Increasing turbocharger efficiency on legacy medium speed diesel and gas engines

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Nina Aksenova, Sales & Business Development, Hedemora Turbo & Diesel
Ernst Dahlin, Senior Sales & Business Development, Hedemora Turbo & Diesel

In association with HEDEMORA TURBO & DIESEL

worldwide turbocharger guide

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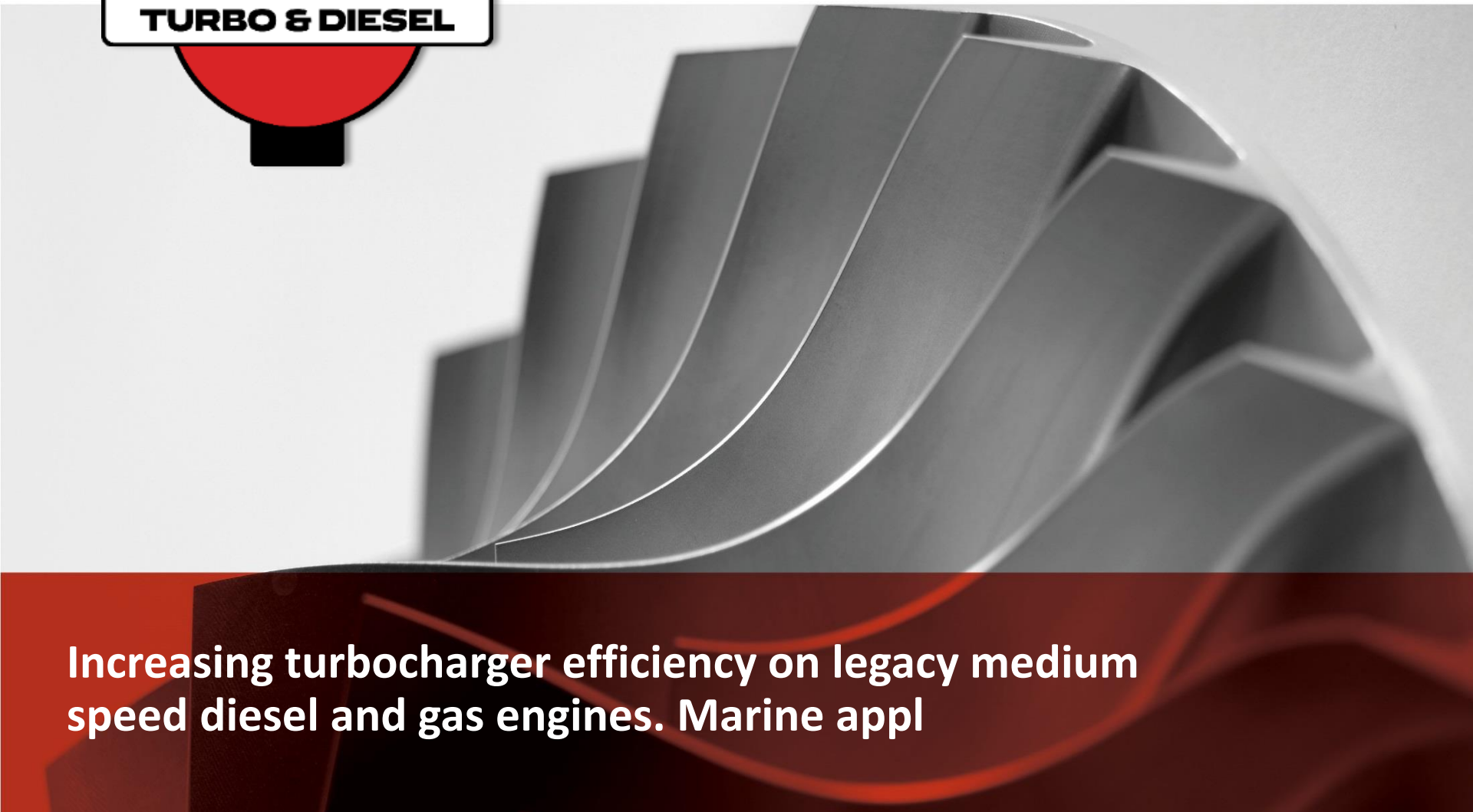


Increasing turbocharger efficiency on legacy medium speed diesel and gas engines. Marine appl

HS Series Turbochargers

Important Factors for the Engine Efficiency related to the turbo

SCAVENGE GRADIENT

Scavenge gradient is a parameter that is important for overall engine performance. It's a representation of the difference in pressure between the intake manifold and the exhaust manifold.

