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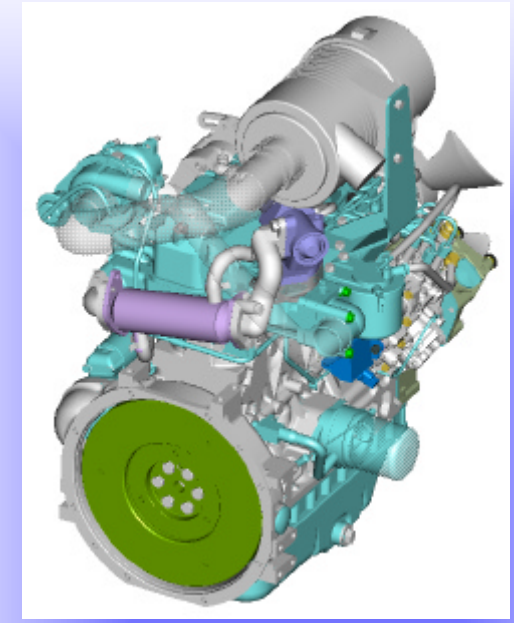
# TNV TIER3 INTRODUCTION



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# *Introduction program:*

TNV TIER3 Technology (basic introduction)

- Engine model and technical update
- (DIS)advantages NEW technology

TNV ECO governor (practice & visualization)

- ECO governor system operation

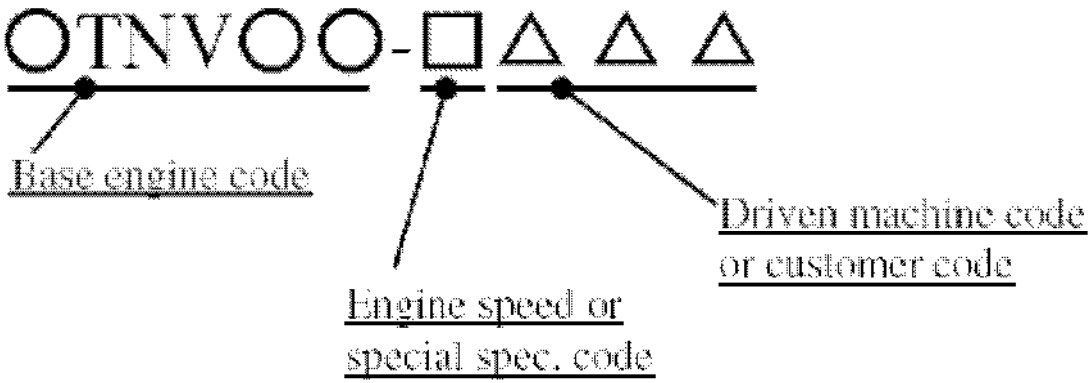
Yanmar service tool

- Yanmar Service tool explanation
- Diagnostics & troubleshooting

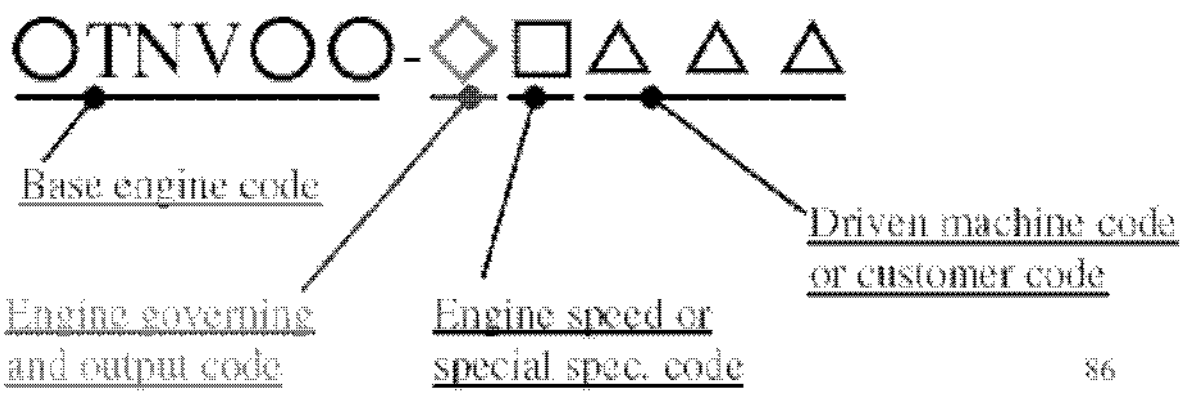
# TNV Tier 3 Technology

Engine model coding (**new**)

Tier2




Tier3






B: mechanical governor

U: mechanical governor and derating

Z: electric governor

E: electric governor and derating

# TNV Tier 3 Technology



Target is to comply with EPA Tier 3 / Intermediate 4 regulations enforced from 2008.

NV1 series (< 19 kW), regulation is less strict in comparison to higher CLASS (output). **No modification**

NV2 series (19~37 kW), High pressure FO injection together with combustion matching are needed to comply the regulations. **modification**

NV3 series (37~75 kW), High pressure FO injection together with electronic controlled EGR are needed to comply the regulations. **modification**

1st = Tier3 spec. 2nd = control costs INCREASE of electronic controlled parts
3rd = PRODUCT improvement(capability)

