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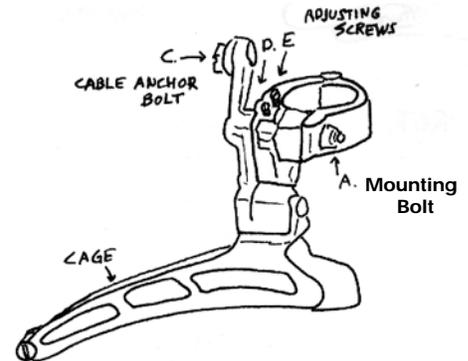


Front Derailleurs

Part One - Planning

I. Objectives

- A. Student can identify a front derailleur in need of adjustment.
- B. Student can name the parts of the front derailleur system and the tools used on it.
- C. Student becomes more familiar with the math concepts of perpendicular and parallel.
- D. Student becomes more familiar with the physics concepts of friction, force and tension.
- E. Student can describe all the major steps of front derailleur placement and adjustment, and follow all the steps.



Demonstration Parts

(all removed from bike)
Front Derailleur
Shifter
Cable
Housing
Drive-side Cranks

Tools

Box Wrench set (8-10 mm)
Allen Wrenches
Adjustable Wrench
Flat-ended screwdriver
Phillips screwdriver
Fourth Hand Tool
Pliers

Other Materials

Grease
Penetrating Oil
Rags
Rubber Gloves
Ruler or straight edge

II. Materials Needed

III. Setting Workshop, with tool benches, bike repair stand and bike storage.

IV. Evaluation

- A. Teacher Observation During Work Session Rotate amongst the students as you work. Observe for general mechanics skills (e.g. body mechanics, tool use), work habits (e.g. keeping part orderly, replacing tools), and ability to follow the steps of the process in the proper order. Observe for problem solving skills: Is student using visual observations? Is student able to pose questions whose answers will help her/him come up with a solution?
- B. Oral Review at end of work session.
 - 1) **Language:** How many of the parts and specialty tools can students identify? Passively? Actively?
 - 2) **Systems:** Can the student say what components are part of the system on which we worked? How do they function as a whole?
 - 3) **Process:** How many of the steps of the process can students name? Can they get the steps in the correct order?
- C. Written Evaluation How well can student narrate what she did that day on her time sheet?



Part Two - Activity Instructions

I. Tool Check! Students & instructors enter the tool area and confirm as a group that all the tools are there.

II. Process

A. Goal — What are we trying to get done when we replace and/or adjust a front derailleur? Have you ever ridden a bike where the chain wouldn't shift on the front chain rings? What can happen? How hard is it to pedal? The main purpose of the bike's front derailleur is to keep the chain from falling off on the front chain rings and to shift the chain from chain ring to chain ring in order to make the pedaling harder or easier (change the gear ratio) depending on what the rider desires.

A well done front derailleur adjustment or replacement makes sure that:

- the front derailleur is adjusted so that the chain does not fall off the chain rings when shifting the gears;
- the chain shifts smoothly from sprocket to sprocket without excessive grinding;
- the chain does not rub on the front derailleur cage except maybe slightly when in the small chainring in the front and small cog in the rear (a "crossover gear").

B. Steps to Adjusting and Replacing Front Derailleurs — Go over the names of each step, as a list.

Then describe each step to the students and have them each carry out that step on their bikes before you move the group onto the next step.

1. Evaluate Condition of as many parts as possible w/o disassembly.

- a) **Check Adjustment** Try shifting the front derailleur. How does it work? Does the chain rub a lot or come off the chain rings?
- b) **Cable and Housing** Is the exposed part of the cable rusty or frayed? Is your housing broken or rusting?
- c) **Shifter** Is your shifter pivoting smoothly?

2. Decide if Front Derailleur Needs to be Replaced or Adjusted If the derailleur seems to pivot smoothly, isn't bent, and the limit screws work then there shouldn't be any reason to replace the derailleur. It's always a good idea to replace a rusty cable or broken housing but if your front derailleur is in working order you can skip to step 8 (Adjustment). If you want to teach front derailleur installation anyhow, here are the steps to do it.