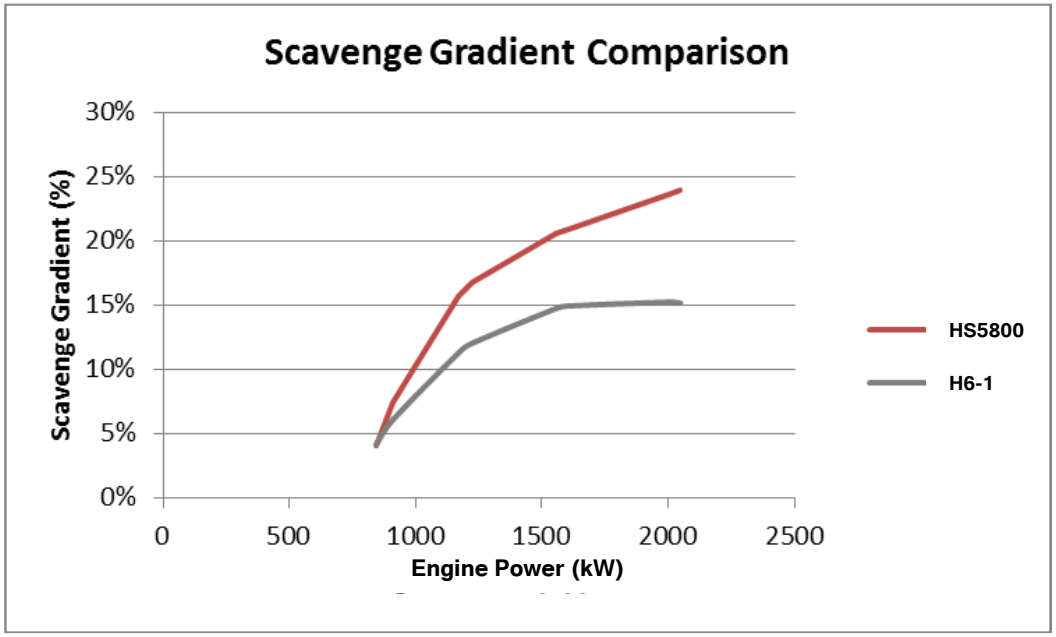
The gradient can be improved in two ways. First, by increasing the intake pressure, second, by decreasing the exhaust backpressure.

Both improvements can be achieved when the engine is upgraded to the modern turbocharger.

SCAVENGE GRADIENT COMPARISION

Here the engine is upgraded to the HS5800 turbocharger, resulting in significant improvement in scavenge gradient across the operating range as shown in Figure.

This is perhaps the best overall illustration of the beneficial impact that a more efficient turbocharger has on the in-cylinder dynamics of the engine.



M/V ”Pavel Kutakhov”

In 2016 turbochargers HS4800 and HS5800 were approved by Russian Maritime Register of Shipping

First project:

Trawler ”Pavel Kutakhov” is equipped with SKL Engine Model:
6 VDS 48/42 AL-2.

In line 6 cylinders 4-stroke engine, operated on heavy fuel.
Power @ Full load (100%): 2650 kW

Engine SKL6 VDS 48/42 AL-2. Replaced turbocharger KBB/Holset H6 - 1

Imprimé ETEB201

HEDEMORA TURBO & DIESEL	Turbocharger Application *Data sheet*	D A 18/A/53.01 Page : 1/2

MODEL **HS 5800** Code : **18**

ENGINE DATA

- Engine Builder : **SKL** Model : **6 VDS 48/42 AL-2**

- Engine Bore :	480	- Engine Stroke :	420
- Number of cylinders :	6	In line ☐ / V formation X	
- Number of TC per engine :	1	2 Stroke ☐ / 4 Stroke X	
- Power @ Full load (100%):	2650 kW	- Engine speed :	500 rpm

Fuel type : - Diesel ☐ - Heavy fuel X - Gaz ☐

Detailed Data

Engine load		75	100	110
Output power	kW	1986	2650	2913
Engine speed	RPM	500	500	500
Boost pressure	bar	1.05	1.50	1.60
Temp. after charged air cooler	°C	48	48	48
Air flow	Kg/s	-	-	-
Exhaust gas temperature *Before turbine*	°C	480	510	520

Date : 2016-10-21 — Documents associés - *Enclosure*

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Lubrication

- Engine lubrication system

Oil pressure : mini/maxi	3.6 – 4.2 bar
Oil temperature : maxi	80 °C
Viscosity :	
Filtration size :	

Operation / Use

- *Propulsion* X
- *Gen set*
- *Railways*
- *Other*

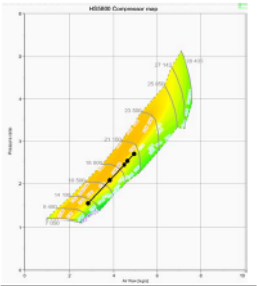
- *Geographic altitude of use :* 0 m.a.s.l.
- *Ambiant temperature :* 0/ + 30 °C

Initial Matching Results

- TC specification : *HS5800A1L91MS179*

- Simulations results :

Load	%	50	75	95	100	110
ENG Wp	kW	1324	1986	2518	2650	2913
COMP Prboost	-	1.54	2.07	2.44	2.52	2.69
COMP m_corrected	Kg/s	2.84	3.83	4.49	4.64	4.95
COMP N_corrected	-	13132	17276	19435	19892	20738
ENG T04	°c	378	421	453	461	475



HS5800 compressor map with engine load 50 – 100 % load plotted

Comments :

- Matching made to meet original boost pressure of 1.5 bar at 100% load.
Turbocharger speed is 20 000 rpm at 100% load with a good margine to maximum speed of 27 000 rpm.

