Bicycle Mechanics and Repair Decal
Mechanical Engineering 98/198
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Lecture 10

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High Tech Bikes

The latest and greatest in bike technology

Outline

- Frame design
- Frame materials
- Electronic shifting
- Bamboo bikes?!
- Formula racing

Cycling Load cases

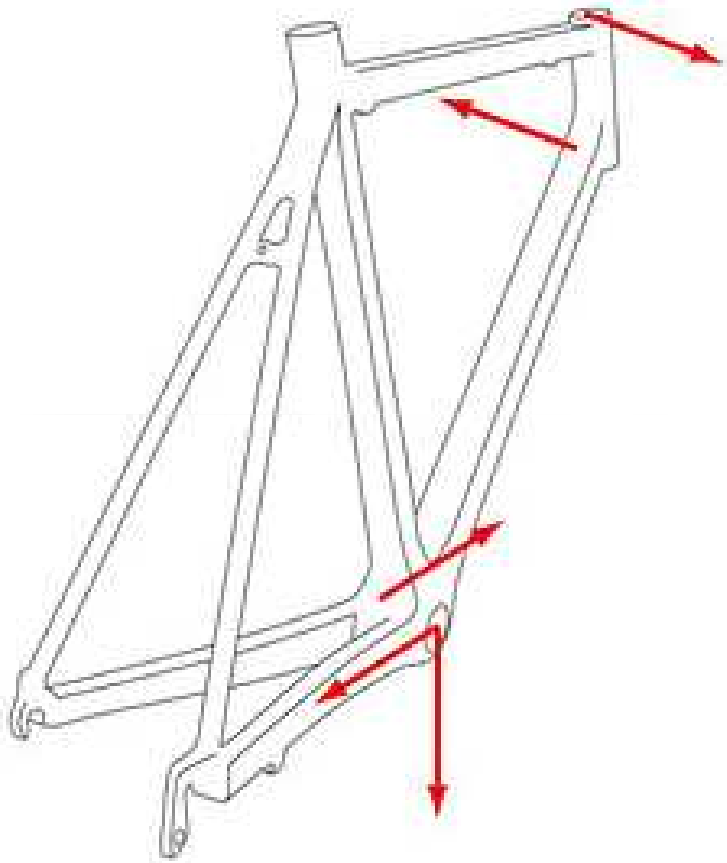
A bicycle frame sees many different combinations of forces (load cases), for example:

- Seated climbing
- Out-of-the-saddle climbing
- Sprinting
- Sweeping corners
- Hairpins
- Technical descending
- Time trialing/steady state riding
- Cobblestone riding
- Etc.

Deconstructing the load case

Each load case is a mix of forces acting on the frame. For example during sprinting, the most important forces are:

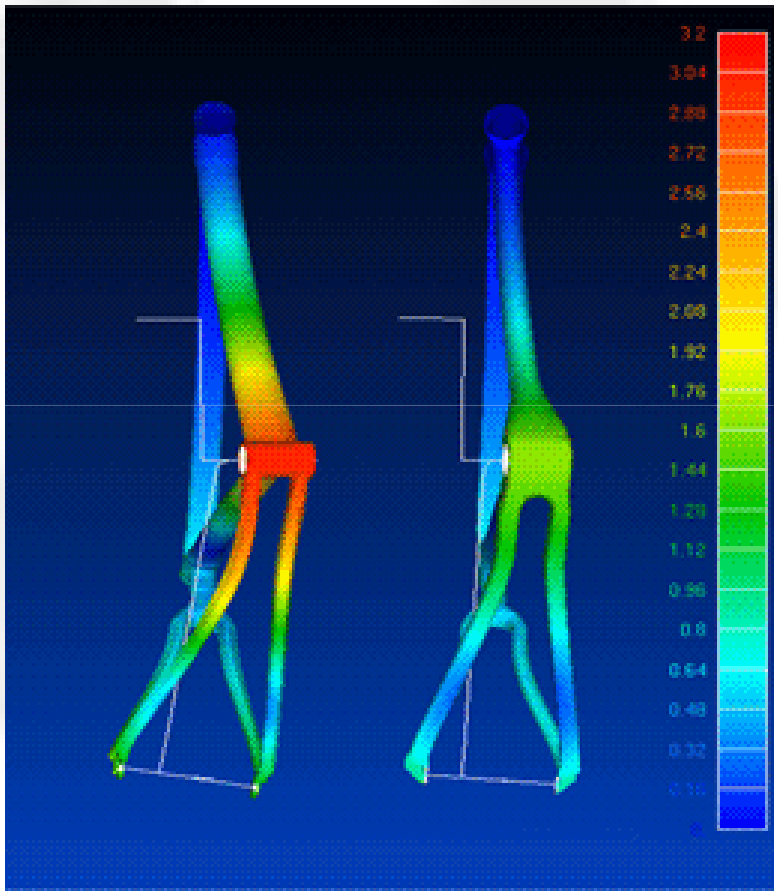
- A downward force on the bottom bracket from the foot pressing on the pedal.
- Twisting forces on the bottom bracket cause by the chain tension.
- A twisting input on the headtube from pulling on the handlebars.



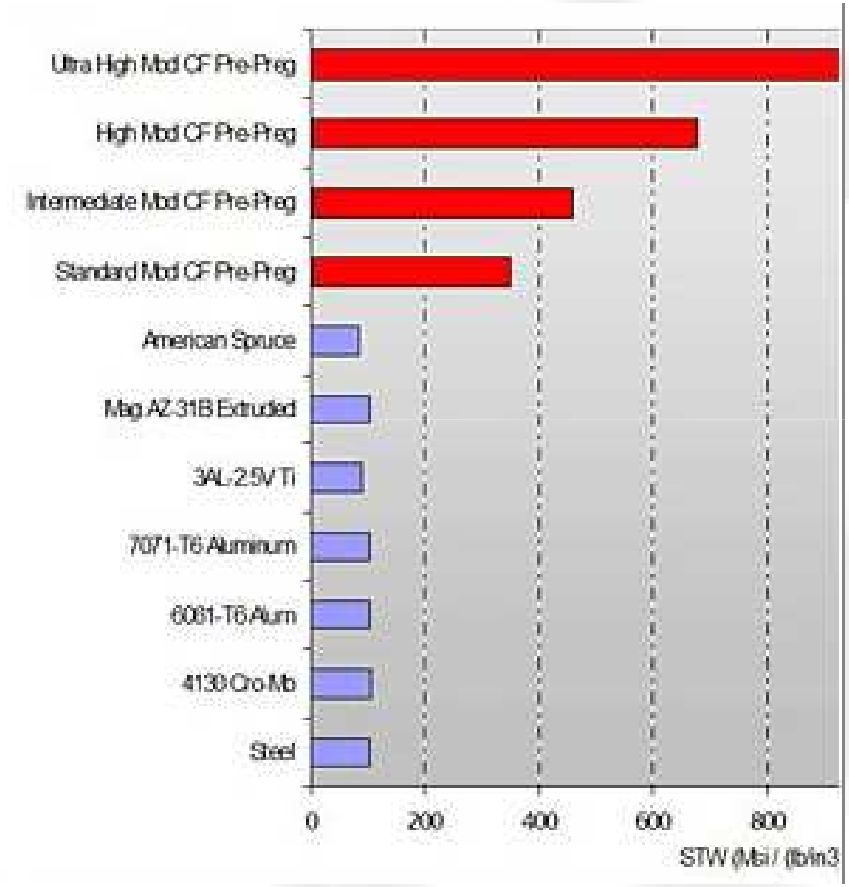
Example of frame loading

Frame deformation is largely due to:

