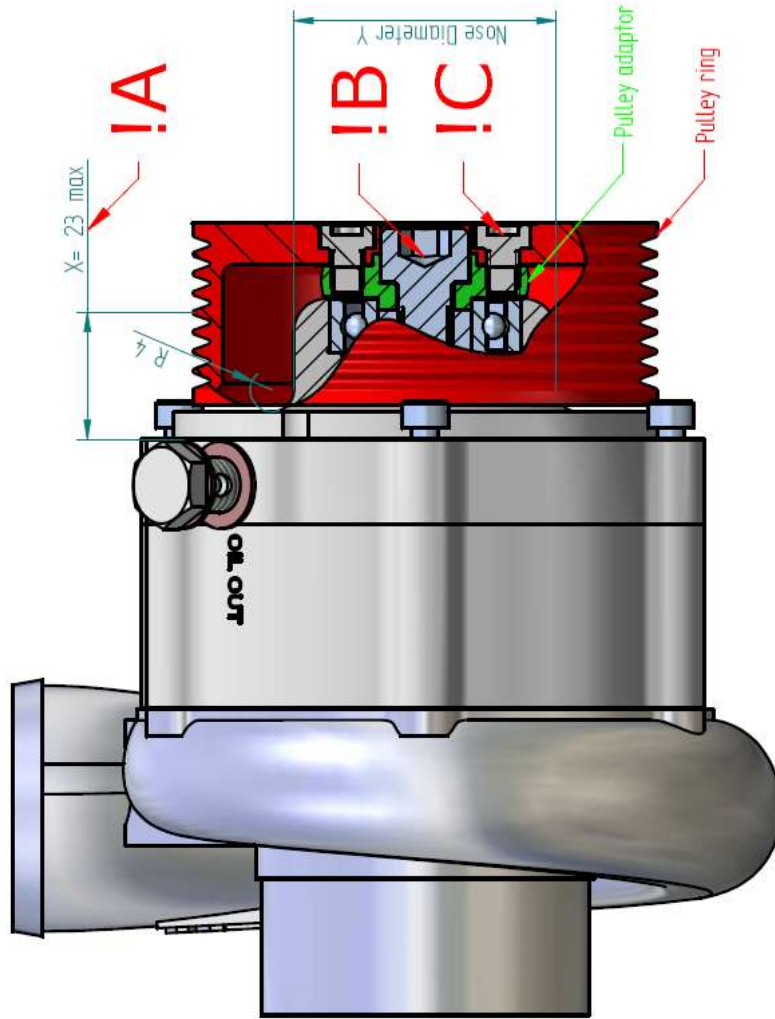
6.1 Pulley ring design guide for C15, C30 and C38

C-range Pulley ring design guide

Design requirements

Not meeting these demands will void warranty and may cause significant damage to the S/C

- **!A** Center of belt must be placed as close as possible to S/C and the distance X should never be more than 23mm.
- **!B** Do not unmount or engage center bolt
- **!C** Only use pulley ring bolts as specified
- Pulley ring bolts 6 pcs: M6x8
Cylinder head torx ISO 14580 grade 8.8
- Pulley ring bolt tightening torque 10 Nm
- Nose diameter Y:
C15=ø48mm
C30=ø53mm
C38=ø60mm
- Pulley ring should be made from quality steel or aluminum
- Use surface treatment that does not significantly reduce friction coefficient
- Contact surfaces on pulley ring and pulley adaptor must be clean when mounting
- Secure pulley while mounting.
Do NOT use the center bolt (B)
- Always consult Rotrex before making your own pulley ring