- Fuel has been changed to HFO and exhaust temperature seems to be 30 - 50 °C after fuel change. Matching of turbine size is made to match lower exhaust temperture.

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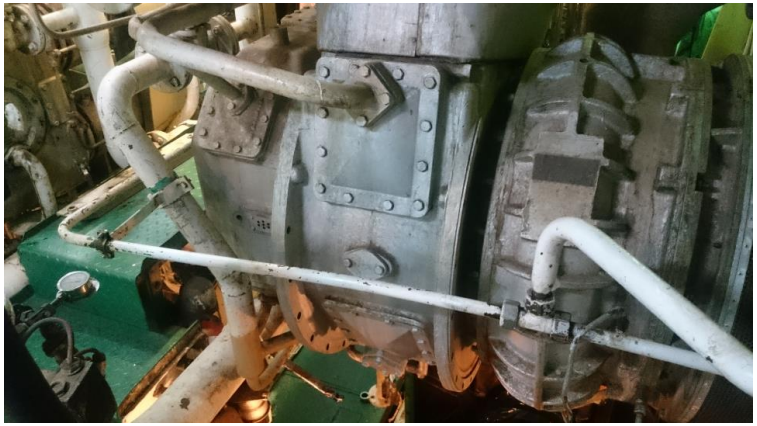
Engine SKL6 VDS 48/42 AL-2. Replaced turbocharger KBB/Holset H6 - 1



Engine Data Comparision HS5800/KBB H6-1

Load		100%		95%	
		HS5800	KBB H6-1	HS5800	KBB H6-1
Engine Power	kW	2650	2650	2518	2518
Boost Pressure	Bar	1,45	1,5	1,4	1,25
Exhaust Gas Temp (cylinder average)	°C	403	413	398	409
Fuel Consumption	Kg/h	489	543	437	521
Fuel Efficiency	g/kWh	185	205	174	207

What are the Advantages for a Customer?

- ✓ Reduced Emissions
- ✓ Improved Fuel Economy
- ✓ Cooler Engine Temperature
- ✓ Elimination of Cooling Water

<u>On top of that:</u>

- ✓ Easy Maintenance
- ✓ Fast Deliveries from stock
- ✓ Spare parts availability

Other installations:
M/V ”Soley”, M/V ”Vasiliy Kalenov”, M/V ” Simonas Daukantas”

Fishing trawlers of the type "Monozund" (Atlantic 488 project) are a series of fishing trawlers built between 1986 and 1993 at the Volkswerft VEB shipyard in Stralsund, East Germany.

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HS 5800 vs. ALCO 165 TURBOCHARGER TEST

Test conducted on M/V Carl Cannon, an inland river towboat owned and operated by American Commercial Barge Lines.

Engine tested: ALCO 16 cylinder 251F rated @ 3000 HP @ 1000rpm.
Turbocharger: ALCO 165 P/N 22602147 with a 19.8 sq. in. nozzle ring installed.
Engine overhauled by: National Maintenance and Repair, Alton Ill.

The engine operated for a 10-hour break-in and test period prior to the start of the turbocharger testing.

The engine testing began on Feb.20 2002 with the ALCO 165 installed. M/V Carl Cannon operated at push dock located at NM&R facility. Engine operated at speeds of 500,600,700,800,900,and 1000rpm's for both turbochargers. The data is presented in the enclosed graphs.

[redacted]

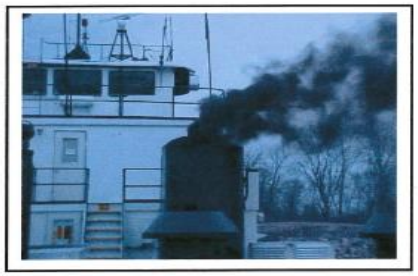
Additional testing was conducted on the engine ship-up and smoke levels. The governor fuel limiter was set at 20mm for both turbochargers.