3. Figuring Out What You've Got

Before we can begin to take apart and replace our front derailleur cable system we've got to figure out just what we've got on our hands. Unlike hubs, rear derailleurs, and all rotational systems, many front derailleurs do not resemble each other in some key aspects. Front derailleurs are the most varied of any bike part in their technology and the most difficult to adjust. Much like the rear derailleur, in most cases, the front derailleur relies on a pivoting parallelogram. (Show students how a double pivot parallelogram allows the derailleur to move in a straight line across the chain rings rather than swinging in a circular motion if there was only one pivot point.)

**3. Figuring Out What You've Got** (continued)

Most likely the kinds of derailleurs that you will encounter fall into these categories:

- 1) Top swing/Bottom pull
- 2) Bottom swing/ Top pull
- 3) Bottom swing/ Bottom pull
- 4) Bottom Swing/ Top pull (see diagram)

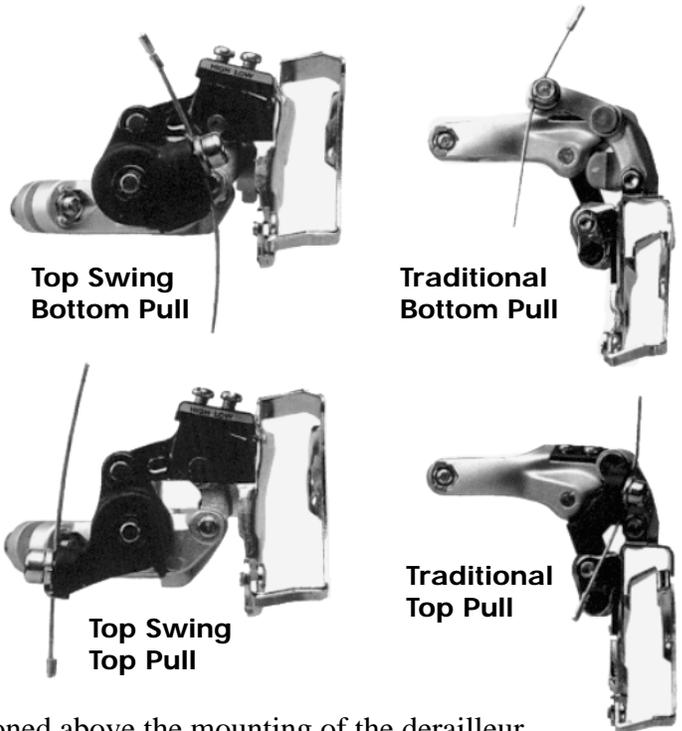
There are other types of front derailleurs out there, some based on a shaft inside a box and others that have single pivot swing arms encased in plastic. The principles covered here really only deal with the four main types of front derailleurs mentioned above.

The type of derailleur you've got depends on two factors: 1) The direction that the cable comes from to pull the derailleur, and 2) where the parallelogram is positioned in relation to the mounting of the derailleur itself. A top swing/ bottom pull would have the parallelogram positioned above the mounting of the derailleur and the cable would be routed underneath the bottom bracket thus pulling the derailleur arm from the bottom.

Once you've determined what kind of derailleur you're dealing with (if you don't think you can remember, write it down) make sure that you've got a working replacement available before discarding your old one. Now you can start into the disassembly.

4. Disassemble

- a) Detach the derailleur cable by loosening the cable anchor bolt and let the cable hang loose
- b) Unscrew the derailleur cage bolt, also called the *entretois*. This is the bolt at the back of the derailleur cage that separates the two cage arms. Be careful to keep track of the spacer from the *entretois* as well as the bolt itself. If you don't unscrew this bolt, the chain will still be threaded through the derailleur cage even after you've taken the derailleur off the bike. You have the option of breaking the chain in order to get the front derailleur off but unless you're going to break the chain anyway, I don't recommend removing the derailleur in this way.
- c) Unscrew the derailleur mounting bolt
- d) Remove the derailleur from the seat tube.



