36 – CABLE-OPERATED RIM-BRAKE CALIPERS

ABOUT THIS CHAPTER

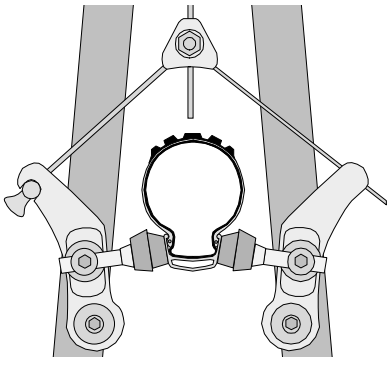
This chapter is about the mechanisms mounted near the wheel that apply pressure to the rim to control the bike's speed. This chapter does not cover brakes that are mounted at the hub, or brakes that are hydraulically operated. The brake calipers in this chapter are operated by a wire-cable system, which is covered in the earlier chapter, **BRAKE-CABLE SYSTEMS.** When working on the brake calipers covered in this chapter, it is usually necessary to work with the brake levers (covered in the earlier chapter, **BRAKE LEVERS**), and the brake-cable system, as well.

After the ***GENERAL INFORMATION*** section, this chapter has a section about brake-pad-alignment systems, and separate sections for several different styles of brake calipers. These sections are: ***PAD-ALIGNMENT SYSTEMS***, ***CANTILEVER CALIPERS***, ***SIDEPULL CALIPERS***, ***DUAL-PIVOT CALIPERS***, ***CENTERPULL CALIPERS***, and ***U-BRAKE CALIPERS***. After the sections on specific types of caliper systems, there is a section called ***FINISHING*** that applies to completing brake work on all types of calipers, and then the chapter ends with the section ***CABLE-OPERATED RIM-BRAKE-CALIPER TROUBLESHOOTING.***

GENERAL INFORMATION

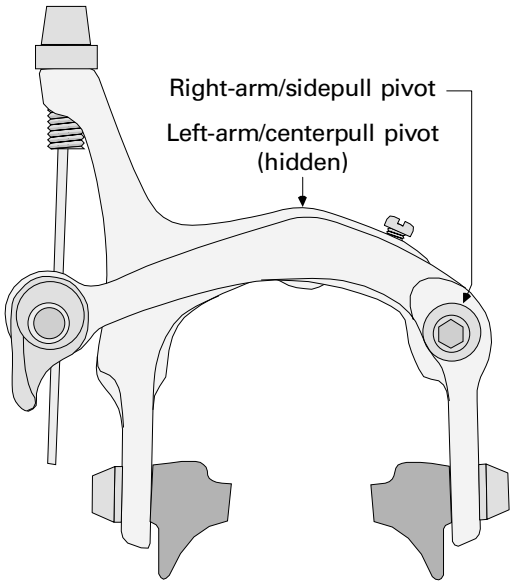
TERMINOLOGY

Cantilever caliper: A caliper system that has each caliper arm mounted to its own pivot; the pivots are fixed to the frame or fork, and are mounted below the rim.



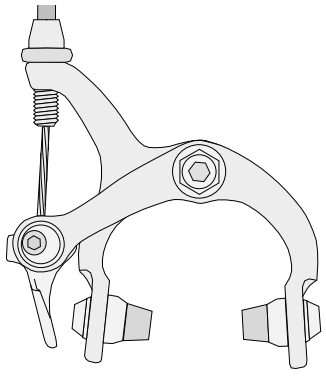
36.1 *A cantilever brake caliper.*

Dual-pivot caliper: A caliper system that has two pivots; the pivot for one arm is centered over the top of the rim (like a sidepull caliper), and the pivot for the other arm is above, and outward from the rim (like a centerpull caliper).



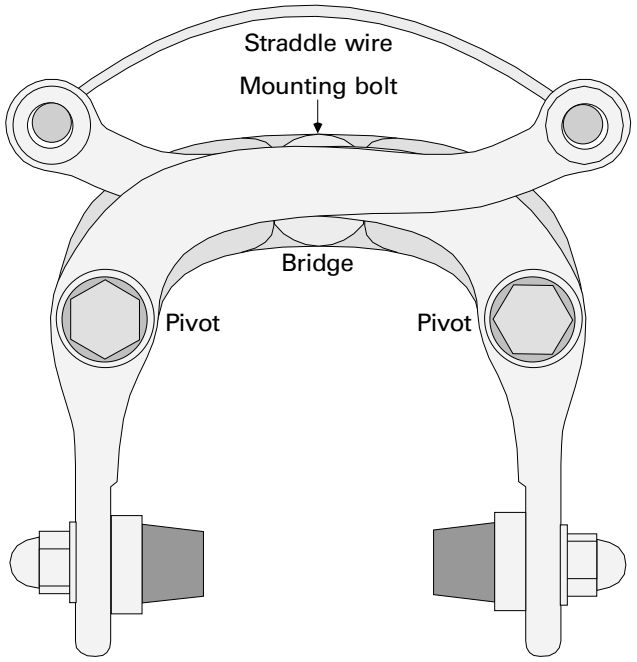
36.2 *A dual-pivot caliper.*

Sidepull caliper: A caliper that is distinguished by two things: the caliper arms share a common pivot (centered above the rim) that also serves as the mount for the caliper, and the cable system attaches to the caliper by means of the housing stopping at one arm and the inner wire attaching to the other arm. The sidepull caliper gets its name from the fact that the common configurations of this design rely on a cable system routed to the side of the caliper.



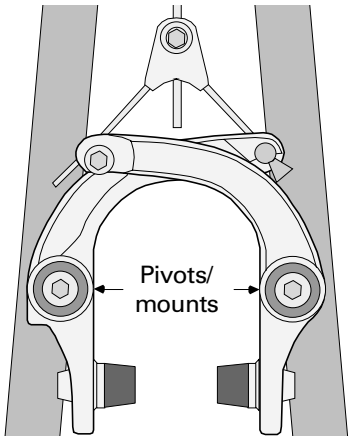
36.3 *A typical sidepull caliper.*

Centerpull caliper: A caliper system that has two pivots mounted on an arch; the pivots are above and outward of the rim. The centerpull caliper gets its name from the fact that the cable system goes directly to the center of the caliper. The name is misleading, because U-brakes (and most cantilevers) have this same feature, but differ in other ways. It is the number and location of the pivots that are unique to centerpull calipers.



36.4 *A typical centerpull caliper.*

U-brake caliper: A caliper that is a cross between centerpull and cantilever calipers. Like a centerpull, the pivots are located above and outward of the rim. Unlike the centerpull caliper, the pivots are fixed to the frame or fork, rather than to part of an arch integral to the caliper. Unlike the cantilever caliper, the pivots are above, instead of below, the rim.



36.5 *A typical U-brake.*

Brake caliper: The mechanism that applies braking force to the rim. It consists of calipers arms mounted on pivots. A brake shoe is mounted on one end of the caliper arm. The cable system is attached to the other end of the caliper arm. The brake caliper can also simply be called a *caliper*.

Caliper arm: The lever arm that applies braking force to one side of the rim. The brake caliper always consists of two caliper arms that work in opposition to each other. A caliper arm can also just be called an *arm*.

Front or **rear** (of the brake)**:** Any reference to the front of the brake applies to the portion that faces out from the frame or fork. This applies to both front and rear brakes. All references to the rear of the brake will mean the portion closest to the frame or fork. Again, this applies to both brakes.

Left or **right** (side of brake, or caliper)**:** These references always apply to the side of the caliper, as seen when viewing the portion of the caliper that faces out from the frame or fork. It does not refer to a particular side of the bike.

Pivot bolt: A bolt that goes through the pivot hole in a caliper arm. Most typically, a pivot bolt is found in sidepull brakes, where it also serves as a mounting bolt.

Brake shoe: The assembly that holds the rubber piece that rubs on the rim.

Shoe stud: The post that connects the brake shoe to the caliper arm. It may be threaded or un-threaded.

Brake pad: The rubber piece that rubs against the rim.

Entry-end (of brake pad)**:** The end of the pad that a point on the rim reaches first as the rim rotates through the brake pads. Traditionally, the word *back-end* would be used, but this only makes sense when the brakes are located somewhere near the top of the wheel, which is not always the case on suspension bikes.

Exit-end (of brake pad)**:** The end of the pad that a point on the rim reaches last as the rim rotates through the brake pads. Traditionally, the word *front-end* would be used, but this only makes sense when the brakes are located somewhere near the top of the wheel, which is not always the case on suspension bikes.

Smooth-stud brake shoe: A brake shoe that has an un-threaded shoe stud. It is retained to the caliper by means of an eyebolt called a shoe-anchor bolt.

Threaded-stud brake shoe: A brake shoe that has a threaded stud. It is retained to the caliper by a nut threaded onto the stud.

Shoe anchor bolt: The shoe-anchor bolt is an eyebolt that the stud of a smooth-stud brake shoe inserts into, in order to mount the brake shoe to the caliper

arm. An eyebolt is a bolt with a hole in its head. When the shoe-anchor bolt is pulled through the caliper arm, the shoe stud is pressed against the face of the caliper arm and immobilized.

Shoe-anchor nut: The nut that threads onto the shoe-anchor bolt to pull the shoe-anchor bolt through the caliper arm to secure the brake shoe to the caliper arm.

Shoe-fixing nut/bolt: A shoe-fixing bolt is a bolt that threads directly into a brake shoe to secure it to a caliper arm. A shoe-fixing nut threads onto the stud of a threaded-stud brake shoe to secure the shoe to the caliper arm.

Alignment washers: Sloped, concave, or convex washers that permit the brake shoe to be aligned at different angles for pad toe and vertical-angle adjustment.

Straddle-wire: A cable on a cantilever, centerpull, or U-brake that goes from one side of the caliper to the other to connect the caliper arms. By means of a cable carrier, the primary wire pulls up on the straddle-wire.

Cable carrier: Connects the primary brake wire to the straddle-wire. The cable carrier contains a pinch mechanism that secures it to the primary wire.

Link wire/unit: Used instead of a straddle-wire on some cantilever brakes, the link unit connects to one caliper arm and diverts the primary wire to the other caliper arm.

Pad height: An adjustment of the brake pad that sets the face of the pad so that it contacts the rim's braking surface at the right height.

Pad toe: An adjustment of the brake pad that sets whether both ends of a pad reach the rim simultaneously, or not.

Pad tangent: An adjustment of the brake pad that sets whether both ends of the pad are the same height relative to the rim.

Pad vertical angle: An adjustment of the pad that sets whether the top and bottom edges of the pad face reach the rim's braking surface simultaneously.

Pad clearance: The clearance between the pad face and the rim.

Pad centering: The adjustment of the pad clearances on both sides of the rim to be equal.

Quick-release: A mechanism that changes the pad clearance so that the tire will clear the brake pads when the wheel is removed.

Adjusting barrel: A hollow screw that changes the effective length of the brake inner wire. It is inserted into the lever body, a caliper arm, or a hanger or stop on the frame. The brake inner wire goes through the adjusting barrel. The outer end of the adjusting barrel has a socket into which the cable housing is inserted.

Pinch mechanism: A bolt and/or nut that secures the inner wire to a caliper arm or a cable carrier.

Braking surface: The relatively flat face of the rim that the brake pads contact.

Pivot stud: A hollow stud, smooth on the outside and threaded on the inside, that a cantilever arm or U-brake arm is mounted on. Some pivot studs are brazed or welded onto a frame; pivot studs may be threaded into a mount that is part of the frame or fork.

Spring plate: A surface with one or more holes into which the caliper-arm return spring inserts.

Pivot bushing: The bushing inside the pivot hole of the caliper arm. Some pivot bushings are fixed to the caliper arm and rotate with it. Other pivot bushings rotate independently of the caliper arm and stay fixed to the pivot stud once the caliper arm is mounted.

PREREQUISITES

Brake calipers are part of a system. To service the caliper without checking or servicing the other parts of the system could be considered negligent. This omission is also just bad service. The systems consists of the brake lever, the cable system, the caliper (including pads), and the rim.

Brake lever

When servicing brake calipers, the brake should be checked for damage, proper alignment, and security. The inner wire is likely to need attachment to the brake lever. All of these items are covered in the **BRAKE LEVERS** chapter.

Brake-cable system

Attachment of the cable system to the caliper is covered in the procedures in this chapter, but cable-system replacement, sizing, and lubrication should all be done when servicing a caliper. These items are covered in the **BRAKE-CABLE SYSTEMS** chapter.

Hub adjustment

If a hub is loose, it will result in lateral motion of the rim. That affects pad clearance and pad centering. Hubs should be adjusted to eliminate visible motion of the rim. Hub adjustment is covered in the **ADJUSTABLE-CONE HUBS** chapter and the **CARTRIDGE-BEARING HUBS** chapter.

Rim true

Lateral true of the rim affects pad-clearance and pad-centering adjustments. Dish errors affect centering adjustments and pad-height adjustments on brake calipers that mount on pivot studs, such as cantilevers and U-brakes. Round errors affect setting pad height; if the rim braking surfaces have a pronounced slope, round errors create erratic brake feel. Spoke-tension errors do not affect brakes, but they lead to unstable true. For truing rims, see the **WHEEL TRUING AND REPAIR** chapter.

Wheel installation

The wheels must be properly aligned in the bike before the pads can be adjusted. The vertical position of the wheel affects pad height. The centering of the wheel in the frame or fork will affect pad-centering adjustments, and in many cases the centering of the wheel will affect pad-height adjustments.

INDICATIONS

Maintenance

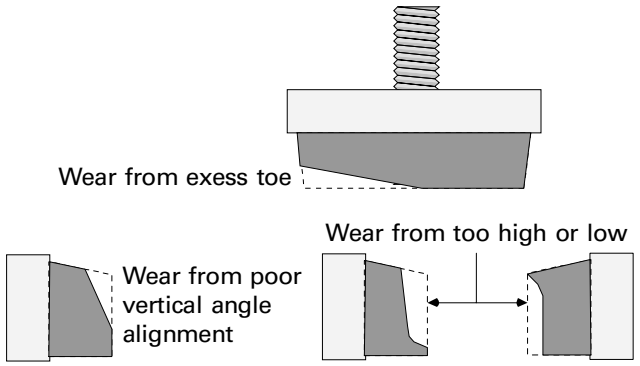
Brake systems need periodic maintenance because pads wear and cable systems deteriorate. Because of safety issues, shops should encourage periodic preventive maintenance, rather than limiting service to repair of existing problems. It is a reasonable policy to require service of the entire brake system if any work is to be done on the brake system at all.

Replacing the wheel or rim

When a rim or wheel is replaced with one that is not identical, changes in the shape of the rim can cause problems with the brakes. Changes in rim width affect pad clearance, pad height, and pad vertical angle. Changes in the angle of the rim's braking surface affect the pad's vertical angle. Changes in the height of the rim's braking surface can affect pad height. When a rim or wheel is replaced with one that is not identical, count on doing extensive brake work.

Symptoms indicating need for pad replacement and alignment

It would be a good idea to replace brake pads any time any type of brake service is being performed. There are, however, some specific conditions that indicate the pads should be replaced. These include: pads worn unevenly because of excess toe, pads worn unevenly because of poor vertical-angle alignment, pads worn unevenly because of being positioned too high or low on the rim's braking surface, pad faces contaminated by metal fragments, pads worn so that grooves or other patterns in the face are gone, and pads worn 50% or more.



36.6 *Pad wear that indicates poor pad alignment.*

Symptoms indicating need for pivot adjustment or service

Some calipers have adjustable pivots, and others do not. Sidepull and dual-pivot calipers usually have adjustable pivots. Loose pivots can cause brakes to squeal and to feel grabby. Either of these symptoms should lead to inspection for free-play in the pivot adjustment if the caliper has an adjustable pivot. If the pivot adjustment is too tight, the caliper will fail to open fully when the brake lever is released. This symptom can be caused by several other factors including excess cable friction, lack of lubrication on pivot surfaces, damaged pivot studs, and weak or damaged return springs.

Symptoms indicating need for clearance or centering adjustment

Pad clearance may need adjustment because the pads are too far, or too close to the rim. When the pads are too far from the rim, the brake lever will come too close to the handlebar or grip during brake operation, and braking force will be limited. When the pads are too close to the rim, three problems occur: it is difficult to keep the pads from rubbing the rim, the rider cannot use the brake levers comfortably, and on some brakes it becomes difficult to use the release system to move the pads away from the rim for wheel removal.

On most brake types, the pads need to be centered to reduce the likelihood of the pads rubbing the rim when the brakes are not in use. On some caliper designs, notably on dual-pivot calipers, when the pads are not properly centered the brakes tend to push the rim to one side during brake operation. This increases the force needed to apply the brakes.

TOOL CHOICES

Some brake tools are virtually universal, while others are specific to certain brands and models of brakes. Table 36-1 covers all the tools for the job. The preferred choices are in **bold**. A tool is preferred for a balance among: ease of use, quality, versatility, and economy. When more than one tool for one function is **bold**, it means that several tools are required for different configurations of parts.

BRAKE TOOLS (table 36-1)

Tool	Fits and considerations
THIRD-HAND TOOLS (for holding pads to rim)	
Park BT-1	Inexpensive, not universally effective
Park BT-4	Inexpensive, works on some cantilevers
Park BT-5	Expensive "universal" tool that is not truly universal
Pocket Pro Velcro	Velcro strap, not universally effective
United Bicycle Tool WB-BRK	A truly universal third-hand tool borrowed from the carpentry trade (called Quick Grip, also)
VAR 02	Expensive, not universally effective
VAR 939	Expensive, not universally effective
Wire-types, various manufacturers	Inexpensive consumer tools, not universally effective
FOURTH-HAND TOOLS (for pulling slack from brake inner wire, same tool used for derailleurs)	
Dia-Compe 556	Tends to let inner wire jam in tool
Hozan C356	Tends to let inner wire jam in tool
Lifu 0100	Consumer tool
Park BT-2	Least tendency for inner wire to jam in tool
VAR 233	Tends to let inner wire jam in tool
SIDEPULL-CALIPER TOOLS	
Dia-Compe 445	Set, includes: 10mm open with 8mm box, and 10mm box with 9mm box: thin wrenches for brake-pivot nuts
Dia-Compe 446	Set, includes: 13mm open with 12mm box, 10mm open with 9mm box, 8mm open with10mm box: thin wrenches for brake-pivot nuts
Park BT-3 (pair)	Used for twisting ends of caliper arms to toe brake pads
Park CBW-6	Set (includes CBW-1 thru CBW-5) of thin 8mm, 9mm, 10mm, and 11mm wrenches for brake-pivot nuts
Park OBW-1	10mm & 13mm thin offset wrench for brake centering and pivot adjustment
Park OBW-2	11mm & 12mm thin offset wrench for brake centering and pivot adjustment
Park OBW-3	14mm thin offset wrench for brake centering and pivot adjustment, with pronged end for muscling caliper springs to adjust centering
Scura Centering Tool	Fits in the coils of a sidepull spring so that spring can be muscled
Weinmann 682/683/693	Set, includes: 9mm/10mm box, 11mm open, 8mm box with 10mm open: thin wrenches for brake nuts
Weinmann 685 & 687	4mm & 5mm sockets for hex fitting on end of pivot bolt on old Weinmann brakes (for centering)
United Bicycle Tool Langley Fifth Hand	Very useful for disengaging and engaging caliper springs
CANTILEVER-CALIPER TOOLS	
Bicycle Research BM-1	Mill for repairing pivot-stud damage and cleaning paint off pivot stud
Shimano TL-CB-10	Set of 6 tools for setting up Shimano Pro-Set type brakes with link-wires

TIME AND DIFFICULTY

Brake service (including caliper, cable system, and lever), is a 10–25 minute job of moderate difficulty. The wide range is because of the differences in types of brakes, and because it would be considered normal to include some minor lateral rim truing in many cases. This time is for a single brake, not a pair.

COMPLICATIONS

Rim-true problems

It is normal to anticipate having to touch-up the lateral true so that pads do not rub at a reasonable clearance setting. In many cases, the condition of the rim cannot be made reasonable with just a touch-up. Ideally, this should be determined at the time the repair is checked into the shop. If it is not caught at this time, the mechanic is faced with choosing between compromising the brake adjustment, giving away extensive time for rim work, or putting the job on hold until the customer authorizes the necessary rim work.

Some rim problems cannot be repaired, and compromise the brake performance to the point that it would be a mistake to complete the brake work, and then imply to the customer that everything is acceptable. If the rim has a significant flat spot, then pads that are set at the correct height will rub the tire at the flat spot. If the braking surface of the rim is distorted (bulging out or indented), then the brakes will grab whenever the damaged section moves through the brake pads. If the rim cannot be brought into a condition of true with 1mm or less lateral wobble, then brake clearance must be compromised (either by letting brakes rub or leaving them too loose). The importance of taking a good look at the wheels before selling a customer brake work cannot be over-emphasized.

Wheel-installation problems

It is very important to make sure the wheels are correctly installed before starting any brake work. For example, if cantilever pads are adjusted to a rim that is 3–4mm off-center in the fork, when the wheel is positioned correctly, the pad heights could easily be off enough to cause a pad to hit the tire or drop below the rim.

Damaged pivot studs

Cantilever pivot studs can be easily damaged in a crash, or by over-tightening the caliper-arm mounting bolt. When a pivot stud is crash-damaged, there is a chance that it may break off during use of the brake. Furthermore, if the pivot stud is bent, it may be very difficult to correctly align the pads. When a mounting bolt is tightened too much on a caliper arm that has a bushing fixed to the arm, the pivot stud takes the load of the mounting bolt. The result can be that the end of the pivot stud can become mushroomed, and inhibit the pivoting of the caliper arm. This condition can be repaired by delicate filing, or by patient use of emery cloth, to reduce the diameter. The Bicycle Research BM-1 mill makes this repair quickly, precisely, and easily.

Mis-positioned pivot studs

Unfortunately, it is not unusual for bikes to be manufactured with poorly-positioned cantilever pivot studs. If the pivot studs are not parallel to each other and to the central plane of the wheel, then it can be difficult to correctly adjust pad toe. If the pivot studs are too low or too high, then it can be difficult to adjust the vertical angle of the pads. In both cases, a repair can be made by changing the angle of the pad face with emery cloth. The negative consequence is the reduced pad wear-life.

Mis-positioned spring plates

The spring plates are usually an integral part of the pivot stud. If the pivot studs are not rotated equally, then the spring-hole heights may not be symmetrical, making it difficult to center a cantilever brake. Holes can be enlarged with some difficulty. The only other alternative is to deliberately distort one of the springs in the brake.

Sidepull and centerpull brake reach

The reach range of a brake caliper is the range of height that the brake pads can be positioned within, measured from the center of the caliper-mounting bolt. Sidepull and centerpull brake calipers come in different reaches. If a caliper with incorrect reach is installed on the bike, it can be impossible to set the brake-pad height correctly. Minor improvement can be made by lengthening the slot into which the shoe stud is inserted.

Poor routing design at the seat cluster

On some frames, the rear brake cable is forced to make some awkward changes in direction in a very confined area. This can cause several problems. The loop of housing may end up with compound bends that increase cable friction. This may cause the brake to feel spongy, and to fail to fully release. On very small-frame bikes with cantilever brakes, this has been such a problem that the frame designers have tried to

dispense with the piece of housing in this location. The alternative is some sort of metal tube that routes the bare wire around the seat tube. These tubes also create extra friction, and sometimes forces the inner wire to approach the caliper at an odd angle. That can adversely affect brake centering.

Compatibility of levers and calipers

Not all brake calipers are compatible with all types of brake levers. If the lever pulls too little cable, then the brake pads will need to be set very close, and maximum brake force will still be limited. If the lever pulls too much cable, it is less of a problem, but the brake pads would need to have more clearance than normal so that the rider would not have to operate the brake with fingers fully extended. There is no way to determine the compatibility in advance. Inspect for the problems described above, if not using brand- and model-matched brake levers and calipers.

Fat tires with narrow rims and cantilevers

When fat tires are used with narrow rims, pads on cantilever brakes may interfere with the tire when the pad height is correct. There is no good solution that does not involve changing equipment; compromising ideal pad height is the only choice except changing the tire, rim, or brake caliper (to something other than a conventional cantilever).

Small frames and cable-carrier clearance

Small frames with conventional cantilever brakes sometimes have a clearance problem between the cable carrier (or link-unit head) and the stop for the cable housing. If the cable carrier is too close, then it may stop at the housing stop before full braking force is applied to the rim. It can appear to be acceptable when the brake is first set up, but then become a problem as the brake pads wear. If necessary, shorten the ideal straddle-wire length or the link-unit length in order to maintain at least 20mm of exposed wire between the cable-carrier/link-unit head and the housing stop.

Loose pivots on cantilevers

Cantilever brakes usually do not have an adjustment to reduce play in the pivots, but excess play can cause brakes to squeal. If a cantilever arm has a fixed pivot bushing, then the manufacturer is relying on the pivot-stud manufacturer to provide a stud with the correct dimension. If the pivot stud is loose in the bushing and causing squeal, a shim can be made out of thin steel, such as feeler-gauge blades that are under .2mm thick. When cantilevers have independent pivot bushings (rotate separately from the caliper arm), then the cantilever manufacturer is in control of the tolerances on both critical parts, and sloppy pivots are rarely an issue.