ALCO 165 ship-up and smoke

Smoke- Heavy black 4 to 26 seconds.
Ship-up time 34 seconds

HS 5800 ship-up and smoke

Smoke-Light Haze 4 to 9 seconds
Ship-up time 20 seconds

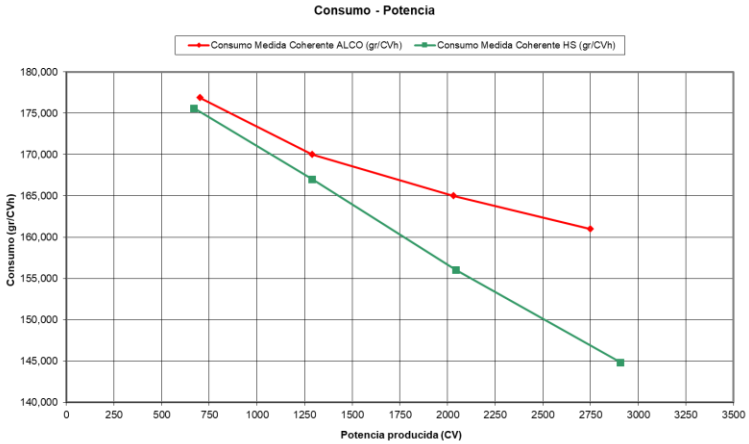


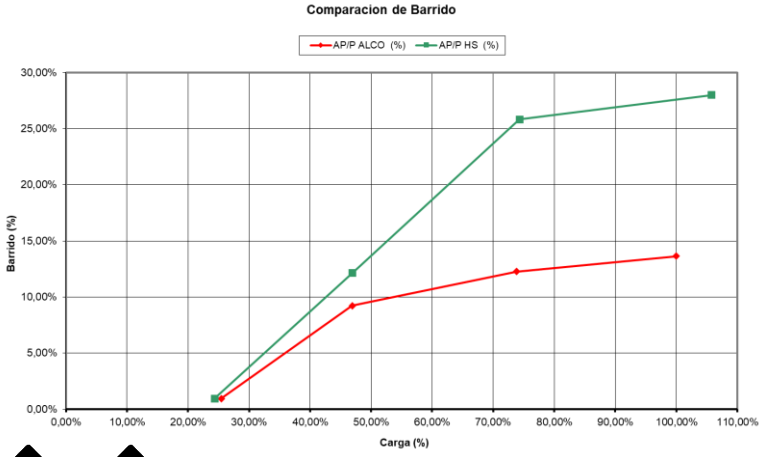
15 seconds into ship-up. ALCO.

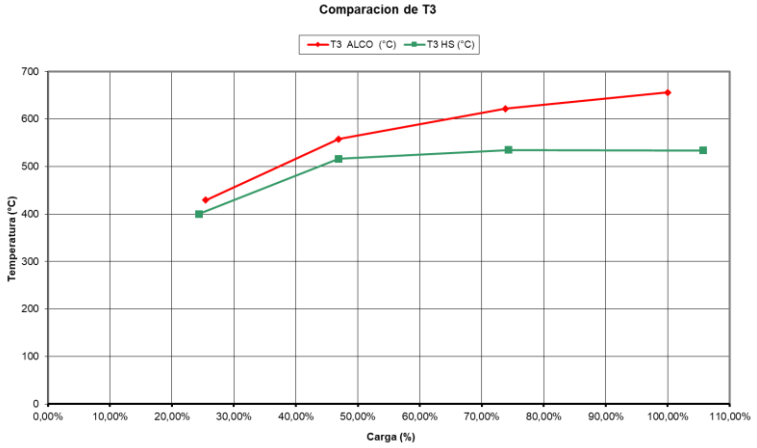
15 seconds into ship-up. HS5800.

HS 5800 Turbochargers Retrofit Marine Applications

Newport-class tank landing ship Hernan Cortez equipped with ALCO 16 251C engines.
Retrofit in 2002-2003, replacing ALCO 720 turbochargers. Spanish Navy







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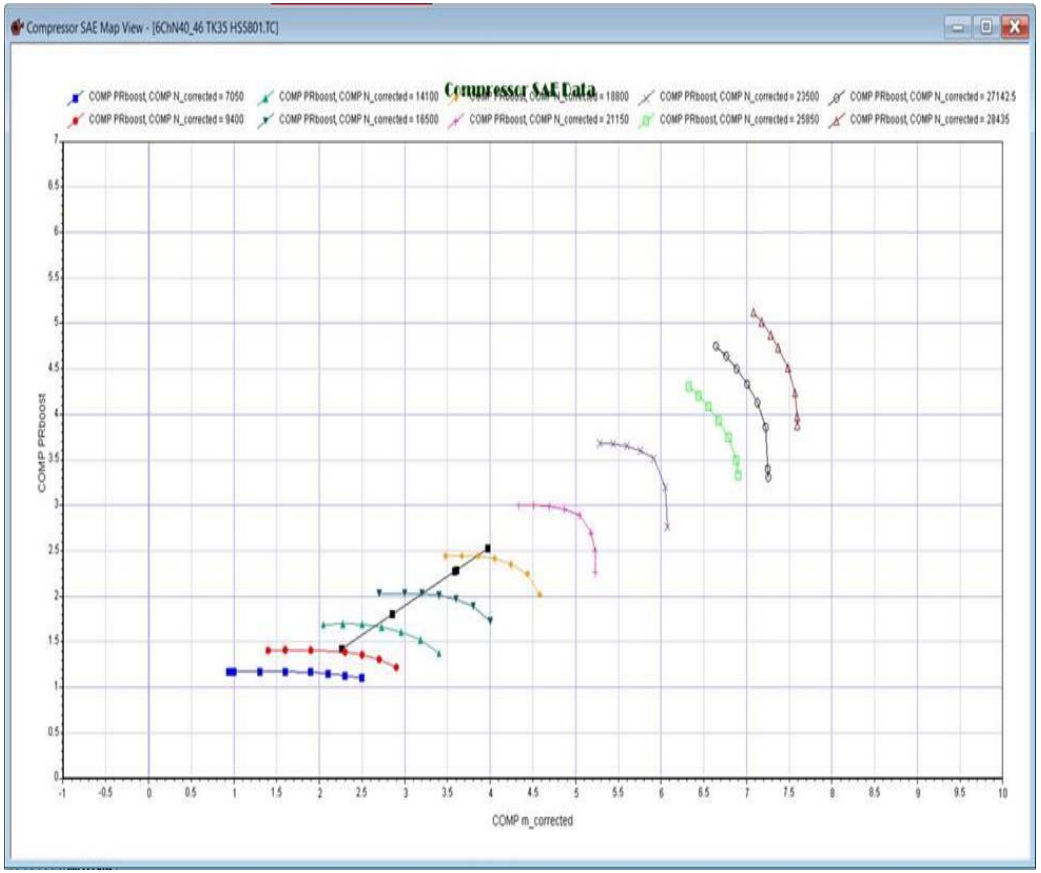
Hedemora Turbochargers

