



Model Writer

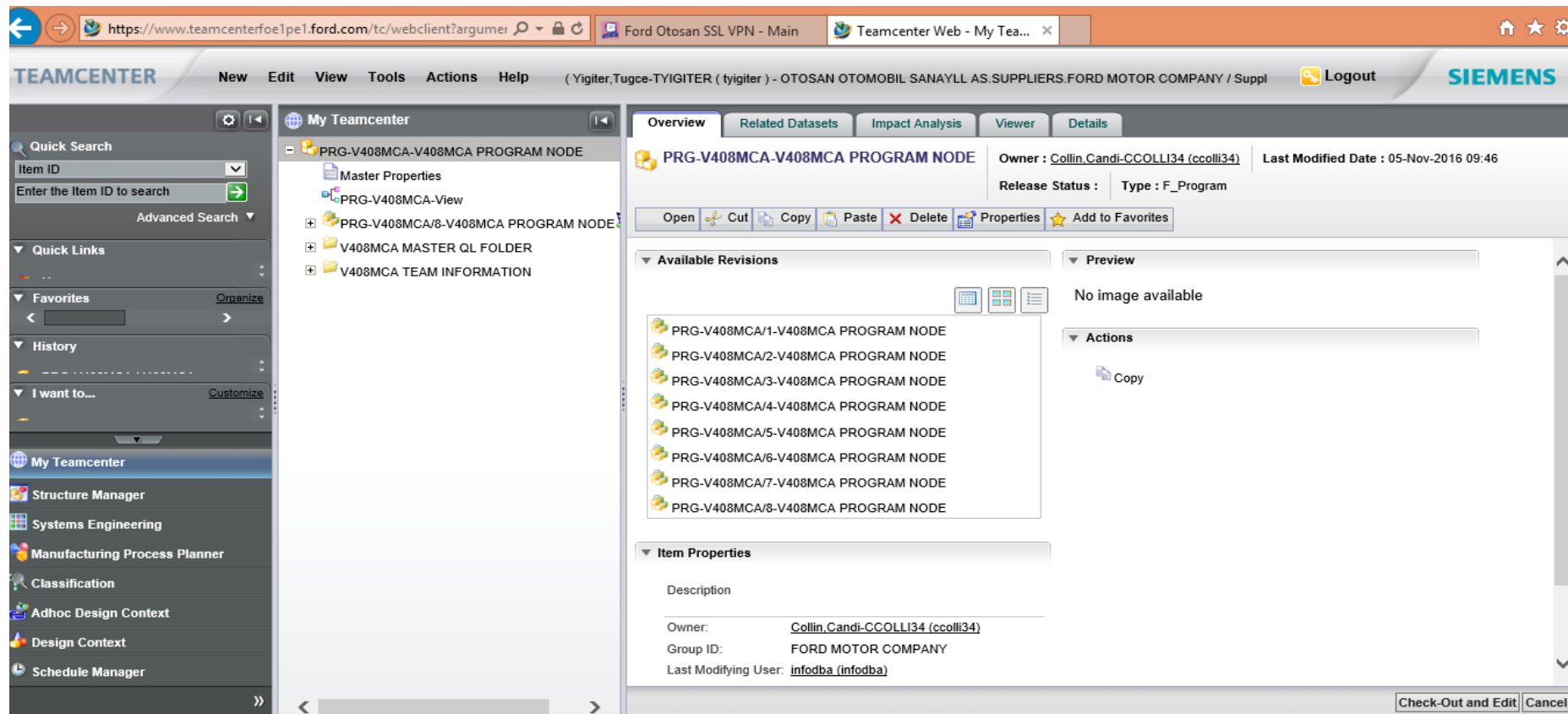
**FEAD (Front End Accessory and Drive) &
EGR (Exhaust Gas Recycling)**

