Machined-From-Solid (MFS) Impellers Wheels

Why MFS?

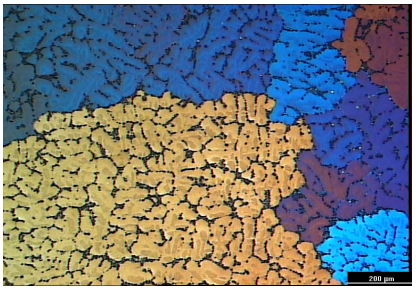
In order to satisfy current and future emissions legislation, modern engines require higher boost pressures. These higher boost pressures have led to an increase in the rotor speeds within the turbocharger, resulting in high cyclical loads, where the traditional die cast compressor wheels are reaching their limits of durability.

This is a particular issue on applications that are subject to a high duty cycle, where engine rpm and turbocharger rotor speeds are changing frequently in a relatively short period of time. Examples are:

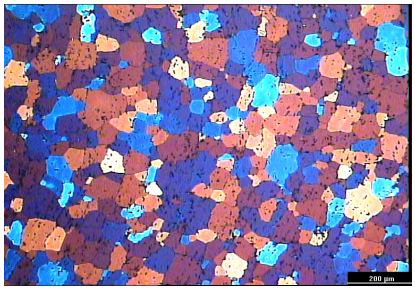
- city buses
- local delivery trucks
- excavators
- garbage trucks
- front-end loaders

Impeller durability is a key factor for all high horsepower applications. Cast aluminium impellers cannot achieve the same durability as Machined from Solid (MFS) forged aluminium turbocharger impellers. MFS impellers have the following beneficial characteristics:

- **Five-axis CNC operation**; allows for intricate aerodynamic impeller blade profile and optimal aerodynamic and mechanical performance
- **Mechanically processed forged alloys**; this breaks down oxide defects (mainly silicon) that might be present and refines the grain structure to improve material fatigue properties
- **Low silicon aluminium option with higher contents of alloying elements**; this further strengthens the material in a forged aluminium component, thus improving its fatigue properties (note the significant difference in grain size of cast and forged alloys)

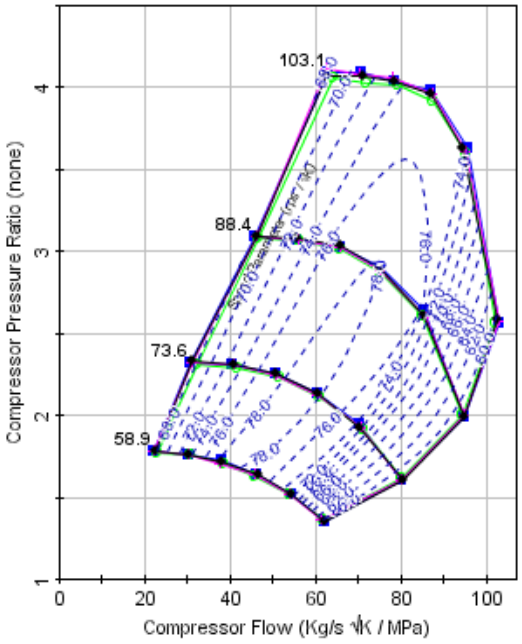


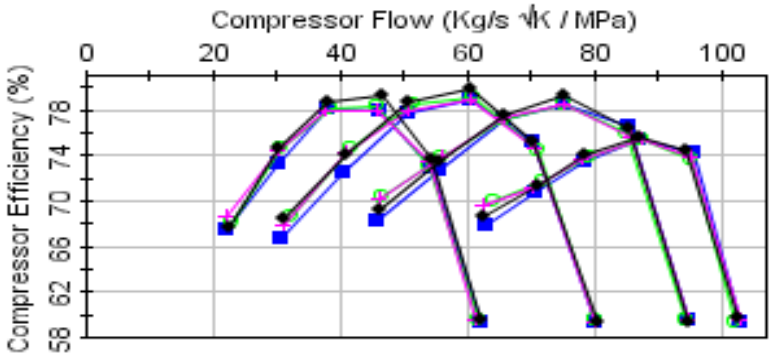
Cast microstructure



Forged microstructure

- **Measurably superior base material properties in solid forged aluminium**; this is superior to, and more dependable than cast aluminium alloys bringing an inherent life improvement
- **Impellers for some applications are 'shot peened'**; this further improves the durability of the product by primarily increasing fatigue life and prevents stress, corrosion and cracking of metal parts.
  - The method of shot peening involves bombarding the surface of the finished part with either a round steel, glass, ceramic or aluminium bead shot. Every piece of shot acts as a minute peening hammer. When the surface has been peened by the abundance of impacts, the resulting compressed surface layer is highly resistant to the formation of stress cracks
- **No loss in performance compared to cast aluminium**; test results show a transparency in the performance of the wheels (cast/MFS) within 0,5 % efficiency. See maps below.





Proven Technology

Cummins Turbo Technologies has applied MFS compressor wheels to Holset Turbochargers for a number of years. MFS has been a popular choice for many OEM customers including:

- Scania
- Volvo Truck and Bus
- Cummins
- Fiat Power Train
- Daimler

Turbo Technologies

Technical Bulletin

April 2009

All turbochargers have been tested and approved by Cummins Turbo Technologies. We have conducted field tests worldwide. These tests were carried out in high duty cycle and high altitude environments in Australia and South Africa. Tests were also carried out retrofits for bus fleets in Columbia and Chile.

Cummins Turbo Technologies approve the MFS wheels through the use of a 75 % speed cycle. This means that if the maximum design speed is 100,000 rpm, the test cycle would be between 25,000 and 100,000 rpm using a 6 seconds time cycle. Since 1990 Cummins Turbo Technologies has tested over 382 MFS wheels within 15 design variants of wheels from Holset HX30 to HX60.

MAN D20 and D28 Holset HX50 Turbochargers

Recently MAN approved the Holset HX50 range of turbochargers, as fitted to the MAN D20 and D28 engine range, which have been modified to MFS impeller wheels.

MAN Cast Version	Competitor Cast Version	Holset Cast Version	MAN MFS Version	Competitor MFS version	Holset MFS Service Turbo
51.09100-7460	5331-988-7117	3593896	51.09100-7785	5331-988-7141	2836326
51.09100-7463	5331-988-6710	3593894	51.09100-7784	5331-988-6727	2836325
51.09100-7481	5331-988-7117	3593896	51.09100-7786	5331-988-7141	2836326
51.09100-7484	5331-988-6710	3593894	51.09100-7783	5331-988-6727	2836325
51.09100-7487	5331-988-7201	3597285	51.09100-7766	5331-988-7206	2836327
51.09100-7516	5331-988-7201	3597285	51.09100-7768	5331-988-7206	2836327
51.09100-7541	5331-988-7201	3597285	51.09100-7768	5331-988-7206	2836327
51.09100-7572	5331-988-7501	4032186	51.09100-7767	5331-988-7508	2836329
51.09100-7599	5331-988-7503	2834106	51.09100-7769	5331-988-7507	2836324
51.09100-7606	5331-988-6902	4032106	51.09100-7765	5331-988-6910	2836328
51.09100-7607	5331-988-6902	4032106	51.09100-7764	5331-988-6910	2836328