- Material construction
  - Steel, aluminum, or carbon fiber?
  - High or low modulus
  - Composite materials
- Frame design
  - Aero or low weight
  - FEA and CFD analysis



High Modular Carbon Fiber



Higher Young's Modulus = Stiffer Material

Problem: You don't want your CF to be too stiff!

- Ride quality
- Need deformations to absorb shock
- Beware of marketing gimmicks


Integrated seatpost
Aero center tube
Reinforced headtube,
Airfoil design
Reinforced bottom bracket
FUJI

Electronic Shifting

Shimano Di2 Dura Ace

- Electronically-assisted shifting
- No cable friction or contamination
- Shifters are series of electrical switches
- No chain rub
- $4,700 component group

Bamboo Bikes

Improved weight and vibration-damping:

- Heat-treated bamboo
- Hemp lugs
- Flexible frame geometry
- Unparalleled bad-assery

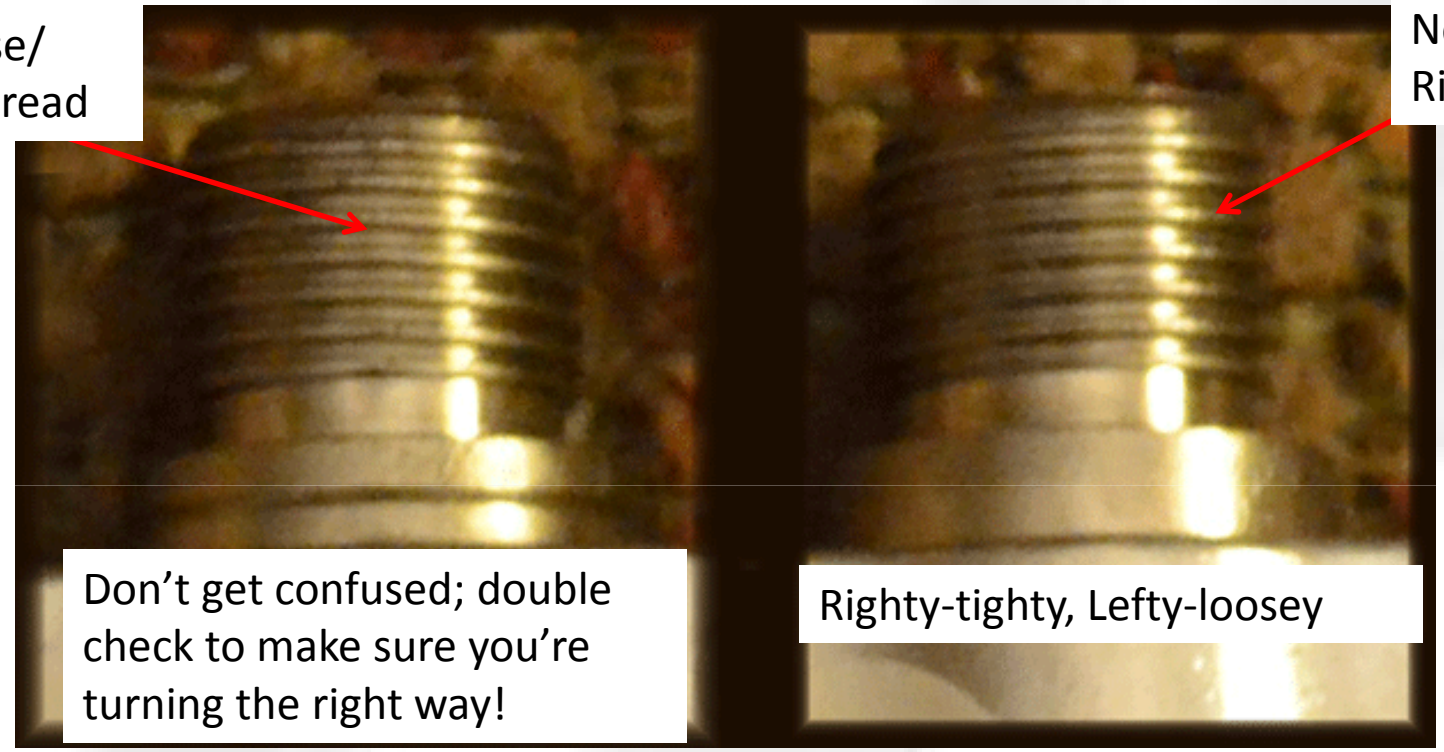
The World's Most Advanced Bicycle?

Built by British firm BERU F1 Systems:

- Carbon composite chassis
- Twin-bladed fork design
- Carbon ceramic or steel disc brakes
- Integrated biometric performance monitor with LCD touchscreen display
- Shimano Di2 shifters

Components

Reverse Thread



Other places with reverse threads

- Left Pedal
- Right side of adjustable bottom bracket
- Left side of one-piece crank bottom bracket
- Lockring on single rear cog

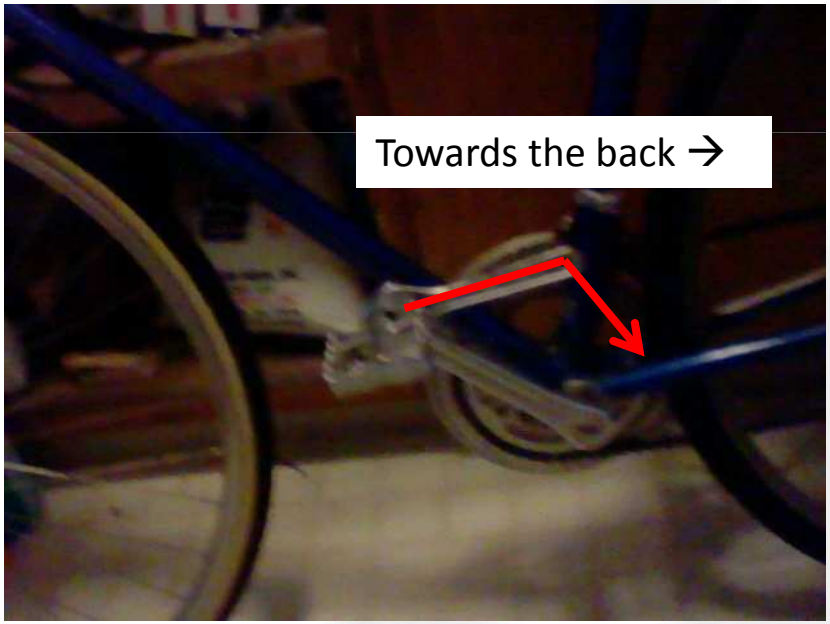
Removing Pedals

- Tools: 15mm long handle wrench
  - Longer handles will make it easier. $\tau = rF$

- Left pedals are left-threaded (reverse) and Right pedals are right-threaded (normal)

Removing Pedals

- Rule of thumb – When loosening pedals, always turn wrench towards the back of the bike!