06.11.2016

Siemens – TeamCenter

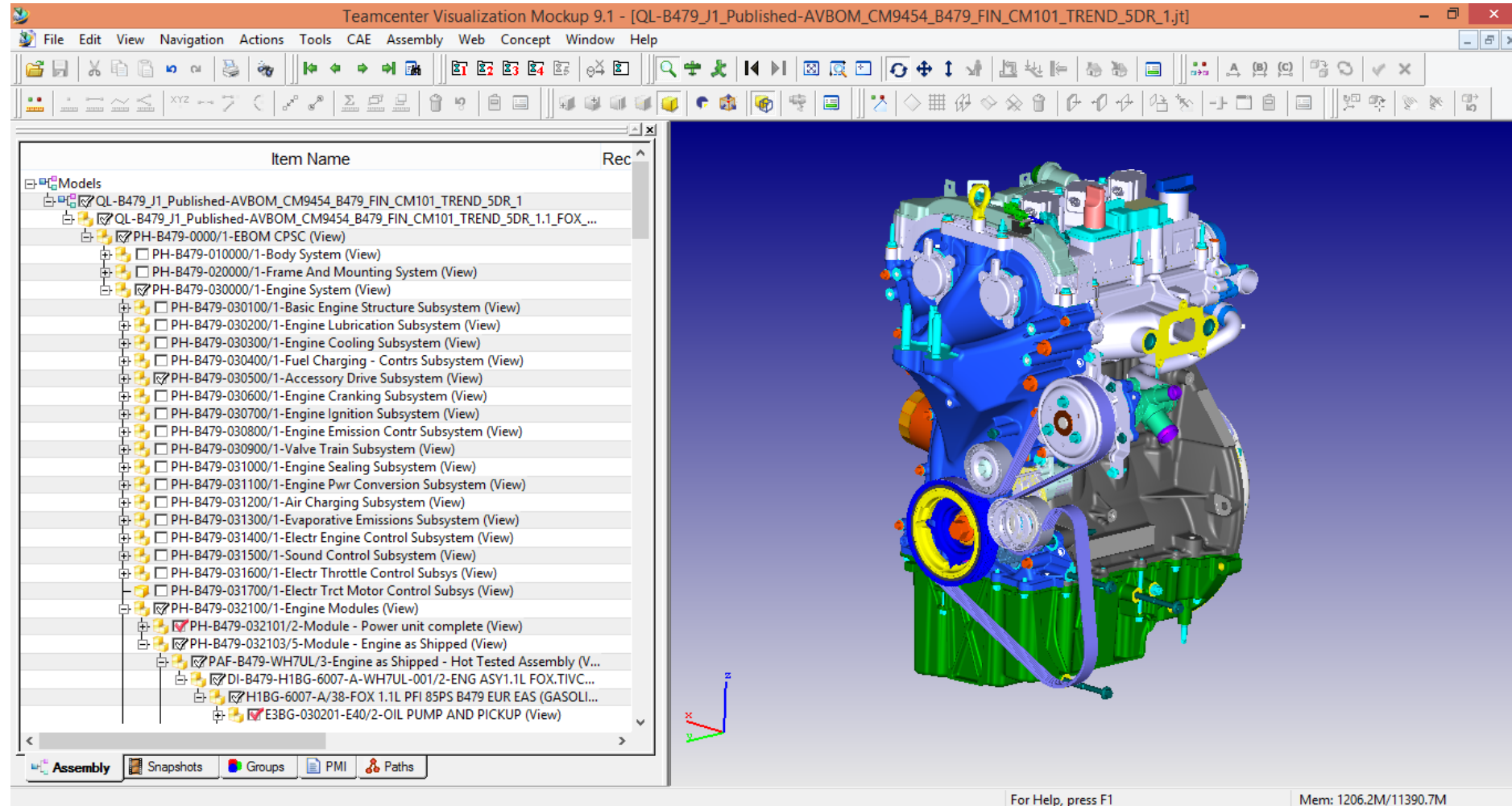
Ford Otosan is using Siemens Team Center for sharing and uploading the internal documents. Siemens has 6 server for Ford. Ford Otosan is currently using Ford of Europe (FOE) servers.

<https://www.teamcenterfoe1pe1.ford.com/tc/webclient>



Siemens – TeamCenter Visualization Mockup 9.1

Ford Otosan is using Siemens TeamCenter Visualization Mockup 9.1 for displaying the documents.



Facts, Impact, and KPIs

- Total number of rules in the whole system? About 2000 rules
- Expected Rule Coverage in the use cases? At least 50%
- Impact in FO: Total number of systems in which the tool can be applied? 70/80 teams (disciplines)
- Principles for each disciplines (
 - EGR: Thermodynamics, Fluids Dynamic
 - FEAD: Mechanical Construction
 - Suspension: Mechanical Construction
 - Electronic: Electrical Engineering and Embedded Systems
- Total number of items in a vehicle with respect to CPSC system? About 10000 items per vehicle
- Performance Metrics
 - Expected Response time in seconds per each validation operation? At most 2 seconds
 - Server-side High Performance Computing is need for checking consistency and reasoning processes.
- Ergonomics
 - Siemens PLM Visualization Integration



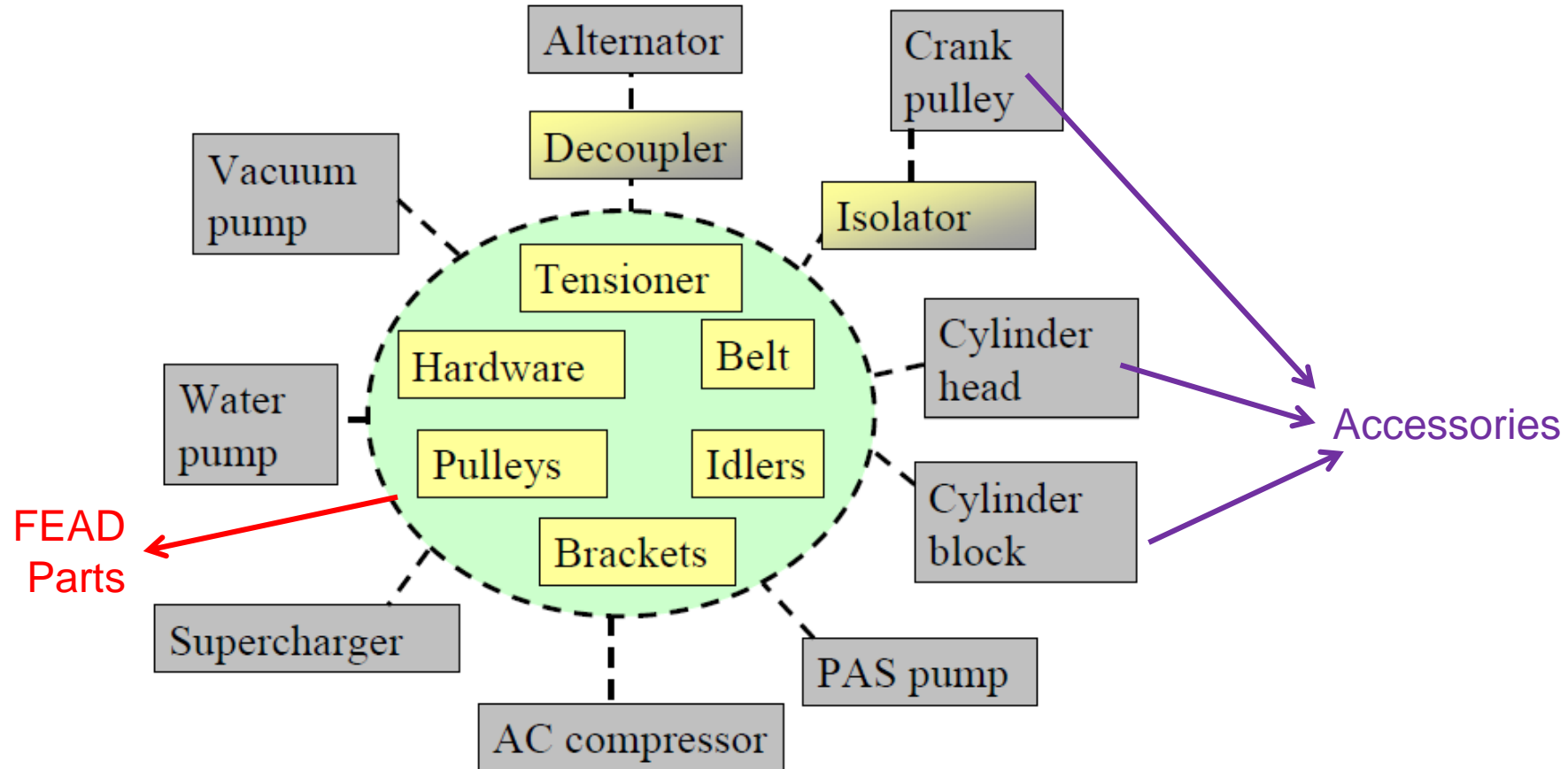
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FEAD (Front End Accessory and Drive)