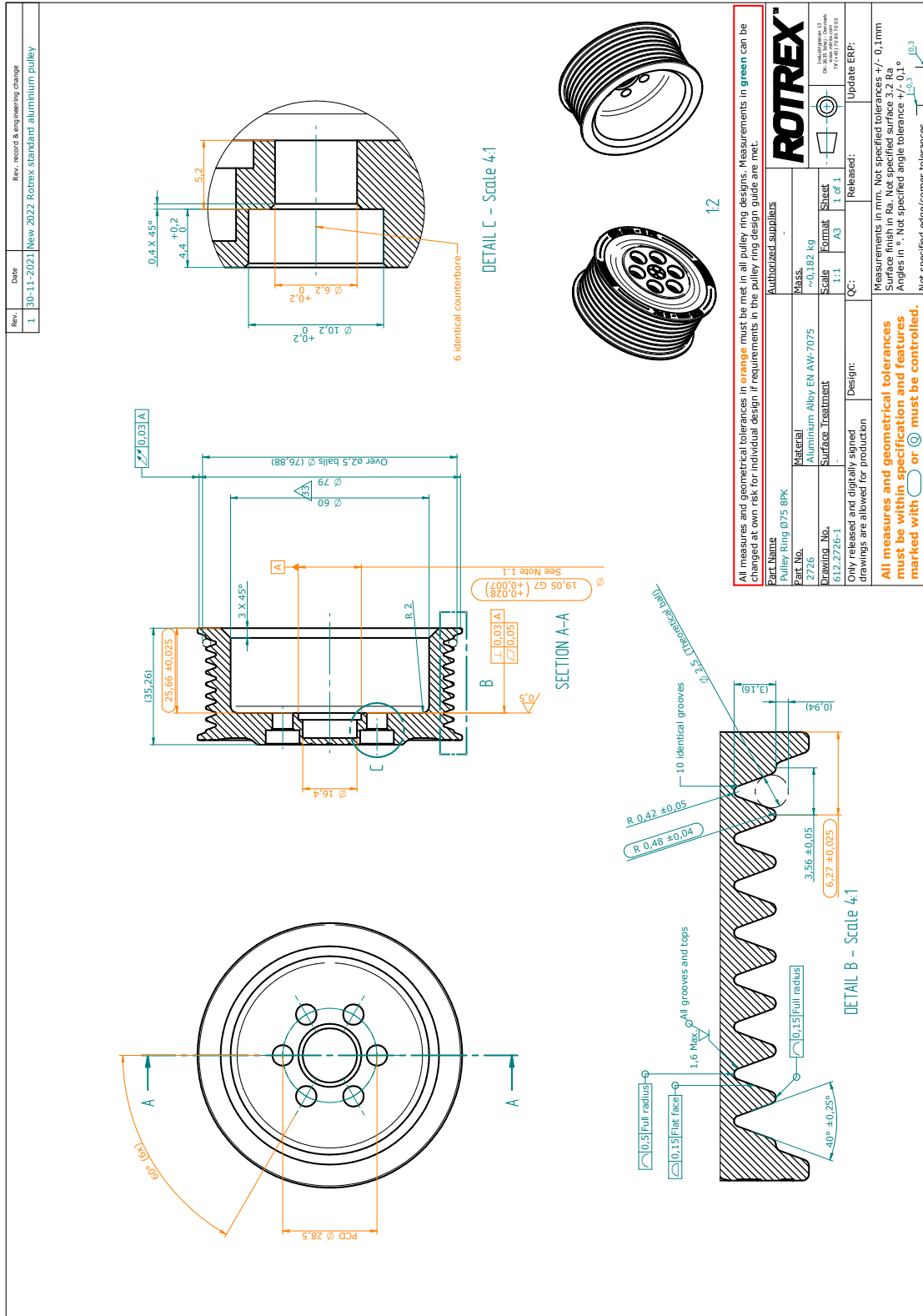
ROTREX™

Rotrex Industrietechnik
 64375 Frankfurt, Germany
 Tel. (+49) 70 40 70 00
 Telex (+49) 70 40 70 00

Measurements in mm
 Surface finish in Ra

Important notes and info sources

6.2 Pulley ring drawing for C15, C30 and C38



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Important notes and info sources

