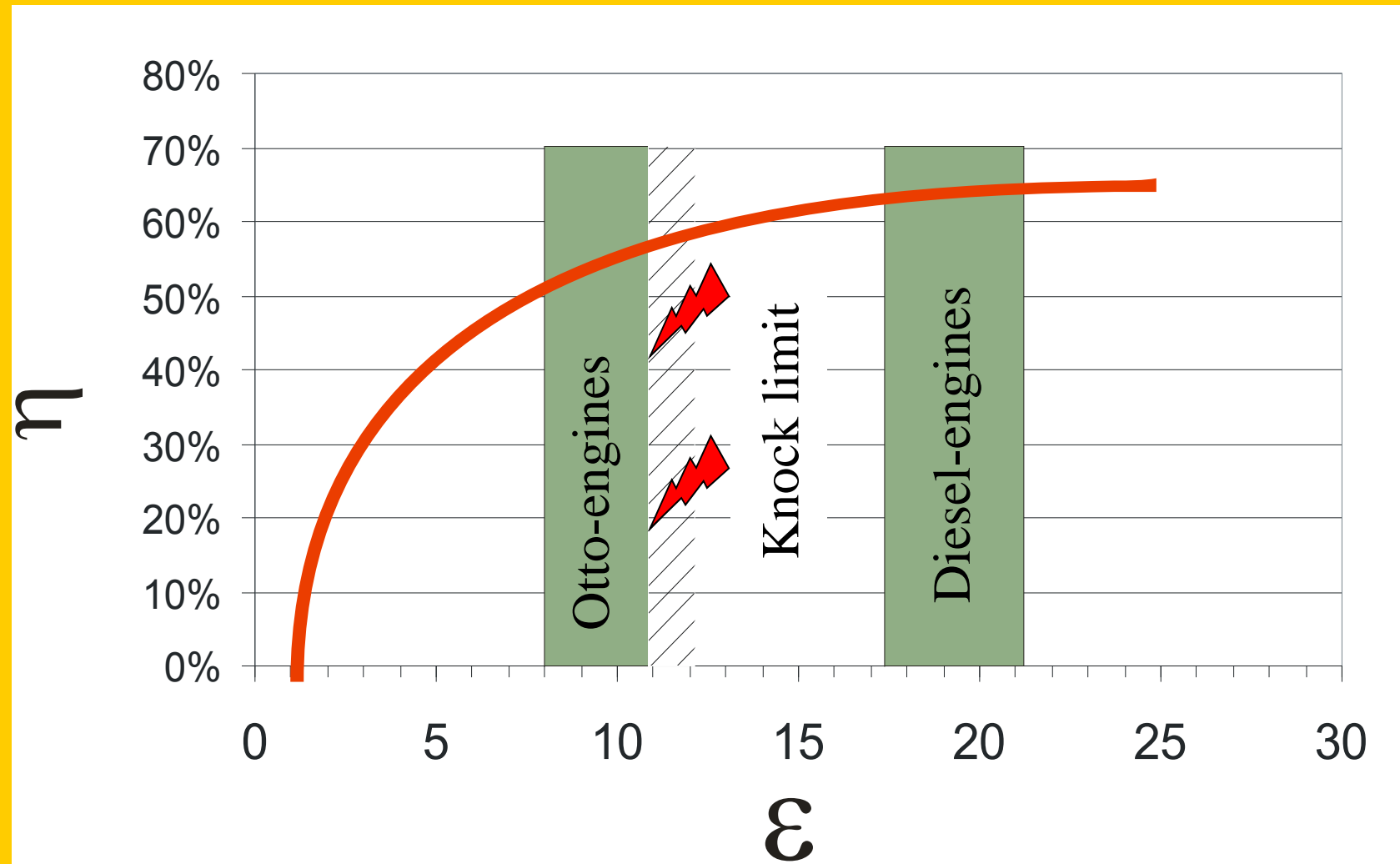
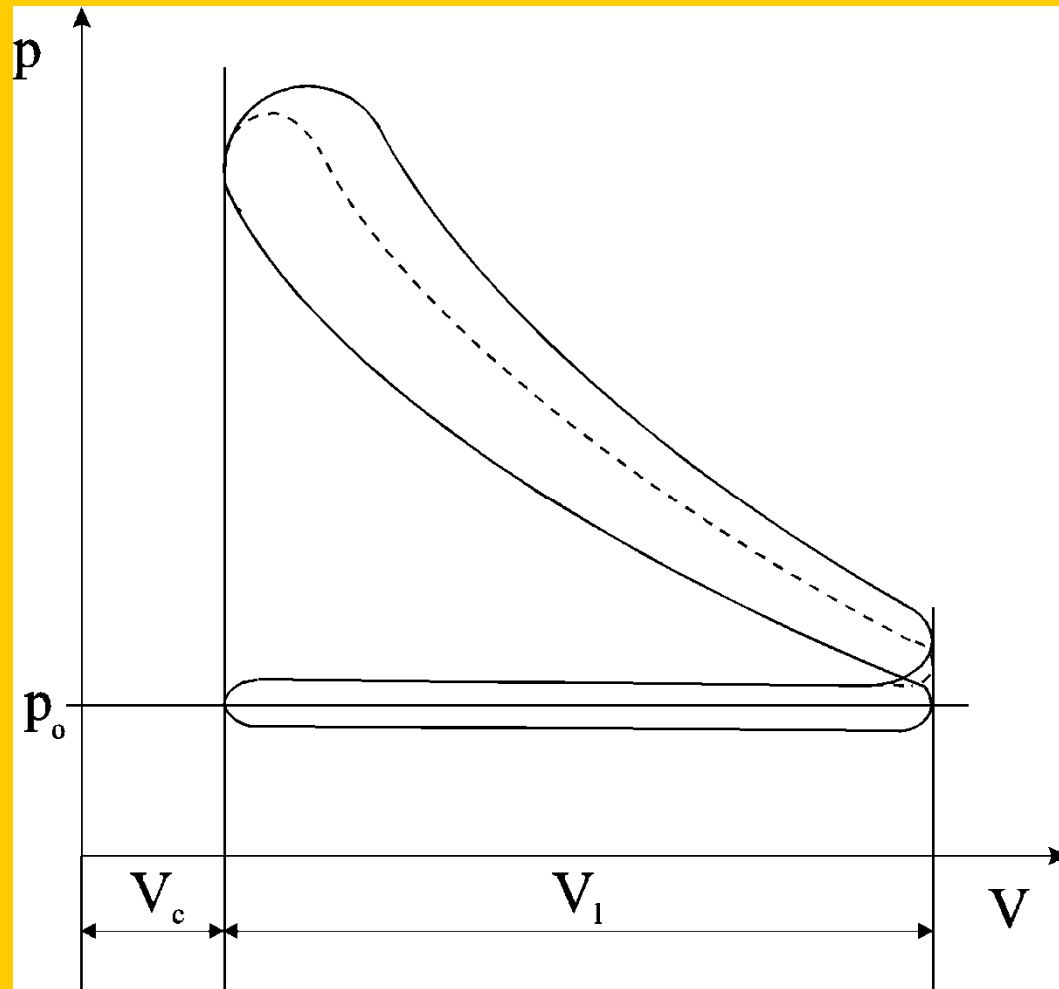


# Diesel or CI Engines

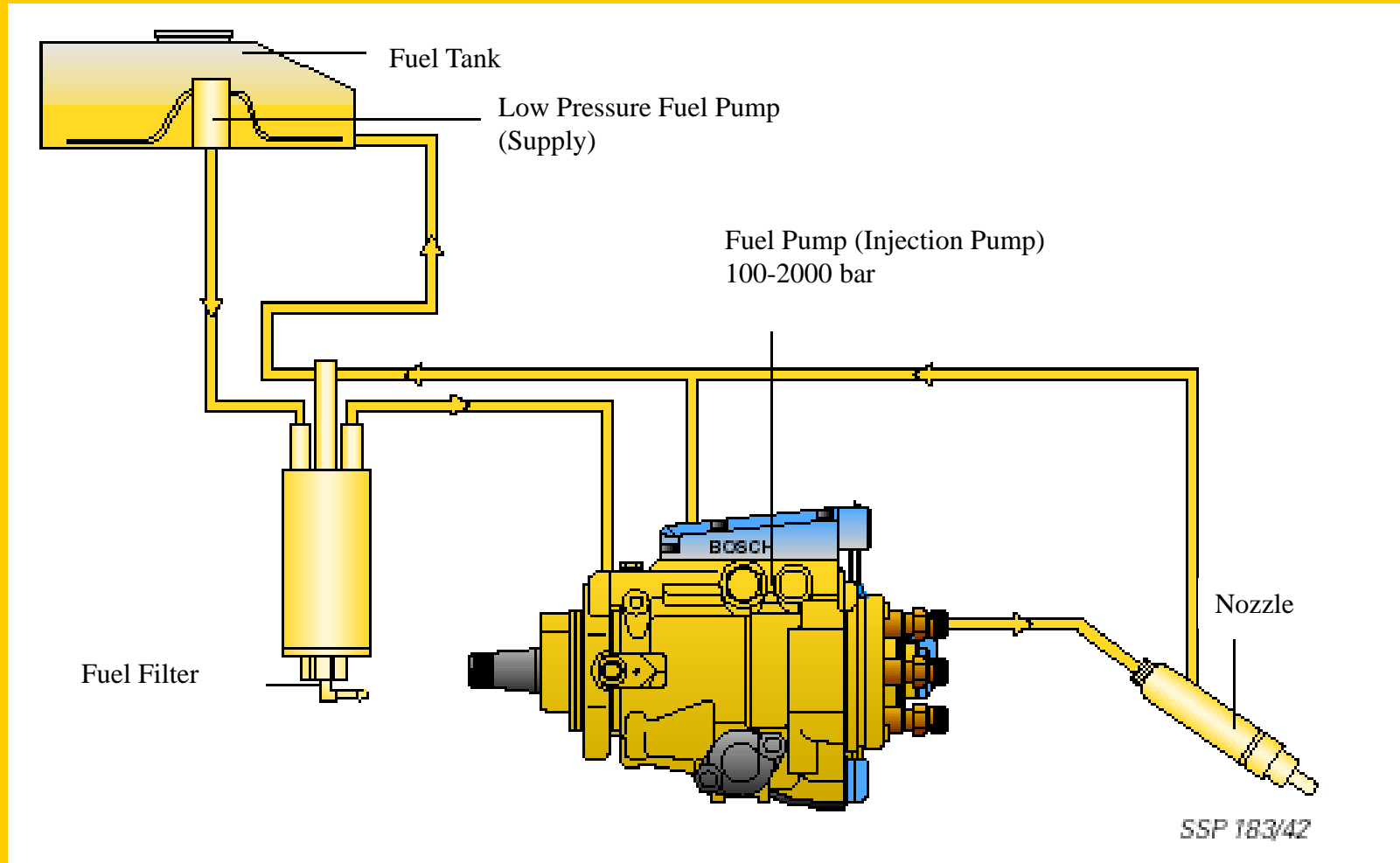
# Efficiency in the function of the compression ratio



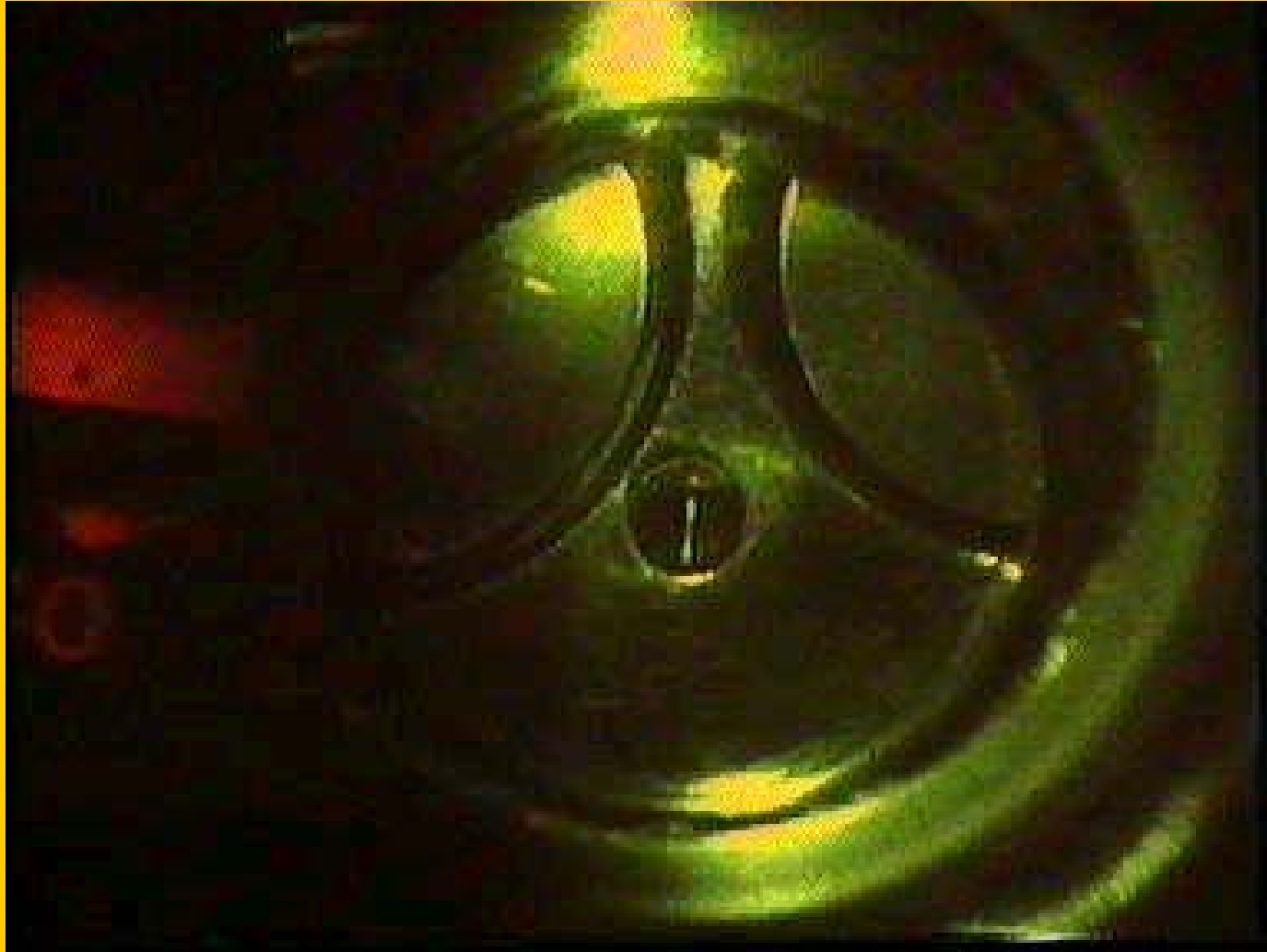


Diesel Control process (- full, --- partial load)