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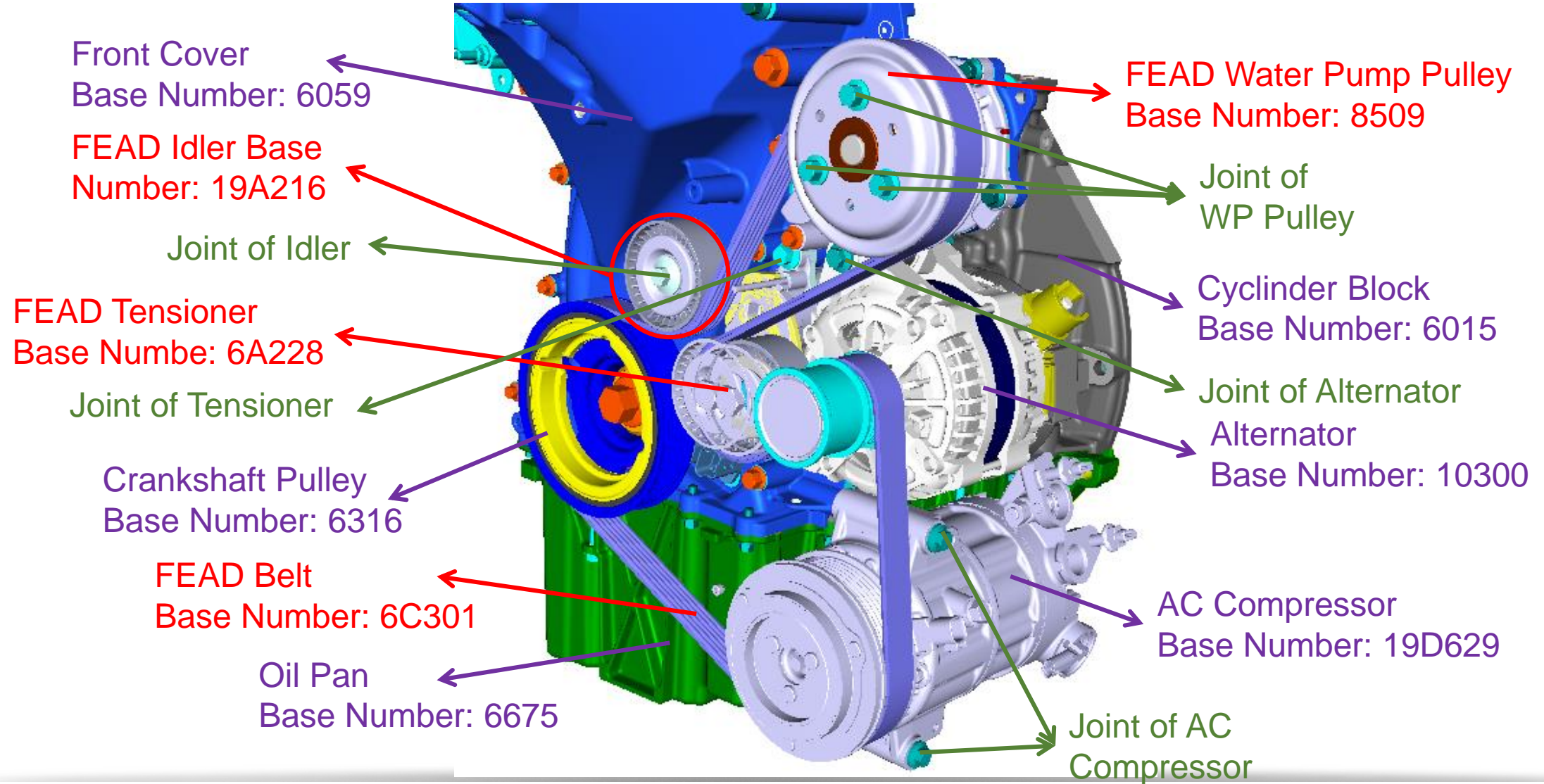
Front End Accessory Drive Design

- The objective of good accessory drive design is to transmit power to turn the various accessories with maximum efficiency under all driving conditions, without the customer knowing the job is being done.