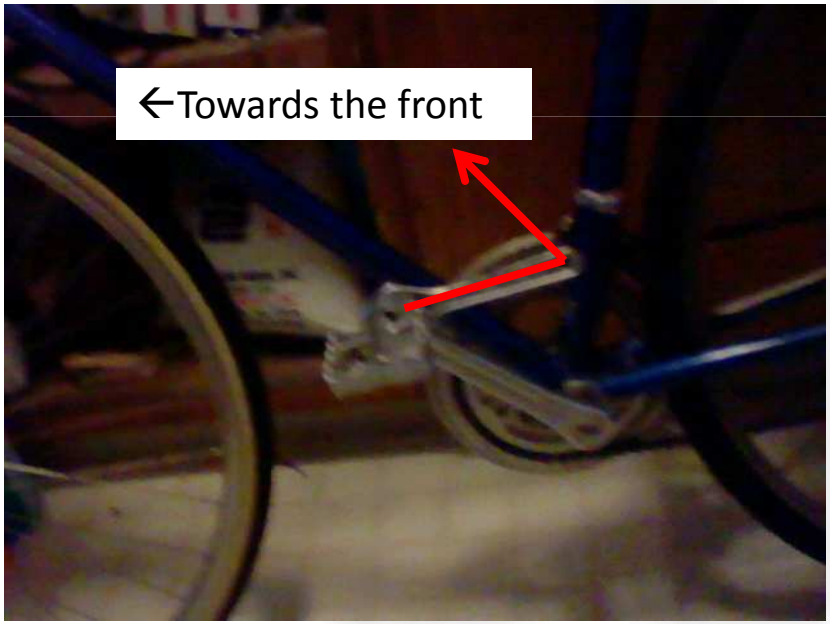


Left pedal

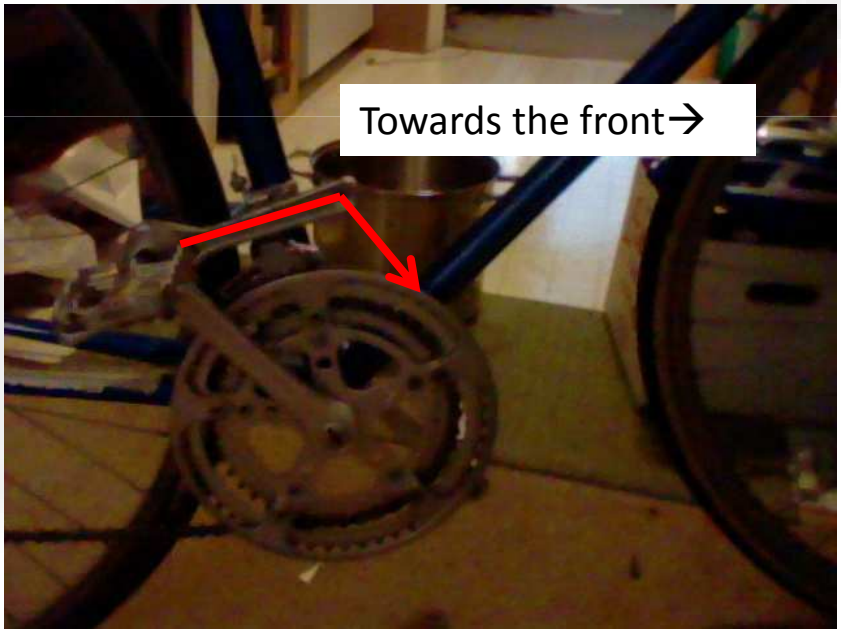
Right pedal

Inserting Pedals

- Remember that left pedals are left-threaded and right pedals are right-threaded.
  - Always turn wrench towards the front!



Left pedal



Right pedal

Cranks!