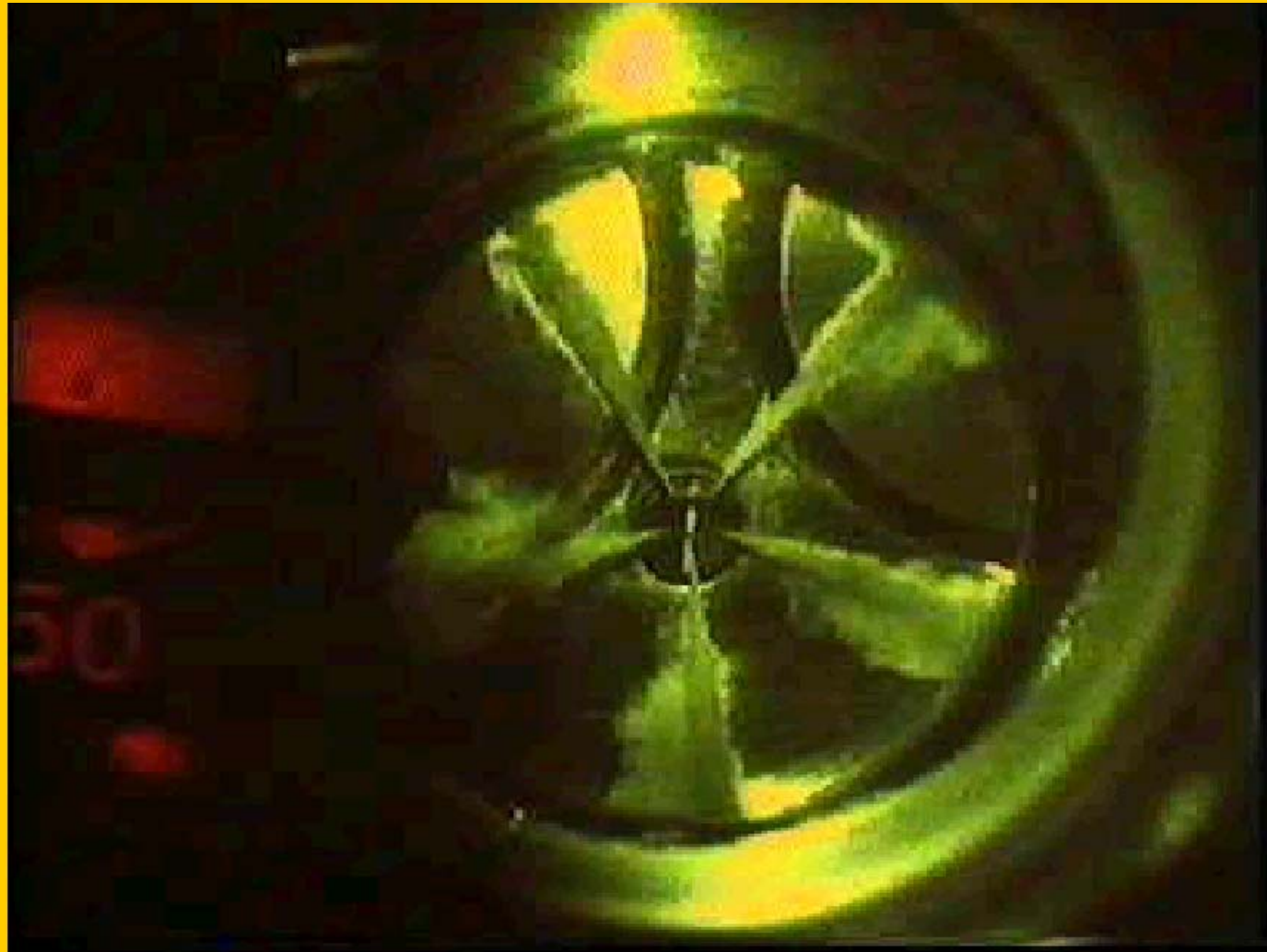
# Diesel Fuel System



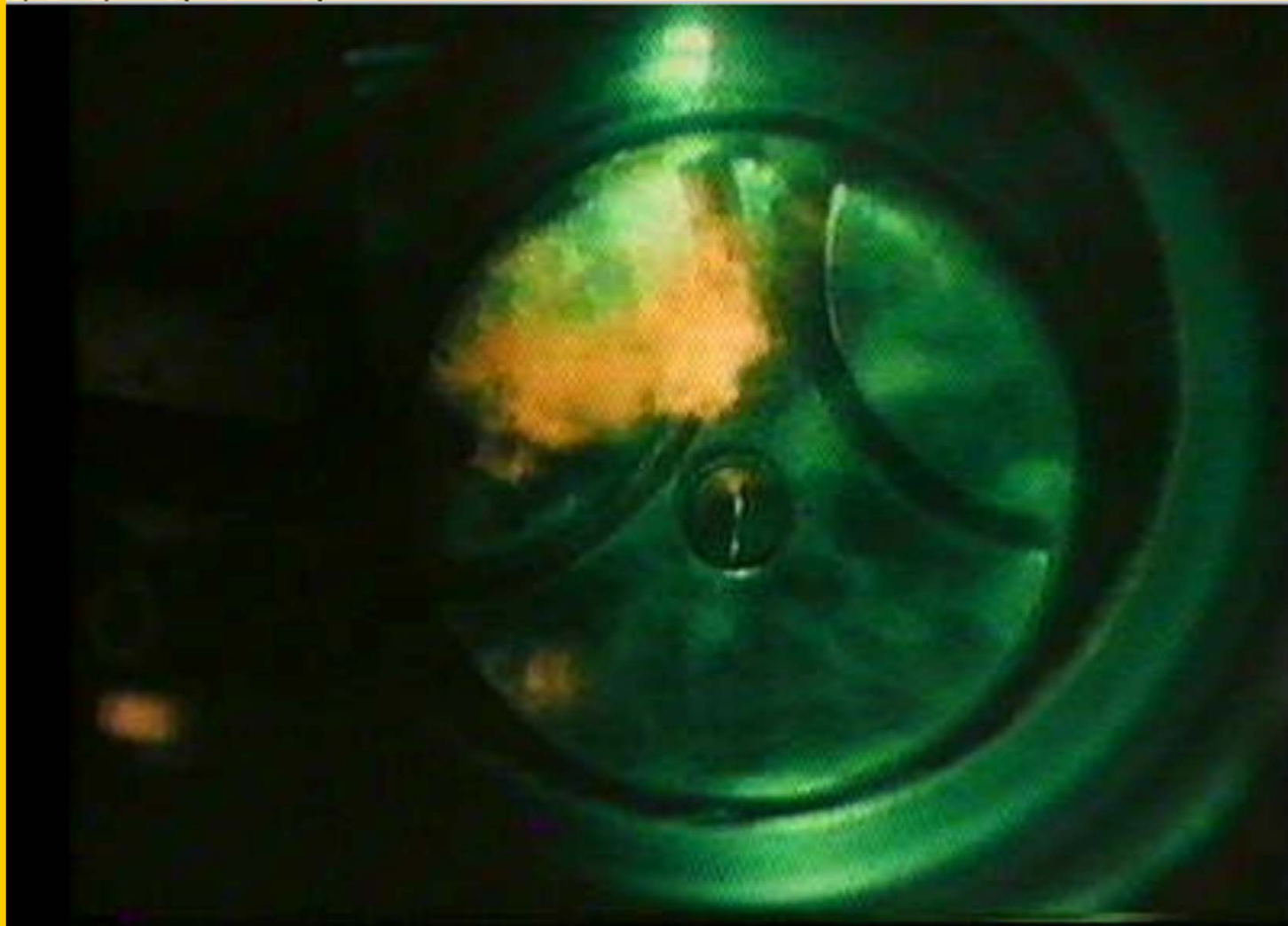
# Direct Injection Combustion



# 1- Injection



## 2- Start of Combustion

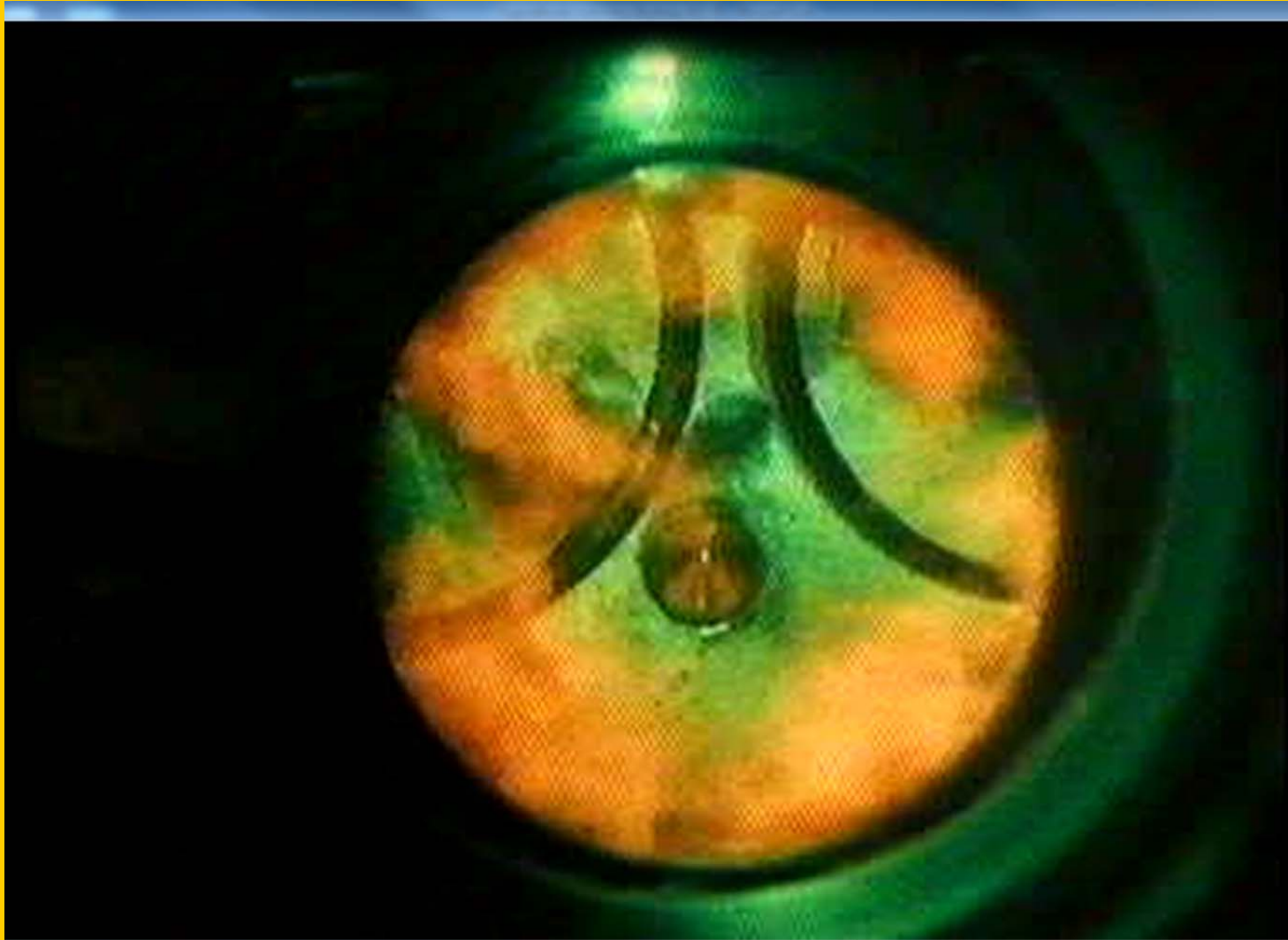


### 3-Premixed Combustion



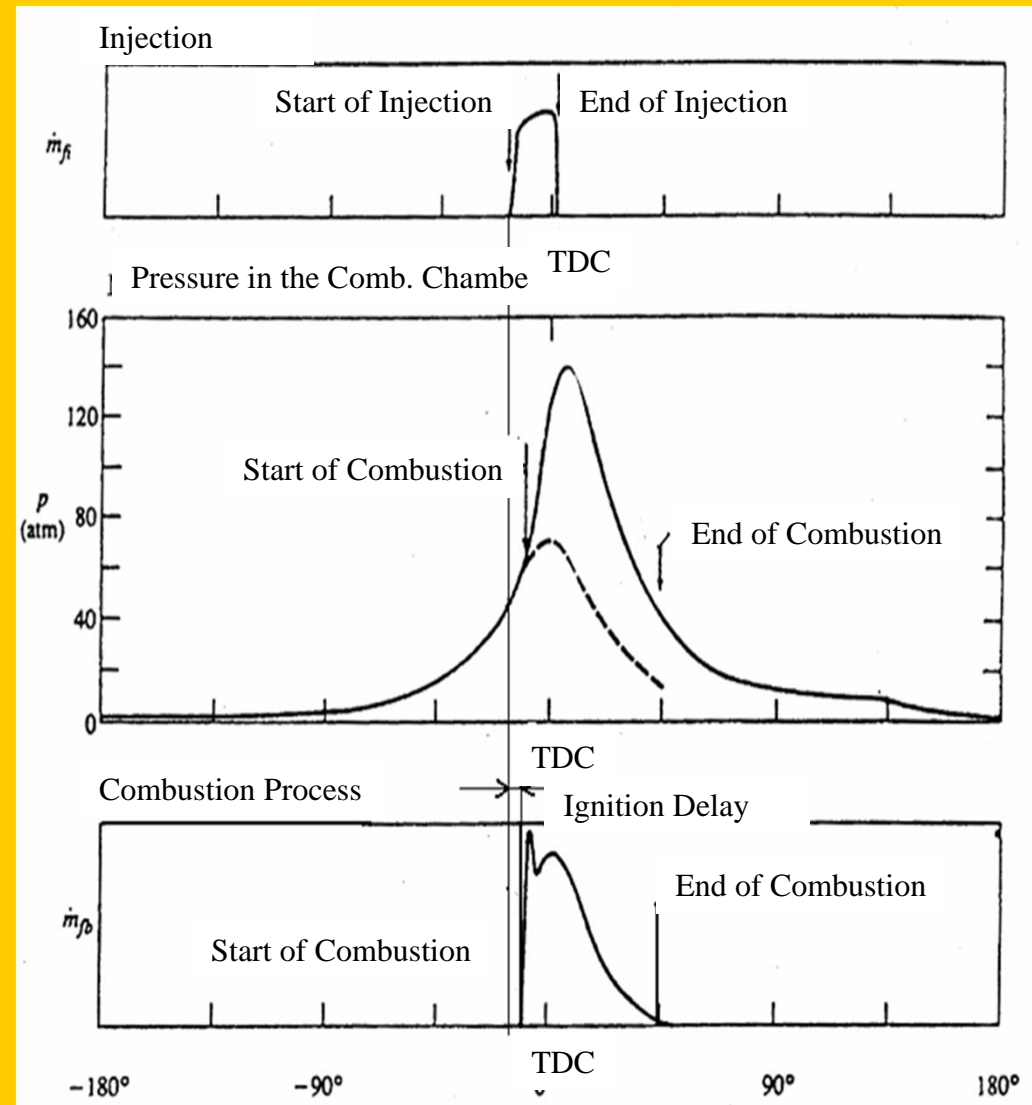


## 4- Diffusion Combustion



# Combustion Process

- Ignition Delay:  
Delay between the Start of Injection and the Start of Combustion (Cetan Number)

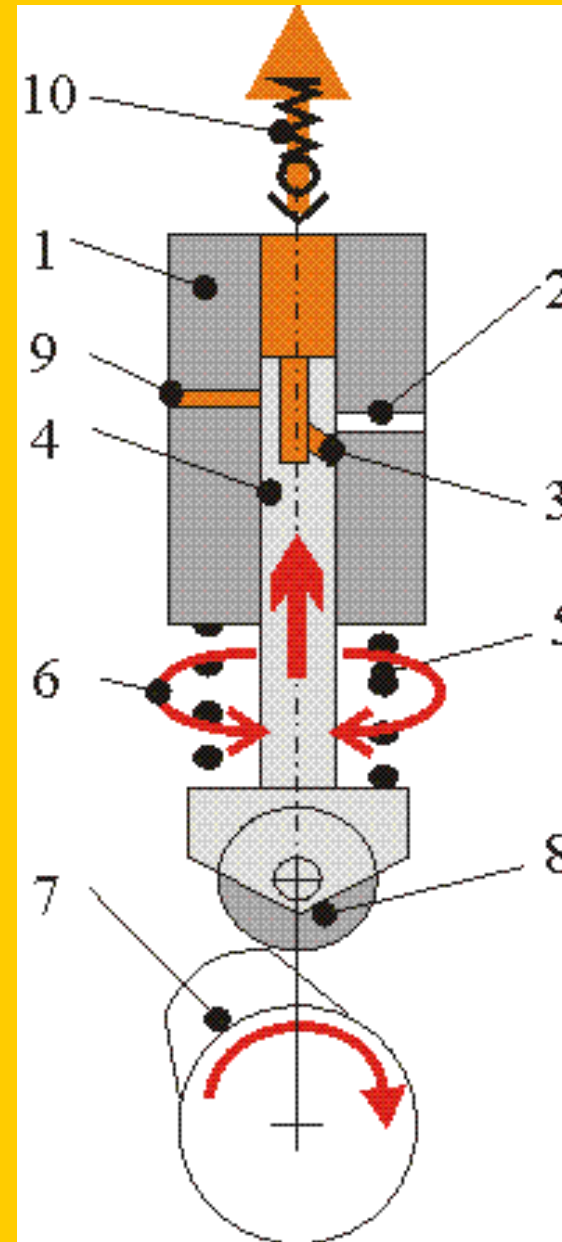


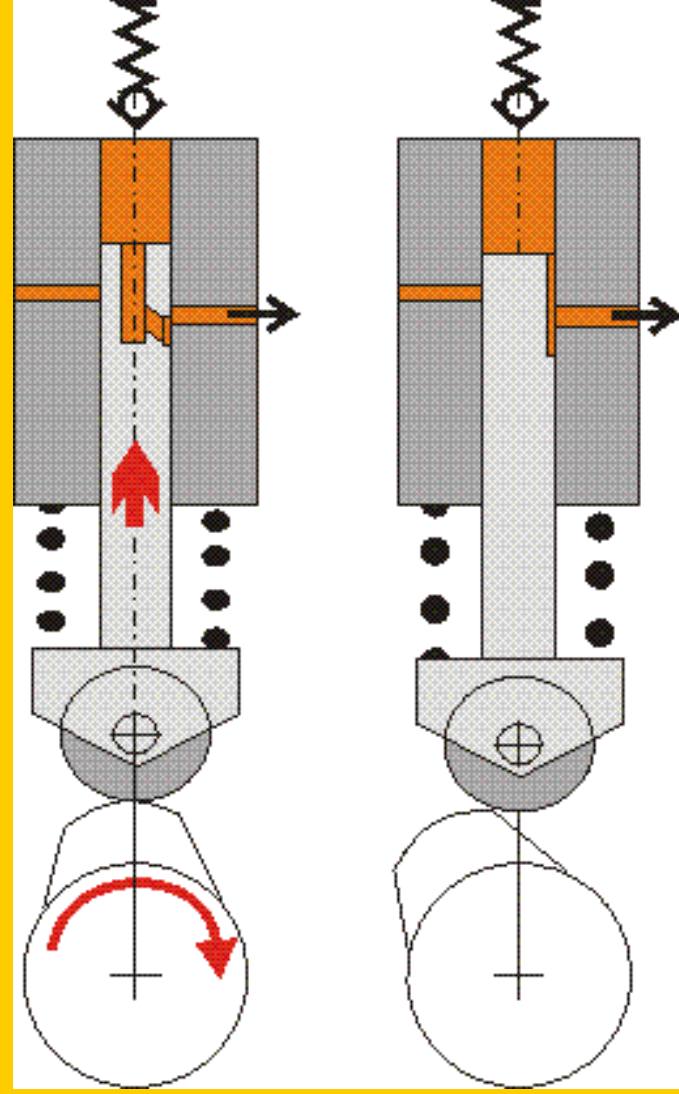
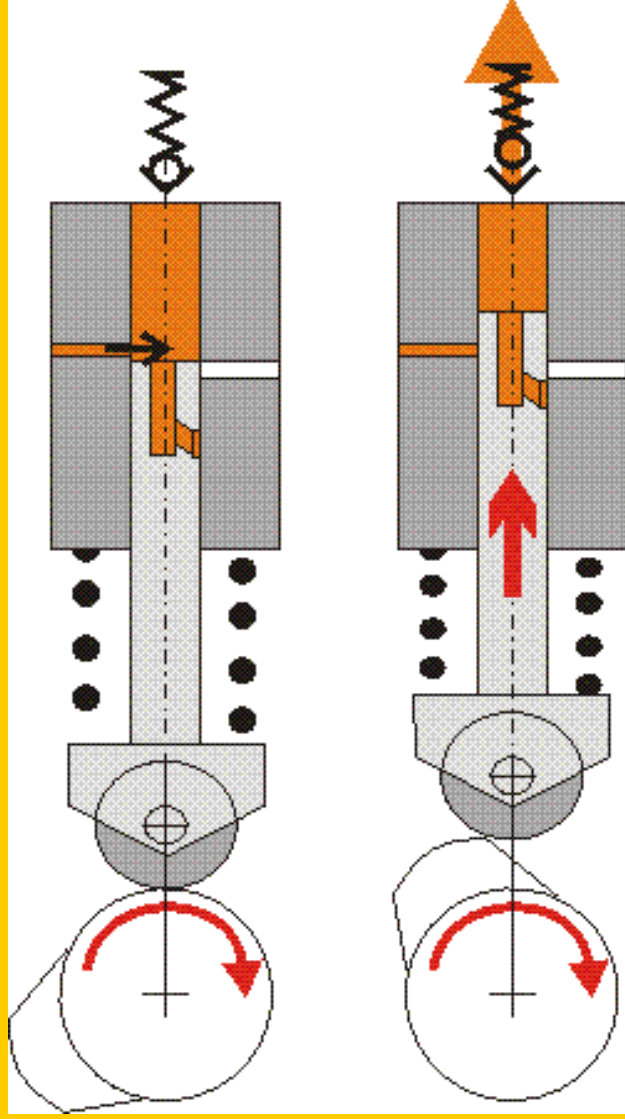
# The Main Tasks of the Injector pumps:

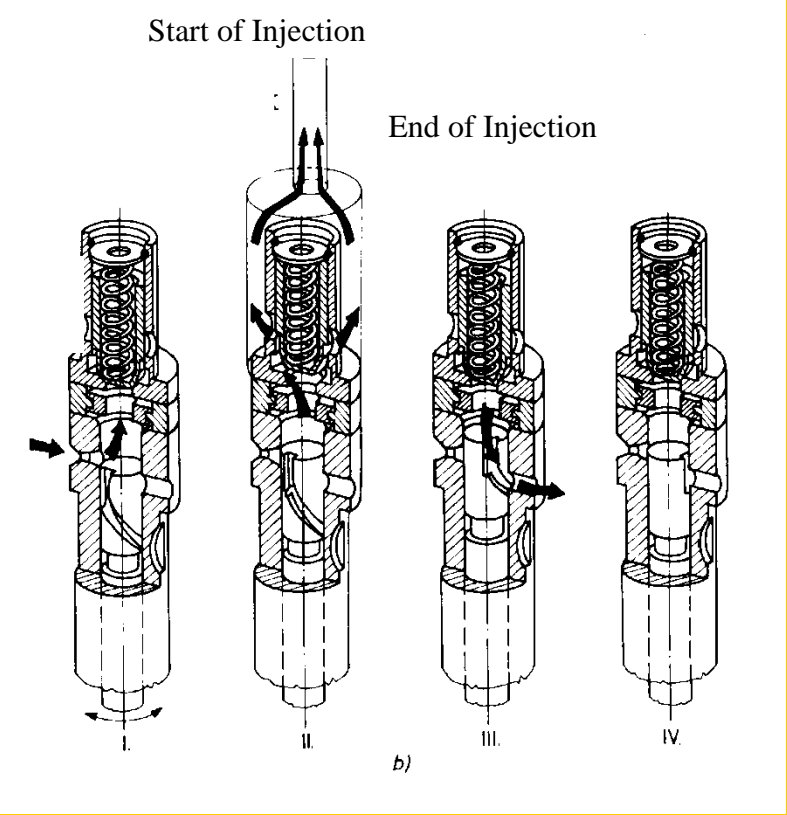
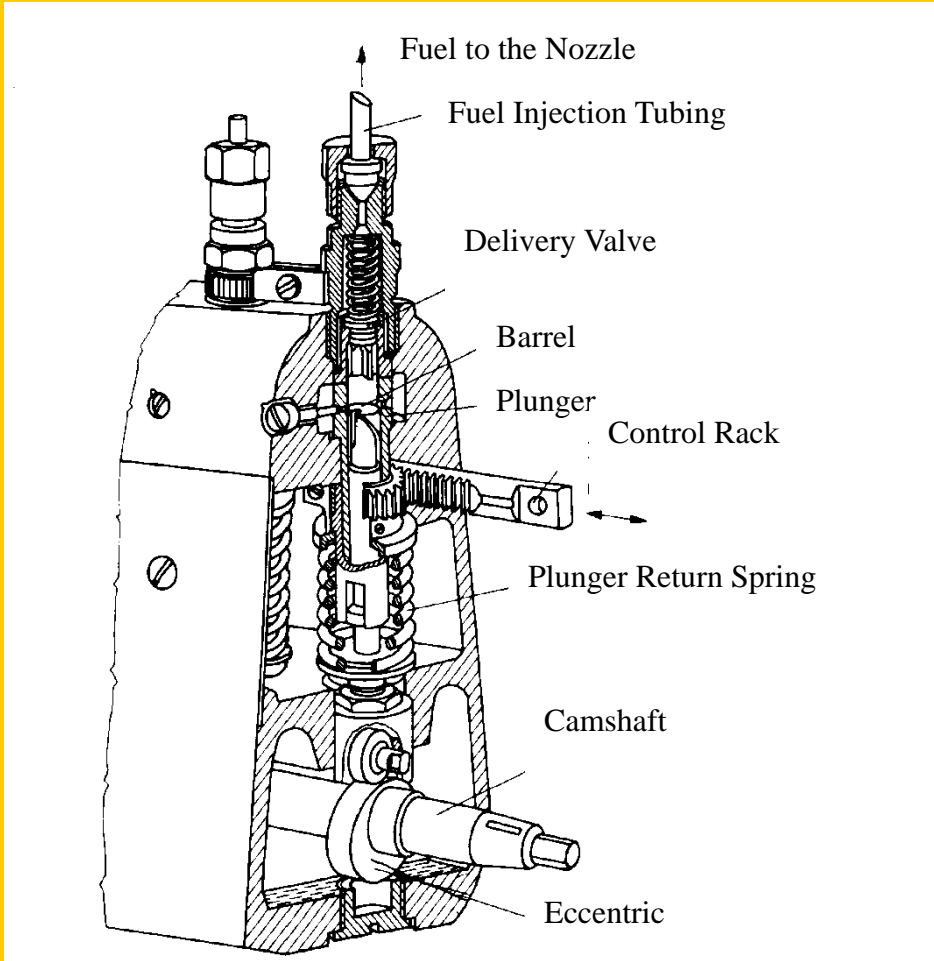
- Supply the fuel:
  - At the right time
  - Proper pressure
  - Right propotion

## In-Line Fuel Injection Pump

1. Injector house
2. By-pass (overflow port) channel
3. Helical groove
4. Barrel
5. Plunger Return Spring
6. fuel amount controller
7. Eccentric
8. Roller
9. Charging channel

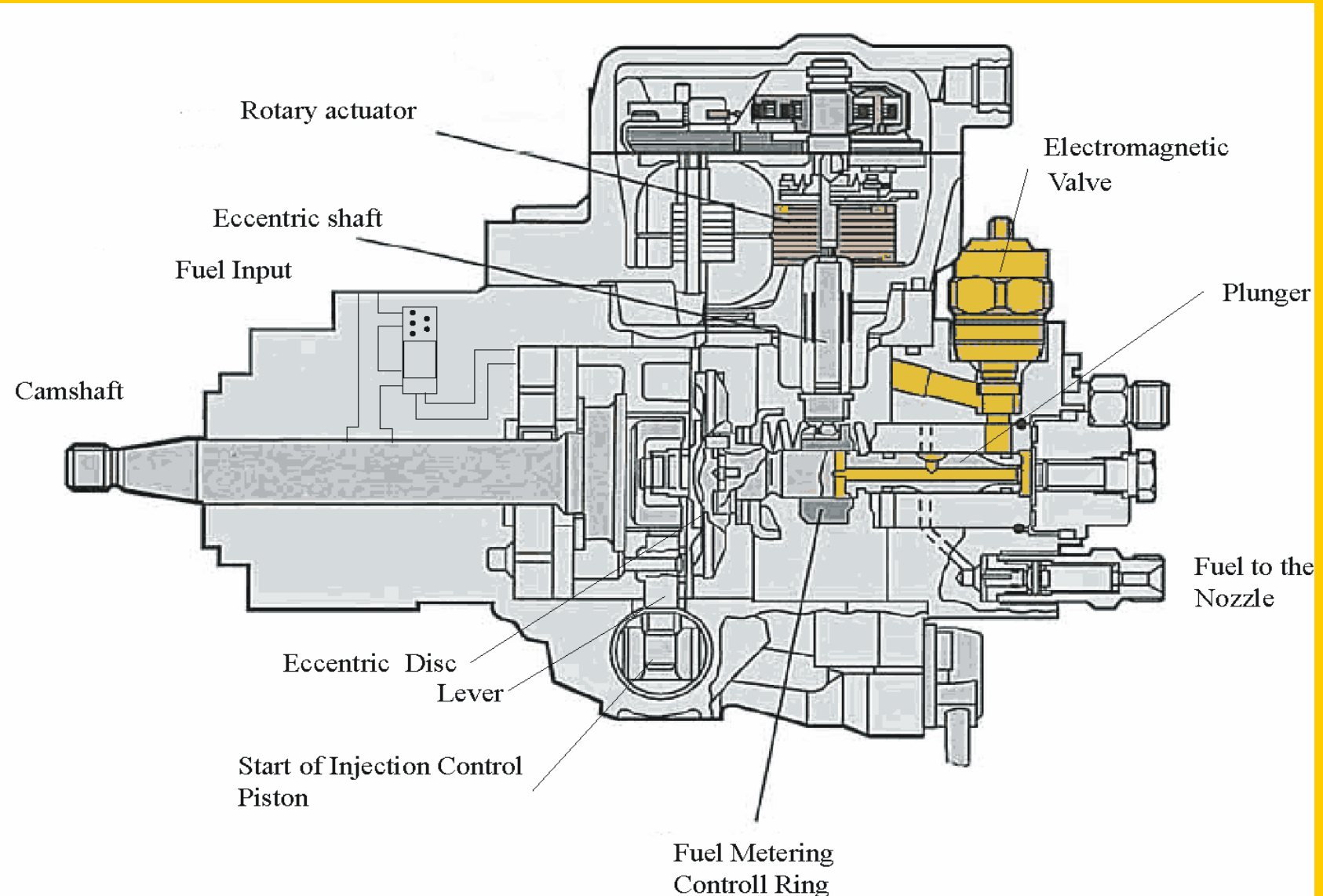




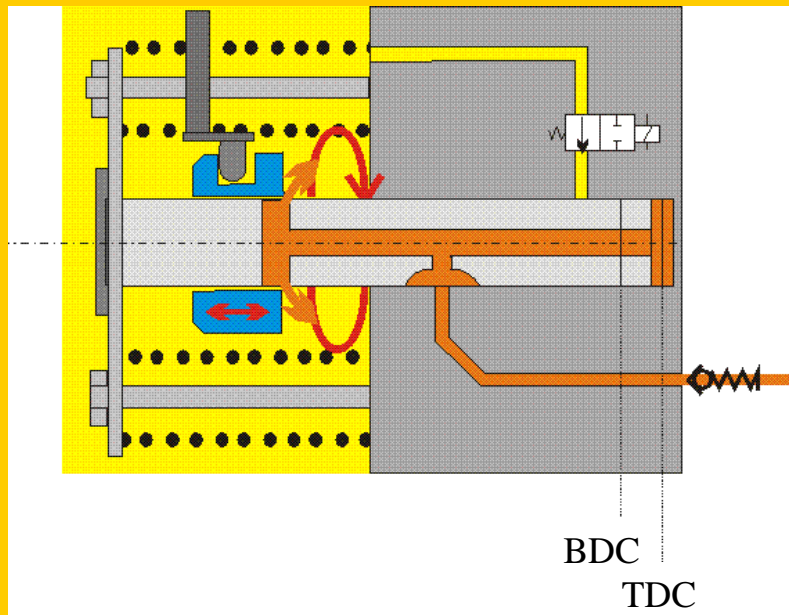
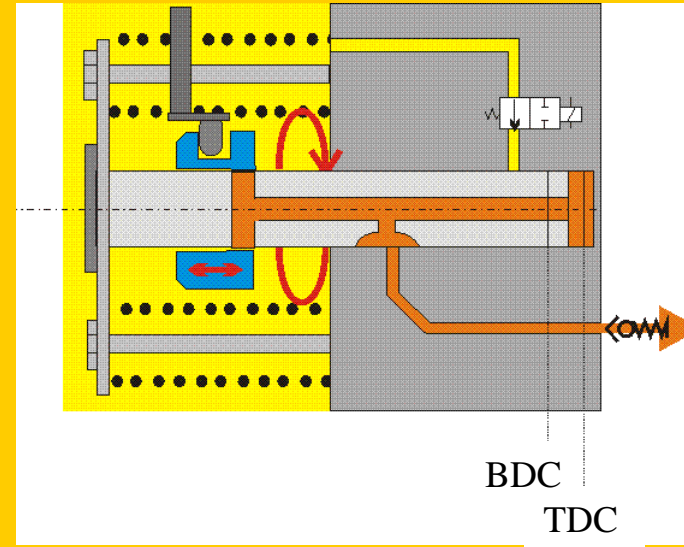
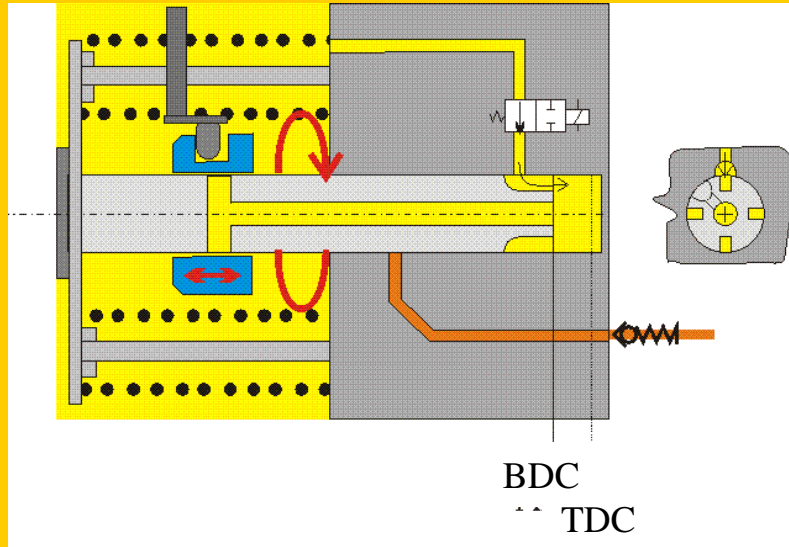


In-Line Fuel Injection Pump (Bosch)

# BOSCH VE type Distributor type Injection Pump (radial-piston)



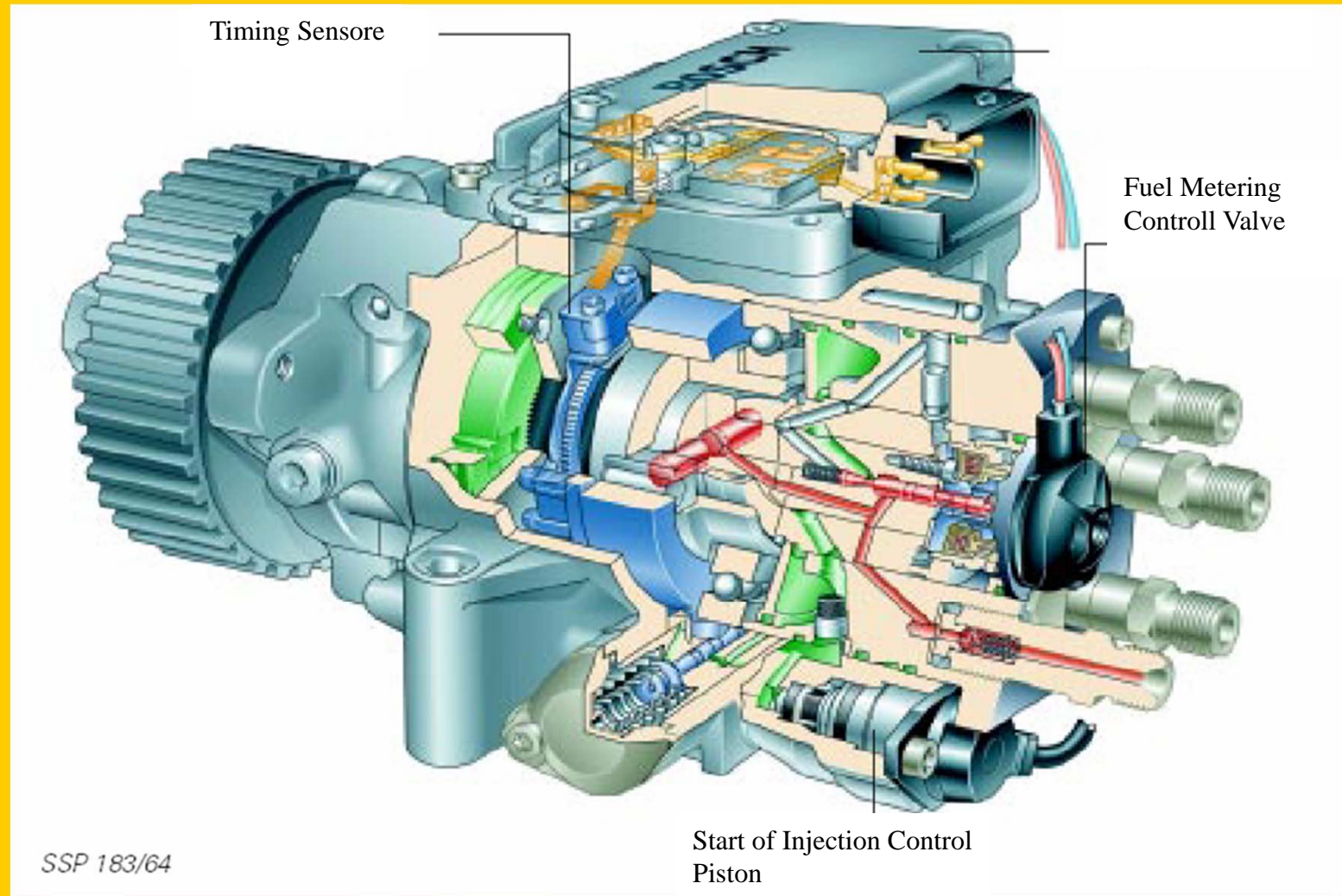
# BOSCH VE type Distributor type Injection Pump (radial-piston)



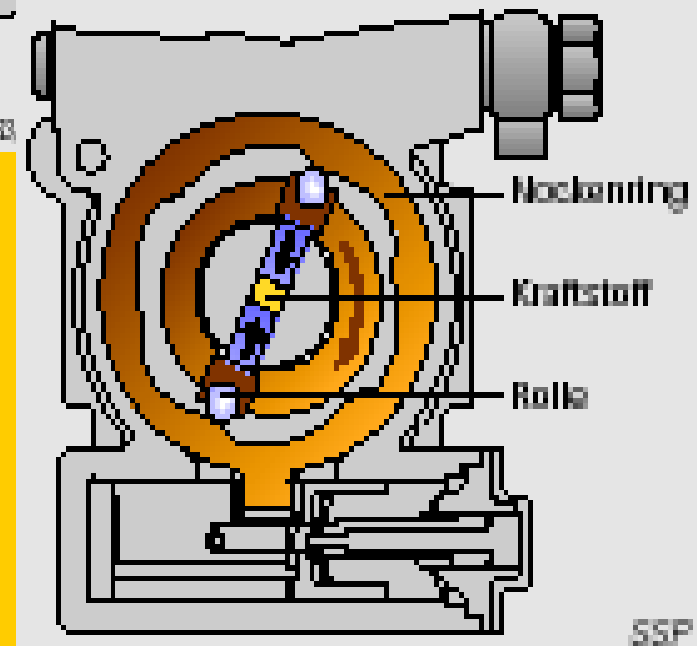
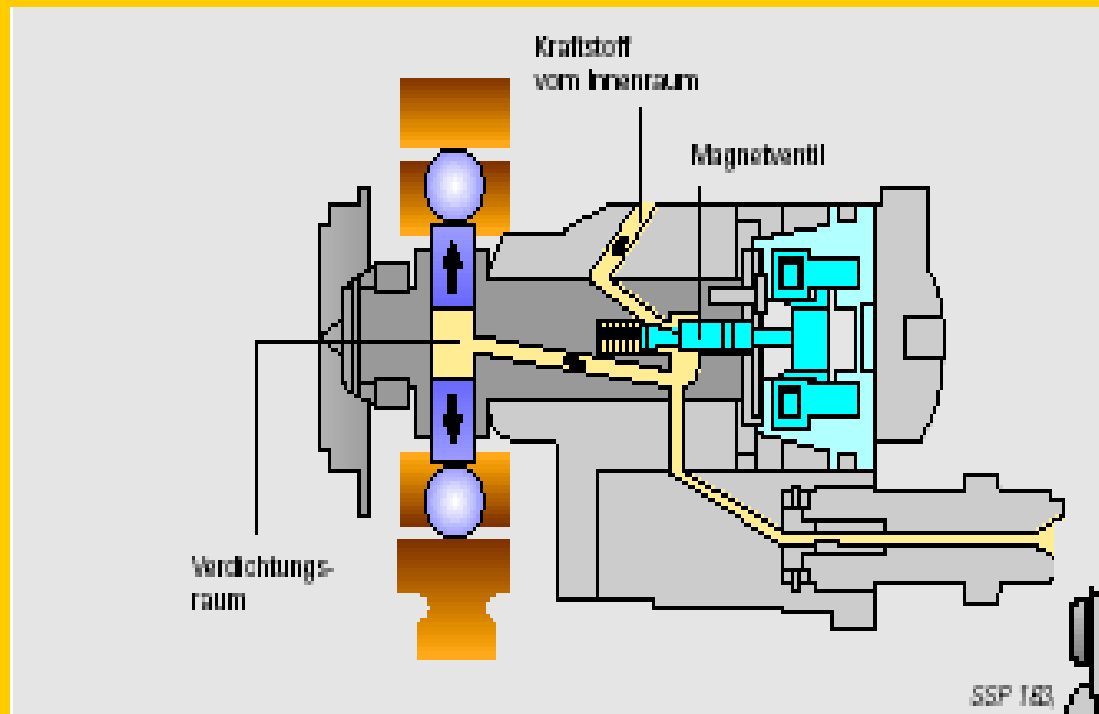