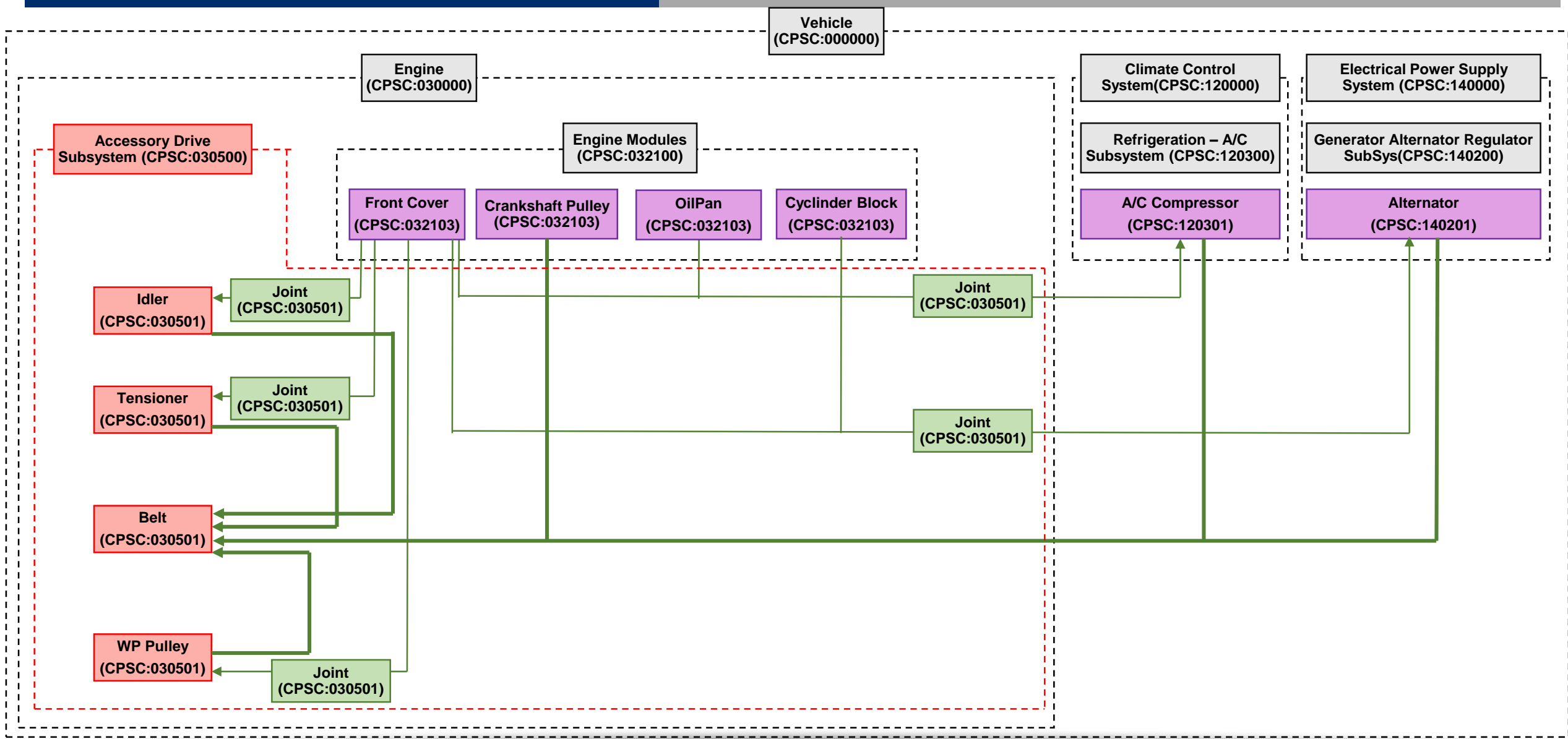


RELATION BETWEEN FEAD PARTS

Please see the FEAD part (red and green) and the other related parts (purple) layout below.



BOUNDARY DIAGRAMS OF THE PARTS



FEAD PART LIST AND REQUIRED INFORMATIONS

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Prefix*	Base*	Suffix*	Name*	CPSC*	Engineering Commodity	Remarks (Fastener Attaching Statement)
	W500025	S437	BOLT M8X30 HF 8	030501	FASTENERS (PMT400)	FROM: 6A228; TO: 6059;
	W500214	S437	BOLT M6X20 HF PIL 8	030501	FASTENERS (PMT400)	FROM: 19A216; TO: 6059 ;
	W704693	S442	BOLT M8X95 HF PIL 8	030501	FASTENERS (PMT400)	FROM: 10300; TO: 6059 & 6015 ;
	W704693	S442	BOLT M8X95 HF PIL 8	030501	FASTENERS (PMT400)	FROM: 19D259; TO: 6059 & 6675 ;
	W714914	S303	BOLT M8X13 HF SERR STL	030501	FASTENERS (PMT400)	FROM: 8509; TO: 6059;
C1BQ	8509	AC	CVR-ACC DRV	030501	FEAD	
CM5Q	19A216	AB	IDL ASY ACC DRV BEL	030501	FEAD	
CM5Q	6A228	BA	TENS ASY ACC DRV	030501	FEAD	
CM5Q	6C301	BA	BEL ACC DRV	030501	FEAD	



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EGR (Exhaust Gas Recycling) System

