FPT FUEL PRESCRIPTIONS

Revision 6.0_Jan 2023

REVISION HISTORY

FPT internal document reference

Rev	Date	Description
3.0	05/04/2018	Update, added Marine Engines

Symbols Reference

	DESCRIPTION
	Go to document cover page
	Go to main index
	Back to previous page
	Go to external document

All data is subject to change without notice

INTRODUCTION

Document scope

The overall scope of this document is to list the allowed and recommended fuels to preserve and grant engine reliability and durability according to FPT tests.
Any different product is in principle not allowed so must be explicitly requested to FPT for approval.
FPT engines are certified and fully warranted with fuels compliant with international standards, like EN 590 and ASTM D975.
The usage of not fuel additive will invalid any warranty to the engine and any further consequence. May have also effects on laws in use in the country where the machine operate.
Any fuel not enclosed in the present document shall be considered not allowed so FPT will not respond for whichever event or damage may occur.
With the terms "Emissions limit equivalent" is intended emission limits that are enough close to the one declared to avoid any damage to the engine. The check of equivalence from emission limit point of view is under Customer and FPT Dealer responsibility if not exists an official and written FPT statement.

Document usage

The document is addressed to customers who buys and installs FPT engines via FPT Dealer network (no direct FPT supply).

INDEX

STANDARD DIESEL FUEL

OFF ROAD /INDUSTRIAL POWER UNIT (IPU), POWERGEN ENGINES - Compatibility of standard fuels with emissional limits

Legenda
FIE: Fuel injection system
ODI: Oil drain interval
ATS: Aftertreatment system
AWP: Anti-Wear Package for FIE

Full warranty	
To be homologated / validated, compatible	
Limited compatibility on application basis to be assessed by specific validation	
NOK	

Engine	Fuel	StageV	Stage IV Tier4B - TremIV	StageIIIB - Tier4A	StageIIIA - Tier3
F28 - F5 - S8000 - NEF - CURSOR - VECTOR	Standard Diesel fuels: **EN 590 (NATO F-54) ASTM D975 GB 19147 JIS K2204**	F5/S8000/F28 engines: robustness package RP6 required for ASTM D975	F5/S8000/F28 engines: robustness package RP6 required for ASTM D975		

Table 1.

ON ROAD ENGINES - Compatibility of standard fuels with emissional limits

Engine	Fuel	Euro 6/VI - GBVI Proconve P8	Euro 5/V - GBV Proconve P7	Euro 4/IV	Euro III (or previous emissions levels)
F1A - F1C - NEF - CURSOR	Standard Diesel fuels: **EN 590 (NATO F-54) ASTM D975 GB 19147 JIS K2204**				

Table 2.

ALTERNATIVE DIESEL FUELS

OFF ROAD /INDUSTRIAL POWER UNIT (IPU), POWERGEN ENGINES - Compatibility of alternative fuels with emissional limits