Turbo Matching with Engine Russkij Diesel (Pielstick) ChN40/46

Next target:

Engine specification

Output kW	2600
Speed rpm	520
Exhaust gas temperature before turbo °C	510
Required boost pressure bar	1.4



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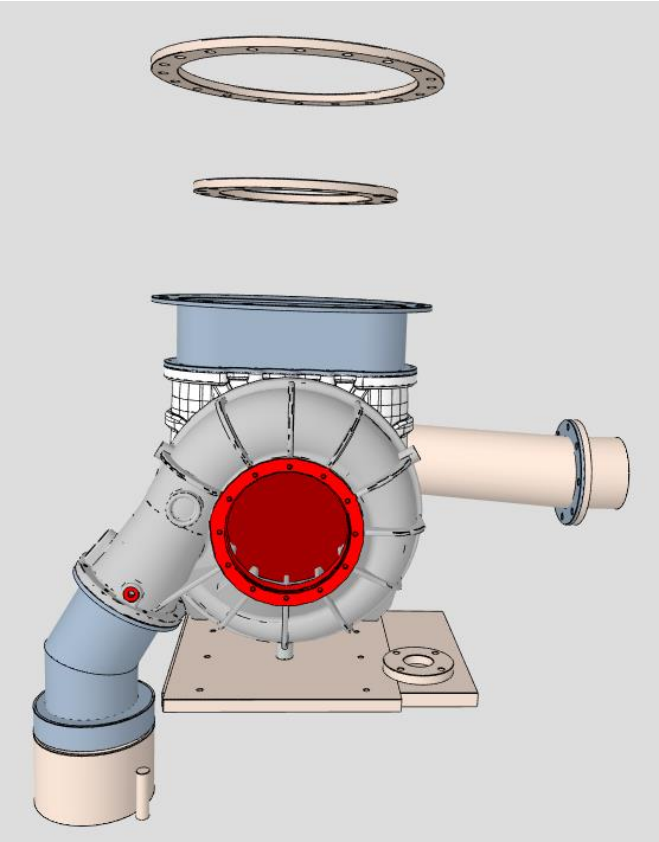
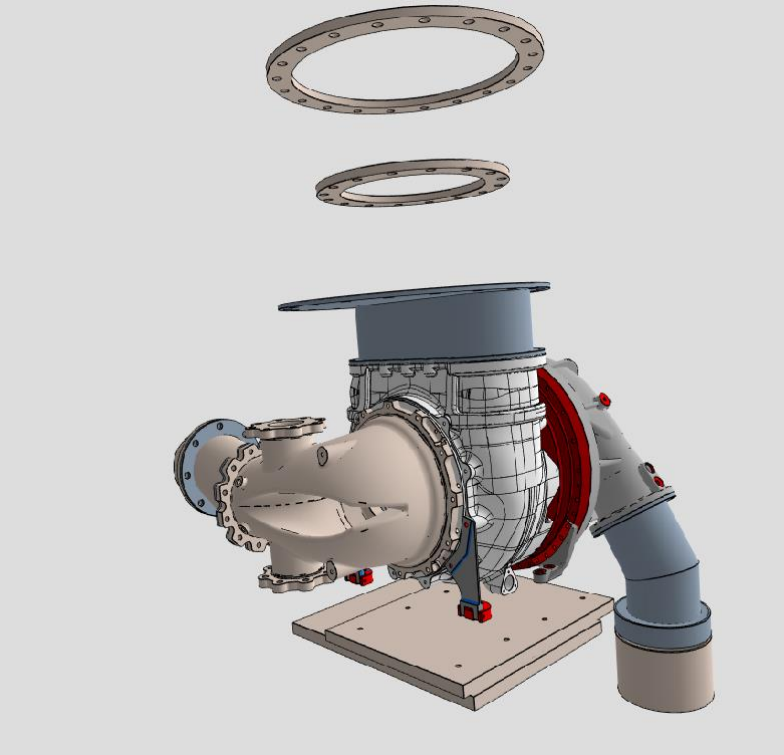
Hedemora Turbochargers