06.11.2016

OVERVIEW OF EGR SYSTEM

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Cylinder head
Base num: 6090

EGR module bolts
Base num: 8B530

EGR parts
Joints
Related parts

EGR Tube bolts
Base num: 8B530

Intake manifold tube
Base num: 9S331

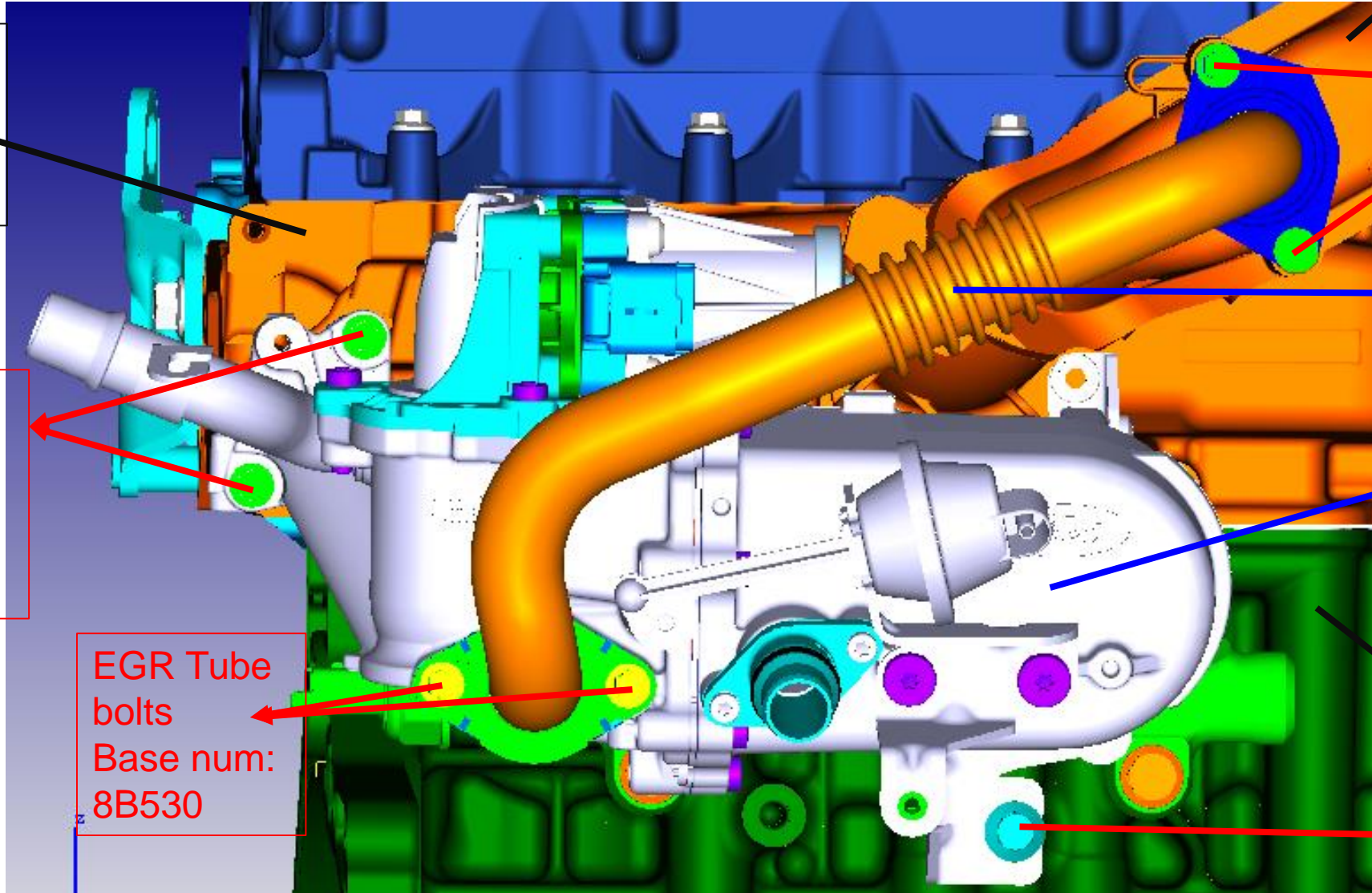
EGR Tube bolts
Base num: 8B530

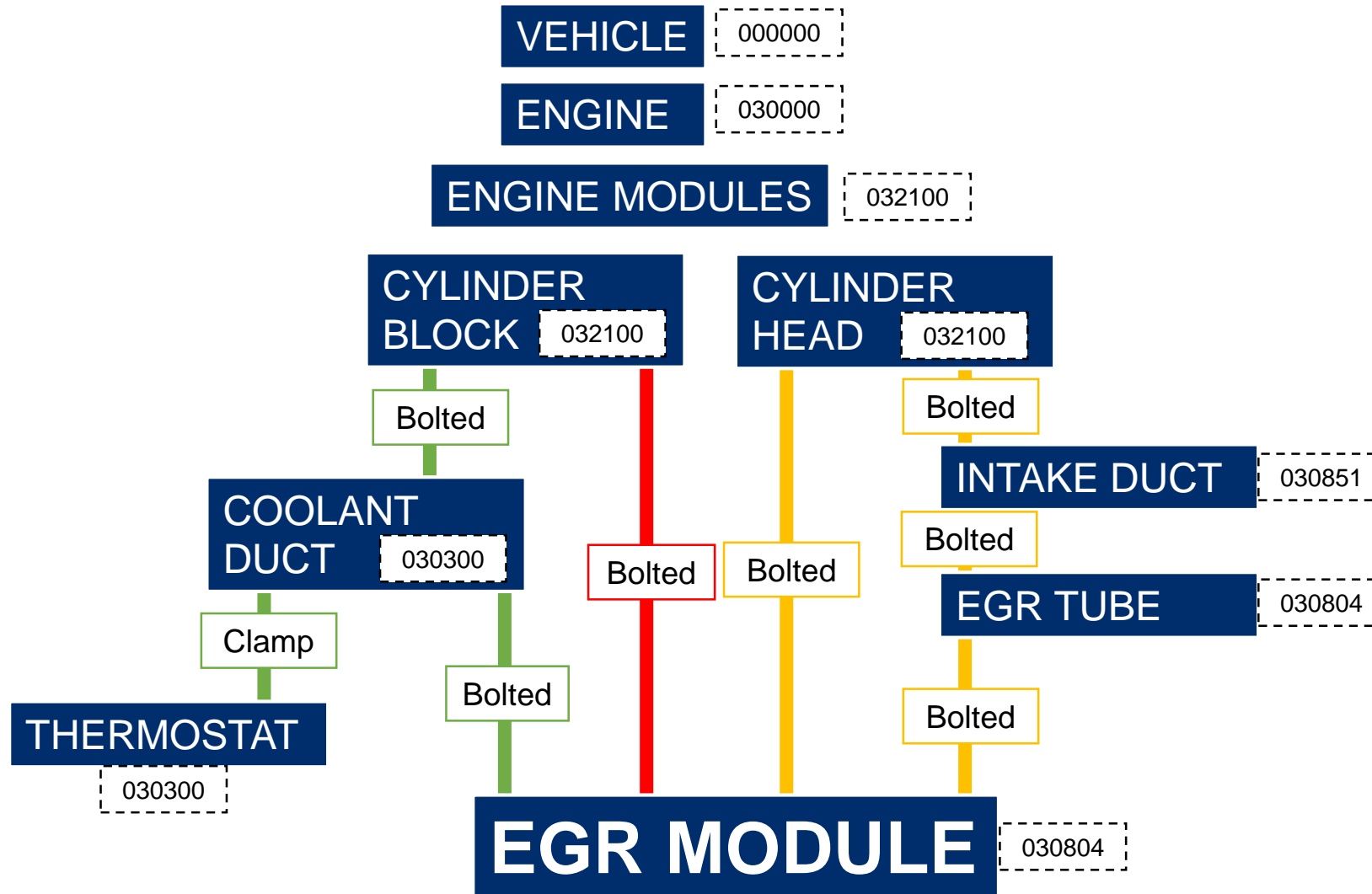
EGR Tube
Base num: 9D477

EGR Module (Cooler & Valve) base num: 9D475

Cylinder block
Base num: 6015

EGR module bolt
Base num:c3





Joints are shown with lines.

- Liquid transfer
- Gas transfer
- Structural
- CPSC

CPSC Code is a 6-digit numerical code that is defined to identify commodities. In our example, our commodity is in ENGINE AS SHIPPED. Which means, the parts that are assembled in engine plant, there are also other engine parts that are assembled in vehicle plant afterwards, those parts usually have other unique CPSC codes.

Prefix*	Base*	Suffix*	Name*	CPSC*	Engineering Commodity	Remarks (Fastener Attaching Statement)
	W500223	S437	BOLT M8X20 HD PIL	030804	FASTENERS (PMT400)	FROM: 6A228; TO: 6059;
FM5Q	9D475	AA	VLV-ASY E/G/R	030804	DRESSED ENGINE	
7M5Q	8B530	AA	SC CVR WTR PM	030804	DRESSED ENGINE	FROM: 9D475; TO: 6090
FM5Q	9D477	AA	TUB ASY E/G/R OLET	030804	DRESSED ENGINE	