Final = YANMAR introduced ECO governor system

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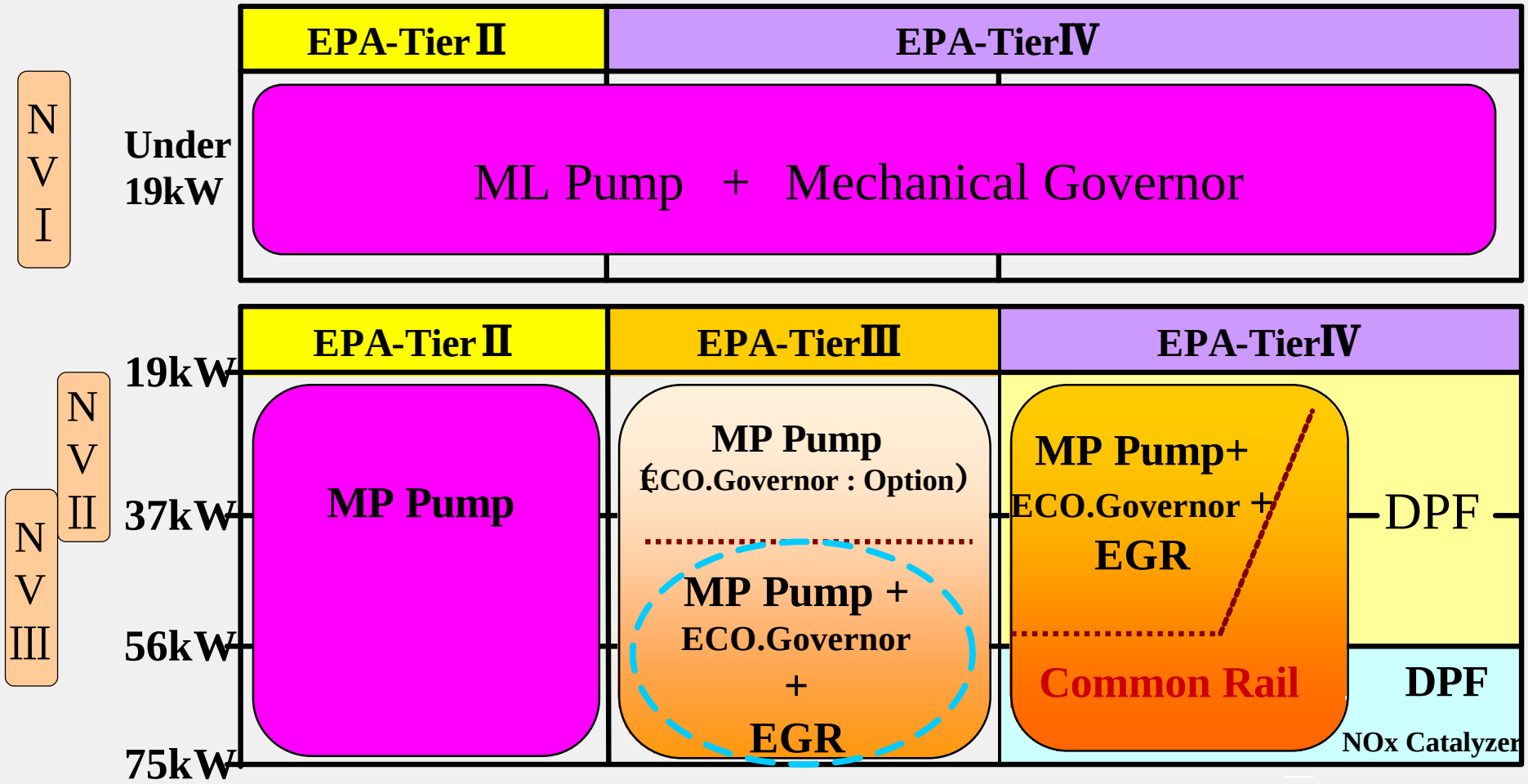
# TNV Tier 3 Technology

Engine model
technical update




※MP Pump = Mono Plunger Pump

※ML Pump = Mini in Line Pump

※ECO.Governor = Electronic Control Governor

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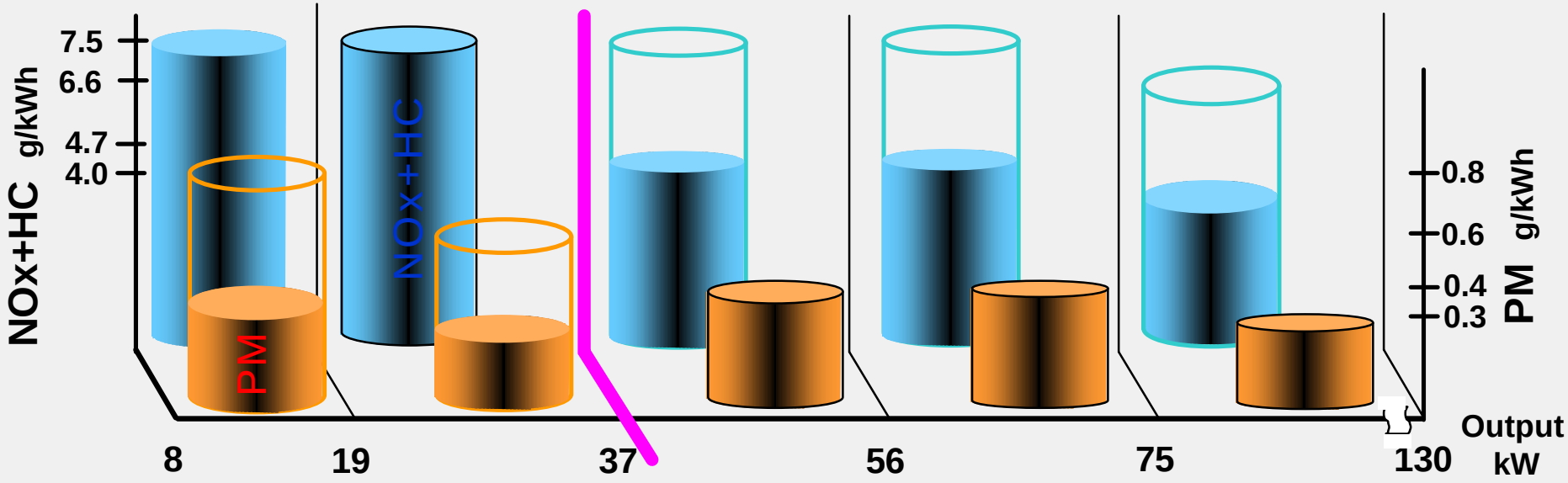
# TNV Tier 3 Technology

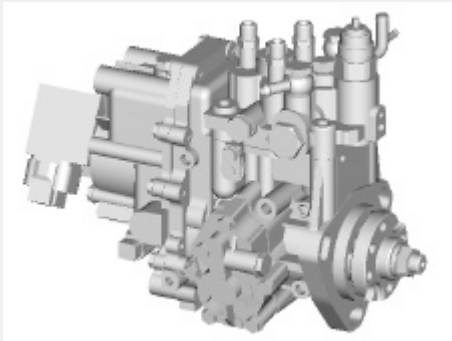
Engine model
technical update

## For 2008 Regulations (US.EPA-TierIII & EC-StageIIIA )




IDI | DI

| | | |
|---|---|---|
| ~~In-Di Inj. ... anical ... overnor~~ NO MODIFICATION | Direct Inj. Fuel Pump with Mechanical Governor<br>Optional ECO governor | Direct Inj. Fuel Pump with Electric Governor + Electric controlled EGR system |



YANMAR =MP= pump
for Direct inj.