CAMPAGNOLO
record


SICKLINES CONTENT
e*thirteen
Guide Ring
TORS SET

Cranks can be attached…

Different bottom brackets call for cranks with different tapered fits

Tools for Crank Removal

The crank puller

Threaded screw within a threaded screw

Installing and Removing

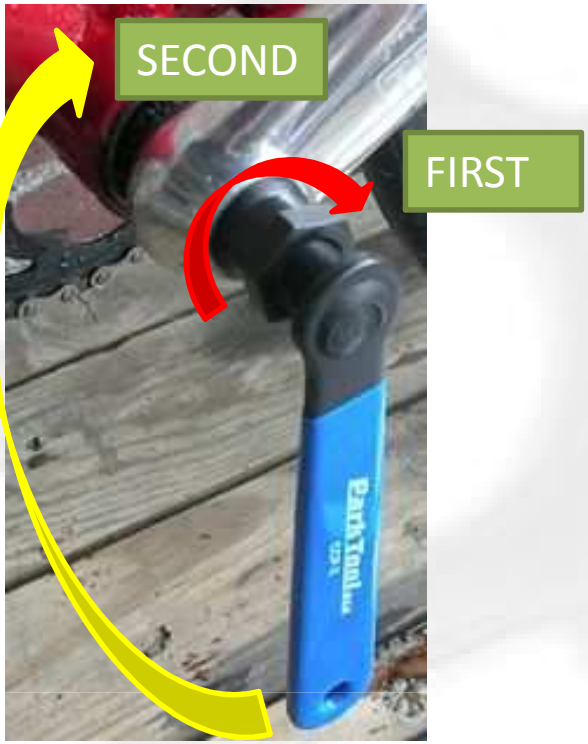
Different cranks = different tools

Removing

1. Remove dust caps (if you have any)

2. Remove the crankbolt

3. Thread on the large threaded barrel of the crankpuller TIGHT



4. Tighten the crankpuller arm until the crankarms fall off!

Exceptions

Cranks with attached spindles

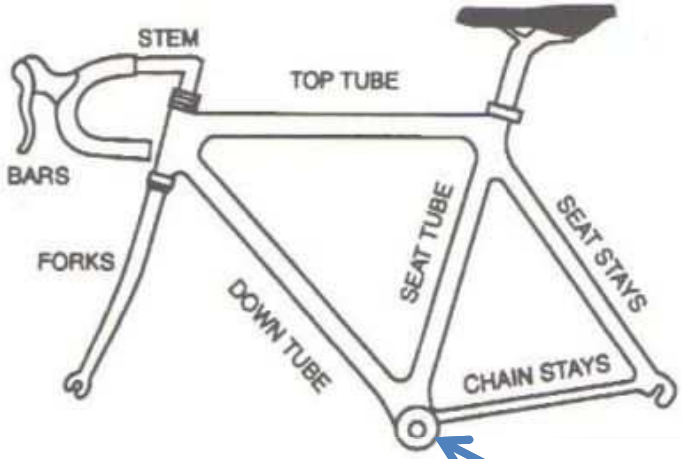
built-in crank remover

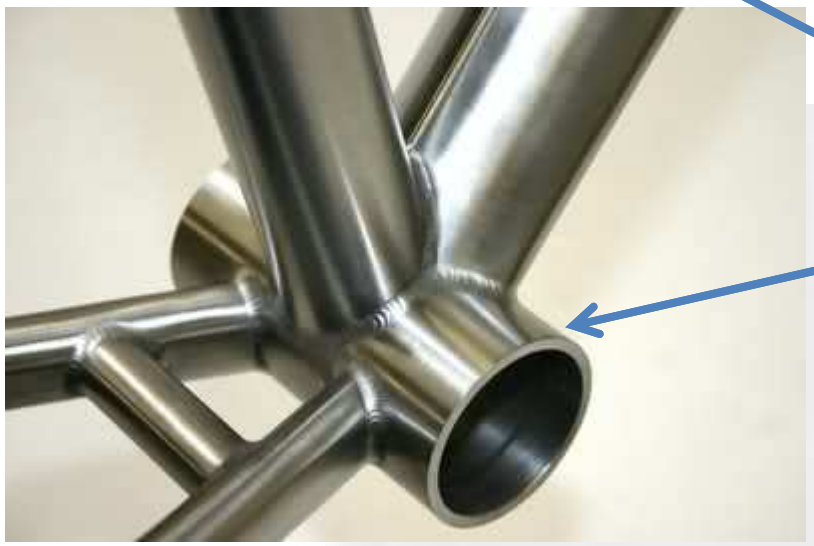
Exceptions

BMX cranks

…use a hammer

Bottom Brackets





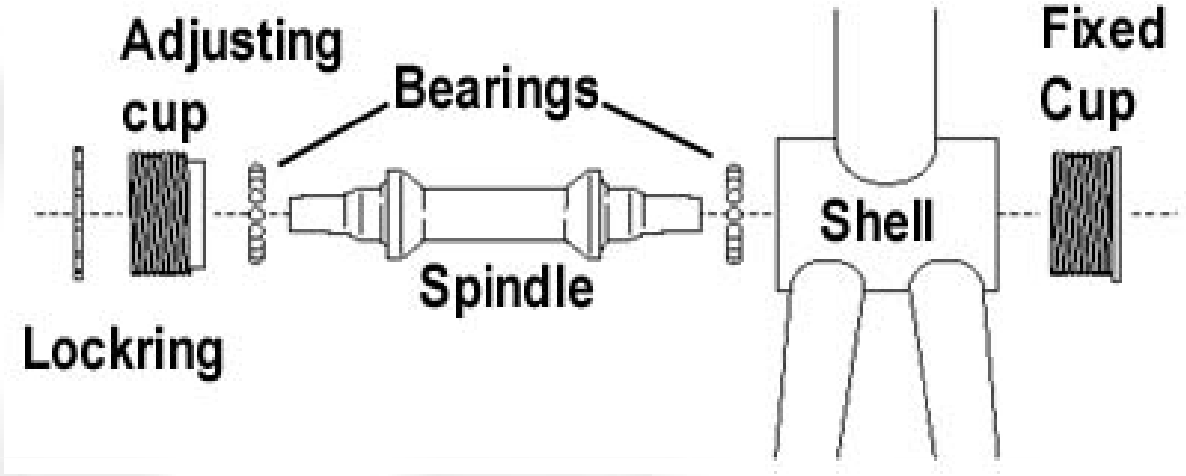
Definition 1:
Part of the frame that houses the mechanism allowing the crank arms to rotate.

Definition 2:
Mechanism the fits in the frame allowing the crank arms to rotate

Adjustable Bottom Bracket

Adjustable Bottom Bracket

- Bearings can be accessed and re-greased or replaced
- Bearings are adjustable
- Found on older bikes and some current low-end bikes



Cartridge Bottom Bracket

Cartridge Bottom Bracket
- Usually cheaper
- Cannot be adjusted or disassembled
- Found on newer bikes

One-Piece Crank Bottom Bracket

One-Piece Bottom Bracket: Axle and crank arms are a single piece
Found on old American bikes and some department store bikes