# Radial-piston Distributor Pump

P= 1500 bar



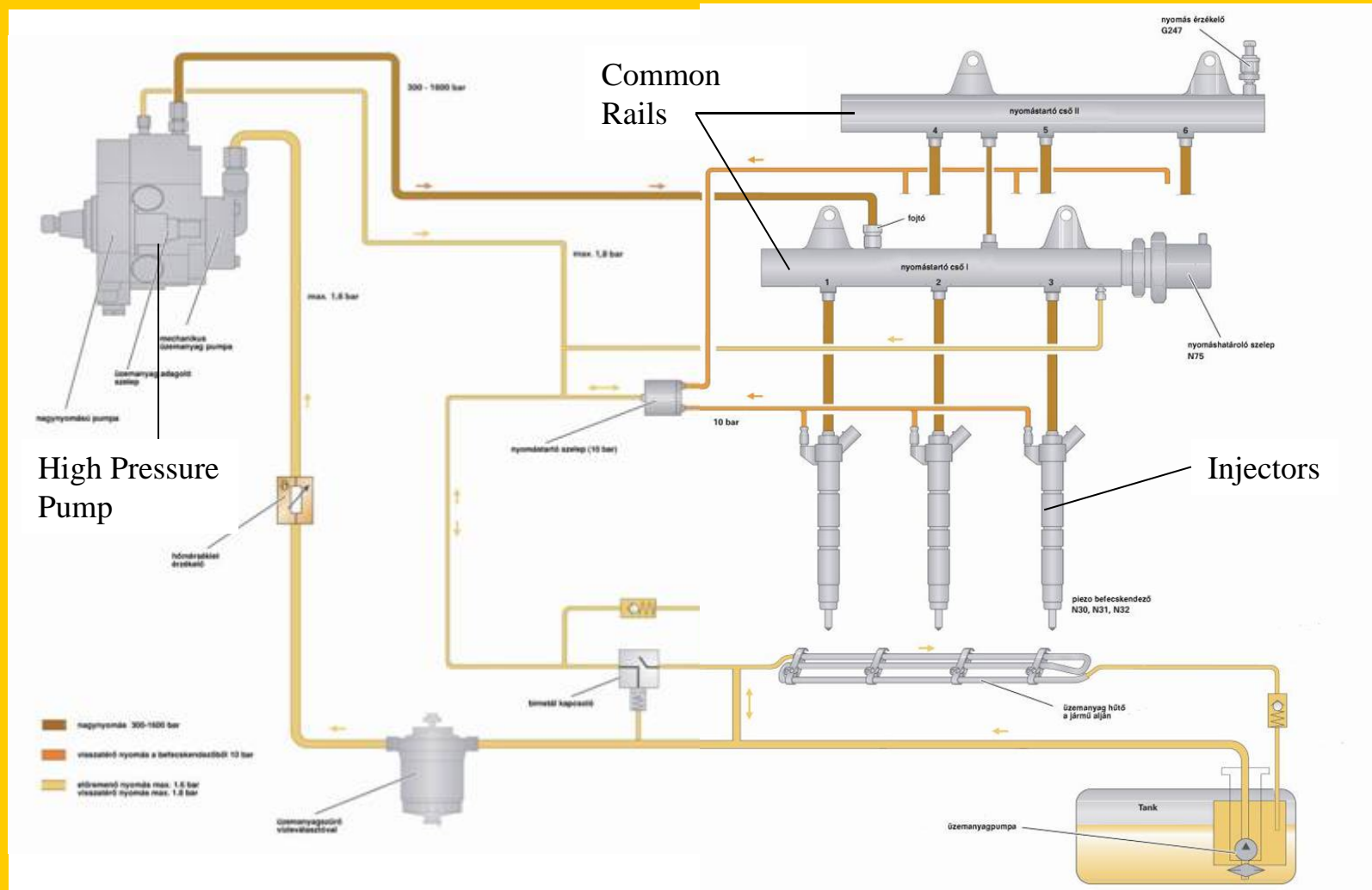
# Radial-piston Distributor Pump



# Common Rail System

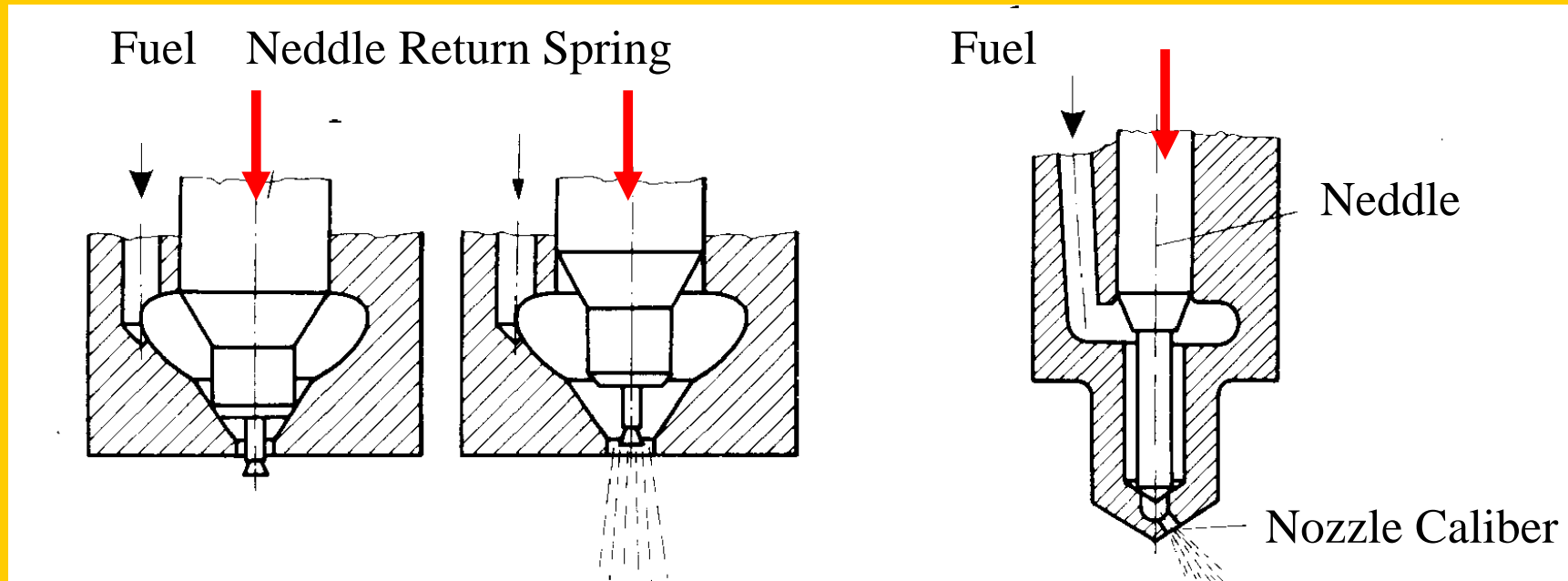


P= 300 –1800 bar



## Open Type Injector

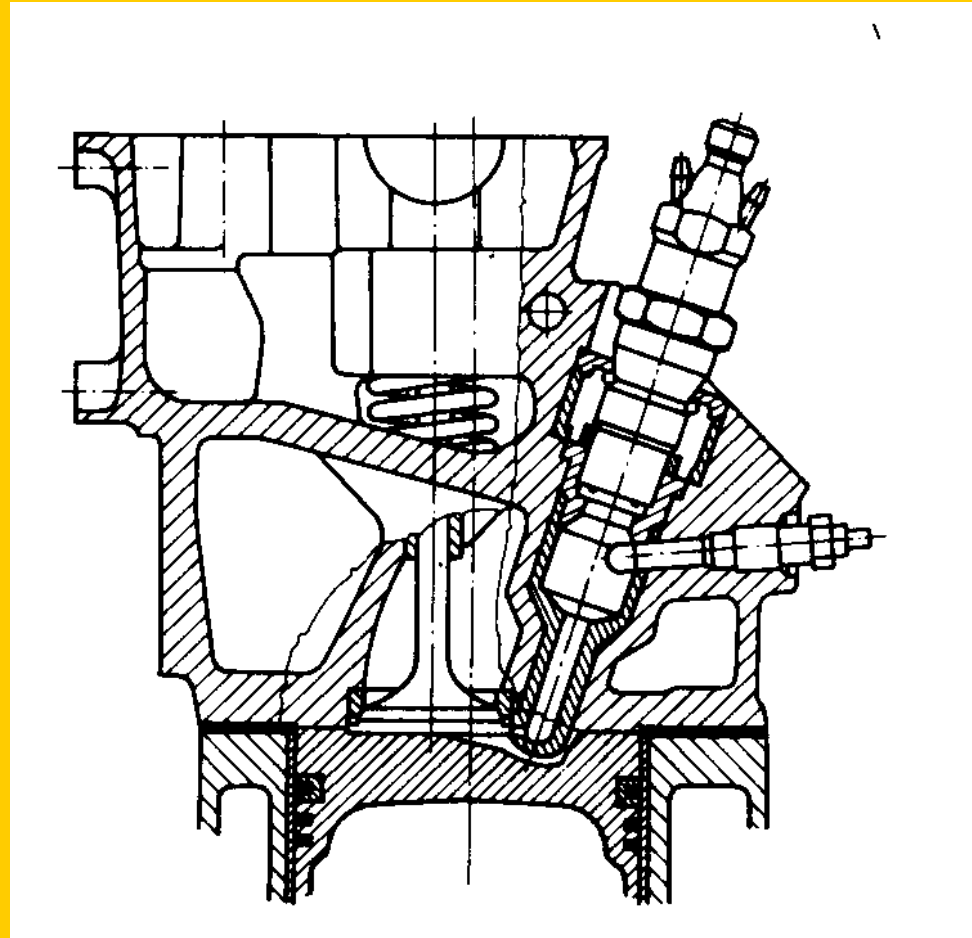
## Closed Type Injector



### **The Main Task of the Nozzels:**

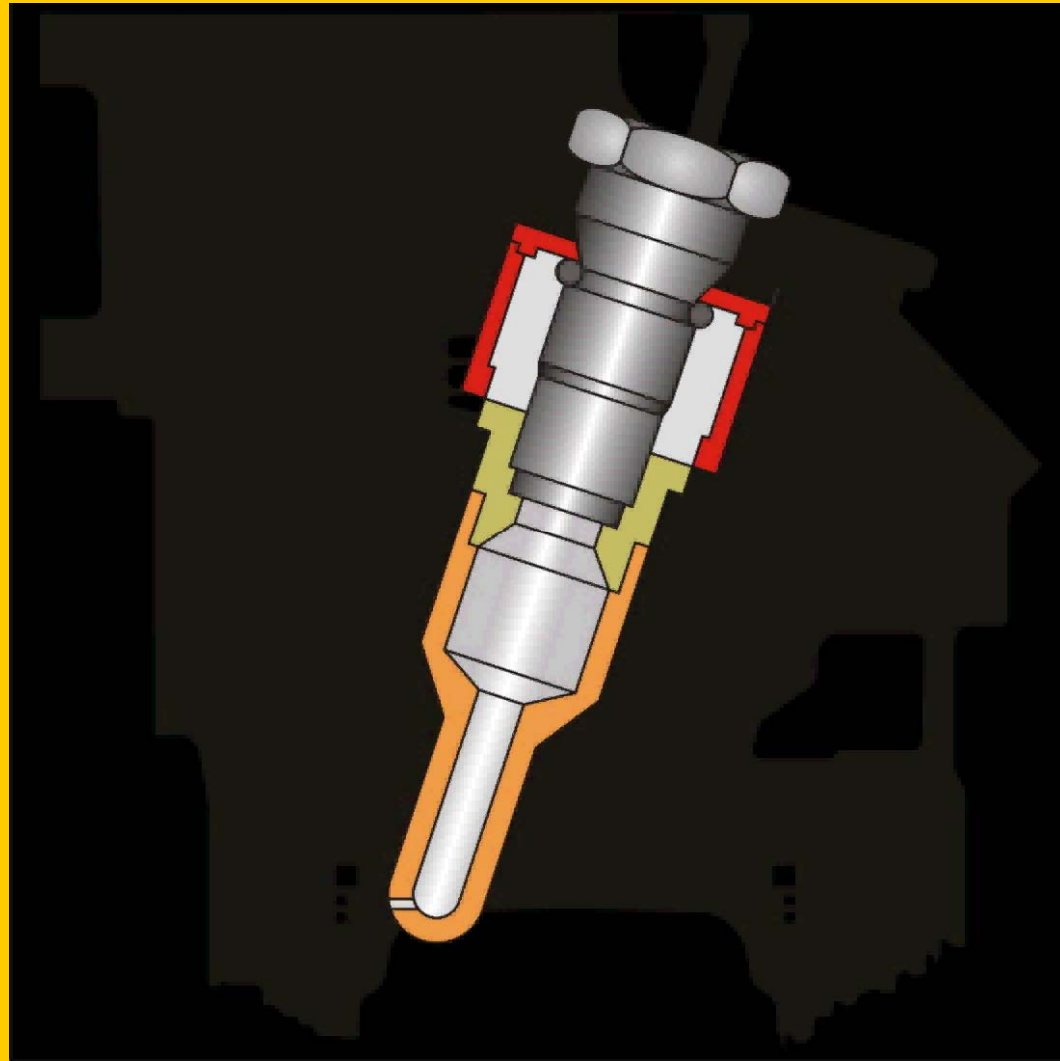
- Provide homogeneous Fuel Jet
- Guaranty Satisfactory Droplet Size
- Promote Fuel Jet Development
- Avoid of Back Flow

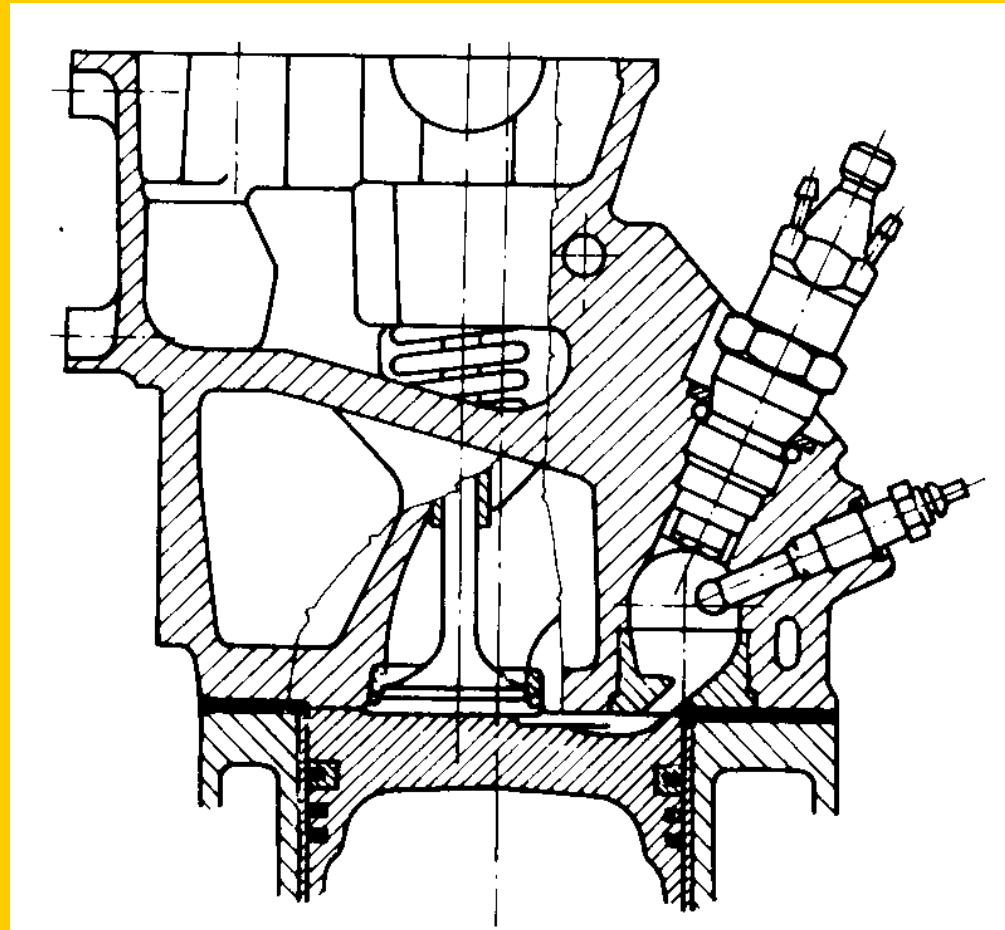
.....



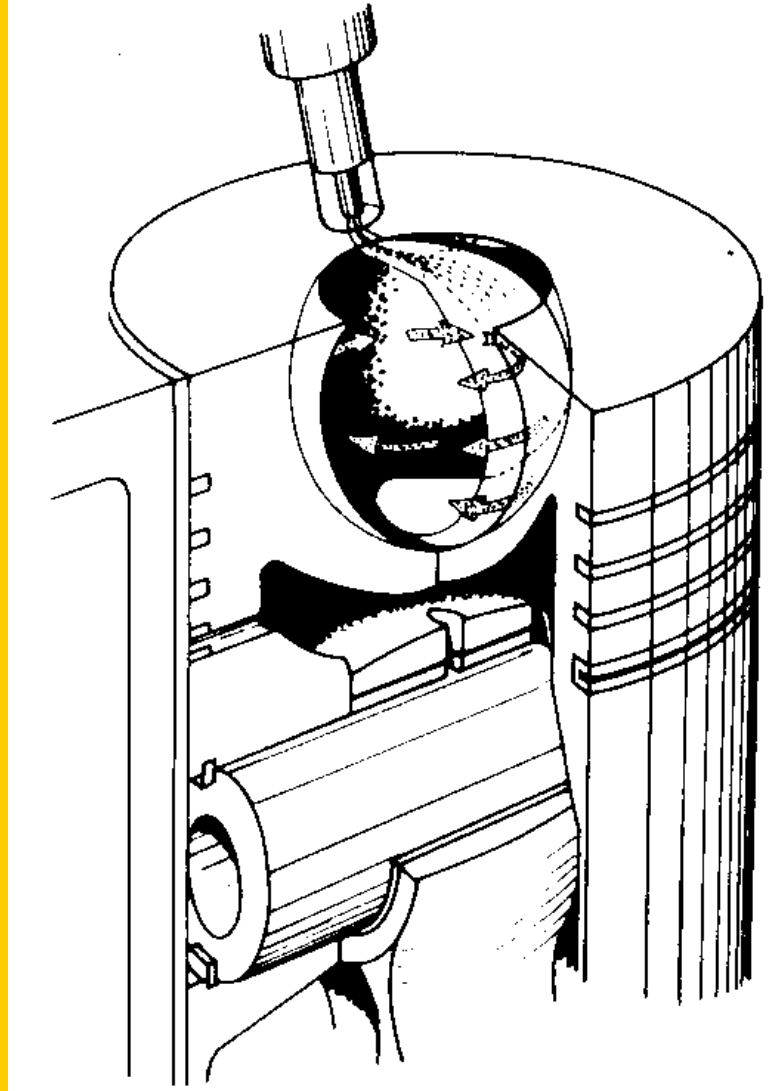
Pre-chamber type C.C.

