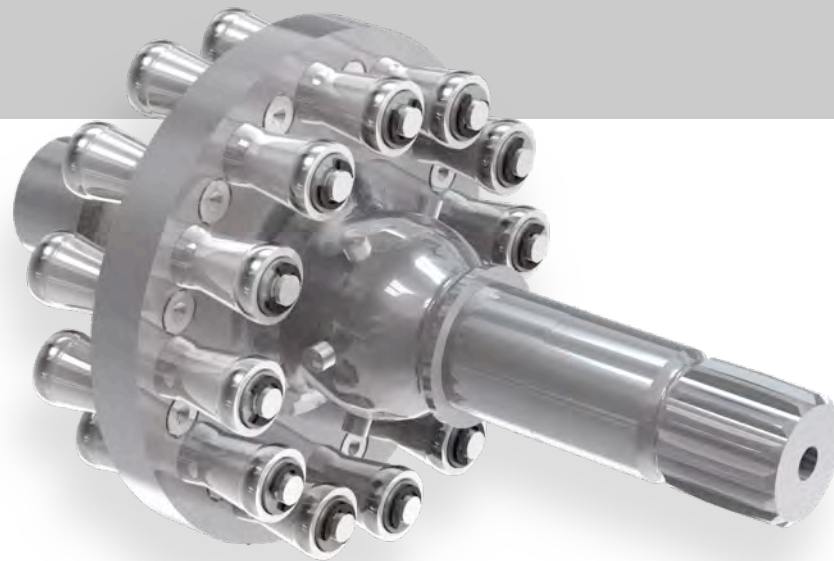
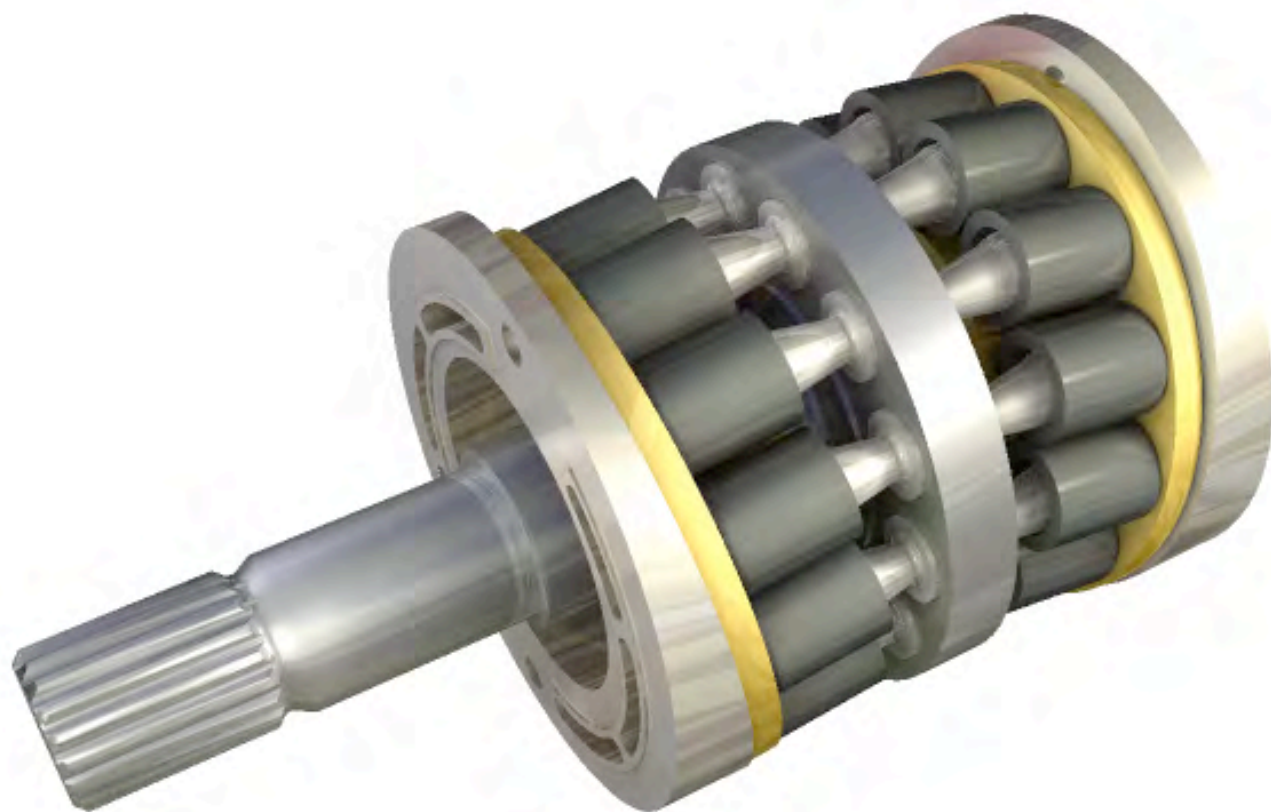


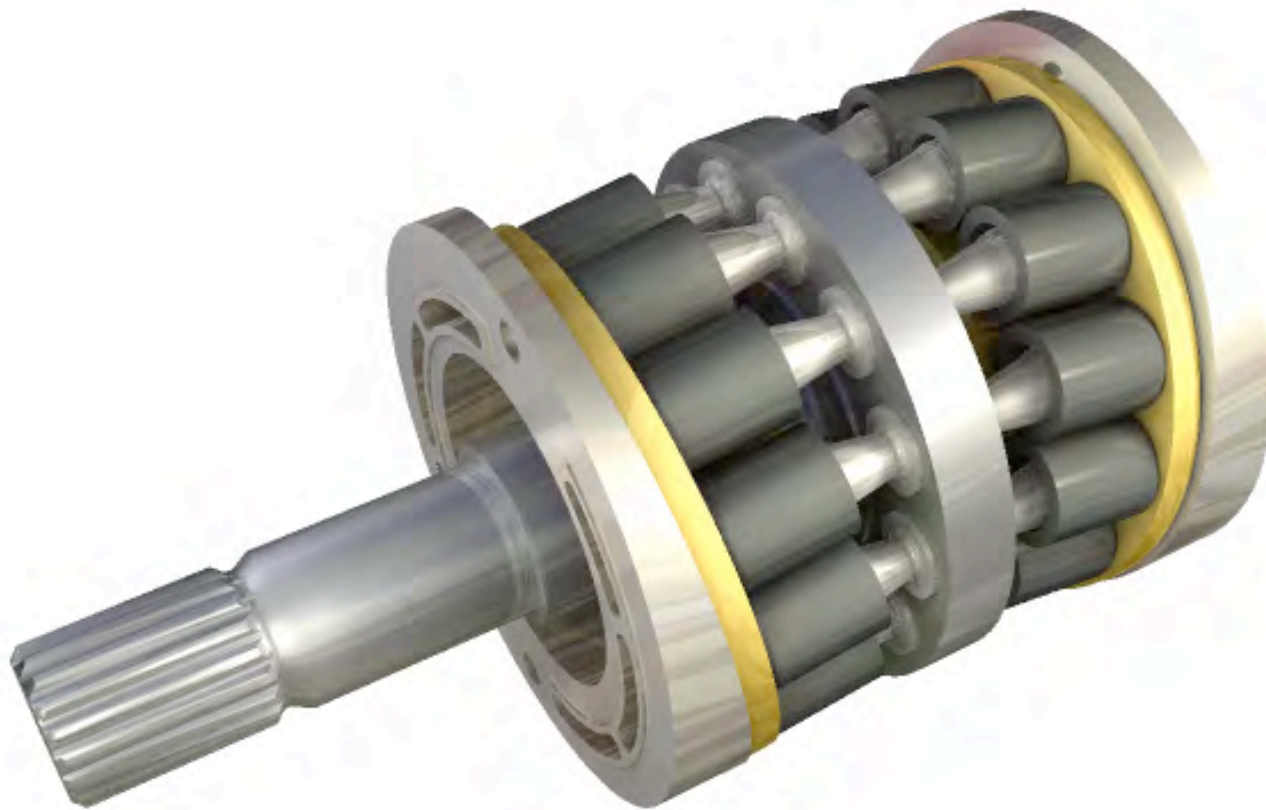
Floating Cup

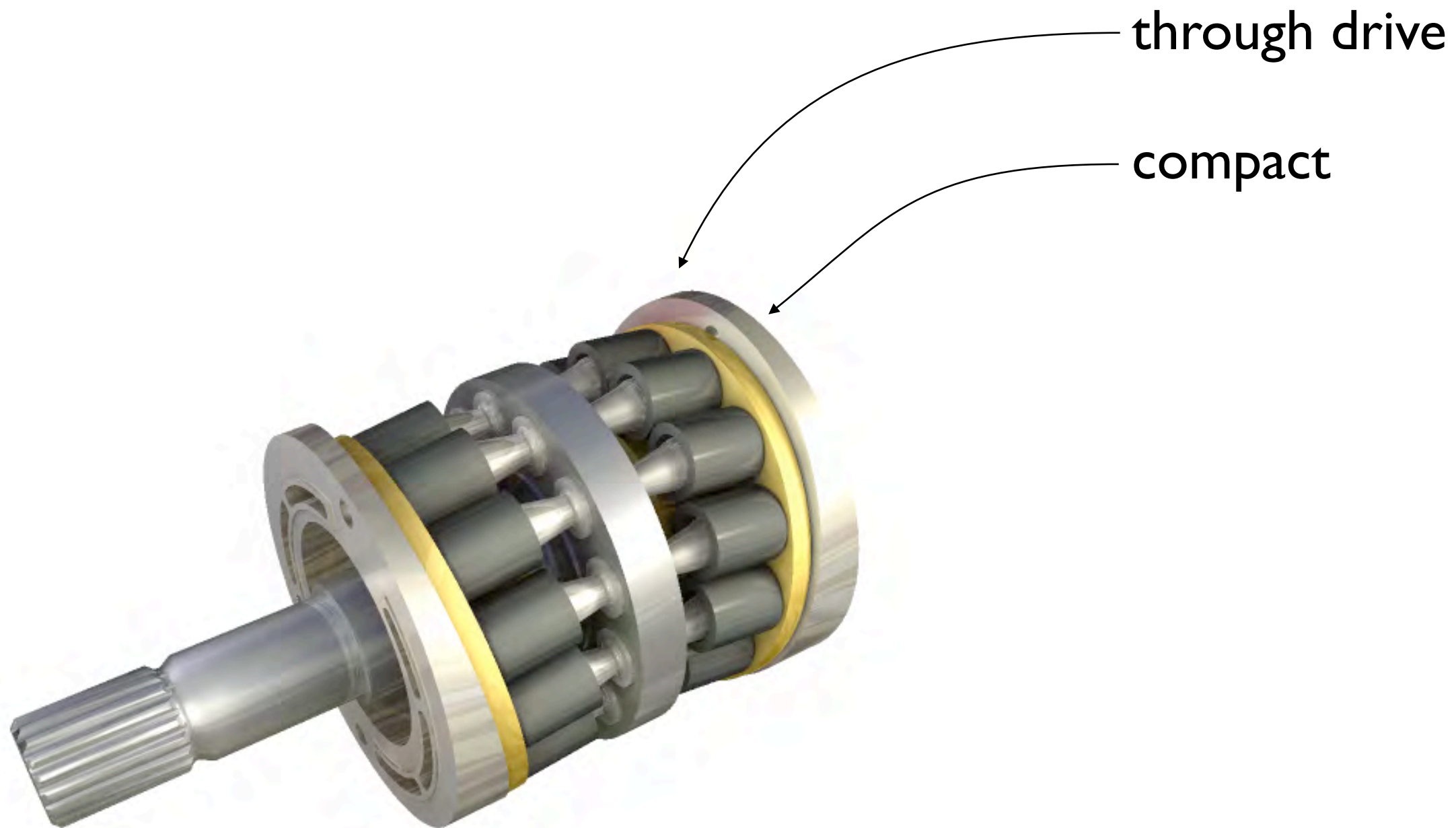


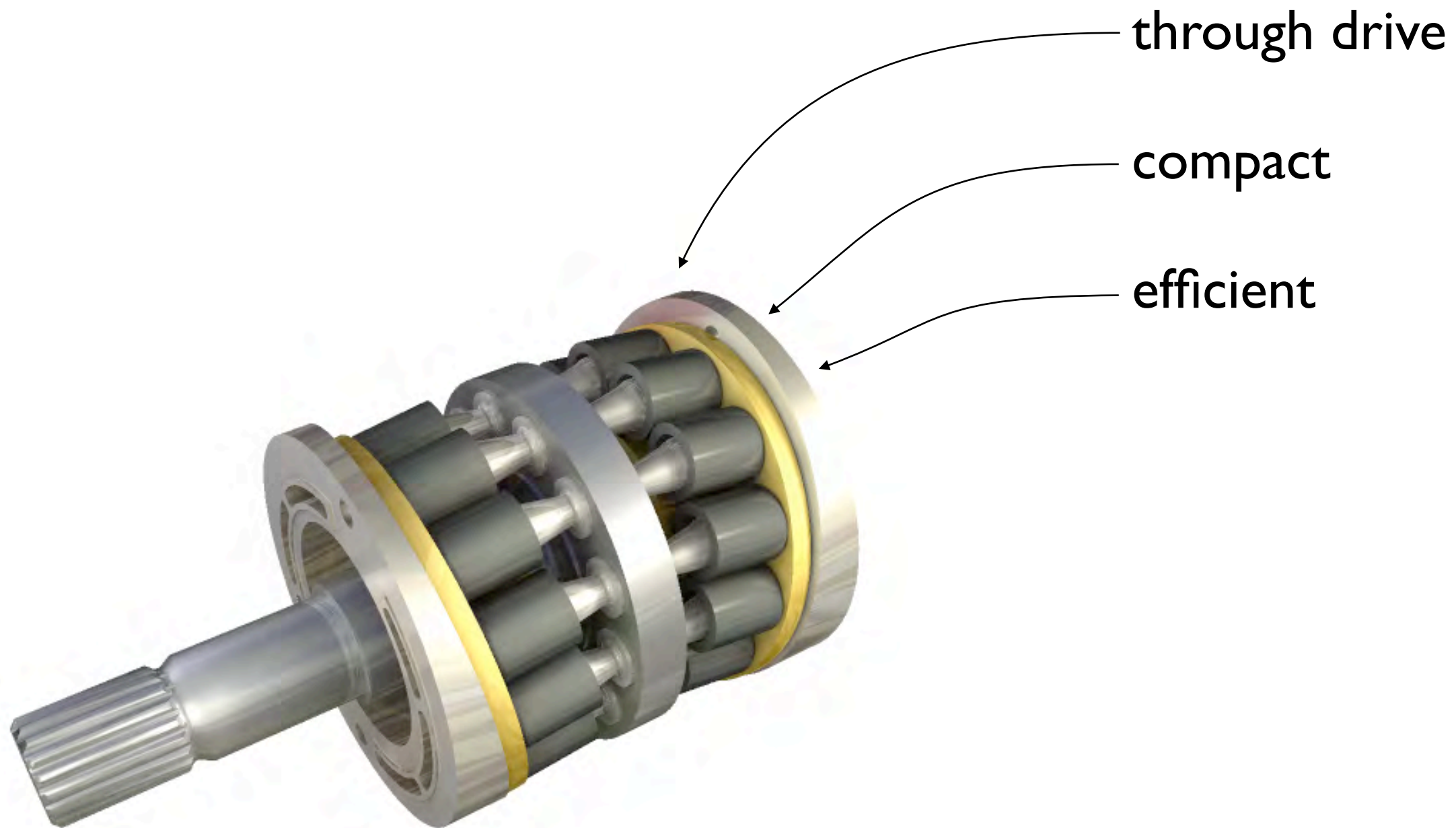
a new axial piston principle
for pumps, motors and hydraulic transformers