Engine	Fuel	StageV	Stage IV Tier4B - TremIV	StageIIIB - Tier4A	StageIIIA - Tier3
F28 - F5 - S8000 - NEF - CURSOR - VECTOR	Paraffinic diesel fuels according to the EN 15940 XTL (HVO, GTL, BTL, …)		All Stage IV / Tier 4B / TremIV engines with full warranty on FIE if fuel pumps are equipped w/ AWP	No FIE warranty Compatibility only in case of CR + fuel pump w/ AWP	No FIE warranty Compatibility only in case of CR + fuel pump w/ AWP
	Biodiesel blends: EN 16734 (B10) EN 16709 (B20-B30) ASTM D7467 (B6-B20) EN 14214 or ASTM D6751 (B100) Technical release of biodiesel blends higher than B8 must be carried out for each off-road application / market considering the actual biofuel quality and agreed with FPT.	NOK Up to max B8 only	Max B20** for Minnesota & other US States in summer season only (all Tier 4B engines) Max B20** for NEF & Cursor Tier 4B engines (w/ Fe-zeolite SCR ATS) FIE warranty up to B30 for F5/S8000/ F28 w/ RP6, NEF w/ AWP & Cursor 9, 11, 13 and 16 For F5/S8000/F28 with RP6, for NEF with fuel pump w/ AWP, and for C9: FIE compatible up to B30, but ATS not covered Compatibility with Brazilian Biodiesel (according to ANP30/2016) only with Robustness package RP6 Halved oil / oil filter maintenance Reduction of fuel filter maintenance to be revised with Supplier / based on validation fleet results Specific biodiesel blends requirements to be fulfilled **	Max B20 for ATS compatibility For F5/S8000/F28, Cursor and NEF (with CR + fuel pump w/ AWP): compatibility on FIE up to B30. FIE warranty to be revised on application basis. Compatibility with Brazilian Biodiesel (according to ANP30/2016) only with Robustness package RP6 Halved oil / oil filter maintenance Reduction of fuel filter maintenance to be revised with Supplier / based on validation fleet results Specific biodiesel blends requirements to be fulfilled **	Up to B100 For F5/S8000/F28, C9 and NEF (with CR + fuel pump w/ AWP): compatibility on FIE up to B100. FIE warranty to be revised on application basis. Compatibility with Brazilian Biodiesel (according to ANP30/2016) only with Robustness package RP6 Halved oil / oil filter maintenance Reduction of fuel filter maintenance to be revised with Supplier / based on validation fleet results Specific biodiesel blends requirements to be fulfilled **

Table 3.

Engine	Fuel	StageV	Stage IV Tier4B - TremIV	StageIIIB - Tier4A	StageIIIA - Tier3
F28 - F5 - S8000 - NEF - CURSOR - VECTOR	Military / Naval / Jet fuels (e.g. Kerosene fuels)	NOK Specific military applications to be considered case by case w/ FPT	NOK Specific military applications to be considered case by case w/ FPT	FIE replacement every 600 hrs (1000 hrs for C9), w/ 0-km warranty by Bosch Fuel filter replacement every 300 hrs / 12 months Halved oil / oil filter maintenance Halved fuel filter maintenance High risk of ATS deterioration / failure	FIE replacement every 600 hrs (1000 hrs for C9), w/ 0-km warranty by Bosch Fuel filter replacement every 300 hrs / 12 months Halved oil / oil filter maintenance Halved fuel filter maintenance
	High sulphur fuels (S > 15 ppm)	NOK Specific Customer requests to be analyzed case by case w/ FPT	NOK Specific Customer requests to be analyzed case by case w/ FPT	General recommendations: <500 ppm low risk; up to 2000 ppm medium risk **Please contact FPT Customer Management for specific case-by-case application**	General recommendations: <500 ppm low risk; up to 2000 ppm medium risk **Please contact FPT Customer Management for specific case-by-case application**

Table 4.

** *FPT engines / ATS systems compatible w/ biodiesel blends greater than B8 up to B20 compliant with **EU AGQM / US BQ-9000 Quality Standards** and not exceeding:*
- 1.0 mg/kg for Group I Metals (Sodium + Potassium)
- 1.0 mg/kg for Group II Metals (Calcium + Magnesium)
- 1.0 mg/kg for Phosphorus