Retrofit PIELSTICK ChN40/46

Original turbochargers TK35 with single gas inlet casing replaces with HS5800





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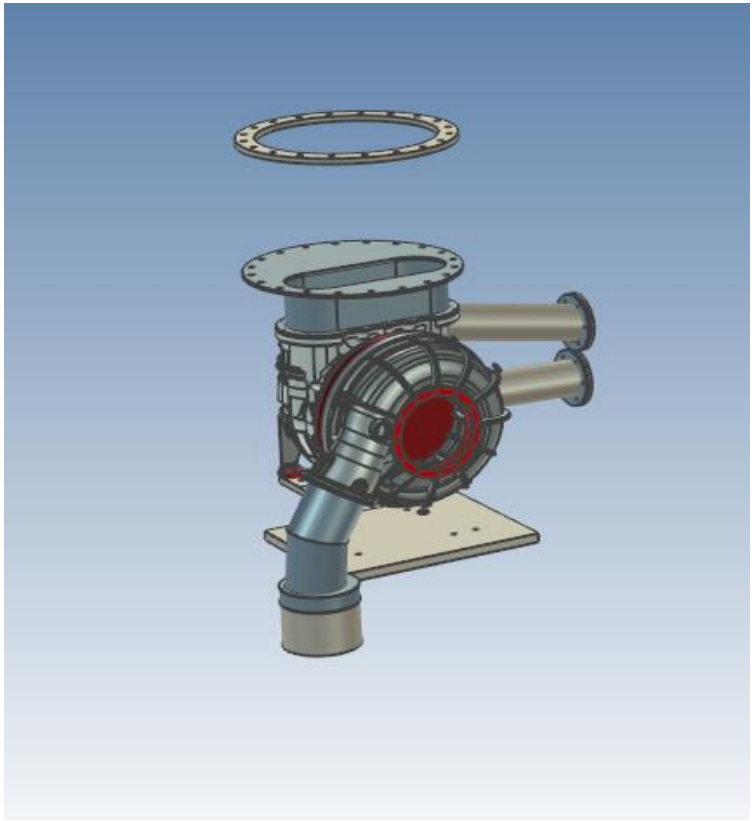
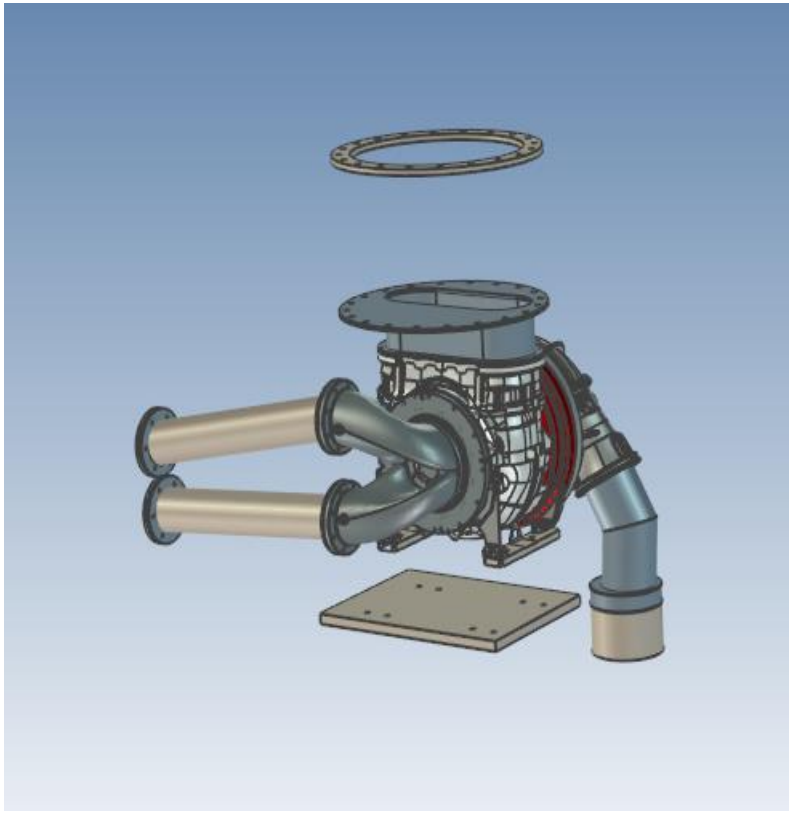
Hedemora Turbochargers

Retrofit PIELSTICK ChN40/46

Original turbochargers TK41 with double gas inlet casing replaces with HS5800





HEDEMORA TURBO & DIESEL

All parts are available from stock in Hedemora / Sweden warehouse.

Service parts can be shipped within 48 hours from order.

Service is made with standard tools on site, only need for few special tools.

