

HEAVY TEC PEOPLE

The CAT 3500professional and C-Seriesprofessional

423754

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01 Cooperation KLC and PowerTrainTechnologies

01 KLC and PowerTrainTechnologies Cooperation





Worldwide Sales organization

Research and Development

Service contracts with large mining operators in South America

Company Presentation PowerTrain



02 Company Presentation PowerTrain





<u>Overview</u>

•	Company	: Power Train Technologies S.A. (Power Train)	
•	Establishinent	. 1986 (Marubelli participation, Dec 2016)	
•	Employees	: 280 (as of April 2022), sales approx. Mio\$ 150	
•	Business	: Engine Component repair & Maintenance service for mining equipment	
•	Location	: Santiago, Antofagasta, Minera Escondida, Minera Centinela	
•	Overseas	: Argentina, Peru, Colombia, USA	
•	Main customers	: Escondida (BHP), Spence (BHP), Centinela (AMSA), Mantos Copper (PE Fund)	5

Antofagasta / Component





<u>Santiago / Engine</u>





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Experience and Targets







We offer "new-man" CAT series C and 3500 injectors which incorporate advanced technology in the main components of the injector; our product name: *Cprofessional* and CAT 3500*professional*

We have researched and identified all the parts, which due to the temperature, stresses or fatigue they are subjected to during their life cycle, cannot be reused. These parts are always replaced with new products of the highest technology and quality, in terms of material, processes and enhanced design.

Main technologies:

• **Springs:** Working with one of the world market leaders from Germany the design of all springs has been subjected to a rigorous R&D process.

Result: the main spring was modified to a progressive design to improve its resistance to fatigue

• **Control Valve:** The set of parts in the high pressure zones has been redesigned, resulting in the incorporation of better materials and treatments.

Result: fastest response times and avoidance of cavitation

• **Solenoid:** new high quality to improve durability and ensure fastest possible signal processing times. Result: fastest response times

• **Nozzles:** Carefully selected, upgraded materials to improve erosion resistance as well as new design (radius rather than angle) to improve flows of the fuel in the **system**.

Result: best control and fuel savings, increased operating lifetime

Upgrades





Springs

Completely professional new design









Result: resistance to fatigue and better performance.

Upgrades





1) Main injector spring differences CAT 3500 OE vs PTTprofessional

The following graph shows the main difference **between OE and PTT** injector.

The **improved** spring designed by PTT reduces the stress produced by the operating conditions, avoiding premature fractures and failures.

Currently the 3500 OE injectors have premature failures that occur between 4500 to 9000 hours of operation, see real image of an OEM injector.





Result: Our design allows for in excess of 15,000 hours of operation without premature failures.

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Upgrades





Main injector spring differences 3500 OE vs

PTTprofessional

A numerical simulation was performed to assess the level of stress across the different operating speeds and different working loads.

The stress overview graph shows that the progressive spring does not experience these very high peaks. The progressive design damps the peaks.

In red boxes, stress levels are observed in critical operation speeds (between 700 and 900 rpm).

It is easy to identify that the progressive spring damps the peaks, which implies an improved dynamic performance throughout its useful life.



Upgrades





4) Nozzles Complete *professional* new design



New design of nozzle holes, new material

A: standard shape of a nozzle hole

B: first CR nozzle hole shape (conical, hydroerosive drilling)

C: present shape of CR-holes (rounded corners)

Result: significantly improved control, fuel savings and increased operating lifetime (less corrosion/cavitation)

Upgrades





4) Nozzles Complete *professional* new design

Analysis spray angle effect







Result: Improved *professional* design of spray angles reduces cavitation and increases fuel efficiency and operating lifetime of the engine!

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Upgrades





5) Trim-code



Definition and facts

Due to slight variations in tolerances, friction between parts and magnetic forces, different injectors have different rates of output as well as other impacts on the engine and performance. By using trim codes to adjust the injection duration for each individual injector, the net output of the injectors for each cycle is the same in an engine.

Many different factors play a part in consistency, and the power generated by each individual cylinder is perhaps the most important factor that needs to remain constant. If each cylinder is producing the exact same amount of power, they will produce the optimum power output.

Not installing trim codes or high variations in parameters could result in a rough idle, poor fuel economy, overfueling, under-fueling, increased emissions and poor engine performance. In extreme scenarios, not installing trim codes or installing incorrect trim codes could lead to engine damage.

In order to find the most accurate Trim-code for each injector, more test-cycles mean higher precision! Genuine parts run such test-cycles for approx. 2 minutes; the PTT injectors run test-cycles for approx. 20 minutes, for each injector! This results in the more precise Trim-code needed for the best injection.



Upgrades

Trim-code









Result: better engine performance, increased durability, fuel saving and reduced emissions

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Upgrades



Summary of advantages of CAT 3500professional

Trim code tolerances: electrical signal processing time from ECU to the injector-system is greatly improved (\rightarrow response time, actuation of system)

Mechanical parts of injector: Incorporating high precision parts with unique improved design, tolerances and materials pressurization and decompression is much faster than in genuine design (\rightarrow control (on/off) of injection of Diesel in the fastest possible way)

Engine: due to fastest on/off time, narrow trim codes, spray pattern of nozzles as well as selection of improved materials the combustion of all cylinders is equally balanced (\rightarrow better response times, improved combustion, lower CO₂ emission, fuel savings, longer service intervals, less downtime, less service cost)

Savings – Cost saving calculation

Sample

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Calculation	of savings							
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Fuel consumption:		average consumption of engine I/h:					400	0 professional PARTNERSHIP
		operating hrs	per year				4500	<mark>o</mark> la de la constancia de la c
		savings:					5%	6 5% min; up to 8% plus engine performance
		cost per ltr:				€	1,60	
		savings per ye	ar per eng	ine:		€	144 000,00	
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Lifeume:		CAT documents state 4.500hrs				-		standard lifetime in tough applications with DTT engin
		PTTInjectors	ectors rated at 12.000nrs					
		Cost of	f 1 set of CAT injustors				2,000000007	
		COSUO	16	f inge	2 200 00	f	35 200 00	
			10	* fa	ictor - 1	€	58 666,67	
Service tim	e and cost:	service work	days	_	€/day	-		
			4	€	1 000,00	€	4 000,00	minimum, dep. on damages
Out of ope	ration cost:	factor * servic	e days	cos	t per day			
		6,666666667		€	5 000,00	€	33 333,33	
		(Lifetime ext * Service time)						
Total saving	gs per year p	er engine				€	240 000,00	
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Calculation sheet will be provided on request for individual cost-savings calculations.

03 Fertigung in D und Südamerika





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Related Products and Services





- 1) CAT 3500-Series*professional* Injectors, Cylinderheads, Liners etc.
- 2) C 27 and C32professional Camshafts
- 3) Machining and Services

Thank you! Your professional Team.