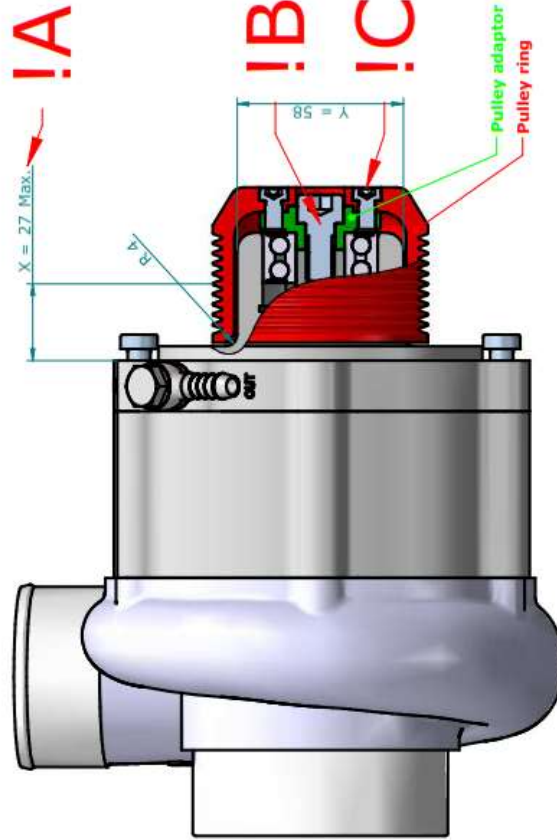
6.3 Pulley ring design guide for C8R

C38R Pulley ring design guide

Design requirements

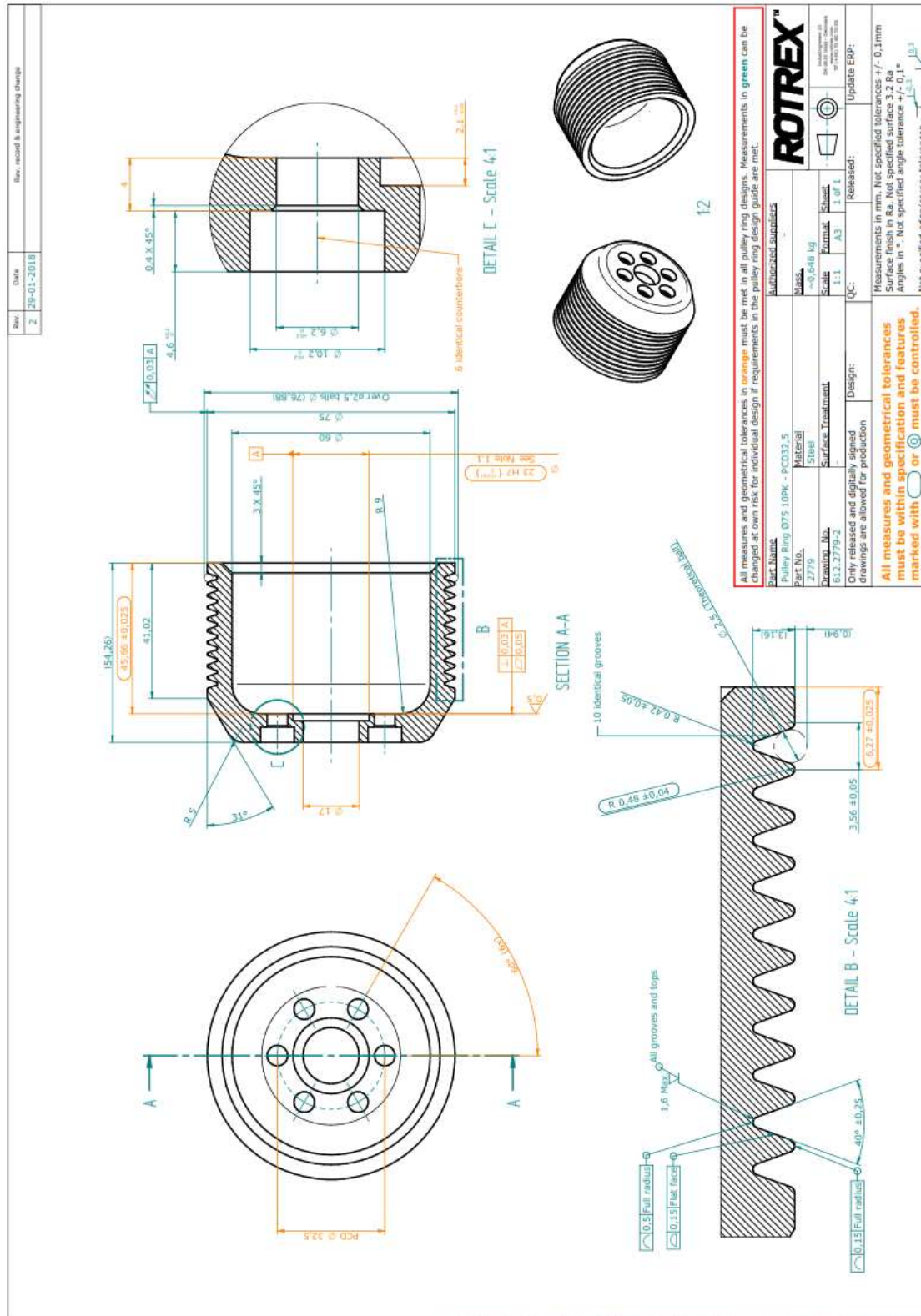
Not meeting these demands will void warranty and may cause significant damage to the S/C