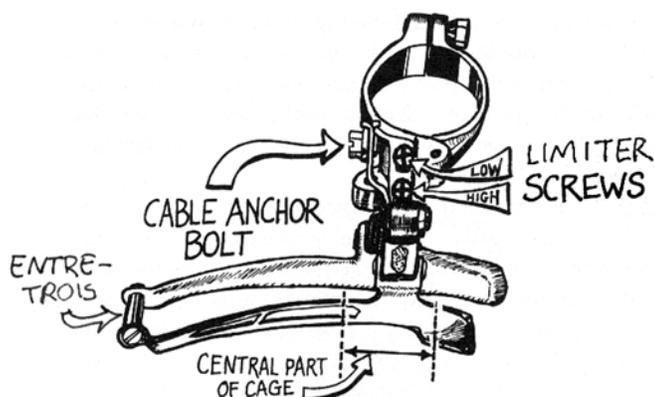


5. Clean and Inspect

Take some light oil or solvent and a tooth brush and scrub the derailleur. Since there are so many small parts, it's nice to have a compressor hose around to spray the derailleur once you've scrubbed it down. Inspect:

- a) Cables and housing- Rusty, frayed, or broken? Cable bent too much to go back through the housing?
- b) Derailleur cage- Is it bent?
- c) All bolts and nuts- Stripped?
- d) Limiter screws- Turn easily and are not stripped?

6. Replace Parts Parts are rarely replaced on derailleurs, since each model derailleur usually has slightly different dimensions. However, if you have a good supply of used parts around, you can often find a new limiter screw, *entretois*, or anchor bolt from a matching derailleur. The other parts of the system that do need replacing more frequently happily are made to a common standard: the cables, housing, and the cable and housing ends.



7. Reassemble This is just disassembly in reverse.

- a) Thread the chain through the derailleur cage and replace the cage bolt (*entretois*), making sure not to forget the spacer on the bolt.
 - b) Reattach the derailleur to the seat tube of the frame, making sure the central part of the cage clears the teeth of the largest chain ring by 1 mm (in the case of some Biopace chain rings the distance may vary so make sure to spin your chain rings to be sure) and
 - c) Make sure the outside edge of the cage is parallel to the chain when it is on large ring in the front and small cog in the back.
- d) With your shifter all the way down, i.e. as if the chain were in the smallest chain ring, attach the cable to the derailleur with the anchor bolt. As with the rear derailleur, there are many signs to tell you how your cable should be routed. The best bet is to remember how it was routed before you took it apart. But, if you've forgotten, here are some pointers.
- i. Look under the bottom bracket for your cable guide. There should be two places for a cable to move through. One should follow the line of the drive side chain stay. That's the guide for the rear derailleur cable. The other guide should curve up between the two chain stays. That's your front derailleur cable guide.
 - ii. If you don't see a cable guide underneath your bottom bracket, then most likely your cable goes above the bottom bracket. Look for a possible brazed-on or bolted-on cable guide that routes the cable just above the bottom bracket and up to the front derailleur.
 - iii. If you don't see a cable guide anywhere, then your cable is most likely routed through a short piece of housing that goes from a housing stop brazed onto the down tube close to the bottom bracket. This short piece of housing reaches, in a curve that touches the top of the bottom bracket, to the base of the front derailleur.
 - iv. If the derailleur is top pull then you won't have any cable guides at all.

**7. Reassemble - continued**

e) If you are using a new cable, you must pre-stretch it at this point. After attaching it with the cable anchor bolt, grab an exposed portion of the cable and pull it as hard as you can ten times.

*** Special note: In many cases there is a small metal tab that overlaps the spot where your cable mounting bolt is. Your cable does not go behind this tab. The cable goes over the tab and is pulled tight so that it comes perpendicular to the derailleur itself. This creates a higher leverage point and thus a better swing of the derailleur. The tab is there to keep the correct orientation of the anchor bolt.