AV6Q	9S331	AA	INTK MANF TUB	030851	DRESSED ENGINE	

EGR Systems Design Rules

KPAC Set ID	Title	Author	Type
0308_EG-S1	Exhaust Gas Recirculation Design Rule Saved Set for Diesel	Ewen, Ken (kewen)	Check List
0308_EG-S1	Exhaust Gas Recirculation Design Rule Saved Set for Gasoline	Ewen, Ken (kewen)	Check List
0308_EG-S1	Exhaust Gas Recirculation Design rule Saved Set for Low Pressure	Ewen, Ken (kewen)	Check List




Engine Fasteners (Bolted joints) Design Rules

KPAC Set ID	Title	Author	Type
PT_FAST-S1	Cup Plug Design Rule Saved Set	Murphy, Mark (mmurphy9)	Check List
PT_FAST-S1	Dryseal Pipe Thread Design Rule Saved Set	Murphy, Mark (mmurphy9)	Check List
PT_FAST-S1	Dowel and Bushing Design Rule Saved Set	Murphy, Mark (mmurphy9)	Check List
PT_FAST-S1	Fastener and Joint Design Rule Saved Set	Murphy, Mark (mmurphy9)	Check List
PT_FAST-S1	Threaded Fastener Design Rule Saved Set	Murphy, Mark (mmurphy9)	Check List
PT_FAST-S1	Wrench and Socket Design Rule Saved Set	Murphy, Mark (mmurphy9)	Check List
PT_FAST-S1	Ball Plug Design Rule Saved Set	Murphy, Mark (mmurphy9)	Check List
PT_FAST-S1	Port Plug Design Rules Saved Set	Murphy, Mark (mmurphy9)	Check List
PT_FAST-S1	Thread Forming Screws in Plastic Saved Set	Murphy, Mark (mmurphy9)	Check List