# Combustion in a Pre-chamber



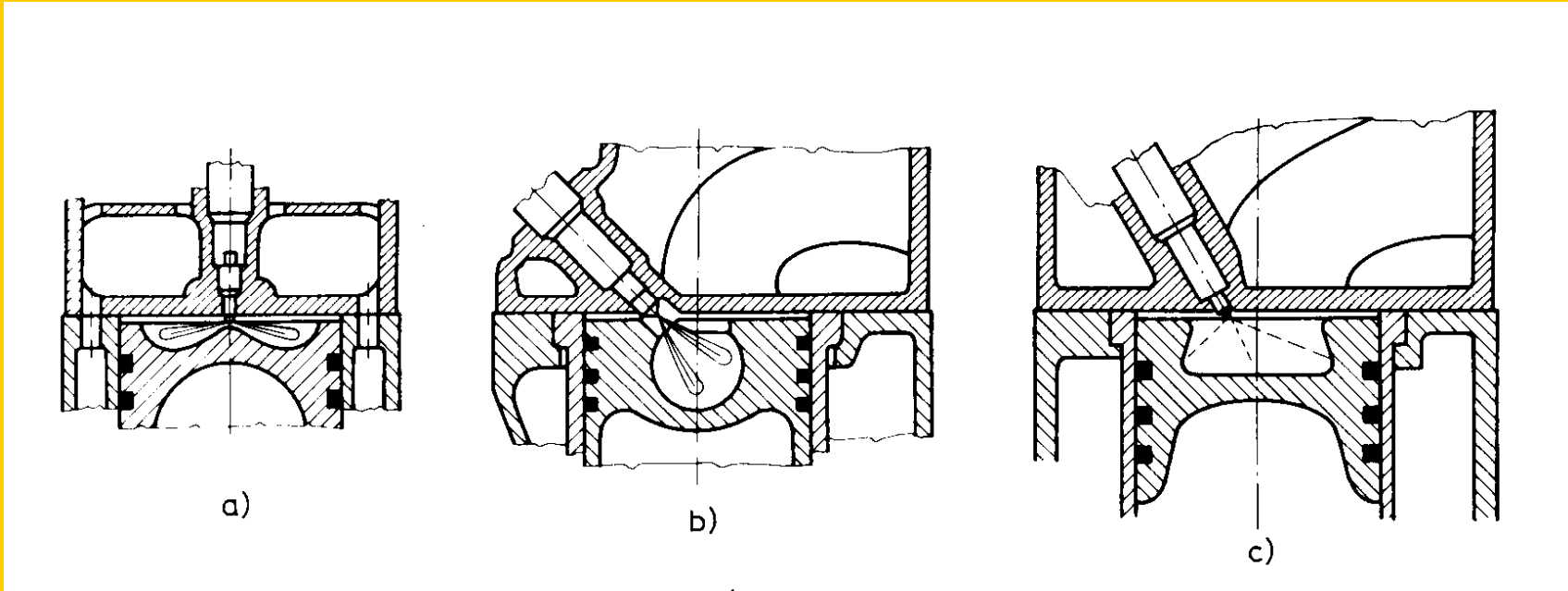


Swirl Chamber type C.C.

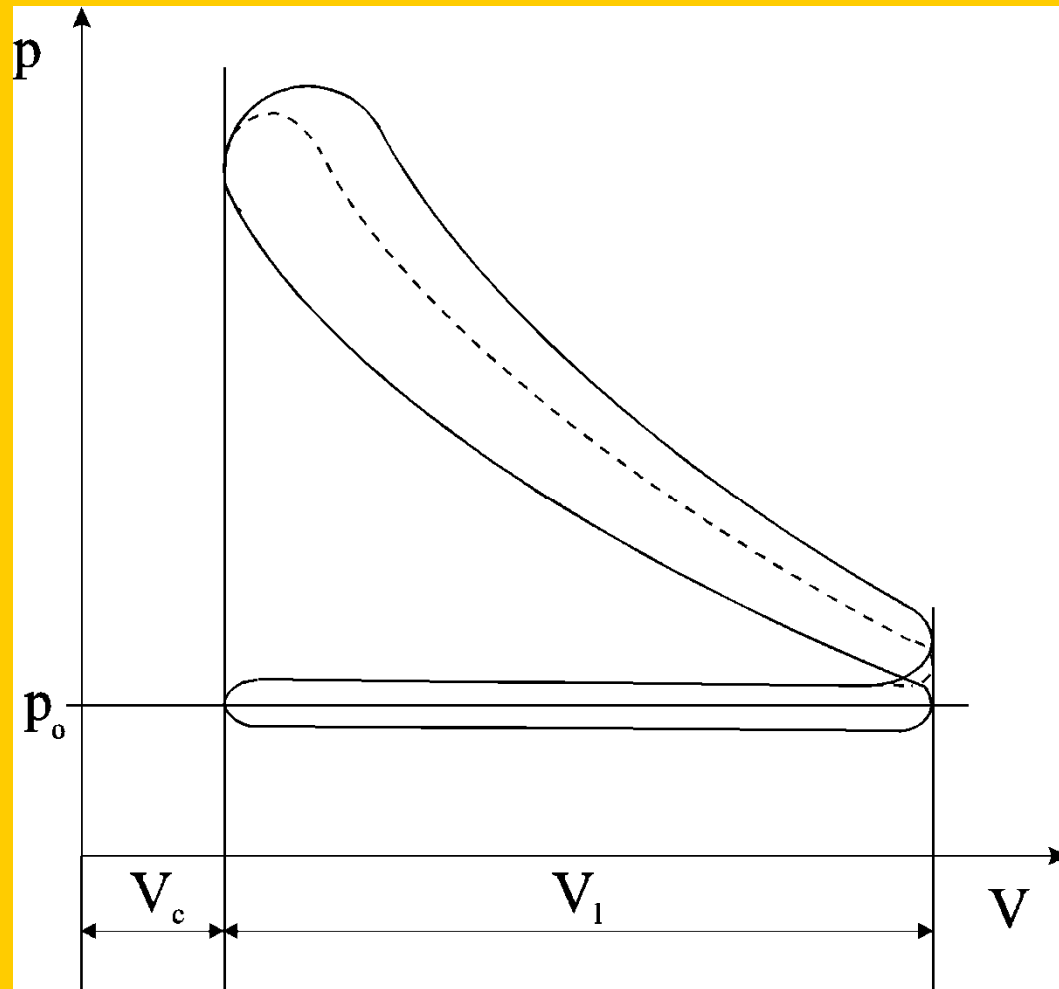


Piston Pre-chamber type C.C. (M)





Different Open C.C. Designs (DI)



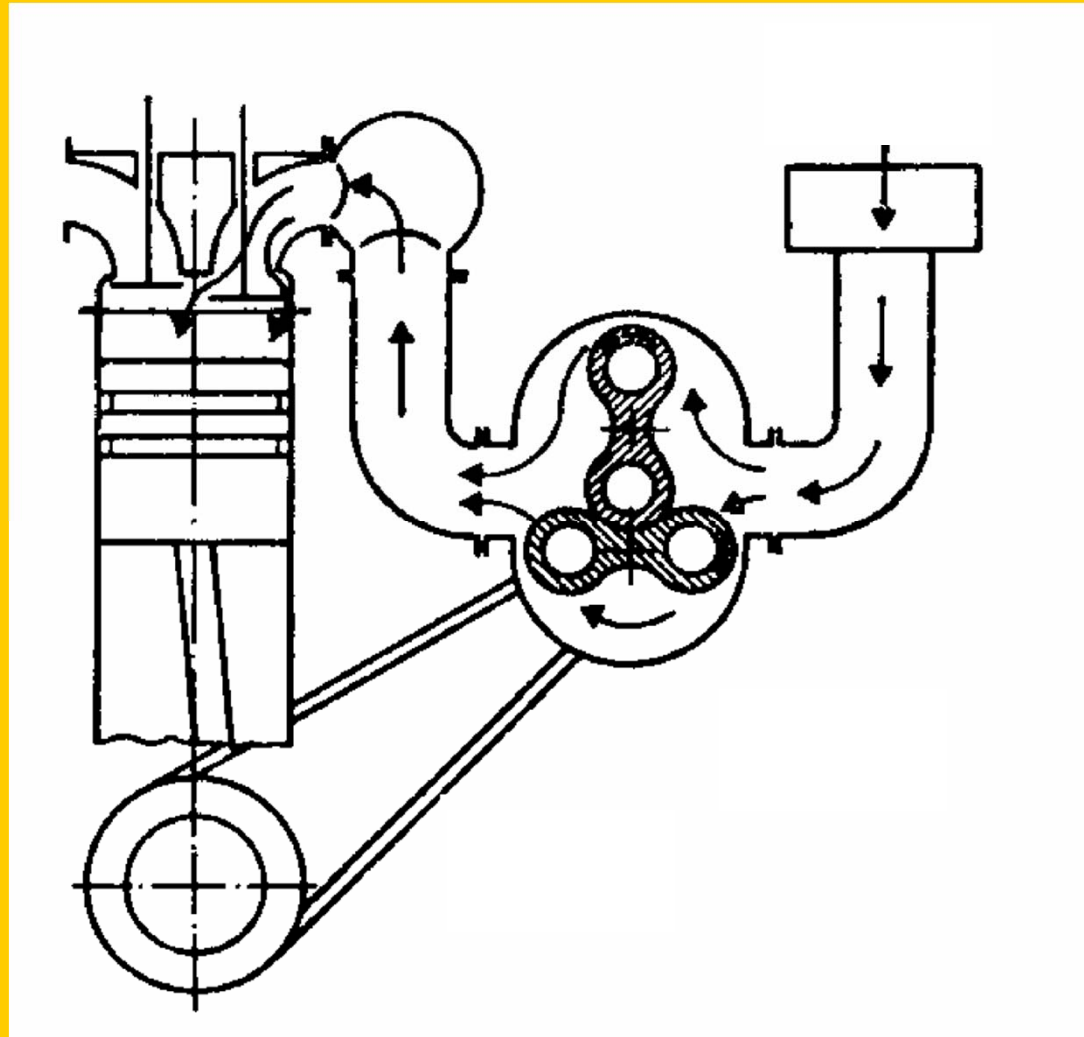
Control of the Diesel cycle (- full load, --- partial load)

# Charging systems

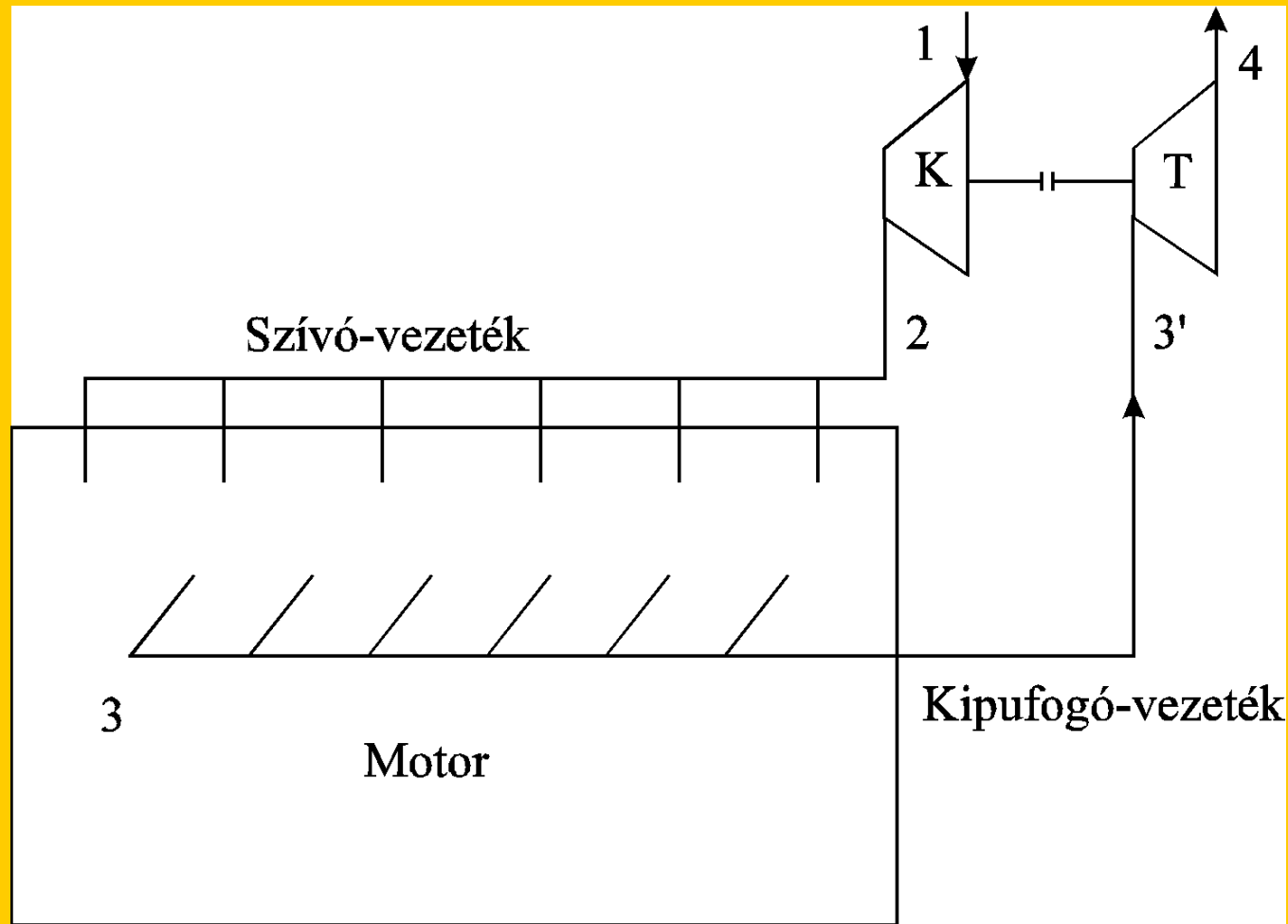
- Naturally aspirated
- **Mechanically charged**
- **Turbo charged**
- **Acoustical charged**

# Advantages and Disadvantages

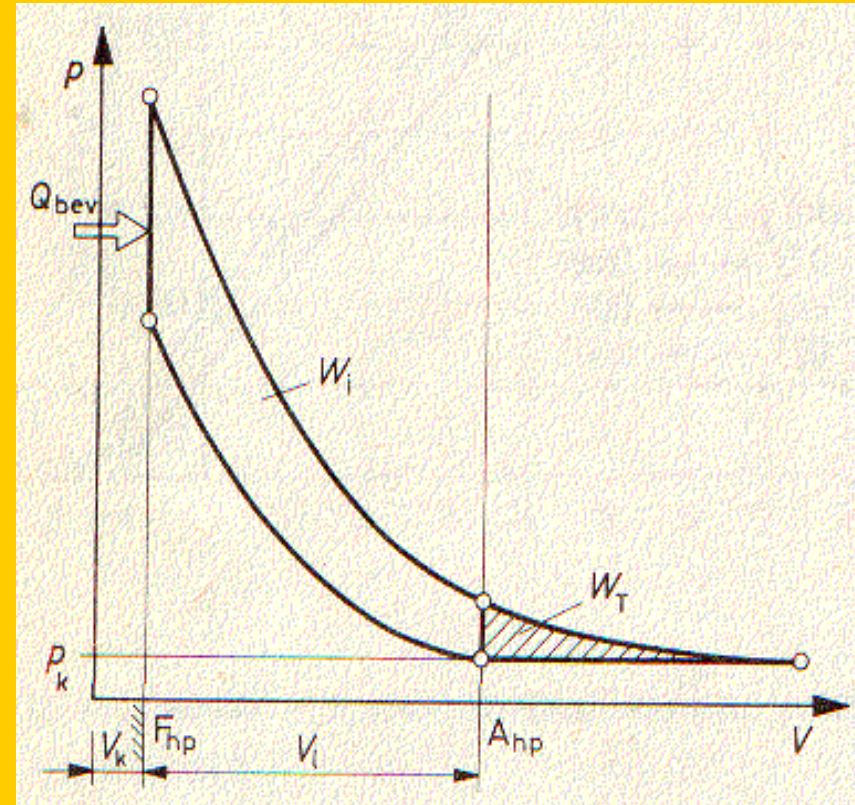
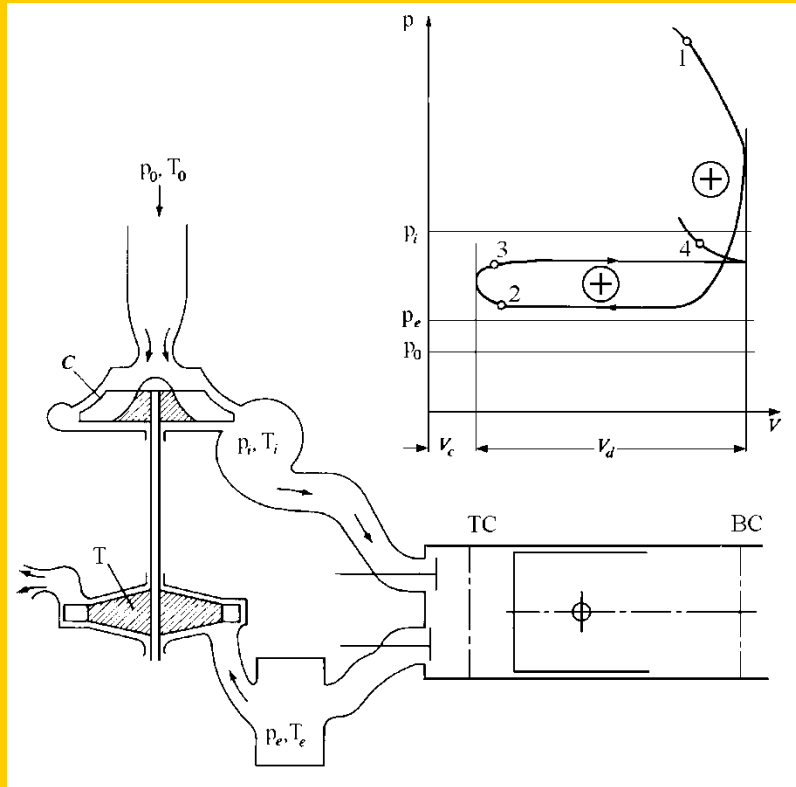
- Smaller Engine Dimensions (Down-sizing)
- Higher Power/mass ratio
- Higher efficiency
  - Pe/Pm ration better
  - Positive pumping work ( $W(-) \rightarrow W(+)$ )
- Smaller Cooler
- Thermically and Mechanically Load increases



Mechanical Supercharging(Roots)