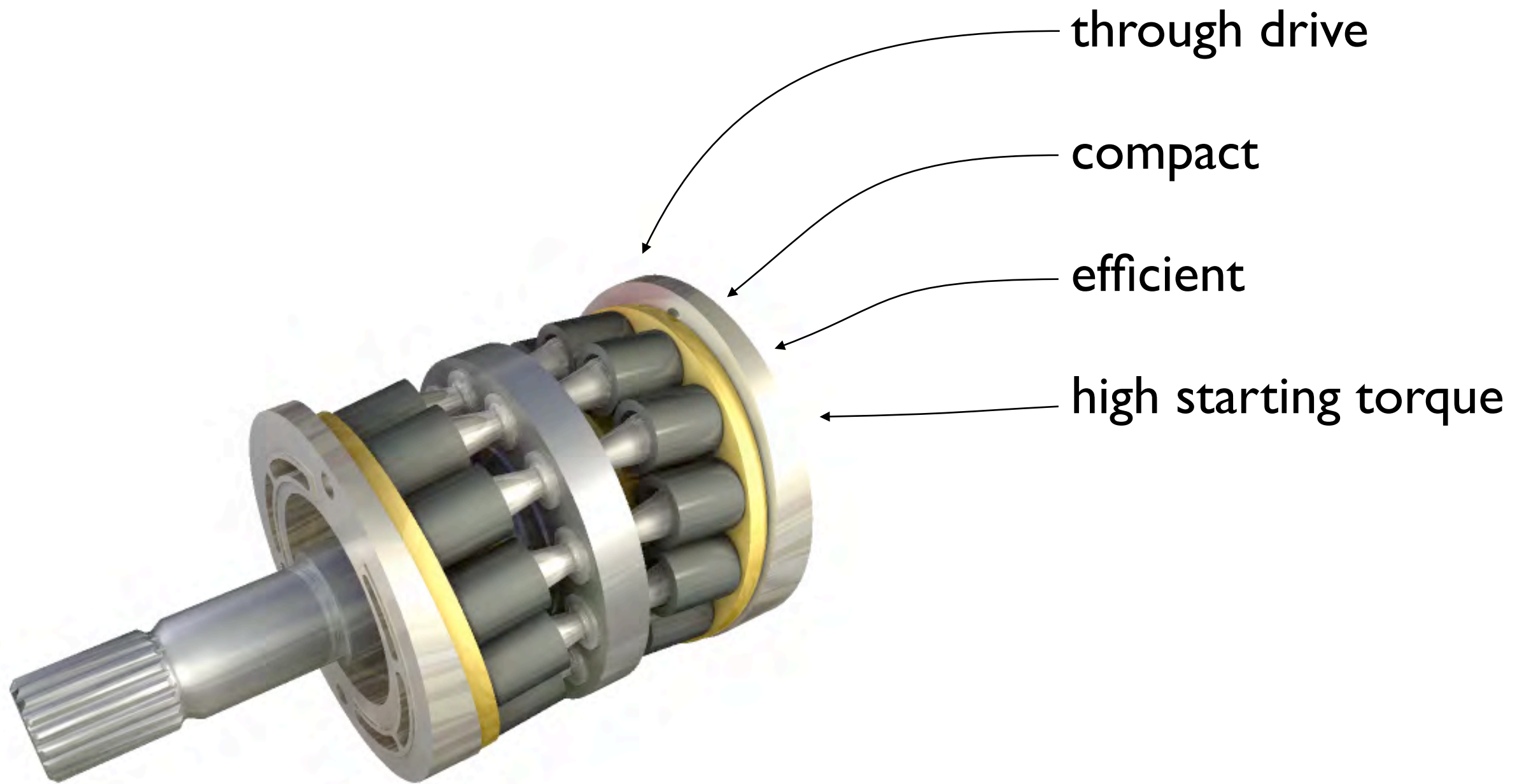


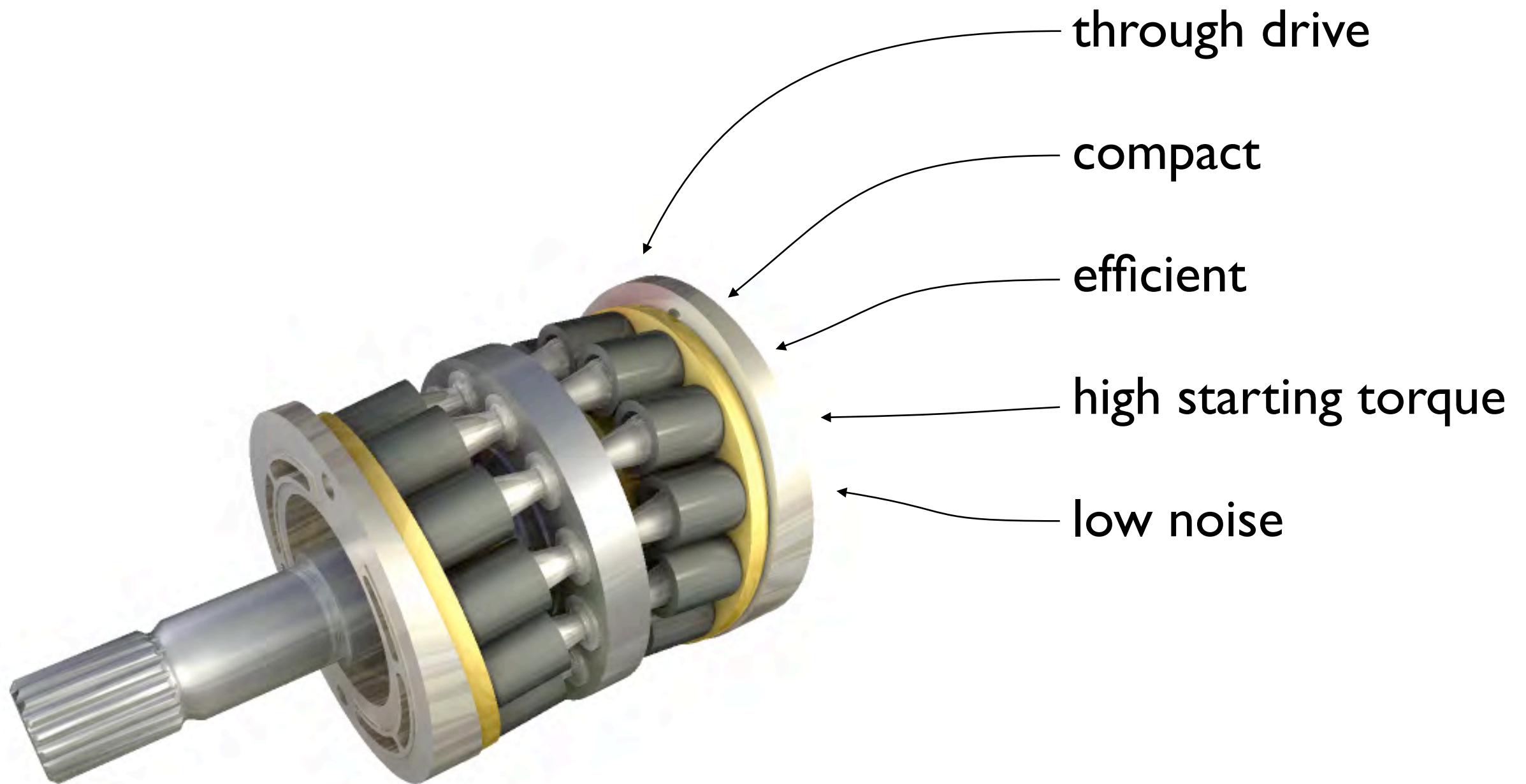
through drive

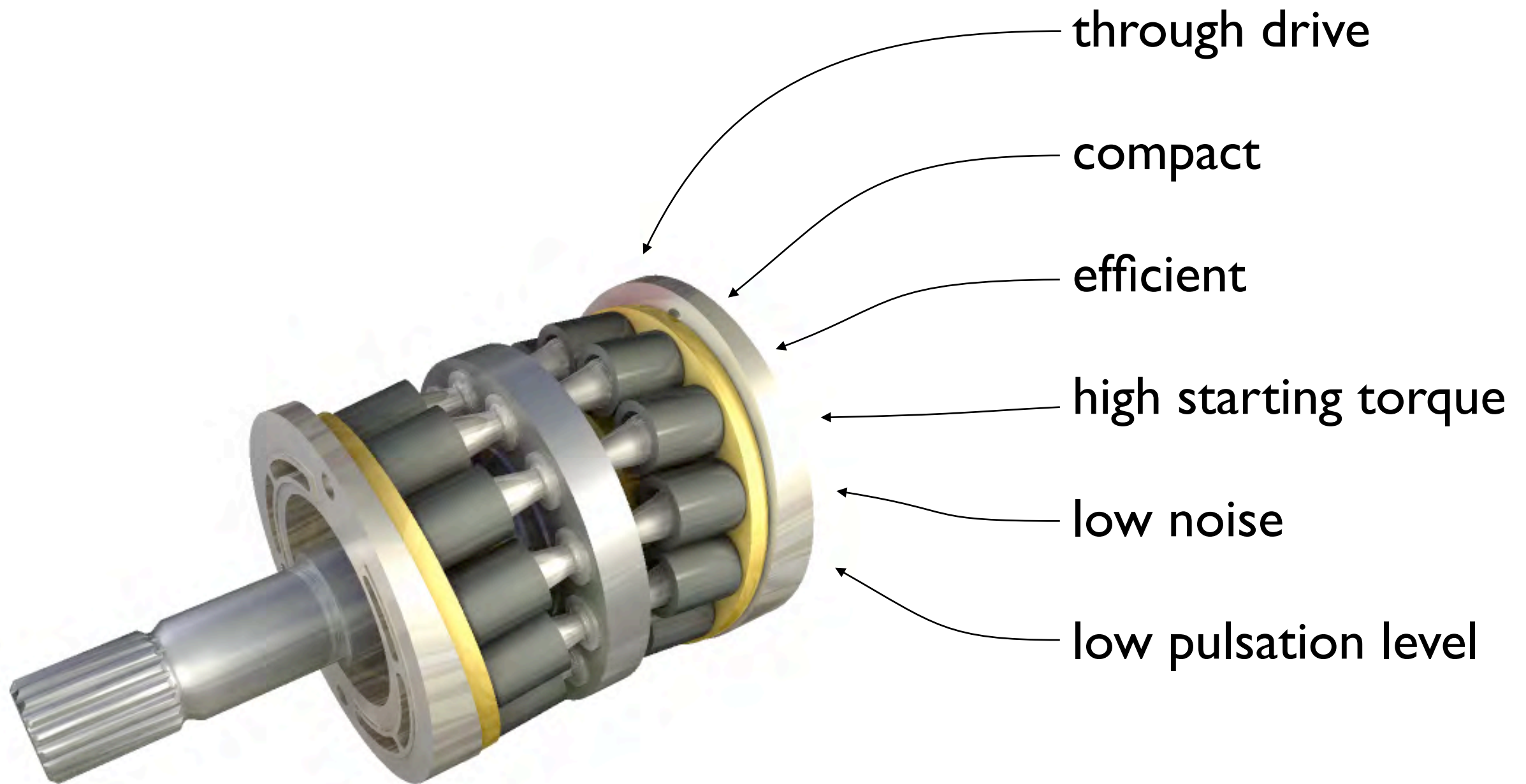


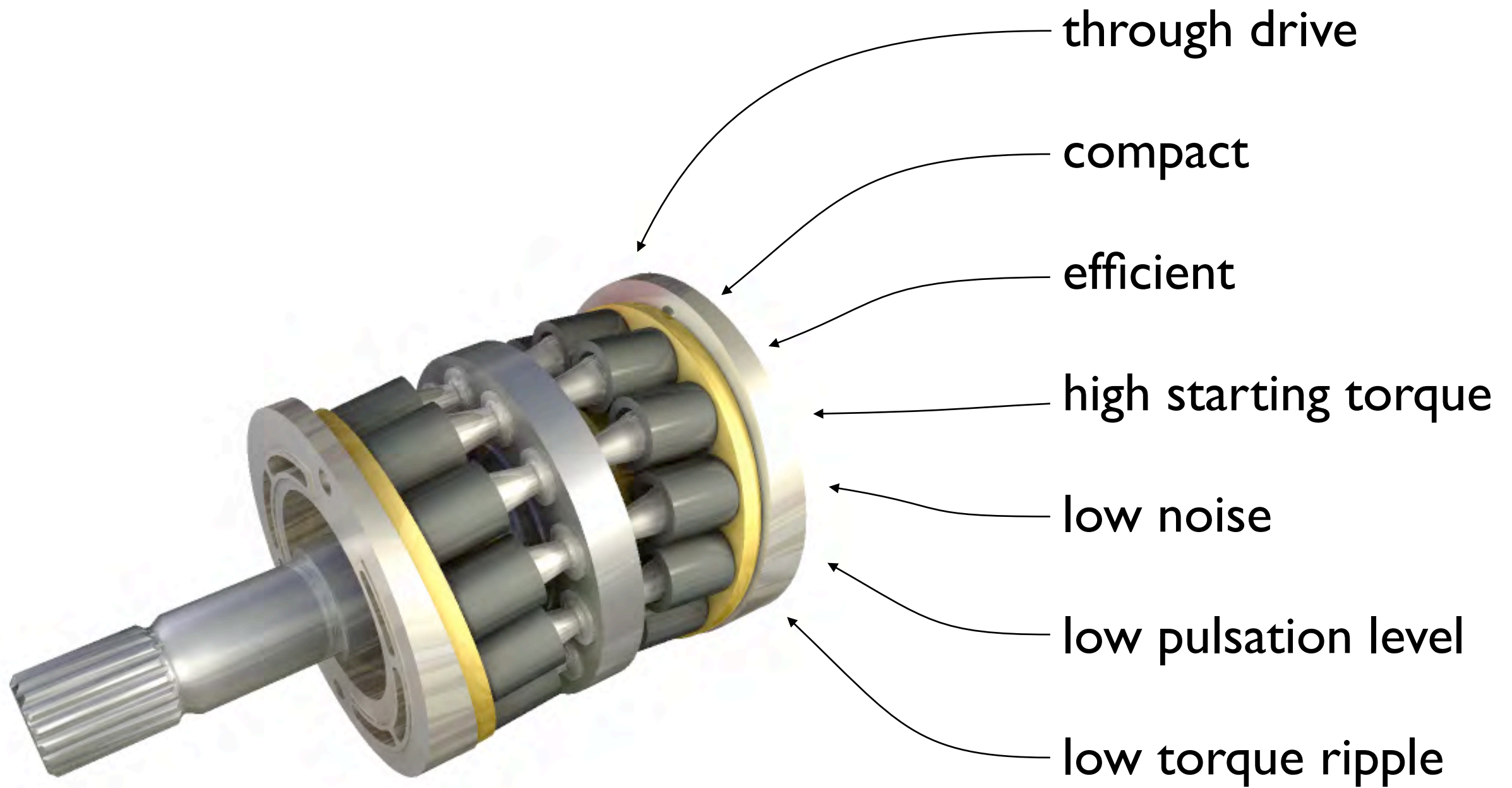


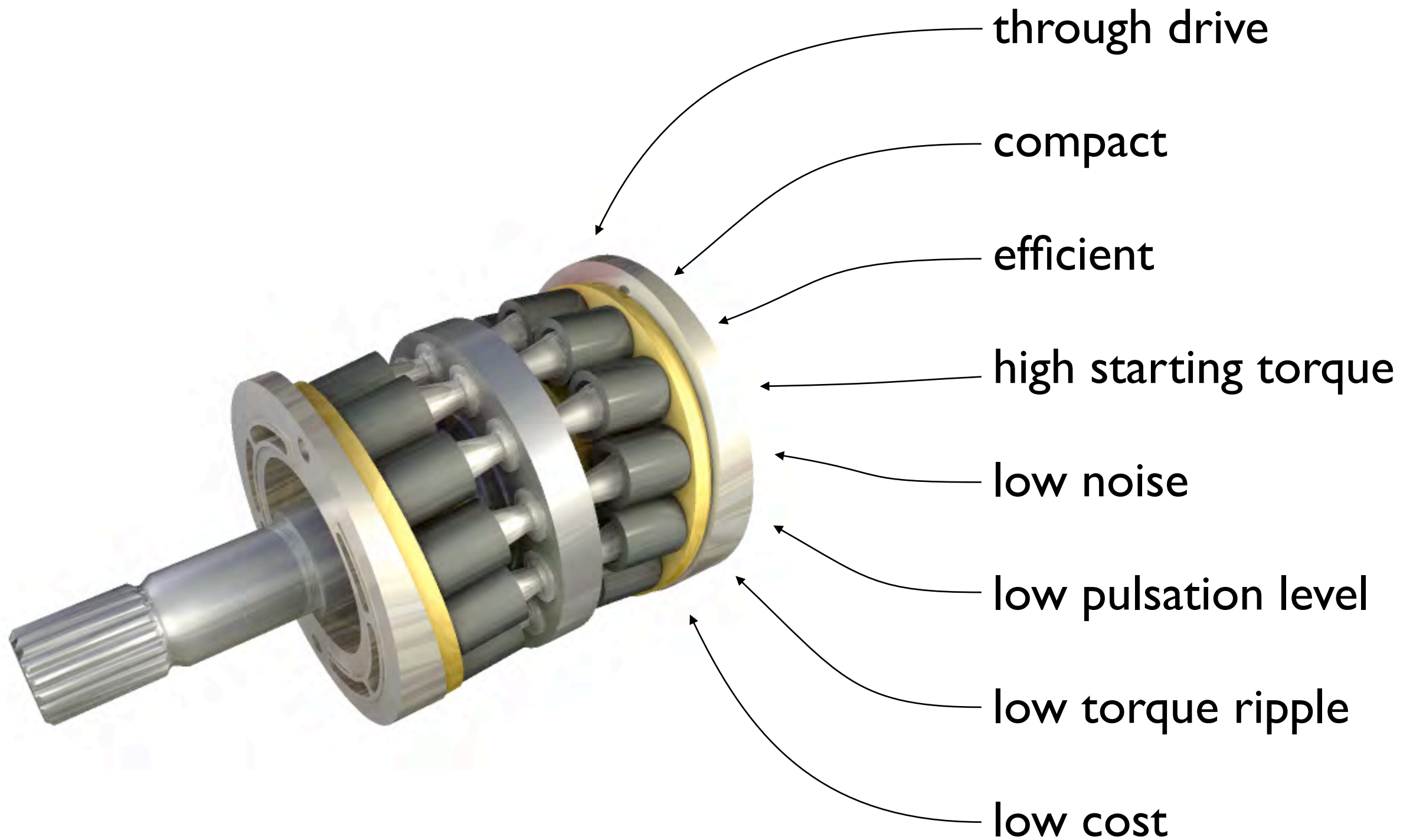


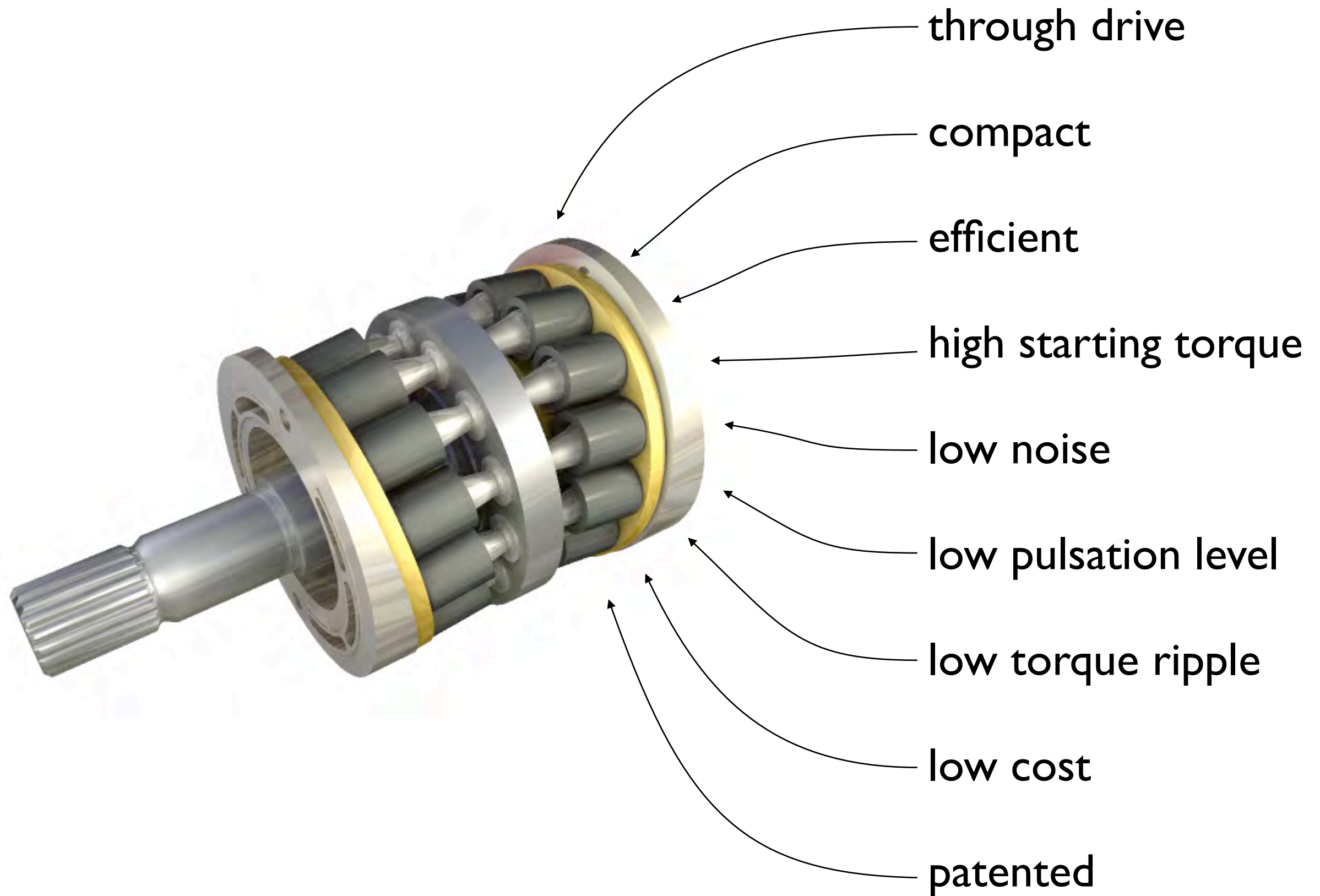












construction

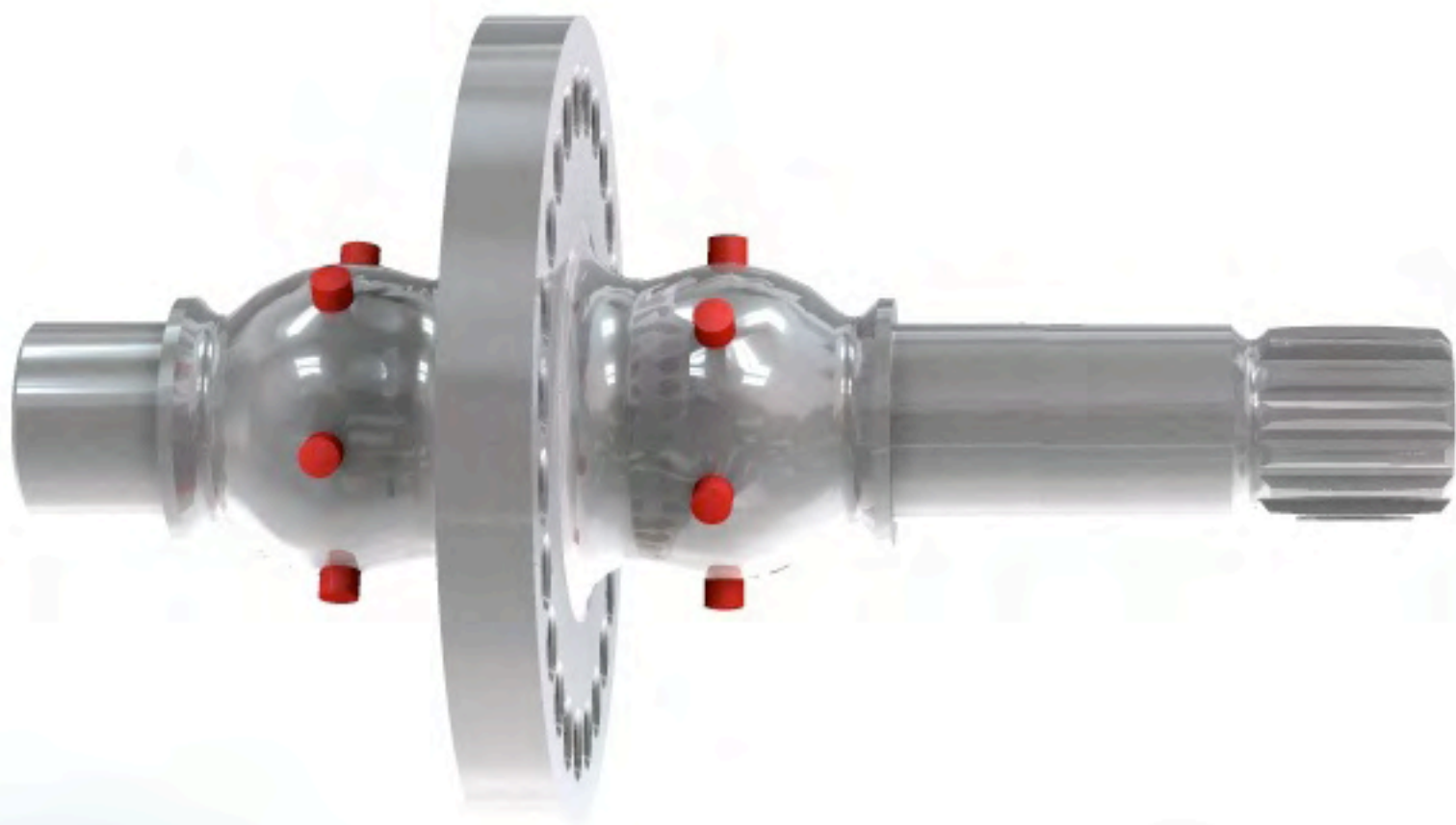


strong shaft

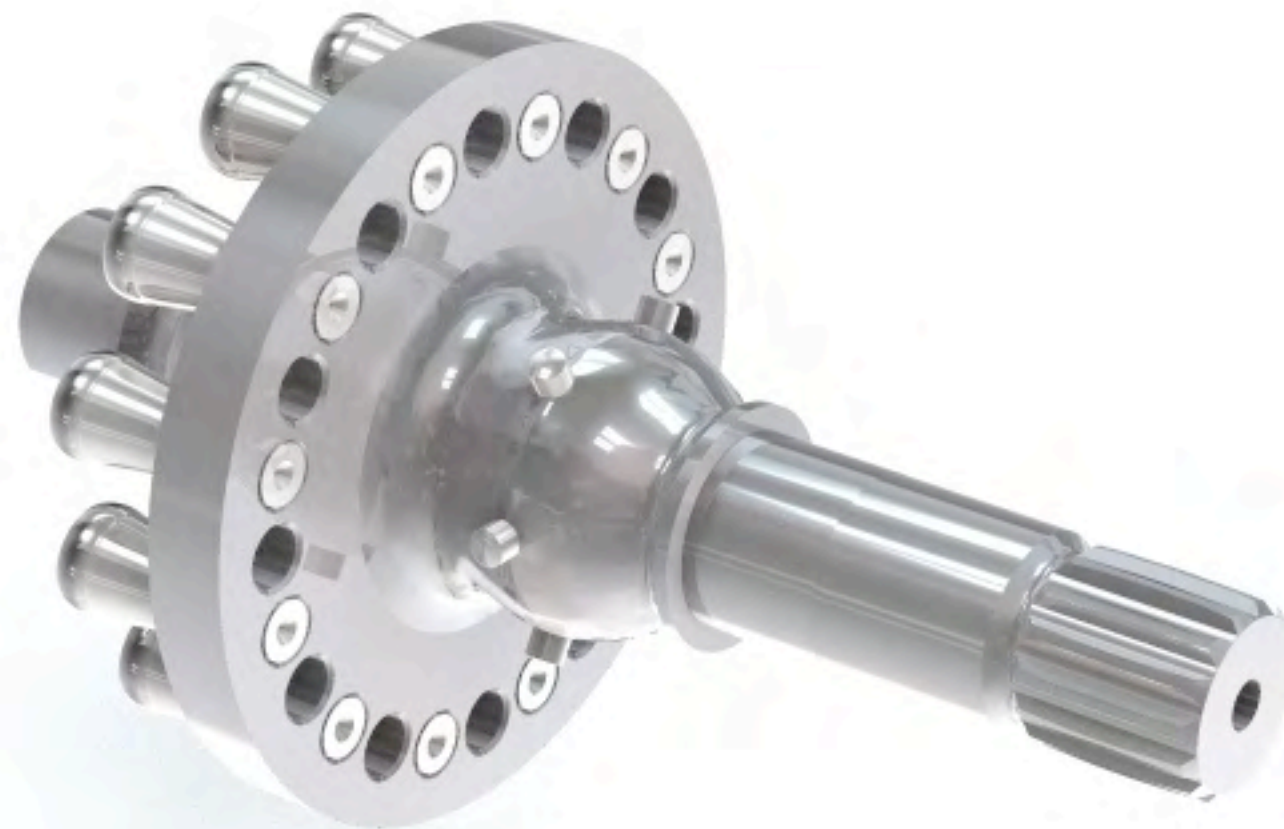


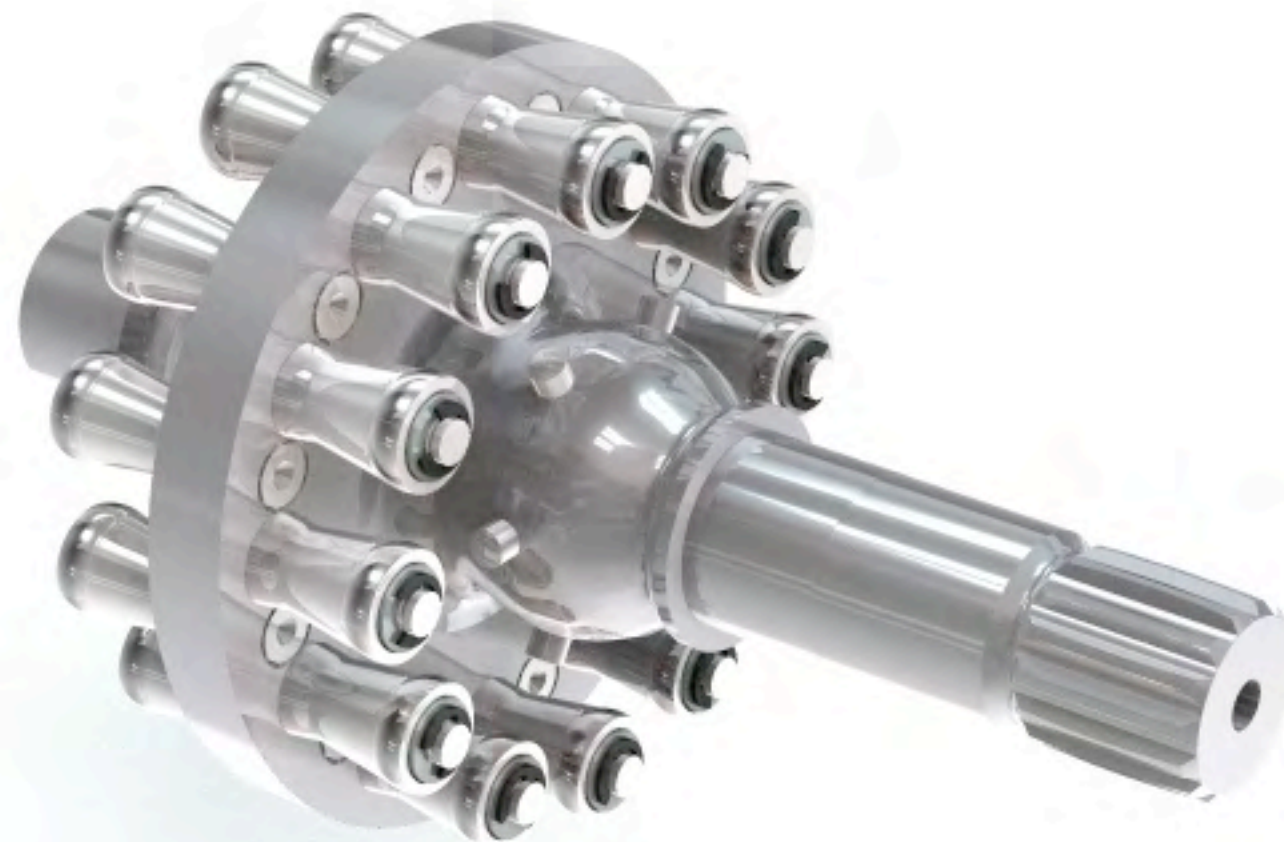
strong shaft
through drive is possible

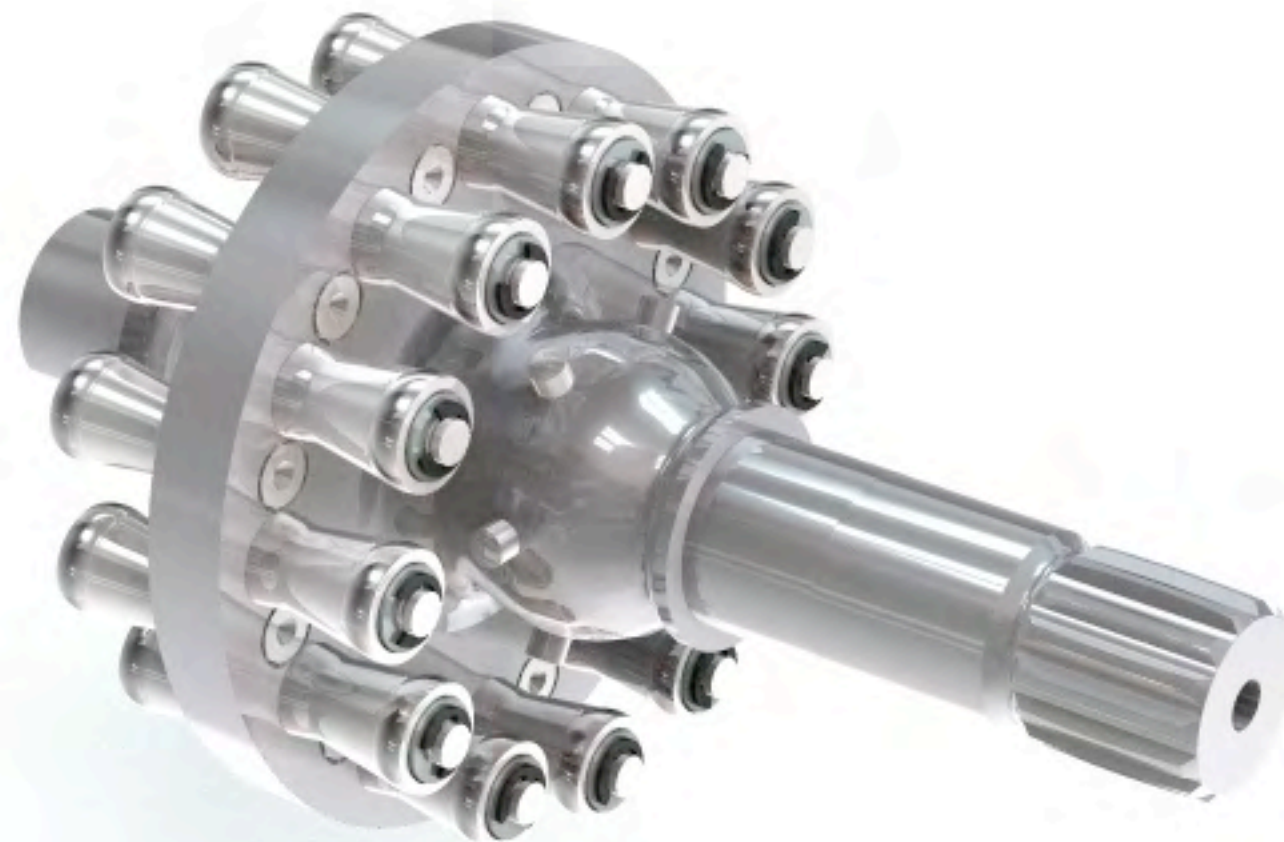




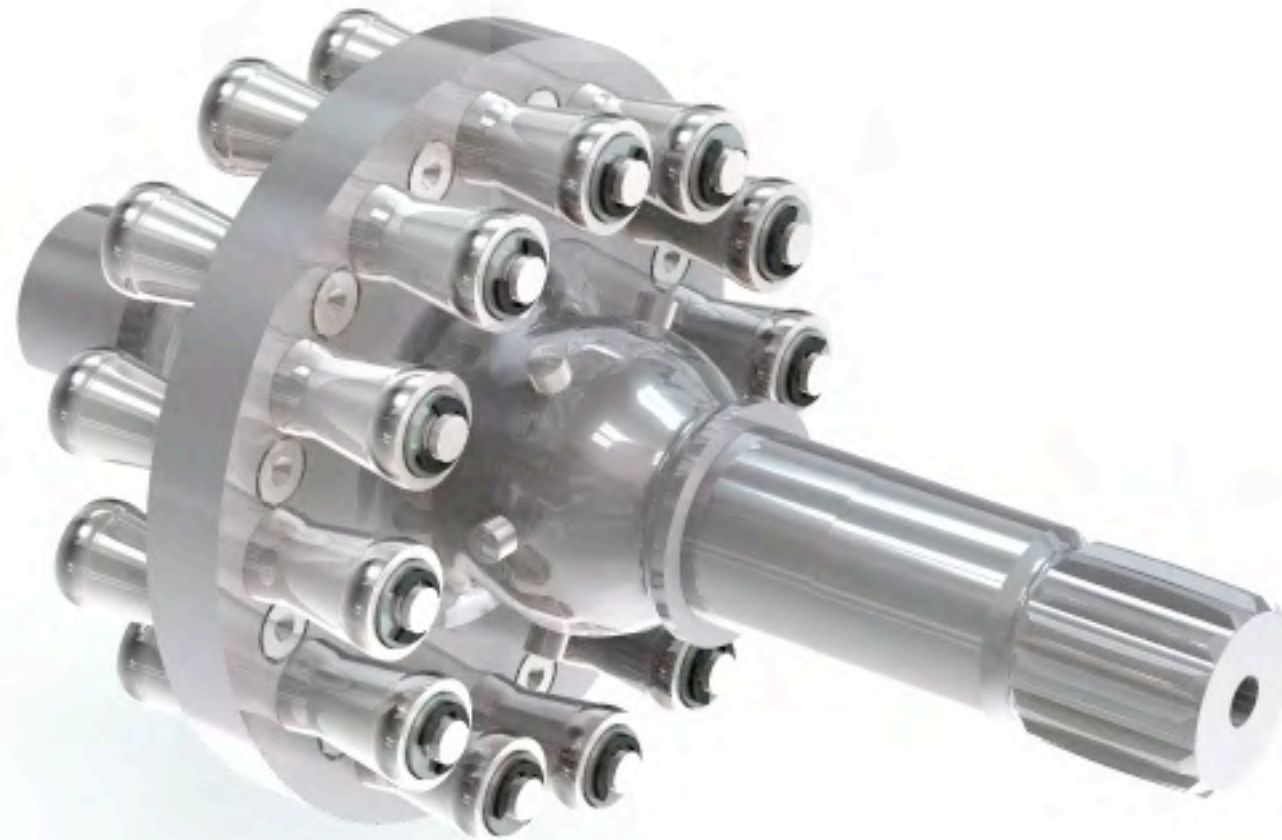






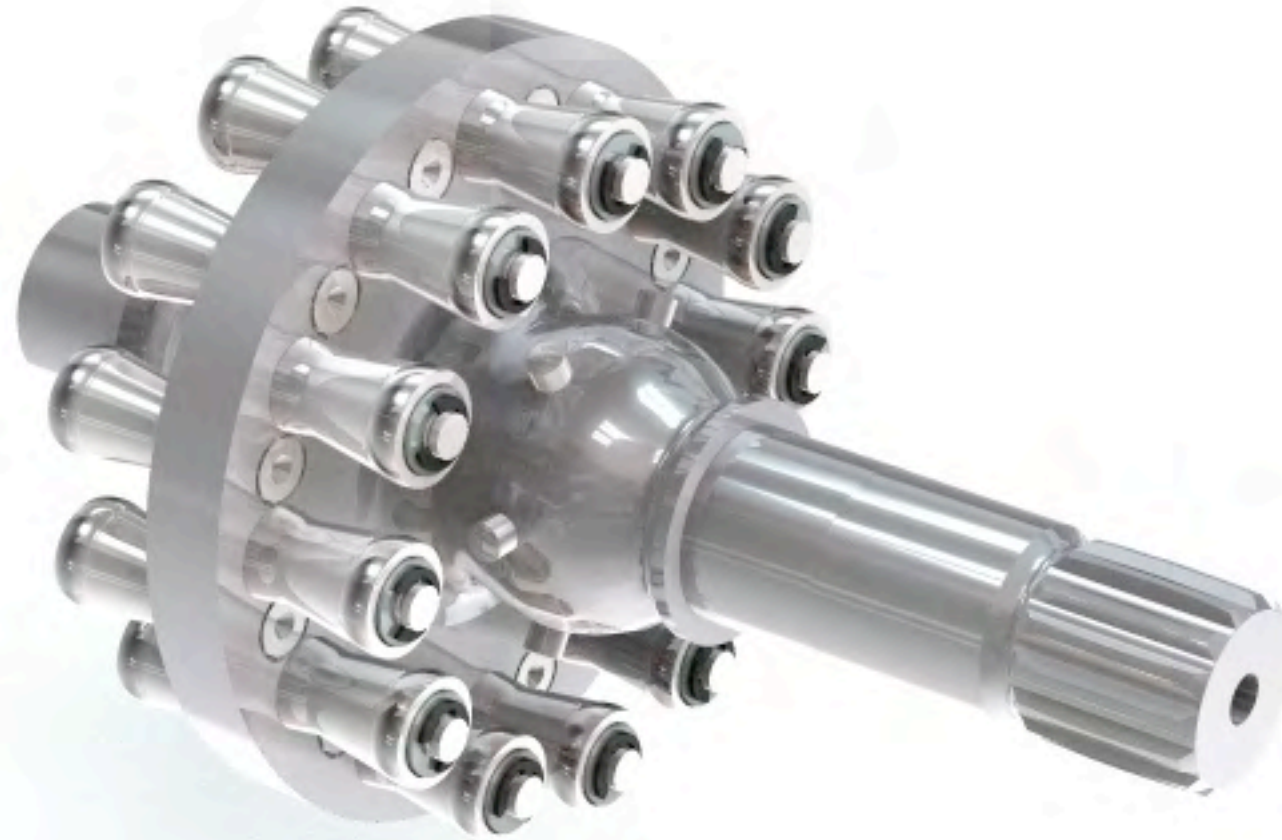


multi piston