HS5800 Service intervals:

(Recommendations at normal conditions)

Inspection	**12 000**	**hours**
Bearings	**24 000**	**hours**
Rotating assembly	**48 000**	**hours**

Hedemora Turbo & Diesel AB Contacts

Hedemora Turbo & Diesel

Sturegatan 2
Hedemora, 776 35

P: +46 225 59 58 00

E: info@hedemoratd.com

www.hedemoratd.com

HEDEMORA
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Turbochargers

A SUSTAINABLE TURBO SOLUTION

We offer a complete solution for your application, including development engineering, manufacturing, service overhaul and testing of turbochargers.

Hedemora Turbo & Diesel is part of Australian leading industrial and financial group Engenco Corp., based in Sweden, was founded in 1903. With over 70 years of engine manufacturing experience, the company has gained the priceless knowledge,specialized in engine performance and related processes.

In 2009 Hedemora Turbo & Diesel acquired Turbo design and production business from French company Turbomeca and launched the production of HS Turbochargers in Hedemora, Sweden. Our Turbo solutions include design, complete installation, customer support and full range of services.

4000 engines charged

designed for 740 to 4200 kW engine power

24 000 h operation life cycle

30 high-qualified specialists

deliveries to 20 countries all over the world

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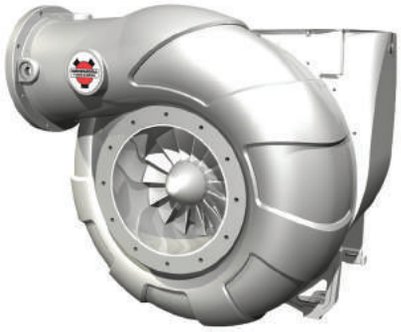
Hedemora Turbochargers

HS4800

1000 - 2500 kW | Max pressure ratio – 4.5

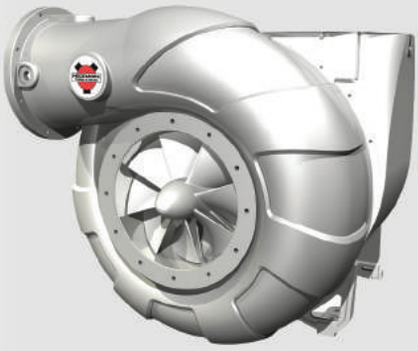
Mass Air Flow – 4.8 kg/sec | Air & Oil cooled | 320 kg



HS5800

1500 - 3700 kW | Max pressure ratio – 4.5

Mass Air Flow – 5.8 kg/sec | Air & Oil cooled | 420 kg



HS6800

1700 - 4000 kW | Max pressure ratio – 4.5

Mass Air Flow – 7 kg/sec | Air & Oil cooled | 450 kg

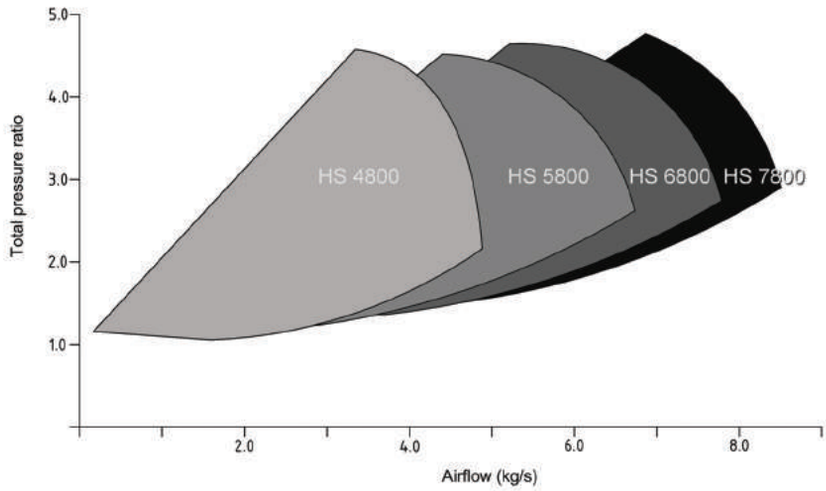
HS7800

2000 - 4200 kW | Max pressure ratio – 4.5

Mass Air Flow – 8 kg/sec | Air & Oil cooled | 450 kg

Smaller models are also available:

- **HS430** 740-1700 kW
- **HS550** 1700-2700 kW



Hedemora Turbochargers are designed for different applications: Railways, Maritime, Power&Energy

DESIGN ADVANTAGES	BENEFITS
Efficiency up to 74%	Lower fuel consumption
Compact	Lower weight and smaller outside dimensions for easier placement
Long life time	Low maintenance costs
Low mass	Fast throttle response
Individually balanced rotor components	Maintainability
Air-cooled	Improved efficiency
Environmental frienldy	Reduces engine emissions and smoke

More values You get from Hedemora Turbo & Diesel:

- Fast delivery
- Individual approach › equipment for special requirements
- Personal training provided › simple maintenance on-site
- After-sales services
- Turbocharger lifetime Customer support

