31 – DERAILLEUR-CABLE SYSTEMS

ABOUT THIS CHAPTER

This chapter is about setting up and servicing the cables that operate the derailleurs. It covers selection of the inner wire and housing, and the sizing and preparation of the housings. Attaching the inner wire to the shifter is covered in the **SHIFT-CONTROL MECHANISMS** chapter (page 30-1). Attaching the inner wires to the derailleurs and adjusting the tension on the inner wires is covered in the **REAR DERAILLEURS** (page 32-1) and **FRONT DERAILLEURS** (page 33-1) chapters.

GENERAL INFORMATION

TERMINOLOGY

Indexing-compatible: This term signifies that a component is suitable for use with an indexing derailleur system. Most modern derailleurs are indexing. This means that the shifter moves in distinct increments. When the shifter is moved from one position to the next, it is supposed to be just the right amount to move the derailleur from one gear to the next. The thickness of an inner wire determines how much inner wire will move as it wraps around the shifter drum. The friction and compression in the cable system have to be low and consistent for the indexing to work.

Cable: The term cable will be used to refer to the complete cable system, including the inner wire, housings, and fittings. The term *cable* is often used to refer to the inner wire as well. To avoid confusion, this book will always use *cable* to describe the whole system, and *inner wire* to describe the wire portion of the cable system.

Housing: The outer sheath that covers part of the inner wire. It is used to guide the inner wire around bends and to connect two points that move in relation to each other.

Compressionless housing: This housing type has stiff wires embedded in it, running along the housing length, that reduce compression. To identify this housing, look at the cut end. Many wire-ends will be seen.

Housing liner: A plastic sheath inside the housing that is used to reduce friction. These days, it is almost always fixed permanently in place.

Wound housing: This type of housing, more typically used on brakes, consists of a single coil wound from one end of the housing to the other. It is usually covered in a plastic sheath and usually has a liner inside. To identify it, look at the cut end. It will look like the end of a coil spring. If not sure after looking at the end, strip off the plastic sheath for a few millimeters at the end. Whether it is a single coil (wound), or multi-strand (compressionless), will become completely clear. Wound housing is not considered suitable for use on indexing derailleur systems.

Ferrule: The cap that fits on the end of the housing to improve fit to the housing stop.

Inner wire: The wire that is attached to the shifter, passes through housing on the way to the derailleur, and attaches to the derailleur. At times, it may just be called the *wire*.

Drawn wire: A type of inner wire that has been drawn through a die to change its shape. The process flattens the individual strands of the inner wire so that the surface of the inner wire is smoother.

Inner-wire head: The drum- or disc-shaped bead at the end of the inner wire. It fits in a socket in the shifter.

Housing stop: The socket-like fitting on the frame, shifter, or derailleur that is the point where the housing stops and the inner wire continues.

Adjusting barrel: An adjustable housing-stop that is threaded into the derailleur and/or shifter. An adjusting barrel is a screw with a socket on the end that the housing fits into. There is a small hole all the way through that the inner wire passes through.

Cable guide: An *inner-wire guide*, but the conventional term will be used here to avoid confusion. It is usually a plate of plastic with a groove or tunnel that guides a bare inner wire around a bend, such as the bottom of the bottom-bracket shell.

PREREQUISITES

Whenever cables are serviced or installed, derailleur adjustments must be done.

INDICATIONS

Maintenance

Cables just wear out. There may be no overt symptoms, but a cable can operate sluggishly just because it is old. Cables are relatively inexpensive and are vital to derailleur performance. It is not an extravagance to automatically replace the cable system annually, particularly if adjusting a derailleur.

Indexing malfunctions

Problems with the cable can cause an indexing derailleur to malfunction. The usual scenario is that a system has stopped working that formerly worked. When the cable tension is adjusted so that it does not seem too tight for the release shifts, it is not tight enough for the opposite shifts. Then if it is adjusted to be tight enough for the shifts when the inner wire is being pulled, it becomes too tight when the cable is being released. This problem can be caused by chain wear and component-compatibility problems, as well.

Difficult shifter operation

Particularly on friction-shifting systems, when the lever becomes difficult to operate, and lubing and adjusting the friction tension on the shifter does not solve the problem, it is likely there is a cable problem.

Rusty or damaged inner wire

Inner wires fail because they get rusty, fray, become kinked, or because the wire sheath tears on a Gore-Tex cable. Replace all wires with these problems, even when the damage does not seem to be in a critical location.