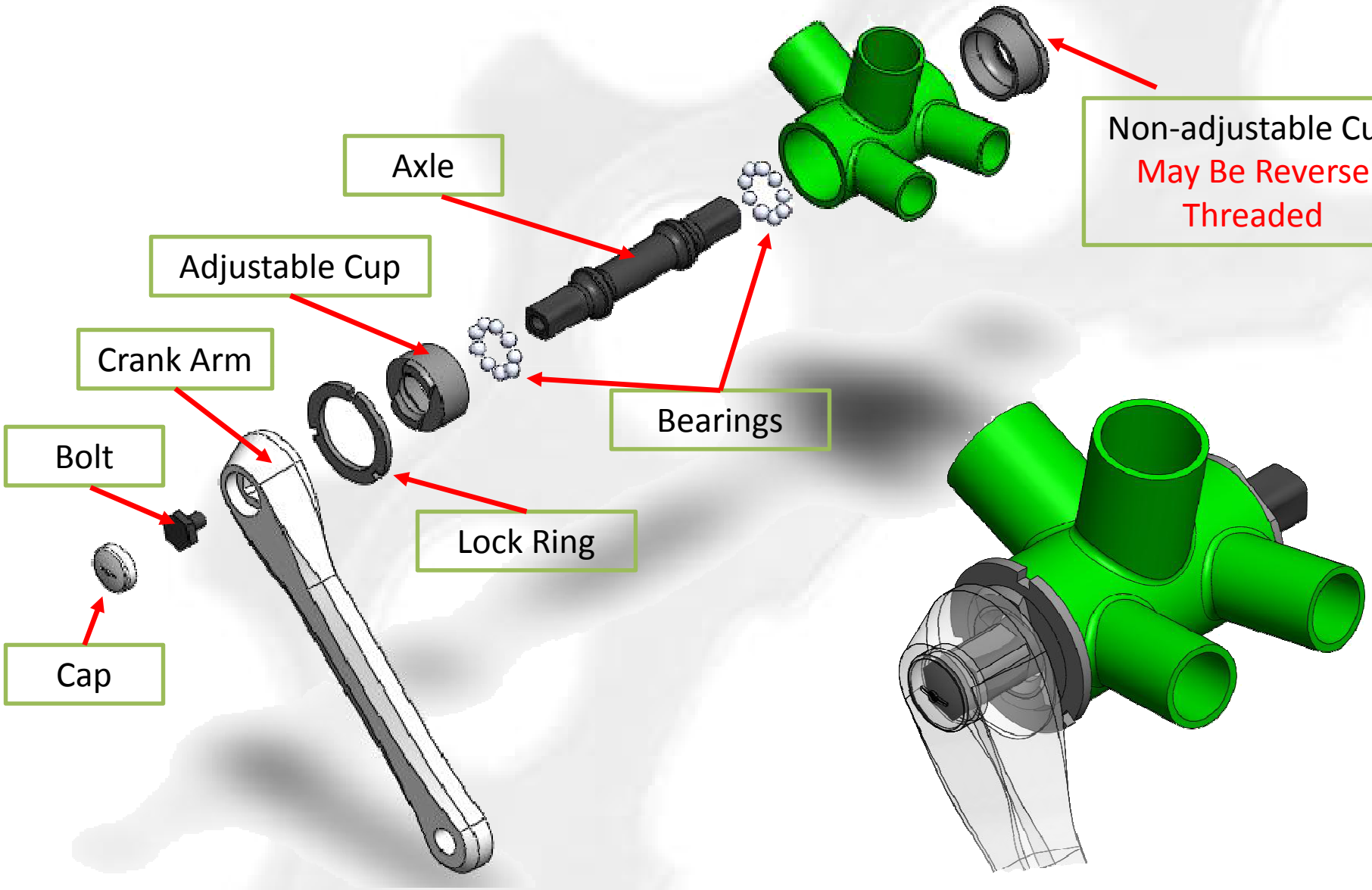
External Bottom Bracket

External Bottom Brackets

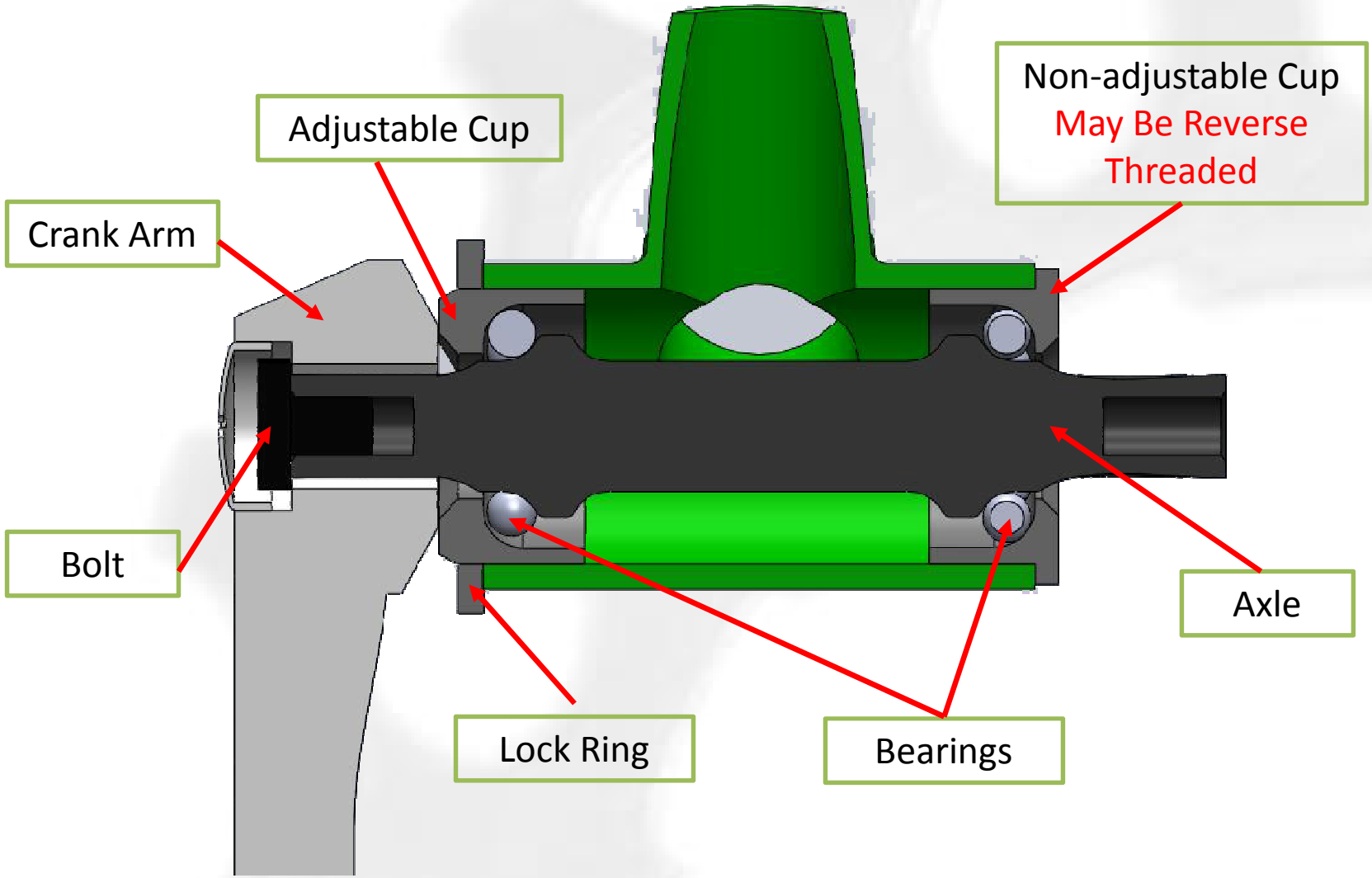
- allows for bearings and spindle to be larger
- more durability and more stiffness
- hollow through center ➔ lighter

Bearings are housed outside frame.