Damaged caliper parts

Damaged caliper arms and pivot bolts are dangerous. Bent parts should not be bent back. If the parts are available, then they should be replaced. Most often, it is necessary to replace the whole caliper.

Alignment washers and shoe studs with memory

Alignment washers and smooth shoe studs often get imprinted by the surface they press against when the brake shoe is secured. If the pad was secured when it was improperly aligned, then it may tend to seek the same improper position each time the pad is secured. Sometimes the imprinted surfaces can be cleaned up with a file or emery cloth. Sometimes rotating a washer, or switching it to the opposite side of the caliper, will solve the problem. Other times it will be necessary to replace the washers or brake shoe to solve the problem.

ABOUT THE REST OF THIS CHAPTER

The rest of this chapter is divided into the following sections:

PAD-ALIGNMENT SYSTEMS
CANTILEVER CALIPERS
SIDEPULL CALIPERS
DUAL-PIVOT CALIPERS
CENTERPULL CALIPERS
U-BRAKE CALIPERS
FINISHING
CABLE-OPERATED RIM-BRAKE-CALIPER TROUBLESHOOTING

Each caliper section contains sub-sections about pivot overhaul and adjustment (when appropriate), caliper installation, cable attachment, pad alignment, and clearance and centering adjustments. Each of these sections may be further subdivided into further subsections that cover specifics for a variety of brakes. This means that to complete a section (on cantilever brakes for example), it will be necessary to skip over several sub-sections that apply only to brakes of another type. This is necessary because of the recent proliferation of brake-caliper designs.

PAD-ALIGNMENT SYSTEMS

There are four systems for aligning brake pads. Many of these apply to several types of brake calipers. Rather than repeating the same alignment technique for several systems, each is described in detail in this section, before description of the various brake-caliper types. In the procedure for a specific caliper type, you will be asked to identify the pad-alignment system. It is assumed that you will already be familiar with the different systems, or that you will refer back to this section to determine the correct method of pad alignment.

The simplest alignment system is a plain threaded-stud pad in a slot in the caliper arm. With this system, the stud is always perpendicular to the mounting surface on the caliper arm. For obvious reasons, this system is called **simple threaded-stud-pad alignment**. A variation on this system relies on a set of concave and convex washers between the caliper arm and the shoe, and between the caliper arm and the mounting nut. These washers permit the stud to be moved away from a perpendicular position to the mounting face of the caliper arm, so that more alignments can be done. This system is called **threaded-stud/curved-washer pad alignment**.

There are two pad-alignment systems in which the shoe stud is smooth, instead of threaded. One smooth-stud system features a curved washer between the shoe stud and face on the caliper arm. This system is called **smooth-stud/curved-washer pad alignment**. The other of these systems features a sloped washer between the shoe stud and the caliper arm face. This system is called **smooth-stud/sloped-washer pad alignment**.

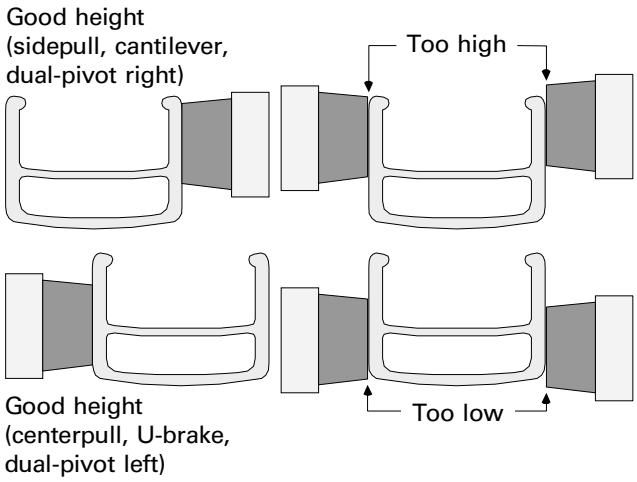
SIMPLE THREADED-STUD-PAD ALIGNMENT

This type of pad-alignment system is found on dual-pivot calipers, sidepull calipers, and centerpull calipers. A threaded stud on the brake shoe fits in a slot in the caliper arm. Height and tangent of the pad are fully adjustable, but no adjustments for toe or vertical angle are built into the system.

Height adjustment

1. [ ] Loosen mounting nut/bolt.

2. [ ] Slide shoe stud up/down in slot until desired height setting is achieved.



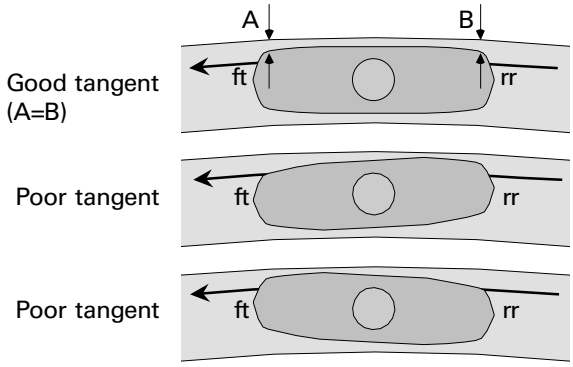
36.7 Proper pad height varies with the type of brake.

3. [ ] Gently secure mounting nut/bolt.

Tangent alignment

4. [ ] View brake pad from side of bike, then move viewpoint up or down until top corners of brake shoe are even with top edge of rim.

5. [ ] Twist brake shoe around axis of shoe stud until front and back corners of pad are simultaneously even with top edge of rim.



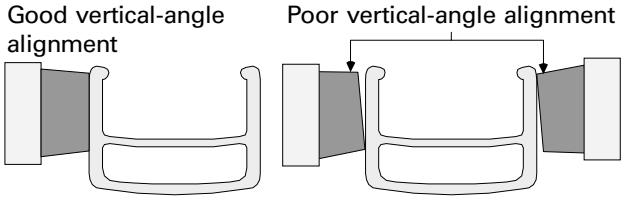
36.8 When pad tangent alignment is correct, the upper front and rear corners of the pad are equidistant from the top of the rim.

6. [ ] Check that height adjustment is still correct, then stabilize shoe with fingers or adjustable wrench while tightening mounting nut to 50–60in-lbs (17–20lbs@3').

Vertical-angle alignment

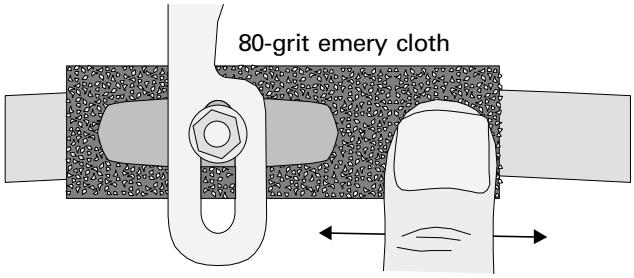
There is no easy adjustment for vertical-angle alignment. The vertical angles of the faces on different brake pads vary. One type of pad may match the angle of the rim's braking surface closely, while another may not. If possible, change pads to get a closer vertical-

angle alignment between the pad face and rim. The following procedure should be considered a good option if the vertical-angle alignment is close, but the procedure should not be ignored even if there is a big angle difference. When there is a big difference in the angles, pad wear will be rapid and the clearance adjustment will be lost quickly.



36.9 *The vertical angle of the pad face should closely match the vertical angle of the rim's braking surface.*

7. **[ ] Place strip of 80-grit emery cloth between rim and brake pad (grit toward pad face).**
8. **[ ] Squeeze pads against rim with third-hand tool.**
9. **[ ] Rotate wheel and emery cloth back and forth through brake pads until vertical angle of pad face matches angle of rim face.**

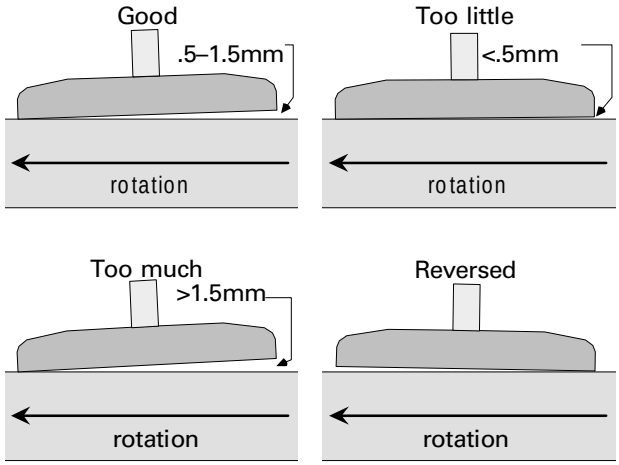


36.10 *With the aligned pad pressed against the emery cloth, move the emery cloth and rim back and forth until the pad has been sanded to match the rim's vertical angle.*

Toe alignment

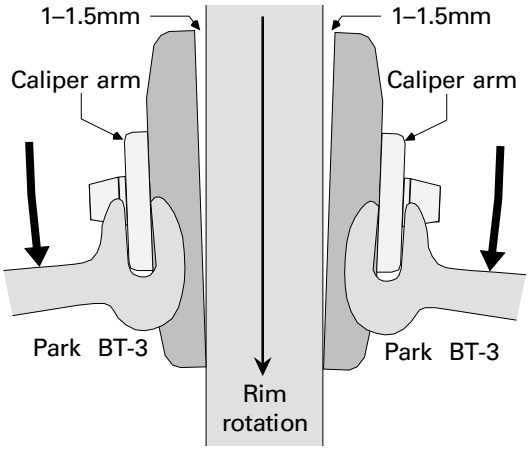
Brake pads need toe to reduce squeal, particularly when the pads are new. When a pad is properly toed, the exit-end of the pad should reach the rim before the entry-end of the pad (see figure 36.11). If both brakes were at the 12:00 position on the wheel, toe could be described as having the front ends of the brake pads reach the rim before the rear ends. If pads have broken in properly to the rim, no toe should be needed, unless the pads squeal on a test ride.

Because simple threaded-stud shoes have no means for adjusting toe, some rather crude means must be used to make this alignment. The most common method is to twist the caliper arms to align the pads. This method is suitable in most cases, but when the calipers are too strong or too finely finished, the preferred method is to modify the face of the pad by holding it against a spinning grinding wheel. The following procedure covers the arm-twisting method only (see figure 36.12). When twisting arms, it is important to not twist the pivot bolt or mounting bolt of the caliper. To prevent this, both caliper arms should be worked with at once. If one needs to be twisted and not the other, then support one with the tool while bending the other. If both need twisting, twist both at once.



36.11 *Properly-toed pads should clear the rim by .5–1.5mm at the entry end of the pad when the exit end just touches the rim.*

10. **[ ] Place Park BT-3 on each caliper arm, above or below pad (whichever is most convenient).**
11. **[ ] Apply twisting load to arm(s) until desired amount of clearance is achieved at rim entry-end of brake pad(s).**



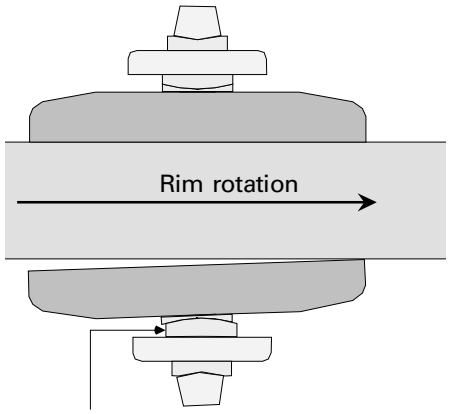
36.12 *Using Park BT-3 tools to twist the caliper arms to adjust toe.*

THREADED-STUD/CURVED-WASHER PAD ALIGNMENT

This type of pad-alignment system is primarily found on cantilever brakes and U-brakes. It is also found on upgrade pad sets that can be used with any caliper that comes with a simple threaded-stud pad-alignment system. A threaded-stud on the brake shoe fits in a slot in the caliper arm. Height and tangent of the pad are fully adjustable (in the same way as the simple threaded-stud system), but alignment washers between the shoe and the caliper arm permit simultaneous alignment of the toe and vertical angle of the pad face.

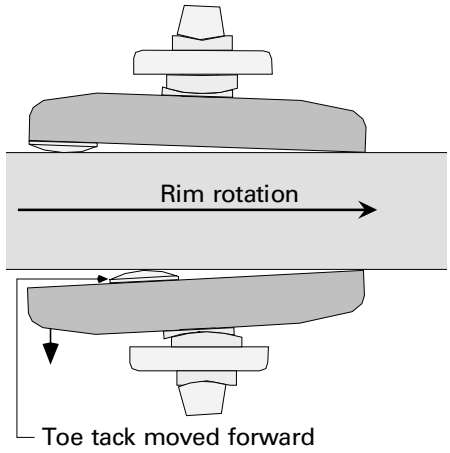
Toe alignment

Brake pads need toe to reduce squeal, particularly when the pads are new. When a pad is properly toed, the exit-end of the pad should reach the rim before the entry-end of the pad. If both brakes were at the 12:00 position on the wheel, toe could be described as having the front ends of the brake pads reach the rim before the rear ends reach the rim. If pads have broken in properly to the rim, no toe should be needed, unless the pads squeal on a test ride.



36.13 *When the convex washer is moved forward or backward, the end of the pad moves in or out.*

The curved washer between the inside face of the caliper arm and the brake shoe enables toe adjustment. When this washer is pushed one way, the forward end of the pad moves in. When the washer is pushed the other way, the forward end of the pad moves out. Some mechanics find it easiest to manipulate the washer to align the pad. For other mechanics, the easiest approach is to manipulate the pad in order to position the washer. If the mounting nuts are loose and the cable is adjusted so that the caliper arms are pressing the pads against the rim, the pads will automatically align to have no toe. To adjust pad toe, a spacer can be put between the entry-end of the pad and the rim to space it further out. A #4 (1/2") thumb tack pressed into the face of the entry-end of the pad makes a good spacer. With this thumb tack (henceforth called *toe-tack*) in place, toe adjustment is semi-automatic. Moving the toe-tack closer to the exit-end of the brake pad increases the amount of toe. Manipulation of the washer may be necessary to finesse the alignment.

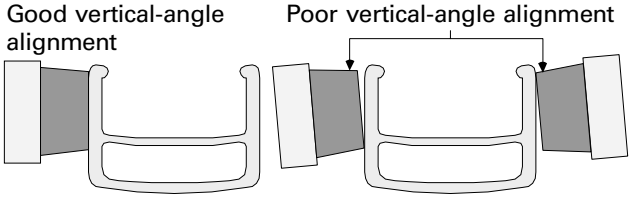


36.14 *Toe tacks can be moved toward the exit-end of the pad to increase the toe.*

1. [ ] **Complete ATTACH CABLE TO CALIPER procedure for the type of cable system being used.**
2. [ ] **Check that toe-tack and exit-end of brake pad are both contacting rim simultaneously, and manipulate curved washer between arm and shoe to improve toe as necessary.**

Vertical-angle alignment

Vertical-angle alignment can also be affected by changing the position of the curved washer against the inside face of the caliper arm. When this washer is pushed in one direction, the pad face angles down. When the washer is pushed in the other direction, the pad face angles up. Some mechanics find it easier to manipulate the washer to align the pad. Other mechanics, find the easier approach is to manipulate the pad to position the washer. The procedure for setting the toe usually also sets the vertical-angle alignment, but it may need additional fine tuning.



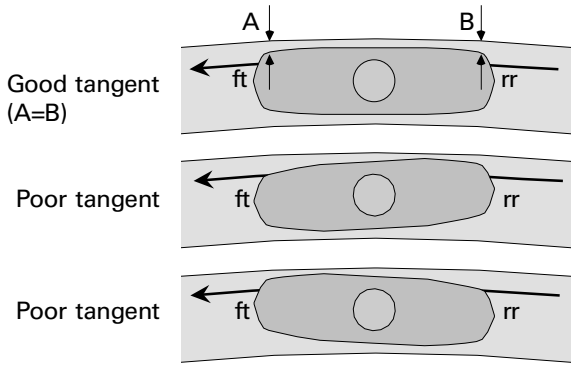
36.15 *The vertical angle of the pad face should closely match the vertical angle of the rim's braking surface.*

When manipulating the washer or pad to improve the vertical angle of the pad face, it is not unusual for the height of the pad to end up too high or too low. The height is adjusted later, so do not compromise the vertical-angle alignment at this time in order to maintain acceptable height.

3. **[ ] Inspect at either end of brake pad to see if vertical angle of pad face is parallel to vertical angle of rim face, then manipulate washer between caliper arm and shoe up or down to fine-tune alignment.**

Tangent alignment

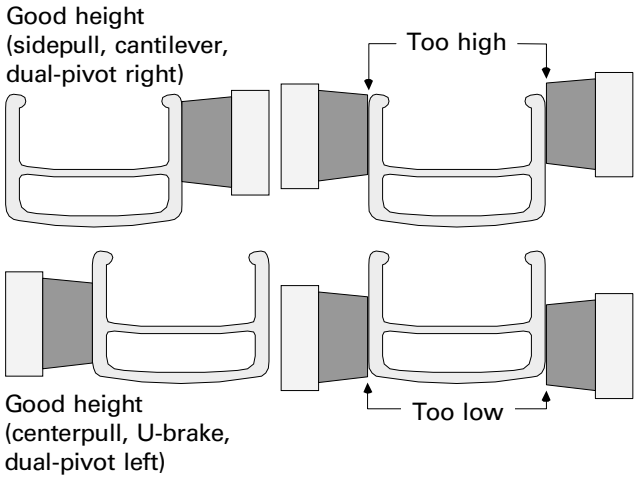
4. **[ ] View brake pad from side of bike and move viewpoint up or down, until top corners of brake shoe are even with top edge of rim.**
5. **[ ] Twist brake shoe around axis of shoe stud, until front and back corners of pad are simultaneously even with top edge of rim.**



36.16 When pad tangent alignment is correct, the upper front and rear corners of the pad are equidistant from the top of the rim.

Height adjustment

6. **[ ] Slide shoe stud up/down in slot until desired height setting is achieved. If acceptable height cannot be achieved, compromise vertical angle just enough to enable setting of height.**

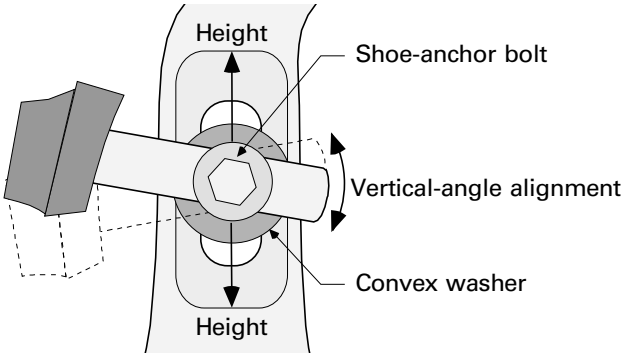


36.17 Proper pad height varies with the type of brake.

7. **[ ] Gently secure mounting nut/bolt.**
8. **[ ] Stabilize shoe with fingers or adjustable wrench while tightening mounting nut to 50–60in-lbs (17–20lbs@3').**
9. **[ ] Check that all alignments were maintained during securing of mounting nut.**

SMOOTH-STUD/CURVED-WASHER PAD ALIGNMENT

This type of alignment system is found on most Shimano cantilevers, many other cantilevers, and some U-brakes. The front of the caliper arm has a curved face against which an oppositely-curved washer is nestled. The shoe stud is inserted through a hole in a shoe-anchor bolt. The stud of the shoe-anchor bolt is inserted through the curved washer and the slot in the face of the caliper arm. Like other pad-alignment systems, height is adjusted by moving the bolt up and down in the slot (see figure 36.18, below). Tangent is aligned by rotating the shoe about the axis of its stud. Toe is adjusted by means of moving the curved washer in the face of the caliper arm (see figure 36.19, page 36-12), which enables the end of the shoe anchor to twist in or out (relative to the rim). Vertical angle of the pad is adjusted by rotating the shoe-anchor bolt about its axis (see figure 36.21, page 36-12).

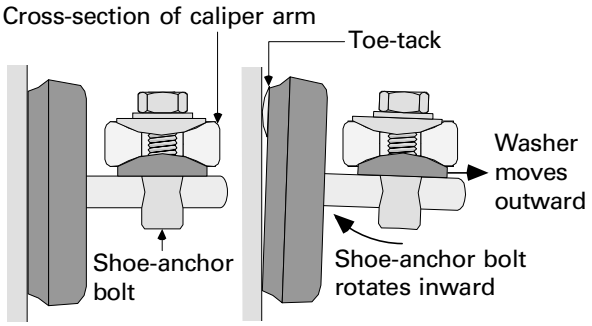


36.18 Height is adjusted by moving the shoe-anchor bolt up or down in the slot. Vertical-angle alignment is done by rotating the shoe-anchor bolt around its axis.

Toe alignment

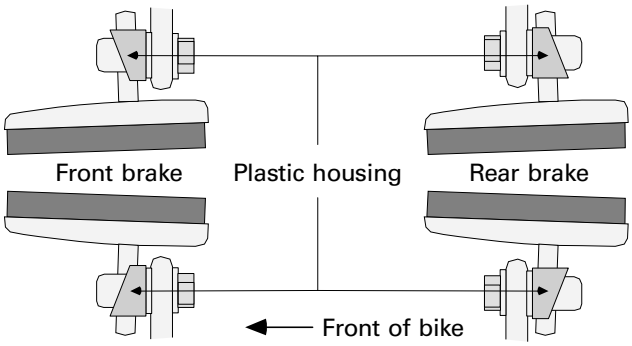
Brake pads need toe in order to reduce squeal. This is particularly true when the pads are new. When a pad is properly toed, the exit-end of the pad should reach the rim before the entry-end of the pad. If both brakes were at the 12:00 position on the wheel, toe could be described as having the front ends of the brake pads reach the rim before the rear ends reach the rim. If pads have broken in properly to the rim, no toe should be needed, unless the pads squeal on a test ride.

The curved washer between the face of the caliper arm and the shoe-anchor bolt enables toe adjustment, by allowing the head of the shoe-anchor bolt to pivot toward or away from the rim. When the head of the shoe-anchor bolt pivot moves out from the rim, the exit-end of the pad moves in. Conversely, when the head of the shoe anchor bolt pivot moves in toward the rim, the exit-end of the pad moves out. Some mechanics find it easier to align the pad by manipulating the shoe anchor. For other mechanics, the easier approach is to position the shoe-anchor bolt by manipulating the pad. If the shoe-anchor nut is loose and the shoe stud is pushed to press the pad against the rim, the pads will automatically align to have no toe. To adjust pad toe, a spacer can be put between the entry-end of the pad and the rim to space it further out. A #4 (1/2") thumb tack pressed into the face of the entry-end of the pad makes a good spacer. With this thumb tack (henceforth called *toe-tack*) in place, toe adjustment is almost automatic. Moving the toe-tack closer to the exit-end of the brake pad increases the amount of toe. Manipulation of the washer may be necessary to finesse the alignment.



36.19 *When a toe-tack is put between the entry end of the pad and the rim, it cause the head of the shoe-anchor bolt to rotate toward the rim and the convex washer to twist and move outward.*

Some Shimano calipers have an automatic-toeing system called *Easy-Set*. With the Easy-Set system, there is no need to use toe-tacks, or any other system that creates toe alignment before the shoe-anchor nut is tightened. This system, instead, relies on a special washer between the shoe stud and the curved washer to automatically create toe. The washer sits inside a plastic housing that fits flat against the curved washer. It appears flat but has a distinctly sloped face that faces out from the brake caliper. The washer is designed to collapse on one side, but not on the other. The side of the washer that collapses is in the lower portion of the plastic housing. When the low side of the plastic housing is on the rim-side of the shoe-anchor bolt, the end of the pad that is in front of the face of the caliper arm moves closer to the rim. When the low side of the plastic housing is on the non-rim-side of the shoe-anchor bolt, the end of the pad that is in back of the face of the caliper arm moves closer to the rim. Use the figure 36.20 as a guide to positioning the plastic housings.