Damaged and dirty housings

Housings fail because they get kinked or bent, and because the plastic outer sheath cracks. Dirt can also get inside a housing and substantially increase the friction.

Housings get kinked or bent because of impact and overextension, but they also get damaged in the same way because they are mis-sized. It is very common that the loop of housing at the rear derailleur is too short, resulting in a bend in the housing where it comes out of the rear-derailleur adjusting barrel. Kinked and bent housings should be replaced, unless the housing is too long and the damage is confined to an area that will be cut off.

Dirt gets inside housings and increases friction. There is no good way to inspect for dirt and there is no good way to clean it out. It could be abrasive particles embedded in the inner liner. This hidden dirt is the likely reason that a used cable system thatlooks fine does not shift as well as it did when new. This hidden dirt is a good reason to just routinely replace cable systems when adjusting derailleurs.

Handlebar and stem changes

When the shifters are mounted on the handlebars, and the handlebar width or stem height and length are changed, the loops of housings at the shifters need to be re-sized. If the shifters are moving further away because of wider bars or a longer stem, cable replacement is often required.

TOOL CHOICES

The only tools required for installation of cables are appropriate tools for cutting inner wire and housing. Preferred tools are in **bold**. Tools are preferred because a balance between versatility, quality, and economy.

CABLE TOOLS (table 31-1)

Tool	Fits and considerations
Park CN-2	Cuts inner wires only
SunTour TA110	Cuts inner wires only
Hozan C214	Cuts inner wires only
Hozan C215	Cuts inner wires and compressionless housing
Shimano TL-CT10	Cuts inner wires and compressionless housing
VAR 990	Cuts inner wires and compressionless housing
Felco C7 Deluxe	Cuts inner wires and compressionless housing
7–8" diagonal side cutter, any brand	Cuts wound housing

ABOUT THE REST OF THIS CHAPTER

The rest of this chapter is divided into several sections. The first section is about ***CABLE TYPES AND COMPATIBILITY***, which covers the different types of inner wires and housings used for derailleur systems and compatibility of the different types with different shifting systems. The next section is ***SIZING HOUSING LOOPS***, which covers the determination of the optimum length of housing loops from stops on the frame to shifters mounted on the bar or stem. The final section is ***PREPARATION AND INSTALLATION OF THE CABLE SYSTEM***, which covers housing-end finishing, cable-system lubrication, and routing considerations.

Unlike other chapters in this book, there is no section on troubleshooting. This is because cable problems are covered in the respective derailleur chapters.

CABLE TYPES AND COMPATIBILITY

INNER WIRES

Inner wires differ by diameter, type of surface, and type of construction.

Inner-wire diameter

Wire diameter is important in regard to indexing performance and fit in the housing. The typical wire diameters are 1.2mm and 1.5mm. There have been some less common sizes, as well. For 1995 only, Shimano used a 1.1mm diameter. Older Campagnolo equipment came with a 1.6mm diameter wire.

All index systems, with the exception of down-tube Shimano Dura-Ace levers, require 1.2mm diameter wire. The compressionless housing used for index systems will not fit anything larger than 1.2mm wire. The 1.1mm Shimano wire was used in a smaller housing that would not fit the 1.2mm wire. To prevent problems when replacing a 1.1mm inner wire, always replace the housing as well. When Shimano Dura-Ace indexing down-tube levers are used, the wire diameter must be 1.5mm.

Non-indexing systems have no requirements for wire diameter, other than it fit through the housing being used.

Inner-wire surface

Indexing systems require wires with a smooth surface to reduce cable-system friction. One way to insure that the wire is smooth enough is to use nothing but original equipment for replacement inner wires. Another alternative is to use *drawn inner wires*, which have the smoothest surface. Most drawn inner wires will be marketed as such; however, their appearance should identify them clearly. Drawn inner wires have a more reflective surface, and the individual strands are much less obvious. When looking at drawn inner wire, instead of seeing individual strands it just looks like there are tiny grooves spiraling around the inner wire. Drawn inner wire also feels much smoother when pulled between two fingertips.

Non-indexing systems have no requirements for the wire surface, but whatever makes a wire smoother will improve the feel of any shifting system.