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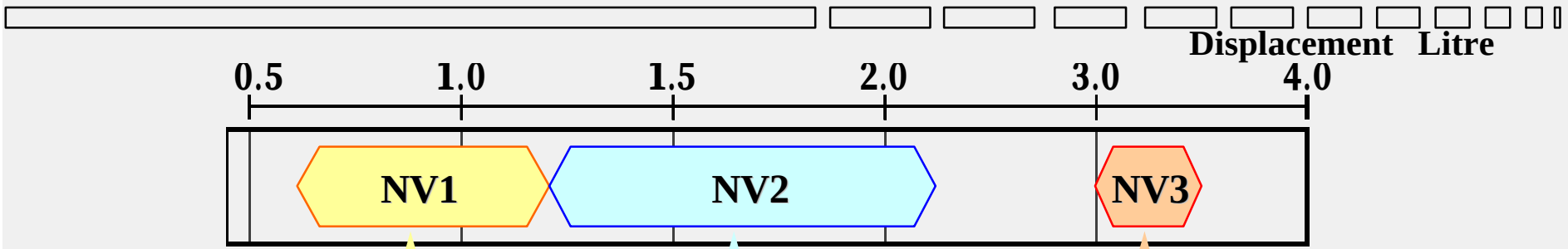
# TNV Tier 3 Technology

Engine model technical update




## NV1 (IDI)

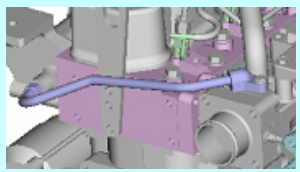
Tier II technology
is applied to Tier III

•ML Pump

## NV2 (DI)

Higher pressure of
fuel injection

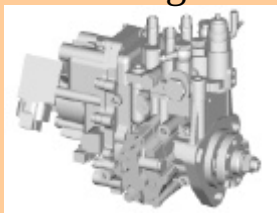
(ECO Governor is option)



## NV3 (DI)

Higher pressure of
fuel injection
＋
Electronic control EGR
＋
ECO Governor

•MP pump with ECO governor

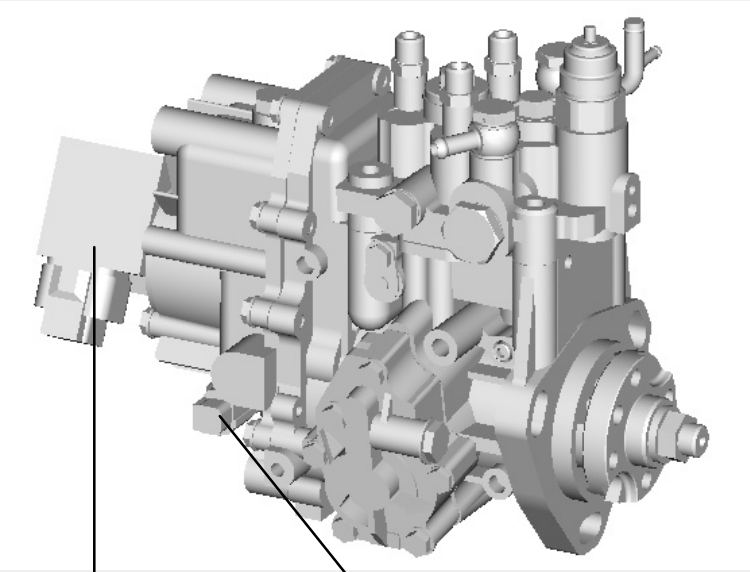


# TNV Tier 3 Technology



## MP pump (FO-injection)

minor change(internal)