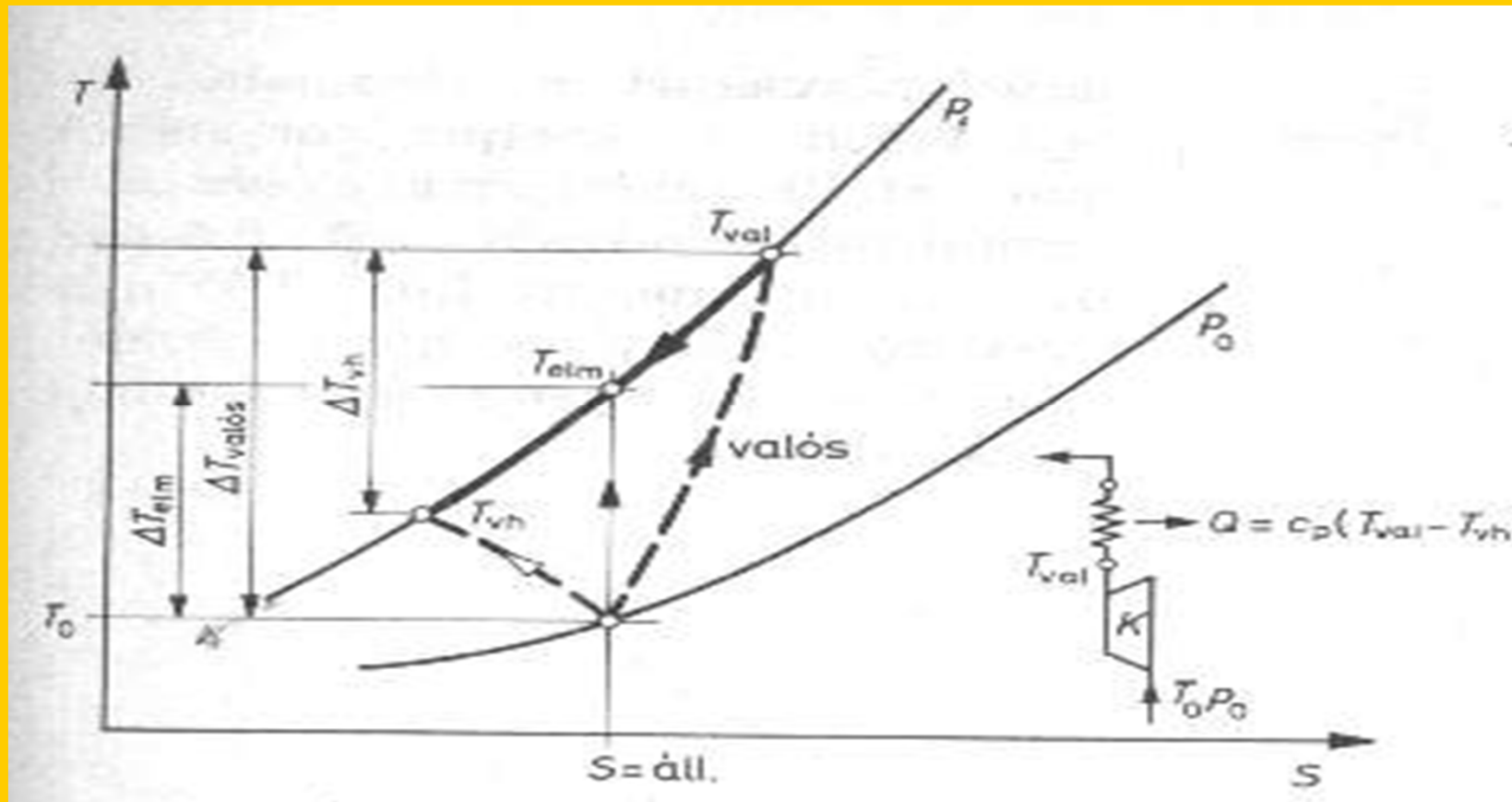


# Turbocharging



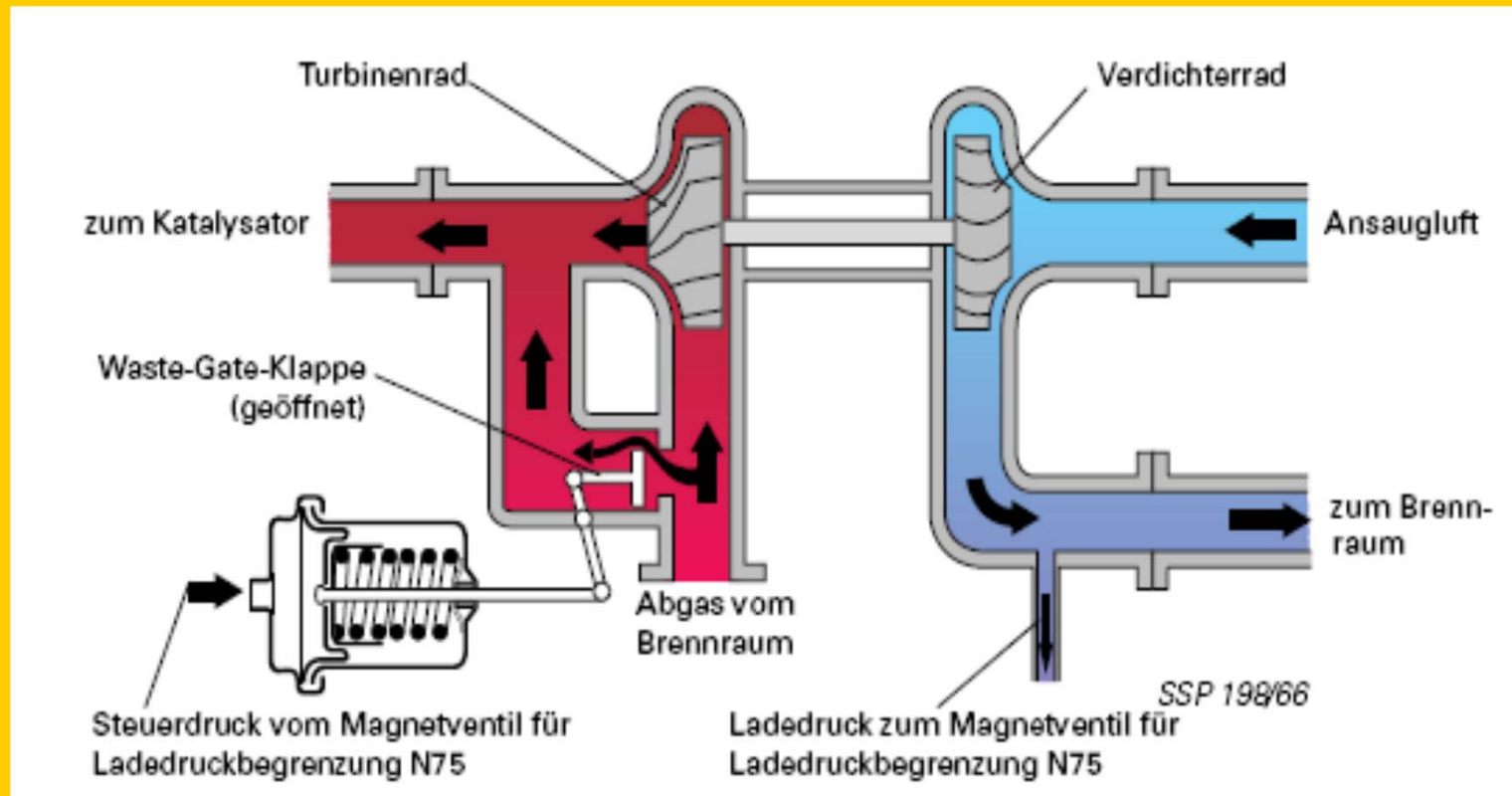
# Turbocharging

# Compression and cooling (Intercooler)

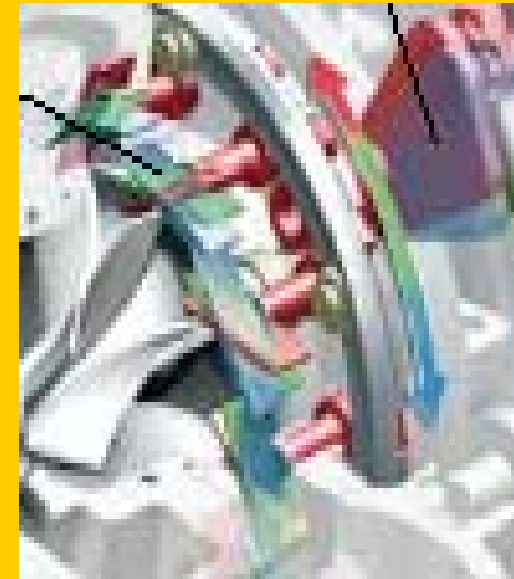
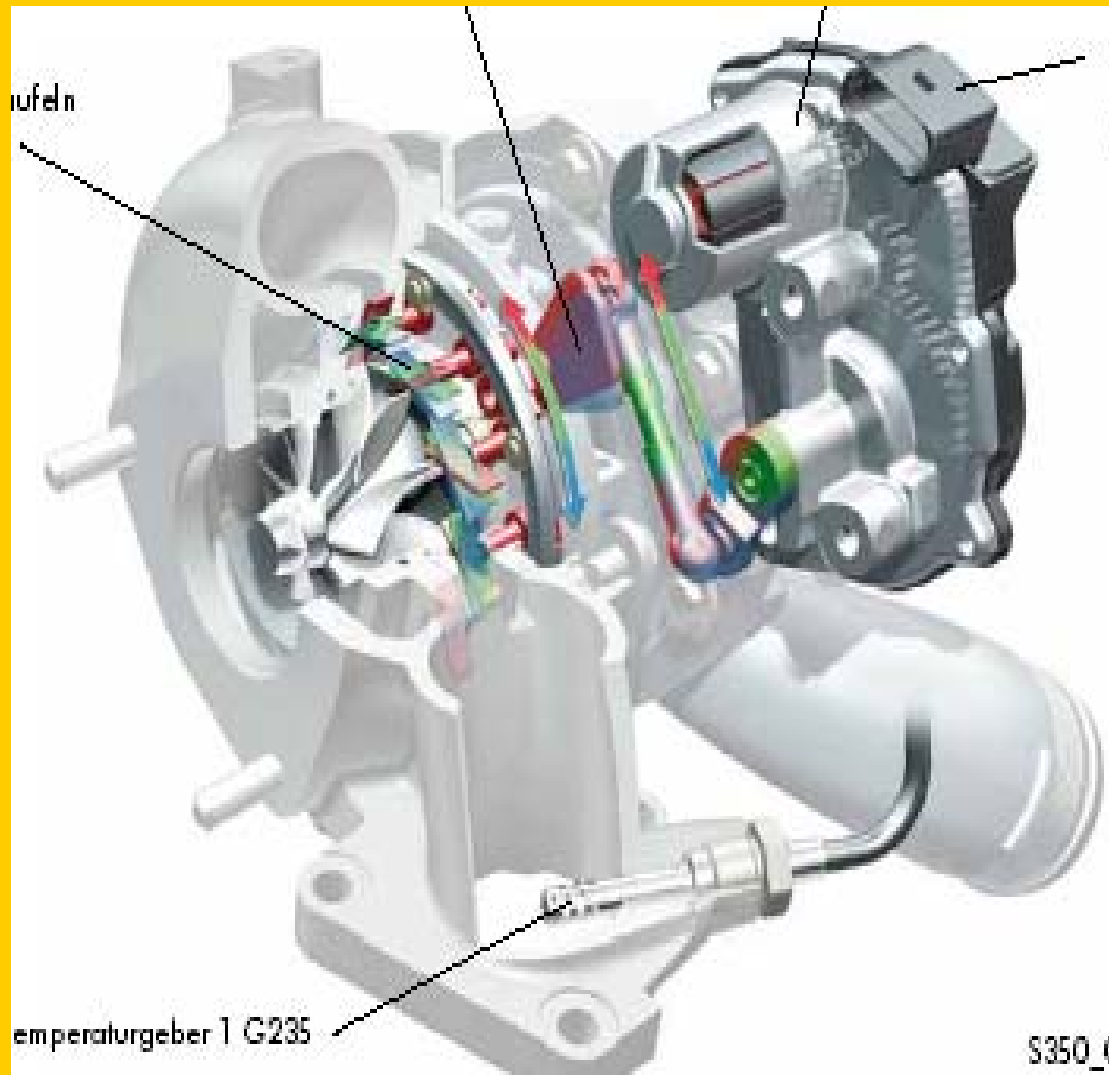