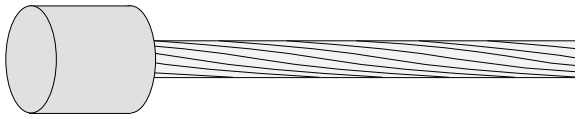
Inner-wire construction

Most inner wires today are a simple twisted wire. Several strands are laid parallel and then twisted together all at once. There is another construction which might be called *braided*. It is not actually braided, but has that appearance. It is made by making several very small twisted-wire cables, and then twisting these together to make a larger cable. This *braided* or *double-twisted* inner wire is more supple than the same thickness of a simple twist. The 1.5mm wire required for use with Shimano Dura-Ace down tube indexing shifters should be the *braided* or *double-twisted* type.

INNER-WIRE HEADS

Barrel heads

The barrel-headed inner wire has always been the most common, and today is almost universal. This type has a cylinder-shaped head that is usually slightly longer than its diameter. The wire goes into the end of the cylinder.



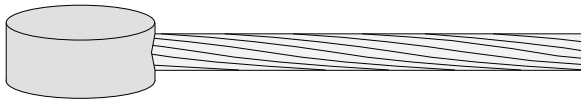
31.1 *A barrel-head on a derailleur inner wire.*

The most common barrel diameter is approximately 4.5mm. Old Simplex and all Campagnolo shifters require something closer to 4.0mm. It is possible to grind or file the wire head to improve fit.

Even some barrel heads that are the correct diameter can be a fit problem. Flashing material left over from fabrication and out-of-roundness can cause the barrel to jam in the socket in the shifter. Always test fit the barrel before setting up the cable system all the way.

Disc heads

Some old Schwinn and Huret shifters required a disc-shaped cable head. This type was also used briefly by SunTour in the X-Press levers. The disc type has the inner wire enter the head at the perimeter of the disc. Disc-types are uniform in size. Inner wires that are sold as *universal* or *double-ended* usually have a barrel at one end and a disc at the other end.



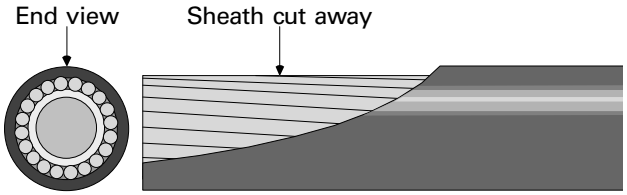
31.2 *A disc-head on a derailleur inner wire.*

HOUSINGS

Housing for derailleur systems may be the compressionless variety, or the wound variety.

Compressionless housing

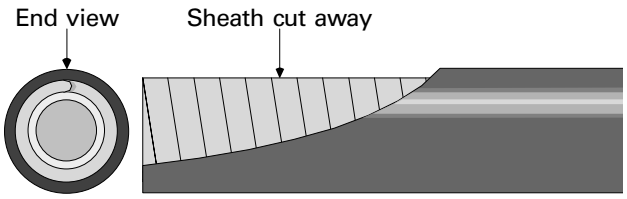
Compressionless housings are required for indexing systems, but are optional for friction systems. However, they improve performance of a friction system. Housing is compatible with a particular inner wire as long as the wire inserts comfortably into the housing. In 1995, Shimano made compressionless housing that was specifically for use with a 1.1mm inner wire. The 1.2mm wires are a tight fit in this housing. To use a 1.2mm inner wire on a bike with this housing, just replace the housing. All compressionless housing has a plastic liner inside.



31.3 *Compressionless housing.*

Wound housing

Wound housings have a metal strip that is wound like a coil spring. These coils compress under load, which translates into lost motion at the shifter. Lost motion occurs when the shifter moves, but the derailleur does not respond. Most wound housing has a plastic liner inside to reduce friction, but some cheap varieties are exposed metal inside. The ones without a liner are not recommended for use with any derailleur system, indexing or friction.



31.4 *Wound housing.*

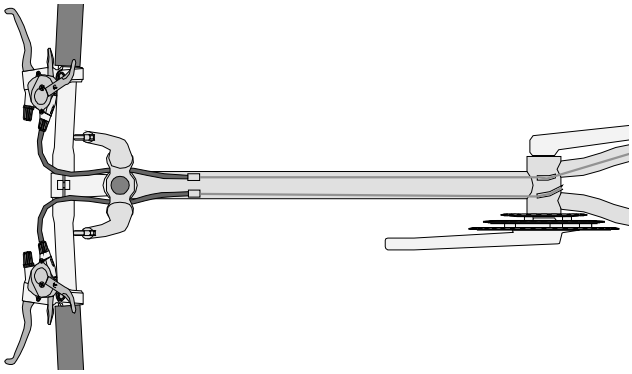
The Shimano Dura-Ace indexing down-tube levers that use a 1.5mm inner wire require high-quality wound and lined housing for the loop at the rear derailleur.