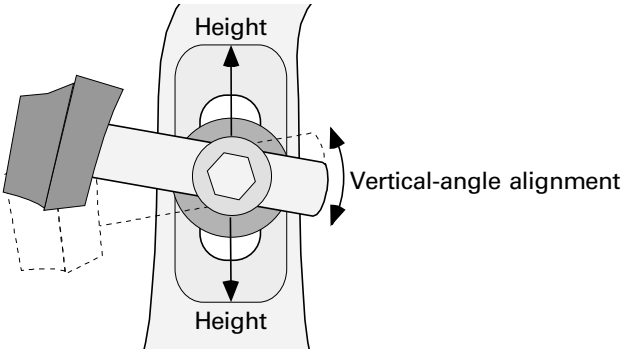


36.20 *The plastic housings reverse orientation on front and rear brakes.*

1. **[ ] Complete ATTACH CABLE TO CALIPER procedure for the type of cable system being used.**
2. **[ ] Push in on shoe stud to press pad against rim, then check that toe-tack and exit-end of brake pad are both contacting rim simultaneously; manipulate shoe-anchor-bolt head in or out to improve toe as necessary.**

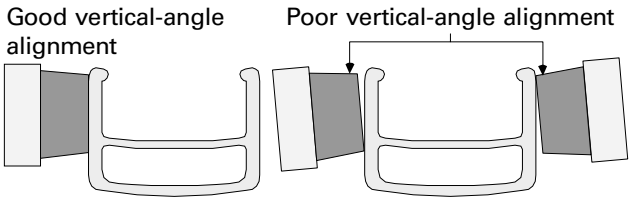
Vertical-angle alignment

Vertical-angle adjustment is also enabled by changing the position of the shoe-anchor bolt, but in this case it is done by rotating the shoe-anchor bolt around its axis. When the bolt is rotated in one direction, the pad face angles down and when it is rotated in the other, the pad face angles up. Some mechanics find it easier to align the pad by manipulating the bolt. For other mechanics, the easiest approach is to manipulate the pad in order to position the bolt. If done properly, the procedure for setting the toe usually also sets the vertical-angle alignment. If it does, it may still need fine tuning.



36.21 *Rotate the shoe-anchor bolt around its axis to change the vertical-angle alignment.*

When rotating the shoe-anchor bolt to improve the vertical angle of the pad face, it is not unusual for the pad to end up too high or too low. The height is adjusted later, so do not compromise the vertical-angle alignment at this time.

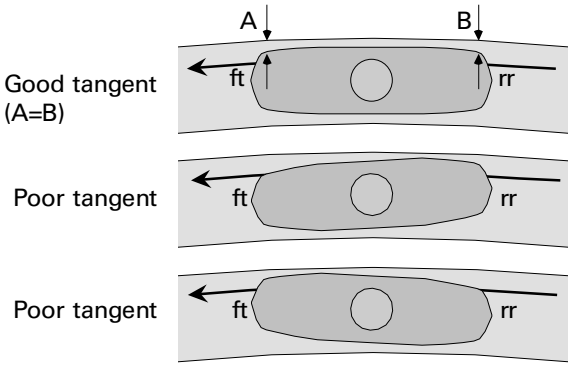


36.22 The vertical angle of the pad face should closely match the vertical angle of the rim's braking surface.

3. [ ] Inspect at both ends of brake pad to see if vertical angle of pad face is parallel to vertical angle of rim face, then rotate shoe anchor bolt around its axis to fine-tune alignment.

Tangent alignment

4. [ ] View brake pad from side of bike and move viewpoint up or down until top corners of brake shoe are even with top edge of rim.

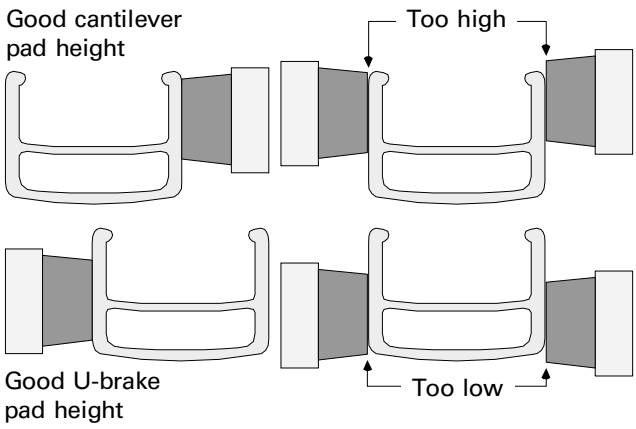


36.23 When pad tangent alignment is correct, the upper front and rear corners of the pad are equidistant from the top of the rim.

5. [ ] Twist brake shoe around axis of shoe stud until front and back corners of pad are simultaneously even with top edge of rim.

Height adjustment

6. [ ] Slide shoe stud up/down in slot until desired height setting is achieved. If acceptable height cannot be achieved, compromise vertical angle just enough to enable setting of height (see figure 36.24).



36.24 Correct pad height varies depending on the type of brake caliper.

7. [ ] Stabilize shoe-anchor bolt with Allen wrench and tighten shoe-anchor nut to 70–80in-lbs (23–27lbs@3").

8. [ ] Check that all alignments were maintained during securing of shoe anchor nut.

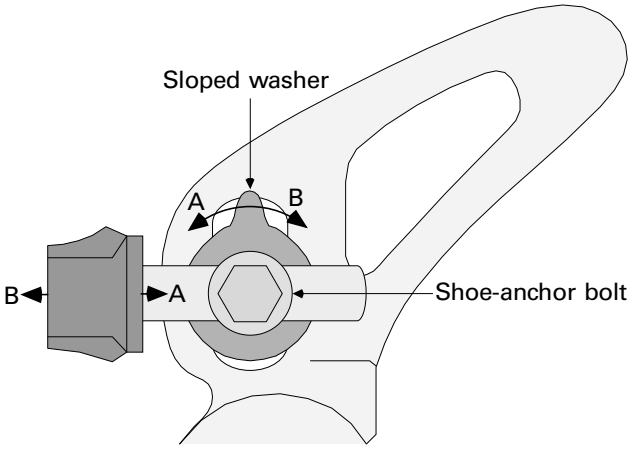
SMOOTH-STUD/SLOPED-WASHER PAD ALIGNMENT

This type of alignment system is commonly found on older Shimano cantilevers and on many after-market cantilevers. The front of the caliper arm has a flat face. The shoe stud is inserted through a hole in a shoe-anchor bolt. The stud of the shoe-anchor bolt is inserted through the sloped washer and through the slot in the face of the caliper arm. The sloped washer has a tab at its perimeter. Like some other pad-alignment systems, height is adjusted by moving the shoe anchor bolt up and down in the slot, and tangent is aligned by rotating the shoe about the axis of its stud. Toe is adjusted by moving the tab on the sloped-washer between the 10:00 and 2:00 position. That enables the end of the shoe anchor to twist in or out (relative to the rim). Vertical angle of the pad is adjusted by rotating the shoe anchor bolt around its axis. (See figure 36.25, page 36-14.)

Toe alignment

Brake pads need toe in order to reduce squeal. This is particularly true when the pads are new. When a pad is properly toed, the exit-end of the pad should reach the rim before the entry-end of the pad. If both brakes were at the 12:00 position on the wheel, toe could be described as having the front ends of the brake pads reach the rim before the rear ends reach the rim. If pads have broken in properly to the rim, no toe should be needed, unless the pads squeal on a test ride.

The sloped-washer between the face of the caliper arm and the shoe-anchor bolt enables toe adjustment, by allowing the head of the shoe-anchor bolt to pivot toward or away from the rim. When the head of the shoe-anchor bolt pivots out from the rim, the exit-end of the pad moves in. Conversely, when the head of the shoe-anchor bolt pivots in toward the rim, the exit-end of the pad moves out. The only way to align the toe is to rotate the sloped washer.

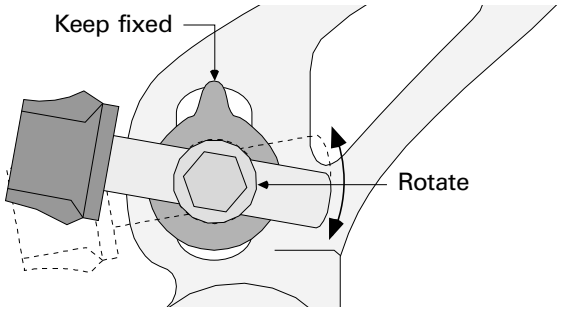


36.25 *When the tab on the sloped washer is rotated back and forth, the end of the pad moves in or out.*

1. **[ ] Complete ATTACH CABLE TO CALIPER procedure for the type of cable system being used.**
2. **[ ] Push on end of shoe stud to move pad to rim, then check that toe-tack and exit-end of brake pad are both contacting rim simultaneously; manipulate sloped-washer tab in or out to improve toe as necessary.**

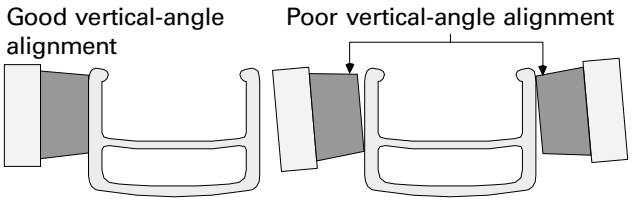
Vertical-angle alignment

Vertical-angle alignment is also enabled by changing the position of the shoe-anchor bolt, but in this case it is done by rotating the shoe-anchor bolt around its axis. When the bolt is rotated in one direction, the pad face angles down and when it is rotated in the other, the pad face angles up. Rotating the shoe-anchor bolt changes the effective position of the sloped washer; it is likely the toe will need fine-tuning if the shoe-anchor bolt needs rotation to adjust the vertical-angle alignment.



36.26 *The vertical-angle alignment is adjusted by rotating the shoe-anchor bolt around its axis.*

When rotating the shoe-anchor bolt to improve the vertical angle of the pad face, it is not unusual for the pad to end up too high or too low. The height is adjusted later, so do not compromise the vertical-angle alignment at this time.

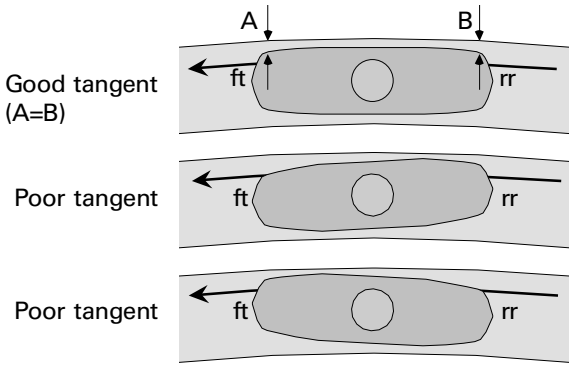


36.27 *The vertical angle of the pad face should closely match the vertical angle of the rim's braking surface.*

3. **[ ] Inspect at either end of brake pad to see if the vertical angle of the pad face is parallel to the vertical angle of the rim face, then rotate shoe-anchor bolt around its axis to fine-tune alignment.**

Tangent alignment

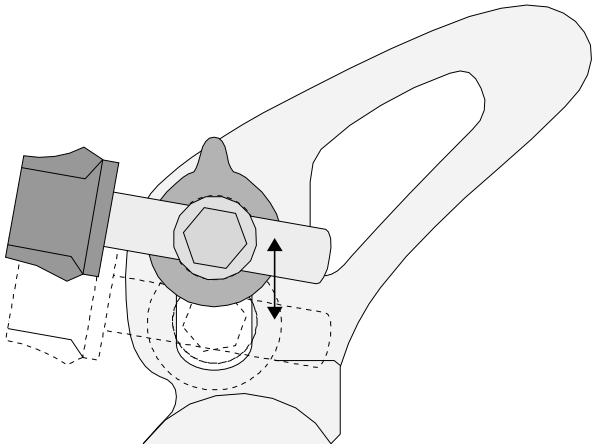
4. **[ ] View brake pad from side of bike and move viewpoint up or down until top corners of brake shoe are even with top edge of rim.**
5. **[ ] Twist brake shoe around axis of shoe stud until front and back corners of pad are simultaneously even with top edge of rim.**



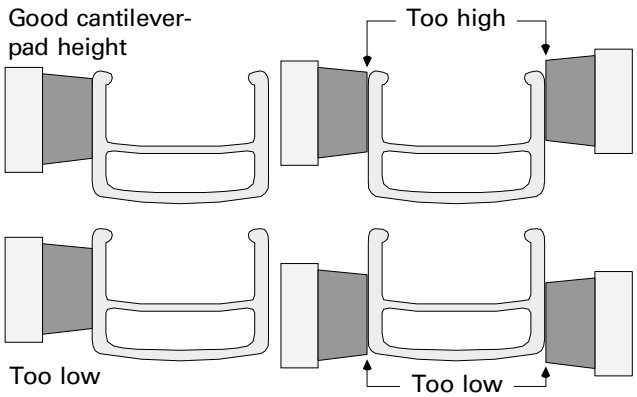
36.28 *When pad tangent alignment is correct, the upper front and rear corners of the pad are equidistant from the top of the rim.*

Height adjustment

6. **[ ] Slide shoe stud up/down in slot until desired height setting is achieved. If acceptable height cannot be achieved, compromise vertical angle just enough to enable setting of height.**



36.29 *To adjust pad height, move the shoe-anchor bolt up and down in the slot in the caliper arm.*



36.30 *Correct cantilever brake-pad height.*

7. **[ ] Stabilize shoe-anchor bolt with Allen wrench and tighten shoe anchor nut to 70–80in-lbs (23–27lbs@3').**
8. **[ ] Check that all alignments were maintained during securing of shoe-anchor nut.**

CANTILEVER CALIPERS

This section covers cantilevers equipped with several different cable systems, including straddle-wire systems, link-wire systems (such as Shimano Pro-Set models), link-unit systems (such as Shimano M-system brakes), and transverse-wire systems (such as Shimano V-brakes). Several different pad-alignment systems are found on cantilever brakes; the following procedure defines the alignment tolerances, but it is expected that you will refer back to ***PAD-ALIGNMENT SYSTEMS*** for the alignment procedure.

CALIPER-ARM INSTALLATION

If working on a bike with the caliper arms already installed , it is still a good idea to remove and reinstall them using the following procedure. *Pivot cleaning, pivot greasing, pivot-stud inspection, and spring greasing are very important and should not be taken for granted!*

When installing caliper arms, it is a good idea to check the pads for proper orientation. Usually, a left-rear caliper arm and a right-front caliper arm are interchangeable, except that the pads might be facing in the wrong direction were you to switch the arms from one end of the bike to the other.

Brake pads often have distinctly different top and bottom sides. If the pad is curved over its length, it should be clear which is the top. Obviously, the curve of the pad should match the curve of the rim. Pads that are not curved may, nonetheless, still have distinct top and bottom sides. Usually, if there is a manufacturer's name on only one side of the pad, that would be the top side. If it is not clear which side of the pad should face up, then determine whether there is a front or back end (front or back of bike), whether the pad should face in any direction in regard to the rim's rotation (exit-end or entry-end), or whether there are any other indications that a pad is a left or right pad.

Some pads are specifically designed to work only on the front or back of the bike. This is often done so that a longer pad can be used. Longer pads often come with the stud off-center. The shorter end of the pad always faces the frame or fork, so that the pad will clear the frame or work when the brakes are released.

It is not unusual for a pad to be specifically designed for its orientation to the rim's rotation. If the shoe is open at one end so that the pad rubber can be slid in or out, then the open end *must* be the entry-end, and the closed end would consequently be the exit-end. This orientation prevents the pad from sliding out of the shoe. When a manufacturer marks a pad with the word *forward*, the end that is *forward* would be the exit-end of the pad.

Some pads are marked for left and right usage. Shimano has done this for years, putting an L or R directly on the pad. Usually, however, it is unlikely that a pad will be marked this way. A combination of other markings may, in effect, make a pad a left or right pad. If a pad were marked for the front of the

bike, curved so that it had a specific top side, and marked with an arrow or the word *forward* (for direction of rim rotation), then it could *only* go on one side of the front brake to meet all these criteria.

1. **[ ] Check for any indications of: which side of each brake pad is top side, which end of each pad should point to direction rim rotates, whether pads are specific to front or rear of bike, and for any markings that indicate pads are specific to left or right side of the bike.**

The next step suggests installing toe-tacks in the face of the brake shoes. Toe-tacks are simply #4 thumb tacks. Placing toe tacks in the pad face is a convenient way to set the toe adjustment. The amount of toe can be controlled by how deep the toe-tack is pressed in, and by how far the toe-tack is installed from the entry-end of the brake pad. Rubber bands wrapped around the entry-end of the pad are alternative method for creating toe. Brake pads that are well broken-in to the rim, and brake pads on Shimano V-brakes, may not need any toe; if this is the case, the next step should be skipped.

2. **[ ] Install toe-tacks in face of entry-end of pad so that they do not extend beyond pad face.**

Before preparing to install the caliper arms on the pivot studs, it is a good idea to test fit the caliper arms on the pivot studs. If the fit is difficult, it could be caused by several things. Paint or rust on a pivot stud can make it a tight fit; these conditions can easily be repaired by using some medium-grit emery cloth on the pivot stud. Pivot studs could be mushroomed on the end, if caliper-mounting bolts have been over-tightened. This mushrooming damage is harder to repair with emery cloth. A Bicycle Research BM1 is a simple and effective tool that will repair mushrooming, as well as remove paint with ease.

If the bike is used, it is a good idea to inspect the pivot studs for bends or cracks at the base. It is *not* a good idea to bend pivot studs back into alignment. Cracked studs are a safety and liability risk that no one should take. If the pivot stud is not replaceable, it may still be possible to repair it without brazing. Some types of brazed-on pivot studs can be repaired with a replacement retained by a bolt that attaches to the original pivot-stud base.

3. **[ ] Grease outside of pivot studs.**
4. **[ ] Grease outside of any bushings to be installed over pivot studs.**

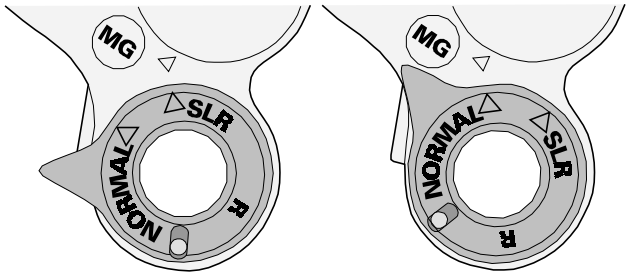
It is very critical that the caliper arms be well-secured, but the design of pivot studs prevents using high torques on the mounting bolts (mushrooming of the pivot stud may occur). The solution to this is to use Loctite #242 to retain the mounting bolt securely without relying on high torque. The Loctite should be put inside the pivot stud, *not* on the mounting bolt threads; Loctite on the bolt threads has a tendency to back out of the pivot-stud hole and get into the space between the pivot stud and the caliper arm. The factory often puts dry Loctite on the mounting bolt that is good for several installations. If the bolt can be threaded in by hand, then fresh Loctite is needed.

5. **[ ] Use Loctite 242 inside pivot-stud threads unless mounting bolts have dry factory Loctite in good condition (or nylon insert) on threads.**
6. **[ ] Grease any coil springs that will be enclosed inside caliper arms.**

There are springs specific to the left and right caliper arms. When a spring is on the correct side, it will always coil tighter as the caliper arm moves the pad closer to the rim, and uncoil as the pad moves away from the rim. Over the years, Shimano has remained very consistent and used a silver spring in the right caliper arm, and a gold spring in the left caliper arm (left and right when facing front of caliper, not in regard to side of bike).

Coil springs often have one leg that fits into a hole in the spring-mounting plate at the base of the pivot stud, and another leg that goes in a hole in the caliper arm. When a spring has legs of different length, the longer leg almost always fits into the spring-mounting plate at the base of the pivot stud.

Certain vintages of Shimano brakes had multiple holes inside the caliper arm into which the spring leg installs. This was done to offer the option of setting up the brake with a soft (SLR) feel, or firmer (NORMAL) feel. After putting the spring into one of the holes, a dustcap is placed over the spring. The triangular indicator on the caliper arm points either to the SLR or NORMAL notation on the dustcap, depending into which hole in the caliper arm the spring was installed. These SLR/NORMAL-marked dustcaps were also marked for left and right side of the brake with an L or R. Particularly as the brakes are getting older, it is a good idea to select the spring hole that sets the brake at the NORMAL setting.



36.31 *Shimano SLR and NORMAL spring and dustcap orientations.*

7. [ ] **Select spring for each side so that spring will coil tighter as brake pad moves in towards rim, and install spring in caliper.**
8. [ ] **Put any dustcaps or spring-adjusting nuts (if any) on backside of caliper, and any removable bushings (greased) inside of caliper hole.**
9. [ ] **Slide caliper assembly onto pivot stud. If there are multiple spring holes in spring-mounting plate, make sure springs go in middle holes.**
10. [ ] **If caliper is Dia-Compe 984 or similar (with spring-tension-adjusting nut on front of caliper), install nut on face of caliper.**
11. [ ] **Install, but do not tighten, mounting bolts.**

All caliper arms have a bushing that fits between the pivot stud and the caliper arm to act as a bearing. In some cases, the bushing is a fixed and permanent part of the caliper arm. In other cases, the bushings is either removable or can be rotated in the caliper arm. If a caliper arm has a fixed bushing, the head of the mounting bolt presses against the end of the pivot stud. In these cases, low torque is needed to prevent mushrooming the pivot stud. If the caliper arm has an independent bushing (removable or free-rotating), then the head of the mounting bolt presses against the bushing. In these cases, the bushing can take higher torque than the pivot stud, and the bushing needs higher torque to prevent it from turning. Inspect the caliper arm to determine whether it has a fixed, or independent, bushing.

Some caliper arms have a nut (or plate) that is installed in front of or behind the caliper arm, to which the spring is attached. This is seen on some Dia-Compe and SunTour brakes. This feature is usually found on one caliper arm. This spring-tension-adjusting nut (or plate) will stay at the position it is set when the mounting bolt is secured. When securing the mounting bolt in the next step, position the spring tension nut so that the positions of the caliper arms on each side of the wheel are symmetrical.

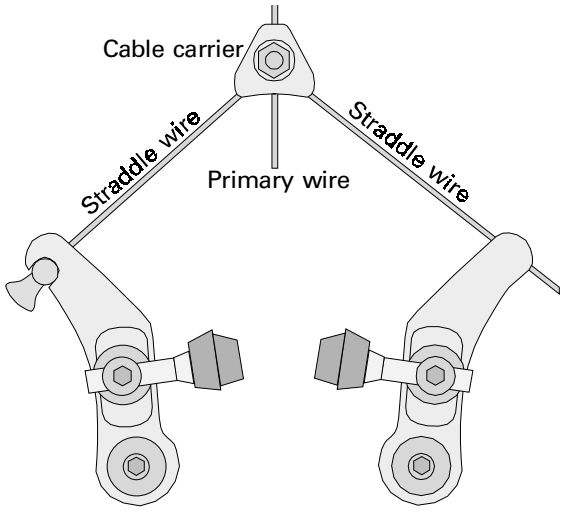
12. [ ] ***Fixed-bushing caliper(s):*** **Secure to 25in-lbs (8lbs@3").**
Independent-bushing caliper(s): **Secure to 50–60in-lbs (17–20lbs@3").**

If the brake uses a link-wire or link-unit cable-attachment system, the brake pads can interfere with getting the cable-attachment system set up properly. For this reason, if the brake has one of these cable systems, the next step requires positioning the pads so that they will miss the rim when the caliper arms move in. On the other hand, brakes with straddle-wires or transverse wires require that the pads are in a normal position in order to attach the cable system to the caliper arms. The pads should be set up close to their final position, but precision adjustment is done later.

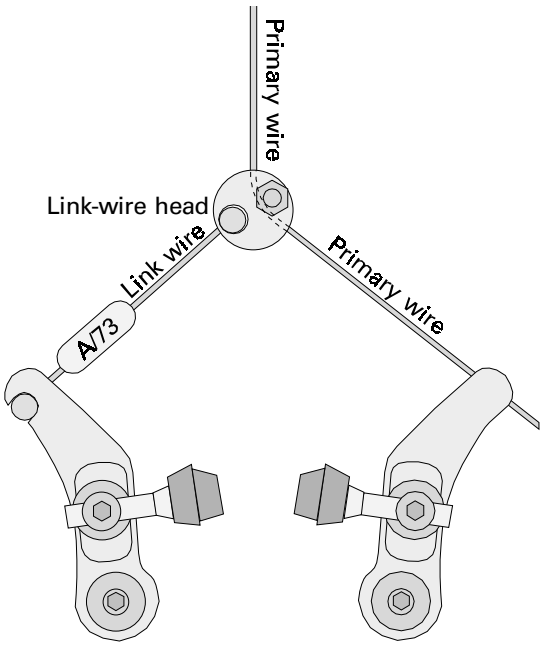
13. [ ] ***Link-wire and Link-unit systems:*** **Position pads so that they will go below rim when caliper arms move in.**
Straddle-wire systems and Shimano V-brake: **Position pads on caliper to approximately correct height, tangent, and toe. Leave nuts/bolts just tight enough to keep shoe in place.**

ATTACH CABLE TO CALIPER

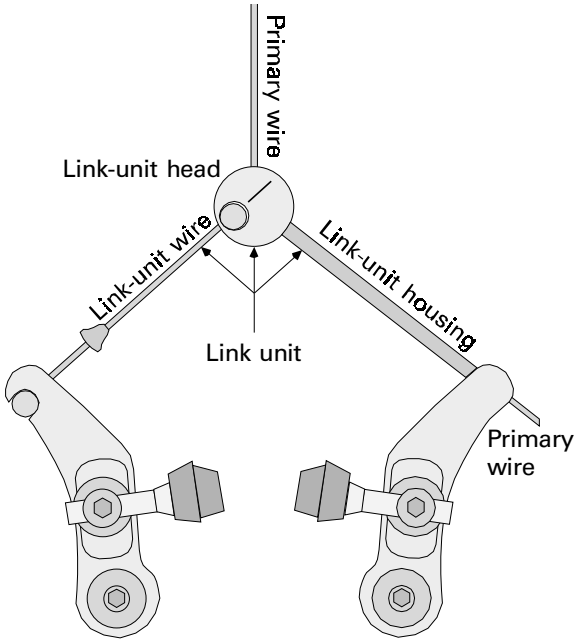
At this point, determine whether the brake system uses a straddle-wire, a link-wire, a link-unit, or a transverse cable. Once this is determined, use the appropriate following section for attaching the cable system to the calipers.