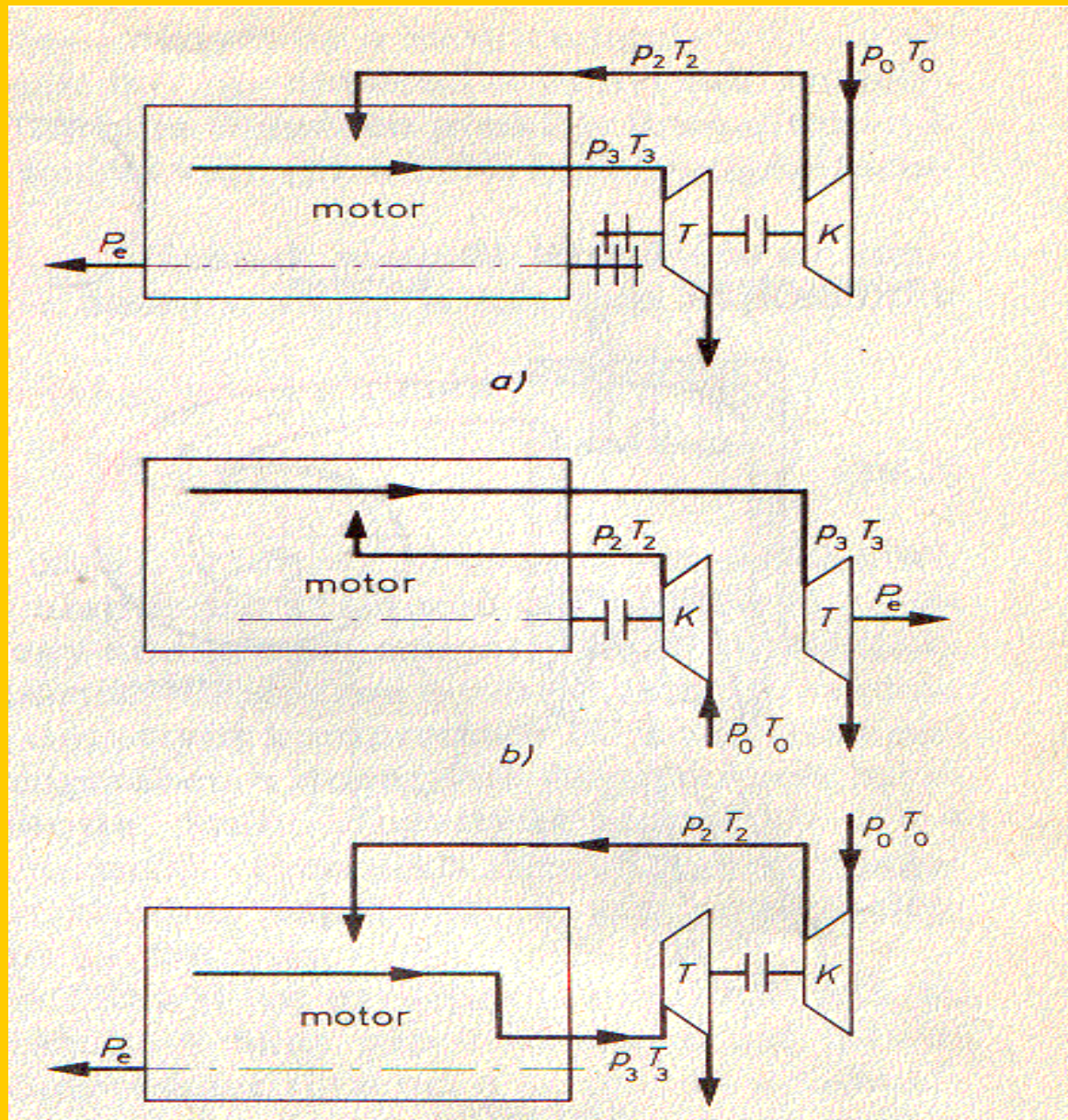


# Waste-Gate Valve Control /SI/

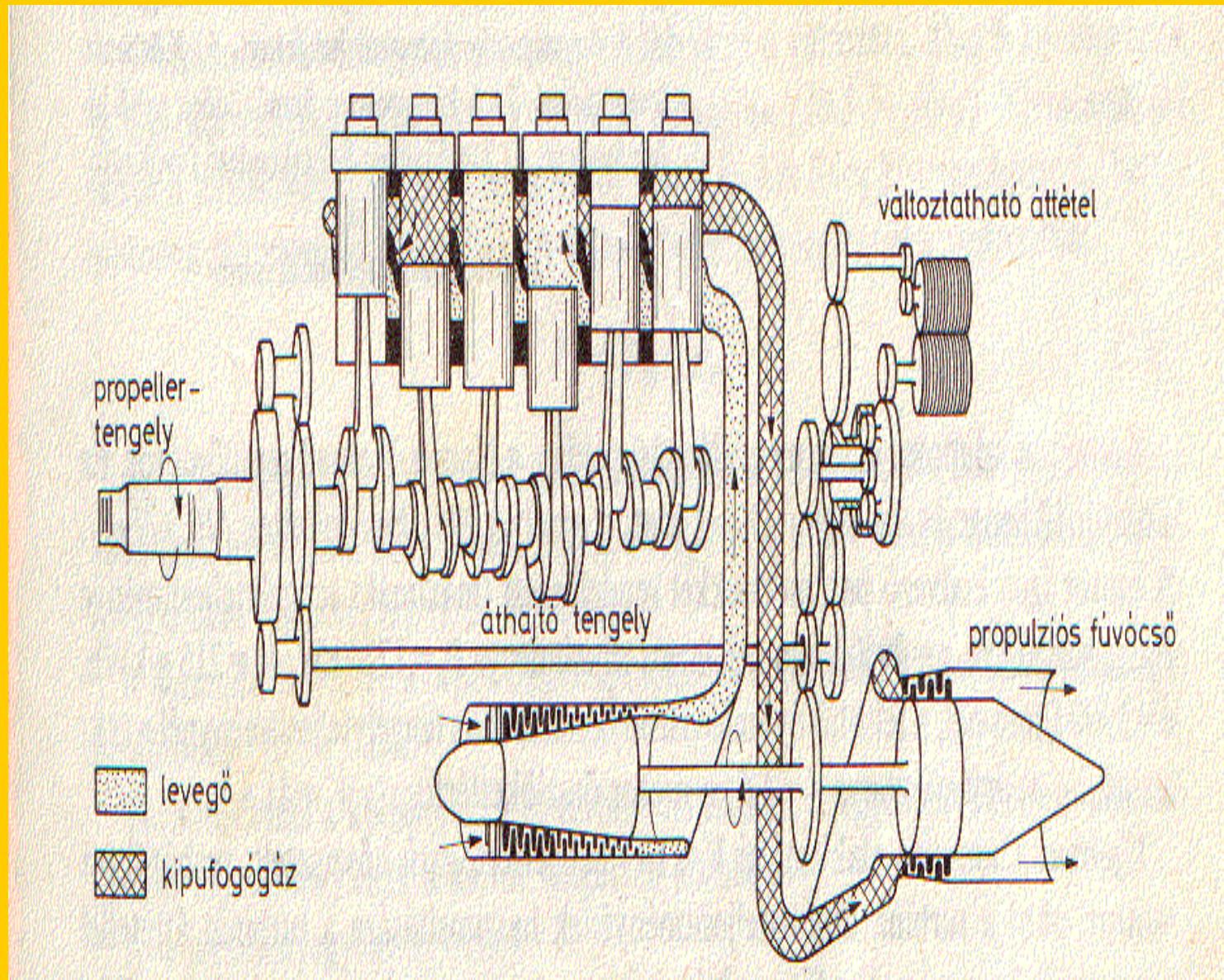


# Variable Geometry Control /CI/





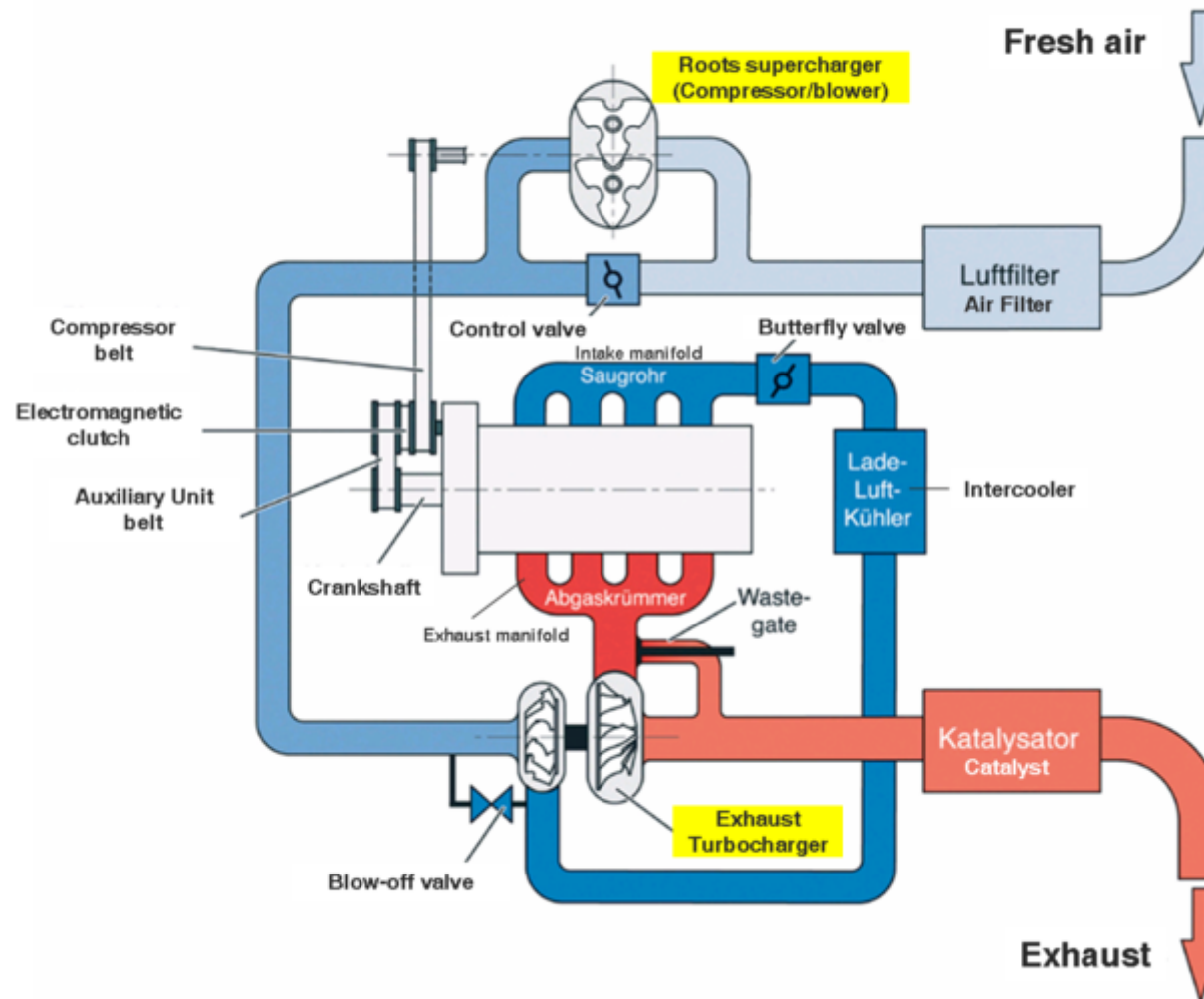
# Different Solutions of Turbocharging



Napier-Nomad Diesel-compound

# VW TSI

## Air Flow in the VW Twincharged TSI



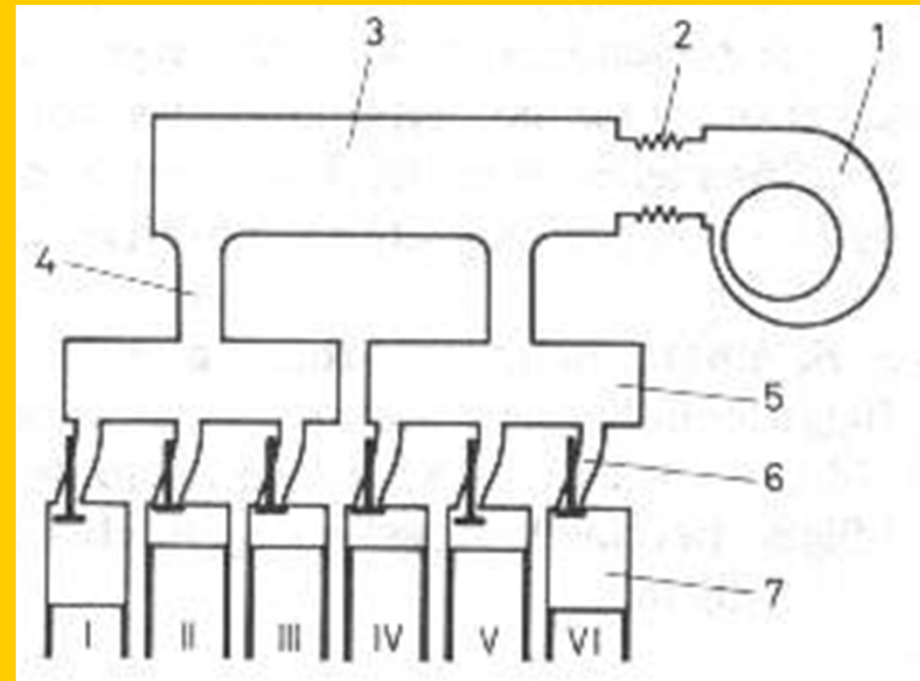
# Acoustical charger

Helmholtz resonator:

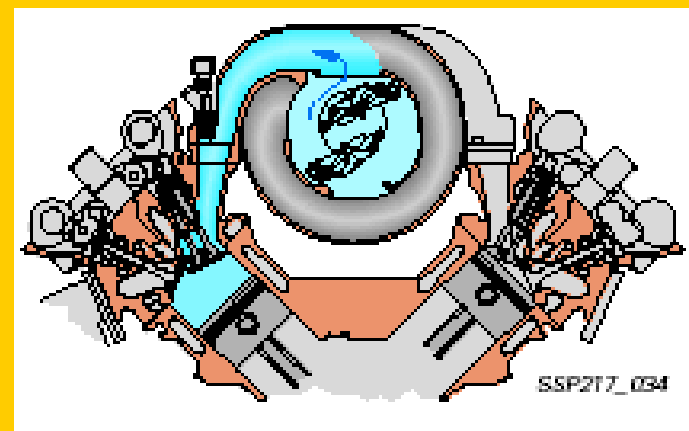
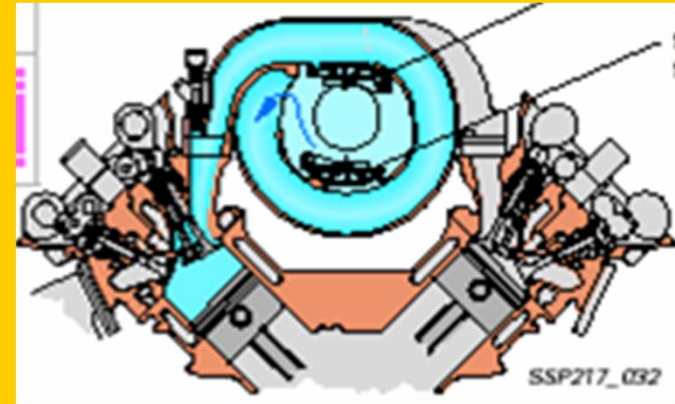
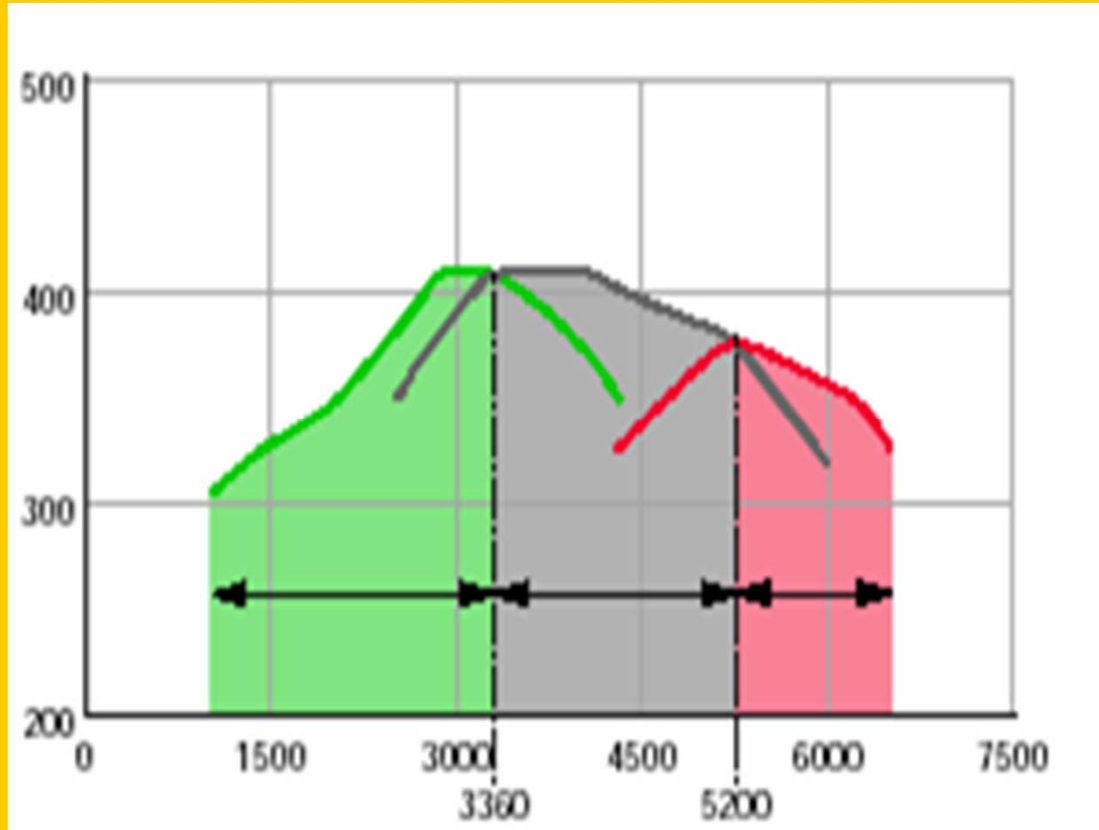
$$f = \frac{a}{2\pi} \sqrt{\frac{A}{V_0 L}}$$

Organe beep effect (quarter wave):

$$f = \frac{a}{4L}$$



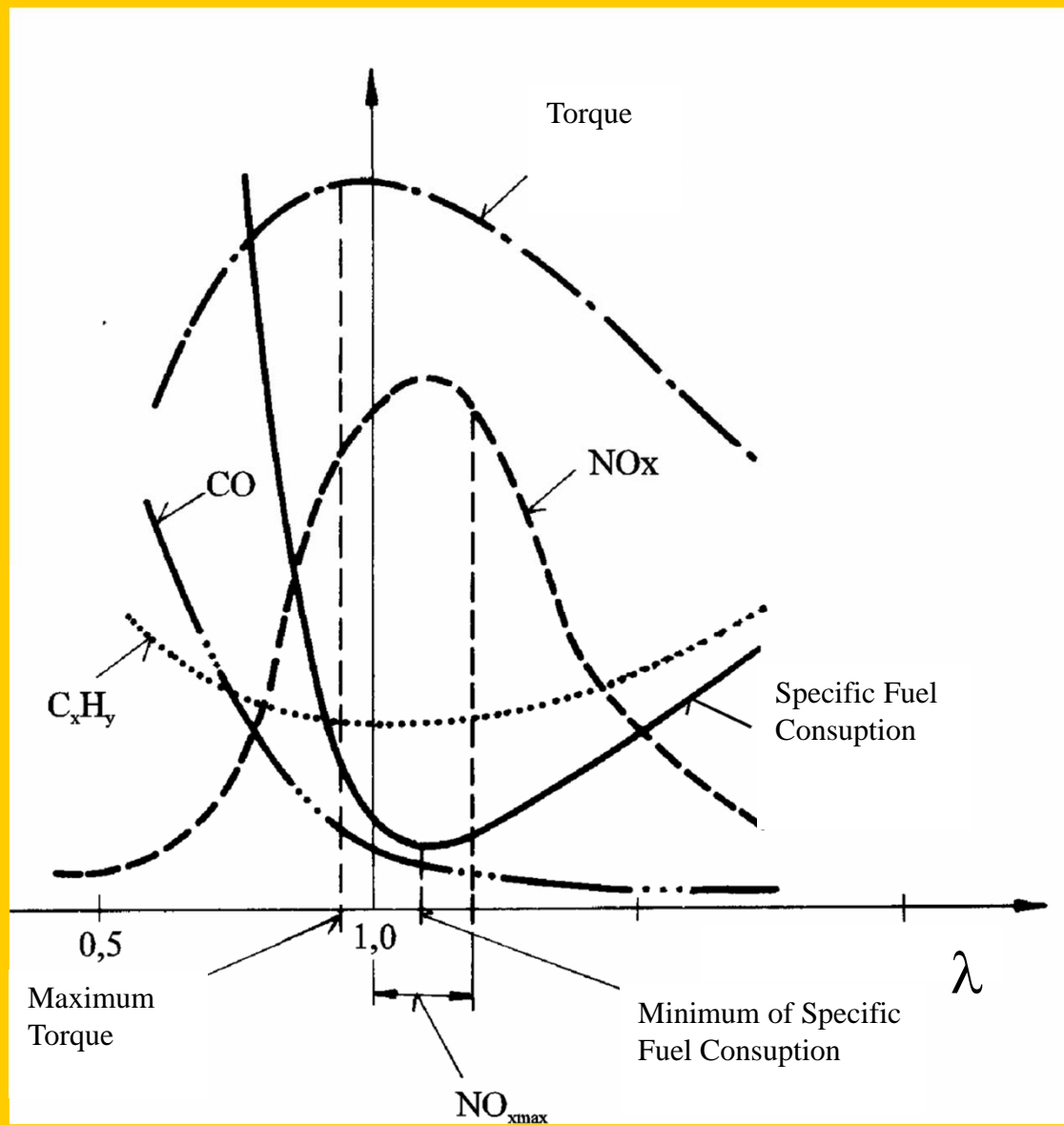
# Acoustical Charger

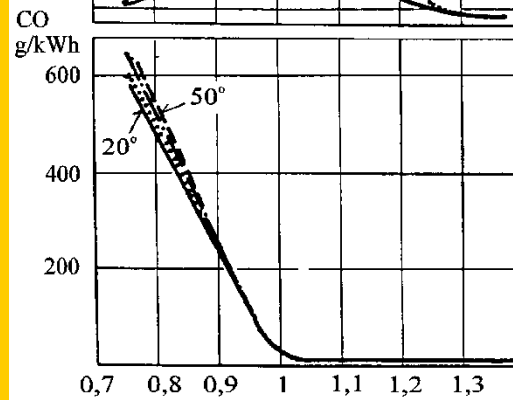
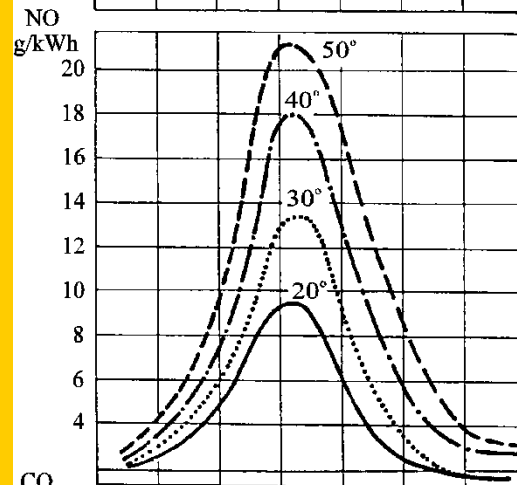
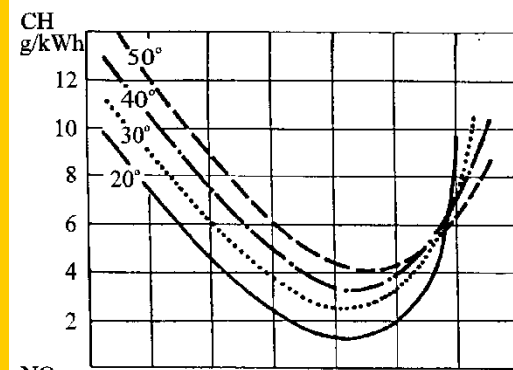


# Possibilities of Emission Decrease

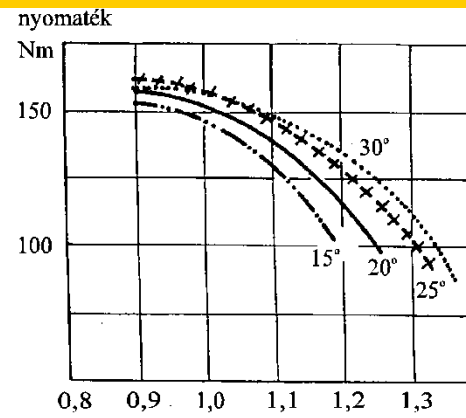
- Emission Decrease:
  - Before Engine
    - Fuel (S, Pb, Heavy metals)
  - In the Engine
    - Constuction
    - EGR
    - Air-to-Fuel ratio
  - After Engine (secunder methodes)
    - 3 way catalytic converter
    - oxidacion catalytic converter
    - .....