- **!A** Center of belt must be placed as close as possible to S/C and the distance X should never be more than 27mm.
- **!B** Do not unmount or engage center bolt
- **!C** Only use pulley ring bolts as specified
- Pulley ring bolts 6 pcs: M6x10
Cylinder head torx ISO 14580 grade 8.8
- Pulley ring bolt tightening torque 10 Nm
- Nose diameter Y: ø58 mm
- Pulley ring should be made from quality steel
- Use surface treatment that does not significantly reduce friction coefficient
- Contact surfaces on pulley ring and pulley adaptor must be clean when mounting
- Secure pulley while mounting.
Do NOT use the center bolt (B)
- Always consult Rotrex before making your own pulley ring



Important notes and info sources

6.4 Pulley ring drawing for C38R



Important notes and info sources

6.5 Pulley changing and removal procedure

6.5.1 Aluminium pulleys

IMPORTANT!

Always use the original pulley bolts, supplied with your Rotrex supercharger
If the supercharger is removed to perform the procedure, make sure to prime the oil system after reinstallation (see page 10)
Do not remove the pulley adapter (hub with centre bolt behind the pulley ring) from the supercharger

To change the pulley, carefully follow the below procedure:


1. Disconnect the battery.
2. Crack loose the 6x M6 Torx30 bolts from the pulley ring – do not remove the bolts completely at this point.
3. Loosen the belt tensioner and remove the drive belt from the pulley.
4. Remove the 6x M6 Torx30 bolts and pulley from the Rotrex supercharger.
5. Install the new pulley on the pulley adapter using the original bolts supplied with the Rotrex supercharger, tightened by hand.
6. Install the pulley belt, make sure the dynamic tensioner is adjusted to the new size. Consult with your Rotrex dealer to make sure your belt is the correct length.
7. Without rotating the supercharger shaft, tighten the 6 bolts in a cross pattern to a torque of 10Nm. (7.5lbf).



