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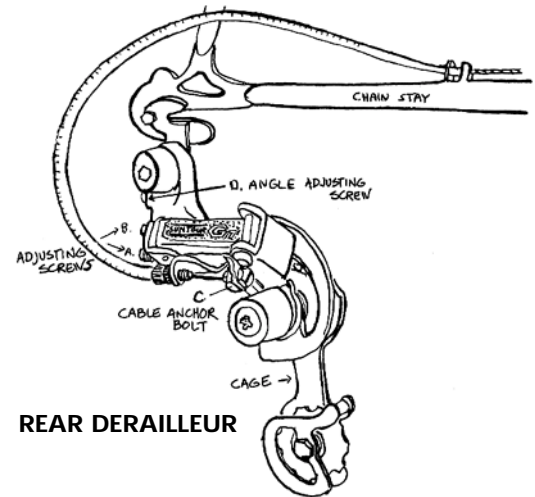


Rear Derailleurs

Part One - Planning

I. Objectives

- A. Student can identify a rear derailleur in need of adjustment.
- B. Student can name the parts of the rear 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 and force.
- E. Student can describe all the major steps of rear derailleur installation and adjustment.
- F. Student can follow all the steps of derailleur assembly and adjustment.



II. Materials Needed

Demonstration Parts

Rear Der. complete w/guts not attached to bike
Shift Lever
Indexing and Non-Indexing
Cable and Housing

Tools

Allen Wrenches
Fourth Hand
Flat ended screwdriver
Phillips Screwdriver
Box Wrenches

Other Materials

Grease
Penetrating Oil
Rags
Rubber Gloves
Ball Point Pen

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 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 worked on? 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

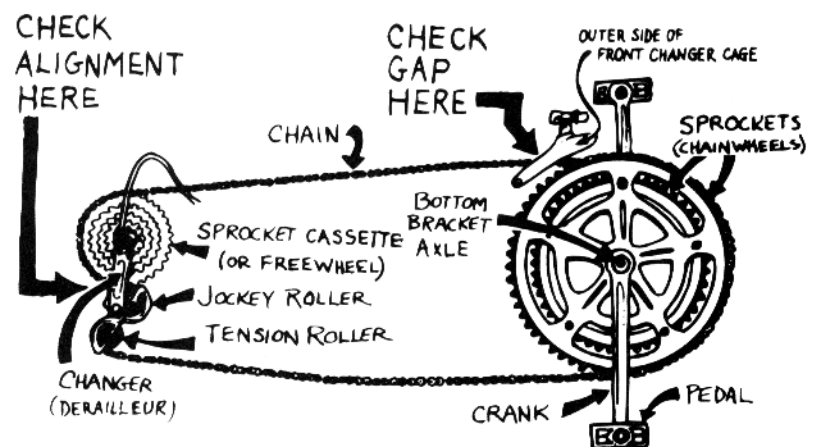
A. Goal — What are we trying to get done when we install and adjust a rear derailleur? Have you ever ridden a bike where gears were messed up or the bike didn't shift right? What can happen? How does this effect your riding? How hard it is to pedal? The main purposes of the bike's rear derailleur system are: 1) To keep proper chain tension at all times, 2) to smoothly and easily change gears while riding without the chain falling into the spokes or the frame. A well done rear derailleur adjustment makes sure that:

- The chain tension is consistent in all of the bicycle's gear combinations.
- The bicycle shifts easily and smoothly through all of the gears.
- The chain does not fall off, into either the frame or the spokes, when shifting gears.

B. Steps to Installing and Adjusting a Rear Derailleur — 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 before you take anything apart.

- a) **Check Adjustment** by pedaling the bike and using the shift lever to shift the rear derailleur. Does it shift smoothly? Does the chain fall off on either side of the rear gear cluster? Look at the derailleur from the rear. Is it bent? Can you push or pull the derailleur into the spokes or frame?
- b) **Derailleur hanger** In addition to the derailleur itself, the hanger that the derailleur is attached to also can get bent. This will keep the derailleur from lining up with the cogs and keep the chain from shifting improperly.
- c) **Cables and housing OK?** are they too short or too long? rusted, cracked or frayed? The proper function of a derailleur depends on the cable being able to move freely and easily through the housing.
- d) **Shifters** pivot easily and are not too loose?