ON ROAD ENGINES - Compatibility of alternative fuels with emissional limits

Engine	Fuel	Euro 6/VI - GBVI Proconve P8	Euro 5/V - GBV Proconve P7	Euro 4/IV	Euro III (or previous emissions levels)
F1A / F1C - NEF - CURSOR	Paraffinic diesel fuels according to the EN 15940 XTL (HVO, GTL, BTL, …)	All Euro VI Step C / D/ E engines homologation for EN 15940 F1A, NEF: required fuel pump w/ Anti-Wear Package (AWP) (e.g. F1A Eu6 Step A to Step D NOK)	Compatibility and full warranty on FIE (only for NEF & Cursor engines CR + fuel pump w/ AWP are mandatory) Specific Euro V homologation for EN 15940 not foreseen	Compatibility only in case of CR + fuel pump w/ AWP FIE warranty to be revised on application basis Specific Euro IV homologation for EN 15940 not foreseen	Compatibility only in case of CR + fuel pump w/ AWP FIE warranty to be revised on application basis Specific Euro III homologation for EN 15940 not foreseen
	Biodiesel blends: EN 16734 (B10) EN 16709 (B20-B30) ASTM D7467 (B6-B20) EN 14214 or ASTM D6751 (B100) Technical release of biodiesel blends higher than B7 must be carried out for each on-road application / market considering the actual biofuel quality and agreed with FPT.	Not OK engines must be specifically homologated for Biodiesel blends above B7	Max B20 due to ATS compatibility For F1A & F1C: no FIE warranty and compatibility up to B30 only in case of fuel pump w/ AWP. For C9 and NEF (with fuel pump w/ AWP): compatibility on FIE up to B30. FIE warranty to be revised on application basis. No FIE warranty with Brazilian Biodiesel (according to ANP30/2016) Halved oil / oil filter maintenance Reduction of fuel filter maintenance to be revised with the supplier / based on validation fleet results Specific biodiesel blends requirements to be fulfilled *	Max B20 due to ATS compatibility For F1A & F1C: no FIE warranty and compatibility up to B30 only in case of fuel pump w/ AWP. For C9 and NEF (with CR + fuel pump w/ AWP): compatibility on FIE up to B100. FIE warranty to be revised on application basis No FIE warranty with Brazilian Biodiesel (according to ANP30/2016) Halved oil / oil filter maintenance Reduction of fuel filter maintenance to be revised with the supplier / based on validation fleet results Specific biodiesel blends requirements to be fulfilled *	Up to B100 For C9 and NEF (with CR + fuel pump w/ AWP): compatibility on FIE up to B100. FIE warranty to be revised on application basis No FIE warranty with Brazilian Biodiesel (according to ANP30/2016) Halved oil / oil filter maintenance Reduction of fuel filter maintenance to be revised with the supplier / based on validation fleet results Specific biodiesel blends requirements to be fulfilled *

Table 5.

Engine	Fuel	Euro 6/VI - GBVI Proconve P8	Euro 5/V - GBV Proconve P7	Euro 4/IV	Euro III (or previous emissions levels)
F1A / F1C - NEF - CURSOR	Military / Naval / Jet fuels (e.g. Kerosene fuels)	NOK Specific military applications to be considered case by case w/ FPT	FIE replacement every 600 hrs (NOK for F1A, 1000 hrs for C9), w/ 0-km warranty by Bosch Fuel filter replacement every 300 hrs / 12 months Halved oil / oil filter maintenance Halved fuel filter maintenance High risk of ATS deterioration / failure **Please contact FPT Customer Management for specific case-by-case application**	FIE replacement every 600 hrs (NOK for F1A, 1000 hrs for C9), w/ 0-km warranty by Bosch Fuel filter replacement every 300 hrs / 12 months Halved oil / oil filter maintenance Halved fuel filter maintenance High risk of ATS deterioration / failure **Please contact FPT Customer Management for specific case-by-case application**	FIE replacement every 600 hrs (NOK for F1A, 1000 hrs for C9), w/ 0-km warranty by Bosch Fuel filter replacement every 300 hrs / 12 months Halved oil / oil filter maintenance Halved fuel filter maintenance **Please contact FPT Customer Management for specific case-by-case application**
	High sulphur fuels (S > 15 ppm)	NOK Specific military applications to be considered case by case w/ FPT	General recommendations: <500 ppm low risk; up to 2000 ppm medium risk **Please contact FPT Customer Management for specific case-by-case application**	General recommendations: <500 ppm low risk; up to 2000 ppm medium risk **Please contact FPT Customer Management for specific case-by-case application**	General recommendations: <500 ppm low risk; up to 2000 ppm medium risk **Please contact FPT Customer Management for specific case-by-case application**

Table 6.