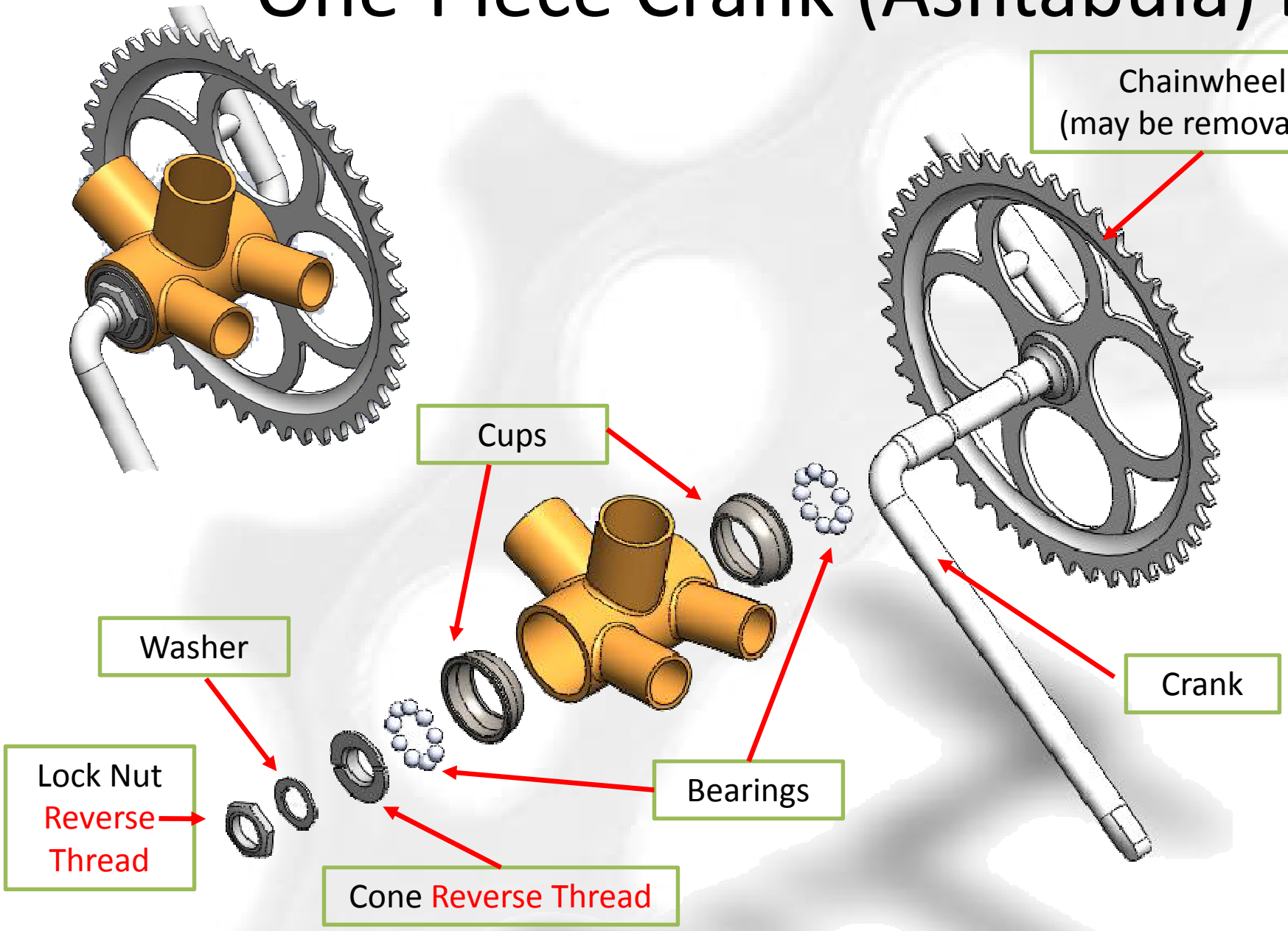
Adjustable Bottom Bracket



Cutaway View



One-Piece Crank (Ashtabula) BB



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