multi piston

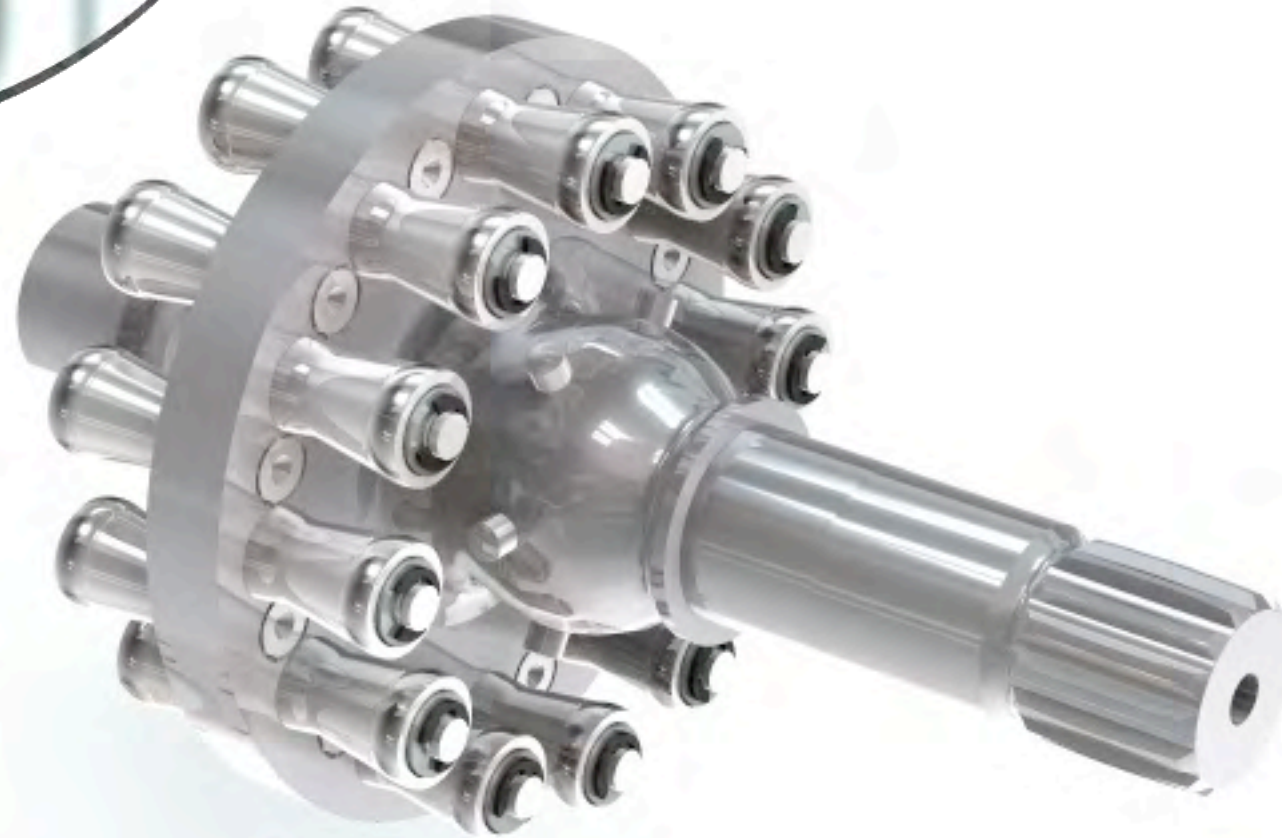
mirrored design

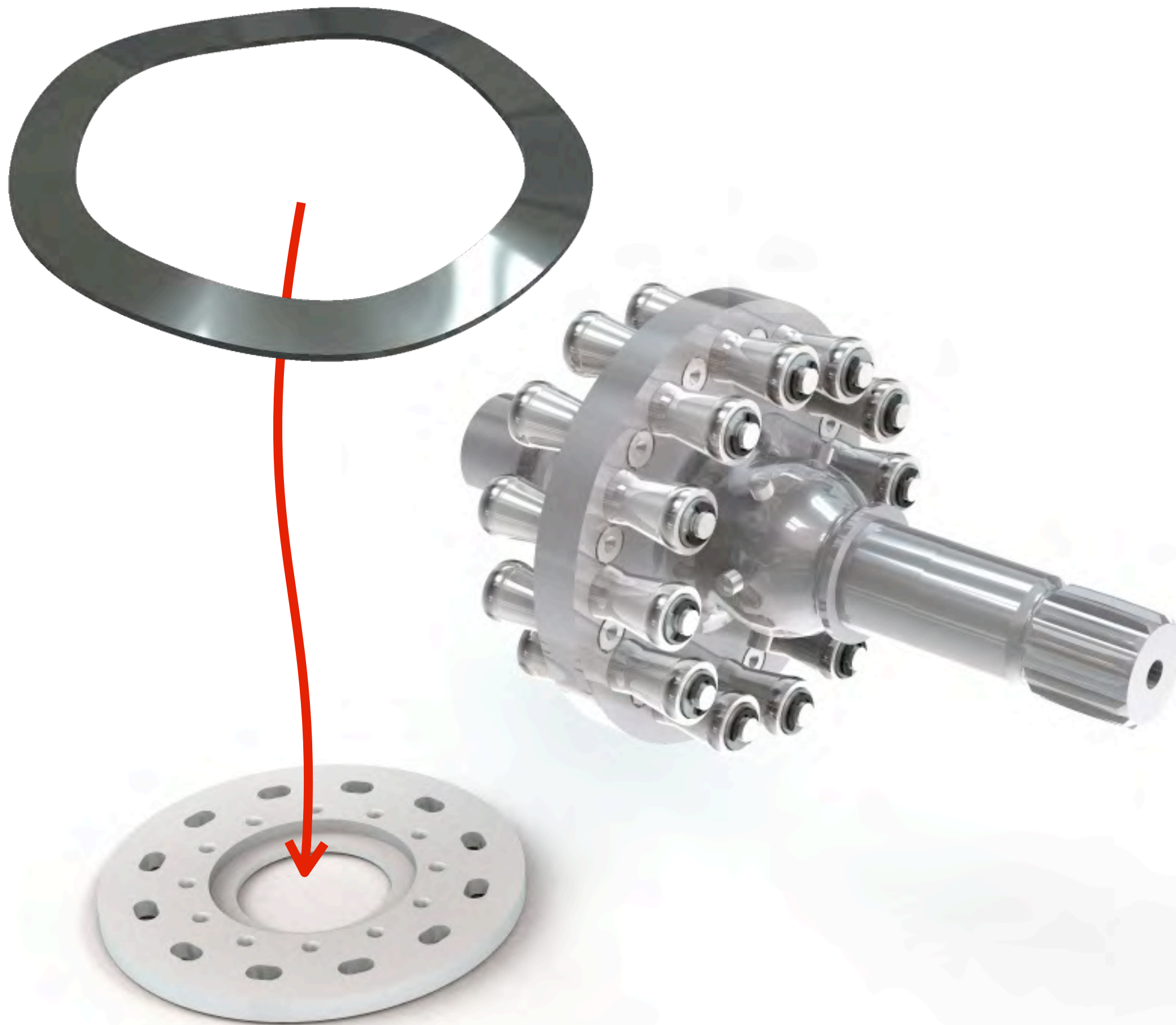


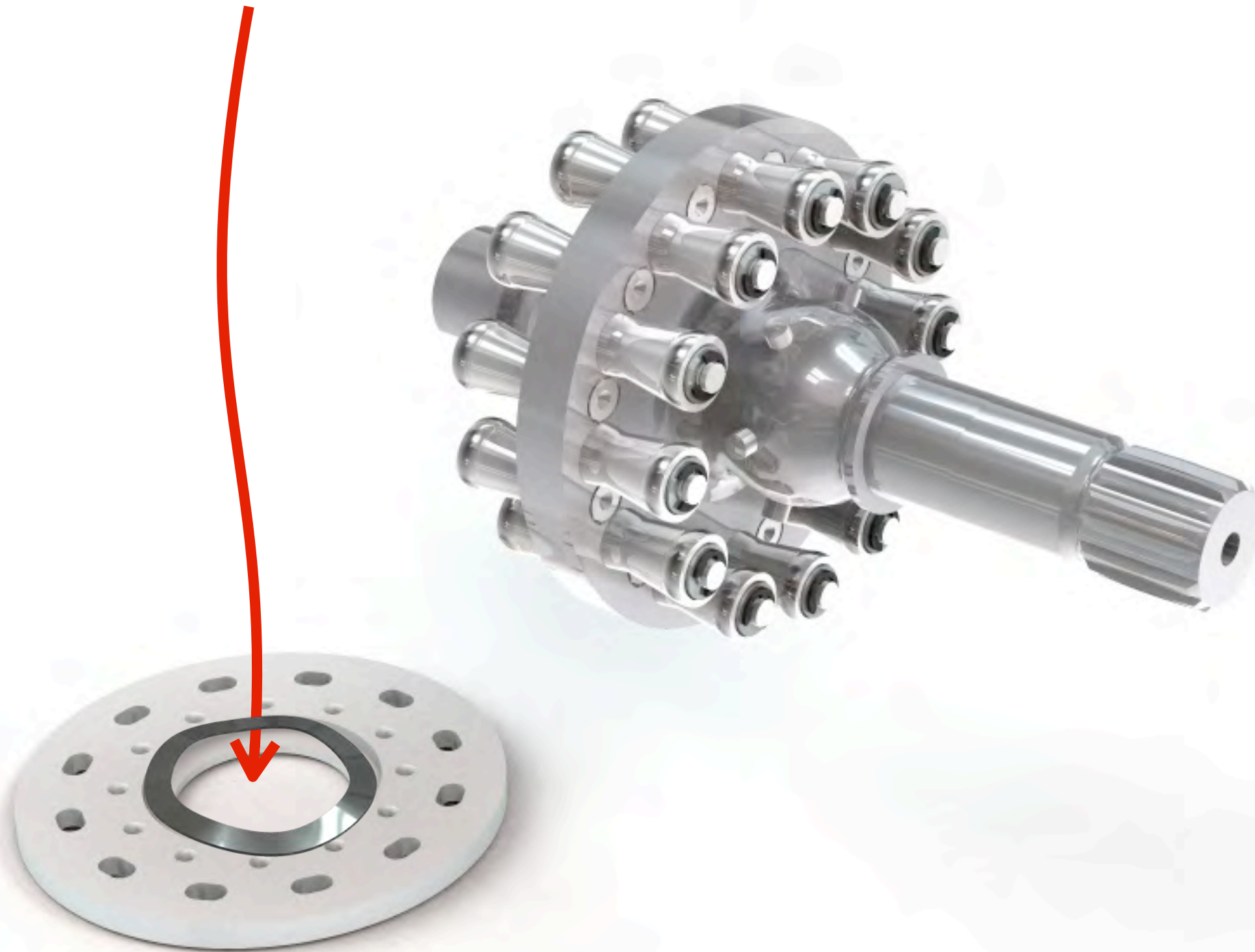


multi piston
mirrored design
out of phase



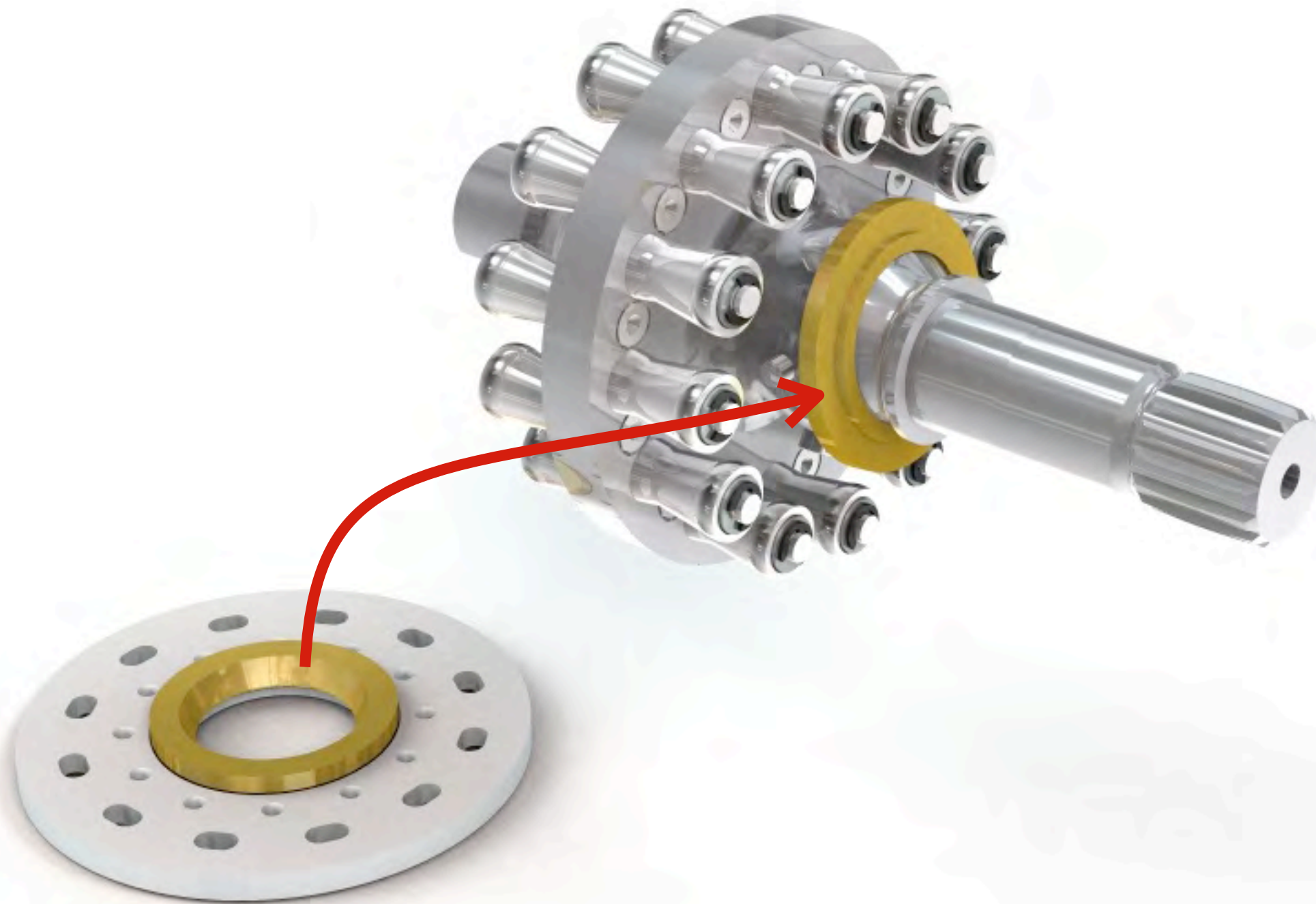


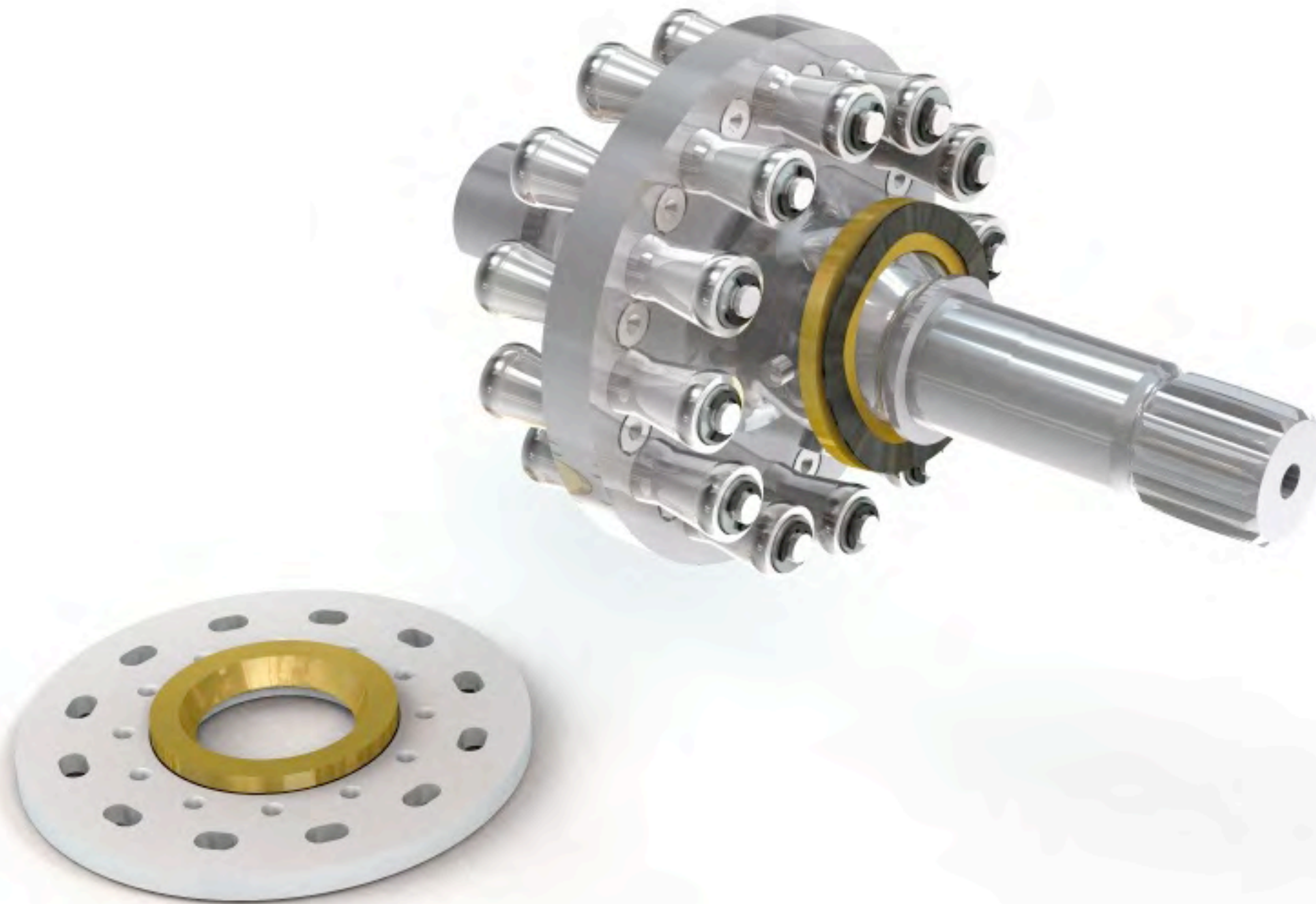


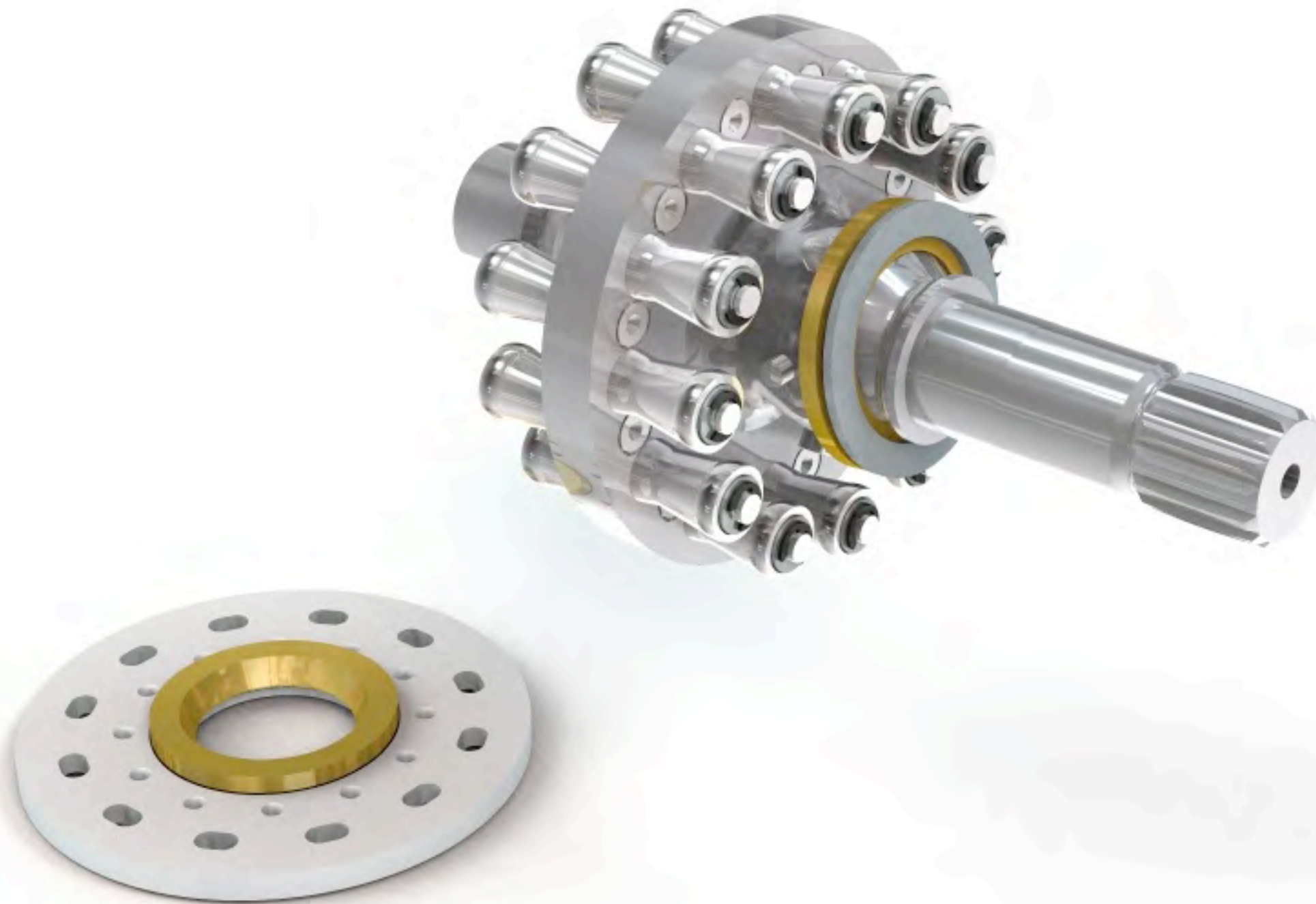


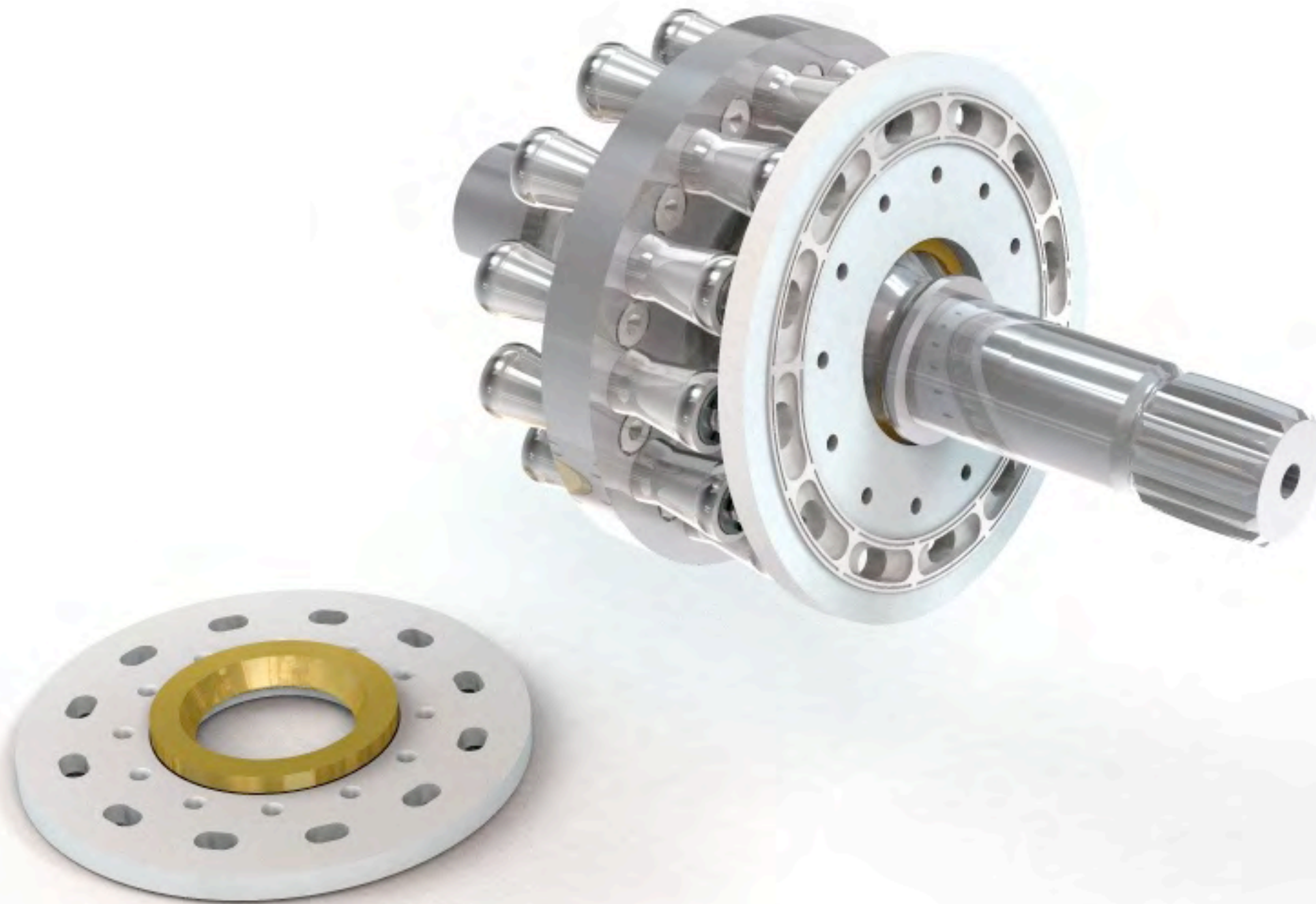




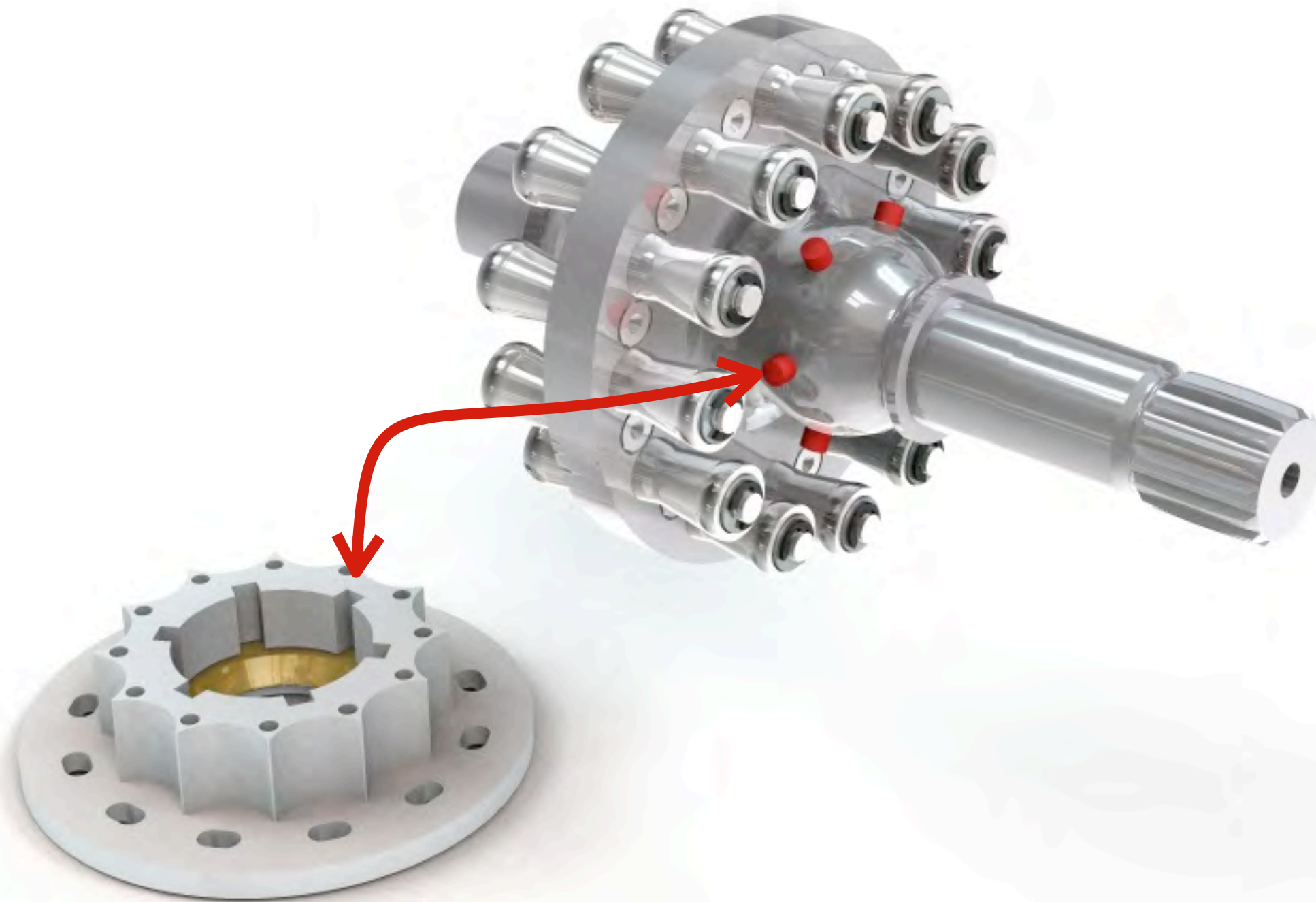




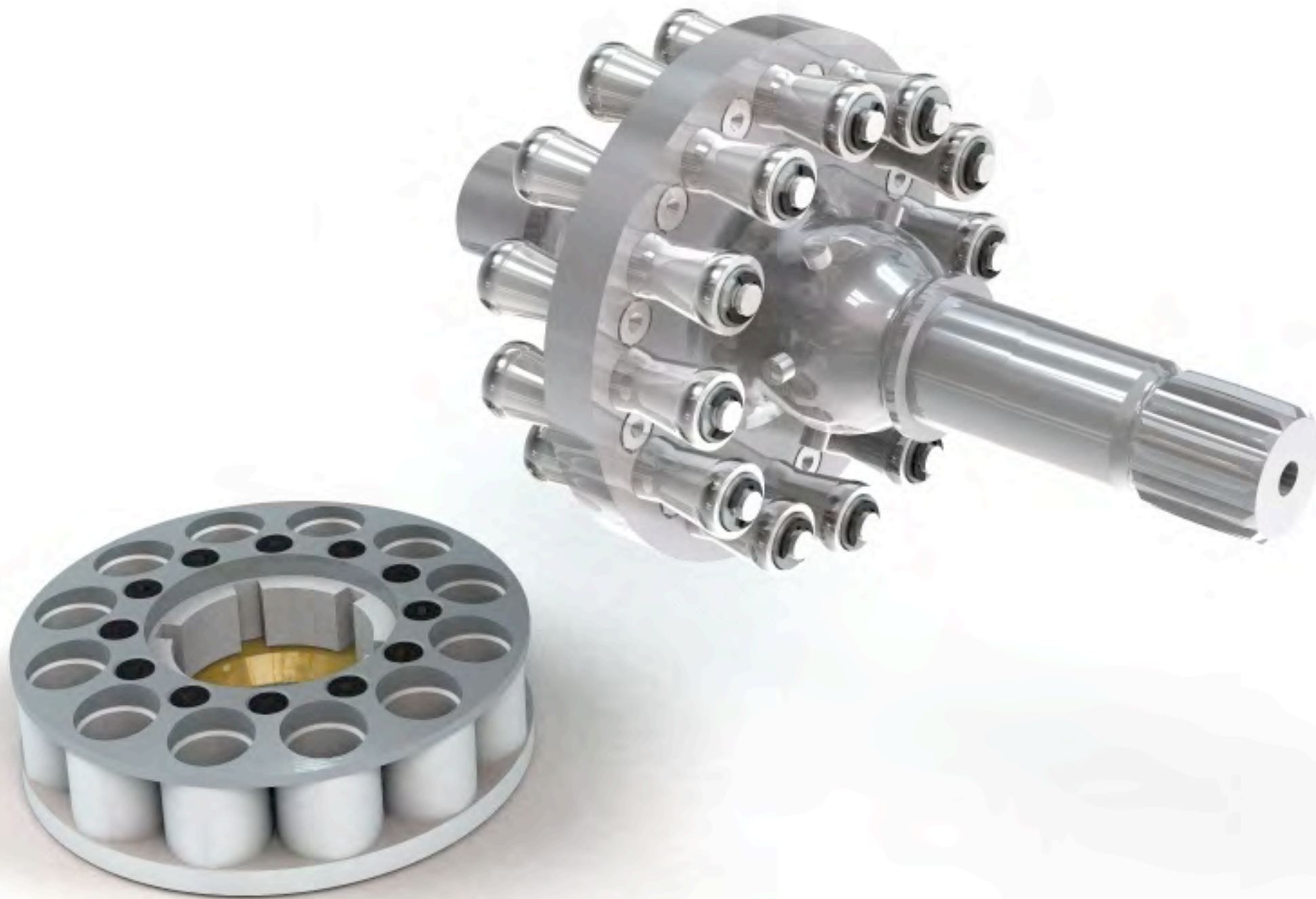


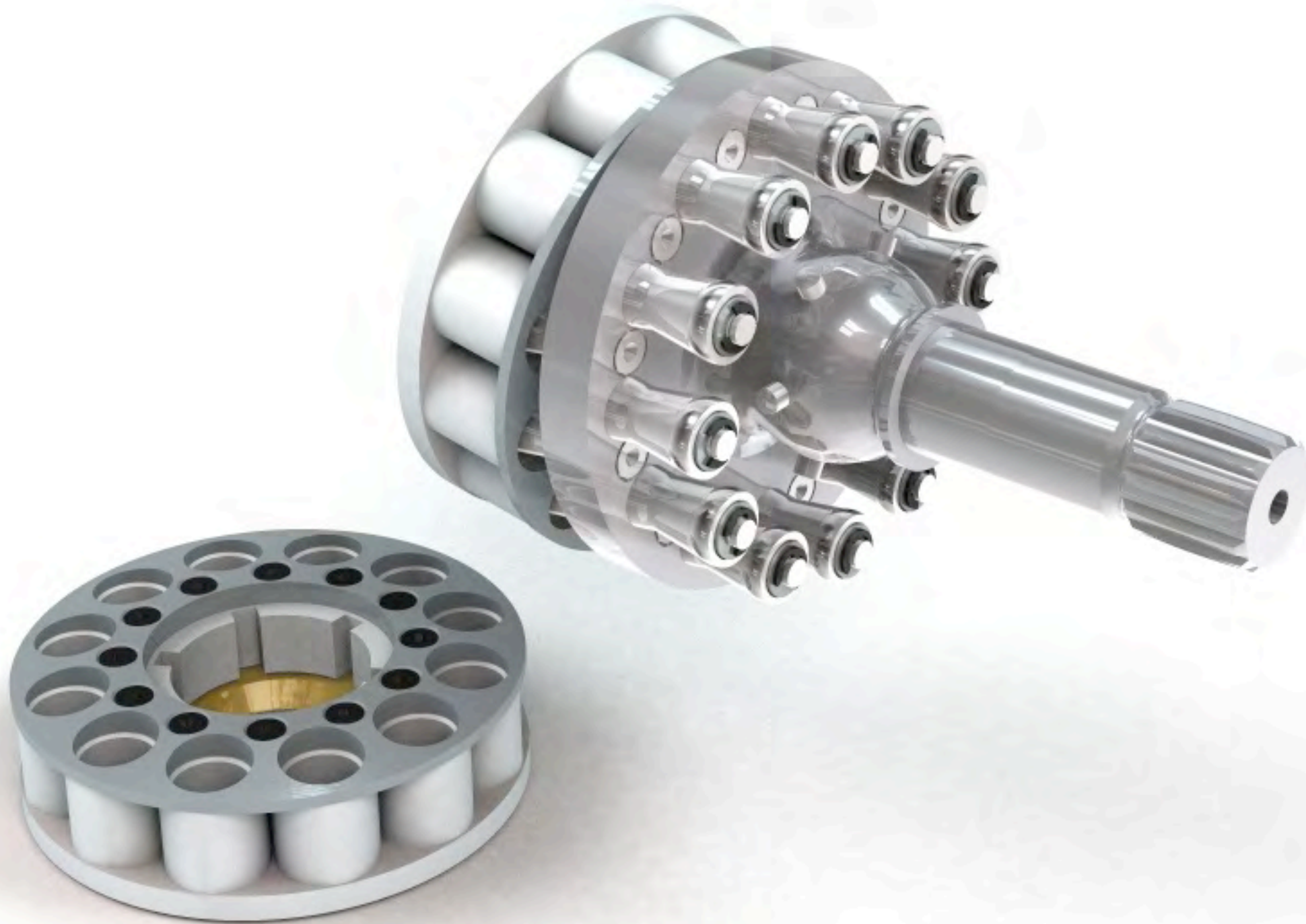


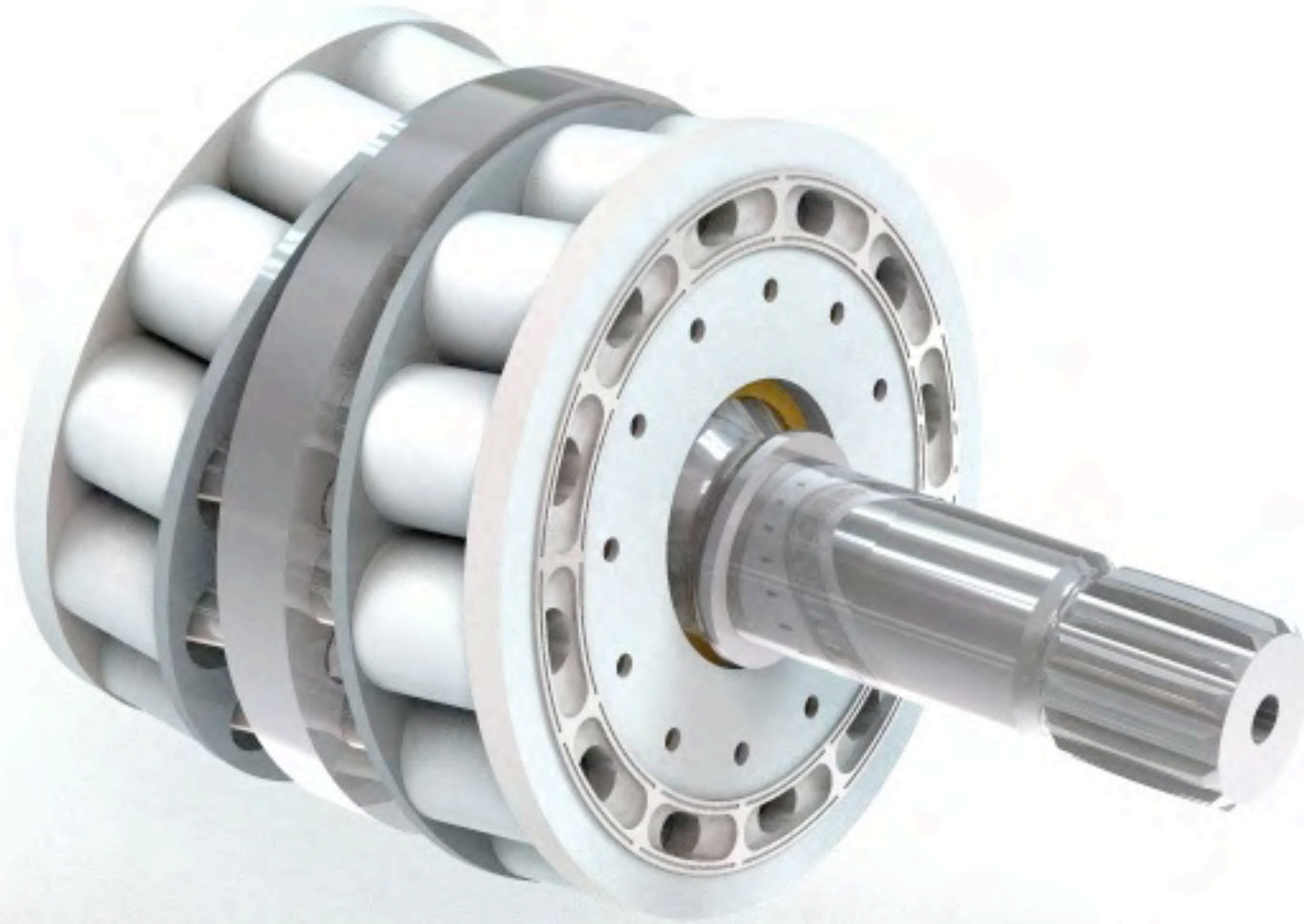


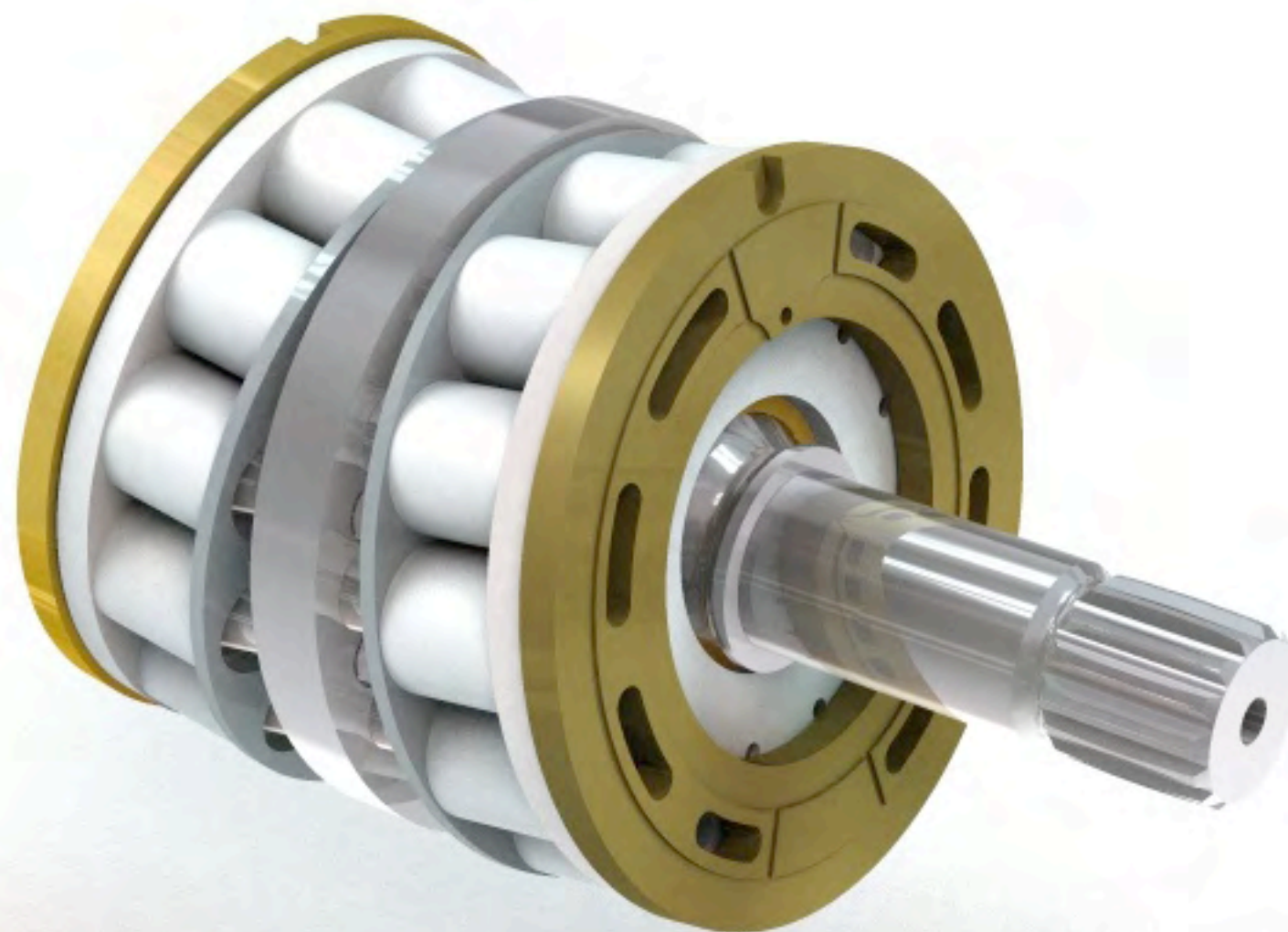


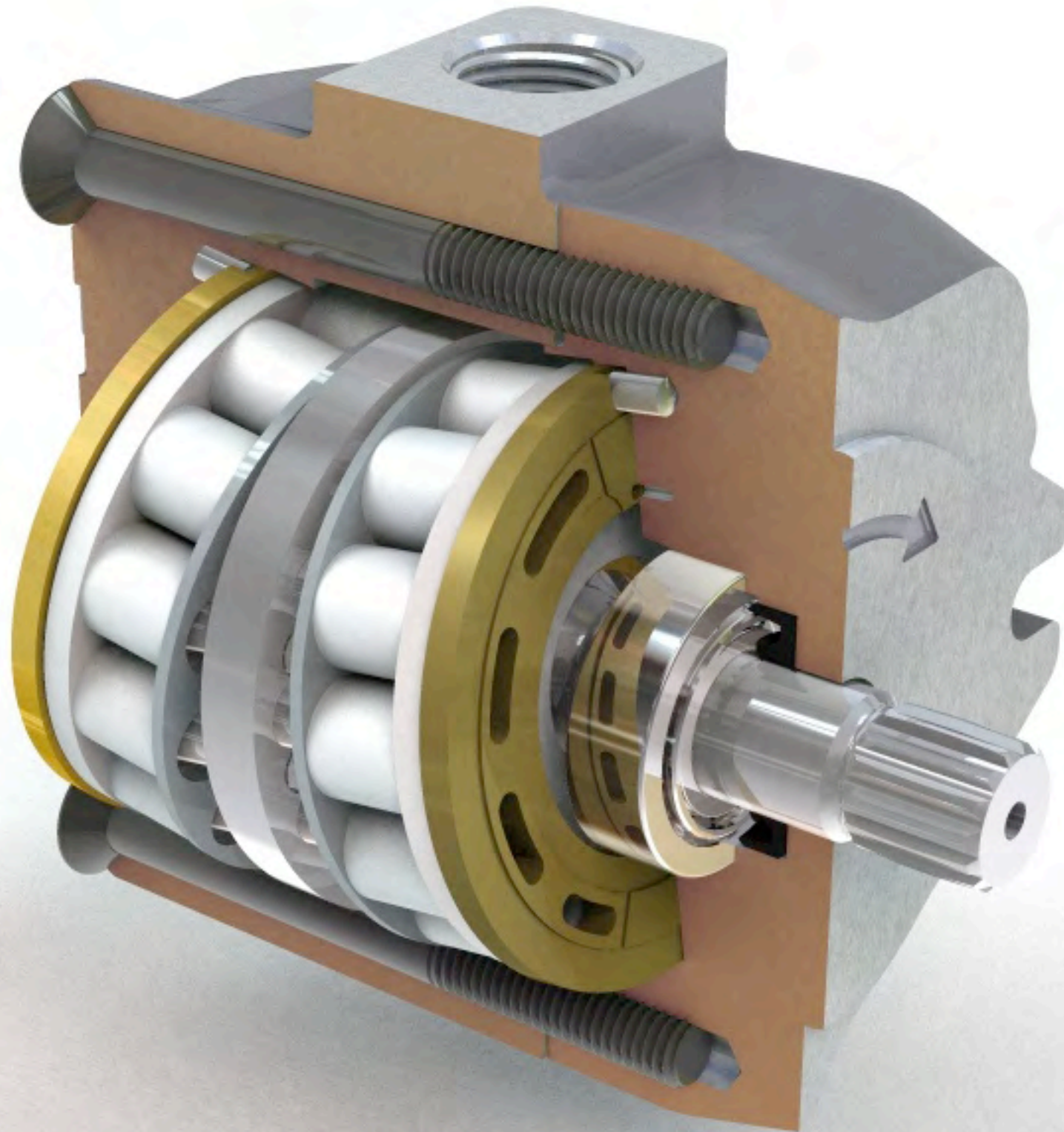