* *FPT engines / ATS systems compatible w/ biodiesel blends greater than B8 up to B20 compliant with **EU AGQM / US BQ-9000 Quality Standards** and not exceeding:*
- 1.0 mg/kg for Group I Metals (Sodium + Potassium)
- 1.0 mg/kg for Group II Metals (Calcium + Magnesium)
- 1.0 mg/kg for Phosphorus

BIODIESEL GENERAL CONSIDERATION

Biodiesel consists of a family of fuels derived from long-chain alkyl (methyl, ethyl, or propyl) esters treated vegetable oils. There are two main types of biodiesel:

1. RME - Rapeseed Methyl Ester (or a blend of rapeseed and sunflower methyl ester), which is the preferred crop in Europe.

2. SME - Soybean Methyl Ester, which is the preferred crop in North America.

Blended biodiesel is defined according to below main standards:

- B5 indicates a blend of max 5% biodiesel fuel and min 95% diesel fuel according to ASTM D975.
- B7 indicates a blend of max 7% biodiesel fuel and min 93% diesel fuel according to EN 590.
- B10 indicates a blend of max 10% biodiesel fuel and min 90% diesel fuel according to EN 16734 .
- B20 indicates a blend of max 20% biodiesel fuel and min 80% diesel fuel according to EN 16709 or ASTM D7467 (min biodiesel content for ASTM D7467 is 6%).
- B100 indicates pure or 100% biodiesel fuel according to EN 14214 or ASTM D6751.

The prescription reported in this document are recommendations to minimize damages to powertrain and ATS systems at the best of our current knowledge. Following such recommendations does not imply and warranty to the powertrain and/or ATS in case of use with fuels other than EN590 diesel.

General requirements for Biodiesel usage

Purchase
The biodiesel must be purchased pre-blended from the certified fuel supplier.

Fuels Storage
The fuel tanks need to be kept as full as possible to limit the amount of air and water vapors inside.
Drain water on regular bases (at least once a week).
Due to the use of biodiesel, avoid contact with: Copper, Zinc, Tin, Lead or alloys of these.
The storage tank must be protected against direct sunlight and frost.

Tank Cleaning & Fuel Storage
Complete cleaning of the whole on-site handling system and storage tanks is required.
Use a fuel filter and water separator and make sure storage tanks, fuel lines are fittings are compatible.
The fuel must not be stored in on-site storage tanks for more than 3 months.
Due to the use of biodiesel, avoid contact with: Copper, Zinc, Tin, Lead or alloys of these.

Vehicle Storage
First filling of vehicle in production must be made with fossil fuel diesel.
If fossil fuel diesel is not available it is recommended to use a blend of fossil fuel with minimum content of FAME.
With more than 7% of FAME it is mandatory to use the specific additive.
Due to risks of growth of microbes and algae, the vehicles should not be stored for more than 3 months with biodiesel in the fuel system.
For longer storage time it is strongly suggested that only fossil fuel diesel is used to clean the system from biodiesel.

Vehicle Long Storage
If storage periods longer than 3 months are needed, engine must run on fossil fuel diesel (NOT gasoline, NOT kerosene blends) for 20hours to flush the biodiesel fuel out of the engine fuel system prior to storage.
During usage of biodiesel, avoid contact with: Copper, Zinc, Tin, Lead or alloys of these.

Maintenance in case of Biodiesel Usage

Oil / Filter maintenance Intervals

- **Oil type ACEA E6 (Europe) & API CJ-4 (North America) or better**
- Oil and filter change interval is reduced down to 50% of the standard value when using biodiesel blends greater than B5 or B7 up to B20.
- If the customer switches back from Biodiesel to EN590, ASTM D6751-9A diesel fuel or after long storage, fuel filters, oil and oil filters should be changed even if this falls between routine service intervals.

ATS maintenance interval estimation
FPT estimates the need of a periodic replacement of the SCRT system (SCR + DPF) with a minimum estimated today around 3000h / 150kkm with B20, still to be confirmed by testing (SCR duration for blends > B20 likely shorter and to be defined by testing activities)