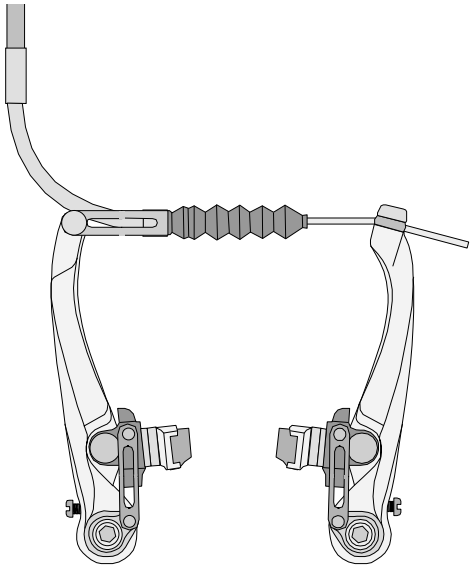
36.32 *A cantilever with a straddle-wire.*



36.33 *A cantilever with a link-wire.*



36.34 *A cantilever with a link-unit.*



36.35 *A Shimano V-brake with a transverse wire.*

Straddle-wire systems

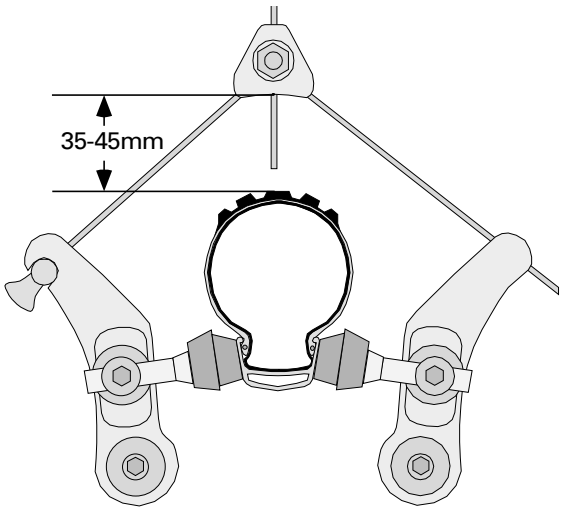
Straddle-wire systems are found on older Shimano cantilever brakes, and almost all current cantilever brakes made by companies other than Shimano. Newer Shimano cantilevers use link-wires, link-units, or transverse wires. It is not unusual to find Shimano cantilevers that were designed with link-wires or link-units converted to a straddle-wire setup.

1. **[ ] Install brake lever and cable system, if not already installed.**
2. **[ ] Set cable-system adjusting barrel to 3 full turns out from fully-in position.**

The cable carrier should be installed on the primary wire so that the name and the nut both face out from the frame or fork, and so that the trough the straddle-wire sits in is on the side of the cable carrier that faces the frame or fork. The purpose of this is threefold: it creates access so that the nut can be tightened with a torque wrench, it creates clearance so that the cable carrier does not interfere with the headset cup, and it is aesthetically correct.

Traditional cable carriers with a simple pinch mechanism are being replaced by carriers made out of extruded aluminum in all types of fanciful shapes. These are most often used to replace link-unit and link-wire systems, on the premise that the link-unit or link-wire system is too troublesome to learn to set up properly. Most of these fancier cable carriers attach to the wires by means of set screws, rather than by a pinch mechanism. A pinch mechanism works by squeezing the wire between two flat surfaces; pinch mechanisms flatten and distort the wires, but do not break strands. Set screws work by *biting* into the wire; they are designed to do this biting on solid metal surfaces, not wires. *Set screws cause wires to fray; cable carriers that use set screws to secure the wire should not be used!*

3. **[ ] Lubricate threads of pinch mechanism on cable carrier.**
4. **[ ] Slide cable carrier over primary wire so that nut faces out from frame or fork.**
5. **[ ] Position cable carrier on primary wire so bottom edge of cable carrier clears tire tread by 35–45mm, or to just clear reflector bracket.**



36.36 *Position the cable carrier on the primary wire so that it clears the tire tread by 35–45mm.*

6. **[ ] Hold cable-carrier bolt with wrench, then torque nut to 50–70in-lbs (17–23lbs@3").**
7. **[ ] Hold pads to rim with third-hand tool.**

8. [ ] **Thread straddle cable through cable carrier and caliper-arm pinch mechanism, then hook straddle-wire bead into other caliper arm.**
9. [ ] **Use fourth-hand tool on end of straddle wire to pull slack out of straddle-wire and inner wire.**
10. [ ] **Torque caliper-arm pinch to 50–70in-lbs (17–23lbs@3").**
11. [ ] **Remove third-hand tool. *Both brake pads should be rubbing the rim at this time!***

Link-wire systems

Link-wire systems are found on a series of Shimano cantilever models that were called Pro-Set cantilevers. The link-wire replaces the straddle wire and cable carrier. The straddle-wire/cable-carrier system is prone to several problems that Shimano helped to solve with the link-wire system (see figure 36.33, page 36-17).

Brake performance is closely tied to the geometry of the cable-attachment system. Since straddle wires have adjustable length, there is no good way for the manufacturer to ensure the brake system would be set up with optimum performance. The link-wire systems solves this problem because the link-wire has a fixed length.

The fact that cable carriers can float back and forth on the straddle-wire creates problems with creating a stable pad-centering adjustment. The fixed nature of the link-wire also solves this problem.

Shimano's original attempts at using a link-wire did not rely on using their Pro-Set tools to set up the link wire. Mechanics found setup to be very problematical. After a short period, Shimano introduced their Pro-Set tools for setting up link-wire systems. The Pro-Set tools make clearance and centering adjustments semi-automatic, if properly used. If the Pro-Set tools are not used, setting up a brake with a link wire can be problematic.

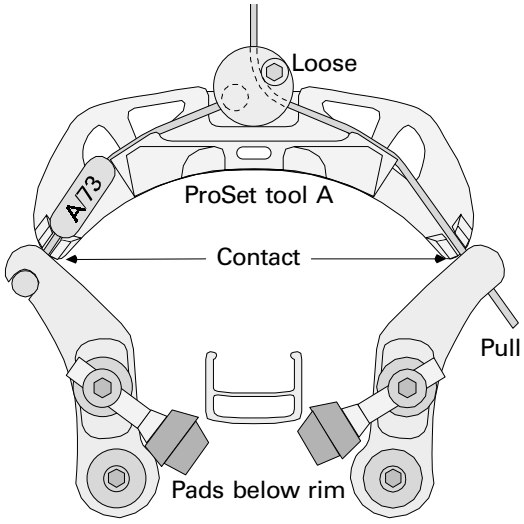
Link-wires come in a variety of sizes that are marked with a letter, or a letter/number combination. The letters are A, B, C, D, E, and S. The A and B sizes are most commonly seen. When replacing a link-wire, try to match the existing size. If a longer link-wire is used, watch out for the link wire head getting too close to the housing stop. A clearance of 20mm is required between the link-wire head and the housing stop.

1. [ ] **Install brake lever and cable system, if not already installed.**
2. [ ] **Set cable-system adjusting barrel to 3 full turns out from fully in position.**

There are two ends to the link-wire. One end is simply a lead cylinder that is called the bead; the other end has another bead that is trapped between two plates. The primary wire is routed through these two plates, as well. The two plates are called the link-wire head. There is a pinch bolt and nut through the link-wire head that fixes the head to the primary wire.

3. [ ] **Lubricate threads of pinch mechanism on link-wire head.**
4. [ ] **Slide link-wire head over primary wire so that aluminum side faces out from frame or fork, when bead of link wire points to caliper arm that has socket for link-wire bead.**
5. [ ] **Oil threads of pinch bolt on caliper arm.**
6. [ ] **Thread primary wire under pinch plate on caliper arm.**
7. [ ] **Hook link-wire bead into socket on other caliper arm.**

Shimano Pro-Set tools are marked with the same letter codes as the link-wires. There is also a number on the tool. The number corresponds to the length of the exposed wire in the link-wire (from the edge of the bead to where the wire enters the head). The number is useful if the marking cannot be found on the link-wire. It is also useful if the link-wire is a non-Shimano imitation (which is likely to be mis-marked).



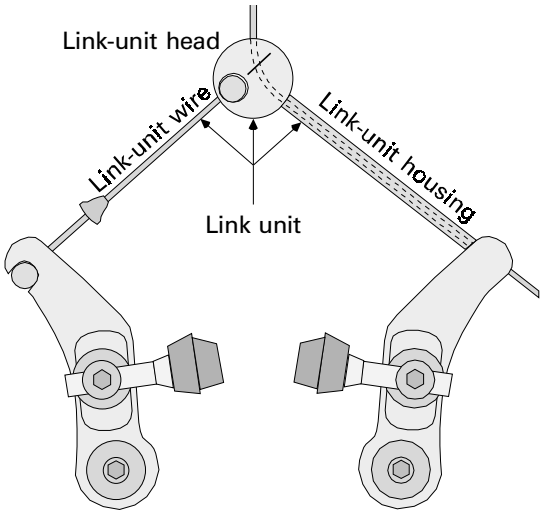
36.37 *A link-wire set-up, with a Pro-Set tool in place.*

8. [ ] **Select Shimano Pro-Set tool that has matching letter to letter that appears on link wire; install tool so that link wire head is nestled in cradle at center of tool, and so that primary wire and link wire are in slots at ends of tool.**
9. [ ] **Use fourth-hand tool to pull slack out of primary wire until both caliper arms are against ends of Pro-Set tool; make sure that tool is properly seated on wires and link-unit head. (Rotate pads down if pads touch rim before Pro-Set tool seats against caliper arms.)**
10. [ ] **Torque caliper-arm pinch to 50–70in-lbs (17–23lbs@3").**
11. [ ] **Hold head of bolt in link-unit with wrench and torque nut to 35–45in-lbs (12–15lbs@3").**
12. [ ] ***Do not* remove Pro-Set tool at this time.**
13. [ ] **Position pad faces against rim and snug shoe-anchor nuts.**

14. [ ] **Hold shoes to rim with third-hand tool.**
15. [ ] **Loosen shoe-anchor nuts.**
16. [ ] **Move calipers/Pro-Set tool assembly to one side or other until equal amounts of shoe stud protrude from each shoe-anchor bolt, then gently secure one shoe-anchor nut.** ***NOTE: Side with loose shoe-anchor nut will be first side to adjust pad alignment on.***
17. [ ] **Remove third-hand tool, but *do not remove Pro-Set tool* at this time.**

Link-unit systems

Shimano invented the link-unit system to replace the link-wire system. Link-units are used on a Shimano brakes called M-system brakes. The link-unit serves all the purposes and functions of the link-wire system, but does not require the use of Pro-Set tools to set it up. A link-unit consists of a link-wire, a link-wire head, and a piece of housing attached to the head that goes to the caliper arm with the pinch mechanism. The piece of housing fixes the distance of the head from the right caliper arm and eliminates the need for the Pro-Set tool.

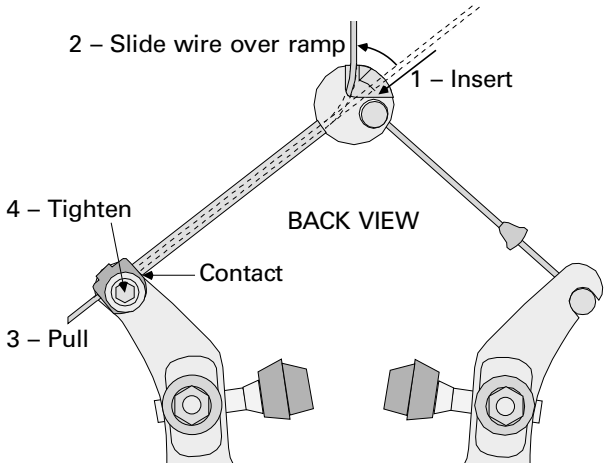


36.38 *A link-unit system.*

1. [ ] **Install brake lever and cable system, if not already installed.**
2. [ ] **Set cable-system adjusting barrel to 3 full turns out from fully-in position.**

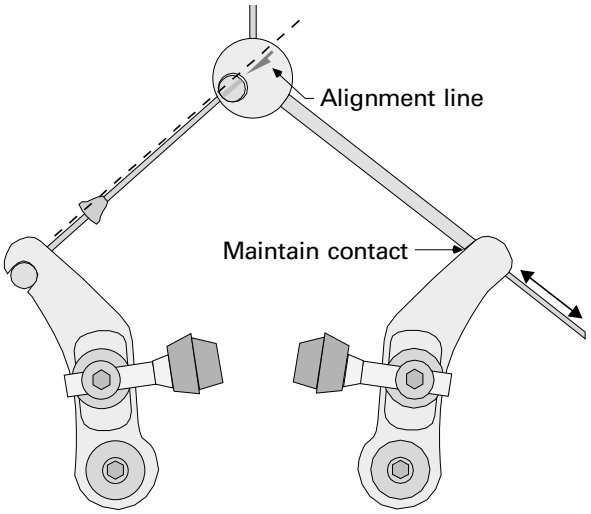
Link-units come in a variety of sizes. They may be marked with letters A, B , C, or D. The A and B sizes are the most common. When replacing a link-unit, try to match the existing size. If a longer link-unit is used, watch out for the link-unit head end up too close to the housing stop. A clearance of at least 20mm is required between the link-unit head and the housing stop.

3. [ ] **Lubricate threads of pinch mechanism on caliper arm.**
4. [ ] **Thread primary wire through link-unit head and then through link-unit housing.**
5. [ ] **Move primary wire over ramp and into working slot in link-unit head.**



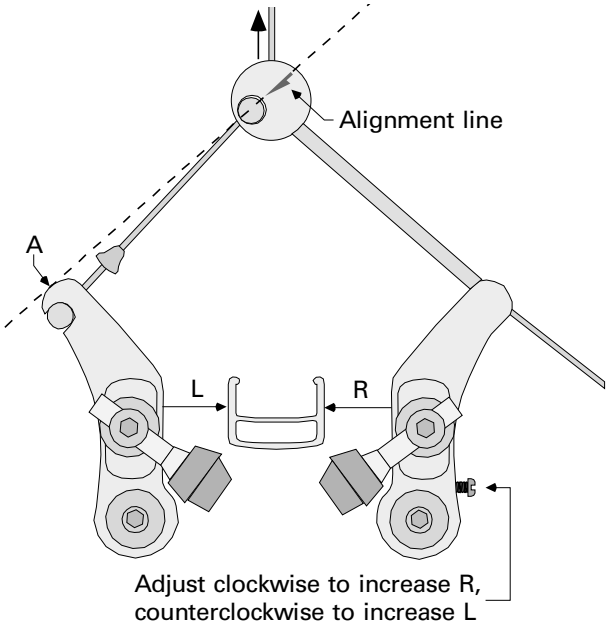
36.39 *Installing the primary wire into the link-unit.*

6. [ ] **Hook lead bead on link-unit into caliper arm.**
7. [ ] **Insert primary wire through pinch mechanism on right caliper arm, then tighten pinch bolt just enough so that cable can still slide through pinch mechanism.**
8. [ ] **Push on link-unit head until link-unit housing stops against caliper arm.**
9. [ ] **Move primary wire through link-unit housing with fourth-hand tool, to align alignment line in link-unit head so that groove is aligned to link-unit wire. (Use straight edge to extend alignment line to make alignment easier to see.)**



36.40 *Use a fourth hand on the primary wire to align the alignment line with the link-unit wire.*

10. [ ] **Torque caliper-arm pinch to 50–70in-lbs (17–23lbs@3").**
11. [ ] **Use cable-adjusting barrel to raise link-unit head up until alignment line points to position A in figure 36.41. (Use straight edge to extend alignment line to make alignment easier to sight.)**



36.41 Use adjusting barrel to move link-unit head up until alignment line points to A.

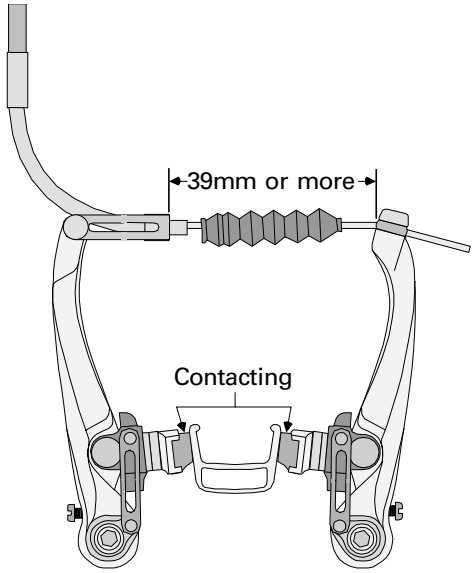
12. [ ] **Use adjusting screw in side of right caliper arm to center arms to rim to <1mm difference. Measure from each caliper to rim as shown in figure 36.41.**

Shimano V-brake (transverse wire)

The Shimano V-brake system differs in appearance from a cantilever, but acts in essentially the same fashion. It is simpler to set up than most cantilever brakes, because the primary wire attaches directly to the caliper arms, much like a sidepull brake.

1. [ ] **Install brake lever and cable system, if not already installed.**
2. [ ] **Set cable-system adjusting barrel to 3 full turns out from fully-in position.**
3. [ ] **Lubricate threads of pinch mechanism on right caliper arm.**
4. [ ] **Hold pads to rim with third-hand tool.**

It is possible to set up a Shimano V-brake so that the ends of the caliper arms actually end up touching under certain conditions. That, of course, makes the application of additional brake force impossible. To ensure that this does not happen, Shimano provides washers that can be moved to different locations to compensate for different combinations of rim and pivot-stud width. The washers are the same concave types used for pad alignments. There is one 6mm-thick concave washer, and another that is 3mm. They can be switched back and forth between their positions inward and outward of the caliper arm to change the distance between the ends of the caliper arm when the pads meet the rim. See figure 36.42, and try switching the washers if the dimension is less than 39mm.



36.42 If the dimension shown is less than 39mm, switch the positions of the 3m and 6mm concave washers in the pad-mounting hardware.

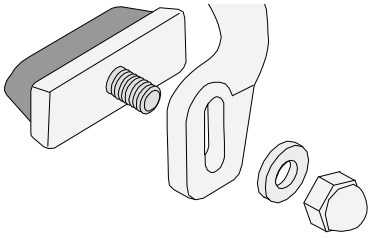
5. [ ] **Measure from end of bracket that holds cable-guide tube, to edge of pinch-bolt head.**
6. [ ] **If dimension in previous step is <39mm, reinstall pads with 6mm concave washers between caliper arm and brake shoe, and 3mm concave washers between caliper arm and mounting nut.**
7. [ ] **Insert cable-guide tube into bracket in left arm.**
8. [ ] **Insert inner wire through cable-guide tube and through pinch mechanism.**
9. [ ] **Pull slack wire through pinch mechanism until pads are against rim, then torque pinch bolt to 50–70in-lbs (17–23lbs@3").**

PAD-ALIGNMENT PREPARATION

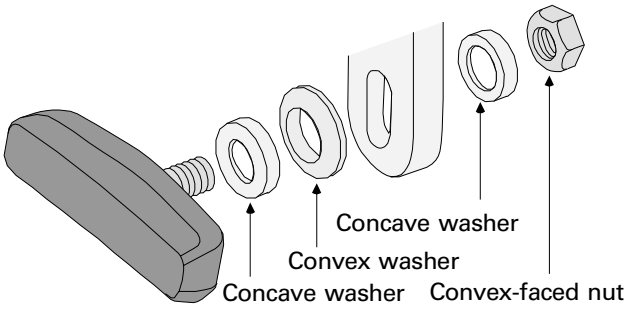
1. [ ] **Loosen shoe-mounting bolts/nuts just enough so that shoe alignment can be manipulated with your fingers (except link-wire and link-unit brakes; this step is already done).**

Determine the type of pad-alignment system used on the calipers. Use the procedures in the earlier section for **SIMPLE THREADED-STUD-PAD ALIGNMENT** (page 36-8), **THREADED-STUD/CURVED-WASHER PAD ALIGNMENT** (page

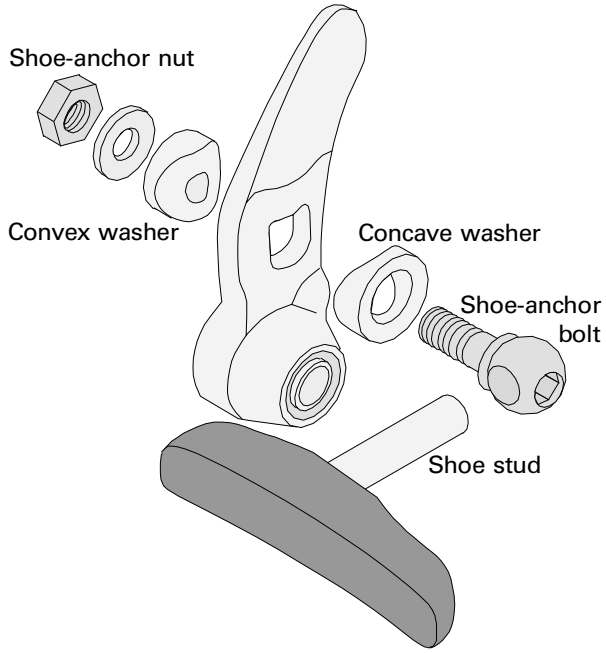
36-10), **SMOOTH-STUD/CURVED-WASHER PAD ALIGNMENT** (page 36-11), or **SMOOTH-STUD/SLOPED-WASHER PAD ALIGNMENT** (page 36-14) Align the pads to the tolerances described in step 2.



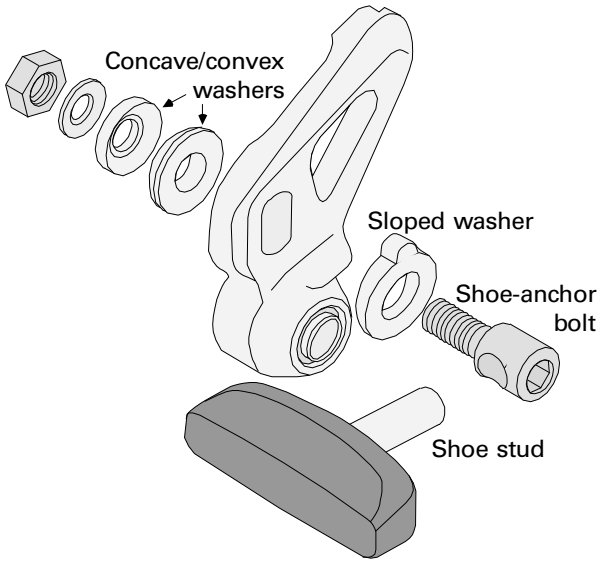
36.43 *A simple threaded-stud-pad alignment design.*



36.44 *A threaded-stud/curved-washer pad-alignment design.*

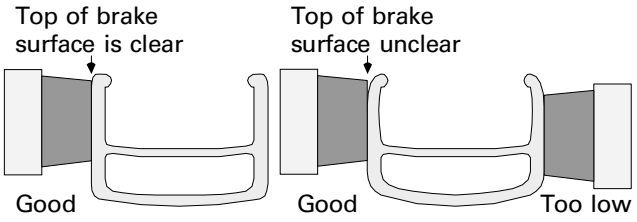


36.45 *A smooth-stud/curved-washer pad-alignment design.*



36.46 *A smooth-stud/sloped washer pad-alignment design.*

Proper-pad height is a very critical to the correct installation of cantilever brakes. The nature of a typical cantilever arm causes the pads to arc significantly downward as the pads move in toward the rim. The inward motion that results from compression after the pads contact the rim causes even more downward motion. Over time, pad wear has an even greater affect on the height of the pad when it reaches the rim. For these reasons, it is critical to set the pads as high on the rim as is safe, when setting up cantilever brakes. Normally, this highest setting would place the top edge of the pad even with the top edge of the braking surface on the rim. Unfortunately, the braking surface is not always clearly delineated. If the braking surface gradually transitions to the "top" of the rim, the correct height is somewhat subjective. Certainly, the top edge of the pad should not be more than 1mm below the top edge of the rim. Figure 36.47 shows good cantilever-pad height on a rim with a clearly delineated braking surface, and on a rim with a gradual transition from the top of the braking surface to the top of the rim. After setting pad height to the ideal position, it is important to check whether the pads interfere with the tire after the brakes are released. This cannot be checked until the brake setup is completed.