8. Adjust the front derailleur Instructions for Index Shifting and a Triple Chainring

a) Put chain on big chain ring and little cog and set the outer limiter screw so that the cage just clears the chain (1 mm or less).

b) Put chain on little chain ring and big cog, set inner limiter screw so that cage just clears chain on the inside by 1 mm.

c) Make sure that each barrel adjuster is screwed all that way down and then unscrewed 2-3 clicks. Loosen the cable anchor bolt, pull the cable through it until it is "hand-tight", i.e. you pull the cable taught with your hand and screw the anchor bolt back down on it - keep the derailleur in the position you put it in in the previous step while you do this!

d) Keeping chain on big cog in back, shift onto big chain ring in front. Then shift back down onto the center chainring. With a new cable (even though you have pre-stretched) adjust the cable tension so that the derailleur cage is just barely brushing the chain on the inside. With an old cable, adjust it so that the chain just barely clears the cage on the inside.

9. Adjust the front derailleur Instructions for Friction Shifting

Follow steps a) and b) of Section 8. above, and you should be done.

10. Test Ride All gear systems can behave differently when you are actually riding the bike than they do when you are testing them with the bike up in a workstand. (What are some of the possible reasons for this?) Put a screw driver that fits your limiter screws and the tool needed to loosen the anchor bolt in your pocket and go out for a brief ride.

a) Put chain on big chain ring and little cog in back, and try shifting back and forth from the large to small chainring at least five times.

i. If the chain falls off on the inside, turn the inner limiter screw in 1/4 turn and try again.

ii. If the chain falls off on the outside, turn the outer limiter screw in 1/4 turn and try again.

iii. If the chain doesn't go smoothly up onto the largest chainring, you need to tighten the cable using the barrel adjuster (you *tighten* the cable by *unscrewing* the barrel adjuster). Unscrew it one turn and try again.

iv. If the chain won't go down onto the smallest chainring, it could be that the cable is too tight, or that the limiter screw is too far in? How can you tell which item to adjust? (You can see the bottom of the limiter screw and check whether it is bottomed out against the stop on the derailleur. If not, it is excess cable tension that is keeping the derailleur from moving the chain down onto the smallest chainring.)

**10. Test Ride** - continued

- b) Put chain on big chain ring and *biggest cog* in back, and try shifting back and forth from the large to small chainring at least five times. Now the chain is pulling at a slightly different angle, and you need to repeat the adjustments as above.

All done!

III. Language Skills

Over the course of the lesson we should introduce all of these terms. At the end of the session it is often helpful to get the students to touch each of these parts on their bikes & say the name.

Main Part (derailleur)

Parallelogram
Cage
Mounting bracket

Main Part (shifter)

Lever
Cables
Housing
Cable guide

Necessary Tools

Box wrenches
Screw driver
Pliers
Fourth hand
Allen Wrenches

Other Materials

Light oil
Grease
Pen

Math & Physics Words

Parallelogram
Friction
Leverage
Perpendicular

IV. System Understanding Try different ways of phrasing this question.

What components are part of the front derailleur system? How do they interact/affect each other/work together? How do they function as a whole? Why can the derailleur system be described as a “cable tension, spring release” system? When you pull on the shift lever, the lever pulls on the cable and moves the derailleur up and out away from the frame. Can you push with a cable (try it with a cable extended between two students!)? When you release the tension on the cable by moving the shifter back to its original position, what pushes the derailleur back down?

V. Problem Solving/Diagnosis

1. What does it mean if you get an adjustment that throws the chain off the biggest chainring? or the smallest?
2. How can you tell if you need a new derailleur?
3. Why might your front derailleur work fine in the stand but not work on the road?
4. What could cause your front derailleur to quickly lose it's adjustment?
5. What other problem solving did we do?

VI. Review**VII. Clean Up**

VIII. Tool Check! Leave tool area as a group after confirming that all tools are present.