

ZF-AS Tronic mid for Terminal Tractors Fuel and Costs Savings at the Terminal

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High Demands on Terminal Tractors





LoLo Terminal Tractors

- Up to 24 hours/7 days operation time
- Constant stop/start work
- Different, unskilled drivers (shift worker)
- Higher demands on emission/fuel reduction
- Constant increase of container handling



ZF Transmission system with reduced fuel consumption, longer oil change and service intervals

We have your solution! - ZF-AS Tronic mid





ZF offers you:

- Innovative, automatic transmission system without transmission cooling
- Reduced life cycle cost thanks to up to 4 years oil change interval
- Emission reduction
- Significant reduced fuel consumption up to 20%

ZF-AS Tronic mid – Technical Data



12-speed					
	12 AS 1210	12 AS 1620			
	10.37 – 0.81 R 10.59	10.37 – 0.81 R 10.59			
Nm	1200	1600 / 1500			
kg	190	205			
dm³	7.8	9.3			
	840	910			
	1/2	1/2			



Maß in () gilt für 12 AS 1210 WO Dimension in () applies to 12 AS 1210 WO

* SAE2 als Option erhältlich / SAE2 optional available

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ZF-AS Tronic mid – Insides of the Transmission System

Mechatronics module with integrated electronics







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ZF-AS Tronic mid – Communication in the Driveline

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Connection to the truck's CAN system with conventional setup



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vehicle and engine data



Vehicle weight	41.5 t, empty vehicle: 18.5 t, ZGG: 65 t				
fR	0.015 – Test Mr. Vesenjak, 23.03.2010				
	0.0135 – Test Mr. Vesenjak, 02.11.2010				
rDyn.	0.557 m				
Vehicle front surface	8.75 m ²				
Cw-index	1.00				
Axle ratio	12.28				
Engine performance data	OM906LA, Euro 3, 147kW@2600min ⁻¹ ; 750Nm@1200-1600min ⁻¹				
Transmission	AS Mid 12AS1620 (10.37, 8.43, 6.49, 5.27, 4.18, 3.4, 2.48, 2.02, 1.55, 1.26, 1, 0.81)				
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12-Speed – Always the Right Speed





Quite natural, when have to be fast skip unnecessary steps

AS Tronic mid

- picking the right gear out of 12
- if possible in 4 steps to maximum vehicle speed
- maximum acceleration for maximum productivity
- all the time in the most economic engine speed

CLC – <u>Container Load Control Principle</u>





Engine off - no fuel is burned





Save the max

- Even a pretty close to perfect engine burns fuel.
- Pay when you need it, run your engine when you need it.
- Engine off while waiting with start stop systems

Yes, we are start-stop system ready

- Start-stop systems are highly developed systems.
- You need to have control of all power using systems like A/C etc. Start-stop systems are part of the carmaker.
- Yes, ZF AS Tronic is start-stop ready.
- Yes, ZF AS Tronic is ready to save the max for you!

ZF-AS Tronic mid – Conclusion of your Advantages





- Fuel savings up to 10% plus (dry clutch instead of torque converter)
- Emission reduction
- No extra cooling system necessary
- Select between manual or automatic gear changing
- Easy to handle even for unskilled drivers
- Driver can focus on traffic and cargo (automatically shifting)
- Longer oil change intervals (up to 4 years)
 - No oil filter change necessary
 - Transmission overhaul after 4 years



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Configuration and Testing Results (2007)



Results from PSA Port of Singapore

- 750 vehicles running in the port of Singapore since 2007 with AS mid
- Configuration SAE1 clutch and Mercedes engine with 750 Nm
- Fuel consumption 8% lower than 6-speed AT
- Total overhaul cost roughly 3.300 € (one overhaul in 8 years vehicle life time)
- Oil change interval 4 years, no oil filter change



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Configuration and Testing Results (2010)



Results from Ports of Malaysia and Europe

- First vehicles running since 2010 in different ports
- Configuration SAE2 clutch and Cat C 6 or Cummins QSB 6.7 engine with 950 Nm
- Fuel consumption between 15 and 20% lower than 4-speed AT
- Oil change interval 4 years, no oil filter change
- Clutch durability 5 years+
- Significant better shift and driving performance thanks to SAE 2 clutch and higher engine power





Configuration and Testing Results – Fuel Consumption Comparison



 Monthly fuel savings from PTP (Terminal Malaysia) (July 2010 till December 2010)

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 Results from PTP show an average of 13.6% fuel savings based on fuel usage per moving trip parameter

	Allison	ZF		_
	Fuel/Move (Litre)	Fuel/Move (Litre)	Fuel save (%)	
JULY	1.9577	1.5126	22.74	
AUGUST	1.5243	1.2183	20.07	
SEPTEMBER	1.8826	1.7516	6.96	Dev
OCTOBER	2.1872	2.0286	7.25	con
NOVEMBER	1.9414	1.5479	20.27	varia
DECEMBER	1.9569	1.8755	4.16	but

Deviations in fuel consumption are due to variation of container load, but it was a real world test.