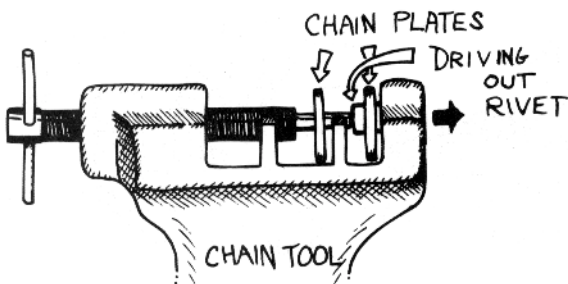
**1. Evaluate Condition** - continued

e) Is the chain stretched? Twelve links (24 pins) of a new, unstretched chain will measure exactly 12 inches. If when you measure 12 links (lay a ruler along the straight section of the chain while it is pulled taught) they are less than 12 1/16 inches long, your chain is fine. If it's stretched 1/16 of an inch, replace the chain. A chain stretched more than 1/16th of an inch over 12 links will have begun to wear down the teeth of the rear gear cogs, and you will have to replace the cogs along with the chain (a new chain will probably skip on the old, worn down cogs). You can usually use a stretched chain without it's slipping on the cogs up to 1/8th to 3/16ths of an inch of stretch. After that the chain will begin to slip even over the cogs of the gears it's worn out. For instructions on removing the rear gear cluster (cassette or freewheel) see the Hubs Chapter.

2. Decide if Derailleur System Needs to be Disassembled If you can get a good adjustment (no grinding, it shifts well, and the chain doesn't fall into the spokes or the frame), then the derailleur is in good shape as is the cable and the housing. If your goal is just to get the bike ready, skip to step 7 and try an adjustment. If you want to teach the disassembly anyway, go on to step 3.

3. Disassemble

a) Unlock the shifter cable from the derailleur On the underneath side of the derailleur find the anchor bolt that holds the shift cable. Loosen that bolt.



b) Break the chain with a chain tool In order to remove the derailleur from the bike its necessary to "break" the chain, i.e. open up a link by pushing a pin most of the way out. Just remember, DON'T push the chain pin all the way out!! That's the pin you'll use to put the chain back together again. Remember which side of the chain was Up at the point where you break it. Some people think that because chains wear in conjunction with the rear cogs, if you put the chain on upside down from how it was on before you may get a lot of slipping in the gears or chain suck.

c) Remove Derailleur Depending on what kind of derailleur you are dealing with this step may mean that you use an allen wrench to unscrew the derailleur from the hanger or you may have to use a wrench to loosen a bolt that holds both the hanger and the derailleur in the rear drop outs of the bike.

d) Remove cable and housing and place all items on a flat, uncluttered surface in the order in which you removed them.

4. Clean and Inspect all the surfaces and threads — rub them with a rag with some light degreaser or penetrating oil.

a) Broken or stuck Jockey Wheels? these are the two wheels on the derailleur swing arm.

b) Swing Arm Bent? make sure the derailleur swing arm which holds both jockey wheels isn't bent or out of line.

c) Springs are all springs on the derailleur still functioning?

d) Cables and Housing Is the cable rusted or frayed? Is the housing rusted or broken? will the cable move easily through the housing? Will the end of the housing fit back into the housing ferrule?



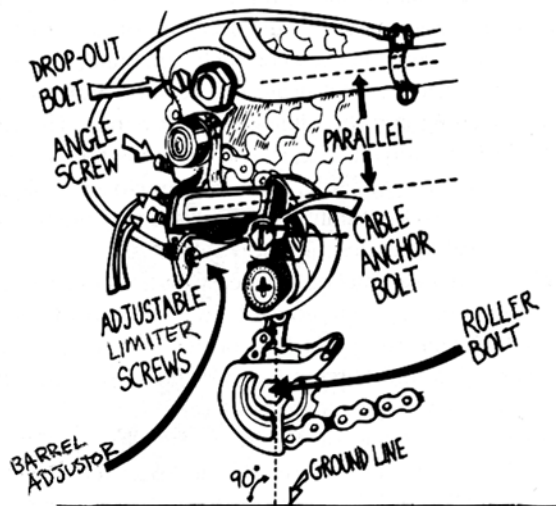
5. **Replace Parts** as necessary. Most of the time the parts that need replacing are the cable and the housing, as these are the parts where grease and grime tend to collect. Sometimes the derailleur itself is bent or broken and it's time to get a new one.
6. **Reassemble** this is just disassembly in reverse.
- Grease the cables** put a little bit of grease or heavy weight oil on the cables whether their new or old. This prevents rust and allows the smooth movement of the cable in the housing.
 - Check your Hanger Alignment**
 - On those bikes that have threads in derailleur hangers you can use a "Derailleur Hanger Alignment Tool" to check or change the alignment.
 - If the derailleur has its own hanger and bolts to the drop out, this step is not necessary.
 - Install derailleur**
 - Reinstall chain** making sure it gets threaded back through the derailleurs and rear cogs in the correct order (look at an installed chain on another bike if you are not sure).
 - The rest of reassembly is part of the adjustment process.