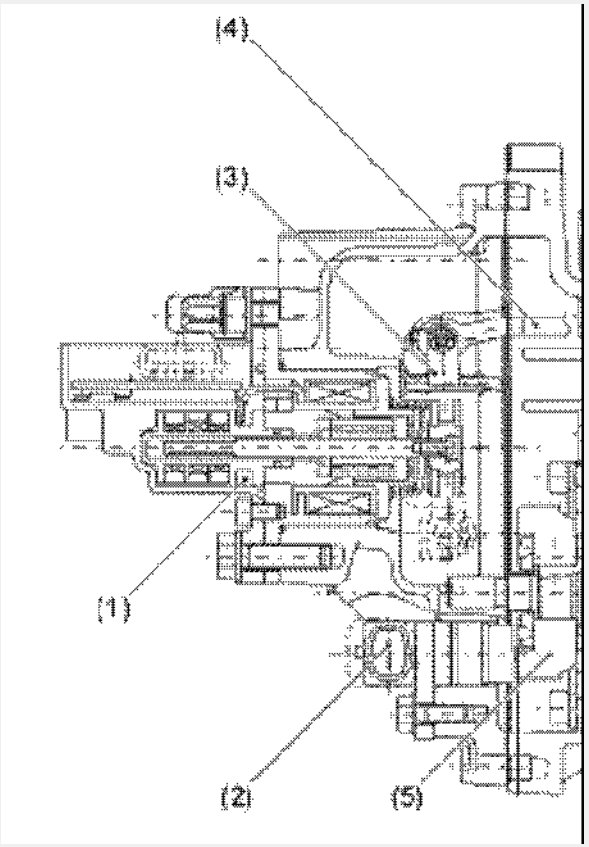


(1) Governor actuator (2) Speed sensor

(3) Governor lever

(4) Governor link

(5) Speed sensor gear



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# TNV Tier 3 Technology

Engine model technical update

## YPD-MP4

**Higher pressure fuel delivery**

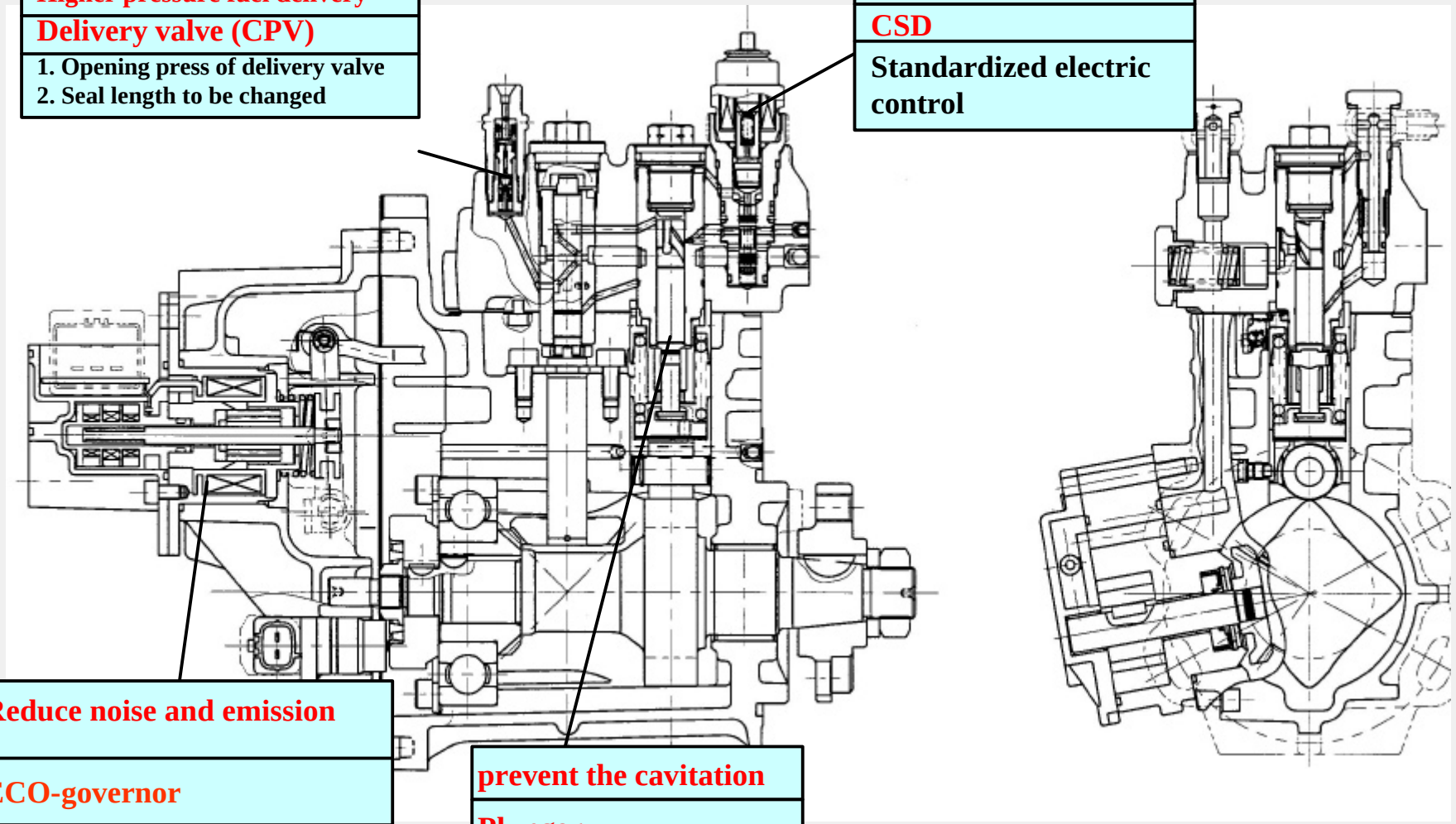
**Delivery valve (CPV)**

1. Opening press of delivery valve
2. Seal length to be changed

**Reduce white smoke**

**CSD**

**Standardized electric control**



**Reduce noise and emission**

**ECO-governor**

**Standardized electric control**

**prevent the cavitation**

**Plunger**

**Add a spill lead for sub-port on plunger**

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# Structural description for YPD-MP4