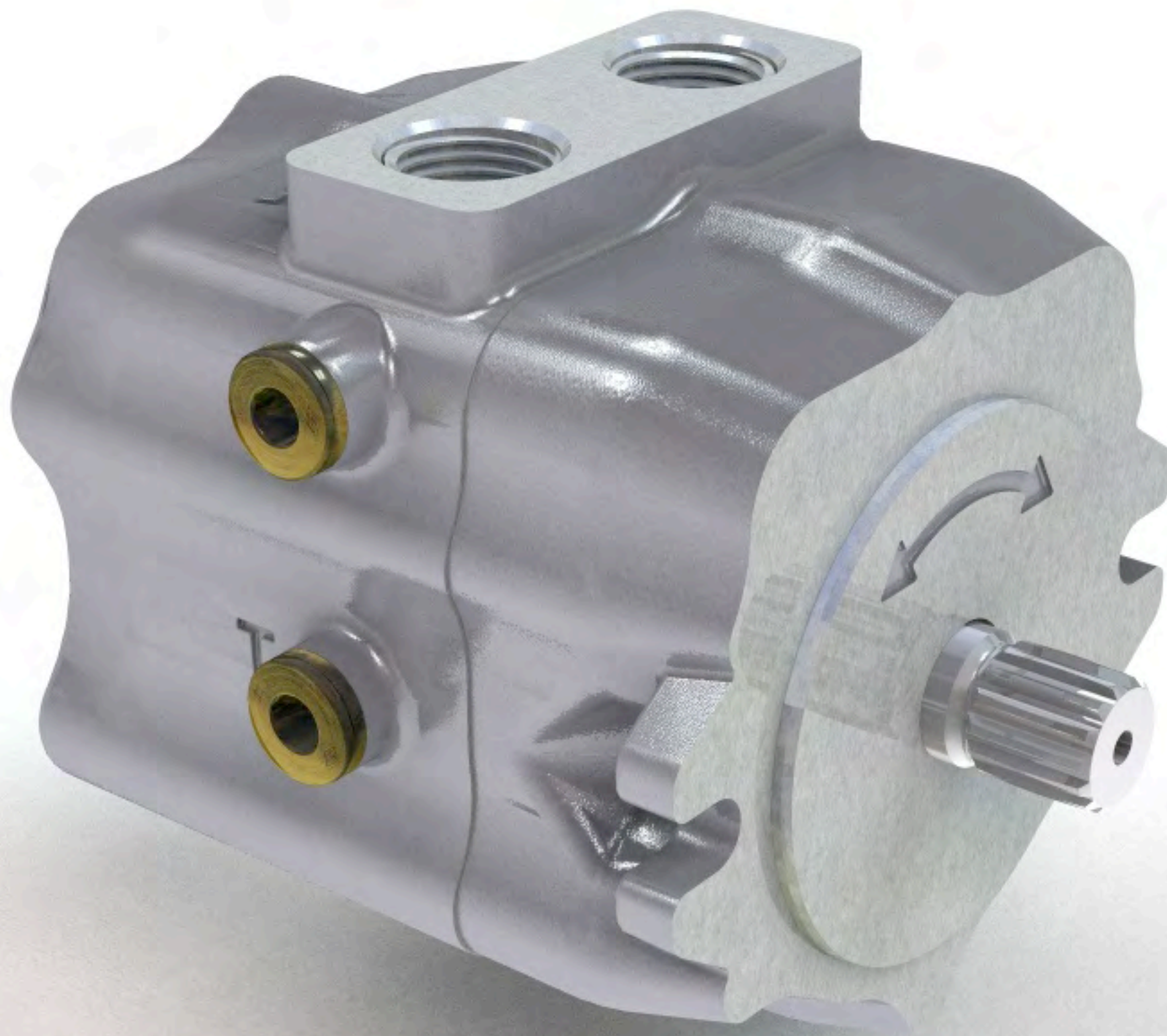






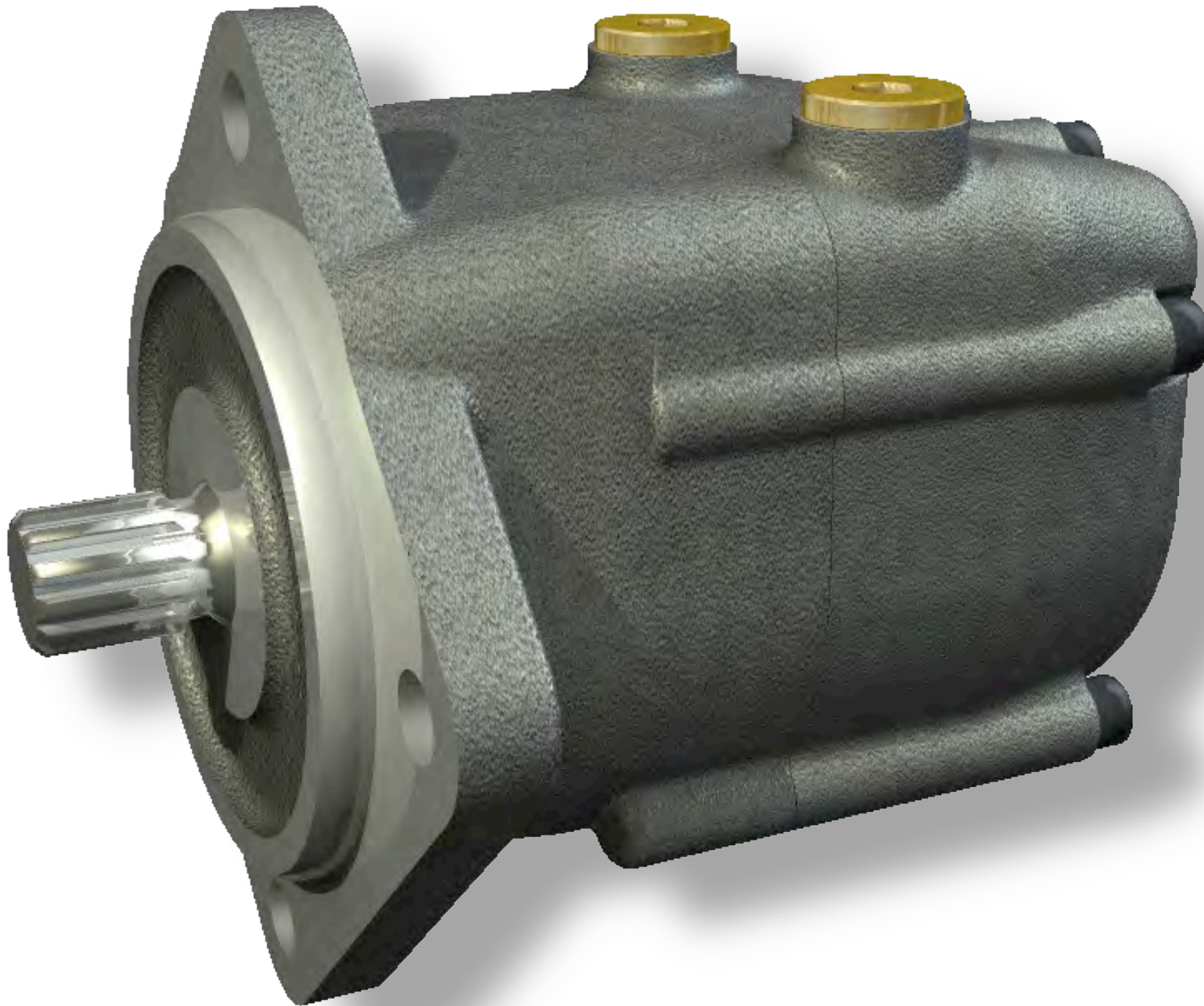




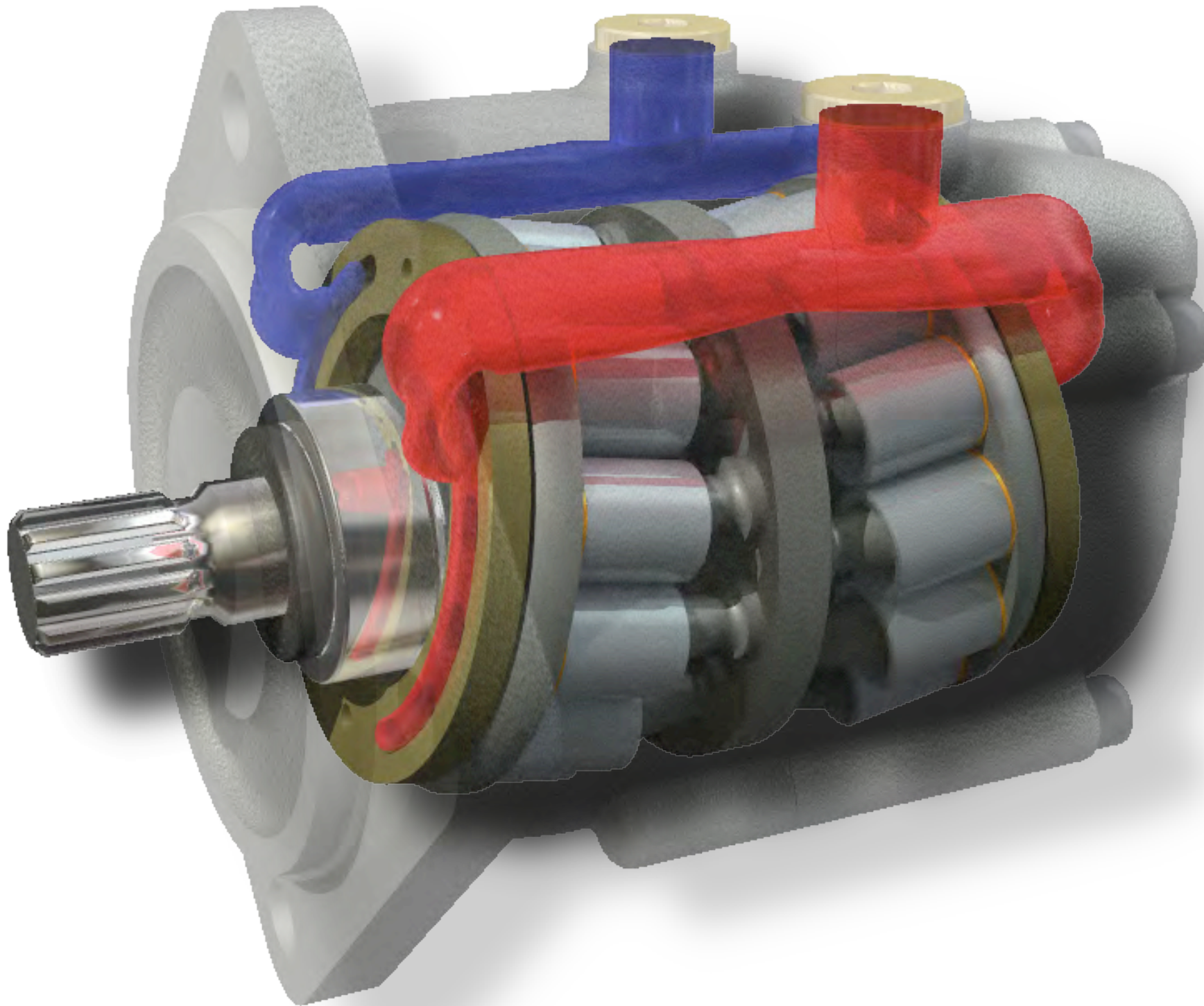


compact

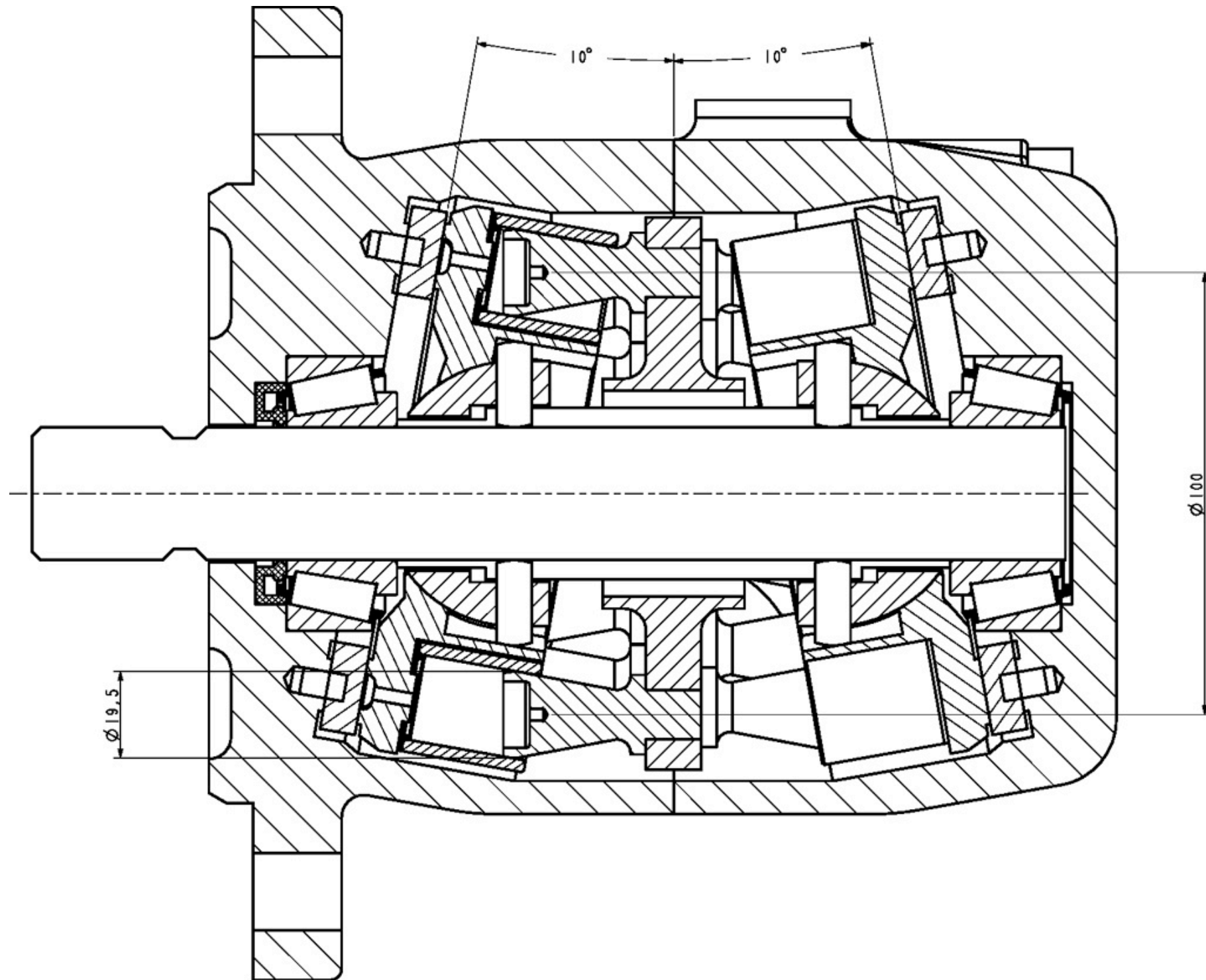
125 cc design



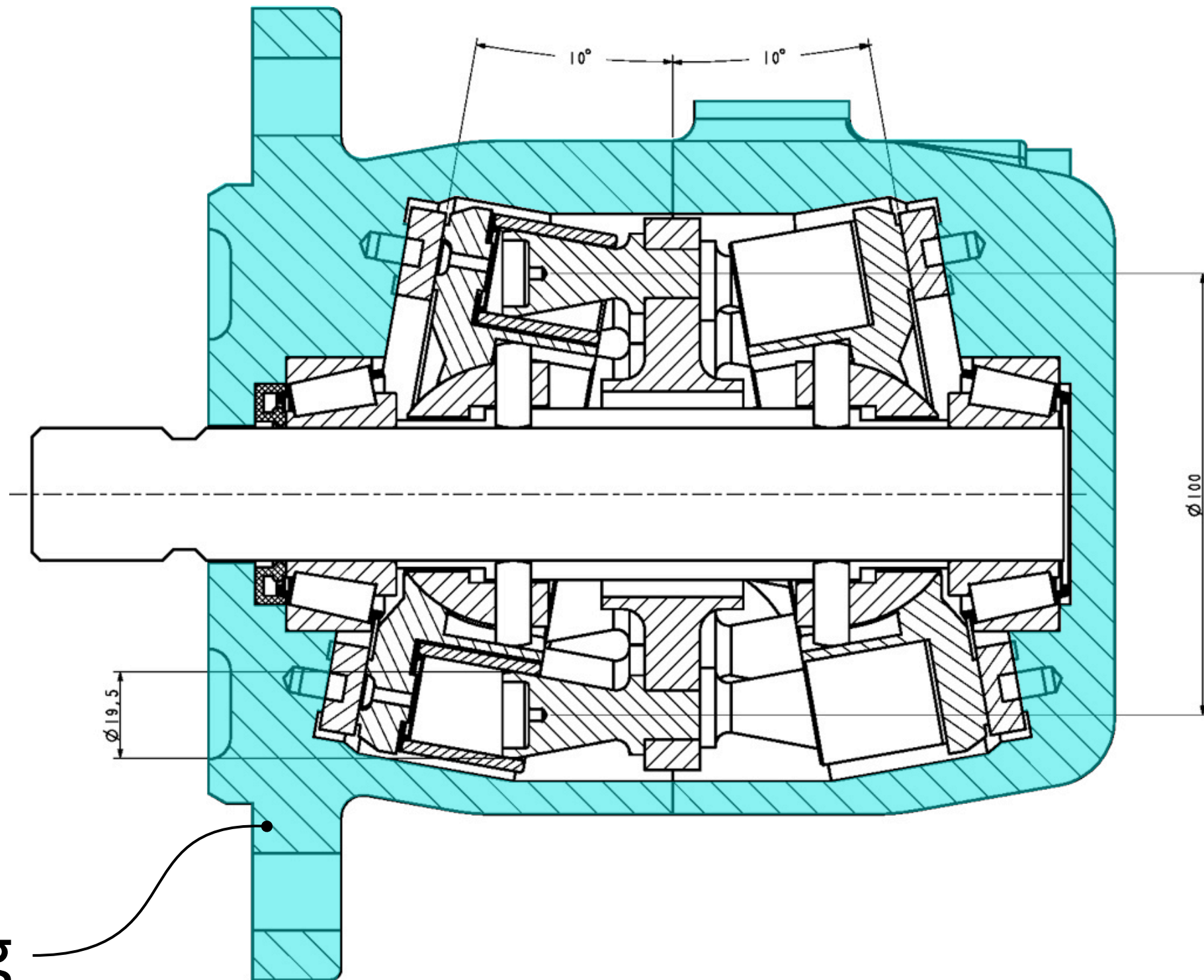
125 cc design



125 cc design

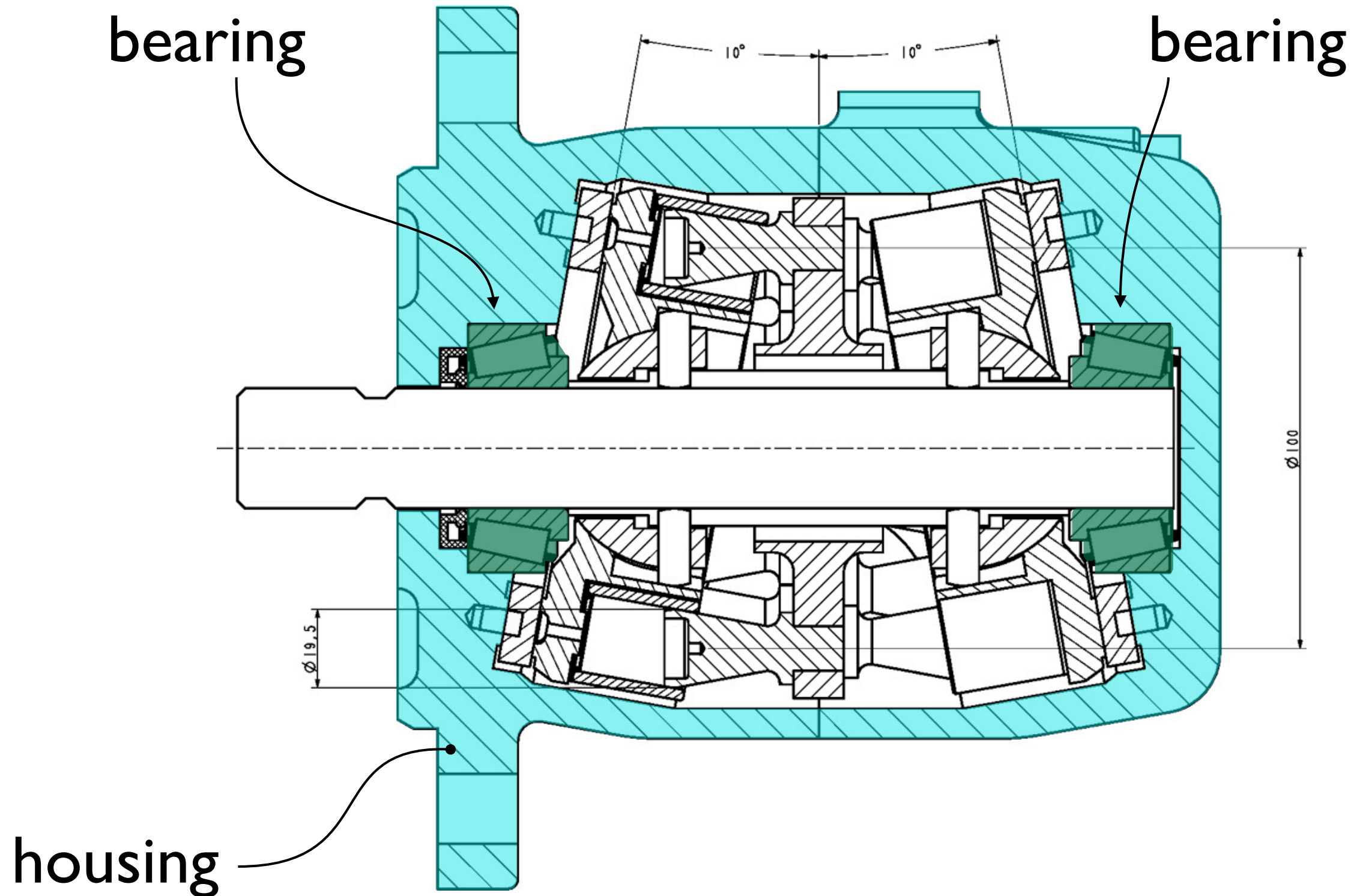


125 cc design

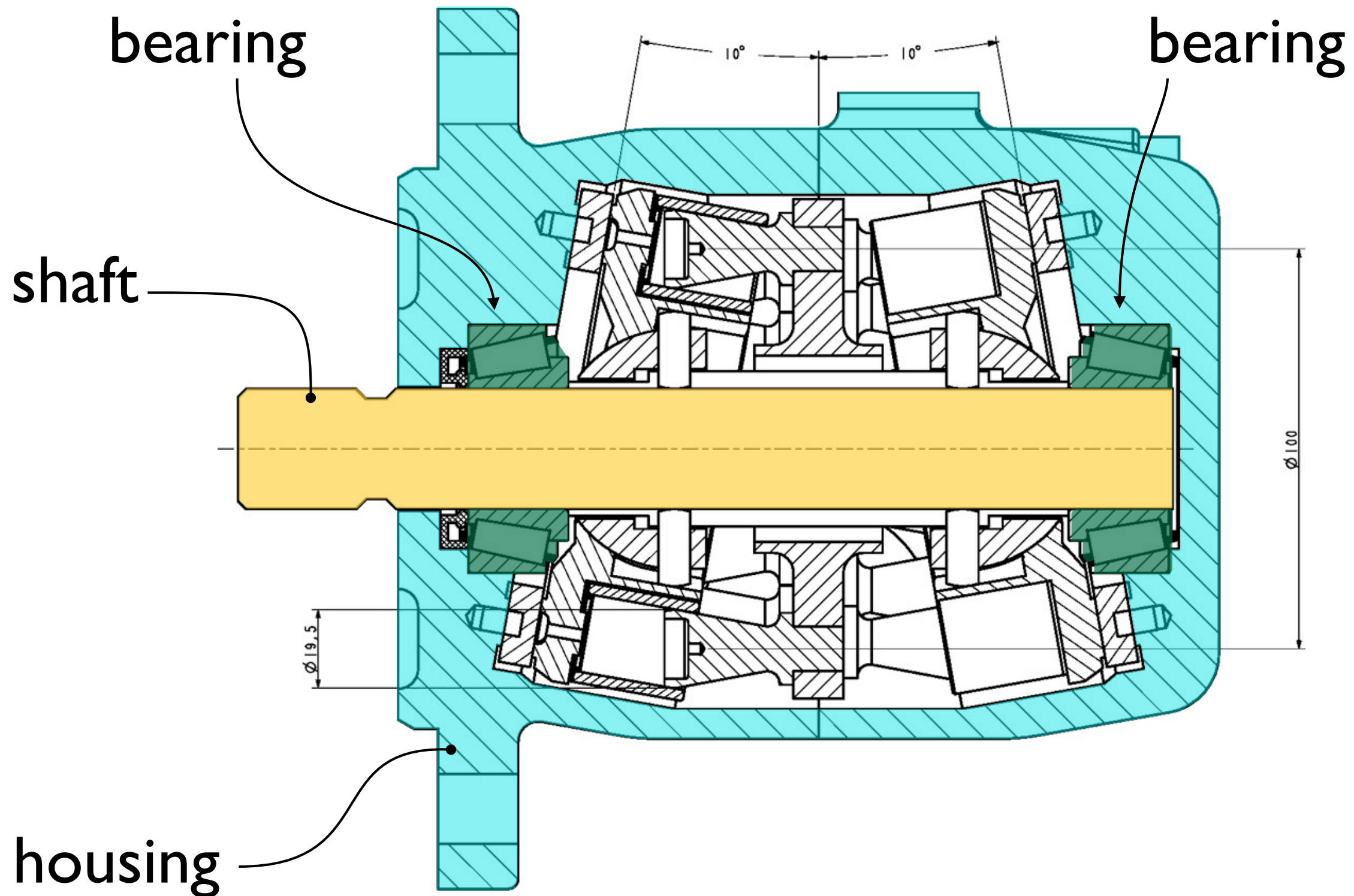


housing

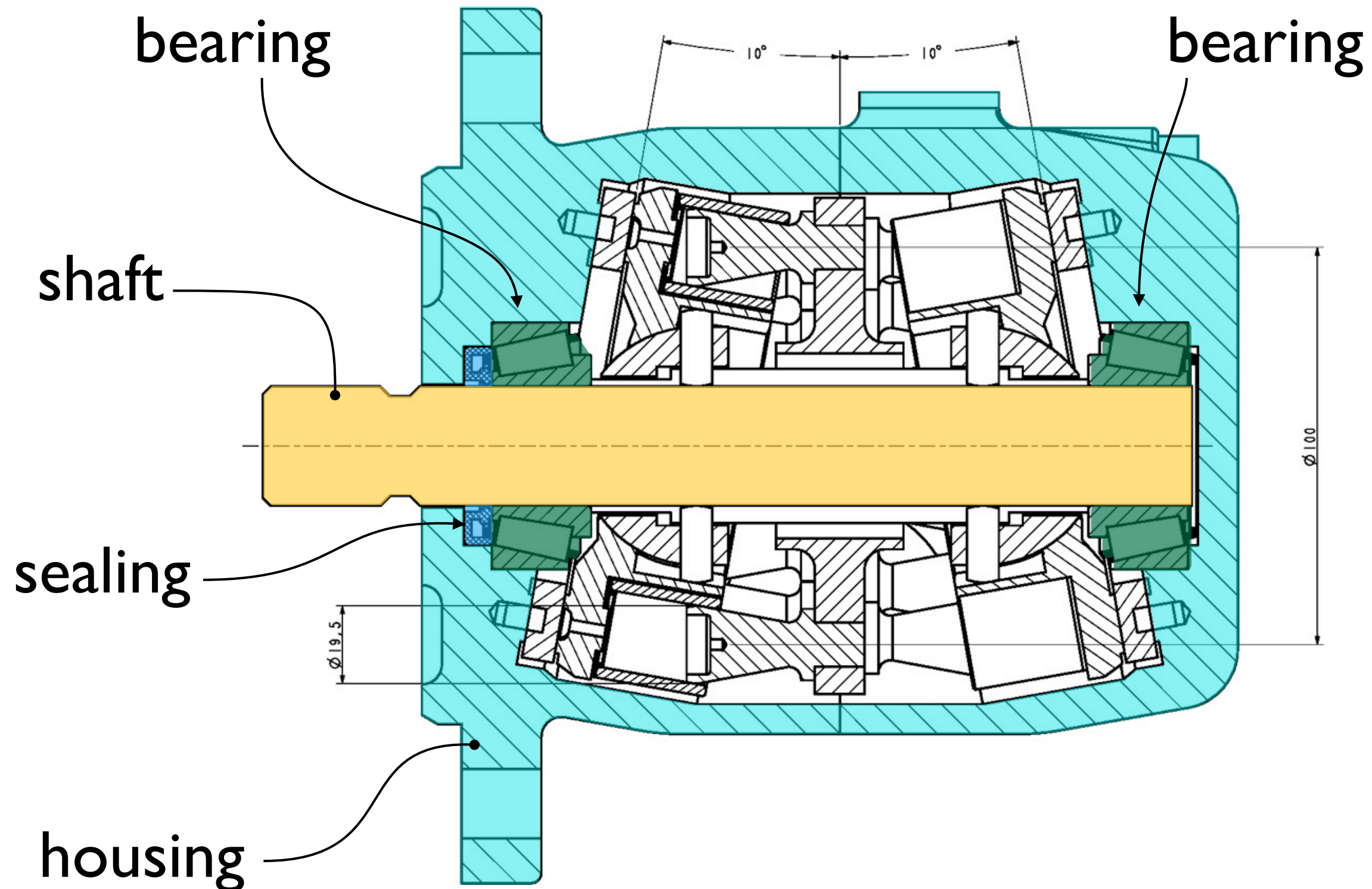
125 cc design



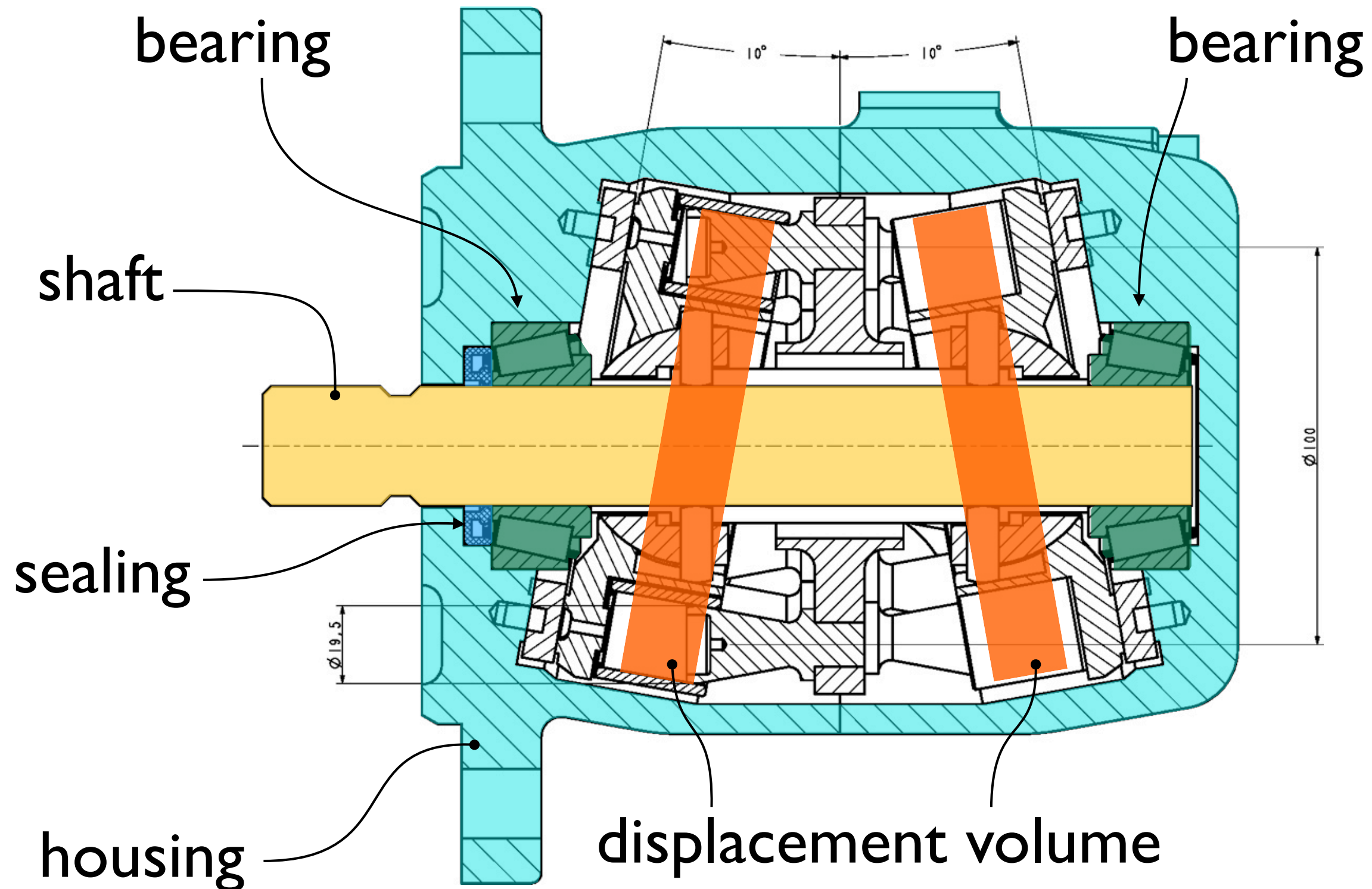
125 cc design



125 cc design



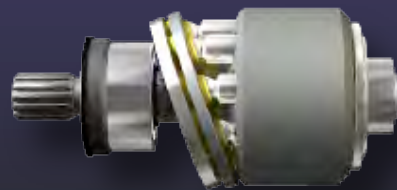
125 cc design



weight 125 cc motors

61 kg

A4FMI25



32 kg