36.47 *Correct cantilever-pad height.*

2. [ ] **Determine what pad-alignment system to use by looking at way shoes are mounted to caliper arm, then use appropriate pad-alignment-system procedure to achieve following tolerances (in order indicated by pad-alignment-system procedure):**
   Pad toe: **entry-end of pad clears rim by .5–1.5mm when exit-end touches rim.**
   Vertical angle: **vertical angle of pad face is parallel to vertical angle of rim face.**
   Pad tangent: **top corners of pad are equidistant from top edge of rim.**
   Pad height: **top edge of pad face is even with top edge of rim's braking surface (unless interference with tire occurs when caliper is released).**
   Smooth-stud engagement: **Position shoes so that both contact rim and amount of shoe stud protruding past anchor bolts is equal on both sides.**

CLEARANCE ADJUSTMENT

1. [ ] **Remove Pro-Set tool from link-wire system, if applicable.**

The brake system is ready to be stressed. To stress the system, squeeze the lever 10 times, as hard as it would be squeezed in a panic stop. This stressing procedure performs several functions: it seats wire beads into their sockets fully, it seats housing ends into the stops fully, it double-checks that pinch mechanisms are adequately secure, it confirms that pads are adequately secure, and it tests for defective wire beads that could pop off under high load.

2. [ ] **Stress cable system by pulling on lever equivalent of 10 hard panic stops.**
3. [ ] **Inspect for pads that have lost alignment and wires that have slipped through pinch mechanisms.**

Before going to the next step, which leads directly to setting the pad clearance, it is important to understand the parameters for pad clearance. There are two parameters: when the pads *first* reach the rim, the lever should have at least 25mm of clearance to the grip, and when the pads are held to the rim by hand, it should be relatively effortless to release the cable system from the caliper.

The 25mm clearance between the lever and the grip is the rule that determines that the brakes are safely set up. If there is not enough lever travel left after the pads first reach the rim, then the potential braking force will be compromised. The 25mm tolerance is adequate for virtually all brakes, but for some low-performance equipment you might exercise discretion and set a larger clearance.

Second, the cables system should release effortlessly. It is common for mechanics to set brake-pad clearance tighter than necessary. There is a belief that it makes the brakes "feel better," and that it is a hallmark of a meticulous mechanic. These misdirected goals should be avoided. Instead, adhere to this second parameter. The primary convenience feature that is established by following this guideline is that it will be easy for the rider to release the brakes when wheel removal is required. The common mechanic's error is to check the cable-system release with the benefit of a mechanic's strong fingers. The procedure recommends handicapping yourself by using any finger combination *not inluding* your thumb, to simulate a rider with more typical finger strength. Another is that the brake lever will travel a reasonable amount before engaging the pads to the rim. When the lever does not travel far before pad engagement, riders with short fingers have to operate the brake levers with fingers that are uncomfortably extended. The additional pad clearance that is created by this parameter makes it more convenient for the rider to install the wheel without the rim rubbing the pads. You (the mechanic) will appreciate the extra pad clearance established when this rule is followed. Extra pad clearance makes the pad-centering adjustment easier.

4. [ ] **Go to step 5 of *Straddle-wire systems* (page 36-23), *Link-wire systems* (page 36-24), *Link-unit systems* (page 36-24), or *Shimano V-brake* (page 36-25), as appropriate.**

Straddle-wire systems

5. [ ] **Pull on brake lever *just* until pads touch rim and check if clearance between lever and grip is < 25mm.**
6. [ ] **If lever clears grip by < 25mm in previous step, turn cable-adjusting barrel out (up to 5 full turns out from fully-in) to tighten cable, then check lever clearance again. (If clearance is still < 25mm after turning adjusting barrel out to 5-turn limit, turn adjusting barrel in 2 full turns, then pull approximately 2–3mm of straddle-wire through caliper-arm pinch mechanism; check lever clearance again.)**
7. [ ] **Hold pads to rim with one hand and pull straddle-wire bead out of socket in caliper arm *using any combination of fingers not including your thumb*.**

8. [ ] **If straddle-wire bead is too difficult to remove, turn adjusting barrel in 1 full turn and check again. Repeat adjustment if straddle-wire removal remains difficult. (If straddle-wire removal is still difficult after adjusting barrel is fully-in, release 2–3mm of straddle-wire through caliper-arm pinch mechanism, secure pinch mechanism, then check straddle-wire removal again.)**
9. [ ] **Unhook straddle-wire, remove toe-tacks, then rehook straddle-wire.**

Link-wire systems

5. [ ] **Pull on brake lever *just* until pads touch rim and check if clearance between lever and grip is < 25mm.**

In the next step, if the adjusting barrel needs to be turned out more than a total of five full turns to correct the condition of the lever getting too close to the grip, several things may have gone wrong in the setup of the brake. It is possible that the primary wire has slipped through the pinch mechanism, the housing ends were never fully seated in the stops, or that the pads were not set to contact the rim when the pad alignment was done with the Pro-Set tool in place. All of these problems require that you start over at **ATTACH CABLE TO CALIPER** (page 36-17).

6. [ ] **If lever clears grip by < 25mm in previous step, turn cable-adjusting barrel out (up to 5 full turns out from fully-in) to tighten cable, then check lever clearance again. (If clearance is still < 25mm after turning adjusting barrel out to 5-turn limit, return to ATTACH CABLE TO CALIPER and start over.)**
7. [ ] **Hold pads to rim with one hand and pull link-wire bead out of socket in caliper arm *using any combination of fingers not including your thumb*.**

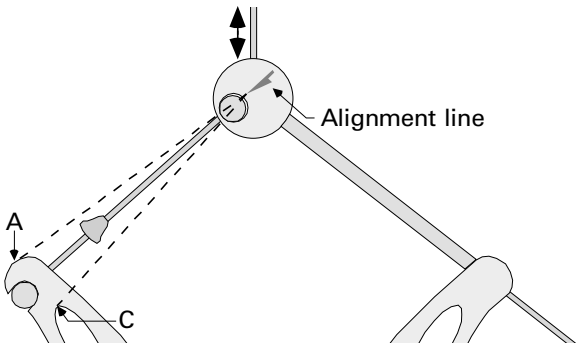
If, in the next step, the adjusting barrel cannot be turned in far enough to create easy cable-system release, several things may have gone wrong in the setup of the brake. It is possible that the adjusting barrel was not out three full turns before attaching the cable to the caliper, the Pro-Set tool was not properly installed, the Pro-Set tool was removed before the pads were adjusted, or that too much tension was put on the wire by the fourth-hand tool. All of these problems are best solved by starting over again at **ATTACH CABLE TO CALIPER** (page 36-17).

8. [ ] **If link-wire wire bead is too difficult to remove, turn adjusting barrel in 1 full turn and check again. Repeat adjustment if link-wire-bead removal remains difficult. (If link-wire-bead removal is still difficult after turning adjusting barrel fully-in, return to ATTACH CABLE TO CALIPER and start over.)**
9. [ ] **Unhook link-wire bead, remove toe-tacks, then re-hook link-wire bead.**

Link-unit systems

There is a line on the face of the link-unit head that is supposed to come close to lining up with the link-wire when the brake is all set up. Establishing this alignment ensures that the cable geometry will offer maximum brake performance.

5. [ ] **Check if alignment line in link-unit head falls between A and C in figure 36.48.**



36.48 *After stressing the cable system, the alignment line in the link-unit head should point between points A and C.*

6. [ ] **If alignment line failed to point between points A and C as in figure 36-48, move inner wire through pinch mechanism on caliper arm to improve alignment.**
7. [ ] **Pull on brake lever *just* until pads touch rim and check if clearance between lever and grip is < 25mm.**

In the next step, if the adjusting barrel must be turned out more than 5 full turns (or if the alignment line would end up pointing above point A) to prevent the lever from coming closer than 25mm to the grip when the pads contact the rim, several things may have gone wrong in the setup of the brake. It is possible that the primary wire has slipped through the pinch mechanism, the housing ends were not fully seated in the stops, or that the pads were set to contact the rim when the alignment line was pointing *above* point A. All of these problems require that you start over at **ATTACH CABLE TO CALIPER** (page 36-17).

8. [ ] **If lever clears grip by < 25mm in previous step, turn cable-adjusting barrel out (up to 5 full turns out from fully-in, or until alignment line points no higher than point A) to tighten cable, then check lever clearance again. (If clearance is still < 25mm after turning adjusting barrel out to limit, return to ATTACH CABLE TO CALIPER and start over.)**

9. [ ] **Hold pads to rim with one hand and pull link-wire bead out of socket in caliper arm *using any combination of fingers not including your thumb*.**

If, in the next step, the adjusting barrel cannot be turned in far enough (or the alignment line must point below point C) to create easy cable-system release, several things may have gone wrong in the setup of the brake. It is possible that the adjusting barrel was not out three full turns before attaching the cable to the caliper or that the pads were set to contact the rim when the alignment line was pointing *below* point A. All of these problems are best solved by starting over again at **ATTACH CABLE TO CALIPER** (page 36-17).

10. [ ] **If link-unit wire bead is too difficult to remove, turn adjusting barrel in 1 full turn and check again. Repeat adjustment if link-unit wire-bead removal remains difficult, but do not adjust until alignment line points below point C as in figure 36.48. (If link-unit wire-bead removal is still difficult after turning adjusting barrel in to limit, return to ATTACH CABLE TO CALIPER and start over.)**
11. [ ] **Unhook link-unit wire bead, remove toe-tacks, then rehook link-unit wire bead.**

Shimano V-brake (transverse wire)

5. [ ] **Pull on brake lever *just* until pads touch rim and check if clearance between lever and grip is < 25mm.**
6. [ ] **If lever clears grip by < 25mm in previous step, turn cable-adjusting barrel out (up to 5 full turns out from fully-in) to tighten cable, then check lever clearance again. (If clearance is still < 25mm after turning adjusting barrel out to 5-turn limit, turn adjusting barrel in 2 full turns, then pull approximately 2–3mm of wire through caliper-arm pinch mechanism; check lever clearance again.)**
7. [ ] **Hold pads to rim with one hand and pull cable-guide tube out of bracket on left caliper arm.**
8. [ ] **If cable-guide tube is too difficult to remove, turn adjusting barrel in 1 full turn and check again. Repeat adjustment if cable-guide-tube removal remains difficult. (If cable-guide-tube removal is still difficult after adjusting barrel is fully-in, release 2–3mm of wire through caliper-arm pinch mechanism, secure pinch mechanism, then check cable-guide-tube removal again.)**

PAD CENTERING

Caliper with spring-tension-adjusting nut

Spring-tension-adjusting nuts are usually found on the back side of the left caliper arm, but may be found on the faces of both caliper arms. The caliper-mounting bolt should be loosened to adjust the spring-tension-adjusting nut(s). A cone wrench works well on spring-tension-adjusting nuts located on the back side of the caliper.

1. [ ] **Operate brake several times, then check whether pads clear rim equally.**
2. [ ] **If caliper has a cable-carrier/straddle-wire-cable-attachment system, try sliding carrier toward side with too much pad clearance; operate brake and see if centering improves and cable carrier holds its position.**
3. [ ] **Loosen caliper-mounting bolt on caliper arm that has spring-tension-adjusting nut on front or back face of caliper arm.**
4. [ ] **Rotate spring-tension-adjusting nut either way until pad centering is acceptable.**
5. [ ] **Holding spring-tension-adjusting nut stationary, torque caliper-arm-mounting bolt to 50–60in-lbs (17–20lbs@3").**
6. [ ] **Operate brake and check whether further adjustment is needed.**

Caliper with spring-tension-adjusting screw

Spring-tension-adjusting screws adjust the position of a spring-mounting plate located inside the caliper arm (where it cannot be seen). The spring-tension-adjusting screw might be a recessed Allen screw or an exposed Phillips screw. The spring-tension-adjusting screw is usually located on the right caliper arm on the outside edge above the arm pivot and below the shoe mount. Turning the screw into the caliper arm always increases spring tension and clearance on the side where the screw is found. Turning the screw out of the caliper arm always decreases spring tension and clearance on the side where the screw is found.

1. [ ] **Operate brake several times, then check whether pads clear equally.**
2. [ ] **If caliper has a cable-carrier/straddle-wire-cable-attachment system, try sliding carrier toward side with too much pad clearance; operate brake and see if centering improves and cable carrier holds its position.**
3. [ ] **Tighten spring-tension-adjusting screw to increase clearance of pad attached to caliper arm that has spring-tension-adjusting screw, or loosen spring-tension-adjusting screw to decrease clearance of pad attached to caliper arm that has spring-tension-adjusting screw.**

4. [ ] **Operate brake and check whether pad clearance is uniform on both sides. If not, repeat adjustment of spring-tension-adjusting screw.**

Changing shoe-stud engagement

When setting up brakes with smooth-stud brake shoes, the objective is to have the same amount of shoe stud protruding out past both anchor bolts. If the centering methods described above do not get the pads equally centered, check whether the shoe studs are protruding evenly. If not, the shoe alignments should be redone. Be certain to set the shoe studs equally.

If the shoe-stud engagements are equal, the cable system is set up properly, and the brakes still cannot be centered, there are usually other problems with the brakes. These problems could be sticky caliper-arm pivots, damaged springs, mis-installed springs, or simply that the wheel is poorly centered between the pivot studs. If any of these problems are found, they should be addressed. If there is still a problem equalizing pad clearance, then shoe-stud engagement in the shoe anchor bolts can be deliberately *offset* to improve pad-clearance symmetry.

FINISHING

See the section called ***FINISHING*** (page 36-43) for cable finish, rim cleaning, and test-ride procedures.

SIDEPULL CALIPERS

This section contains the following sub-sections, which may all be used, or can be used in part:

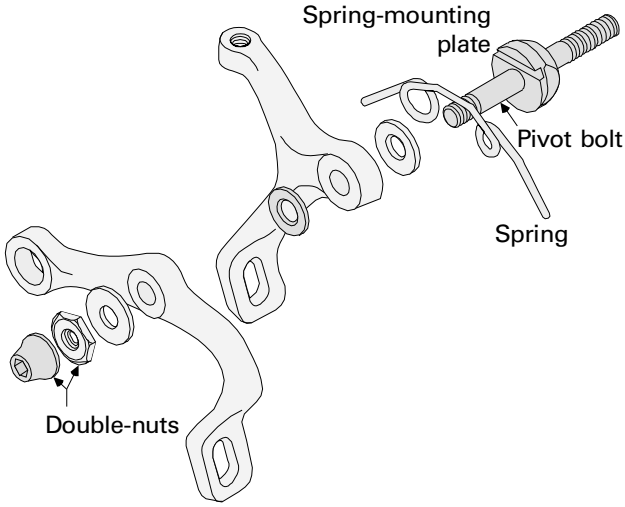
DOUBLE-NUT PIVOT SERVICE
SAFETY-PIVOT SERVICE
CALIPER ATTACHMENT AND LUBRICATION
PAD ADJUSTMENT
CABLE ATTACHMENT AND CLEARANCE ADJUSTMENT
CENTERING ADJUSTMENT

Even if the brake caliper is not being disassembled as part of the brake service, it is nonetheless a good idea to readjust the pivots. Loose pivots cause brake squeal and "grabby" feeling brakes. It is important to remember that loose pivot-adjusting nuts on a double-nut-type pivot *can cause the brake to come apart!*

The **PAD ADJUSTMENT** section provides alignment tolerances only. You must refer back to the earlier section, ***PAD-ALIGNMENT SYSTEMS***, to use the procedure for aligning the pads. (Page numbers are provided in the procedure when needed.)

DOUBLE-NUT-PIVOT SERVICE

The double-nut-pivot type of sidepull caliper is characterized by two nuts that are locked to each other on the face of the caliper. These nuts are used to adjust the pivot. The other common type of pivot design is the safety-pivot type, which has a bolt head on the front of the pivot, instead of the two nuts.



36.49 *Blow-up of a typical double-nut-pivot assembly.*

Disassembly

1. [ ] **Grasp back end of pivot/mounting bolt in soft jaws of bench vise.**
2. [ ] **Disconnect springs from caliper arms by popping them out of their mounts with screwdriver, or Langley fifth-hand tool.**
3. [ ] **Hold inner nut stationary while turning outer nut counterclockwise, until removed.**
4. [ ] **Remove inner nut.**
5. [ ] **Remove front washer(s) and note orientation(s).**
6. [ ] **Remove front caliper arm, and look for washers stuck on back side of arm.**
7. [ ] **Remove any washers between front and back caliper arms. Shimano Dura-Ace caliper #BR7400 may have central washer that is sandwich of plastic washer (contains 14-2mm ball bearings) between two metal washers. Be careful when separating washers so that balls do not drop out.**
8. [ ] **Remove back caliper arm and look for washer stuck on backside of arm. Note orientation of washer.**
9. [ ] **Remove any washer left on pivot bolt and note its orientation.**
10. [ ] **Note orientation of spring and remove it from slot in spring-mounting plate.**

If you are disassembling front and rear calipers at the same time, it is critical that you do not mix up the arms. They may be different lengths, or they may have been twisted to create the pad-toe adjustment. When caliper arms have been twisted for toe adjustment, the direction of twist on the front is opposite of that used on rear calipers. Use a scribe to mark the back face of each caliper arm. A single scribe mark can be used to indicate a front caliper arm, and a double scribe mark can indicate a rear caliper arm.

11. [ ] If disassembling front and rear brakes, mark front and rear arms with different marks.

Brake pads that have broken-in to the rim should always be reinstalled at their original locations and orientations, even if there were no original orientation guidelines on the pads. A convenient way to mark pads is to use the corner edge of a file to put a groove in the *back* and *bottom* edge of the pad. This location for the groove is well hidden from view when the pad is on the bike and has no effect on braking quality. By putting the groove on the back *and* bottom edge, there is no way the pad can be installed incorrectly. See figure 36.53 (page 36-29) for clarification as to where the pads should be marked. Once again, one mark can be used to signify front brake, and two marks to signify rear brake.

12. [ ] Remove brake pads for replacement or cleaning. Note front and back ends of pads, and mark pads so that they will not be switched between front and back of bike.

Cleaning and inspection

13. [ ] Clean all parts in solvent.
14. [ ] Inspect pivot bolt for bends.
15. [ ] Inspect caliper arms for bends.
16. [ ] Inspect pivot bolt and adjusting nuts for damaged threads.
17. [ ] Inspect adjusting nuts for damaged flats.
18. [ ] Inspect spring for stiffness (should be too stiff to remove or install without tools, except when lever has return spring).

Assembly and lubrication

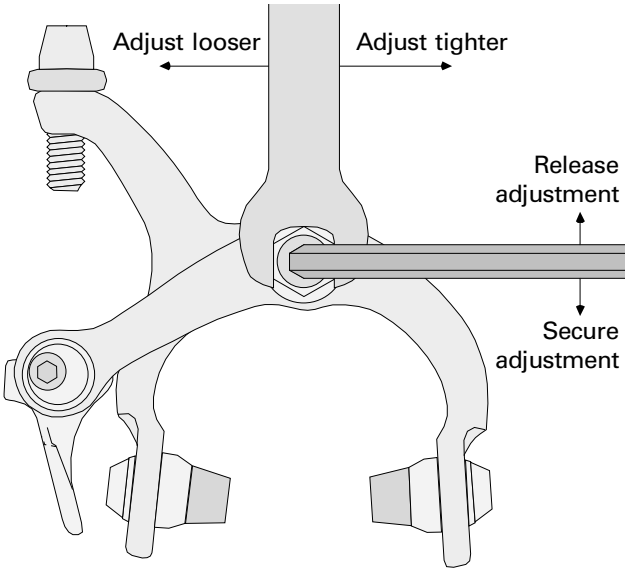
19. [ ] Grasp pivot bolt by mounting end in soft jaws of vise.
20. [ ] Lubricate pivot and threads in front of spring-mounting plate only.

In the next step, the spring is put into the spring-mounting plate. Be careful, it is easy to install the spring incorrectly. The spring should be oriented so that coils protrude back from mounting point and the coils are beside the mounting plate (not above or below). Most calipers are designed so that the slot in the spring-mounting plate should be above the pivot bolt. If, however, mounting the spring above the pivot bolt causes the coils to rise above the caliper arms, then the slot in the spring-mounting plate belongs below the pivot bolt.

21. [ ] Place spring in spring-mounting plate.
22. [ ] Place back washer in its correct orientation on pivot.
23. [ ] Oil front and back of rear caliper arm at pivot.
24. [ ] Place rear caliper arm on pivot, but do not engage spring.
25. [ ] Place middle washer(s) on pivot. (Oil bearings in Shimano Dura-Ace #BR-7400 middle washer.)
26. [ ] Oil front and back of front caliper arm at pivot.
27. [ ] Place front caliper arm on pivot, making sure that cable-pinch-mechanism end of arm is below housing stop end of rear caliper arm. Do not engage spring ends at this time.
28. [ ] Place front washer(s) on pivot in correct orientation.
29. [ ] Thread on two front nuts.
30. [ ] Engage spring ends to posts on back face of caliper arms, and lubricate points at which they bear against arms. Additional oil may be needed in coils themselves, between coils and spring-mounting plate, and between spring and rear caliper arm.
31. [ ] If shoes have been removed, oil mounting threads and mount shoes securely.
32. [ ] Additional oiling should be done on pinch-mechanism threads, cable-adjusting-barrel threads, and quick-release-mechanism pivots.

Pivot adjustment

Adjustment can be accomplished with the brake still mounted on the bike, as long as it is secure, The adjustment can also be done with the mounting bolt secure in a vise with soft jaws.



36.51 *Proper setup for adjusting the pivot on a double-nut-type pivot. The adjustment can be done with the caliper on the bike, or mounted in the vise.*

33. [ ] **If brake was not just oiled, oil front and back of each caliper arm at pivot and at points at which spring ends bear against caliper arms.**
34. [ ] **If brake adjusting nuts are still locked together, hold inner one stationary and break loose outer nut.**
35. [ ] **Turn inner nut clockwise until it bears against caliper arms, then turn it counterclockwise 90°.**
36. [ ] **Holding inner nut stationary, tighten outer nut to torque of 50–70in-lbs (13–18lbs@4").**
37. [ ] **Grasp bottoms of caliper arms and jerk them vigorously forward and back to check for any knocking sensation that indicates adjustment is too loose.**

For the proper directions to turn the inner nut and outer nut for adjusting and securing the pivot adjustment, see figure 36.51 (page 36-27).

38. [ ] **To tighten adjustment, hold inner nut stationary while breaking loose outer nut, then turn inner nut 10° clockwise (about 3/4" at end of 4.5" wrench), and hold it at this position while re-securing outer nut.**

In the next step, it is important to eliminate all play from the pivot adjustment. Loose pivot adjustments cause grabby brakes and squealing brakes.

39. [ ] **Check for knocking again, and repeat adjustment as many times as necessary to eliminate knocking that indicates pivot adjustment is loose.**

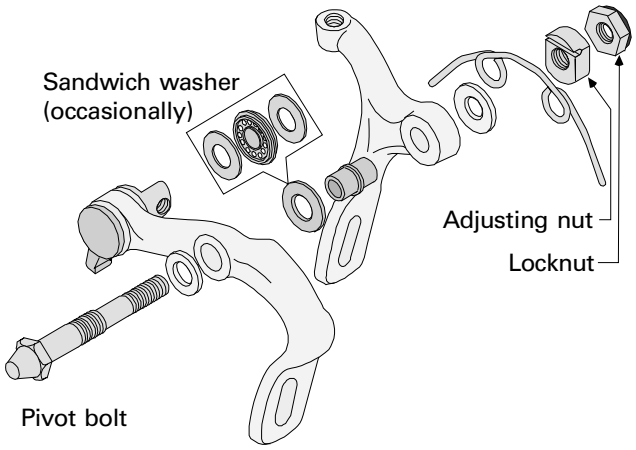
In the next step, the pivot adjustment is checked for excessive tightness. It can appear that the adjustment is too tight because the spring is too soft. The spring should be stiff enough so that it cannot be removed or installed comfortably by hand (unless lever has return spring). Soft springs should be replaced. Soft springs can be stiffened, if necessary, by bending the ends further away from each other. Use a pair of Langley fifth-hand brake tools (or pliers on each end of spring) to spread the spring ends further apart.

40. [ ] **To check for too-tight pivot adjustment, squeeze caliper arms together about 1/2", then release them slowly. If they do not open all way by themselves, adjustment may be too tight, or spring too soft. Check spring before loosening adjustment.**
41. [ ] **To loosen adjustment, hold inner nut stationary while breaking loose outer nut, then turn inner nut 10° counterclockwise (about 3/4" at end of 4.5" wrench), and hold it at this position while re-securing outer nut. Repeat adjustment until knocking is detected, then return to last setting.**

SAFETY-PIVOT SERVICE

Disassembly

The safety-pivot type of sidepull caliper is distinguished by the fact that the pivot bolt has a head on the front of the caliper, unlike the double-nut type which has two nuts threaded onto the pivot bolt at the front of the caliper. The adjustment nut and locknut are located between the caliper and the mounting point on the frame or fork. On some models, there is no adjustment locknut and the adjustment must be done with the caliper mounted on the bike (the mounting nut serves as the adjustment locknut).