S-IMPACT ON ATS

Summary of S-impact – Effect of catalyst S-poisoning

Effect of catalyst S-poisoning	Result	Conseguence	Countermeasure
CO conversion	Lower → efficiency Loss of performance (% light-off): to be evaluated	Emission limits can not be met Less HC conversion → Coking problem of Zeolite SCR catalyst	Catalyst conditioning before test (S-poisoning is reversible at higher T) Pt technology is less sensitive regarding S - poisoning → Problem will be shifted, not solved but, Pt technology is more sensitive regarding temperature aging (Pt sintering)
HC conversion	Lower → efficiency Loss of performance (% light-off): to be evaluated		
PM emission	Higher PM emission → Sulphur in fuel contributer to PM → Sulphates release catalyst at higher T (white smoke visible at the tail pipe) Sulphate formation depends on PGM, → The higher sulphate make		
NO to NO_2 oxidation	Lower efficiency Loss of performance (% light-off): to be evaluated → Less active sites on (catalyst poisoning grade)	Less passive soot burn-off in filter → Filter overload possible Higher active regeneration frequency – DOC aging more severe – Higher stress for filter system (risk to damage the filter) – Oil dilution problem More frequent service regenerations **SCRT/SCR with DOC** Lower SCR activity → Emission limits can not be met → Increasing NH_3 emission	Fuel quality sensor? Self learning passive regeneration model basing on S-poisoning grade Self-leaning SCR model basing on S- poisoning grade of DOC
Active filter regeneration (HC conversion of DOC)	Lower efficiency Loss of performance (% light-off): to be evaluated Required temperature upstream trap not reachable	DOC clogging possible Higher/massive HC slip Less soot burn-off in filter → Regeneration tile longer/ more frequent → Soot burn-off not as estimated/calculated → Filter overload possible → Filter clogging possible → More frequent service regenerations • Higher stress for filter system (risk to damage the filter) • DOC aging more severe	Using of burner systems Self-Learning HC conversion model basing on S-poisoning grade → At least, the problem will be shifted, probably non solved Implementation of DeSOx-steps → Some cleaning at T 450° → Best at active regeneration (anyhow, low T at the inlet of DOC → most poisoning will remain!)

Table 7.

SUMMARY OF S-IMPACT – COMPATIBILITY WITH ATS CONFIGURATION

OFF-ROAD/ POWERGEN Applications

Emission level	ATS	Cursor	NEF	F5C		S8000	
Tier 4B Stage IV Stage V	**YES**	SCR <15 ppm (US market) <10 ppm (EU market)	SCR <15 ppm (US market) <10 ppm (EU market)	[<56kW] PM cat or DOC only <15 ppm (US market) <10 ppm (EU market)	[≥56kW] DOC +SCR or SCR only <15 ppm (US market) <10 ppm (EU market)	[3 cyl <56kW] DOC <15 ppm (US market) <10 ppm (EU market)	[4 cyl ≥56kW] DOC+SCR <15 ppm (US market) <10 ppm (EU market)
Tier 4A Stage IIIB		SCR <500ppm recommended (up to 2000ppm with medium risk on FIS/EGR)	SCR <500ppm recommended (up to 2000ppm with medium risk on FIS/EGR)	DPF + DOC [≥56Kw] <350ppm		No applicable	
Tier3 Stage III	**NO**	<500ppm recommended (up to 2000ppm with medium risk on FIS/EGR)	<500ppm recommended (up to 2000ppm with medium risk on FIS/EGR)	IEGR: <500ppm recommended (up to 2000ppm with medium risk on FIS/EGR)	CEGR: <500ppm recommended (up to 2000ppm with medium risk on FIS/EGR)	IEGR: <500ppm recommended (up to 2000ppm with medium risk on FIS/EGR)	
Tier 2B Stage II or lower emission limits		<500ppm recommended (up to 2000ppm with medium risk on FIS/EGR)	<500ppm recommended (up to 2000ppm with medium risk on FIS/EGR)	IEGR: <500ppm recommended (up to 2000ppm with medium risk on FIS/EGR)	CEGR: <500ppm recommended (up to 2000ppm with medium risk on FIS/EGR)	IEGR: <500ppm recommended (up to 2000ppm with medium risk on FIS/EGR)	

Table 8.