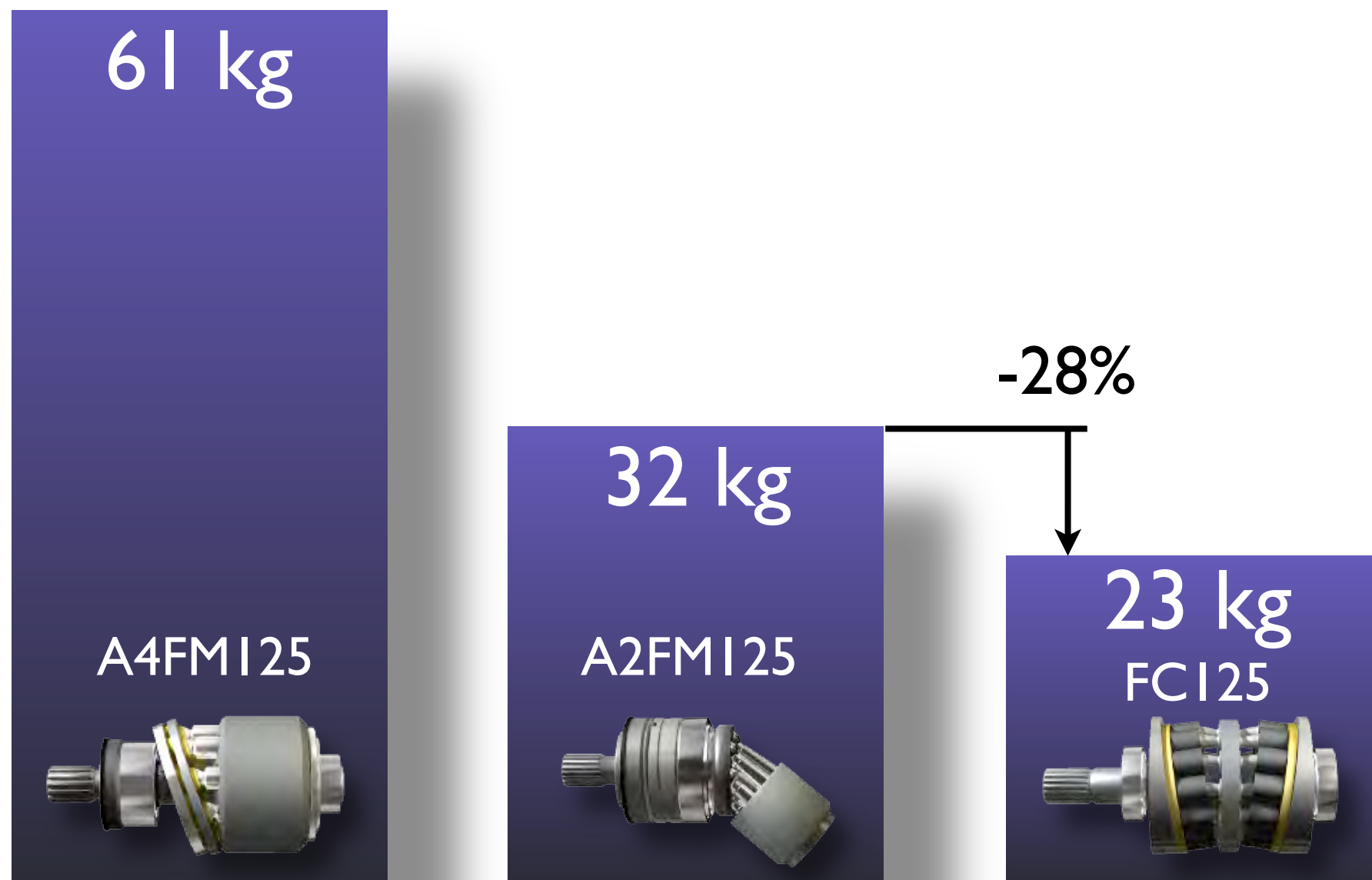
A2FMI25



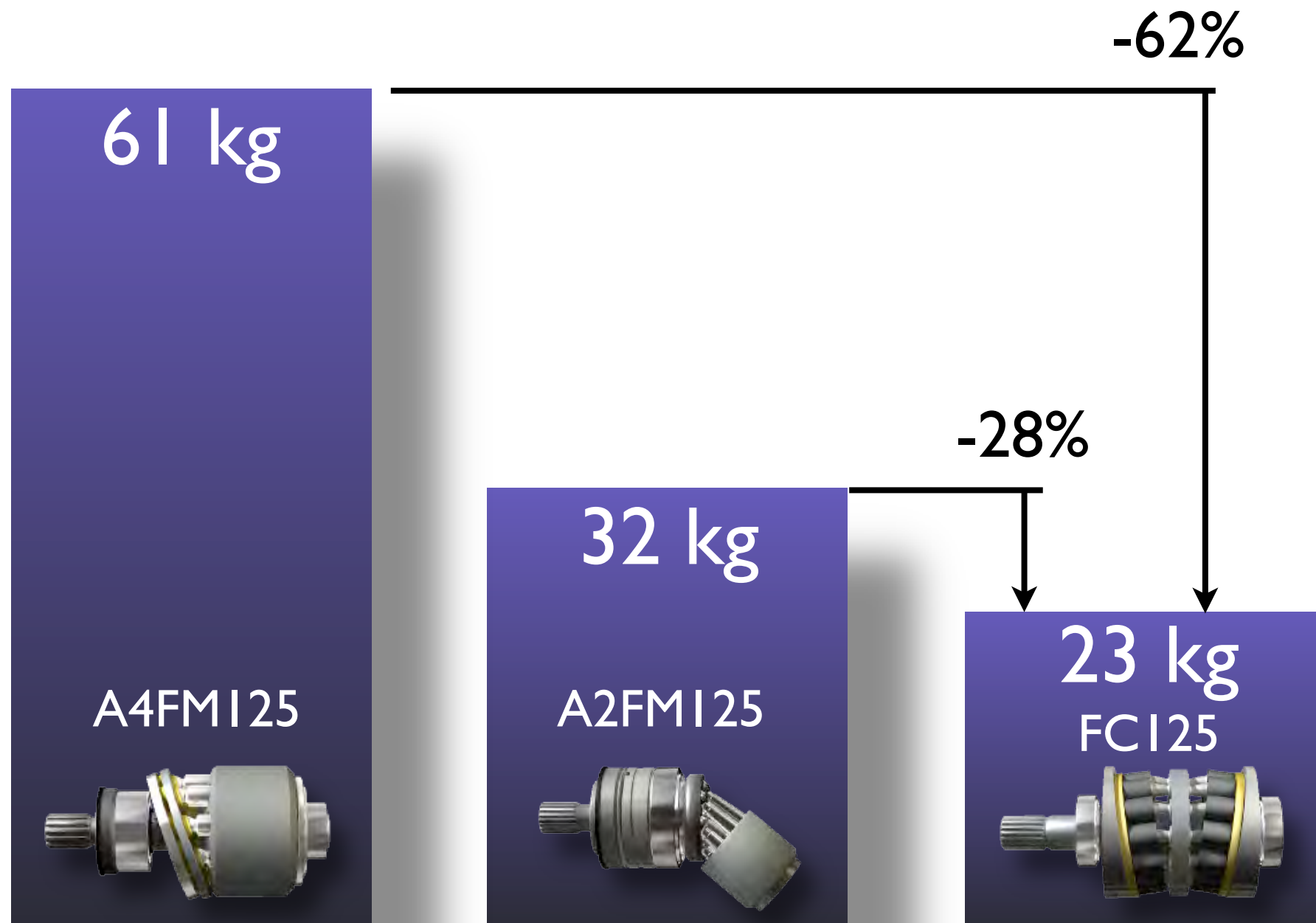
23 kg
FCI25



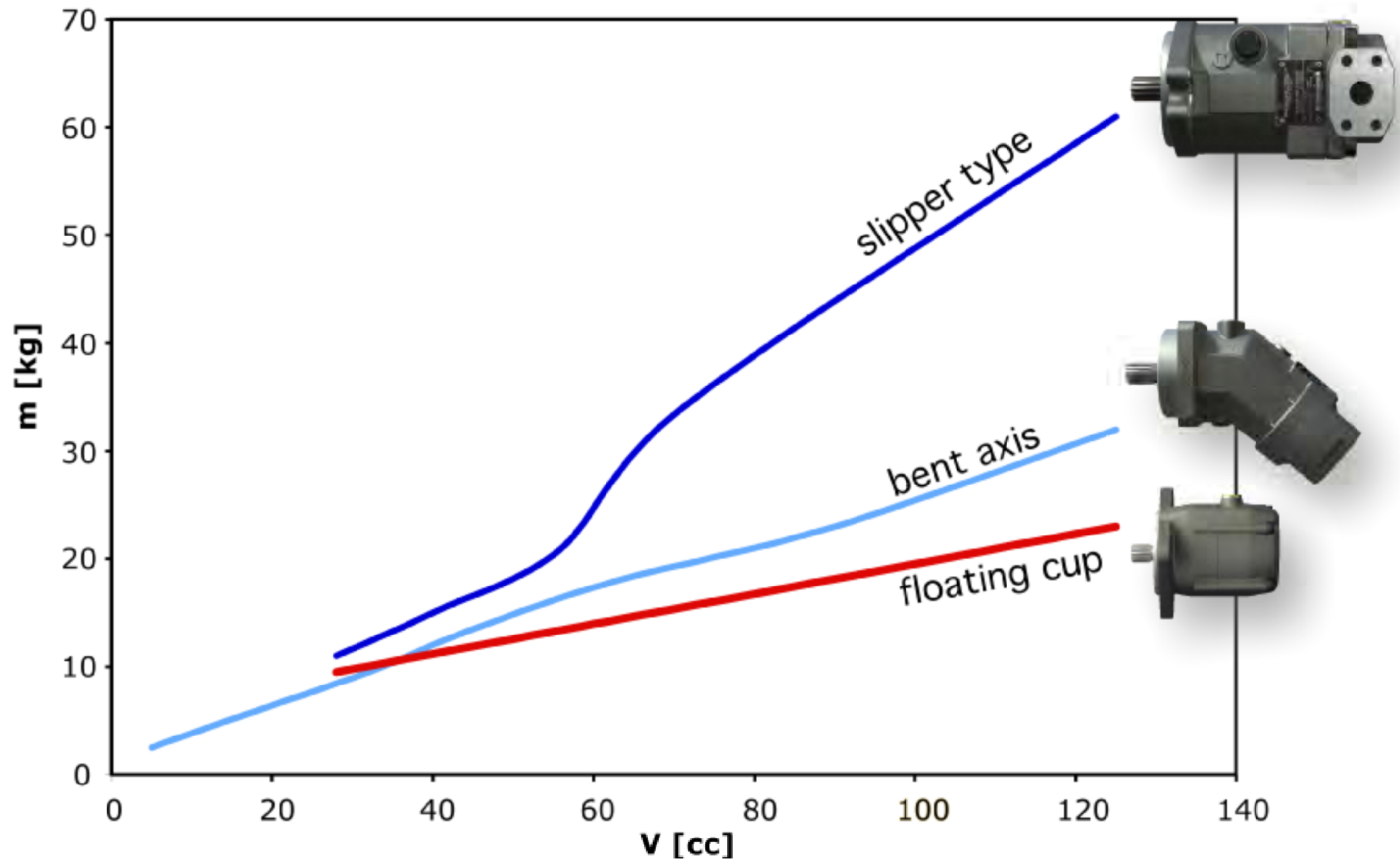
weight 125 cc motors



weight 125 cc motors



weight comparison

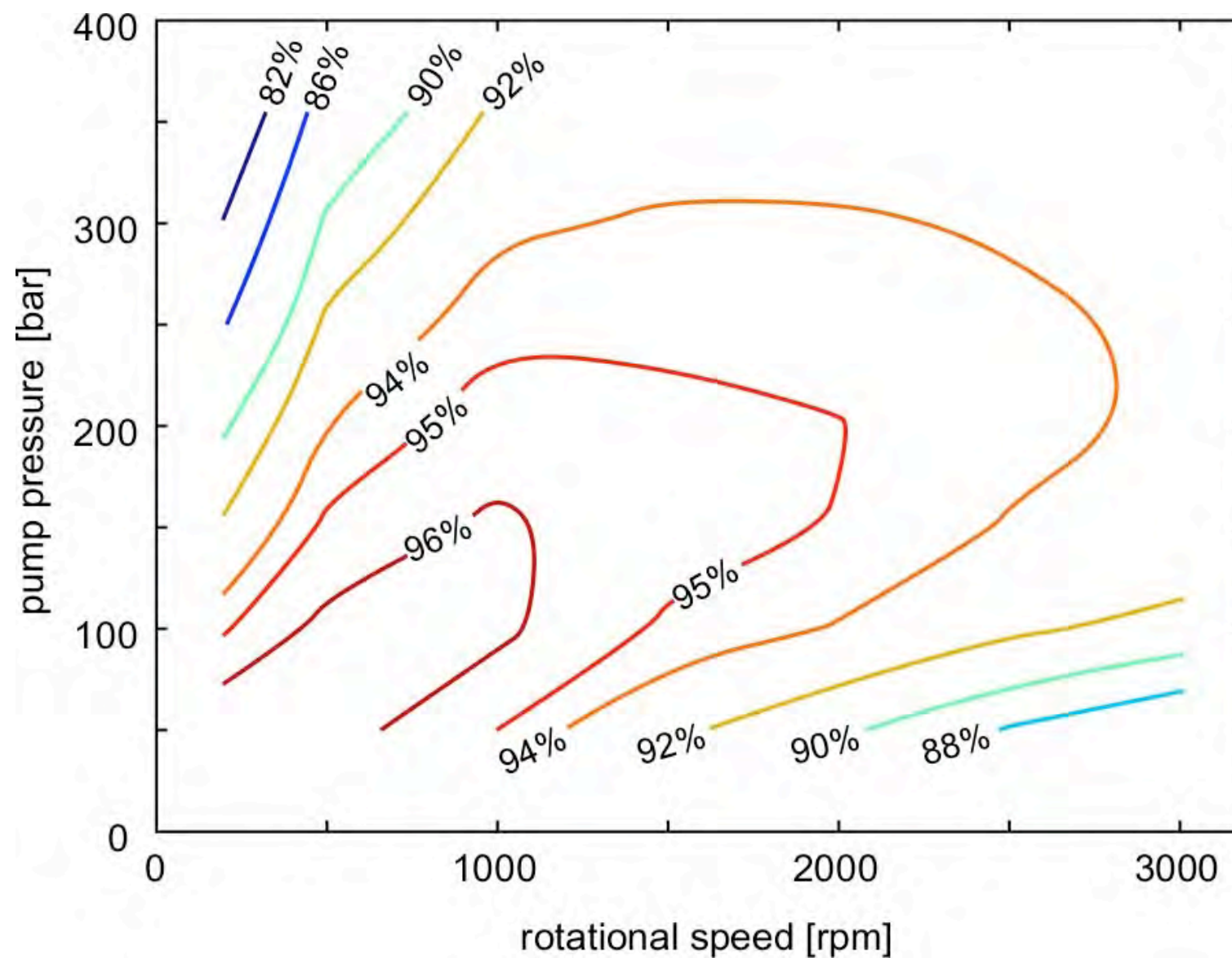


efficiency

total efficiency pump @ $T_{oil} = 40^{\circ}\text{C}$

measurements Eindhoven University of Technology (ISO4409)

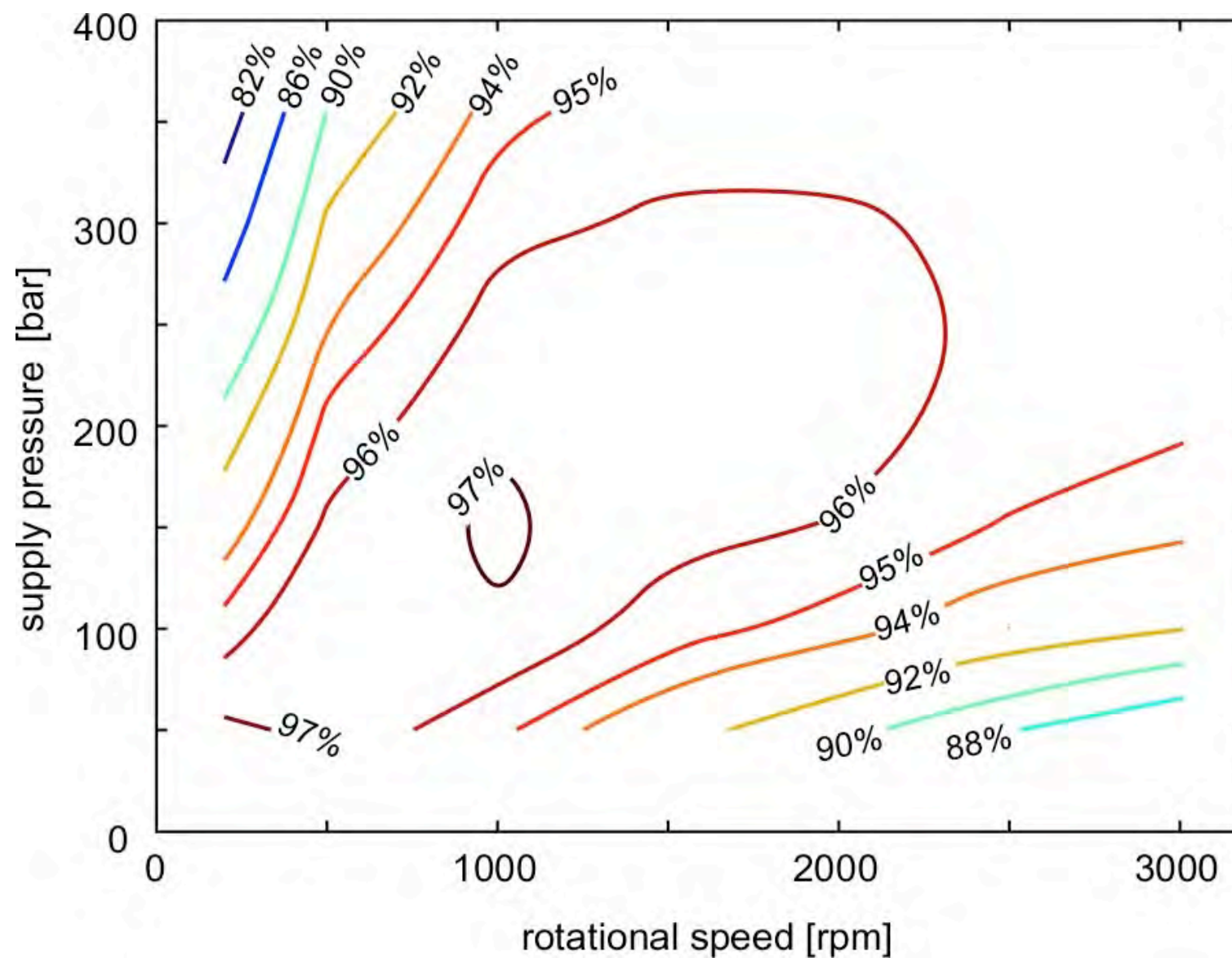
constant displacement 24 FC-motor/pump



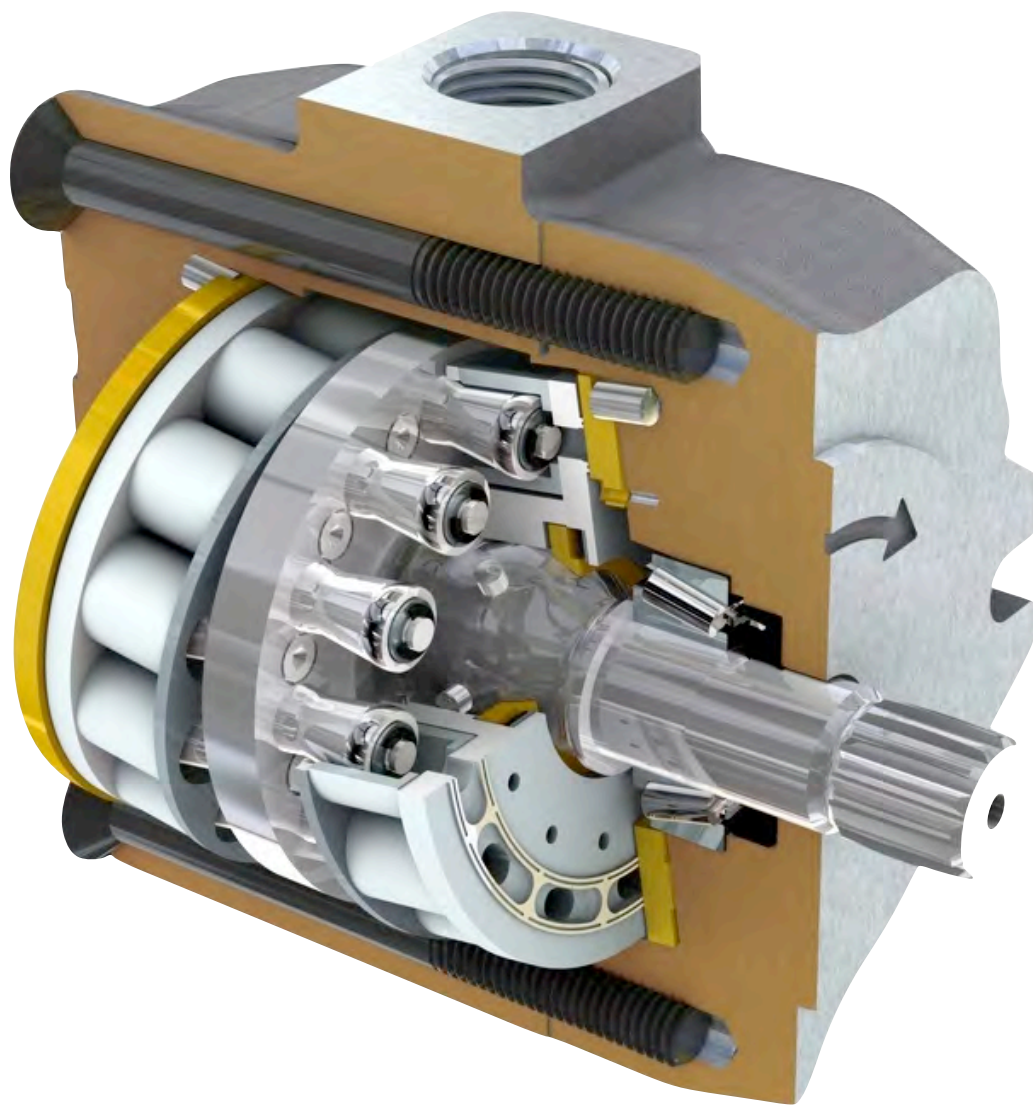
total efficiency motor @ $T_{oil} = 55^{\circ}\text{C}$

measurements Eindhoven University of Technology (ISO4409)