- (22.74 + 20.07 + 6.96 + 7.25 + 20.27 + 4.16) / 6 = 13.6% average fuel save
- Calculated in operating hours

Fuel Consumption Simulation Study (2015)

Approach:

To set the benchmark of transmission for Terminal Tractors

- Scientific simulation approach
- Comparing AS Tronic technology
 with competitor technology
- Backing Up of the mesured results





Fuel Consumption Simulation

Vehicle data

Bezeichnung	Terminal Tractor 4x2			
Fahrzeugmasse	Leergewicht: ca. 18.5t (inkl. Auflieger) Empty			
vehicle weigth	◆ZGG= ca. 65t, "Überladen" = 80t Normal weigth and overload			
_	◆Gewicht mit mittlerer Beladung ca. 41.75t average weight			
Rollwiderstandsbeiwert	0.015 (Mittelwert aus Ausrollversuchen mit versch. 7 Measured coefficient of friction			
Dyn. Reifenhalbmesser	0.557m (11.00x2016PR)			
Fahrzeugquerfläche	8.75m ²			
Cw-Wert	1.00			
Achse	12.28			
Engine	OM906LA, Euro 3 (mit ATL), 147kW@2600min-1; 750Nm@1200-1600min-1			
transmission	12AS1620SO			
Kupplung	MFZ430			

Operating times



Life time Operatin time per year Milage per year Overall milage Overhaul intervall

	12AS1620SO Ist-Stand
Lebensdauer	8-10 Jahre
Einsatzzeit p.a.	7000h
Jahreslaufleistung	30000km
Gesamtlaufleistung	240000-300000km
Overhaul	Nach 150000km



How we did the Simulation





Fuel Consumption Simulation Approach





Simulation Results and Conclusion in %



- In spite of the optimizaton on the powershift transmisson the fuel consumption will be around
 6-11% higher than the AS Tronic transmission
- The 5 speed powershift transmission reduces the fuel consumption by only 2% compared to the 4 speed tm.
- The use of a 6th speed on the powershift transmission will give (almost) no additional benefit.



Annual saving per vehicle Simulation Results and Conclusion in liter and in money



- AS Tronic transmisson saves between 1700 liters and 3300 liters of fuel per year and vehicle
- AS Tronic saves between 5.180 ARD and 10.000 ARD per year and per vehicle



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Road and vehicle data



		-						
		leer	teilbeladen	voll	überladen	Summe		
Strecke To	nnage [t]	18.5	41.75	65	80		Streckenlänge [km]	Zeitdauer [s]
4844by290714011MitIne	chen.str	6.25%	12.50%	5.00%	1.25%	25.00%	13.8	10850
4844by290714012MitIne	chen.str	6.25%	12.50%	5.00%	1.25%	25.00%	34.2	17874
4844by290715000MitInd	chen.str	6.25%	12.50%	5.00%	1.25%	25.00%	37.2	14707
4844by290715001MitIn	chen.str	6.25%	12.50%	5.00%	1.25%	25.00%	28.1	12994
		25.00%	50.00%	20.00%	5.00%	100.00%	113.3km	56425 → Ca. 15.67h



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Influences on Fuel Consumption



potential	Action	
Lowering shift points	Lower shift points so that performance is best for both systems	
No of gears	Calculate powershift tm with 4,5 and 6 gears	
	Calculate AS Tronic with the best of 12 gears	
Close Lock-up clutch in 1st gear	Only for powershift transmissions	



Simulation Variants



	competito	or	AsMid 12AS1620SO	
	Shift program ¹	Anzahl Gänge	Schaltprogramm	Anzahl Gänge
Simulation 1		4	Shift	12
Simulation 2	Basis	5		
Simulation 3		6		
Simulation 4		4	optimized	
Simulation 5	optimized	5		
Simulation 6	-	6		