36.52 *Blow-up of a safety-pivot-design sidepull caliper.*

1. [ ] **Remove brake from bike.**
2. [ ] **Disengage spring. With many models, spring needs to be rotated up for wrench access to adjusting nut (nut closest to caliper).**

The adjustment locknut (outer nut) on some models of Shimano brakes is a 12-point nut that is fit only by a 13mm or 14mm box-end wrench. In the next step, the end of the pivot bolt is grasped in the vise; the box-end wrench needs to be placed over the end of the pivot bolt first.

3. [ ] **Mount pivot bolt in soft jaws of vise.**
4. [ ] **Facing caliper from its back, hold inner nut stationary with cone wrench, then turn outer nut counterclockwise to break it loose.**
5. [ ] **With caliper in hand (not in vise), hold nuts and arms stationary while turning pivot-bolt head counterclockwise to unthread it from nuts. Note order and orientation of each nut as it comes off.**

In the next step, a simple washer may be found between the caliper arms. There may also be a more complex thrust washer with bearings. The thrust washer is a sandwich with a plastic retainer contain-

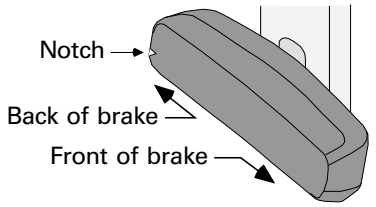
ing 14 tiny 2mm bearings. Because the bearings are easily lost, be careful when separating the metal washer from either face of the plastic retainer.

6. [ ] Remove caliper arms and washers, noting order and orientation of each.

If you are disassembling front and rear calipers at the same time, it is critical that you do not mix up the arms. They may be different lengths, or they may have been twisted to create the pad-toe adjustment. When caliper arms have been twisted for toe adjustment, the direction of twist on the front is opposite of that used on rear calipers. Use a scribe to mark the back face of each caliper arm. A single scribe mark can be used to indicate a front caliper arm, and a double scribe mark can indicate a rear caliper arm.

7. [ ] If disassembling front and rear brakes, mark front and rear arms with different marks.

Brake pads that have broken-in to the rim should always be reinstalled at their original locations and orientations, even if there were no original orientation guidelines on the pads. A convenient way to mark pads is to use the corner edge of a file to put a groove in the *back* and *bottom* edge of the pad. This location for the groove is well hidden from view when the pad is on the bike and has no effect on braking quality. By putting the groove on the back *and* bottom edge, there is no way the pad can be installed incorrectly. See figure 36.53 for clarification as to where the pads should be marked. Once again, one mark can be used to signify front brake, and two marks to signify rear brake.



36.53 Notch the back-bottom edge of the pad. Use one notch for front-brake pads, or two notches for rear-brake pads.

8. [ ] Remove brake pads for replacement or cleaning. Note front and back ends of pads, and mark pads so that they will not be switched between front and back of bike.

Cleaning and inspection

9. [ ] Clean all parts in solvent.
10. [ ] Inspect pivot bolt for bends.
11. [ ] Inspect caliper arms for bends.
12. [ ] Inspect pivot bolt and adjusting nuts for damaged threads.
13. [ ] Inspect adjusting nuts for damaged flats.
14. [ ] Inspect spring for stiffness (should be too stiff to remove or install without tools except when lever has return spring).

Assembly and lubrication

15. [ ] Oil pivot area of pivot bolt.
16. [ ] Oil threads for adjusting nut(s).
17. [ ] Install front washer on pivot.
18. [ ] Oil front and rear face of front caliper arm at pivot point.
19. [ ] Install front caliper arm on pivot.
20. [ ] Install middle washer(s) and bushing (if any). Oil bearings in Shimano sandwich washer with bearings.
21. [ ] Oil front and rear face of rear caliper arm at pivot point.
22. [ ] Install rear caliper arm on pivot.
23. [ ] Install rear washer.

In the next step, the spring is put into the spring-mounting plate. Be careful, it is easy to install the spring in incorrectly. The spring should be oriented so that coils protrude back from mounting point and the coils are beside the mounting plate (not above or below). Most calipers are designed so that the slot in the spring-mounting plate should be above the pivot bolt. If, however, mounting the spring above the pivot bolt causes the coils to rise above the caliper arms, then the slot in the spring-mounting plate belongs below the pivot bolt.

24. [ ] Thread on spring-mounting plate in correct orientation, until it is just close enough to caliper to allow installation of spring. Then install spring.
25. [ ] Thread pivot bolt rest of way into spring-mounting plate.
26. [ ] Install outer nut.

Pivot adjustment

The pivot adjustment on a safety-pivot caliper has to be done with the caliper removed from the bike.

27. [ ] Mount pivot bolt in soft jaws of vise.
28. [ ] Flip spring up out of way if it prevents access to inner nut with wrench from above.
29. [ ] If brake was not just oiled, oil front and back of each caliper arm, and points at which spring ends bear against caliper arms.

In the next step, make the adjustment while viewing the caliper from its back face.

30. [ ] If brake adjusting nuts are still locked together, hold inner nut (spring-mounting plate) stationary while turning outer nut counterclockwise.
31. [ ] Turn inner nut clockwise until it bears against caliper arms. Then turn it counterclockwise 90°.
32. [ ] Holding inner nut stationary, tighten outer nut to torque of 50–70in-lbs (13–18lbs@4").

33. [ ] **Grasp bottoms of caliper arms and jerk them vigorously forward and back to check for any knocking sensation that indicates adjustment is too loose.**
34. [ ] **To tighten adjustment, hold inner nut stationary while breaking loose outer nut, then turn inner nut 10° clockwise (about 3/4" at end of 4.5" wrench), and hold it at this position while re-securing outer nut.**

In the next step, it is important to eliminate all play from the pivot adjustment. Loose pivot adjustments cause grabby brakes and squealing brakes.

35. [ ] **Check for knocking again and repeat adjustment as many times as necessary to eliminate knocking that indicates pivot adjustment is loose.**

In the next step, the pivot adjustment is checked for excessive tightness. It can appear that the adjustment is too tight because the spring is too soft. The spring should be stiff enough so that it cannot be removed or installed comfortably by hand (unless lever has return spring). Soft springs should be replaced. Soft springs can be stiffened, if necessary, by bending the ends further away from each other. Use a pair of Langley fifth-hand brake tools (or pliers on each end of spring) to spread the spring ends further apart.

36. [ ] **To check for too-tight pivot adjustment, squeeze caliper arms together about 1/2", then release them slowly. If they do not open all way by themselves, adjustment may be too tight, or spring too soft. Check spring before loosening adjustment.**
37. [ ] **To loosen adjustment, hold inner nut stationary while breaking loose outer nut, then turn inner nut 10° counterclockwise (about 3/4" at end of 4.5" wrench), and hold it at this position while re-securing outer nut. Repeat adjustment until knocking is detected, then return to last setting.**

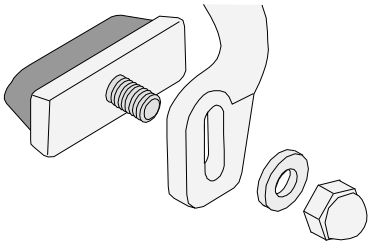
CALIPER ATTACHMENT AND LUBRICATION

1. [ ] **Make sure radiused washer is between brake and mounting surface if mounting surface is curved.**
2. [ ] **Treat mounting-nut threads with Loctite 242, unless mounting nut has nylon insert.**
3. [ ] **Put caliper-mounting stud in mounting hole and thread nut on end of mounting stud (use flat washer under hex nut that seats against flat surface; use radiused washer under hex nut that seats against curved surface).**
4. [ ] **Holding pads firmly to rim, torque mounting nut to 70–85in-lbs (23–28lbs@3").**
5. [ ] **Oil: between pivot-bolt head (or double nuts) and face of front caliper arm, between caliper arms at pivot, at backside of back caliper arm at pivot, where springs push against posts on back side of caliper arms, pinch-mechanism threads, shoe-mounting threads, and adjusting-barrel threads.**

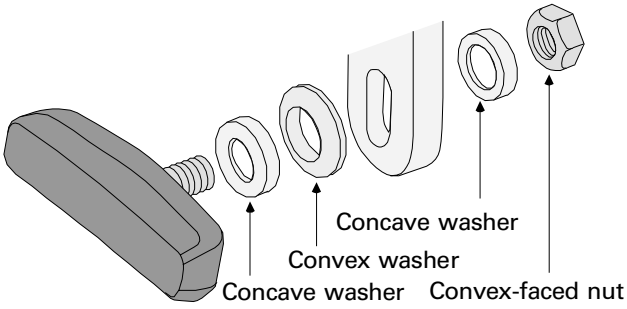
PAD ADJUSTMENTS

1. [ ] **Check each pad for directional arrows and/or right/left indications; make sure pads will be installed with arrows pointing in the direction of rim rotation, and any pad marked with "R" is mounted on right side of bike and any marked with "L" is on left side of bike.**

Determine what type of pad-alignment system is on the calipers. Use the procedures in the earlier section for **SIMPLE THREADED-STUD-PAD ALIGNMENT** (page 36-8), or **THREADED-STUD/CURVED-WASHER PAD ALIGNMENT** (page 36-10). Align the pads to the tolerances described in step 2.



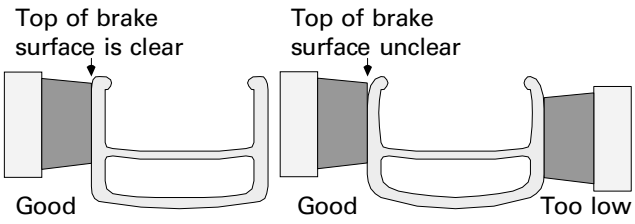
36.54 *A simple threaded-stud pad-alignment design.*



36.55 *A threaded-stud/curved-washer pad-alignment design.*

Sidepull-caliper pads move down as they move in. So that the pads do not end up too low, they should be set so that the top edge of the pad is even with the top edge of the rim's braking surface. Complicating pad height setting is the fact that the top edge of the braking surface is not always distinct. Sometimes the rim just begins to curve inward gradually, and the braking surface just "fades" away. In this case, consider the edge of the braking surface to be the point of transi-

tion where the surface of the rim changes from facing towards the pad to facing more up. In no case should the top edge of the left pad be more than 1mm below the absolute top of the rim.



36.56 *Correct sidepull caliper-pad height.*

2. [ ] **Determine what pad-alignment system to use by looking at way shoes are mounted to caliper arm, then use appropriate pad-alignment-system procedure to achieve following tolerances (in order indicated by pad-alignment-system procedure):**
   Pad toe: **entry-end of pad clears rim by .5–1.5mm when exit-end touches rim.**
   Vertical angle: **vertical angle of pad face is parallel to vertical angle of rim face.**
   Pad tangent: **top corners of pad are equidistant from top edge of rim.**
   Pad height: **top edge of pad face is even with top edge of rim's braking surface.**

CABLE ATTACHMENT AND CLEARANCE ADJUSTMENT

1. [ ] **Install brake lever and cable system, if not already installed.**
2. [ ] **Lubricate threads of pinch mechanism on caliper arm and threads of cable-adjusting barrel on other caliper arm, if not already done.**
3. [ ] **Set cable-system adjusting barrel to 3 full turns out from fully-in position.**
4. [ ] **Hold pads to rim with third-hand tool.**

Many sidepull calipers come equipped with quick release (Q.R.) mechanism. This mechanism is usually a lever that can be flipped up or down to change the pad clearance in order to facilitate wheel removal. The cable-pinch mechanism is usually attached to the Q.R. mechanism. When the Q.R. mechanism is operated, it should be possible to see the pinch mechanism moving closer to and further from the cable-housing stop. When the two are closer together, the Q.R. mechanism is in the released position and when the two are farther apart, the Q.R. mechanism is in the non-released (brake operational) position. The brake should be setup with the Q.R. mechanism in the non-released position.

5. [ ] **Make sure Q.R. mechanism lever is in non-released position.**
6. [ ] **Thread inner wire through cable-adjusting barrel and cable-pinch mechanism.**
7. [ ] **Draw slack out of cable with fourth-hand tool.**
8. [ ] **Secure pinch bolt to torque of 50–70in-lbs (17–23lbs@3").**
9. [ ] **Stress cable system by pulling against lever 10 times with maximum force that would be used during a panic stop.**
10. [ ] **Set up stack of feeler gauges to equal 3mm (or use 3mm Allen wrench) to check clearance at exit-end of one brake pad when other pad is held to rim.**
11. [ ] **If clearance is >3mm, draw more wire through pinch mechanism.**
12. [ ] **When clearance is <3mm, turn down cable-adjusting barrel(s) until clearance is 3mm.**
13. [ ] **If clearance is still <3mm when adjusting barrel is fully down, let 2–3mm more cable through pinch mechanism and check clearance again.**

CENTERING ADJUSTMENT

Double-nut-caliper pad centering

NOTE: In steps 1 and 2, references to clockwise and counterclockwise are as seen when viewing the brake from its front.

1. [ ] **If right pad is closer to rim, rotate inner nut (on front of brake) and mounting nut simultaneously counterclockwise the same amount, to rotate pivot assembly.**
2. [ ] **If left pad is closer to rim, rotate outer nut (on front of brake) and mounting nut simultaneously clockwise the same amount, to rotate pivot assembly.**
3. [ ] **Operate brake with lever to check result of adjustment.**
4. [ ] **Repeat adjustment in either direction as necessary.**

Safety-pivot caliper pad centering

1. [ ] **With one wrench on pivot-bolt head and another wrench on mounting nut, rotate both wrenches simultaneously clockwise to move left pad away from rim, or simultaneously counterclockwise to move right pad away from rim (viewed from front of brake).**
2. [ ] **Operate brake with lever to check result of adjustment.**
3. [ ] **Repeat adjustment in either direction as necessary.**

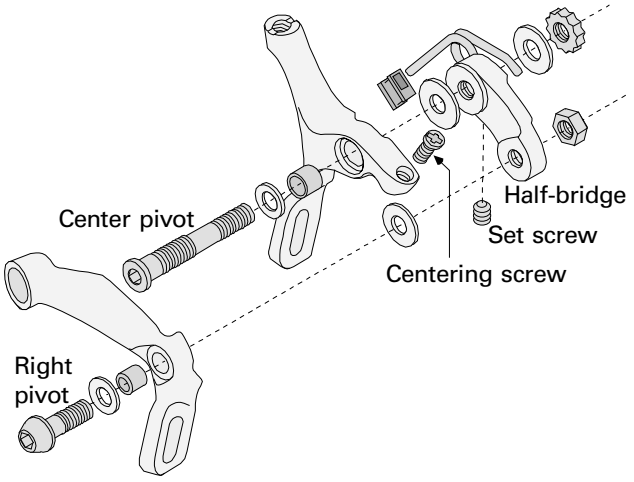
FINISHING

See the section called ***FINISHING*** (page 36-43) for cable finish, rim cleaning, and test-ride procedures.

DUAL-PIVOT CALIPERS

The dual-pivot brake is unique, with one caliper arm operating like a sidepull-caliper arm, and the other operating like a centerpull-caliper arm.

All references to the brake in this section will be the same, regardless of the brake's position on the bike. Simply put, the right arm is on the right as viewed from the face of the brake. "Front" is the face of the brake, and "rear" is the backside of the brake, or the part that faces the frame or fork.



36.57 *Blow-up of a Shimano dual-pivot caliper.*

The caliper consists of three main pieces and two pivots. Refer to the accompanying illustration.

- The right caliper arm is the most forward piece. It is the one that operates like a centerpull arm, arcing on a pivot that is outward of the rim.
- The left caliper arm is the middle piece of the brake. It is the one that operates like a sidepull-caliper arm, arcing on a pivot that is centered over the rim.
- The remaining piece, closest to the frame or fork, is similar to the bridge of a centerpull caliper. Due to this similarity, it is called the half-bridge.
- At the center of the brake, there is a bolt that serves to mount the brake to the bicycle and also as a pivot bolt for the left arm. It will be called the center pivot. With the other parts that make up the pivot assembly, it is called the center-pivot assembly.
- The right caliper arm is mounted to the half-bridge. The bolt that holds these together is referred to as the right-pivot bolt. With the accompanying parts, it is called the right-pivot assembly.
- One more unique part is found on top of the extreme right end of the left caliper arm. It is a screw that can fit a Phillips or standard screwdriver. It is used to center the caliper arms, and is called the centering screw.

NOTE: If adjusting brakes only, and no pivot adjustment is necessary, go to* MOUNTING CALIPER TO FRAME *(page 36-35).

This section contains the following sub-sections, which may all be used, or can be used in part:

DISASSEMBLING THE CALIPER
ASSEMBLING THE CALIPER
MOUNTING CALIPER TO FRAME
INSTALLING AND ADJUSTING PADS
CABLE ATTACHMENT, CLEARANCE, AND CENTERING ADJUSTMENTS

If the brake caliper is not being disassembled as part of the brake service, it is still a good idea to use the part of the **ASSEMBLING THE CALIPER** section regarding pivot adjustment (page 36-33). Loose pivots can cause the brakes to squeal and feel grabby.

The **PAD ADJUSTMENT** section provides alignment tolerances only. You will need to refer back to the earlier section, ***PAD-ALIGNMENT SYSTEMS***, to use the procedure for aligning the pads (page number provided in the procedure when needed).

DISASSEMBLING THE CALIPER

1. [ ] **Remove caliper assembly from bike.**
2. [ ] **Use Langley fifth hand (or pliers) to disengage spring, then remove rectangular sleeve on the springs (Shimano non-Dura-Ace only).**
3. [ ] **Remove brake shoes, note and mark right/left and front/back orientations as necessary.**
4. [ ] **If intending to disassemble or adjust center pivot only, face brake and push down and in on right arm to expose center pivot-bolt head (Shimano only).**

NOTE: Shimano and Campagnolo dual-pivot calipers differ primarily in regard to the design of the right pivot. Use steps 5–8 only for the type of caliper being serviced.

Disassembling Shimano right pivot

5. [ ] **Hold pivot bolt stationary with 4mm Allen wrench.**
6. [ ] **Turn 10mm nut on back side of half-bridge counterclockwise (facing back) to break nut loose and remove nut.**
7. [ ] **Turn pivot bolt counterclockwise (facing front) to remove bolt.**
8. [ ] **Disassemble pivot assembly and observe sequence of parts.**

NOTE: Go to Disassembling center-pivot assembly now.

Disassembling Campagnolo right pivot

NOTE: There is a set screw in one of the faces of the hex nut on the back of the right-pivot assembly that will destroy the threads on the pivot stud, if not loosened before turning the hex nut.

5. [ ] **Loosen set screw in wrench flat of rearmost nut on right-pivot assembly.**
6. [ ] **Hold square nut stationary and unthread hex nut on back side of right-pivot assembly.**
7. [ ] **Unthread square nut from backside of right-pivot assembly.**
8. [ ] **Disassemble pivot assembly and observe sequence of parts.**

Disassembling center-pivot assembly

NOTE: There is a set screw in the half bridge (or the nut on the back of the center-pivot assembly) that will destroy the threads on the pivot stud if not loosened before turning the center pivot.

9. [ ] **Loosen set screw on bottom of half-bridge immediately below center-pivot bolt with 2mm hex wrench (set screw is on rearmost nut of center-pivot assembly on Dura-Ace and Campagnolo models).**
10. [ ] **Place wrench on nut on back side of half-bridge (12-point nuts require box-end wrench), and then secure threaded end of the center-pivot bolt in soft jaws in vise. (Place assembly in vise so that you can easily face assembly's back side.)**
11. [ ] **Holding half-bridge stationary, turn nut counterclockwise to break it loose.**
12. [ ] **Remove assembly from vise.**
13. [ ] **Thread off nut.**
14. [ ] **Slip off large thin washer.**
15. [ ] **Remove spring from groove in back face of half-bridge, being sure to observe how unique end of spring fits in groove so that spring cannot pull straight out.**
16. [ ] **Thread center-pivot bolt counterclockwise out front of assembly, being careful to not let assembly fall apart.**
17. [ ] **With bolt out, disassemble center-pivot assembly and observe sequence of parts.**
18. [ ] **From face of left caliper arm, remove small washer.**
19. [ ] **From inside hole in left caliper arm, remove plastic bushing (except Campagnolo).**

Depending on the model, there may be a simple washer, or a sandwich-washer, between the left caliper arm and the half-bridge. Be careful when separating the caliper arm and half-bridge because the sandwich washer has twelve 2mm bearings trapped in holes in the plastic washer which are easily lost.

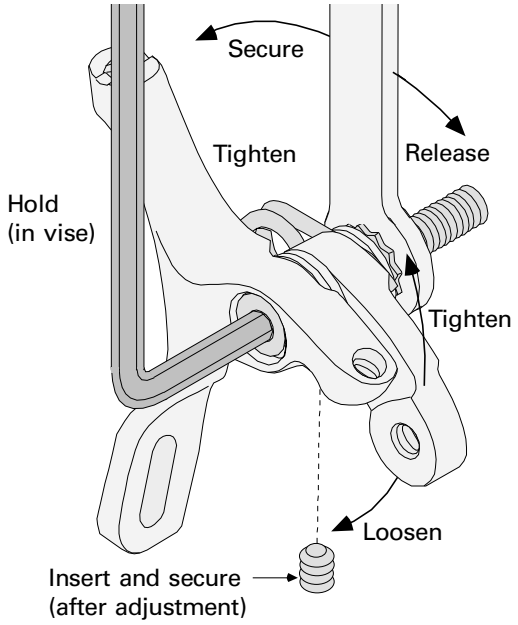
20. [ ] **From between left caliper arm and half-bridge, remove washer or sandwich-washer assembly.**

ASSEMBLING THE CALIPER

21. [ ] **Lubricate washer or sandwich-washer that goes between left arm and half-bridge, and place it between these two pieces.**
22. [ ] **Lubricate small washer that goes on face of left arm, and place it on face of left arm.**
23. [ ] **Lubricate larger diameter threads of center-pivot bolt. Slip bolt into face of left caliper arm and thread it fully into half-bridge.**
24. [ ] **Place spring and large washer onto back of center-pivot assembly.**
25. [ ] **Thread nut onto center-pivot bolt (Shimano: make sure subtly concave face is against large washer).**

Adjust center-pivot assembly

Even if the caliper has not been disassembled, it is a good idea to adjust the pivots to eliminate any free play. Such play can cause brakes to squeal and feel grabby. The Shimano center-pivot assembly can be adjusted without disassembling the right-pivot assembly. With the mounting bolt held in soft jaws of a vise, by pushing down and in on the right-pivot assembly, the head of the center-pivot bolt becomes exposed. The Campagnolo center-pivot assembly is only accessible after disassembling the right-pivot assembly.



36.58 *Adjusting the center-pivot assembly.*

26. [ ] Place wrench on nut.
27. [ ] Grasp threaded-end of center pivot firmly in soft jaws of vise with assembly positioned so that you are facing its back side.
28. [ ] Turn half-bridge clockwise until it bottoms out, then counterclockwise about 60°.
29. [ ] Holding half-bridge stationary with your fingers, turn nut clockwise to tighten it against half-bridge to a torque of 60–70in-lbs (20–23lbs@3").
30. [ ] Jerk in and out on end of left caliper arm to check for free play or knock.
31. If knock is felt:
[ ] Hold half-bridge stationary.
[ ] Break nut loose (counterclockwise).
[ ] Turn half-bridge clockwise so that its end moves 5–10mm.
[ ] Hold half-bridge stationary and secure nut.
[ ] Check for knock again. Repeat step 31 as many times as necessary until no knock is felt.
32. If no knock is felt, check that left caliper arm is pivoting freely without excessive drag. If excessive drag is felt:
[ ] Hold half-bridge stationary.
[ ] Break nut loose (counterclockwise).
[ ] Turn half-bridge counterclockwise so that its end moves 5–10mm.
[ ] Hold half-bridge stationary and secure nut.
[ ] Check for excessive drag again. Repeat step 32 as many times as necessary until knock is felt, then return to last setting.
33. [ ] *Shimano non-Dura-Ace only:* Slip spring sleeve onto spring.
34. [ ] Engage spring in its notch on back side of left caliper arm.

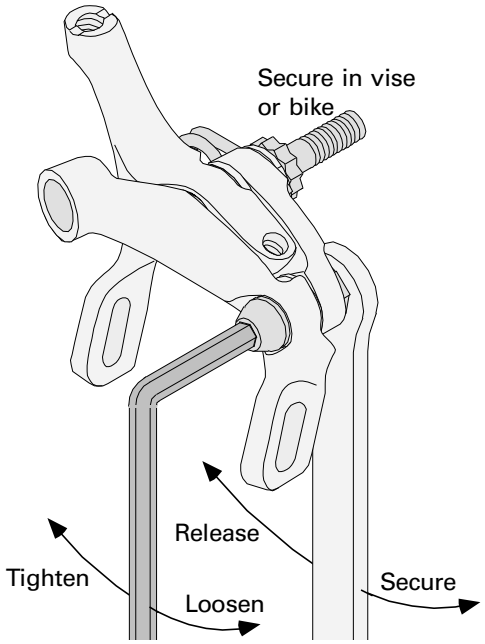
On Shimano non-Dura-Ace calipers, the sleeve on the spring can be flip-flopped two ways to adjust spring tension. On Shimano Dura-Ace and Campagnolo models, there is a threaded adjustment for changing spring tension. The tighter setting is for excess cable friction that results from long or unusual routings.