Tier3 ; part to be changed

Tier2 ; part was applied

| function | part name | structure |
|---|---|---|

**Higher pressure fuel delivery**

**Delivery valve (CPV)**

1. To be changed opening press of delivery valve
2. To prevent cavitation, seal length to be changed

**Reduce white smoke**

**CSD**

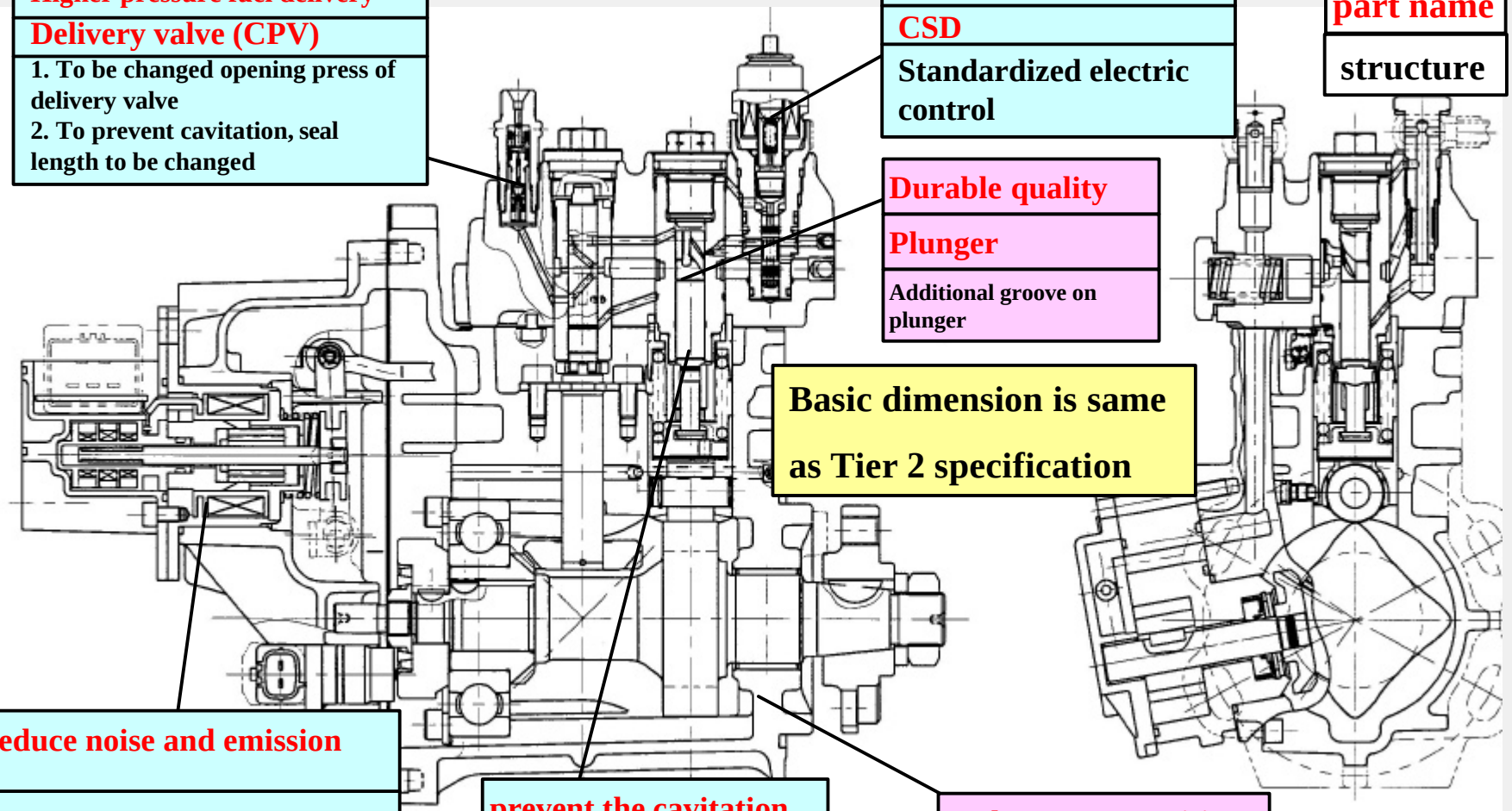
Standardized electric control

**Durable quality**

**Plunger**

Additional groove on plunger

**Basic dimension is same as Tier 2 specification**



**Reduce noise and emission**

**ECO-governor**

Standardized electric control

**prevent the cavitation**

**Plunger**

Add a spill lead for sub-port on plunger

**Reduce LO transition**

**Pump housing**

Additional drain hole etc..

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# TNV Tier 3 Technology

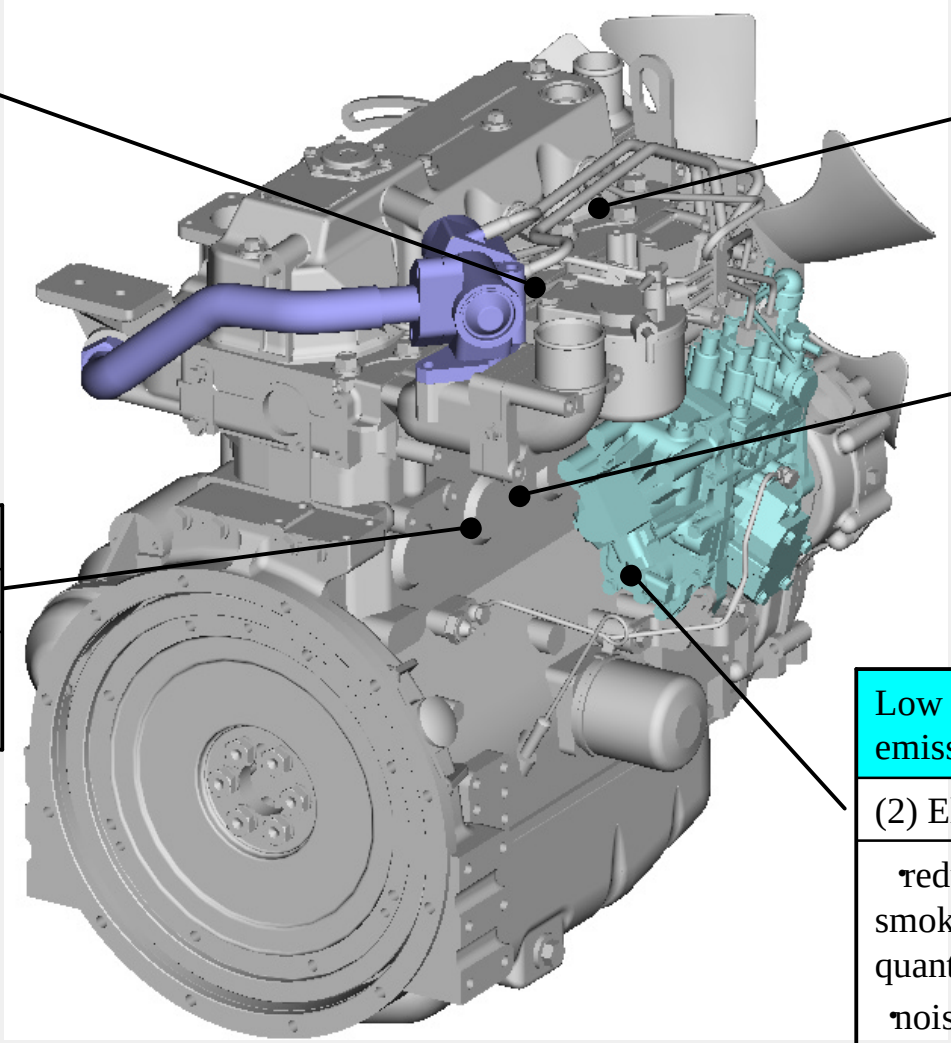
Engine model technical update

NV3 range ➡ Optimization of combustion = exhaust emission improvement

| Low exhaust gas emission |
|---|
| (1) Electric EGR valve |
| Reduction of NOx in exhaust gas re-circulation |

| Low exhaust gas emission |
|---|
| (5) Fuel injection nozzle |
| Optimization of nozzle hole diameter |

| Improvement of reliability |
|---|
| (4) Cylinder block |
| Reduction of FOP vibration |



| Improvement of reliability |
|---|
| (3) Piston ring |
| •Improvement of friction<br>•Improvement of corrosion |

| Low noise & Low exhaust gas emission |
|---|
| (2) Electric control governor |
| •reduction of free acceleration smoke , smoke at starting in fuel quantity control<br>•noise reduction in Iso-chronous control at high idle speed |

# TNV Tier 3 Technology



## Principle of EGR system

How to reduce NOx?

*Temperature (The higher the temperature is, the more Nox generated.)

*Intake air (The more the quantity of intake air is, the more Nox generated.)

2-ways to achieve this:

1. Retard (delay) ignition timing.

   GOOD for emission regulation

   BAD for Engine performance & fuel economy

**CREATES soot and its reducing OIL change interval**

2. Reduce amount of oxygen in cylinder, to slow down combustion process.

   Less oxygen drops cylinder and combustion process temperature.