Engine Sealing Design Rules

KPAC Set ID	Title	Author	Type
0310_ES-S1	Cam Cover Design Rule Saved Set	Smith, Thomas (tsmith57)	Check List
0310_ES-S1	Dynamic Seal Rule Saved Set	Smith, Thomas (tsmith57)	Check List
0310_ES-S1	Fasteners Rules for Covers Saved Set	Smith, Thomas (tsmith57)	Check List
0310_ES-S1	Front Cover Design Rule Saved Set	Smith, Thomas (tsmith57)	Check List
0310_ES-S1	Oil Pan Design Rule Saved Set	Smith, Thomas (tsmith57)	Check List
0310_ES-S1	Rear Seal Retainer Design Rule Saved Set	Smith, Thomas (tsmith57)	Check List
0310_ES-S1	Static Seal Design Rule Saved Set	Smith, Thomas (tsmith57)	Check List

- Three types of EGR systems are listed. We need to choose the correct system to see the correct rules.

KPAC Set ID	Title	Author	Type
0308_EG-S1	Exhaust Gas Recirculation Design Rule Saved Set for Diesel 	Ewen, Ken (kewen)	Check List
0308_EG-S1	Exhaust Gas Recirculation Design Rule Saved Set for Gasoline 	Ewen, Ken (kewen)	Check List
0308_EG-S1	Exhaust Gas Recirculation Design rule Saved Set for Low Pressure 	Ewen, Ken (kewen)	Check List

The particular example we are working on is using a **High Pressure** EGR System on a **DIESEL** engine. So we will need to choose the first ruleset. The other 2 rulesets are not related to our system, they are there for **GASOLINE** and **Low Pressure EGR** engines..

- We have identified the joints in our systems. EGR means Exhaust Gas Recirculation, which means it includes a lot of gas transfers. Additionally, EGR systems usually includes a cooler as well. In our example system, the cooler and the valve of the EGR system is packaged inside one module. So our system also includes coolant (liquid) transfer, to cool down the gases.
- As we have all these gas and liquid transfers, some of our related joints should be leak proof, sealed properly. To support this, there are design rules for **ENGINE SEALING**.

KPAC Set ID	Title	Author	Type
0310_ES-S1	Cam Cover Design Rule Saved Set	Smith, Thomas (tsmith57)	Check List
0310_ES-S1	Dynamic Seal Rule Saved Set	Smith, Thomas (tsmith57)	Check List
0310_ES-S1	Fasteners Rules for Covers Saved Set	Smith, Thomas (tsmith57)	Check List
0310_ES-S1	Front Cover Design Rule Saved Set	Smith, Thomas (tsmith57)	Check List
0310_ES-S1	Oil Pan Design Rule Saved Set	Smith, Thomas (tsmith57)	Check List
0310_ES-S1	Rear Seal Retainer Design Rule Saved Set	Smith, Thomas (tsmith57)	Check List
0310_ES-S1	Static Seal Design Rule Saved Set	Smith, Thomas (tsmith57)	Check List

- In this list, there are some design rulesets for specific systems. As there is no specific design ruleset for EGR systems inside here, we will choose Static Seal Design Ruleset. The others, for example Cam Cover design ruleset should be used when the related part is indeed a cam cover.

- Lastly, as there are also fasteners that connects the parts to eachother, we have general rules for these fixations. As you can see on the below list there are a few different rulesets for that.

KPAC Set ID	Title	Author	Type
PT_FAST-S13	Cup Plug Design Rule Saved Set	Murphy, Mark (mmurphy9)	Check List
PT_FAST-S13	Dryseal Pipe Thread Design Rule Saved Set	Murphy, Mark (mmurphy9)	Check List
PT_FAST-S13	Dowel and Bushing Design Rule Saved Set	Murphy, Mark (mmurphy9)	Check List
PT_FAST-S13	Fastener and Joint Design Rule Saved Set	Murphy, Mark (mmurphy9)	Check List
PT_FAST-S13	Threaded Fastener Design Rule Saved Set	Murphy, Mark (mmurphy9)	Check List
PT_FAST-S13	Wrench and Socket Design Rule Saved Set	Murphy, Mark (mmurphy9)	Check List
PT_FAST-S16	Ball Plug Design Rule Saved Set	Murphy, Mark (mmurphy9)	Check List
PT_FAST-S16	Port Plug Design Rules Saved Set	Murphy, Mark (mmurphy9)	Check List
PT_FAST-S19	Thread Forming Screws in Plastic Saved Set	Murphy, Mark (mmurphy9)	Check List

You can see that some special types of fasteners (like ball plug, dowel/bushing, cup plug etc. has unique design rulesets. In our example, we do not have a special feature on any of our fixing points, so we will just use the generic Fastener and Joint design rule and Threaded Fastener design ruleset.

Tensioner

- The function of a tensioner is to control system tension at a sufficient level to prevent belt slip under any driving condition.



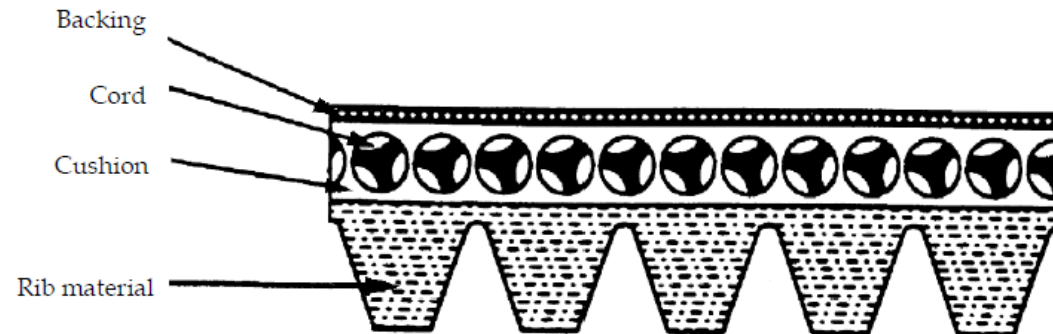
Manual

Rotary - automatic

Strut - automatic

Belt

- The belt transmits the driving power from the crankshaft to the accessories.