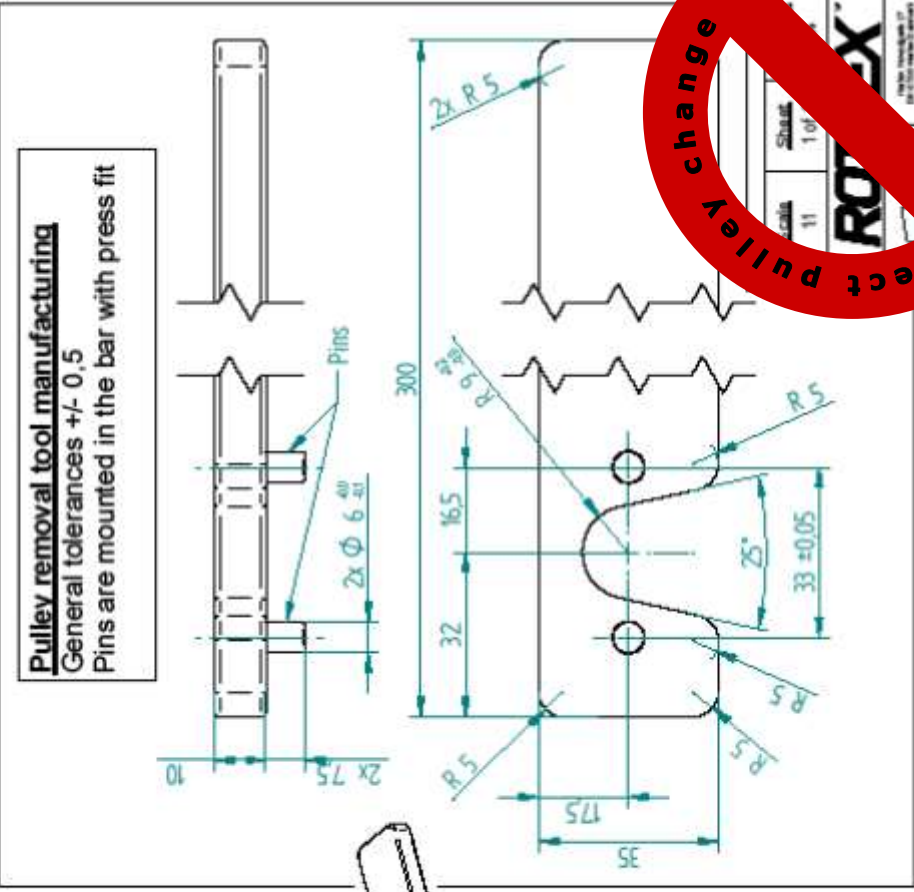
Important notes and info sources

6.5.2 Steel pulleys (Up to dec 2021)

Unmounting Steel pulley with counterbore screw



Pulley removal tool manufacturing
General tolerances +/- 0,5
Pins are mounted in the bar with press fit

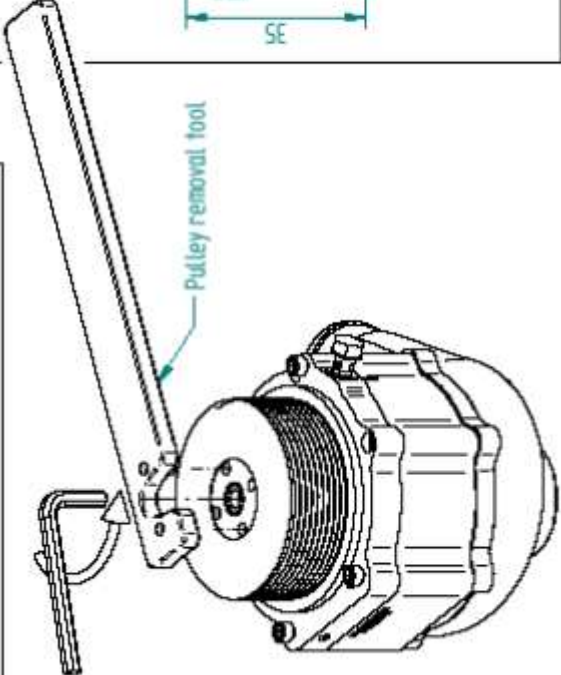



Disassembly process

1. Place S/C with pulley up
2. Remove sticker
3. Secure pulley with Pulley Removal Tool
4. Unscrew pulley bolt with 8mm hexagon key (DIN912 - M10x20 - Grade 12.9 - Dacromet)

Mounting process

5. Lubricate drive shaft thread before mounting.
6. Contact surfaces on pulley and S/C must be clean when mounting.
7. Secure pulley with Pulley Removal Tool
8. Pulley bolt tightening torque 70Nm