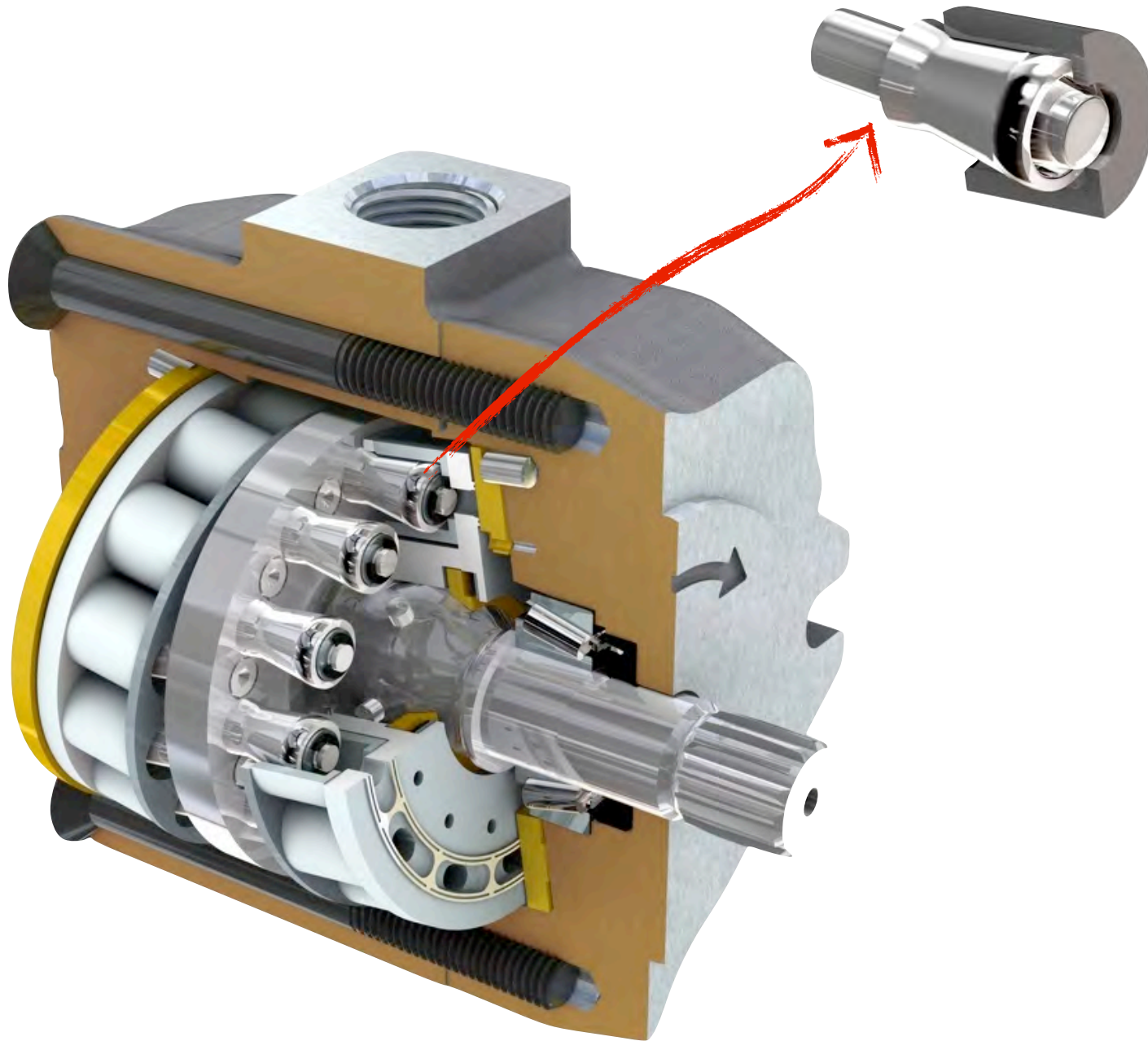
constant displacement 24 FC-motor/pump



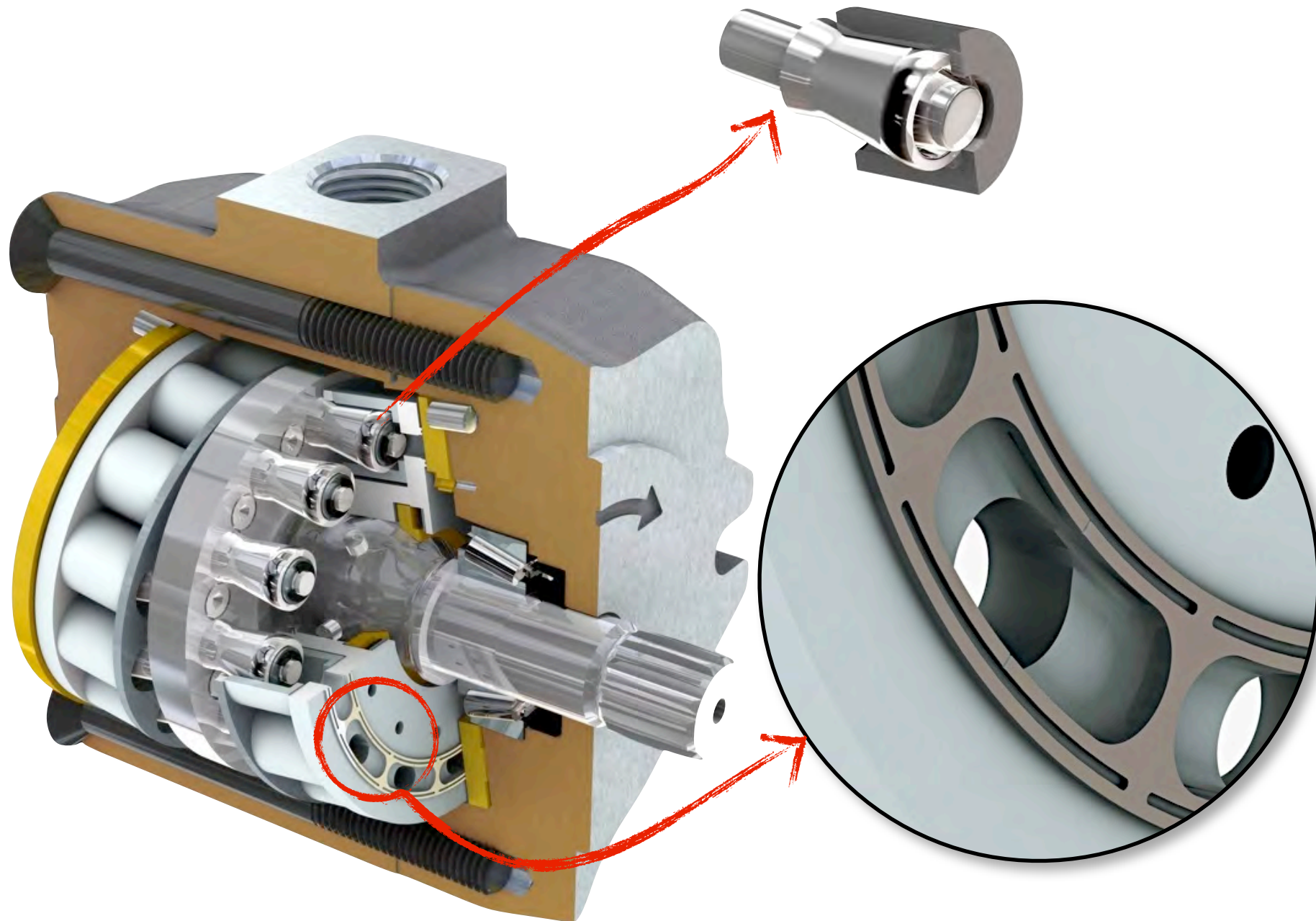
efficiency improvement



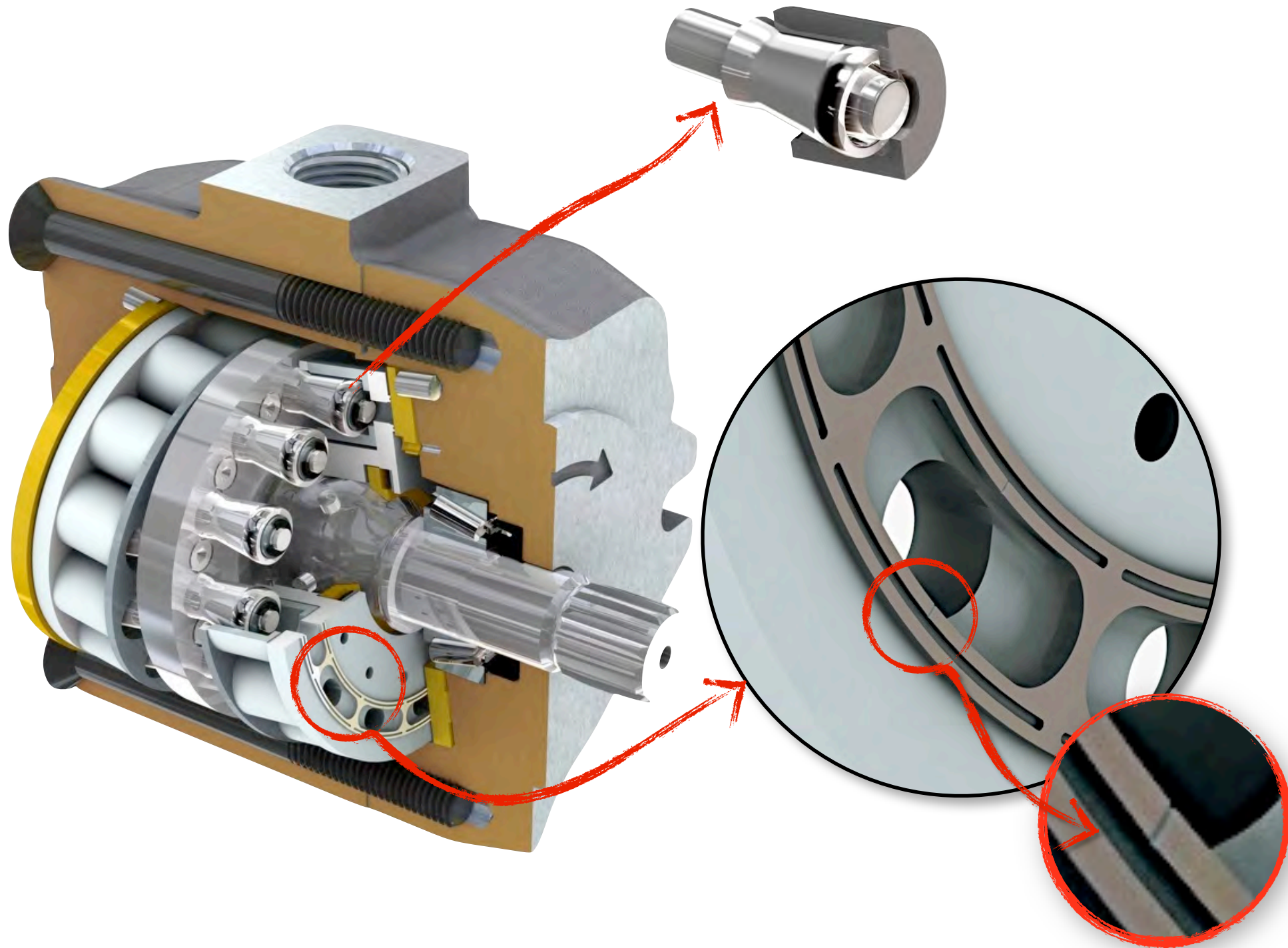
efficiency improvement



efficiency improvement

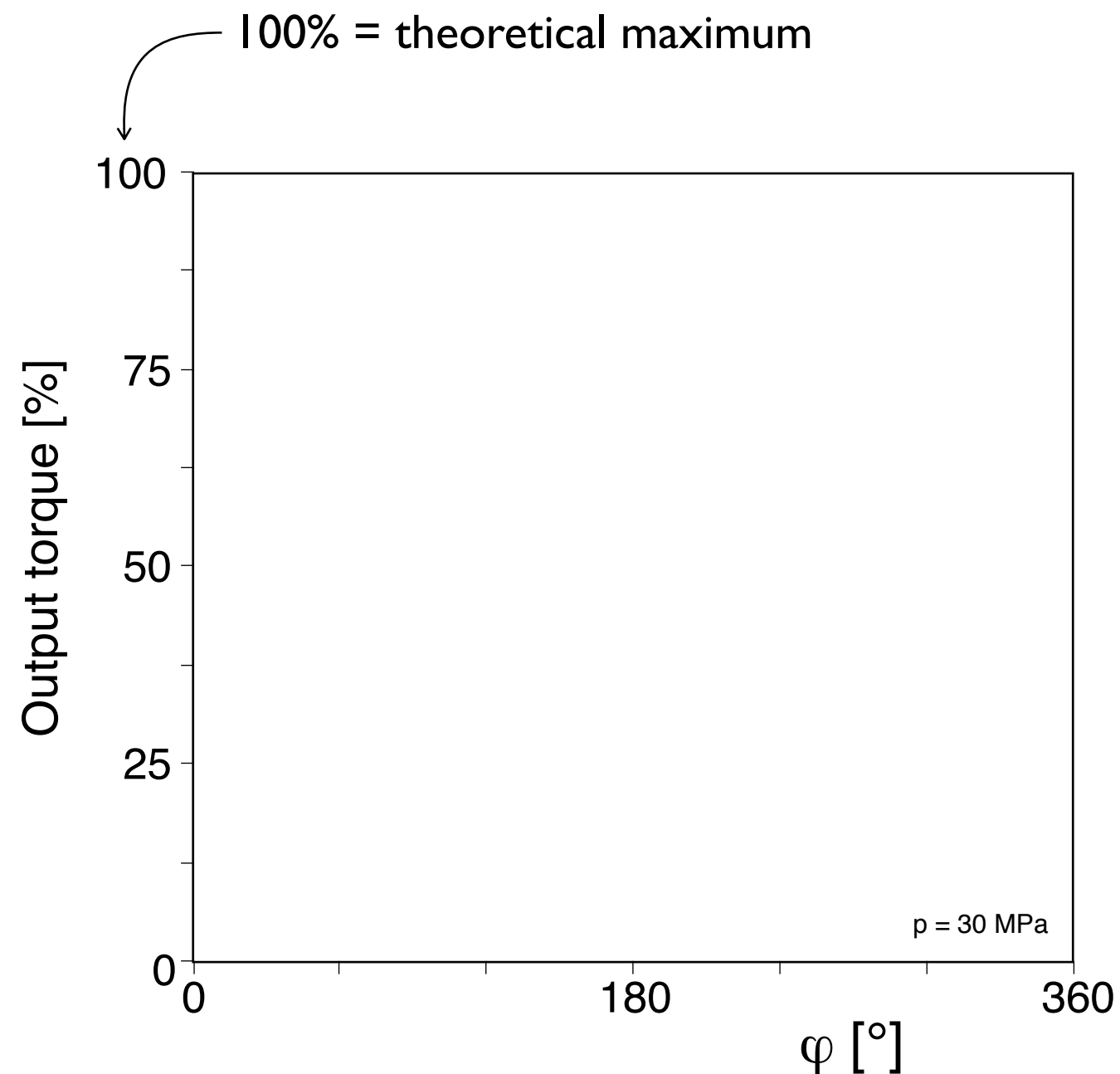


efficiency improvement

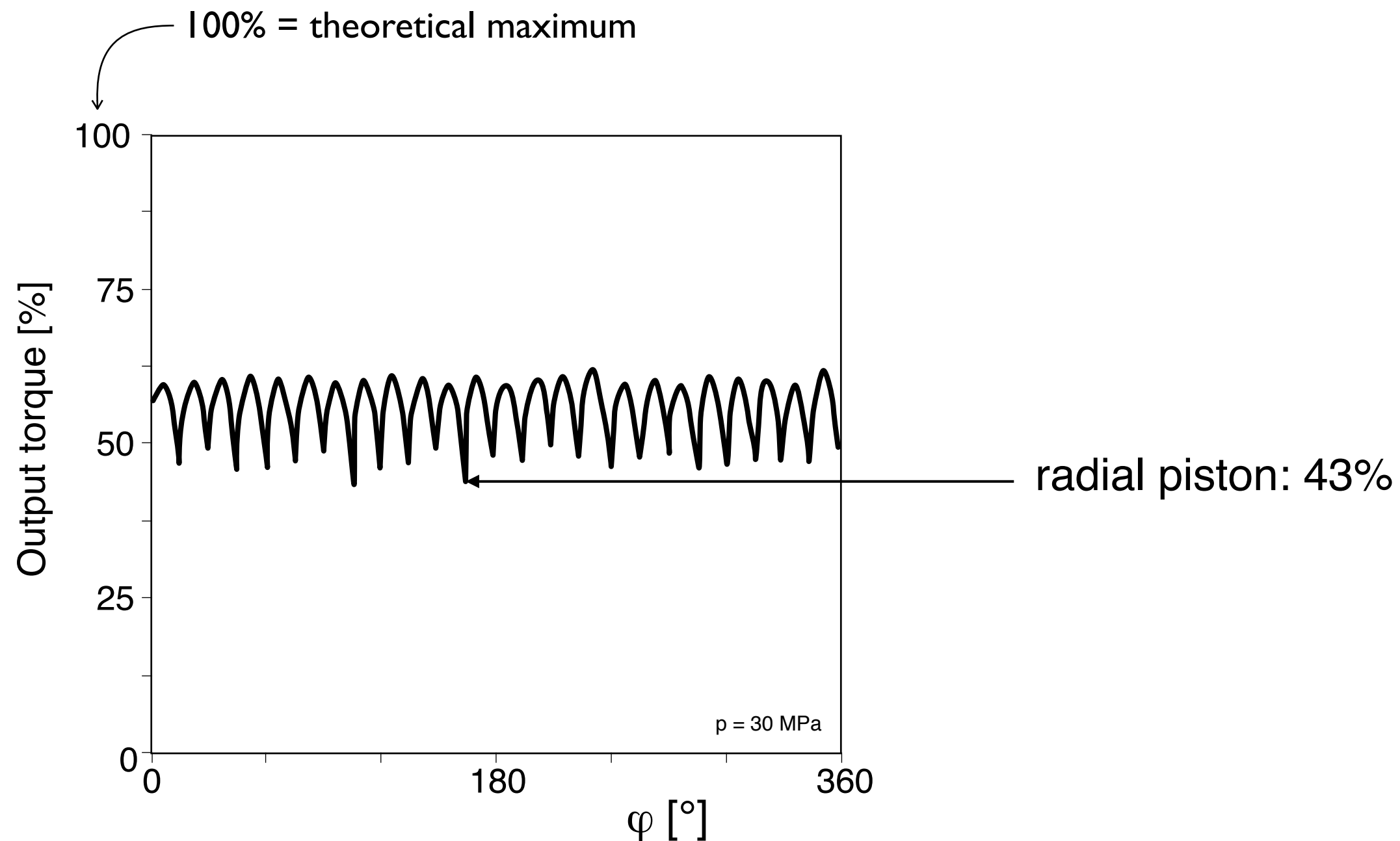


high start-up torque

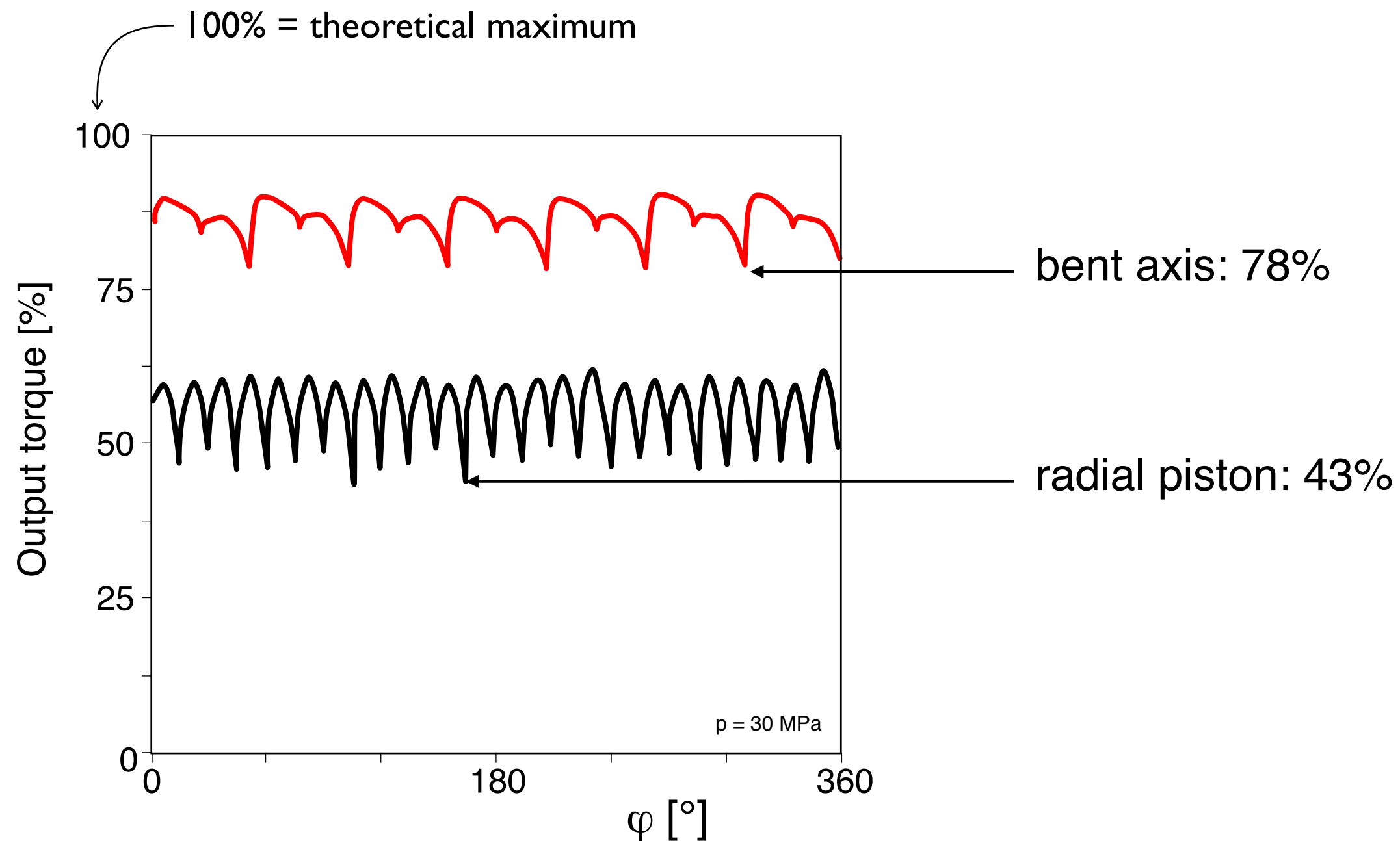
measurement low speed torque ($n < 1$ rpm)



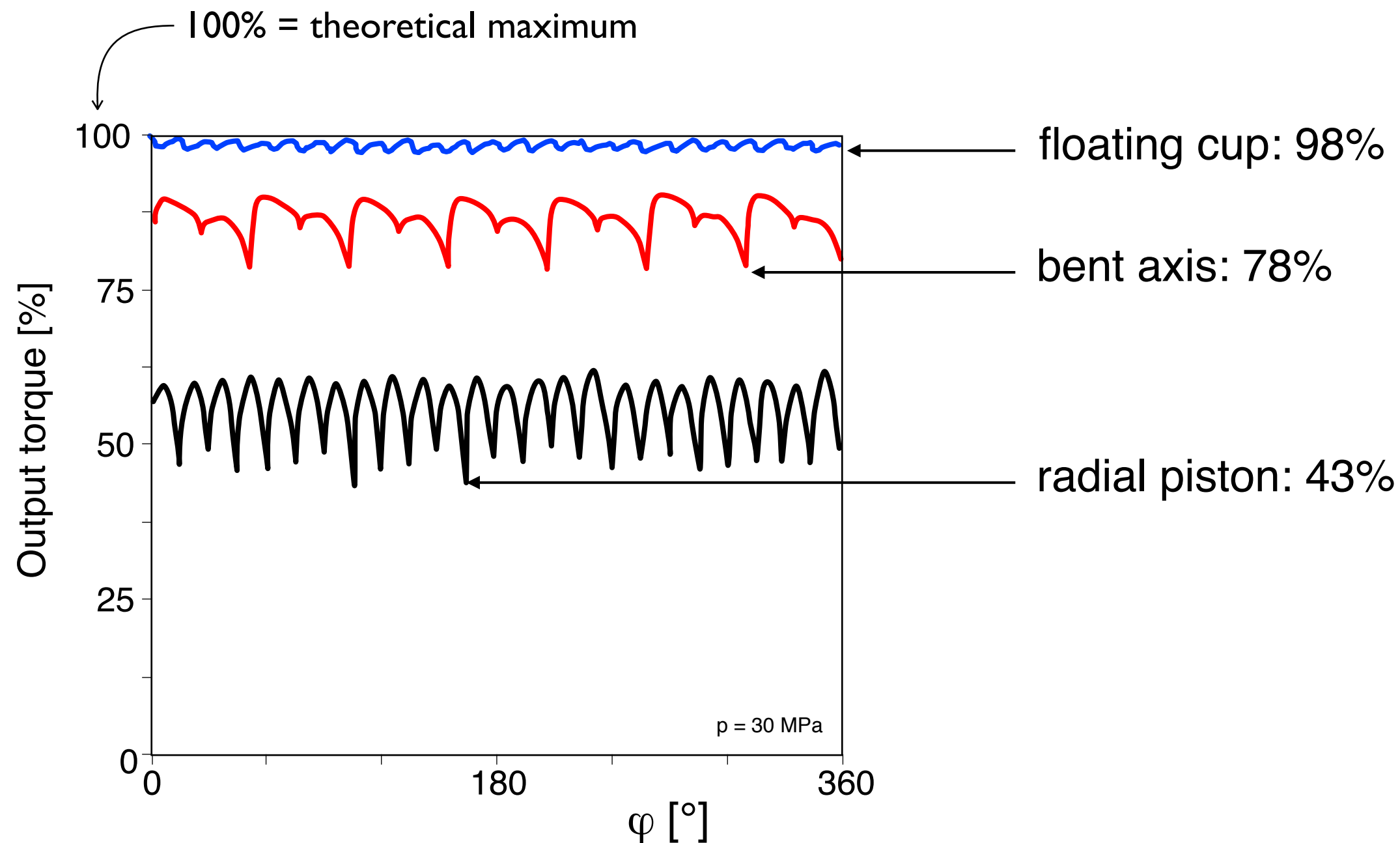
measurement low speed torque ($n < 1$ rpm)



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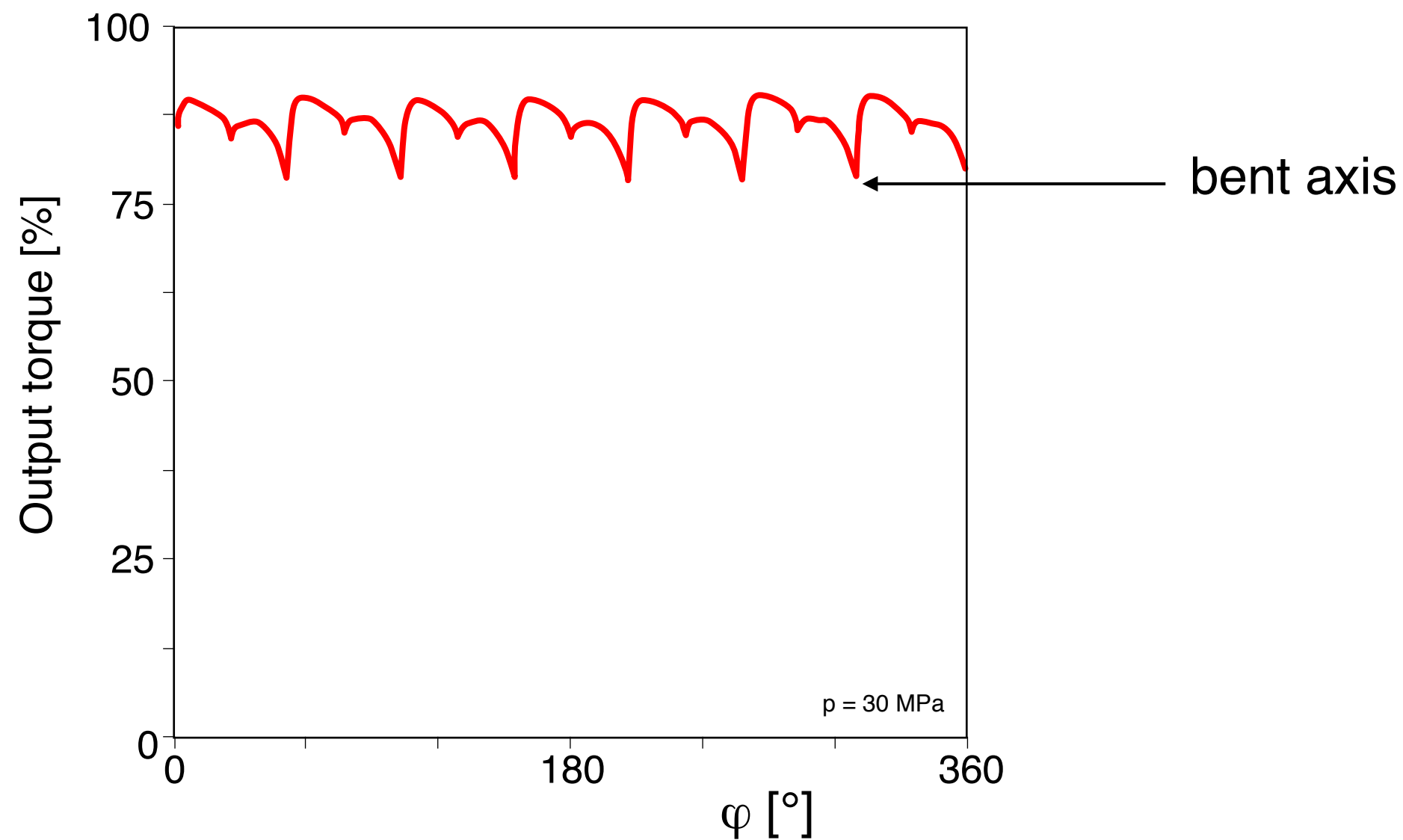


measurement low speed torque ($n < 1$ rpm)

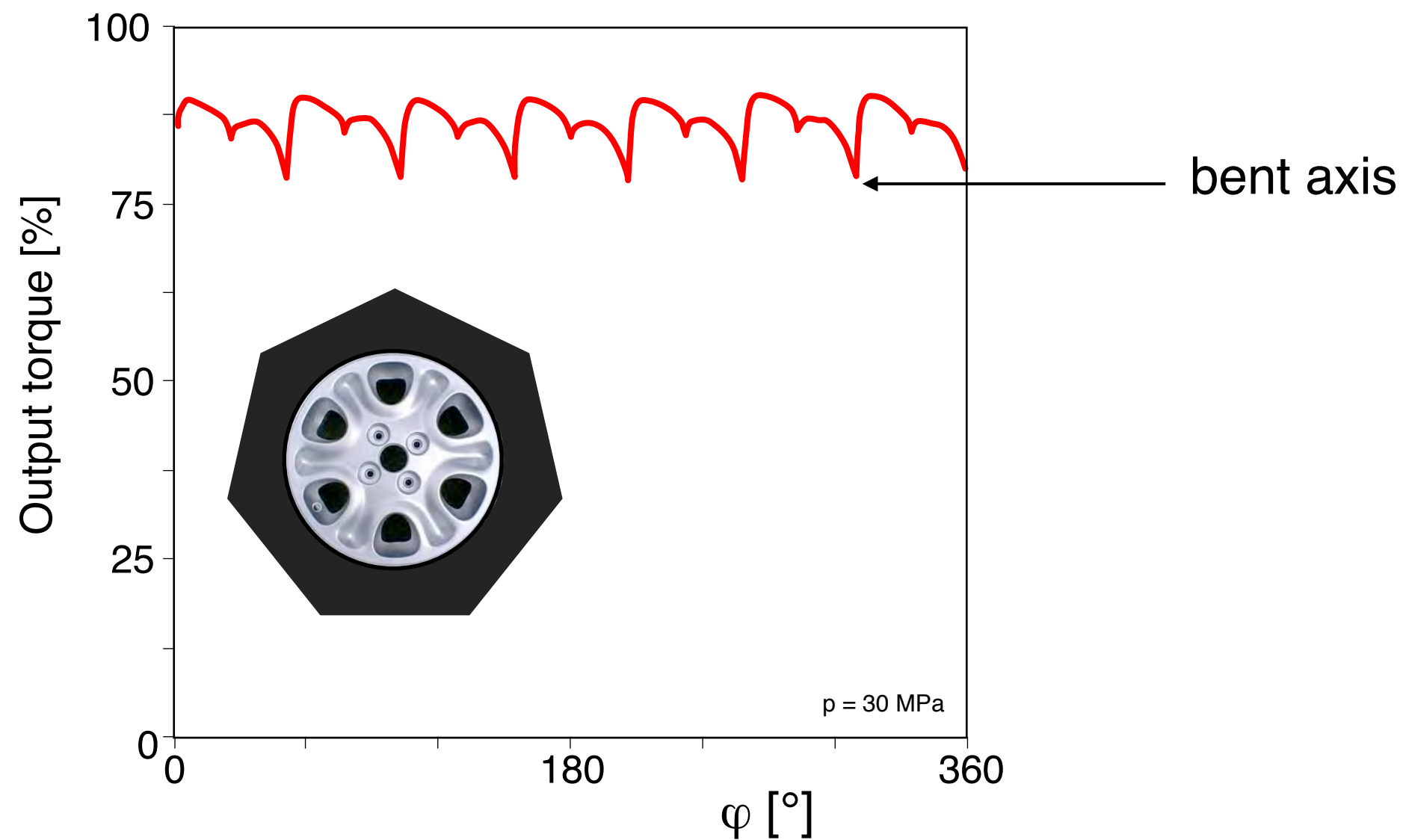


smooth torque

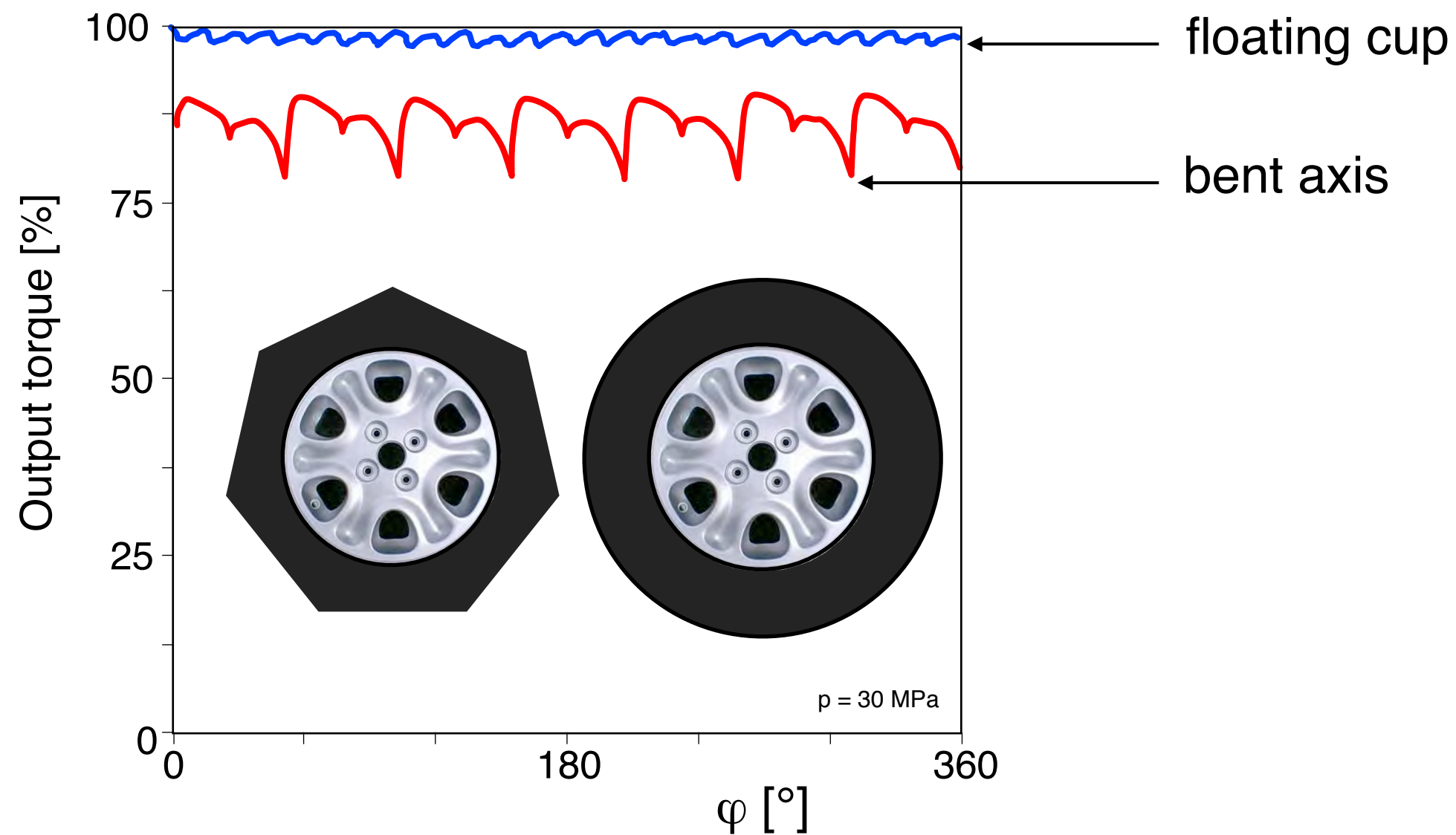
torque variation



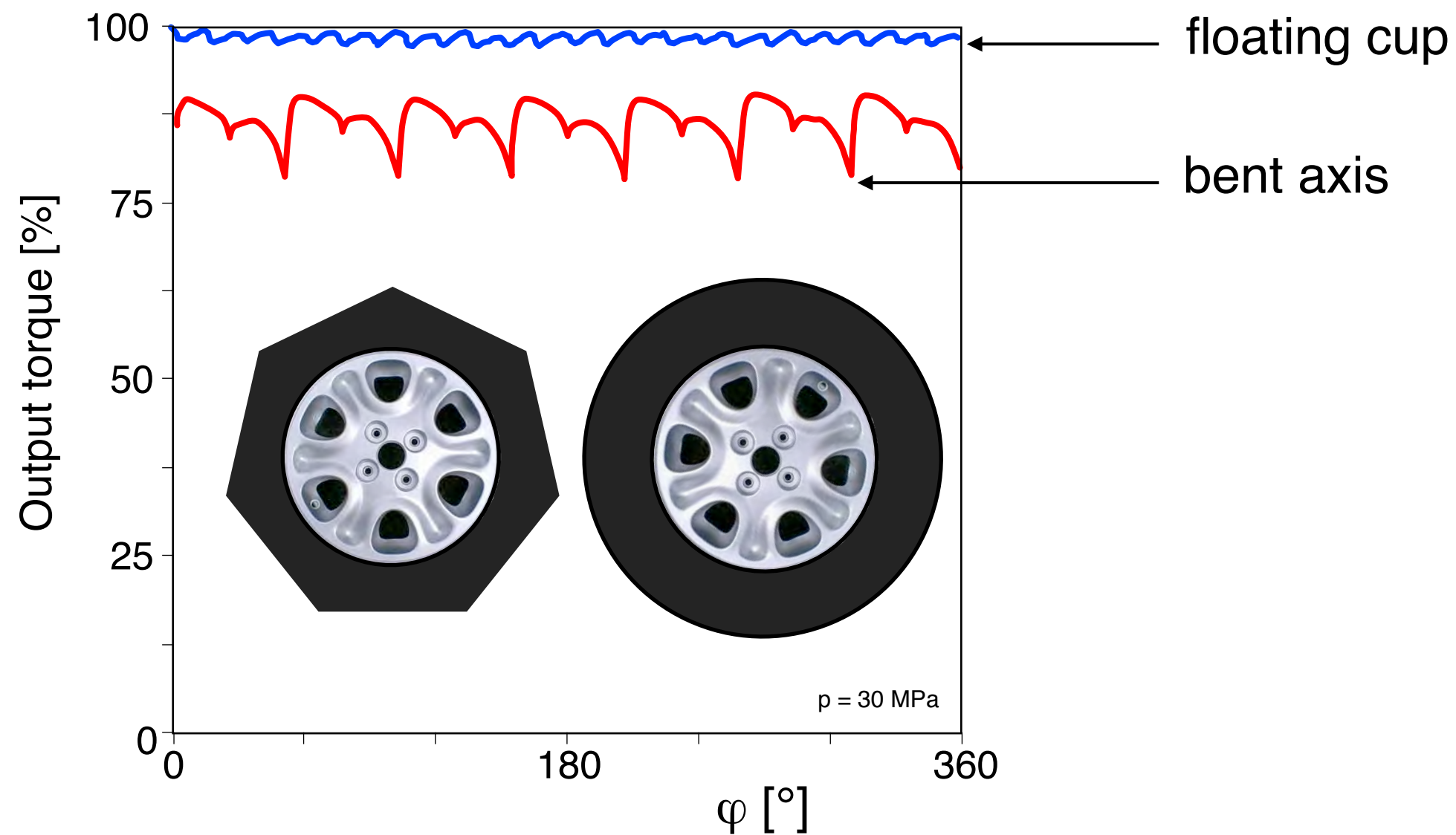
torque variation



torque variation

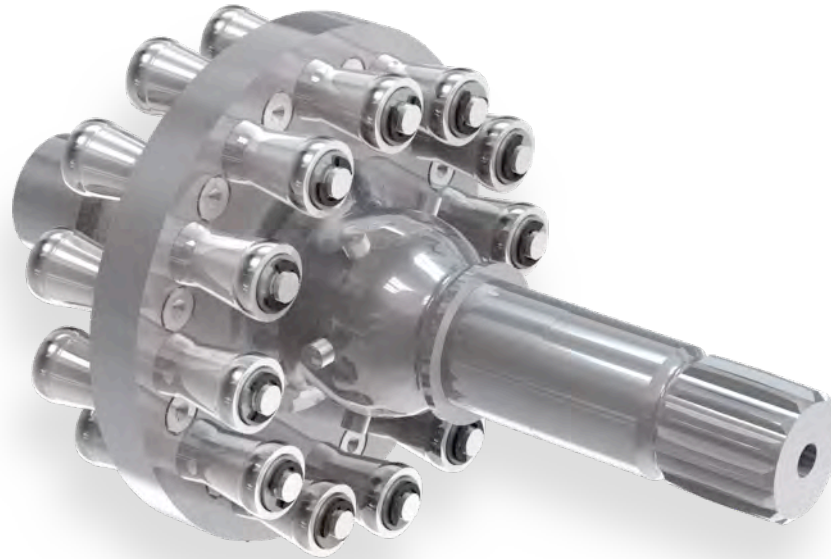


torque variation

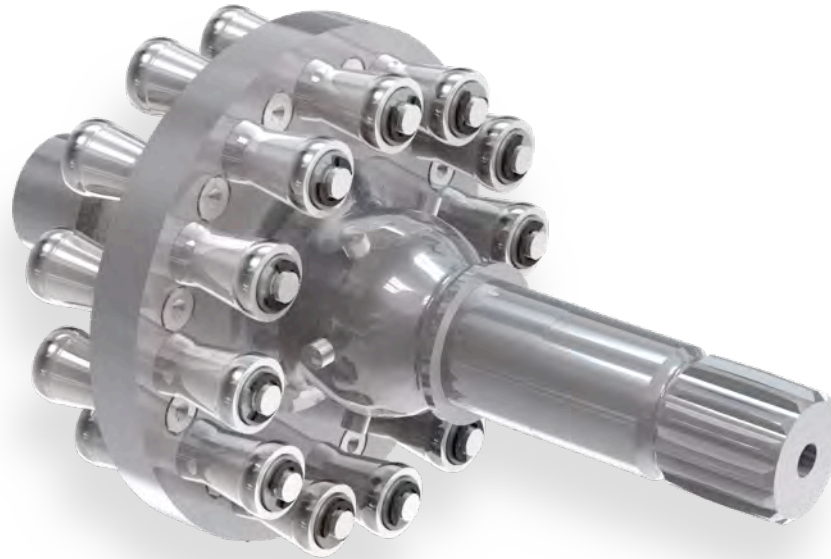


low noise and pulsation levels

floating cup principle

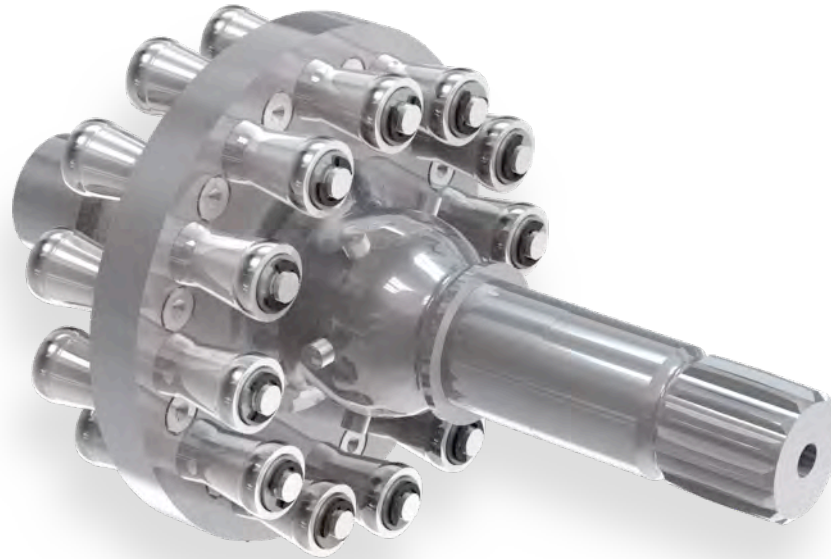


floating cup principle



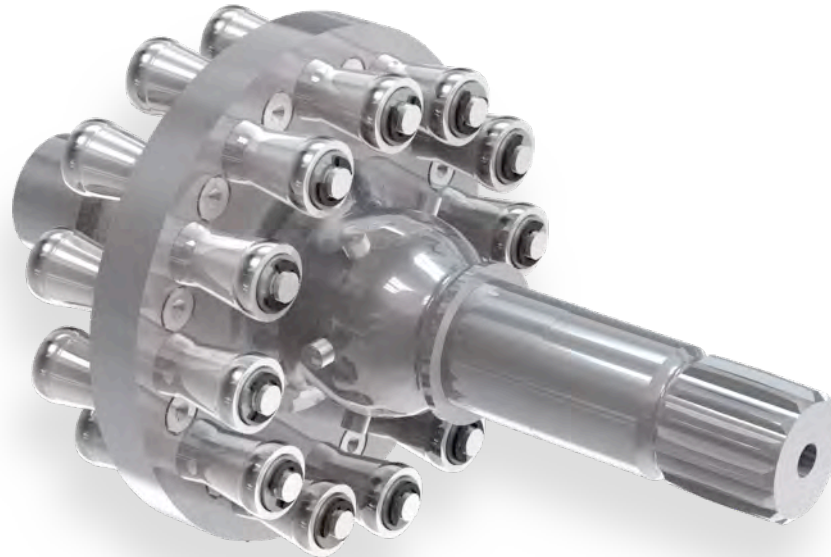
- ❖ multi piston (20 ...30 pistons)