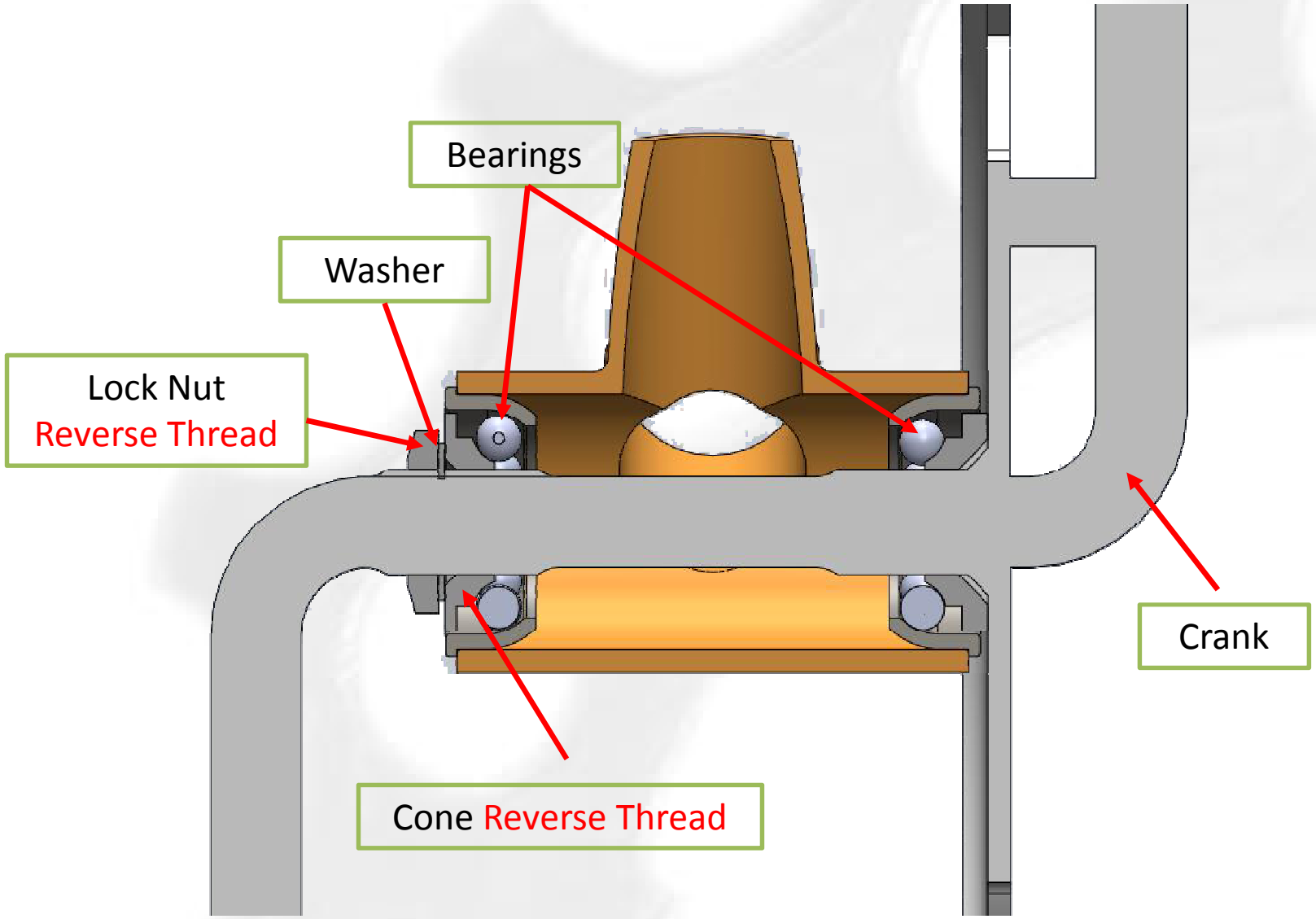
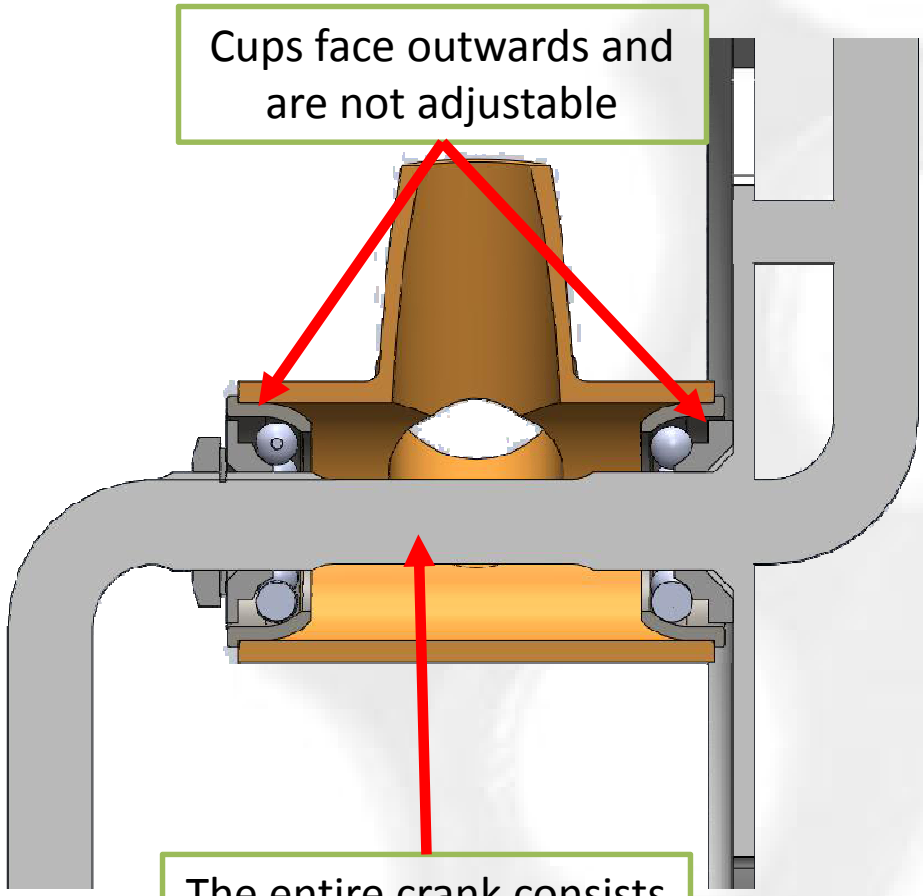
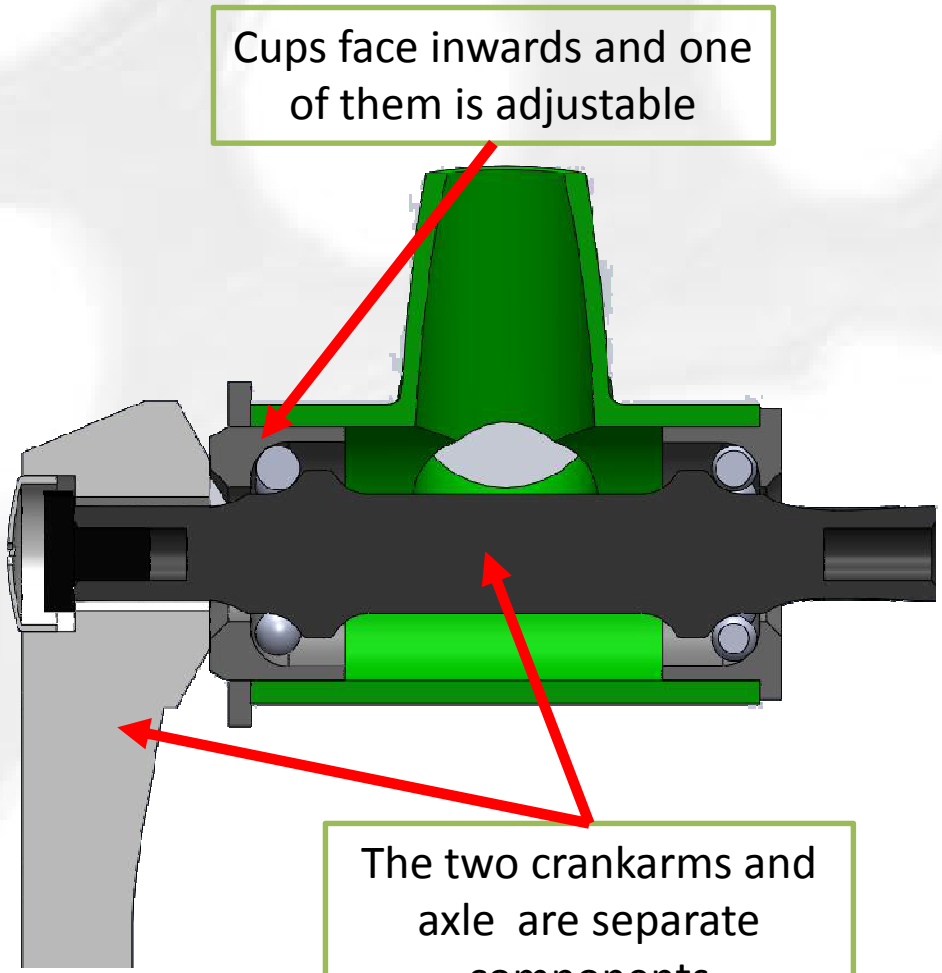
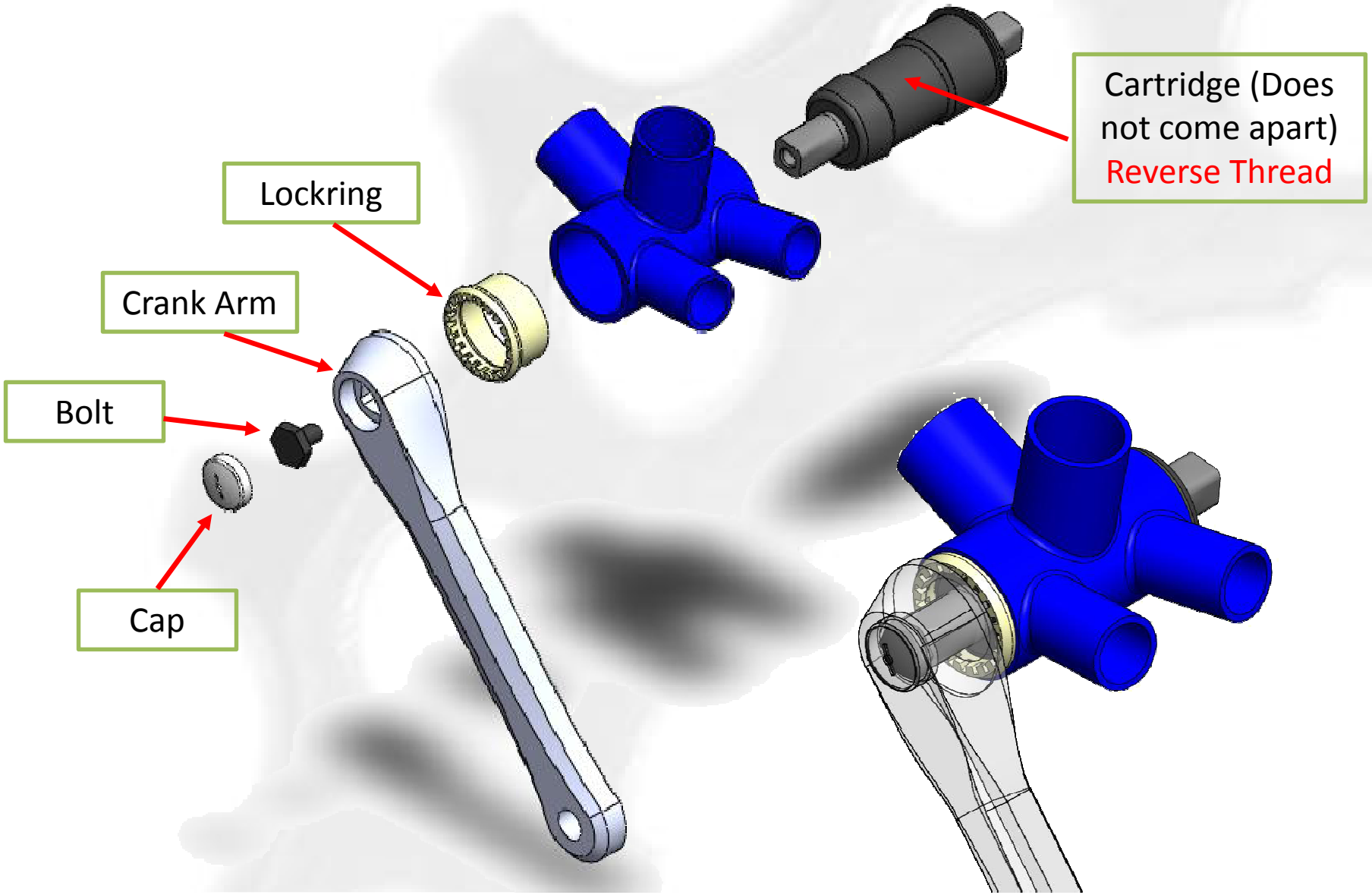