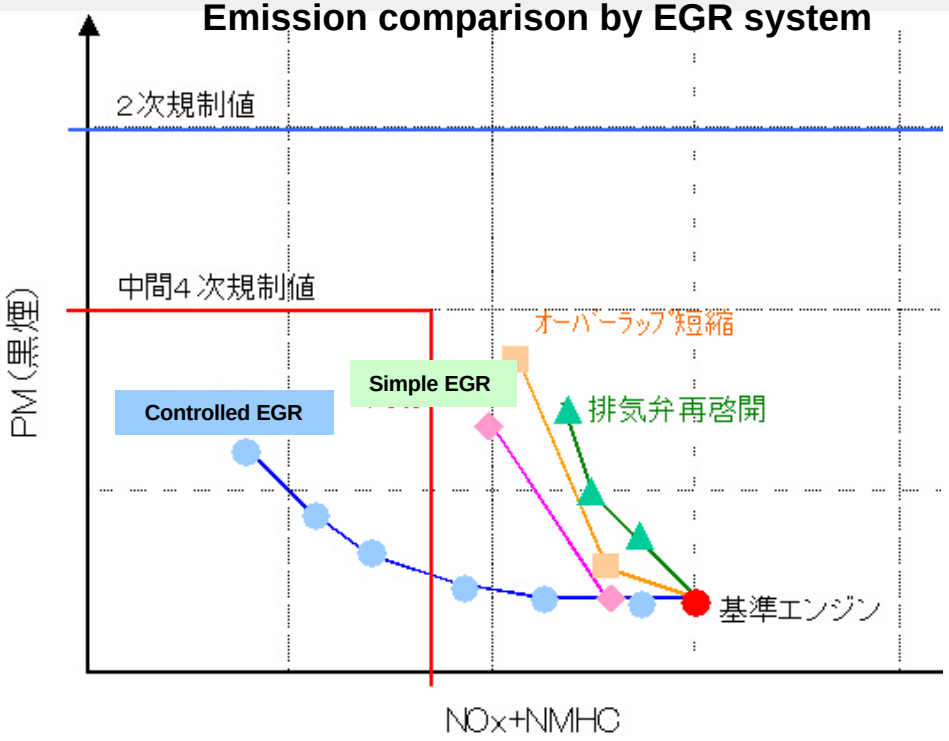
This is done by re-circulating some exhaust gas back into the cylinder