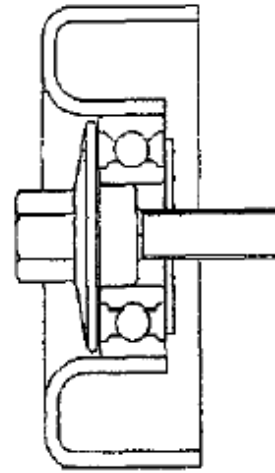
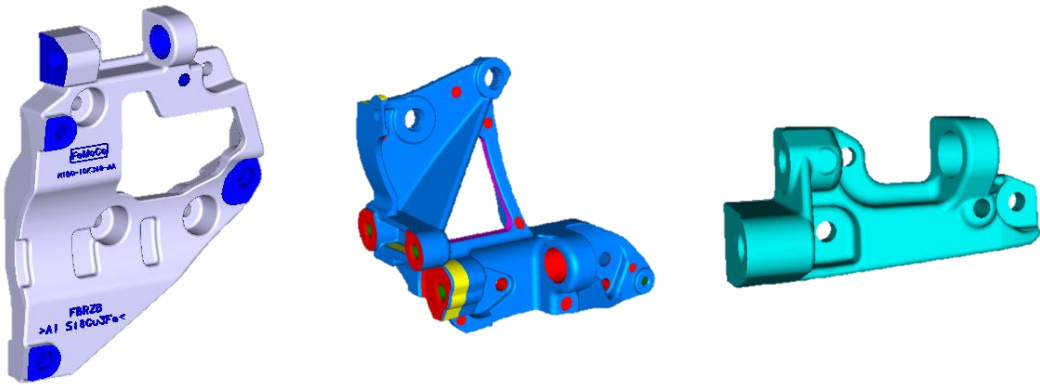


Idler Pulleys

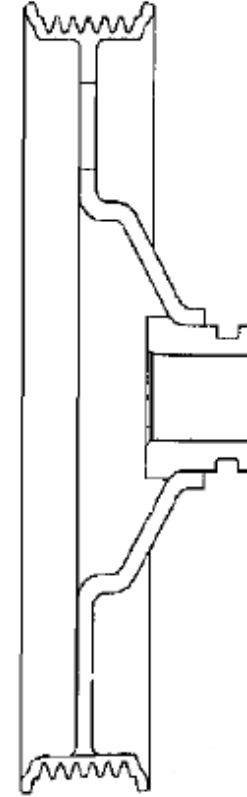
- An idler pulley is introduced into the system to guide the belt to achieve the following requirements:
 - a) Reposition the belt path to avoid obstacles,
 - b) Create more belt wrap on adjacent pulleys,
 - c) Control vibration on long spans.

Brackets

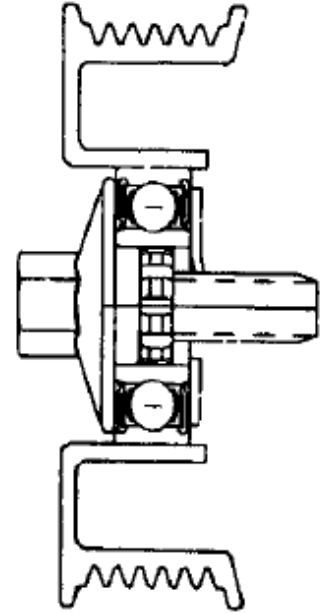
- Creates suitable positioning points for accessories.



Flat idler



Grooved pulley



Grooved idler

- **EGR – Exhaust Gas Recycling** is a method of controlling combustion through the addition of exhaust gases into the intake side of an internal combustion engine.

In its simplest form an EGR system comprises of the following steps

1. Exhaust gases pass through a take-off tube connected to the exhaust system.
2. The exhaust gas flow is metered through a control valve
3. A proportion of exhaust gases are passed into the combustion chamber through the engine intake

Internal EGR - Engines equipped with variable valve timing on the intake and exhaust camshafts are able to trap exhaust gasses within the cylinder by not fully expelling it during the exhaust stroke, dramatically increasing the residual gas fraction. This is called internal EGR. All the benefits of EGR are not realised by this method. However, in certain cases, internal (uncooled) EGR is preferred:

Gasoline – At low loads to reduce pumping losses while maintaining combustion stability

Diesel – At low loads and during cold start

EGR Cooler Function

Diesel - EGR cooling reduces engine out NOx and increases intake charge density, allowing for increased EGR % without compromising desired air/fuel ratio.

Gasoline - For downsized boosted applications, cooled EGR not only reduces NOx but also improves fuel economy by mitigating knock and reducing or eliminating enrichment to maintain proper turbine temperatures.

EGR Valve Function

An EGR Valve is used to control the amount of EGR flow which enters the intake system. The valve assembly contains a DC electronically controlled motor, a gearbox and usually a poppet on seat valve. Depending on design and material specification, the assembly can be placed either side of the EGR cooler. Valves exposed to high temperatures will have additional channels in the casting for coolant flow.