Primary Differences

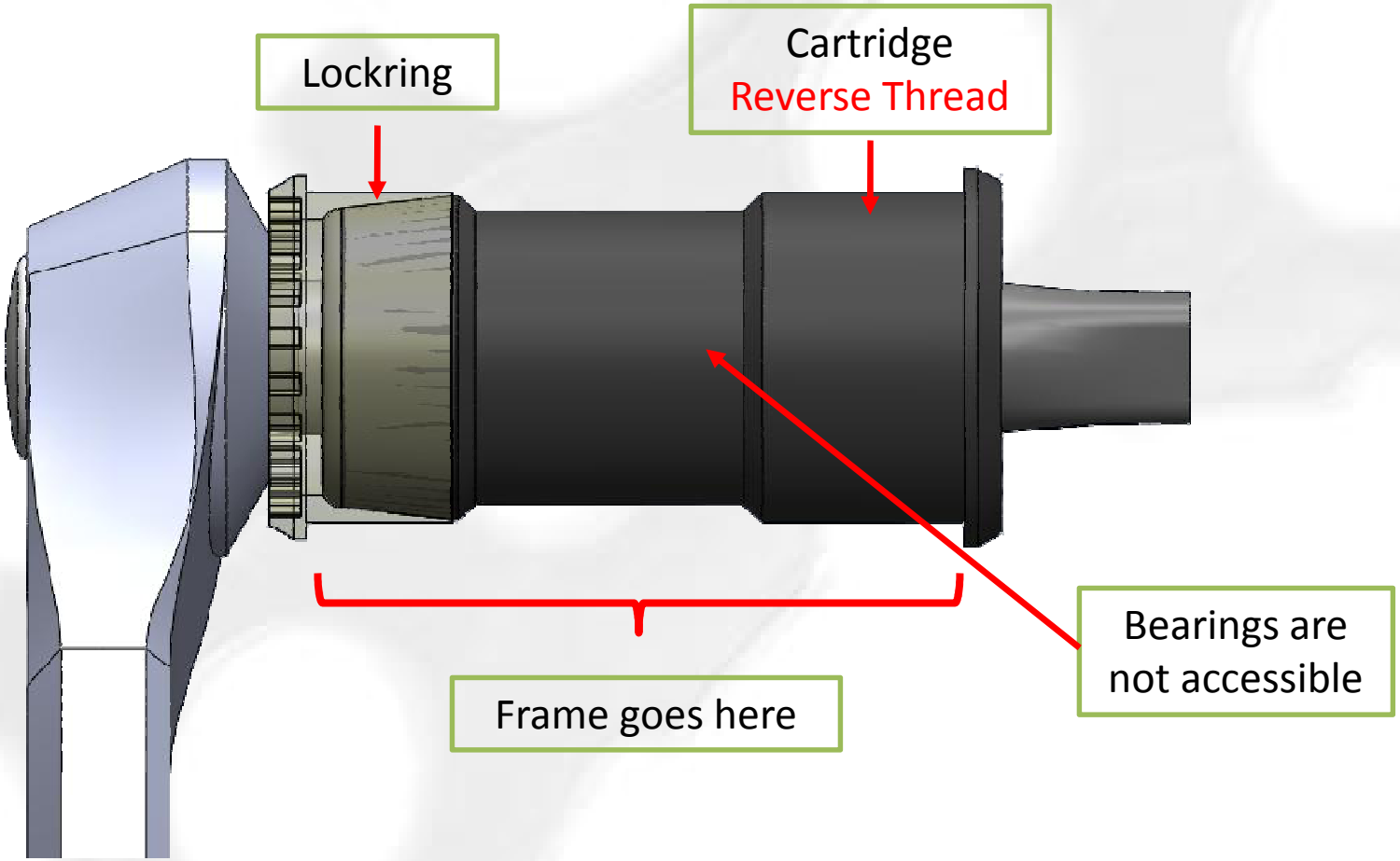




Cartridge Type Bottom Bracket



View Through Frame



There is no way to adjust this type of bottom bracket. It is replaced as a unit as soon as a malfunction appears.