floating cup principle



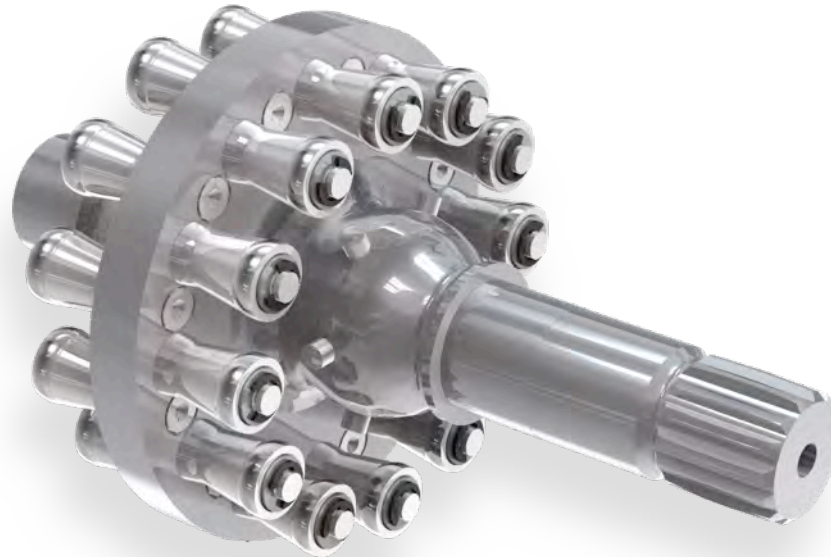
- ❖ multi piston (20 ...30 pistons)
- ❖ mirrored design

floating cup principle



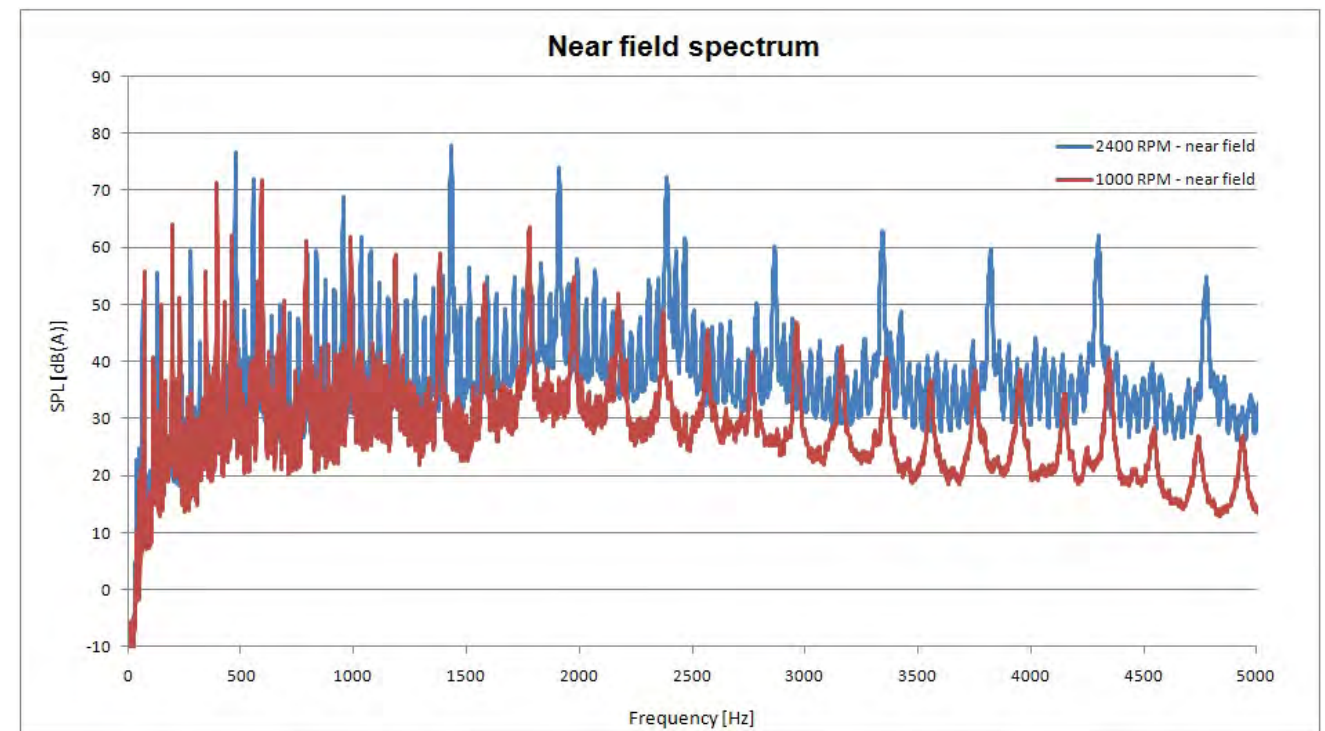
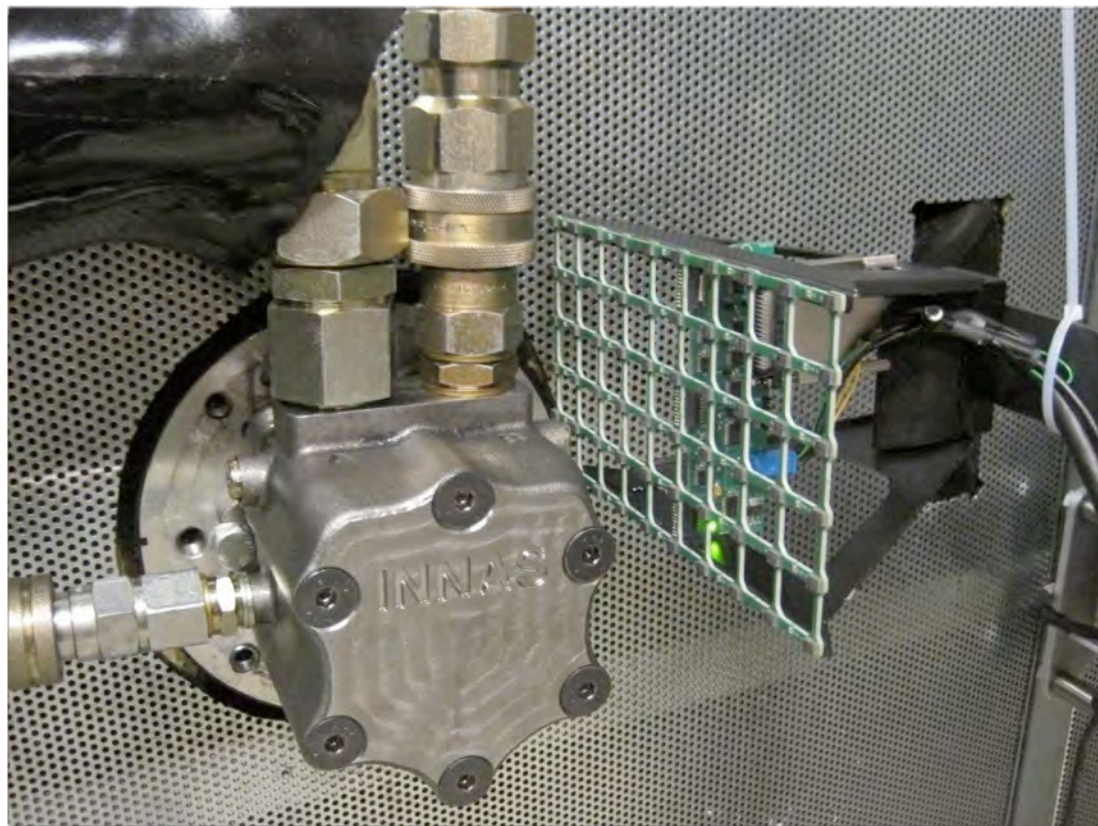
- ❖ multi piston (20 ...30 pistons)
- ❖ mirrored design
- ❖ left and right side out of phase

floating cup principle

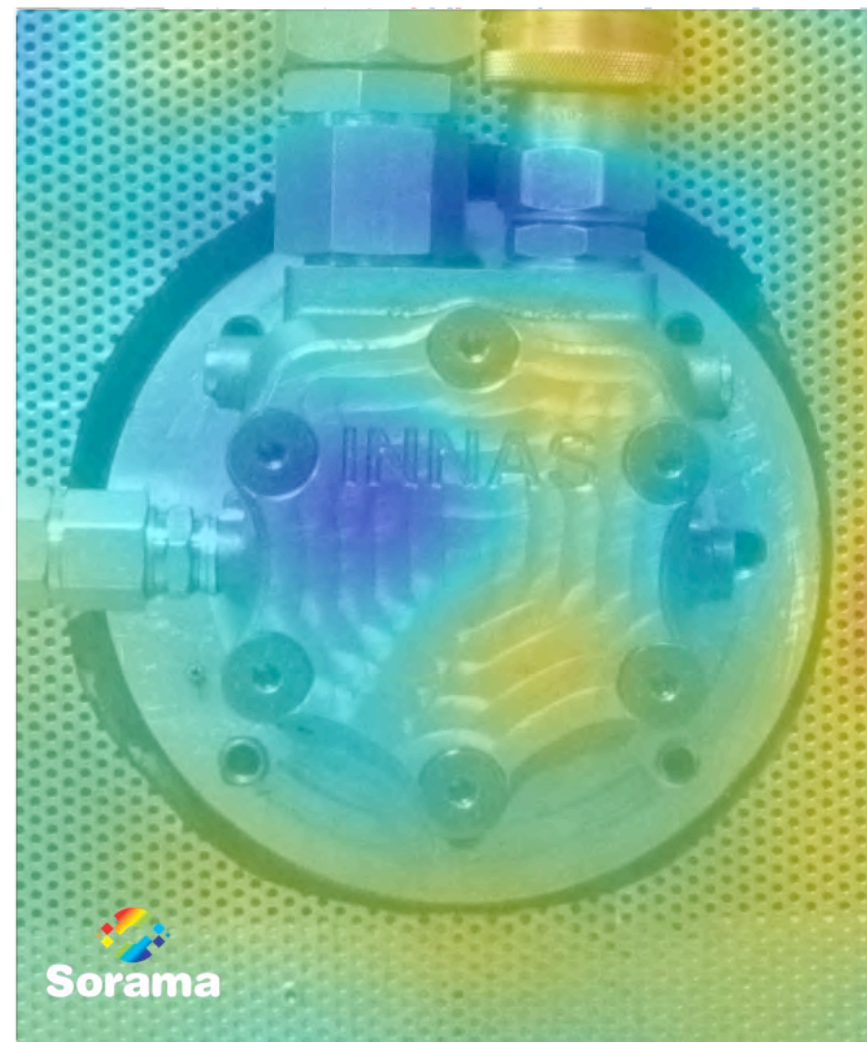
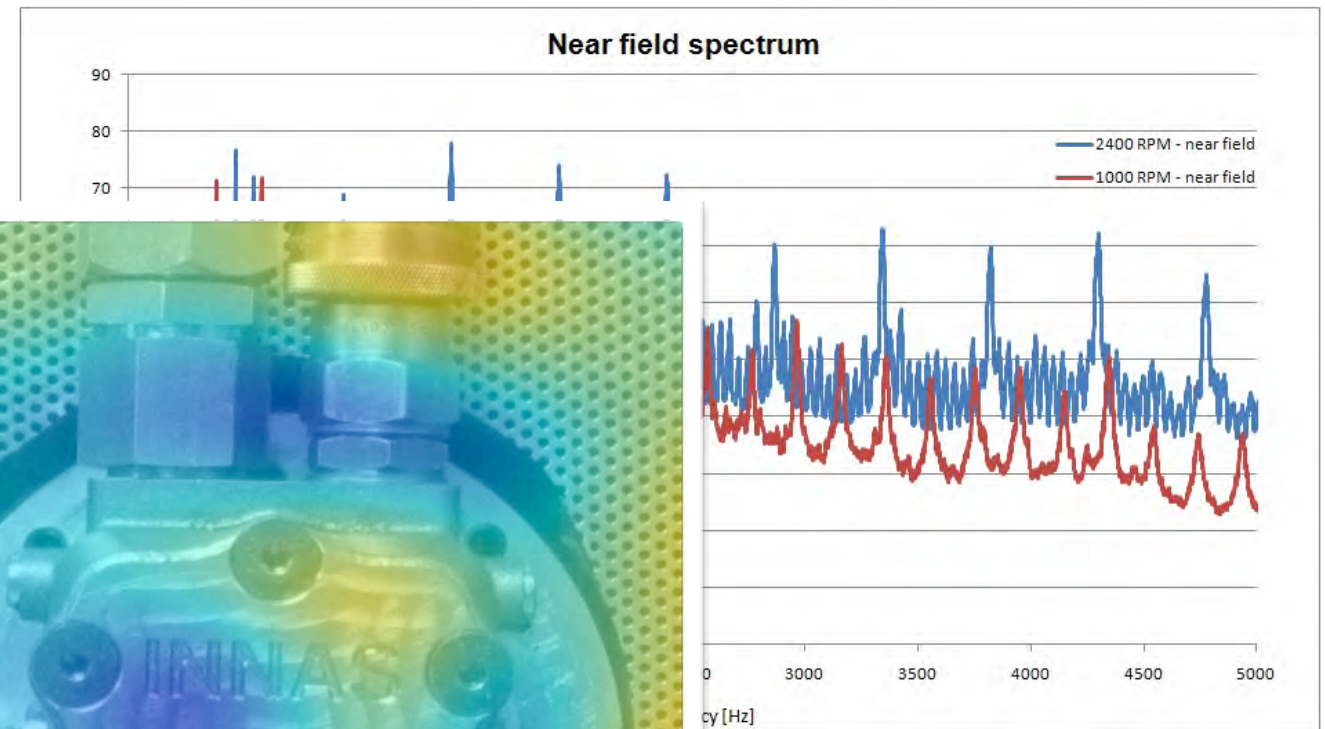
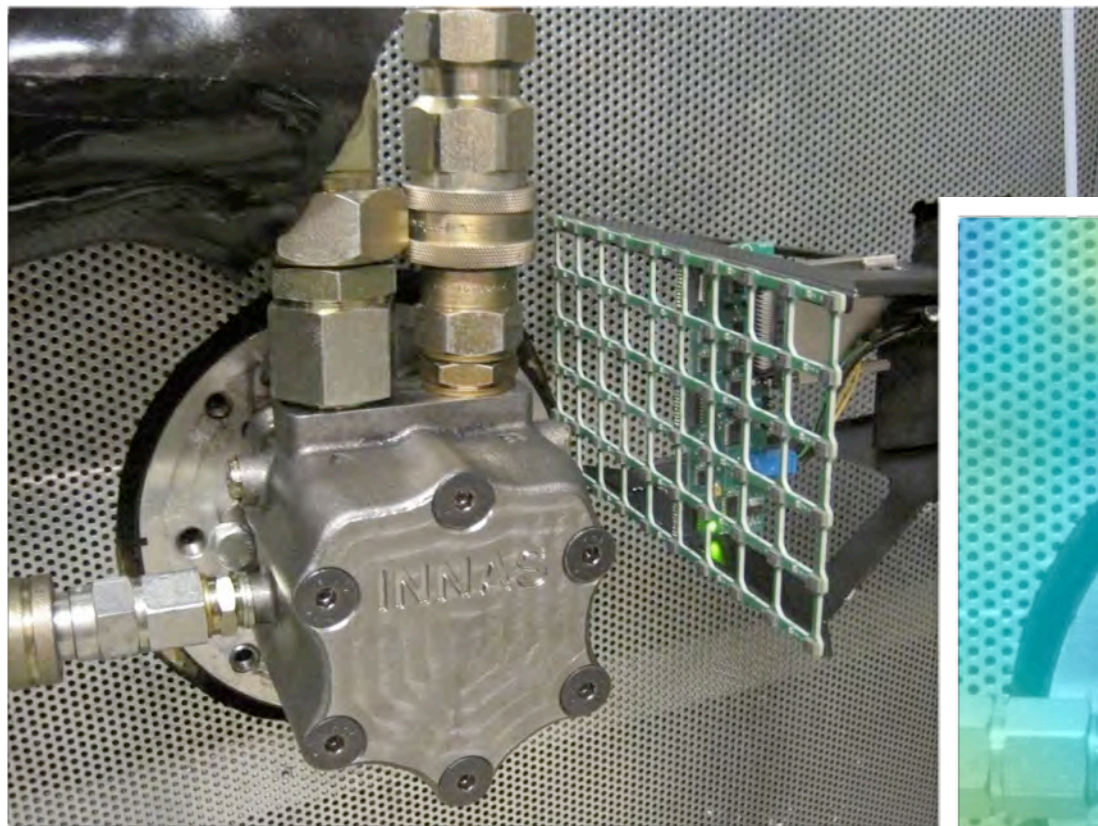


- ❖ multi piston (20 ...30 pistons)
- ❖ mirrored design
- ❖ left and right side out of phase
- ❖ low bearing force

noise reduction

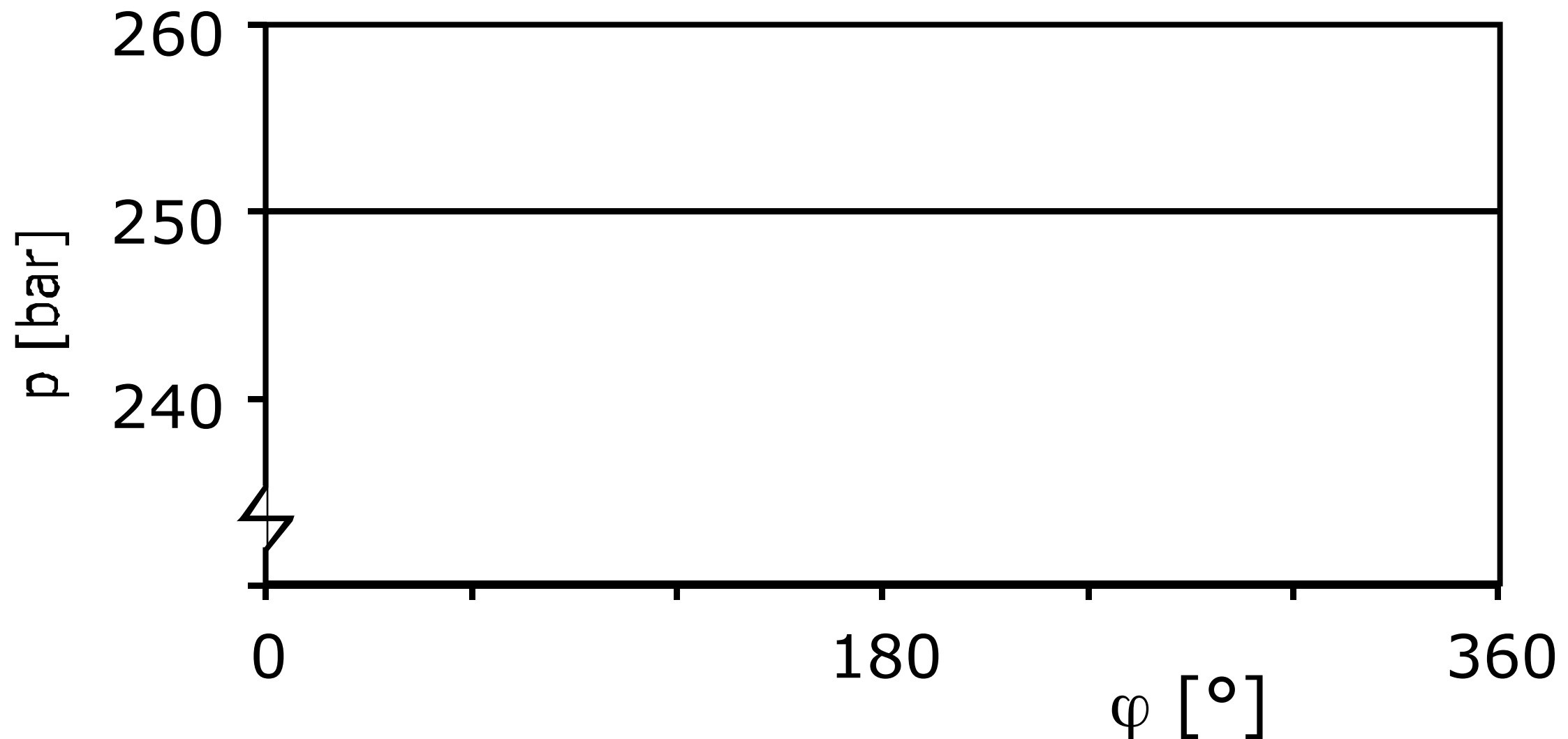


noise reduction



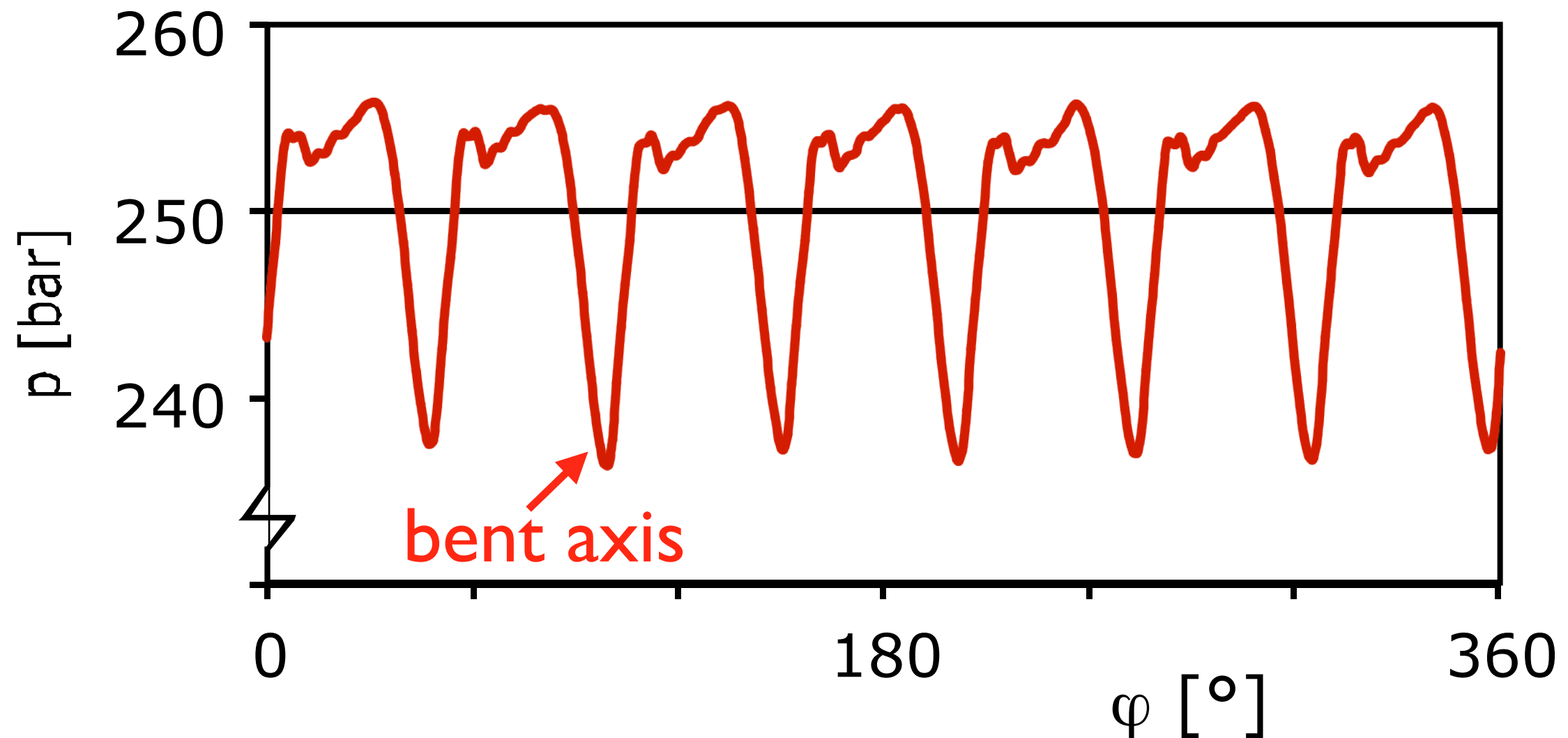
measured pressure pulsations

IFAS, RWTH Aachen, Germany, anechoic line output, 2500 rpm, 250 bar



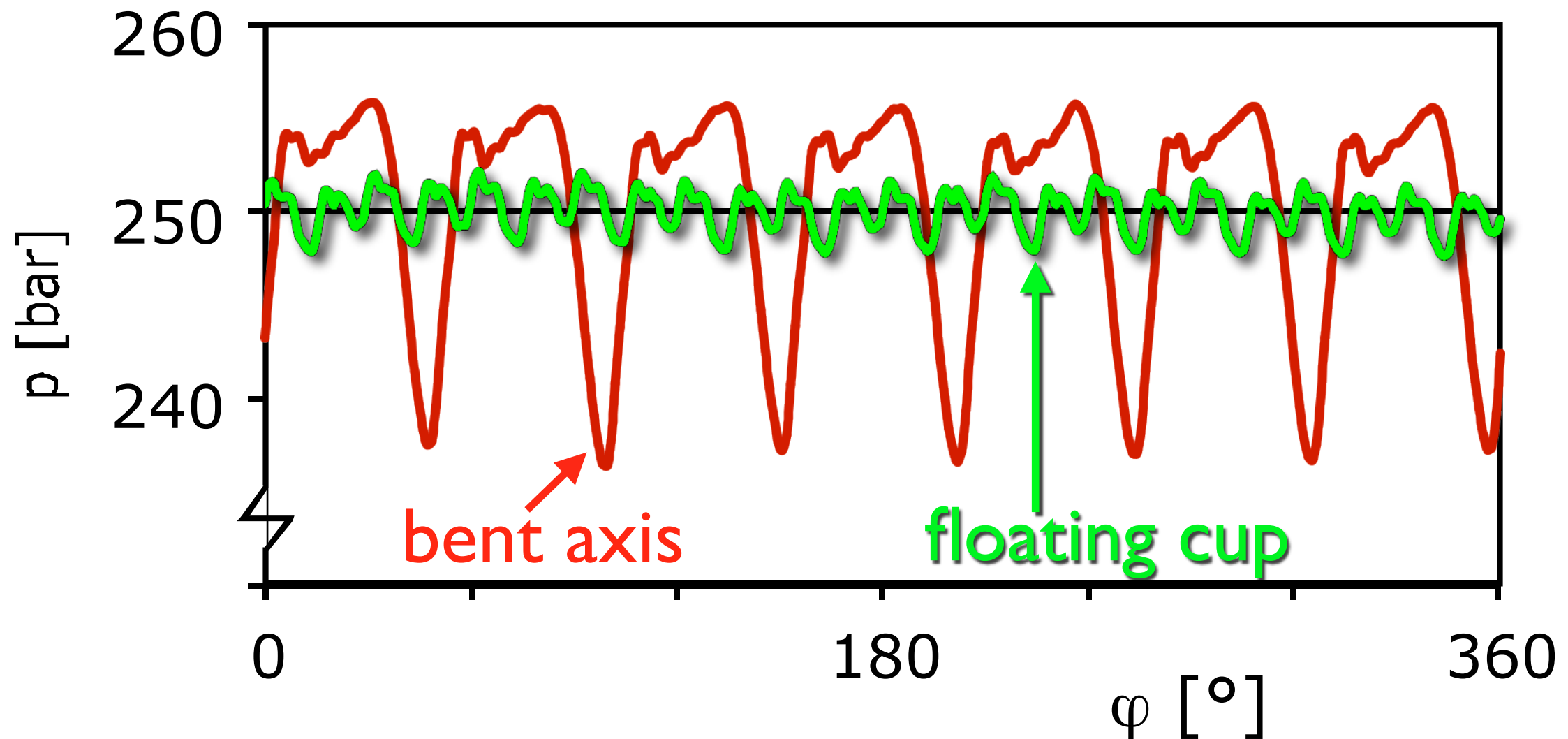
measured pressure pulsations

IFAS, RWTH Aachen, Germany, anechoic line output, 2500 rpm, 250 bar



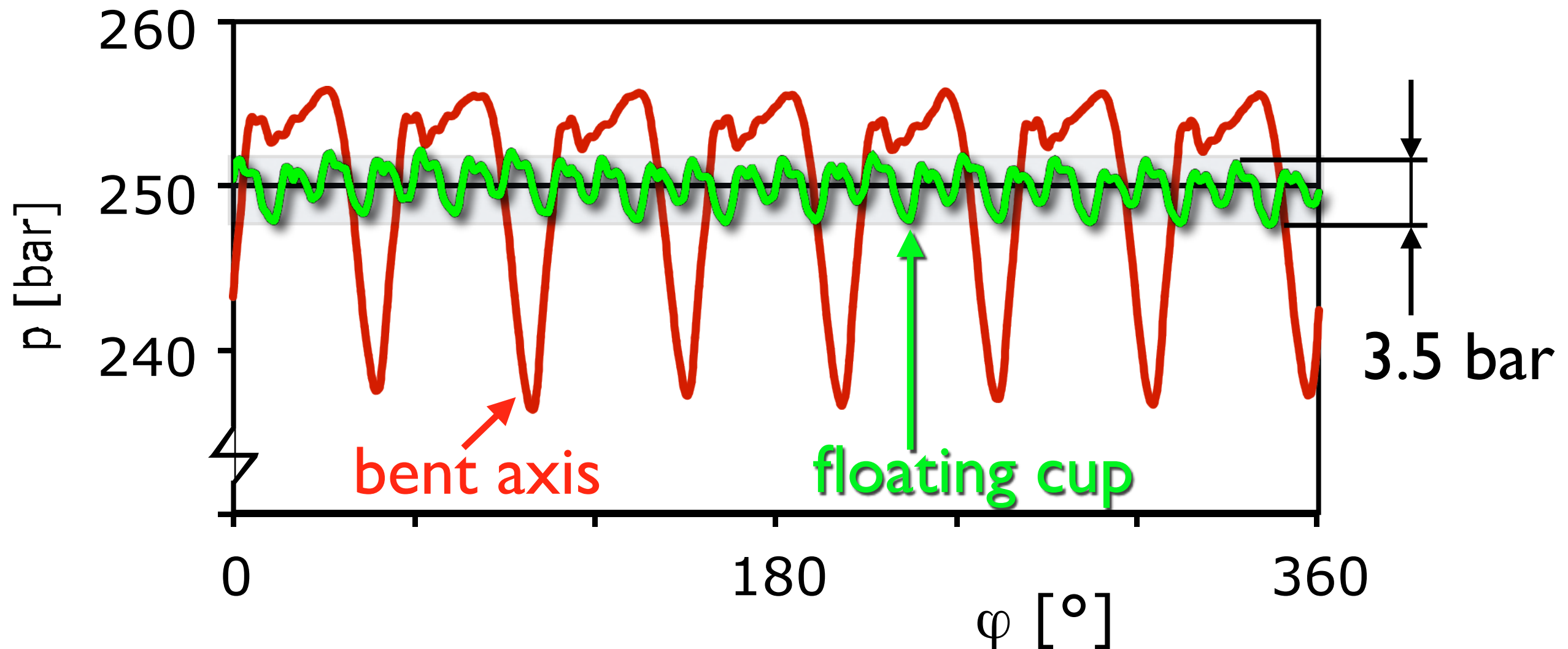
measured pressure pulsations

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measured pressure pulsations