ON-ROAD Applications

Emission level	ATS	Cursor	NEF	F1A	F1C
Euro VI	**ATS**	SCR or SCR-T <10 ppm (EU market)	SCR or SCR-T <10 ppm (EU market)	DOC+DPF+SCR <10 ppm (EU market)	DOC+DPF+SCR <10 ppm (EU market)
Euro V		SCR <500ppm recommended (up to 2000ppm with field tests)	SCR <500ppm recommended (up to 2000ppm with field tests)	EGR+CCDPF (DOC+DPF) <350 ppm	EGR+CCDPF (DOC+DPF) <350 ppm
Euro IV		SCR <500ppm recommended (up to 2000 ppm with medium risk on FIS/ EGR)	SCR <500ppm recommended (up to 2000 ppm with medium risk on FIS/ EGR)	EGR+DOC <500ppm recommended (up to 2000 ppm with medium risk on FIS/ EGR)	EGR+DOC <500ppm recommended (up to 2000 ppm with medium risk on FIS/ EGR)
Euro III	**NO ATS**	<500ppm recommended (up to 2000 ppm with medium risk on FIS/ EGR)	<500ppm recommended (up to 2000 ppm with medium risk on FIS/ EGR)	EGR only <500ppm recommended (up to 2000 ppm with medium risk on FIS/ EGR)	EGR only <500ppm recommended (up to 2000 ppm with medium risk on FIS/ EGR)

Table 9.

FUELS COMPATIBILITY ASSESSMENT FOR MARINE COMMON RAIL ENGINES

	Engine Type	F1	NEF		C9	Cursor 13		Cursor 16
	Common Rail / Mechanical Injectors / Unit Injectors	CR	Mech	CR	CR	UIN	CR	CR
FUEL TYPE	EN590 (B7)							
	JIS KK 2204							
	ASTM D975-2							
	EN16734 (B10)							
	NATO F-54							
	JP-5 (NATO F-44) / ASTM D975-1	• FIS/FIE @ 600 hrs* • Halved oil drain interval • Halved oil/ fuel filter maintenance (300h)		• FIS/FIE @ 600 hrs* (400h from approval letter) • Halved oil drain interval • Halved oil/ fuel filter maintenance (300h)	• FIS/FIE @ 1000 hrs* • Halved oil drain interval • Halved oil/ fuel filter maintenance (300h)		• FIS/FIE @ 600 hrs* • Halved oil drain interval • Halved oil/ fuel filter maintenance (300h)	• FIS/FIE @ 600 hrs* • Halved oil drain interval • Halved oil/ fuel filter maintenance (300h)
	JP-8 (NATO F-34) / JET-A1 (NATO F-35) / NATO F-63	• FIS/FIE @ 600 hrs • Halved oil drain interval • Halved oil/ fuel filter maintenance (300h)		• FIS/FIE @ 600 hrs** (400h from approval letter) • Halved oil drain interval • Halved oil/ fuel filter maintenance (300h)	• FIS/FIE @ 1000 hrs** • Halved oil drain interval • Halved oil/ fuel filter maintenance (300h)		• FIS/FIE @ 600 hrs** • Halved oil drain interval • Halved oil/ fuel filter maintenance (300h)	• FIS/FIE @ 600 hrs** • Halved oil drain interval • Halved oil/ fuel filter maintenance (300h)
	NATO F-75 / NATO F-76							
	XTL according to EN 15940 (GTL, BTL, HVO, ...)	Compatibility only in case of Anti-Wear package on fuel pump	NOK	Compatibility only in case of Anti-Wear package on fuel pump	Compatibility only in case of Anti-Wear package on fuel pump	NOK	Compatibility only in case of Anti-Wear package on fuel pump	Compatibility only in case of Anti-Wear package on fuel pump

Table 10.

Notes:

* *based on similarity with JP-8;*

** *based on test report.*

Full warranty	
To be homologated / validated, compatible	
Limited compatibility on application basis to be assessed by specific validation	
NOK	

BACK TO OUR ROOTS
WHILE ANTICIPATING THE FUTURE

FPT POWERTRAIN TECHNOLOGIES

FPT Industrial S.P.A. a brand of CNH Industrial
Via Puglia, 15 10156 Turin - Italy . P.IVA. IT09397710014