# TNV Tier 3 Technology

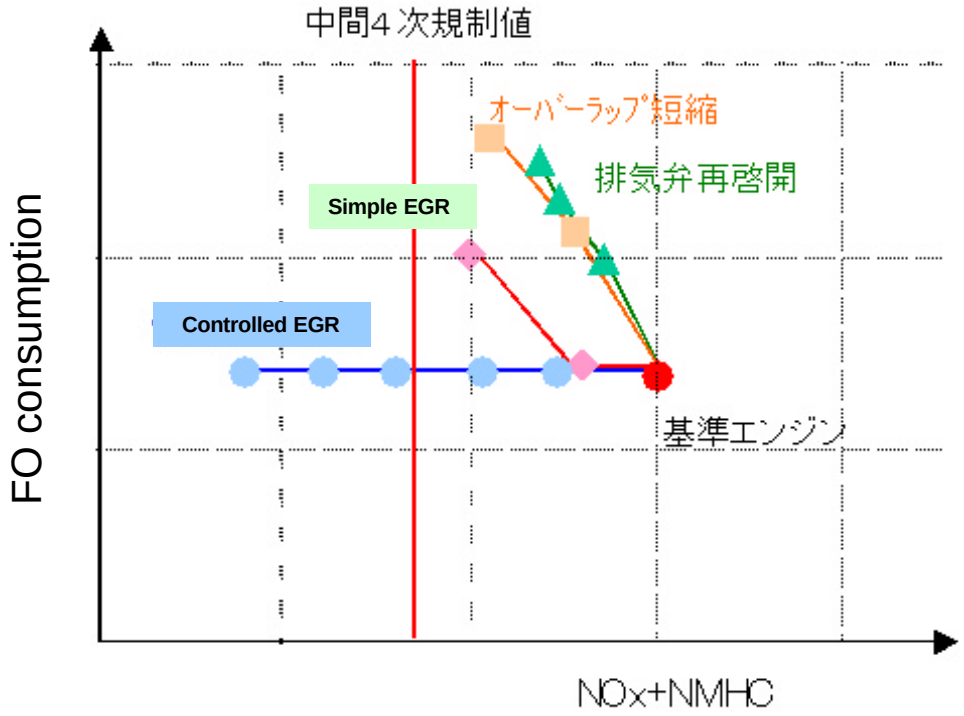


## Electric Control EGR system

### Emission comparison by EGR system



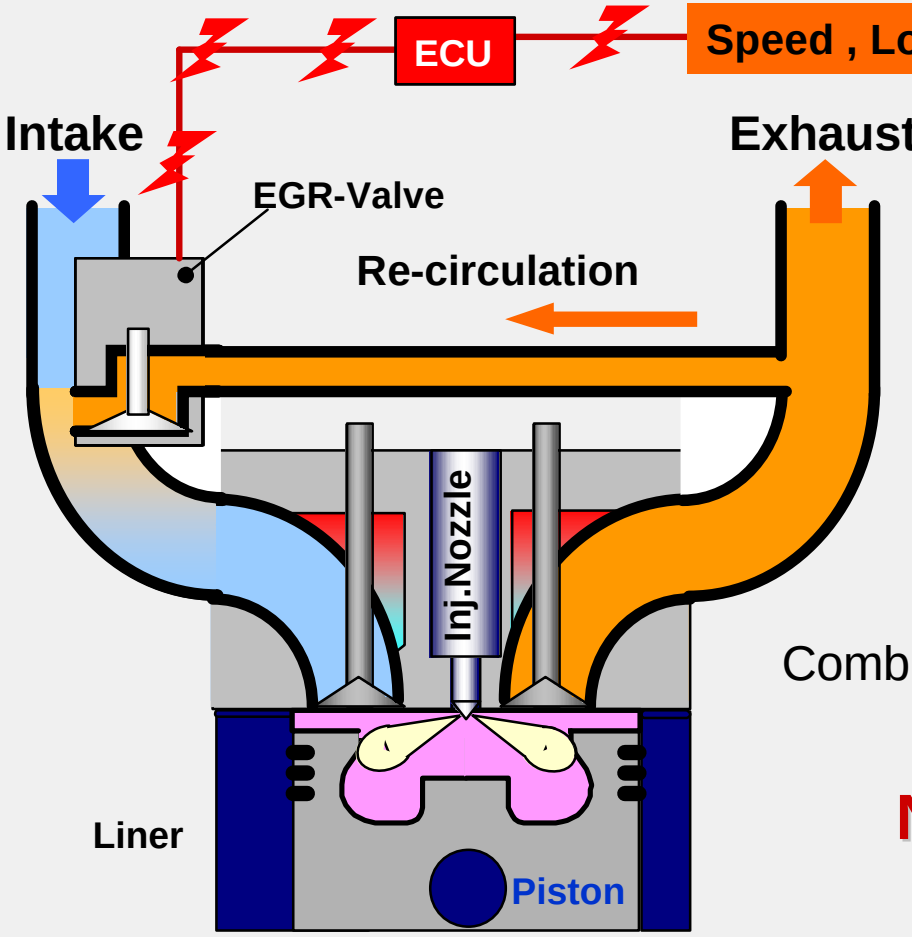

### FO consumption by EGR system

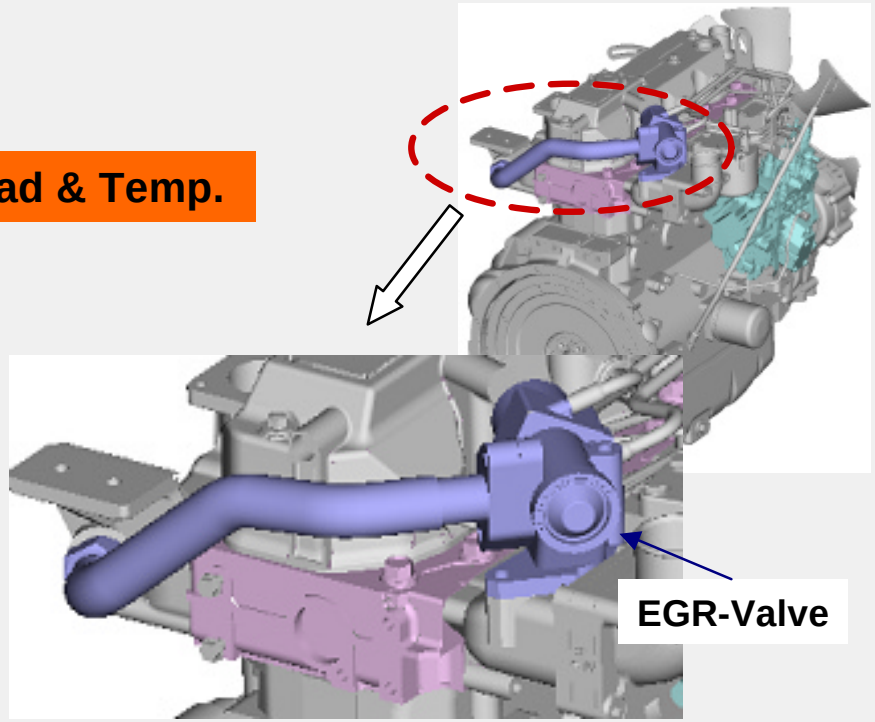


# TNV Tier 3 Technology



## Electric Control EGR system




Combustion Temperature could be reduced.

**Nox will be Decrease**

# TNV Tier 3 Technology



## Advantages of ECO governor

- Controlled EGR valve by engine speed and load
  ⇒Reduce NOx level for environmental friendly
- Optimum fuel delivery rate at starting and acceleration
  ⇒Reduce smoke level which is the weak point for diesel engine
- Combination control with ECU on machine side using CAN-bus correspondence
  ⇒Adjustable engine speed and droop by machine condition
- Available failure mode diagnosis and service tool
  ⇒Using personal computer

# TNV Tier 3 Technology



## Advantages of ECO governor

BIG feature is complete free control of engine speed versus FO amount. NO major restrictions. We can get best power output which matches the work performance of customers machine / application.

A. Droop control
- **Torque matching LOW speed range** — **Establish EG output**
- **Engine performance @ partial load enhanced.**

B. Isochronous control
- **EG speed match acc. machine requirements** — **Setting of EG speed**
- **Idling (L&H) adjustment not needed**
- **Optimization of FO consumption** — **MOST effective EG performance (speed > noise reduction)**