7. Adjust your Rear Derailleur System

- a) **Set your Limiter Screws** Remember, derailleurs are built to pivot from side to side. They are not built to automatically know how far they should pivot. This is why we invented limiter screws. If you've ever had your chain fall into your spokes or get trapped in between your gears and the frame you know what its like to have misadjusted limit screws.

1) Look down at the derailleur and find two screws one marked (H)igh and the other marked (L)ow. These are your limit screws. They have nothing to do with have the chain shifts from one cog to another, except for the innermost and outermost cogs. This is because these screws control how far the derailleur can travel from side to side.

- 2) Holding your index finger against the frame and your thumb against the derailleur, begin pedaling the bike and push the derailleur with your thumb all the way as far as you can in towards the spokes. If the chain passes the edge of the biggest cog and falls into spokes then the (L)imiter screw is not screwed in far enough, thus allowing the derailleur to pass beyond the largest chainring (and possibly into the spokes!). If the chain will not shift onto the largest cog, then your (L)imiter screw is screwed in too far. When your (L)ow gear limiter screw is set correctly, the chain should move all the way onto the largest cog, but not fall into the spokes. At that point, the jockey wheels should be in line with the largest chain ring and there should be NO!!!! grinding sounds while you pedal the bike.



**7.a) Set your limit Screws** (continued)

- 3) Now take your hand off the derailleur and let it fall back into the highest gear as you pedal the bike. Your (H)igh gear limiter screw should keep the chain from passing beyond the smallest cog and falling into the frame. It should also allow that the chain to run smoothly on the highest gear (on the smallest rear cog). Try as hard as you can to pull the derailleur so that the chain would fall into the frame. If the chain does fall into the frame your (H)igh gear limiter screw needs to be screwed in a little farther in order to limit the derailleurs movement towards the frame. If the derailleur holds its position and the chain does not grind off the gear your (H)igh limiter screw is All Set!

b) Attach the derailleur cable

- 1) Make sure that the shifter is all the way down i.e. its in the position of the highest gear, where it does not pull on the cable at all.
- 2) Route cable properly, making sure that the ball end fits snugly into the shifter and that the cable runs the proper route from the shifter to the derailleur. This task may sound easy but it can be deceiving. In some cases the cable may run over or under the bottom bracket or may run with or without housing at different spots. Always try to remember how the cables were run when you first saw the bike.
- 3) Make sure that all barrel adjusters have space to adjust in both directions (usually there is only one on the back side of the derailleur that the cable routes through though on some of the newer bikes there is a second one on the either the down tube or as a part of the shifter). If your barrel adjusters are either screwed in all the way or out all the way you won't have the ability to adjust cable tension once you attach the cable.
- 4) Make sure derailleur is in the highest gear (i.e. your chain is on the smallest rear cog). With your shifters in the highest gear and your derailleur in the highest gear, you make sure that you are not going to end up with a lot of extra cable slack once you attach the cable.
- 5) Attach Cable Look carefully at the derailleur cable anchor bolt and the surface of the derailleur against which the cable clamps. Usually you can tell how the cable wants to be routed by looking for a slight groove in either the bolt or the derailleur itself. This groove indicates what line the cable should follow. Nine times out of ten this will be a straight line out of the barrel adjuster. Now pull the cable through and bolt it down making sure to only pull the cable hand-tight. If you use a fourth hand or pull the cable tight with a pair of pliers, the cable will be too tight and the derailleur will be unable to shift into the highest gear.
- 6) If you are using a new cable, grab it on a stretch where it's outside of the housing and pull on it as hard as you can, several times. This stretches the cable so that once we've adjusted our shifting we won't lose our adjustment because of our cable stretching. Be sure to stretch it as hard as you can. Don't worry, we've never met anyone who ever broke a cable. Sometimes the cable will slip out from behind the anchor bolt on the derailleur, but that's just because you didn't tighten the bolt down enough. After you've stretched the cable repeat step 5) and reattach it hand-tight.