35. [ ] Secure set screw in half-bridge (or locknut on backside of half-bridge) with 2mm Allen wrench.

NOTE: Go to Assembling and adjusting Campagnolo right pivot, if brake being serviced is a Campagnolo model.

Assemble and adjust Shimano right pivot

Even if the caliper has not been disassembled, it is a good idea to adjust the pivots to eliminate any free play. Such play can cause brakes to squeal or feel grabby. The Shimano right-pivot assembly can be adjusted without removing the caliper from the bike.



36.59 Adjusting a Shimano right-pivot assembly.

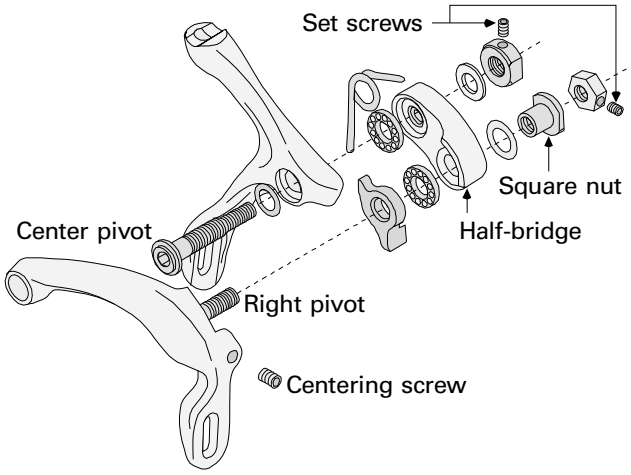
36. [ ] Lubricate both sides of both washers, inside and outside of bushing, and threads of right-pivot bolt.
37. [ ] Sandwich large washer between back of right caliper arm and front of right end of half-bridge.
38. [ ] Put small washer on face of right caliper arm.
39. [ ] Put right-pivot bolt through right caliper arm and thread it fully into half-bridge.
40. [ ] Thread on, but do not secure, 10mm nut on back side of half-bridge.
41. [ ] Mount brake securely to frame or fork.
42. [ ] Turn right-pivot bolt clockwise (facing brake) until it bottoms out, then back it off 90°.
43. [ ] Hold right-pivot bolt stationary while securing 10mm nut to torque of 50–70in-lbs (17–23lbs@3").
44. [ ] Jerk in and out on end of right caliper arm and check for free play or knock.
45. If knock is felt:
[ ] Hold bolt stationary.
[ ] Break loose 10mm nut.
[ ] Turn bolt clockwise (1/2" at end of 3" Allen wrench
[ ] Hold bolt stationary and secure 10mm nut.
[ ] Check for knock again. Repeat step 45 as many times as necessary until no knock is felt.

46. [ ] If no knock is felt, check that right caliper arm is pivoting freely without excessive drag. If excessive drag is felt:
[ ] Hold bolt stationary.
[ ] Break loose 10mm nut.
[ ] Turn bolt counterclockwise (1/2" at end of 3" Allen wrench).
[ ] Hold bolt stationary and secure 10mm nut again.
[ ] Check for excessive drag again. Repeat step 46 as many times as necessary until knock is felt, then return to last setting.

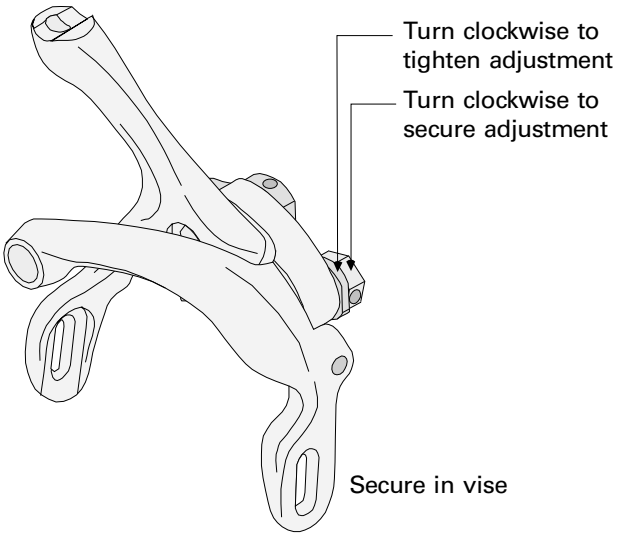
***NOTE: Go to* MOUNTING CALIPER TO FRAME.**

Assemble and adjust Campagnolo right pivot

Even if the caliper has not been disassembled, it is a good idea to adjust the pivots to eliminate any free play. Such play can cause brakes to squeal or feel grabby. The Campagnolo right-pivot assembly can be adjusted without removing the caliper from the bike.



36.60 *Blow-up of a Campagnolo dual-pivot assembly.*



36.61 *Adjusting a Campagnolo right-pivot assembly.*

36. [ ] Lubricate sandwich-washer, then assemble centering cam and washer onto pivot stud in back face of right arm.
37. [ ] Place half-bridge over right-arm pivot stud.
38. [ ] Put small washer on back face of half-bridge.
39. [ ] Grease square-head sleeve nut, then thread onto pivot stud so that sleeve goes inside hole in half-bridge.
40. [ ] Thread nut onto right-arm pivot stud, but do not secure.
41. [ ] Grasp bottom end of right caliper arm in soft jaws in vise, with back face of brake up.
42. [ ] Turn square nut clockwise until bottomed, then back of approximately 90°.
43. [ ] Hold square nut stationary and secure hex nut to torque of 50–70in-lbs (17–23lbs@3").
44. [ ] Jerk in and out on end of right caliper arm and check for free play or knock.
45. If knock is felt:
[ ] Hold square nut stationary.
[ ] Break loose hex nut.
[ ] Turn square nut clockwise (1/2" at end of 3" wrench).
[ ] Hold square nut stationary and secure hex nut again.
[ ] Check for knock again. Repeat step 45 as many times as necessary until no knock is felt, then secure 2mm Allen set screw in wrench flat on hex nut.
46. [ ] If no knock is felt, check that right caliper arm is pivoting freely, without excessive drag. If excessive drag is felt:
[ ] Hold square nut stationary.
[ ] Break loose hex nut.
[ ] Turn square nut counterclockwise (1/2" at end of 3" wrench).
[ ] Hold square nut stationary and secure hex nut again.
[ ] Check for excessive again. Repeat step 46 as many times as necessary until knock is felt, then return to last setting and secure 2mm Allen set screw in wrench flat on hex nut.

MOUNTING CALIPER TO FRAME

1. [ ] Treat mounting-nut threads with Loctite 242, unless mounting nut is hex-nut variety with nylon insert for thread locking (leave untreated).
2. [ ] Install mounting stud on back of caliper into hole in frame or fork, then thread mounting nut onto mounting stud.
3. [ ] Install brake pads so that they will strike rim at normal position. This is not final pad adjustment.

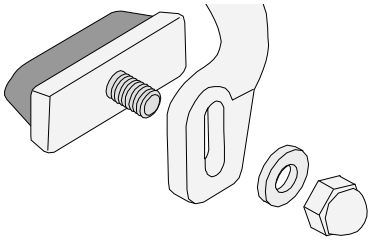
Shimano and Campagnolo dual-pivot brakes have centering screws that must be used to make an adjustment in either direction. The screws are located in different places. For Shimano, look for a Phillips screw on top of the left caliper arm at its rightmost end. For Campagnolo, look for a recessed Allen set screw in the outward face of the right caliper arm, just below the right pivot.

4. [ ] ***Shimano:*** **Adjust centering screw so that bottom edge of its head is even with the top of hole in left caliper arm that screw goes into.** ***Campagnolo:*** **Adjust centering screw so that it is in one full turn out from flush with face of right caliper arm.**
5. **Hold caliper so that pads are equidistant from rim, then secure mounting nut to torque of 70–85in-lbs (23–28lbs@3").**

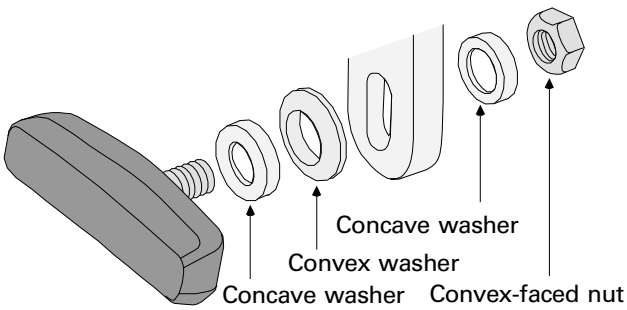
INSTALLING AND ADJUSTING PADS

1. [ ] **Check each pad for directional arrows and/or right/left indications; make sure pads will be installed with arrows pointing in the direction of rim rotation, and any pad marked with "R" is mounted on right side of bike and any marked with "L" is on left side of bike.**

Determine what sort of pad-alignment system is on the calipers. Use the procedures in the earlier section for **SIMPLE THREADED-STUD-PAD ALIGNMENT** (page 36-8), or **THREADED-STUD/CURVED-WASHER PAD ALIGNMENT** (page 36-10). Align the pads to the tolerances described in the next step.

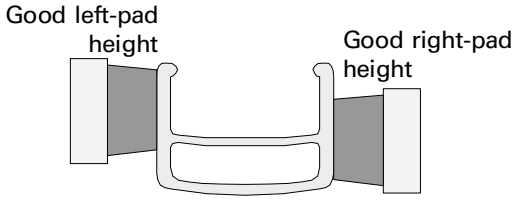


36.62 *A simple threaded-stud pad-alignment design.*



36.63 *A threaded-stud/curved-washer pad-alignment design.*

Pad height is a very different with dual-pivot brakes. The right pad swings up as it moves in, and the left pad swings down as it moves in. Consequently, the right-pad height needs to be set so that its bottom edge is even with the bottom edge of the rim's braking surface, and the left-pad height needs to be set so that its top edge is even with the top edge of the rim's braking surface. Although it looks unusual, dual-pivot pad heights are correct when the heights are not even. Complicating pad-height setting further, is the fact that the bottom and top edges of the braking surface are not always distinct; sometimes the rim just begins to curve inward gradually, and the braking surface just "fades" away. In this case, consider the edge of the braking surface to be the point of transition where the surface of the rim changes from facing towards the pad to facing more up or down. In no case should the top edge of the left pad be more than 1mm below the absolute top of the rim, and in no case should the bottom edge of the right pad extend below the rim.



36.64 *Correct dual-pivot pad height.*

2. [ ] **Determine what pad-alignment system to use by looking at way shoes are mounted to caliper arm, then use appropriate pad-alignment-system procedure to achieve following tolerances (in order indicated by pad-alignment-system procedure):**
   Pad toe: **entry-end of pad clears rim by .5–1.0mm when exit-end touches rim.**
   Vertical angle: **vertical angle of pad face is parallel to vertical angle of rim face.**
   Pad tangent: **top corners of pad are equidistant from top edge of rim.**
   Right-pad height: **bottom edge of pad face is even with bottom edge of rim's braking surface.**
   Left-pad height: **top edge of pad face is even with top edge of rim's braking surface.**

CABLE ATTACHMENT, CLEARANCE, AND CENTERING ADJUSTMENTS

Cable attachment

1. [ ] **Install brake lever and cable system, if not already installed.**
2. [ ] **Lubricate threads of pinch mechanism on right caliper arm, and threads of cable-adjusting barrel on left caliper arm.**
3. [ ] **Set cable-system adjusting barrel to 3 full turns out from fully-in position.**
4. [ ] **Hold pads to rim with third-hand tool.**
5. [ ] **Make sure Q.R. mechanism lever is fully down.**
6. [ ] **Thread inner wire through cable-adjusting barrel and cable-pinch mechanism.**
7. [ ] **Draw slack out of cable with fourth-hand tool.**
8. [ ] **Secure pinch bolt to torque of 50–70in-lbs (17–21lbs@3").**
9. [ ] **Stress cable system by pulling against lever 10 times with maximum force that would be used during a panic stop.**

Adjust pad centering

The purpose of the centering adjustment is to ensure that the pads reach the rim simultaneously. The centering adjustment is not primarily designed to ensure that the pads end up equally clear of the rim when released, as a sidepull or cantilever does. When the centering is set so that the pads reach the rim simultaneously, they will also end up clearing the rim almost evenly. If not set in this way, then the first pad to reach the rim will push the rim to the side until the other pad meets the rim. This then requires higher braking effort.

10. [ ] **Operate brake and observe whether brake tends to push rim to one side, or one pad reaches rim before other. If either condition exists, centering adjustment is needed.**
11. [ ] **Turn centering screw clockwise to move the brake's right pad (as seen when facing brake) away from rim and left pad toward rim.**
12. [ ] **Turn centering screw counterclockwise to move brake's right pad (as seen when facing brake) toward rim and left pad away from rim.**

Fine tune brake-pad clearance

When released, each pad should clear the rim by at least 1mm and a maximum of 2mm. The clearances need not be precisely identical. Use feeler gauges to check clearance at the point the pad(s) is closest to the rim.

13. [ ] **Move cable-adjusting barrel in to increase clearance, or out to reduce clearance until each pad clears rim by 1–2mm.**
14. [ ] **Move inner wire through pinch mechanism to change clearance if adjusting barrel cannot move down far enough, or if adjusting barrel must be moved up >4mm from bottomed, to make clearance tight enough.**

FINISHING

See the section called ***FINISHING*** (page 36-43) for cable finish, rim cleaning, and test-ride procedures.

CENTERPULL CALIPERS

CALIPER MOUNTING

1. [ ] **Install radius washer between caliper and frame, wherever frame/fork mounting surface is not flat. Reflector bracket may serve this function in some cases.**
2. [ ] **Install radius bushing between frame/fork and mounting nut, if surface is not flat.**

The mounting nut should be the type with a nylon insert so that it cannot work loose. If no such nut is available, use Loctite #222 or #242 on the threads.

3. [ ] **Install flat washer under mounting nut.**

The brake should be mounted loosely enough so that it can be centered by hand, but secure enough that it will not shift on its own. A nylon insert or Loctite on the threads, and not high torque, ensures that brake will not work loose.

4. [ ] **Secure nut to torque of 12–36in-lbs (4–12lbs@3").**

LUBRICATION

1. [ ] **Oil arm pivots at front and back of each arm.**
2. [ ] **Oil spring ends where they bear against caliper-arm posts and bridge posts.**
3. [ ] **Oil sockets in caliper arm for straddle wire end(s) and pinch mechanism (if any).**
4. [ ] **Oil threads of any pinch mechanism on straddle wire or primary wire.**
5. [ ] **Oil threads of adjusting barrel at end of cable housing.**
6. [ ] **On many Weinmann and Dia-Compe brakes, there is tab on back side of front caliper arm that rides in slot in face of rear caliper arm so that arms always move in unison. Oil tab.**

PIVOT ADJUSTMENT

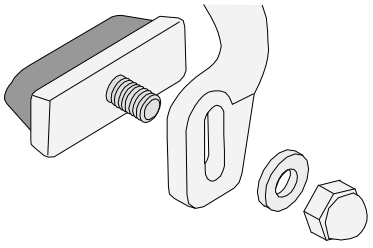
Most centerpull pivots are not adjustable. Non-adjustable pivots are characterized by the lack of a locknut on the back end of the pivot bolt, or by a locknut mounted in a recess in the back side of the brake-arm bridge. The pivot is usually a bushing that is longer than the hole in the caliper arm. When the pivot bolt is tightened, it seats against the bushing, but not the caliper arm. The bolt should be checked for proper security on all new bikes and during all repair situations. The bushing parts may be replaced, when available, to reduce free play in the pivots, but this is rarely done.

Adjustable pivots are found on some models, including the old Shimano Tourney centerpull. When the pivot is adjustable, there will be a fully accessible locknut for each pivot bolt on the back side of the brake-arm bridge. Hold the pivot bolt stationary, then turn the locknut counterclockwise (as viewed from the back of the caliper) to release the pivot bolt. The pivot bolt may now be turned clockwise to reduce play, or counterclockwise to reduce binding. After changing the adjustment, hold the pivot bolt stationary and secure the locknut.

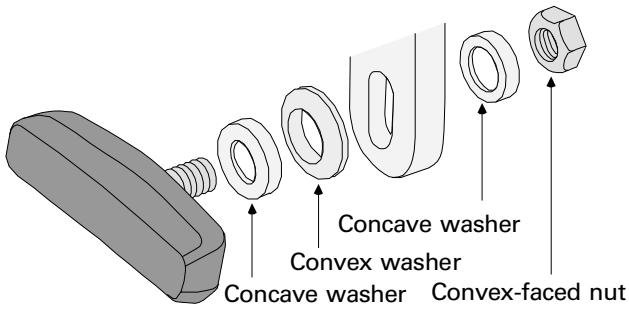
PAD INSTALLATION AND ALIGNMENTS

1. **[ ] Rock caliper bridge side-to-side until pads are equidistant from rim.**
2. **[ ] Check each pad for directional arrows and/or right/left indications; make sure pads will be installed with arrows pointing in the direction of rim rotation, and any pad marked with "R" is mounted on right side of bike and any marked with "L" is on left side of bike.**

Determine what type of pad-alignment system is on the calipers. Use the procedures outlined in the earlier section for **SIMPLE THREADED-STUD-PAD ALIGNMENT** (page 36-8), or **THREADED-STUD/CURVED-WASHER PAD ALIGNMENT** (page 36-10). Align the pads to the tolerances described in the next step.

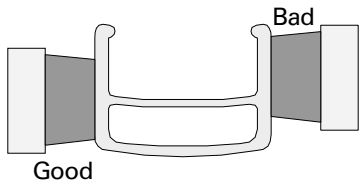


36.65 *A simple threaded-stud pad-alignment design.*



36.66 *A threaded-stud/curved-washer pad-alignment design.*

Pads on centerpull calipers swing up as they move in; set the pad height so that the bottom edge of the pad is even with the bottom edge of the rim's braking surface.



36.67 *Correct centerpull pad height.*

3. **[ ] Determine what pad-alignment system to use by looking at way shoes are mounted to caliper arm, then use appropriate pad-alignment-system procedure to achieve following tolerances (in order indicated by pad-alignment-system procedure):**
   Pad toe: **entry-end of pad clears rim by .5–1.5mm when exit-end touches rim.**
   Vertical angle: **vertical angle of pad face is parallel to vertical angle of rim face.**
   Pad tangent: **top corners of pad are equidistant from top edge of rim.**
   Pad height: **bottom edge of pad face is even with bottom edge of rim's braking surface.**

CABLE ATTACHMENT, CLEARANCE ADJUSTMENT, AND CENTERING

1. **[ ] Set cable-adjusting barrels so that they are turned 3–4 turns out from fully-in.**
2. **[ ] Hook cable carrier onto straddle wire (name side of carrier should face out).**
3. **[ ] Thread primary wire through pinch bolt. If pinch bolt is in carrier correctly, primary wire should be on same side of cable carrier as straddle wire.**
4. **[ ] Hold pads to rim with third-hand tool.**

5. [ ] **Check that wire end is properly seated in lever, and that housing ends are fully seated in their stops and adjusting barrels.**
6. [ ] **Use fourth-hand tool to simultaneously tighten straddle wire and primary wire by bracing fourth-hand on bottom side of cable carrier, then pulling primary wire through pinch bolt.**
7. [ ] **Secure pinch nut enough to hold cable temporarily, then remove fourth-hand tool.**
8. [ ] **Use an open-end 8mm, 9mm or 10mm wrench to hold pinch bolt while tightening nut to torque of 50–70in-lbs (17–23lbs@3"), then remove third-hand tool.**
9. [ ] **Stretch cable system by squeezing lever firmly at least 10 times. If cable seems to slip, loosen cable pinch and repeat from step 4.**
10. [ ] **Check pad clearance by pushing one pad to rim while measuring gap between other pad and rim at closest point.**
11. [ ] **Use cable-adjusting barrel to adjust clearance so that gap at one pad (when other touches rim) is 2–3m. If clearance cannot be achieved when adjusting barrel is turned all the way in, or out more than 5 full turns, then cable must be reset in cable-carrier pinch mechanism.**
12. [ ] **Center pads by rocking caliper bridge to one side or other by hand. Loosen mounting nut if necessary.**

FINISHING

See the section called ***FINISHING*** (page 36-43) for cable finish, rim cleaning, and test-ride procedures.

U-BRAKE CALIPERS

U-brake calipers are similar to centerpull brakes, but the pivot studs are an integral part of the frame, rather than simply a part of a caliper bridge which is bolted to the frame. The fact that the pivot studs are part the frame makes U-brakes appear similar to cantilever brakes, but the dimensions and locations of the pivot studs in relation to the rim are completely different. Because of those differences, U-brakes are a completely different brake system than cantilever brakes.

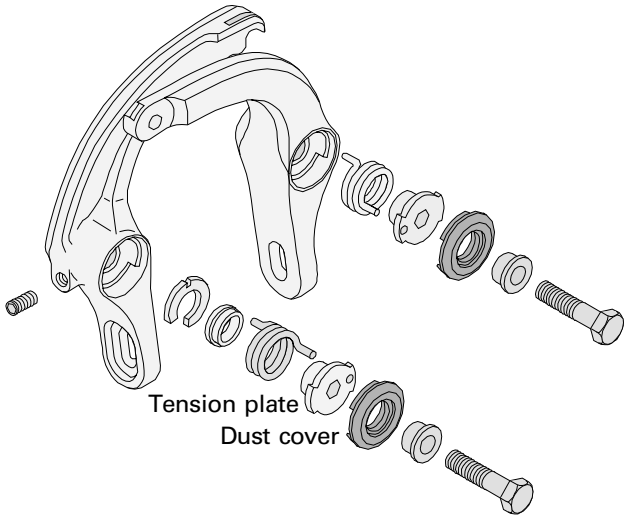
Another variety of brakes, called Rollercam brakes, fits on the same pivot studs as U-brakes. Rollercam brakes have been discontinued, and never were as popular as U-brakes. Parts availability is limited. Service instructions for Rollercam brakes are not included in this book. It is strongly recommended to replace problematic Rollercam brakes with U-brakes.

REMOVAL AND DISASSEMBLY

1. [ ] **Disconnect cables.**
2. [ ] **Turn mounting bolt(s) counterclockwise (spring tension will be lost) to remove. (On Dia-Compe #AD-990/992, mounting bolts are Allen bolts, not large nuts with 13mm pair of flats and 19mm hex.)**
3. **Caliper arms should pull off studs once mounting bolts are removed.**

Disassembling of Shimano-type U-brake

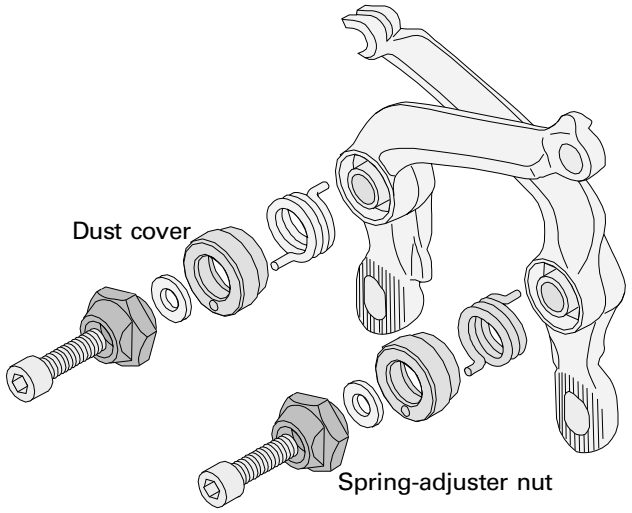
It is not necessary to disassemble these brakes for adequate cleaning and lubrication. *It is recommended to leave Shimano U-brakes assembled, except to replace damaged parts!*



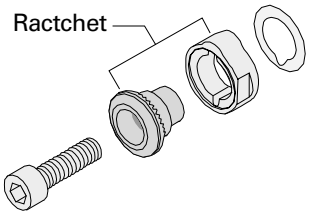
36.68 *Blow-up of a Shimano U-brake.*

1. [ ] **Remove plastic dustcap or "shark's tooth."**
2. [ ] **Put an Allen wrench of appropriate size in spring-tension plate.**
3. [ ] **For inner arm (no pinch bolt), turn Allen wrench small amount clockwise while pressing in. Then pull out with wrench and let tension plate unwind (counterclockwise). Tension plate should pull out after spring tension is released.**
3. [ ] **For outer arm (with pinch bolt), turn Allen wrench small amount counterclockwise while pressing in. Then pull out with wrench and let tension plate unwind (clockwise). Tension plate should pull out after spring tension is released.**
4. [ ] **Pull spring(s) out and observe which end of each spring was in caliper arm, and which color spring was in each arm.**

Disassembly of Dia-Compe AD-990/992 type



36.69 *Blow-up of Dia-Compe AD-990 U-brake.*



36.70 *Dia-Compe AD-992 spring-tension mechanism.*

1. [ ] **Pull off large spring-tension nut or ratchet.**
2. [ ] **Remove plastic dust cover.**
3. [ ] **Pull out spring, observing which color spring comes from which arm.**

ASSEMBLING CALIPER ARMS

All models of U-Brakes fit the same pivot studs as Rollercam brakes, but not the same pivot studs as cantilevers. The pivot stud should be 9mm outside diameter and 16.5mm long. It may be a female or male thread. A conversion kit may be needed if the pivot stud is male.