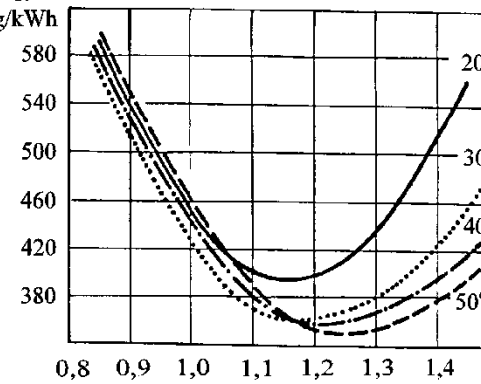


$\lambda$



$\lambda$

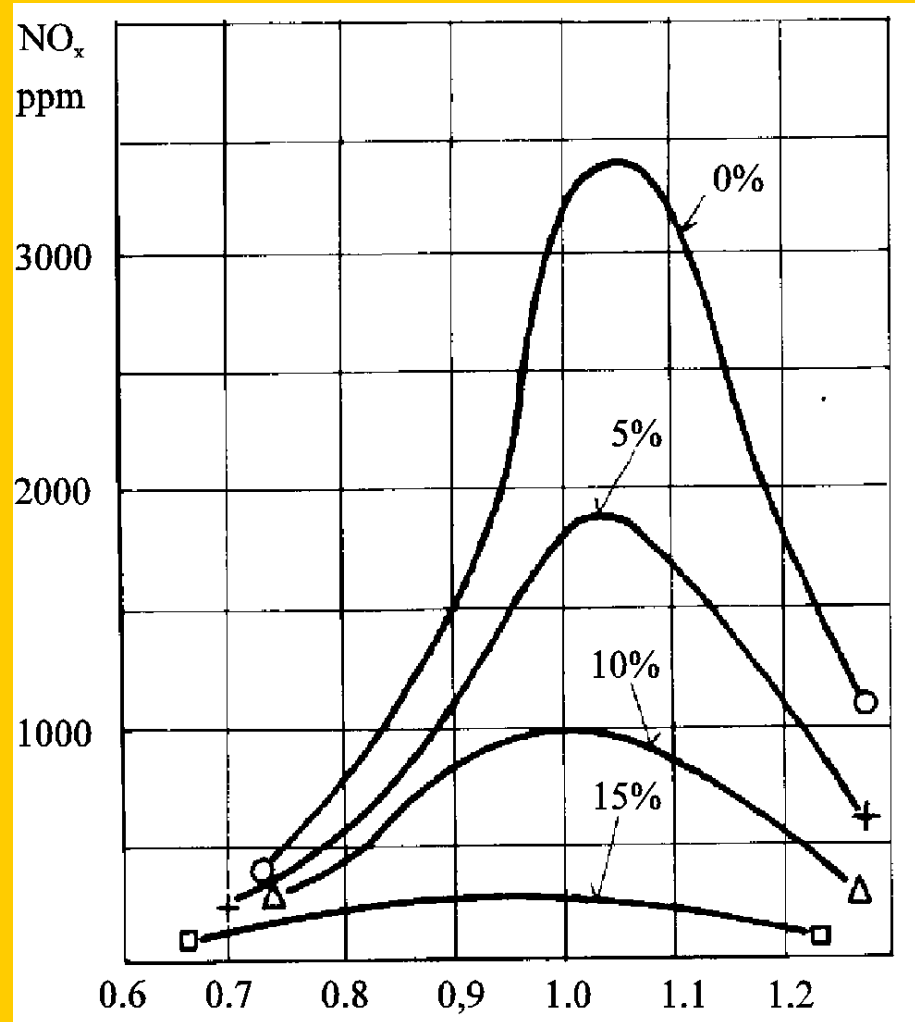
fajlagos  
fogyasztás  
g/kWh



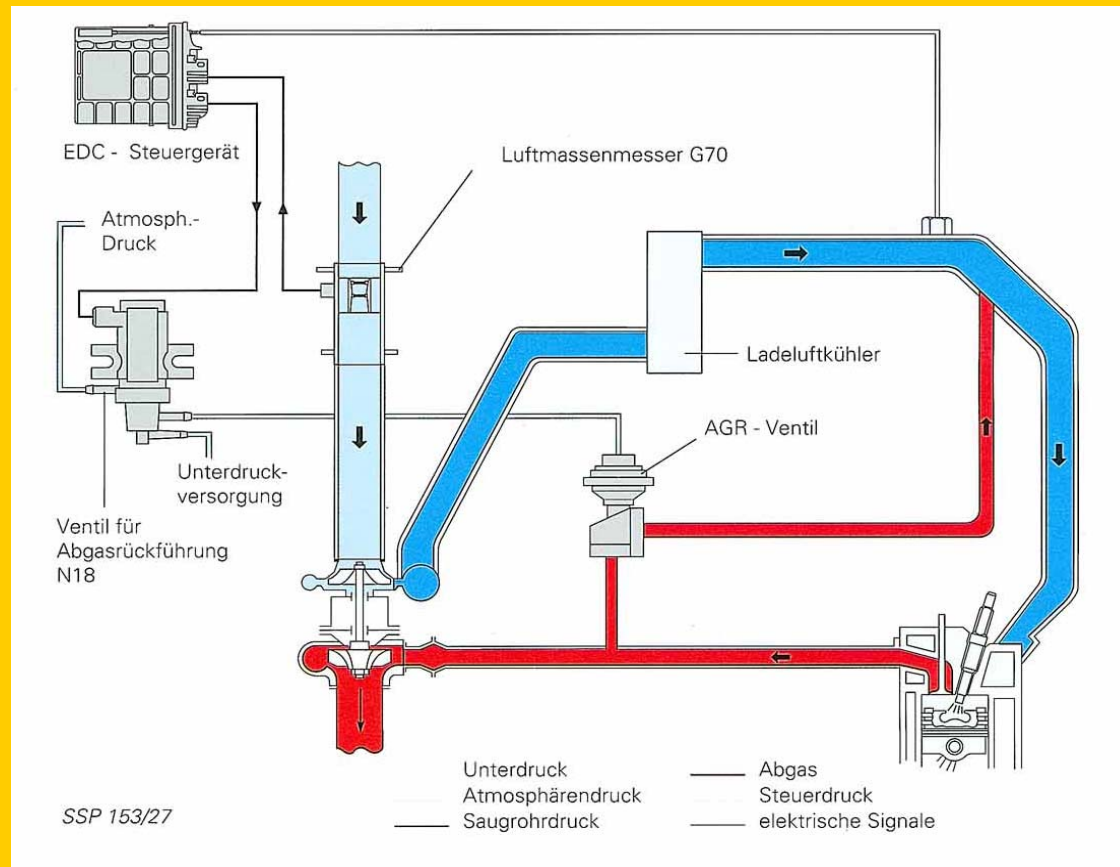
$\lambda$

Effects of the pre-ignition settings

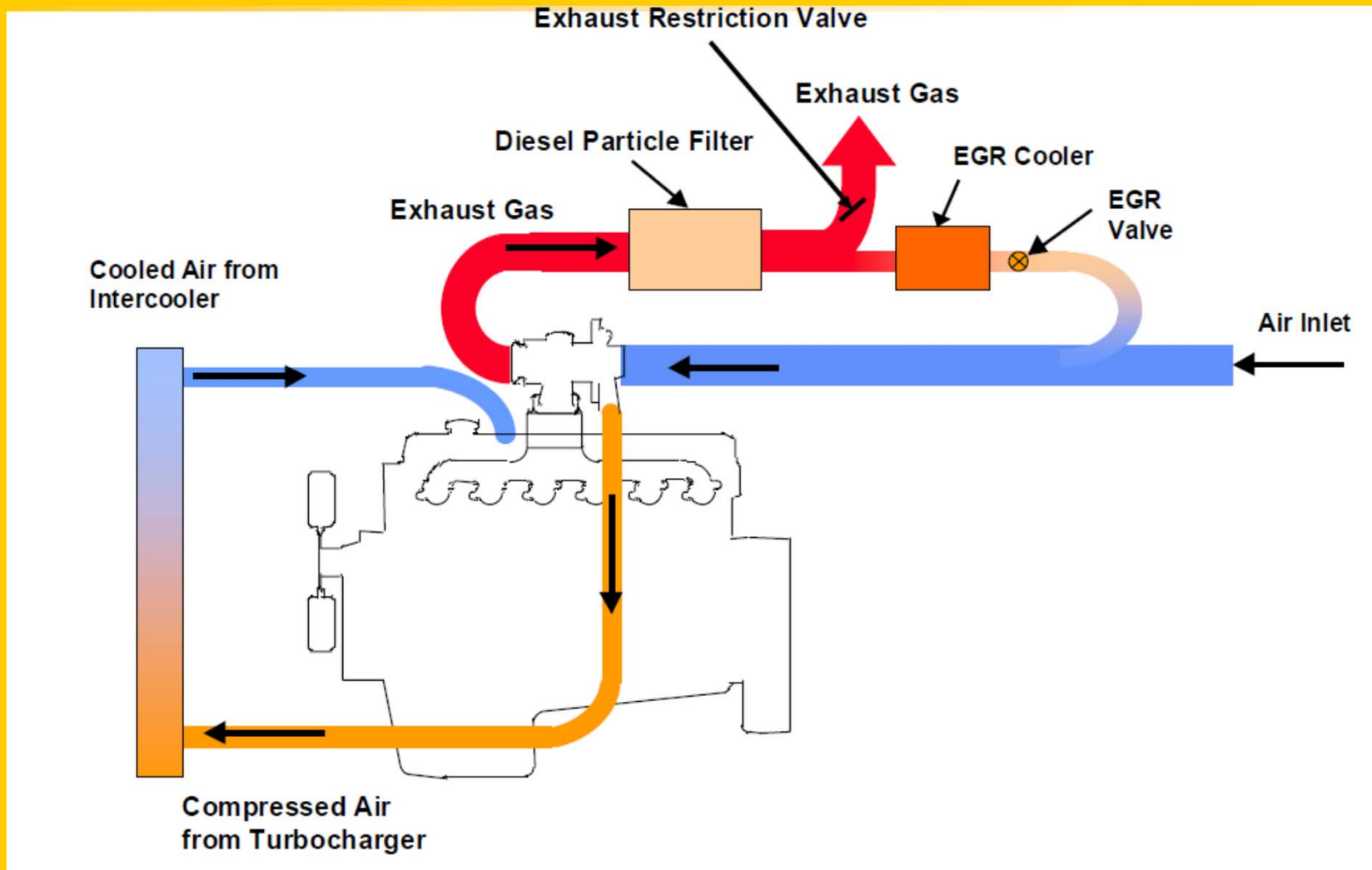
# Exhaust Gas Recirculation (EGR, AGR)



# High pressure EGR,

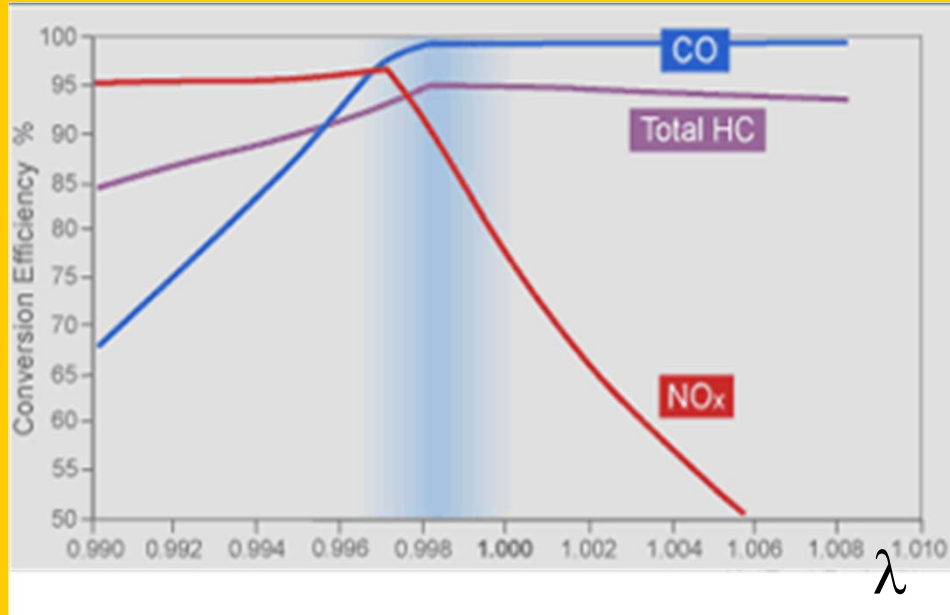


# Low pressure EGR,

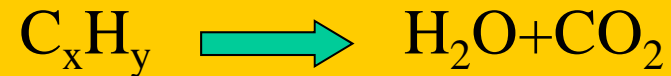
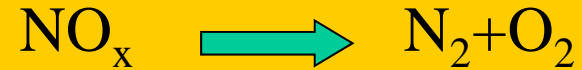


After Engine  
(secondary methods)

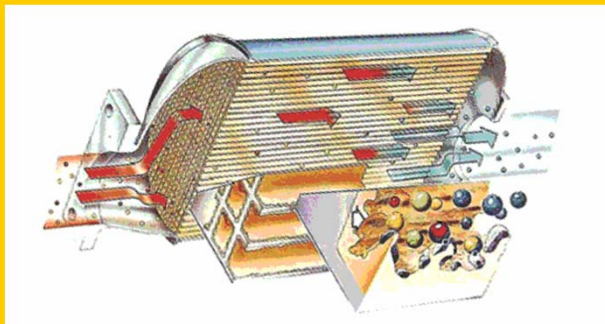
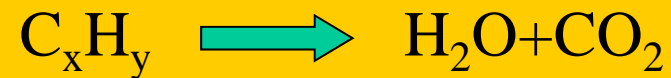
# Catalytic Converters



## 3-way (NSCR) Catalysts ( $\lambda=1$ )

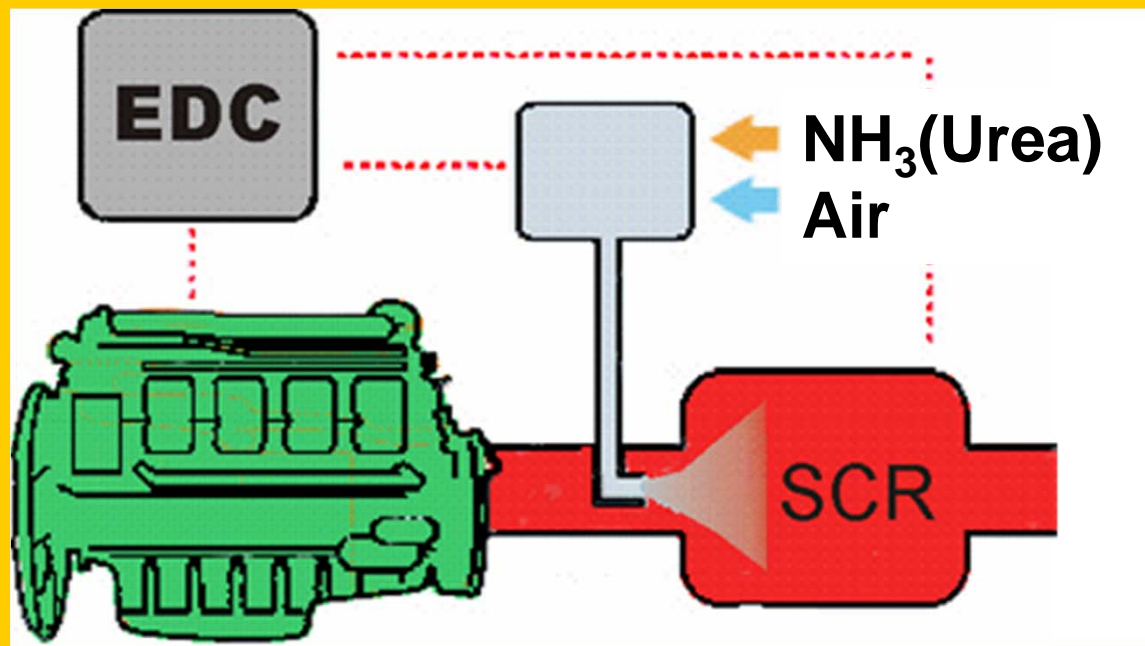


## 2-way (oxidation) Catalysts



# Catalytic Converters

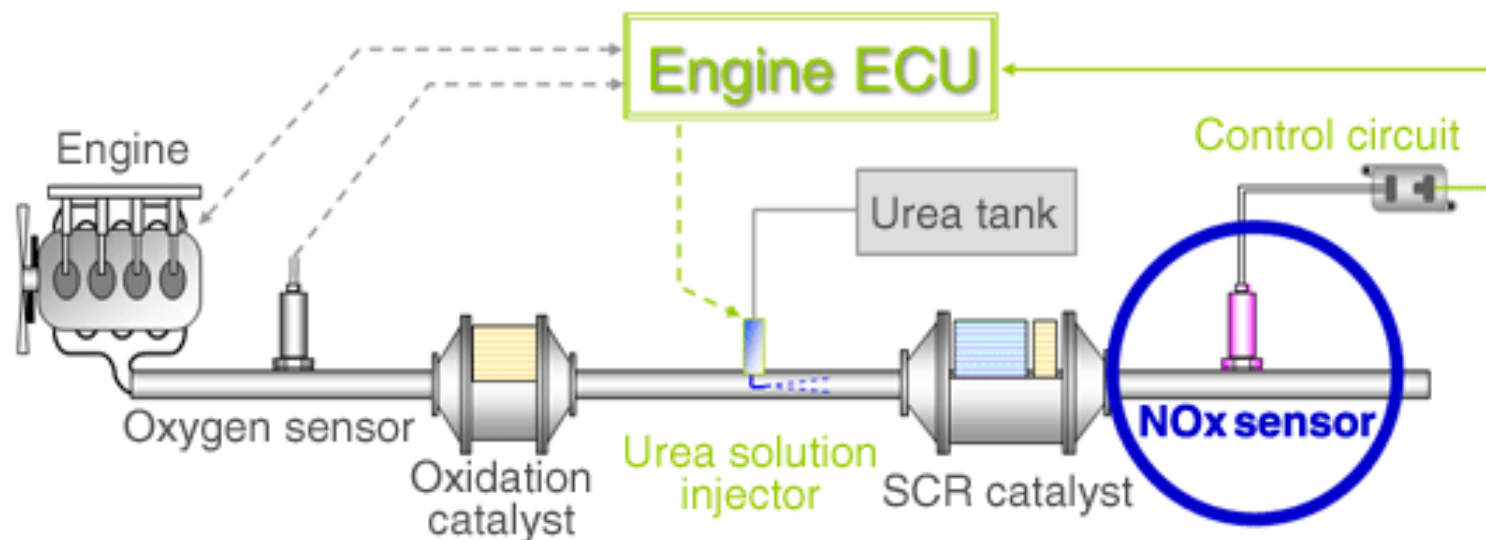
Selective Catalytic Reduction (SCR)





## Usage example SCR system

SCR: Selective Catalytic Reduction



**Monitors NOx values downstream of the catalyst and controls the amount of urea injected**

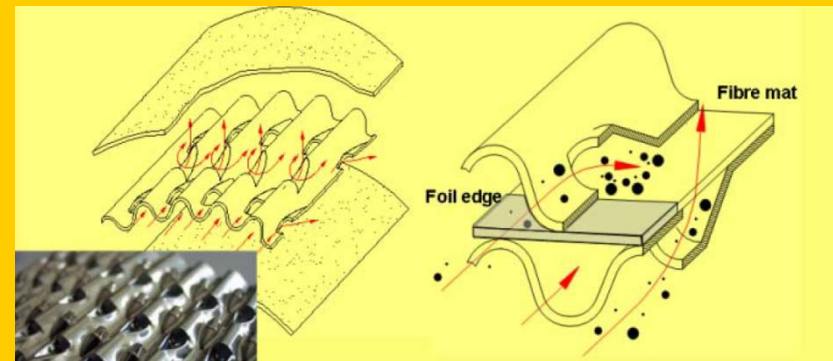
Optimization of the amount of urea injected  
Improved purification efficiency

# Particulate Filter types

- Monolit PF

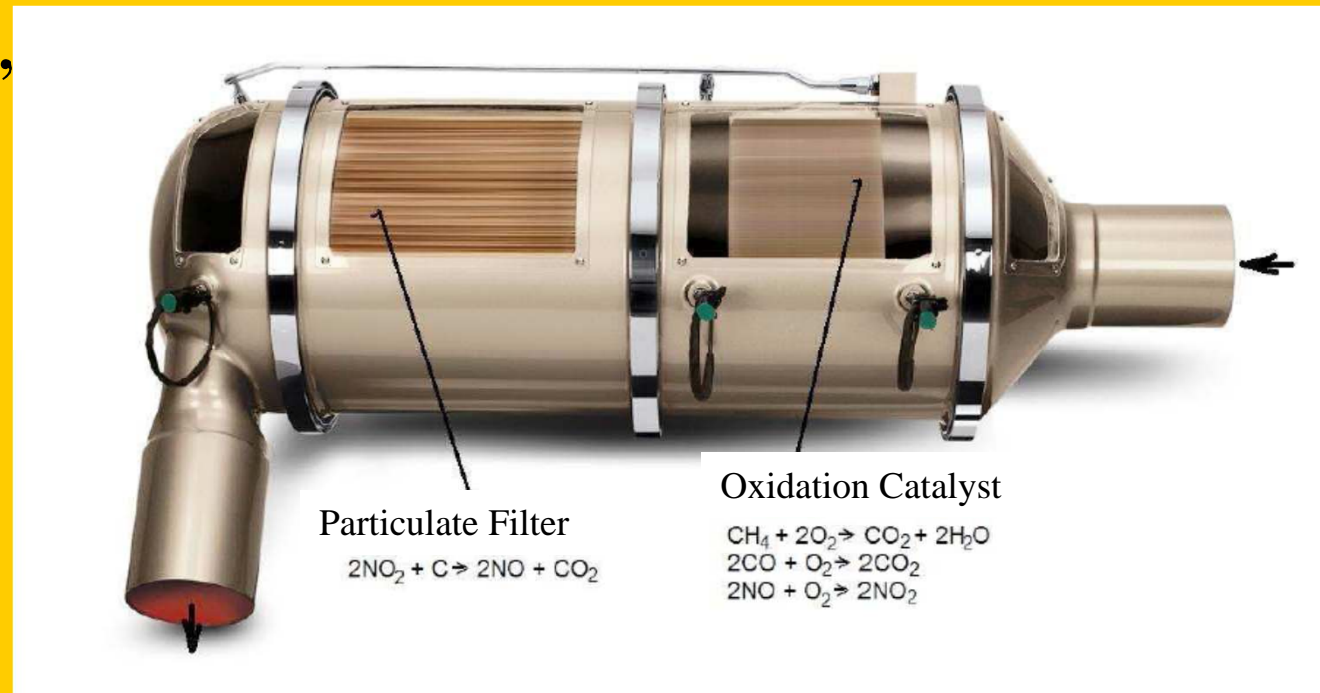


- Sintered PF



# PF types

- CRT (Continuously Regenerate Technology),
- CDPF (Catalyzed Diesel Particulate Filter),
- CCRT (Catalyzed Continuously Regenerating Technology),



END