c) **Adjust Your Shifting** This process is slightly different for index shifting than it is for friction shifting. Index shifting is the one “click,” one shift mechanism. It’s made so that there should be no guess work when it comes to finding your gear. Friction shifting doesn’t have any “clicks.” You just have to look around for the gear you want. The positive aspect of friction shifting is that if your shifting isn’t dependent on these “clicks”. If your cable tension and “clicks” are not completely synchronized your bike won’t shift properly. With friction shifting, even if you don’t have perfect cable tension you can still find the proper gear.

- 1) With friction shifters once you’ve set your limit screws and attached your cable most of your work is done. Now all you have to do is make sure your cable has enough tension on it. You should be all set. Try shifting the bike making sure that you don’t have to push the shifter beyond its limit to get the bike into the lowest gear.
- 2) Index shifters are a little more difficult. You must fine-tune the cable tension. After pulling the cable hand-tight and attaching the cable to the derailleur with the anchor bolt, then, while pedaling the bike, shift the shifter up until you hear the first click. Now unscrew (or screw in!) your barrel adjuster until the chain shifts up onto the second cog, and the center of the chain is directly over the center of the cogs (as you look at the assembly from the rear of the bike). In theory, you now have the correct cable tension to make each shift up to the next cog happen snappily with each next click. With the shifter, move the chain up one to each gear cog. Do this all the way up to the lowest gear and back down again. adjust your chain tension with the barrel adjuster if you hear any grinding sounds in each gear, or if the chain moves sluggishly. NOTE: unscrewing the barrel adjuster moves the derailleur (and thus the chain) in towards the wheel, screwing in the barrel adjuster moves the derailleur out away from the wheel - why? (Hint: are you making the housing longer or shorter relative to the cable?) Now you should be All Set!!

With these newfangled grip shifters you need to shift just a little bit past the click each time in order to get a proper adjustment.

8. 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 you pocket and go out for a brief ride.

- a) Put chain on large chainring and smallest cog in back, and try shifting back and forth from the smallest to the next cog at least five times.
 - i. If the chain falls off on the outside, turn the (H)igh gear limiter screw in 1/4 turn and try again.
 - ii. If the chain doesn’t go smoothly down onto the smallest cog, 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.) If it’s the cable tension, you need to loosen the cable using the barrel adjuster (you *loosen* the cable by *screwing in* the barrel adjuster). Screw it in one turn and try again.

**8. Test Ride** - continued

- b) Put chain on small chainring and smallest cog in back, and try shifting back and forth from the largest to the next cog at least five times. Now the chain is pulling at a slightly different angle, and you may need to repeat the adjustments as above.
- c) Put chain on the smallest chainring and *biggest* cog in back, and try shifting back and forth from the biggest to next cog at least five times.
 - i. If the chain falls off on the inside, turn the (L)ow gear limiter screw in 1/4 turn and try again.
- d) Put chain on biggest chainring and *biggest* cog in back, and try shifting back and forth from the largest cog to the next cog down at least five times. Now the chain is pulling at a slightly different angle, and you may 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 put their finger on each of these parts on their bikes & say the name.

Main Parts - Derailleur

Jockey Wheels
Swing Arm
Limiter Screws
Barrel Adjuster

Necessary Tools

Allen Wrenches
Box End Wrenches
Flat Head Screwdriver
Phillips Screwdriver
Cable Cutters
Housing Cutters
Chain Tool

Other Materials

Grease
Light oil
Rags

Math/Physics Words

Parallel
Perpendicular
Friction
Gear Ratio

Note: Mention here the other systems you end up dealing with in the course of this lesson (wheels, steering, etc.), and include the main words to remember:

IV. System Understanding Try different ways of phrasing these questions.

What components are part of this 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 in towards the wheel. 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 your limiter screws are properly set but the chain doesn't shift into the highest gear?
2. How can you tell if you need an overhaul?
3. If the bike stopped shifting properly soon after you made your adjustment what could have happened?
4. 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.