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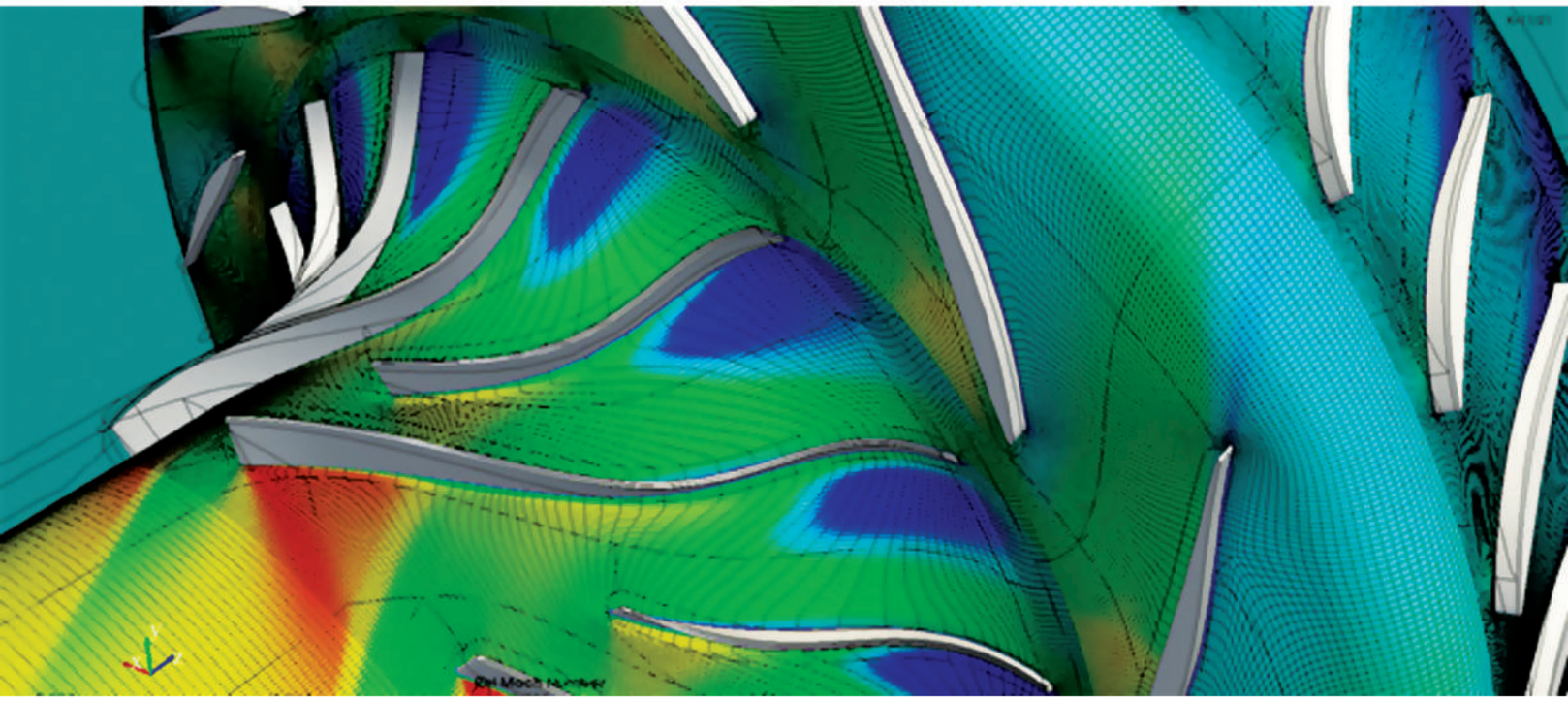
Development & Engineering

Hedemora Turbo & Diesel specializes in manufacturing, maintenance, repair and overhaul of Hedemora Turbochargers. Company's engineers ensure the correct matching of the Hedemora Turbocharger to your engine will achieve maximum efficiency over a large operating range and fuel savings. Our turbochargers provide maximum engine performance even in extreme operating conditions.



Production

Production of Hedemora Turbochargers is held in Sweden. Outsourced parts are manufactured by trusted partners according to the special requirements and unique design of Hedemora T&D.

Assembled turbochargers are tested in-house test facility.

Testing process:

- Validation and commercial test performing
- Testing according to the standard and the agreed requirements
- Measuring results of equipment
- Test reports

Customer satisfaction is a core value of our business. Our focus is on quality ensuring that all products meet the required specifications and standards.

Our company quality and environmental management systems are certified according to international standards ISO 9001 and ISO 14001.

HEDEMORA Turbochargers have passed technical audits for different implementations.

Refurbershment with Hedemora turbocharges is a great opportunity to increase the efficiency, improve overall working parameters and extend life to existing engines.

Hedemora T&D engineers adapt turbochargers to suit your needs. From concept through to installation. Lifetime services support guarantee that our customers get the best product for their application.

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Hedemora Turbo & Diesel AB
Sturegatan 2, 776 35 Hedemora, Sweden
Tel. +46 225 595 800
info@hedemoratd.com

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