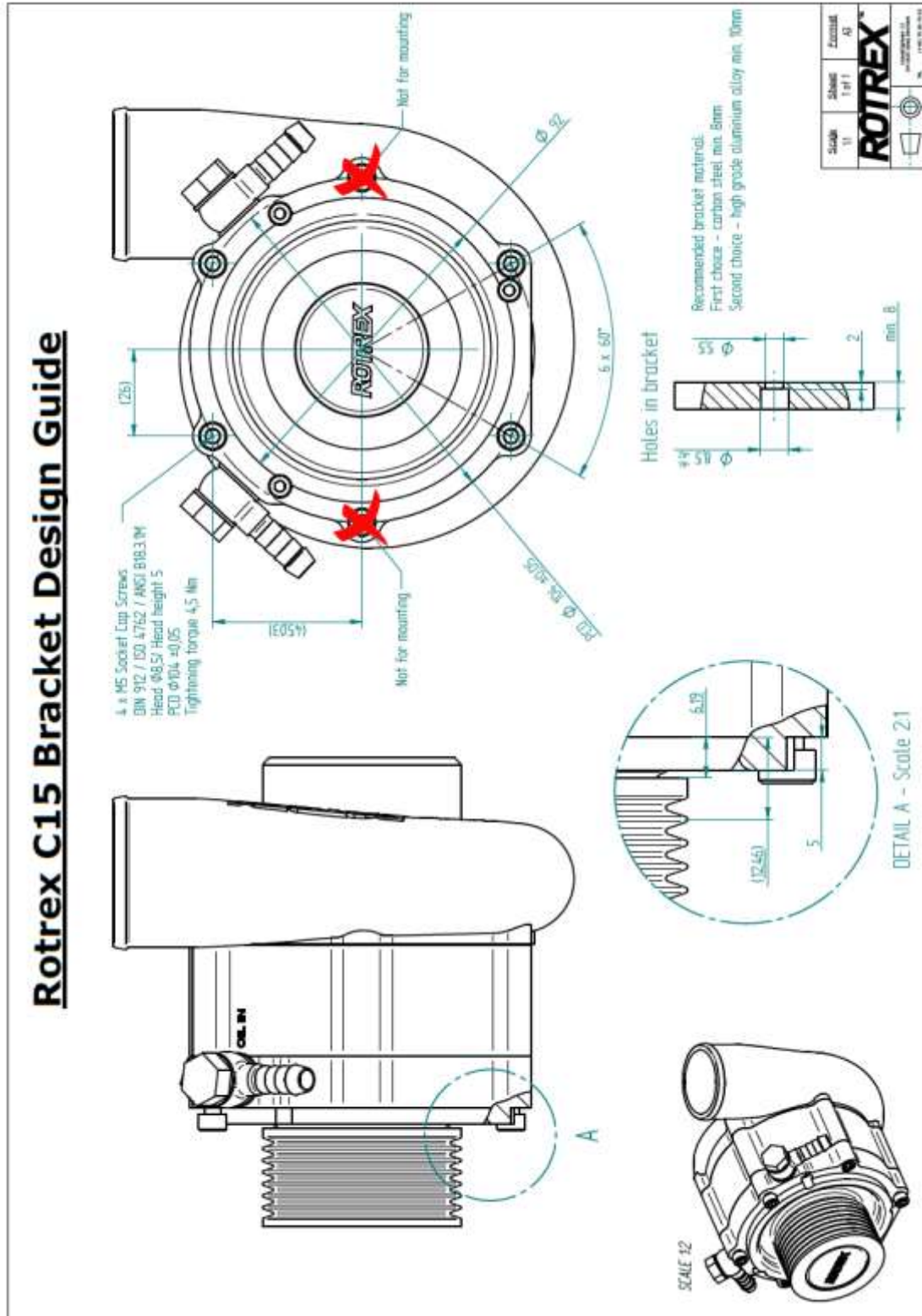


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Important notes and info sources

6.6 Bracket design guide

6.6.1 Bracket design guide for C15



Important notes and info sources

6.6.2 Bracket design guide for C30

Rotrex C30 Bracket Design Guide

4 x M6 Socket Cap Screws
 DIN912 / ISO 4762 / ANSI B18.3 M4
 Head ϕ 10 / Head height 6
 PCD 133 \pm 0.1
 Tightening torque 9 Nm

Not for mounting

Not for mounting

Not for mounting

Not for mounting

133.25

165.25

ϕ 18

6.3.60°

100 ϕ 101

Holes in bracket – Scale 11

Recommended bracket material
 First choice – carbon steel min. 8mm
 Second choice – high grade aluminum alloy min. 10mm