1. [ ] **Fit caliper arm(s) onto pivot stud(s) and check whether they are good fit.**
2. [ ] **If they are tight going on, pivot stud may be rusted, covered with paint, or swollen at tip if mounting bolt was over-tightened. In any case, reduce diameter with an emery cloth.**
3. [ ] **If pivot stud is short, it will not protrude past end of brass bushing in caliper arm when arm is slipped all way on. File or grind back end of bushing in arm to shorten it.**
4. [ ] **Remove caliper arm after checking fit.**
5. [ ] **Grease outside of pivot stud(s).**
6. [ ] **Add Loctite 222 or 242 to female threads (in pivot stud or mounting nut).**

Assembling Shimano-type U-brake

1. [ ] **Grease springs.**
2. [ ] **Install gold spring in arm without pinch bolt. Long end should be pointing out, and should be winding in clockwise direction.**
3. [ ] **Install silver spring in arm with pinch bolt. Long end should be pointing out, and should be winding in counterclockwise direction.**
4. [ ] **Install tension plates with Allen fitting face out, with end of spring in hole in plate.**
5. [ ] **Plate on gold spring should be wound clockwise about 60°, until tab on perimeter of plate is past stop inside arm. Then, press in firmly on tension plate with Allen wrench to seat it in arm.**
6. [ ] **Plate on silver spring should be wound counterclockwise about 60°, until tab on perimeter of plate is past stop inside arm. Then, press in firmly on tension plate with Allen wrench to seat it in arm.**
7. [ ] **Place dustcap(s) over tension plate so protruding spring will engage slot in back of dustcap, and so two notches in back perimeter of dustcap line up with stop tabs inside arm(s).**

INSTALLATION OF CALIPER ARMS

Dia-Compe AD-990/992 type

1. [ ] **Install arm without pinch bolt first, then other arm.**
2. [ ] **Grease springs.**
3. [ ] **Install gold spring in pinch-bolt arm and silver spring in arm without pinch bolt.**
4. [ ] **Install dust covers.**
5. [ ] **Install spring-adjuster nuts.**
6. [ ] ***Model AD-992 only:* install right and left ratchets. Then install and secure mounting bolts. *Model AD-990 only:* install, but do not secure, mounting bolts.**

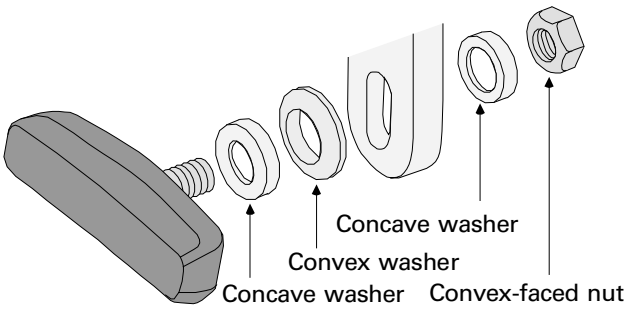
Shimano type

1. [ ] **Install arm without pinch bolt first, and then other arm.**
2. [ ] **Thread in, but do not secure, mounting bolts/nuts.**
3. [ ] **Hold caliper arms in their fully-open position, while securing mounting bolts/nuts to torque of 50–60in-lbs (17–20lbs@3").**

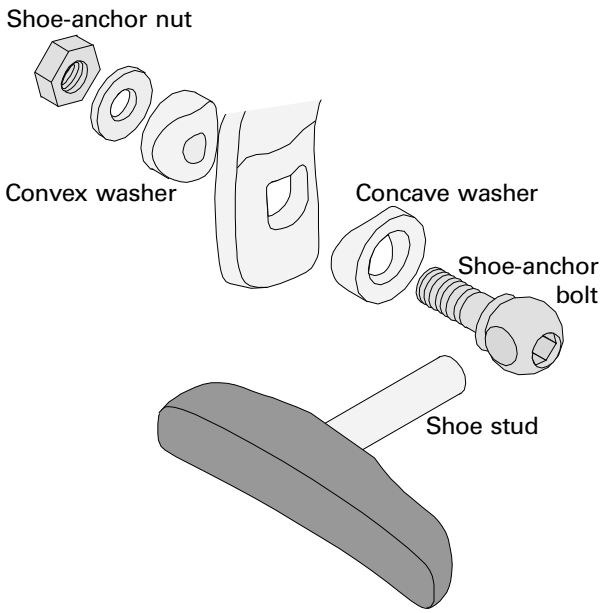
PAD INSTALLATION AND ADJUSTMENT

1. [ ] **Loosen shoe-mounting bolts/nuts just enough so that shoe alignment can be manipulated with your fingers.**

Determine what type of pad-alignment system is on the calipers. Use the procedures outlined in the earlier section for **THREADED-STUD/CURVED-WASHER PAD ALIGNMENT** (page 36-10), or **SMOOTH-STUD/CURVED-WASHER PAD ALIGNMENT** (page 36-11). Align the pads to the tolerances described in the next step.

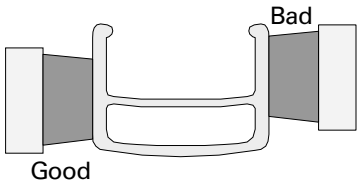


36.71 *A threaded-stud/curved-washer pad-alignment design.*



36.72 *A smooth-stud/curved-washer pad-alignment design.*

Pad height is a very critical consideration with U-brakes. The nature of a typical U-brake arm causes the pads to move up significantly as the pads move in toward the rim. Even the compression after the pads contact the rim also results in significant upward motion. The additional pad travel that results from pad wear has an even greater effect on the height of the pad as it reaches the rim. For these reasons, it is critical to set the pads as low on the rim as is safe, when setting up U-brakes. Normally, this lowest setting would place the bottom edge of the pad even with the bottom edge of the braking surface on the rim. Unfortunately, the braking surface is not always clearly delineated. If the braking surface gradually transitions to the "bottom" of the rim, then the correct height is somewhat subjective. The following illustration shows good U-brake-pad height on a rim with a clearly delineated braking surface.



36.73 *Correct U-brake-pad height.*

2. [ ] **Determine what pad-alignment system to use by looking at way shoes are mounted to caliper arm, then use appropriate pad-alignment-system procedure to achieve following tolerances (in order indicated by pad-alignment-system procedure):**
   Pad toe: **entry-end of pad clears rim by .5–1.0mm when exit-end touches rim.**
   Vertical angle: **vertical angle of pad face is parallel to vertical angle of rim face.**
   Pad tangent: **top corners of pad are equidistant from top edge of rim.**
   Pad height: **bottom edge of pad face is even with bottom edge of rim's braking surface.**
   Smooth-stud engagement: **Position shoes so that both contact rim and amount of shoe stud protruding past anchor bolts is equal on both sides.**

INSTALL AND SIZE STRADDLE WIRE

1. [ ] **Install brake lever and cable system, if not already installed.**
2. [ ] **Lubricate threads of pinch mechanism on caliper arm and threads of cable-adjusting barrel.**
3. [ ] **Set cable-system adjusting barrel to 3 full turns out from fully-in position.**
4. [ ] **Install cable carrier on primary brake wire so that name side and/or pinch nut faces away from frame or fork.**
5. [ ] **Position cable carrier so that there is minimum of 20mm between it and anything that it would bump into when cable is pulled by brake lever. It is preferable to have similar clearance (minimum 20mm) between bottom of carrier and caliper arms, if possible.**
6. [ ] **Hook one end of straddle wire into caliper arm with socket. This socket should be oiled.**
7. [ ] **Place straddle wire in cable-carrier cradle, between carrier and primary cable.**
8. [ ] **Thread end of straddle wire through pinch mechanism. Oil pinch-bolt threads.**

9. [ ] With brake pads held to rim by third-hand tool, draw slack out of straddle wire, and simultaneously primary wire, with fourth-hand tool.
10. [ ] Secure pinch bolt to torque of 50–70in-lbs (17–23lbs@3").

SETTING RETURN SPRING TENSION: DIA-COMPE AD-990/992

AD-990

1. [ ] Loosen mounting bolts if they have been secured.
2. [ ] Turn left tension-adjusting nut approximately 20°–30° clockwise, and hold it stationary while tightening mounting bolt to torque of 50–60in-lbs (17–20lbs@3").
3. [ ] Turn right tension-adjusting nut approximately 20°–30° counterclockwise, then hold it stationary while tightening mounting bolt to torque of 50–60in-lbs (17–20lbs@3").

AD-992

1. [ ] If brake return springs have too much tension already, release torque on mounting bolts and tension will be lost.
2. [ ] Secure mounting bolts to torque of 50–60-lbs (17–20lbs@3").
3. [ ] Turn spring adjusters with 19mm wrench to add tension.
4. [ ] Turn left one clockwise to increase tension.
5. [ ] Turn right one counterclockwise to increase tension.
6. [ ] Make sure mark on spring adjuster does not pass MAX mark on outside of caliper arm.

SETTING PAD CLEARANCE

1. [ ] Squeeze brake lever firmly 10 times so that cable system will be stressed and checked for failure.
2. [ ] Release lever, then pull it gently until pads just touch rim. There should be minimum 25mm clearance at this point between lever and bar.
3. [ ] If there is >25mm clearance, turn cable-adjusting barrel in to reduce clearance at lever when pads reach rim. If cable-adjusting barrel does not provide enough adjustment, loosen straddle-wire pinch bolt and let some more cable back through pinch mechanism.
4. [ ] If there is <25mm clearance, and cable-adjusting barrel is less than 5 full turns out of lever, use adjusting barrel until it is up to 5 full turns out to adjust clearance.
5. [ ] If adjusting barrel is already 5 full turns out and brake lever is too close to handlebar when pads reach rim, loosen straddle-wire pinch bolt and draw more cable through with fourth-hand tool.

PAD CENTERING

Shimano types

A tension-adjusting screw for the left arm return spring is recessed in a hole in the outward side of the caliper arm. It is fit by a 2mm Allen wrench.

1. [ ] If pad is too close on left, turn screw clockwise to increase clearance on left side and reduce clearance on right side.
2. [ ] If pad is too close on right, turning screw counterclockwise to decrease clearance on left side and increase clearance on right side.
3. [ ] Operate brake two or three times, then recheck pad centering and adjust further if necessary.

Dia-Compe types

The spring tension on either side is adjustable, but only one side needs to be adjusted to improve the centering. The AD-990 must have its mounting bolt loosened before the spring-adjuster nut can be turned.

Do not turn the adjuster nut past the MAX mark on the AD-992. If the mark is reached, loosen both mounting bolts to release all tension, and start from scratch. *Do not force the spring-adjusting nuts in the opposite direction to reduce the tension!*

1. [ ] If left pad is too close to rim, turn left spring-adjuster nut clockwise to increase clearance on left and reduce clearance on right.
2. [ ] If right pad is too close to rim, turn right spring-adjuster nut counterclockwise to increase clearance on right and reduce clearance on left.

FINISHING

See the section called ***FINISHING*** (page 36-43) for cable finish, rim cleaning, and test-ride procedures.

FINISHING

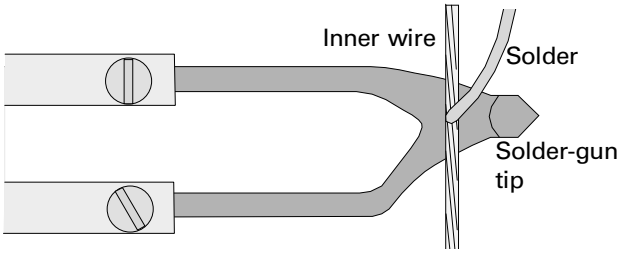
Trimming, soldering, and capping wires

Excess inner wire should be trimmed and finished. Excess length is unsightly and may get caught in the wheel or brake. Soldering prevents fraying, and allows reuse of the cable whether a wire cap is used or not. Wire caps do not prevent fraying, but they do prevent someone getting poked by the wire.

Trim the inner wire to leave about 25–30mm of wire past the pinch mechanism. Before doing this, check to see if the caliper manufacturer has provided a spot to hook the free end of the wire behind the caliper arm. If there is a good spot to do this, leave the wire just long enough to hook it in place.

1. [ ] Trim inner wire with wire cutters 25–30mm past cable-pinch mechanism.

The next step suggests soldering the end of the wire. This is easy to do and prevents fraying. To solder, a soldering gun, thin 40/60 rosin-core solder, and soldering flux are needed. Put flux on the inner wire. Hold the soldering gun tip flat against one side of the wire until the flux sizzles away. Still holding the soldering gun tip flat against one side of the wire, hold the tip of the solder against the other side of the wire until the heated wire causes the solder to melt and flow into the wire. Some wires are specially coated or made of stainless steel and will not accept solder. In these cases the wire will melt the solder, but the solder will not flow into the wire. Instead, it beads up and runs off the wire.



36.74 *Correct soldering technique.*

2. [ ] Solder inner wire end.

Wire-end caps are sometimes used instead of solder to prevent fraying. This will not work. Crimping the cap onto the wire frequently *causes* fraying. A soldered wire will not fray when the cap is crimped on. The real function of the wire cap is to cover the sharp end of the wire.

3. [ ] Put cap on end of inner wire if desired.

Rim cleaning and test-ride procedures

It is always important to clean the braking surface on a rim as you finish any brake job. It is also a very good idea to test ride the bike at that time. Cleaning the rims with alcohol or acetone removes residues left from hands, or just dirt left over from riding. Removing either ensures optimum brake performance. Test riding should be done to check for squeal, and to check overall brake performance. If squeal is detected, check for caliper-arm pivot play and adequate brake-pad toe.

CABLE-OPERATED RIM-BRAKE-CALIPER TROUBLESHOOTING

Cause	*Solution*
SYMPTOM: *Brake squeals when applied hard or softly.*	
Loose pivot(s).	Adjust pivot(s) if adjustable, and/or replace pivot bushings. Condition is not always correctable, particularly with cantilever brakes.
Contamination on rims (oil or dirt).	Clean rims with solvent or heavy-duty cleanser that leaves no residue.
Brakes shoes need toe adjustment.	Toe pads to a maximum clearance of 1.5mm at tail end of pad.
Caliper arms are flexing.	Long and/or skinny caliper arms are prone to flexing, which can only be prevented by using higher-quality, stiffer arms.
Humidity conditions.	Changes in humidity may change a brake's tendency to squeal; there is no solution.
Contamination on pad faces.	Replace pads or regrind pad face(s).
Pads incompatible with rim.	Changing brands of pads may reduce squeal.
Pads not broken-in to rim.	New pads may squeal under high braking force only, then not squeal once they have conformed to the shape of the rim. Recheck all pad alignments, or run emery cloth between the pads and the rim while applying the brakes gently, to accelerate pad break-in.
SYMPTOM: *Brake mechanism(s) squeak when applied and/or released.*	
Lever pivot(s) need oil.	Oil lever pivots.
Cable-anchor pivots in lever need oil.	Oil cable-anchor pivots.
Cable-end socket for barrel-ended cable needs oil in lever.	Oil cable-end socket.
Spring ends need oil where they brace against caliper arms.	Oil spring ends.
Spring coils need oil.	Oil spring coils.
SYMPTOM: *Sidepull caliper will not hold its center adjustment.*	
Caliper-mounting nut not secure.	Secure caliper-mounting nut.
Spring not fixed securely in slot in spring-mounting plate.	Peen down slot in spring-mounting plate to eliminate play between spring and spring-mounting plate.
Caliper pivots need oil.	Oil caliper pivots.
Spring ends need oil.	Oil spring ends.
Spring is fatigued.	Replace spring.
SYMPTOM: *Properly centered sidepull caliper has one arm that moves in before the other.*	
Cable housing resists motion of only one caliper arm.	This is a normal response and needs no correction. The arms act uniformly once both pads reach the rim.
Housing loop to rear brake may be too short, particularly on BMX bikes, so that it loses all bow before the pad contacts the rim.	Lengthen housing loop.

(continued next page)

Cause	*Solution*
SYMPTOM: *Sidepull-caliper-pivot adjustment does not stay correctly adjusted.*	
Improper centering technique.	See section on sidepull-caliper-centering adjustment.
Inadequate adjustment security.	Reset adjustment and secure adequately.
Heavy-duty use.	Treat adjustment nut and adjustment-locknut threads with Loctite #222 and reset adjustment.
SYMPTOM: *Sidepull-caliper-pivot adjustment remains too tight no matter how it is adjusted.*	
Adjustment nut or pivot-bolt threads are stripped.	Inspect and replace damaged parts.
Return spring is fatigued.	Check and replace spring.
SYMPTOM: *Sidepull caliper will not release completely after release of the lever.*	
Pivot needs oil.	Oil pivot.
Pivot too tight.	Adjust pivot to eliminate bind and/or play.
Spring fatigued.	Check and replace spring.
Friction in cable system.	Inspect for poor cable routing, the remove cable system and inspect for rust, kinks, improperly finished housing ends, and lack of lubrication.
Sticky lever.	See ***BRAKE LEVERS*** chapter (page 34-9).
SYMPTOM: *Centerpull caliper will not hold its centering adjustment.*	
Mounting nut not secure.	Secure mounting nut.
SYMPTOM: *Cantilever brakes cannot be properly centered.*	
Wheel out-of-center in frame/fork.	Check and correct wheel centering.
Pivot studs in need of grease.	Remove calipers and grease pivot studs.
Link-wire improperly setup.	Setup again, using proper Pro-Set tool and technique.
Primary wire approaches brake from off-center approach.	It may be necessary to deviate from standard setup procedures to center brake when frame manufacturer forces primary wire to approach brake from off-center.
Caliper arm not pivoting freely on damaged (flared) pivot stud.	Remove arm and use Bicycle Research BM1 pivot-stud mill (or emery cloth) to reduce flare.
Pivot bushing of caliper arm longer than pivot stud.	File caliper-pivot bushing shorter.
Deformed mounting washer pressing against face of caliper arm.	Replace washer.
Depth of shoe stud in each anchor bolt not equal.	Reset shoe-stud depth.
Damaged, mis-matched, or mis-installed springs.	Disassemble caliper and inspect springs.
Springs not engaged in equal hole positions in multiple-hole braze-ons.	Reposition springs.
Braze-ons mis-positioned.	Not correctable.

(continued next page)

CABLE-OPERATED RIM-BRAKE-CALIPER TROUBLESHOOTING (continued)

Cause	Solution
SYMPTOM: *Cantilever arm is not pivoting freely.*	
Pivot stud needs grease.	Grease pivot stud.
Pivot stud flared from over-tight mounting bolt.	Remove arm and use Bicycle Research BM1 pivot-stud mill (or emery cloth) to reduce flare.
Rust on pivot stud.	Clean with emery cloth and grease.
Caliper-arm-pivot bushing longer than pivot stud.	File bushing shorter.
Deformed mounting washer pressing against face of caliper arm.	Replace washer.
SYMPTOM: *Cantilever pads force their way to below the rim.*	
Pads adjusted too low on rim.	Reset pads to as high as possible on rim face.
Poor vertical-angle alignment causes pads to travel too far.	Align vertical angle of pad face to match vertical angle of rim face.
V-shaped rim cross-section incompatible with cantilever brakes.	– Use firm pads to reduce deflection. – Switch rim to more vertical or inverted-slope face.
SYMPTOM: *Cantilever pads cannot be adjusted to have proper height and vertical-angle alignment at the same time.*	
Improper pivot-stud position in relation to rim.	– No complete solution possible; sacrifice proper alignment for best possible height. – Wider rim, narrower rim, or rim with taller braking surface may help.
Caliper arm with threaded-stud/curved-washer pad-alignment system is having to swing too far to reach rim.	If available, switch fat washers from outboard of caliper arm to between caliper arm and brake shoe.
SYMPTOM: *U-Brake will not release completely when hooked up, even though there is no problem with the cables detached.*	
Straddle wire too short.	Lengthen straddle wire.
SYMPTOM: *Shimano U-Brake cannot be centered using the correct technique on the adjustment screw.*	
Pivot stud rusty or needing lube.	Remove, clean and lube.
Improper mounting.	Loosen mounting bolts and resecure with both caliper arms open fully, to reset basic spring tension.
Rim cannot be centered to pivot studs.	Loosen mounting bolt on side where clearance is greater, and re-secure caliper arm with pad rotated closer to rim.
Poorly matched springs.	Reset the basic spring tension to be higher or lower as necessary on just one side.

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Cause	*Solution*
SYMPTOM: *Brake levers bottom-out easily when pads are set at minimal clearance to the rims.*	
Excess housing-loop length.	Shorten housing loops to minimum recommended length.
Spongy housing.	Upgrade housing.
Poorly finished housing ends and/or lack of end caps where they might improve fit.	Finish properly and use end caps.
Light-duty inner wires.	Upgrade inner wires.
Levers mis-positioned on handlebars.	Reposition levers to recommended guidelines.
Mismatched leverage ratio of lever and caliper arms.	Replace one or the other, using brand- and model-matched equipment whenever possible.
Poor vertical-angle pad alignment on cantilever brakes.	Realign vertical-angle alignment of pads.
SYMPTOM: *Brake has inadequate stopping power, but levers are not bottoming out on handlebars.*	
Excess cable friction.	Set housing-loop lengths properly, lubricate cables, finish ends properly, and use end caps where appropriate.
Poor pad alignment.	Realign pads to improve contact to rim.
Pad surfaces hardened from overheating or age.	Replace pads.
Cable carrier, link-wire head, or link-unit head is bumping into housing stop.	Check that there is 20mm clearance between cable carrier, link-wire head, or link-unit head and housing stop.
Straddle wire too long.	Shorten straddle wire to minimum recommended length.
Oil on rim.	Clean rim and replace pads.
Water on rim.	Use high-performance brake pads.
SYMPTOM: *Brake levers require a very high force to start motion, or when pulled gently, they seem to move as though indexed (jerky, not smooth).*	
Excess cable friction.	Set housing-loop lengths properly, lubricate cables, finish ends properly, and use end caps where appropriate.
Adjustable pivot adjusted too tight.	Check pivot adjustment.
Caliper pivot(s) need lubrication.	Lubricate caliper pivots.
Cable-anchor pivot in lever sticking.	Oil cable-anchor pivot.
Barrel-type cable end sticking in lever socket.	Lubricate cable-end socket.
SYMPTOM: *Levers require excess force to pull.*	
Dual-pivot caliper is off-center, causing rim to deflect laterally before second pad will contact.	Check and correct pad centering.
Excess cable friction.	Set housing-loop lengths properly, lubricate cables, finish ends properly and use end caps where appropriate.
Caliper-spring tension set too high.	Reset caliper-spring tension.
Lever pivots and caliper pivots sticky.	Oil all pivots.
SYMPTOM: *Cable frays where it leaves brake lever.*	
Bent or kinked cable housing.	Replace or trim housing.

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CABLE-OPERATED RIM-BRAKE-CALIPER TROUBLESHOOTING (continued)

Cause	Solution
SYMPTOM: *Lever fails to release*.	
Caliper pivot sticking.	Check pivot adjustment, pivot lubrication, pivot studs for damage or rust, or deformed washer on face of caliper.
Calipers with adjustable spring tension set too soft.	Reset spring tension.
Excess cable friction.	Set housing-loop lengths properly, lubricate cables, finish ends properly, and use end caps where appropriate.
Lever pivot sticking.	Oil pivot.
Adjustable lever pivot too tight.	– Check for gum-cover interference. – Check for bent pivot or lever. – Adjust lever pivot.
SYMPTOM: *Brakes are grabby or lack sensitivity.*	
Pivot adjustment loose.	Eliminate all free play if possible.
Wide or narrow seam on rim.	No solution.
Offset seam on non-welded rim.	Use rim pliers to eliminate offset.
Damaged rim sidewalls bulging out.	Use rim pliers to eliminate bulge.
Rim out-of-round (particularly with sloped sidewall rims).	Improve rim round.
Improper match of lever and caliper.	Use brand- and model-matched parts.
Excess cable friction.	Set housing-loop lengths properly, lubricate cables, finish ends properly, and use end caps where appropriate.
SYMPTOM: *Brake pads rub tire.*	
Pad height set wrong.	Reset pad height.
Loose sidepull-caliper pivot.	Eliminate all free play.
Wheel mounted incorrectly.	Check and remount wheel height and center.
Brake caliper's reach too short for frame and wheel combination.	Replace calipers.