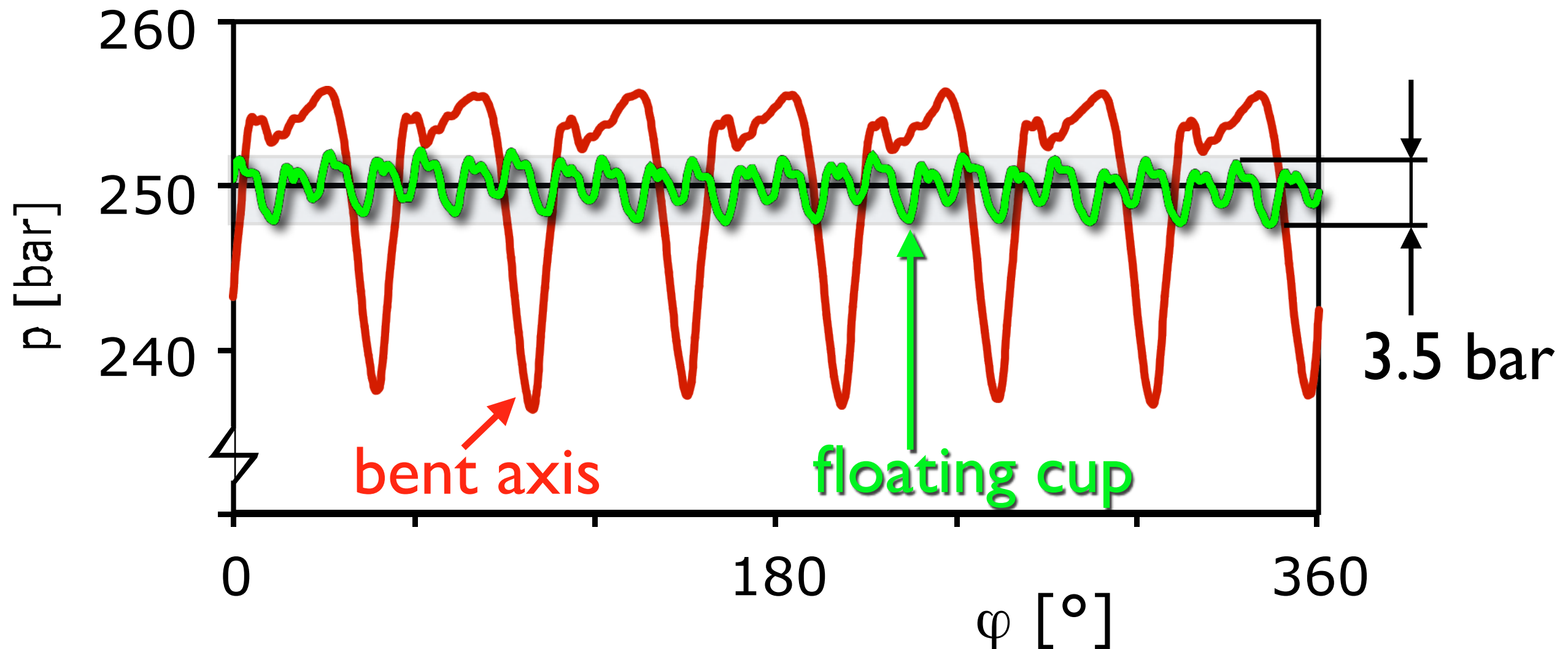
IFAS, RWTH Aachen, Germany, anechoic line output, 2500 rpm, 250 bar



measured pressure pulsations

IFAS, RWTH Aachen, Germany, anechoic line output, 2500 rpm, 250 bar

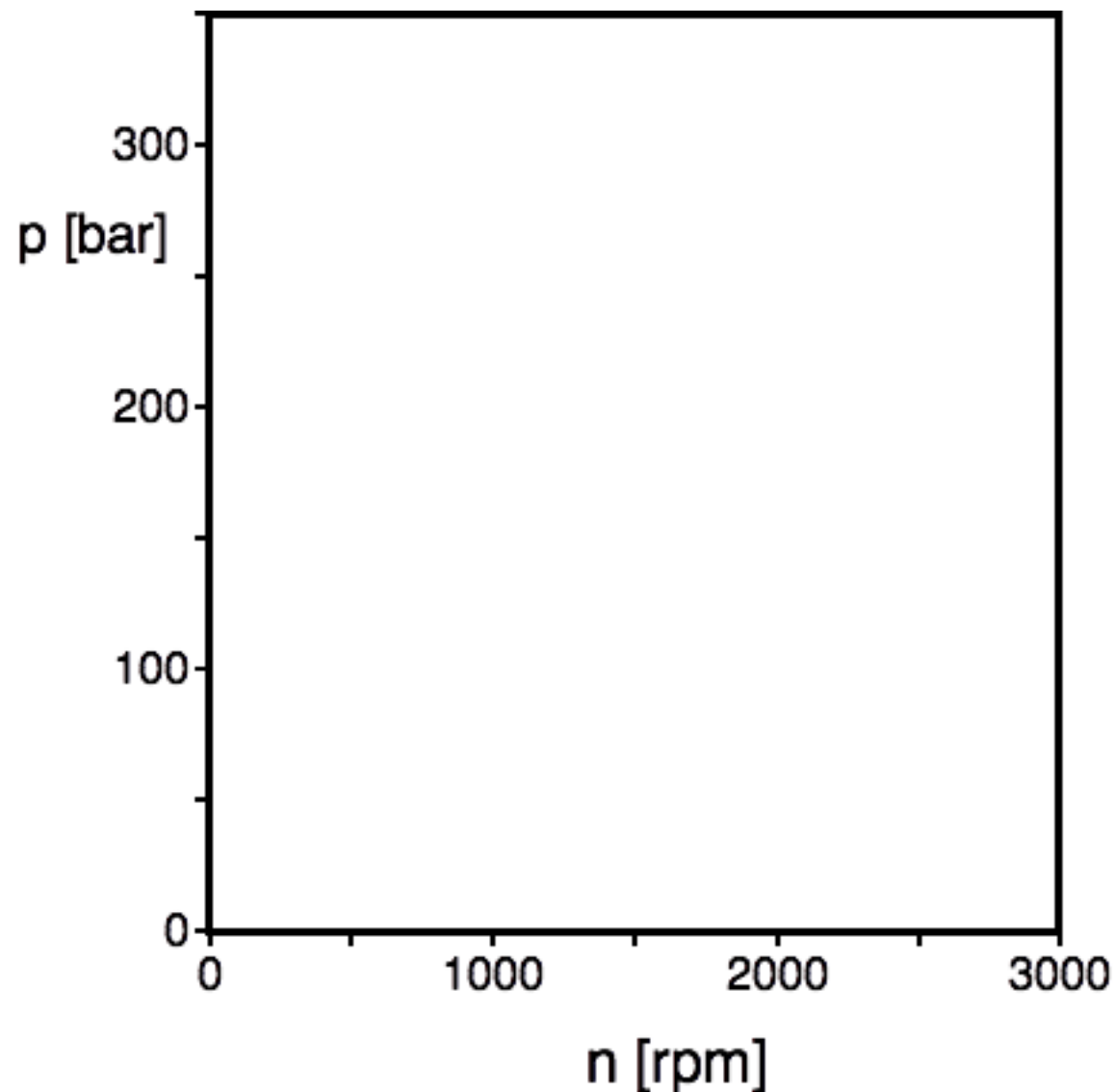
80% reduction



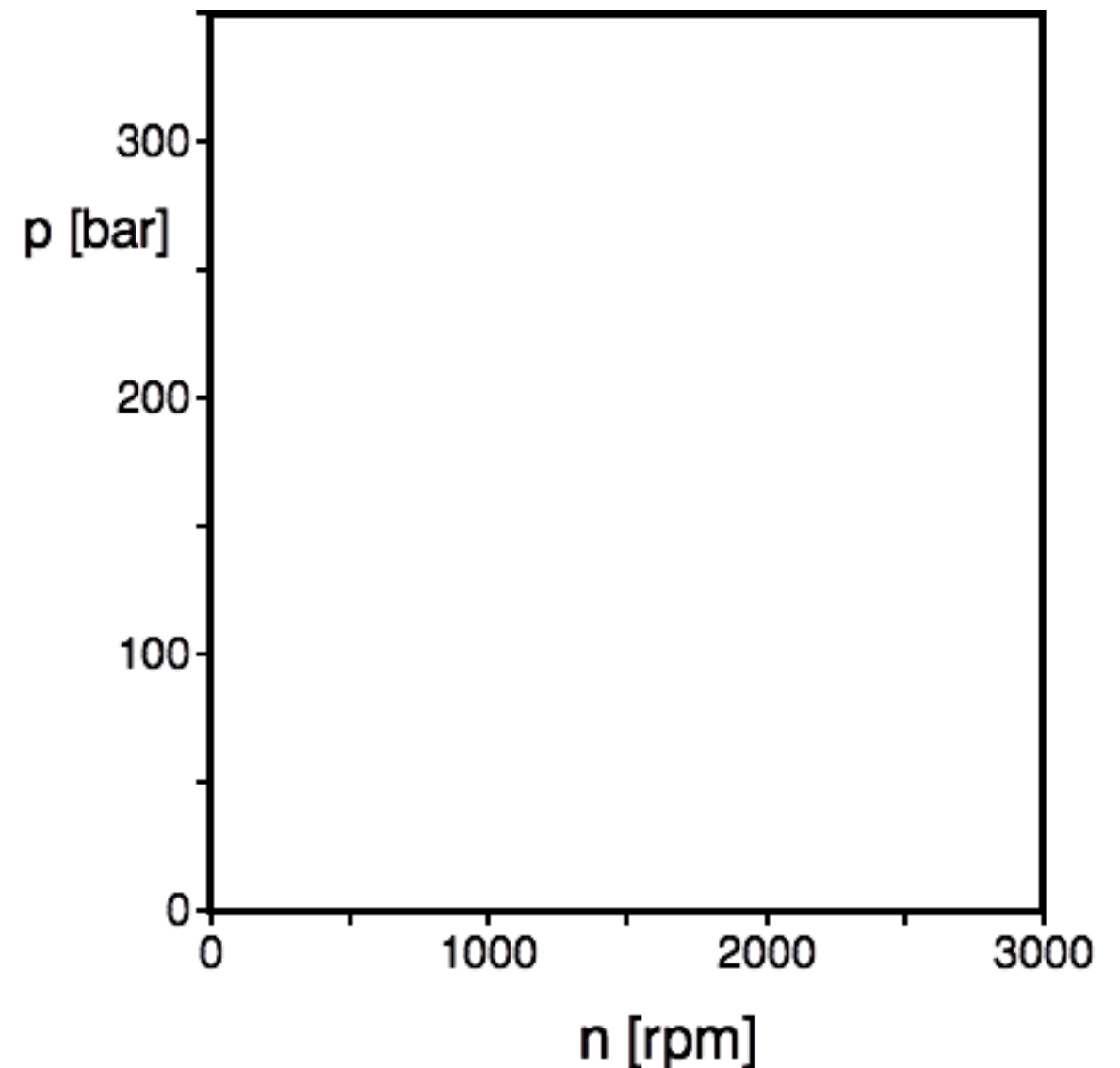
measured pressure pulsations

IFAS, RWTH Aachen, Germany, anechoic line output

bent axis Δp [bar]



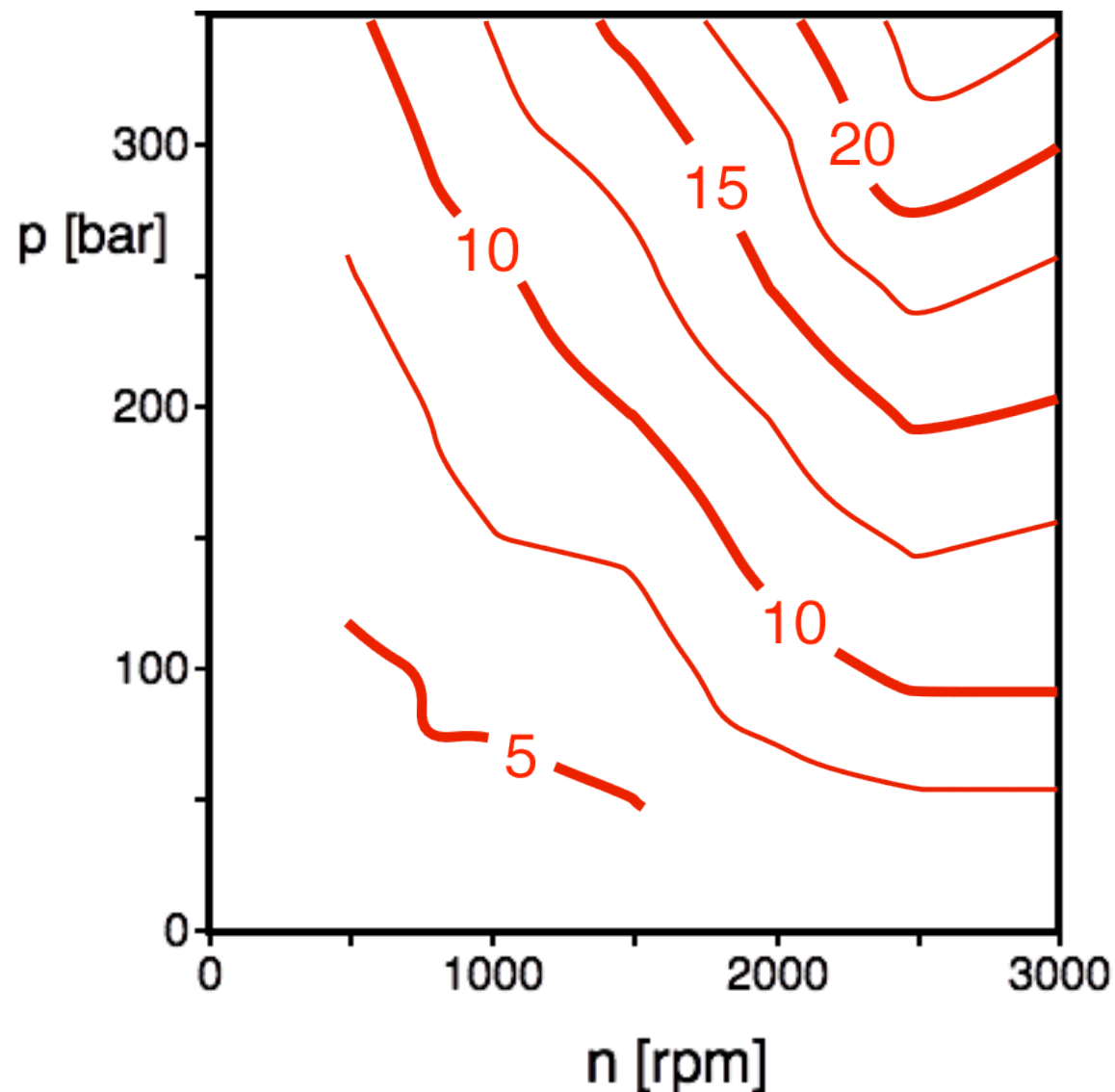
floating cup Δp [bar]



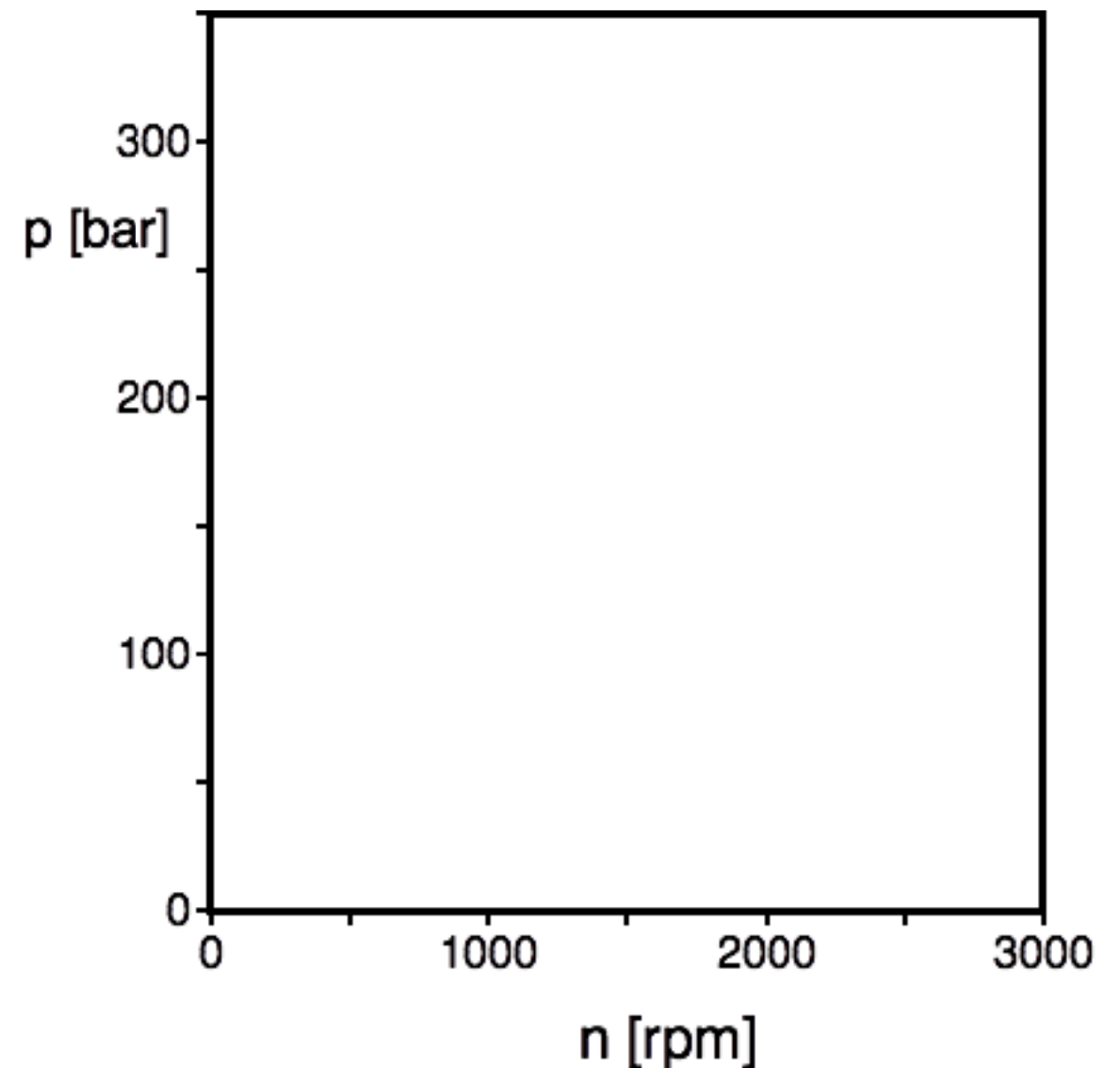
measured pressure pulsations

IFAS, RWTH Aachen, Germany, anechoic line output

bent axis Δp [bar]



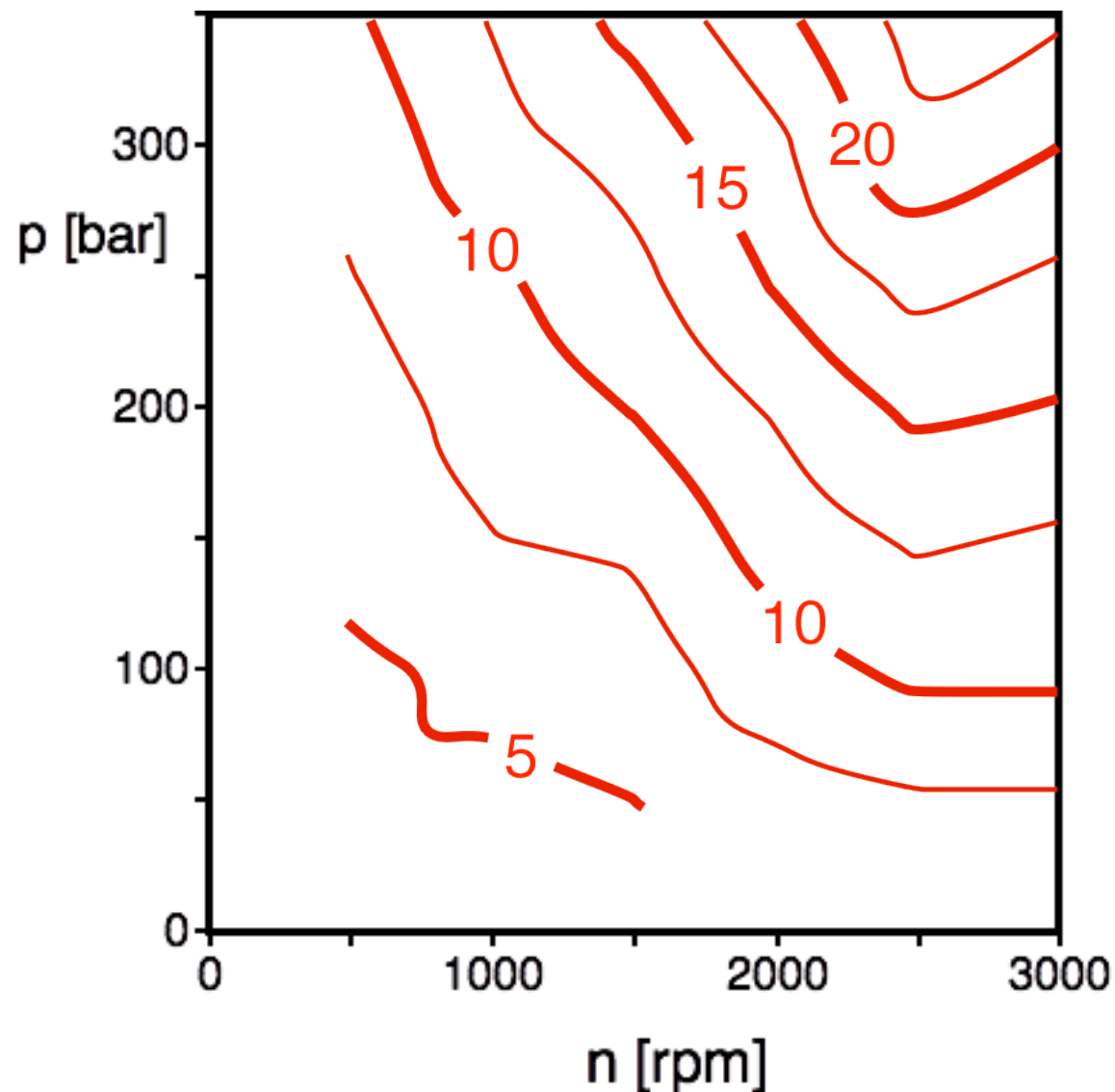
floating cup Δp [bar]



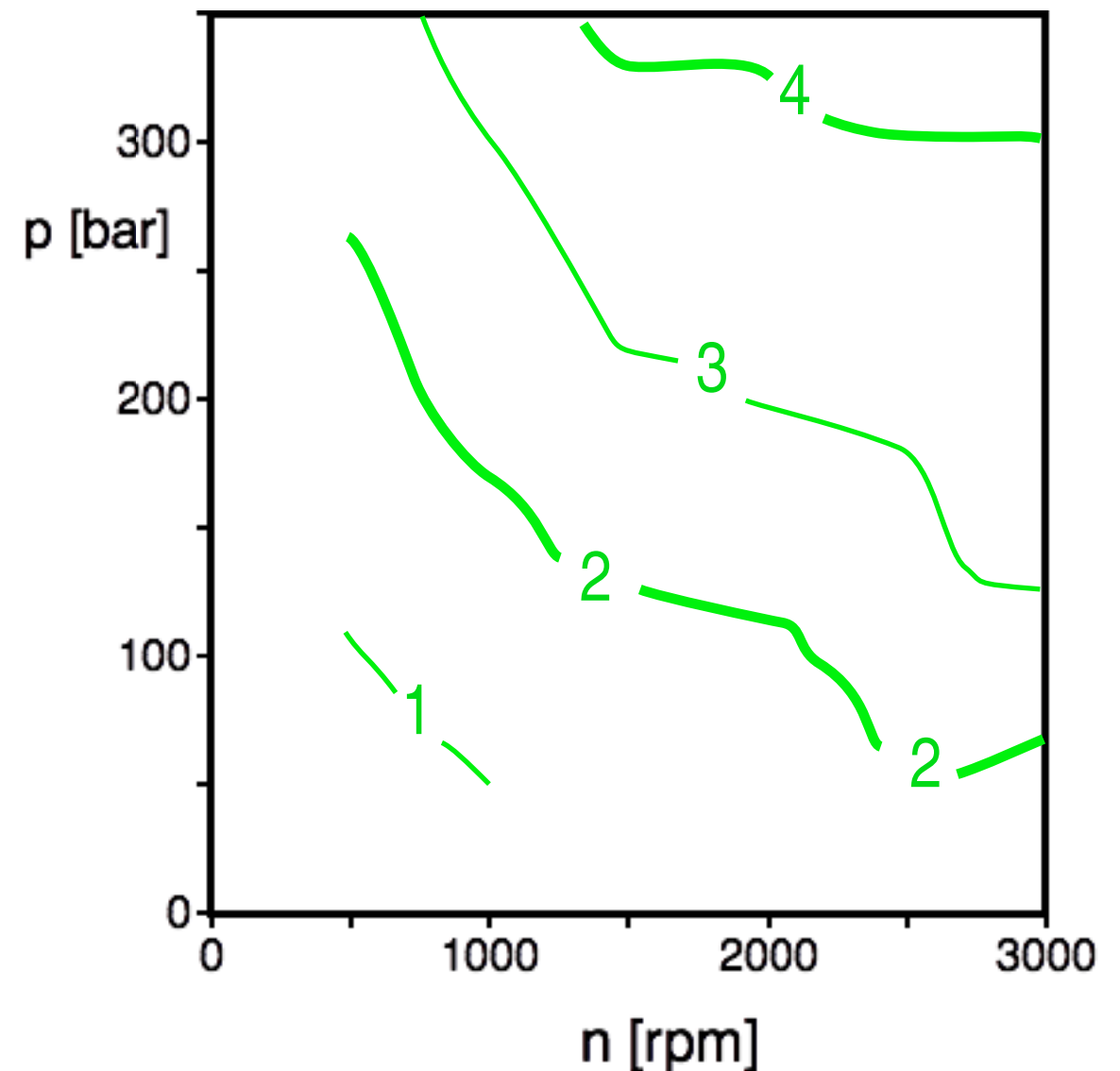
measured pressure pulsations

IFAS, RWTH Aachen, Germany, anechoic line output

bent axis Δp [bar]

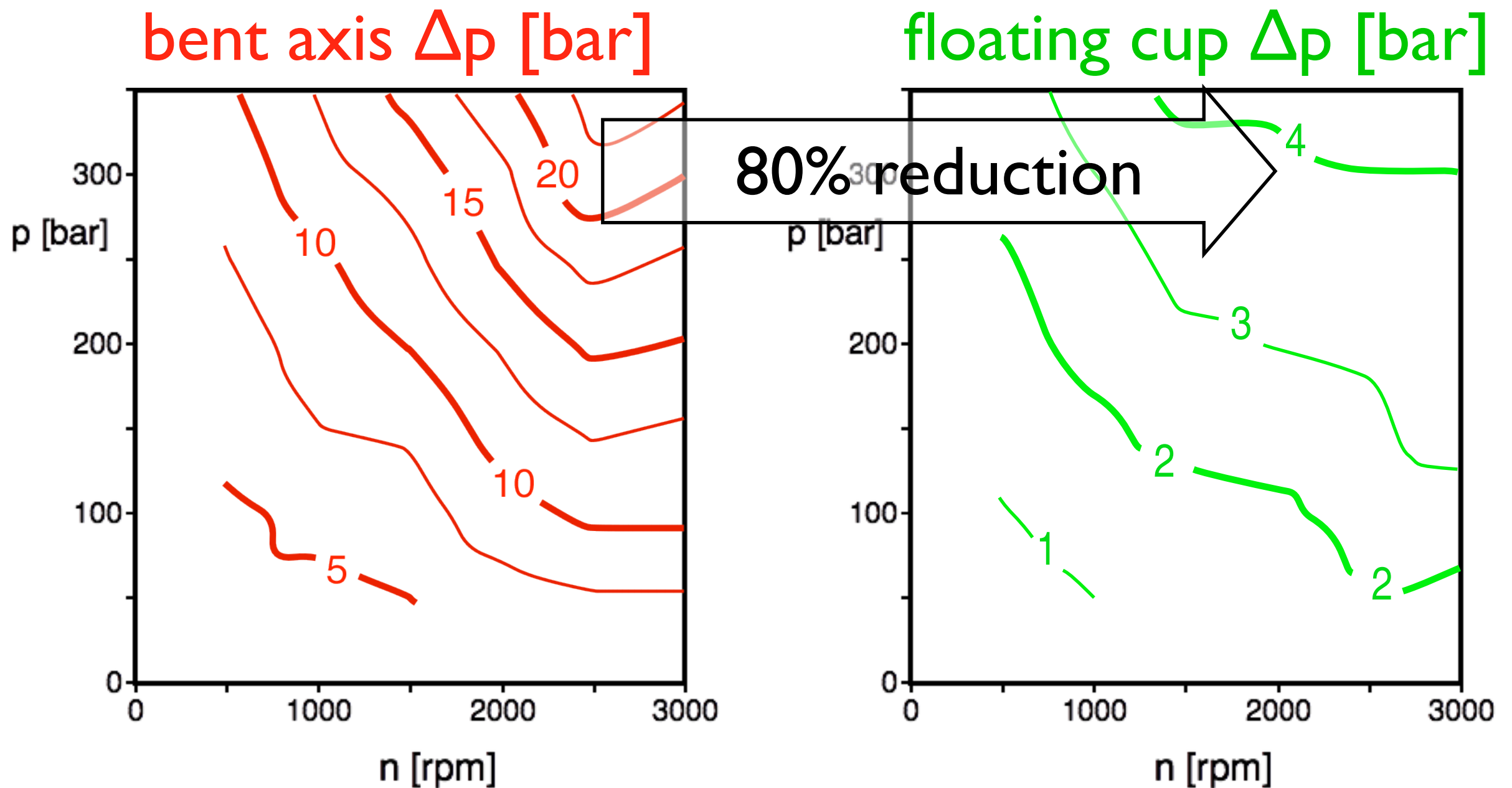


floating cup Δp [bar]



measured pressure pulsations

IFAS, RWTH Aachen, Germany, anechoic line output



low cost

floating cup

floating cup

- ❖ designed for automotive production
 - ▶ deep drawing
 - ▶ fine blanking
 - ▶ sintering
 - ▶ impact extrusion

floating cup

- ❖ designed for automotive production
 - ▶ deep drawing
 - ▶ fine blanking
 - ▶ sintering
 - ▶ impact extrusion
- ❖ tolerance chain reduced to piston-cup-pair

floating cup

- ❖ designed for automotive production
 - ▶ deep drawing
 - ▶ fine blanking
 - ▶ sintering
 - ▶ impact extrusion
- ❖ tolerance chain reduced to piston-cup-pair
- ❖ fit for sorting





piston



cylinder

manufacturing cost target

manufacturing cost target

- ❖ current hydrostatic pumps and motors:
 - ▶ 35-95 €/kg

manufacturing cost target

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 - ▶ 35-95 €/kg
- ❖ automotive engines and transmissions
 - ▶ 12-16 €/kg

manufacturing cost target

- ❖ current hydrostatic pumps and motors:
 - 35-95 €/kg
- ❖ automotive engines and transmissions
 - 12-16 €/kg
- ❖ necessity for the hydraulic industry:
 - reduction of labor cost

manufacturing cost target

- ❖ current hydrostatic pumps and motors:
 - 35-95 €/kg
- ❖ automotive engines and transmissions
 - 12-16 €/kg
- ❖ necessity for the hydraulic industry:
 - reduction of labor cost
- ❖ floating cup:
 - 15-20 €/kg

cost of ownership

cost of ownership

❖ high efficiency:

cost of ownership

- ❖ high efficiency:
 - ▶ reduced fuel cost

cost of ownership

- ❖ high efficiency:
 - ▶ reduced fuel cost
- ❖ high start-up torque:

cost of ownership

- ❖ high efficiency:
 - ▶ reduced fuel cost
- ❖ high start-up torque:
 - ▶ smaller motors and pumps

cost of ownership

- ❖ high efficiency:
 - ▶ reduced fuel cost
- ❖ high start-up torque:
 - ▶ smaller motors and pumps
- ❖ low noise and pulsation levels:

cost of ownership

- ❖ high efficiency:
 - ▶ reduced fuel cost
- ❖ high start-up torque:
 - ▶ smaller motors and pumps
- ❖ low noise and pulsation levels:
 - ▶ lower cost for noise attenuation

patented

solid patent position

solid patent position

- ❖ the floating cup principle

solid patent position

- ❖ the floating cup principle
- ❖ the variable displacement design

solid patent position

- ❖ the floating cup principle
- ❖ the variable displacement design
- ❖ the bearing structure of the barrel

solid patent position

- ❖ the floating cup principle
- ❖ the variable displacement design
- ❖ the bearing structure of the barrel
- ❖ several hydraulic transformer patents

solid patent position

- ❖ the floating cup principle
- ❖ the variable displacement design
- ❖ the bearing structure of the barrel
- ❖ several hydraulic transformer patents
- ❖ the Hydrid

to conclude

positive

negative

robust

too noisy

flexible

too harsh

good cooling

poor efficiency

compact

too expensive

positive

negative

robust

~~too noisy~~

flexible

~~too harsh~~

good cooling

~~poor efficiency~~

compact

~~too expensive~~