min. 8

min. 10

DETAIL A – Scale 11

SCALE 15

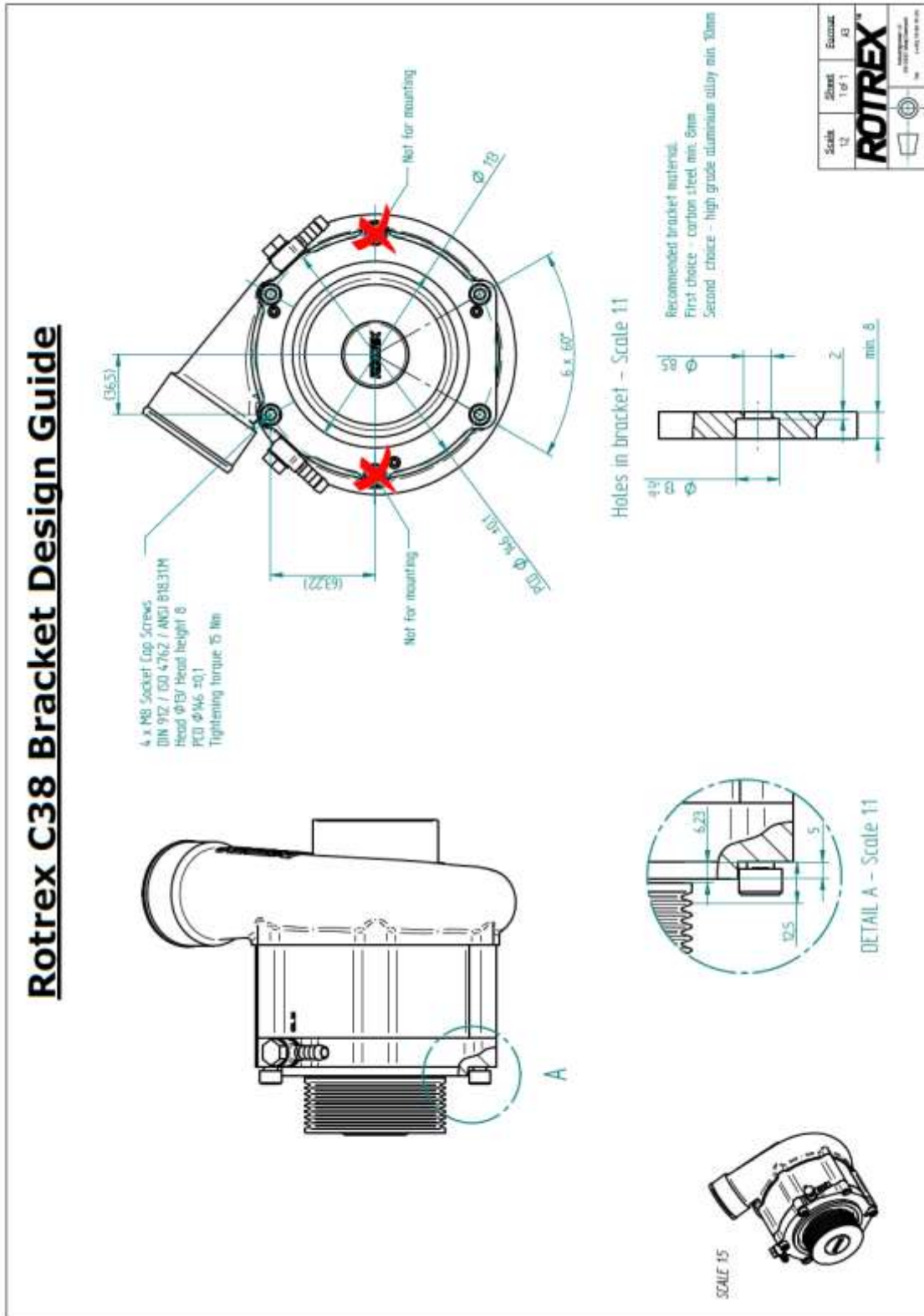
Scale	Sheet	Format
1:2	1 of 1	A3

RO TREX™

RO TREX
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 1000000000

Important notes and info sources

6.6.3 Bracket design guide for C38



Important notes and info sources

6.6.4 Bracket design guide for C38R

Rotrex C38R Bracket Design Guide

4 x M8 Socket Cap Screws:
 DIN 912 / ISO 4762 / ANSI B18.31M
 Head \varnothing 13 / Head height 8
 PCD \varnothing 14.6 \pm 0.1
 Tightening torque 15 Nm

Not for mounting

Not for mounting

PCD \varnothing 14.6 \pm 0.1

\varnothing 118

6 x 60°

(63.22)

(36.51)

Holes in bracket - Scale 1:1

Recommended bracket material:
 First choice - carbon steel min. 8mm
 Second choice - high grade aluminium alloy min. 10mm

Scale 1:2

Sheet 1 of 1

Envent A3

ROTREX™

Scale 1:15

DETAIL A - Scale 1:1