**TOTAL is Torque curve control**

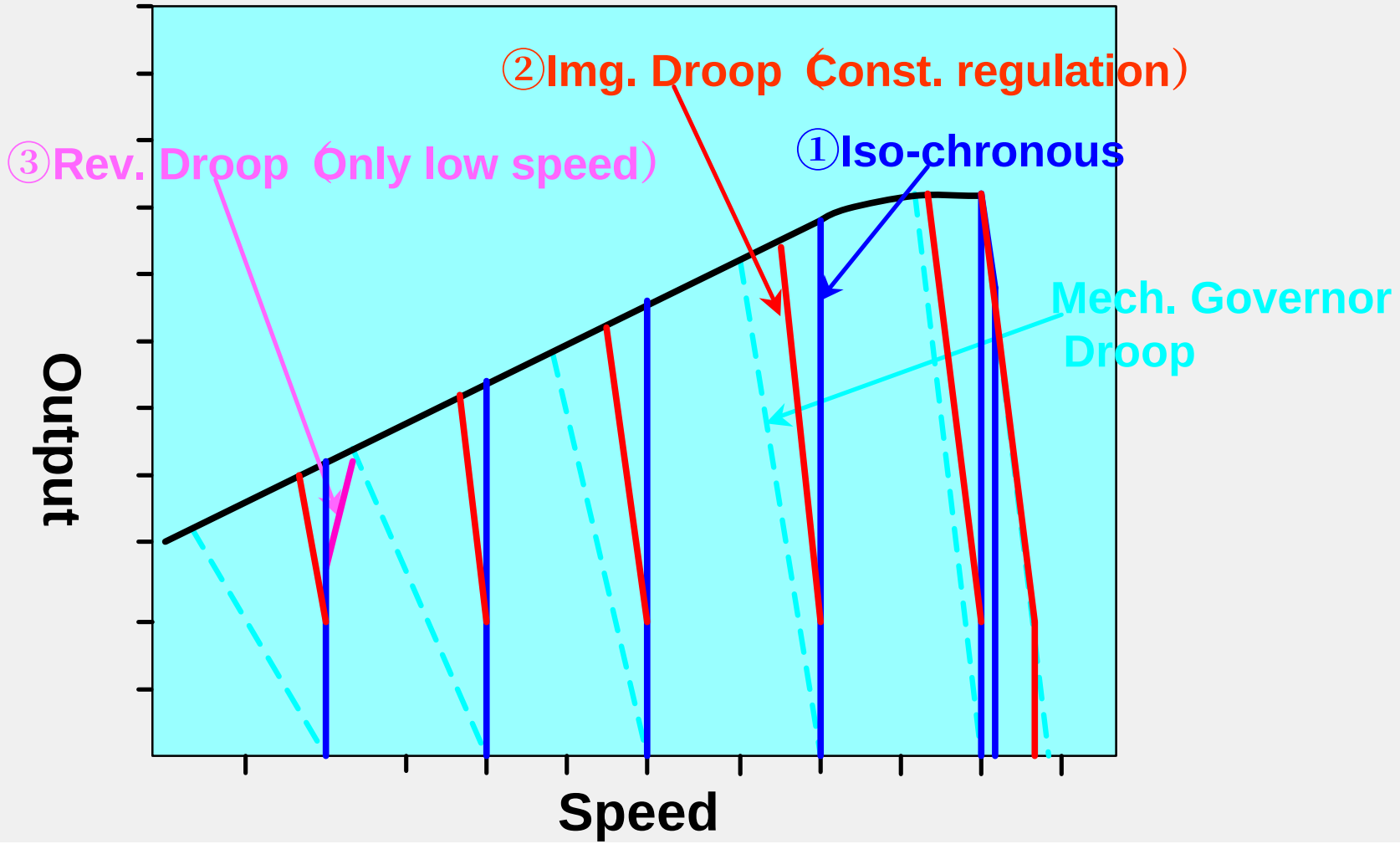
# TNV Tier 3 Technology

(dis)advantages
NEW technology

## Advantages of ECO governor

Torque curve = Droop & Isochronous control

### Selective Governor Mode ~~(③ : Option)~~



# TNV Tier 3 Technology



## Advantages of ECO governor

| | | |
|---|---|---|
| C. Start control | **Optimized rack position (= FO qty) @ EG start** | **Black smoke at starting and acceleration is reduced**<br>**Start Sd 1~2 > Sd 5~6**<br>**Acceleration Sd 2~3 > Sd ~1** |
| | **Improved cold start performance** | **Fuel injection timing is optimized** |
| D. Acceleration control | **FO injection control @ acceleration** | **Fuel amount is optimized** |

# TNV Tier 3 Technology

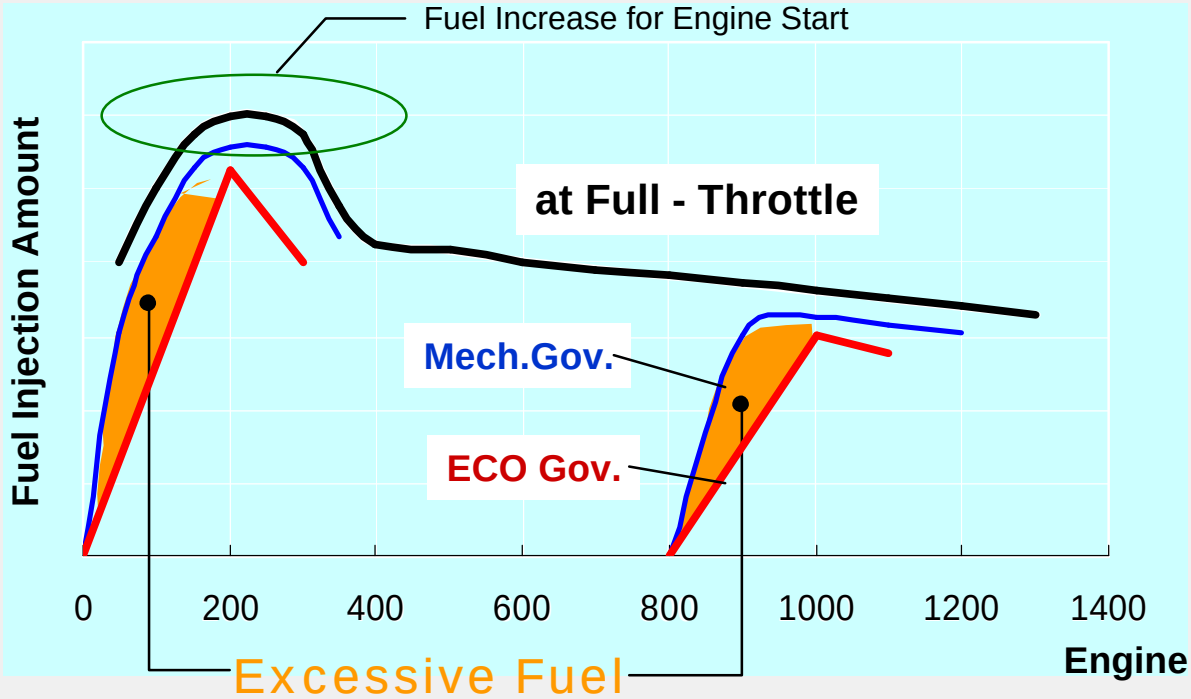


## Advantages of ECO governor

Start control

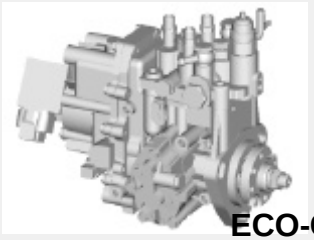
**Optimization of FO supply**

**Black smoke at starting and acceleration is reduced**




consequently

**SMOKE at Starting and Acceleration**



**ECO-Governor**

**NO SMOKE VISIBLE** **at Starting and Acceleration**

# TNV Tier 3 Technology

(dis)advantages
NEW technology

## Advantages of ECO governor

| | | |
|---|---|---|
| E. Idling speed control | **Pending on CW temp. idling speed will be adjusted.** | **EG warm-up time reduced (10-30 min)**<br>**EG protection @ high idle & less white smoke (20~50%)** |
| F. After heat control | **Starting aid devices activated after start** | |
| G. Communication function | **Data gather by ECO system**<br>**CAN function available**<br>**Connection available for troubleshoot (PC)** | **Possible to monitor engine performance**<br>**Optimize machine performance through structured network (CAN)**<br>**System diagnoses (incl history)** |

# TNV Tier 3 Technology



## Disadvantages of ECO governor

A. Costs increase

B. New technology introduced

**New advantaged technology / improved engine performance**

**Customer to be shown advantages**

**Current service system needs to be updated and trained**