SIZING HOUSING LOOPS

MTB-SHIFTER LOOPS

Normal routing

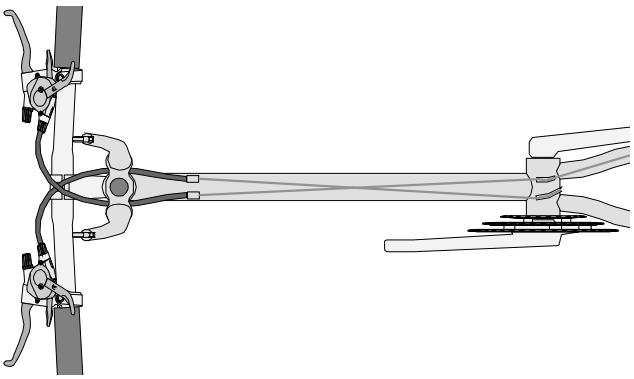
In normal routing, the loop from the right shifter goes by the right side of the head-tube/stem to a housing stop on the right side of the frame, and then the inner wire stays on the right side of the bike all the way to the rear derailleur. The left side is the same, except everything is on the left. On bikes with narrow handlebars (and particularly if the stem is short also) the normal routing may cause the housing to have a dramatic double-bend on its way from the shifter to the housing stop on the frame. If this is the case, consider crisscrossed routing.



31.5 *Normal routing, but crisscross routing would be more suitable on this bike.*

Crisscrossed routing

Crisscrossed routing is used only when normal routing is a problem. Crisscrossed routing cannot be used on all frames, even when the normal routing is a problem. Any time using crisscrossed routing causes an inner wire to drag on a frame tube on its way from the housing stop to the cable guide, it is unacceptable.

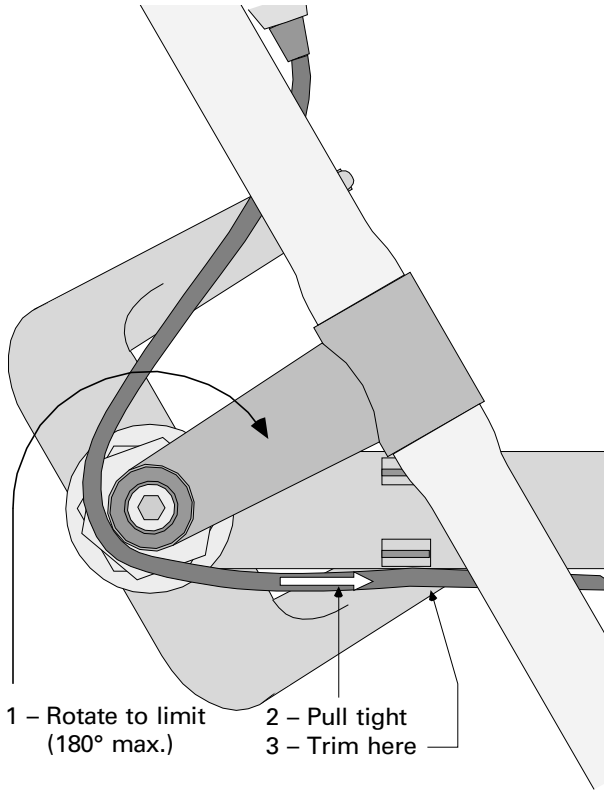


31.6 *Crisscrossed routing.*

Crisscrossed routing is done by routing the housing loop from the right shifter around the *left* side of the head-tube/stem to the housing stop on the *left* side of the frame. The inner wire is then routed back to the right side of the cable guide at the bottom-bracket shell. The left side is the reverse. The inner wires end up crossing each other between the top of the down tube and the bottom-bracket shell.

Sizing procedure

1. [ ] **Slide piece of housing onto inner wire that comes out of shift-control mechanism.**
2. [ ] **Route housing to the housing stop on frame that will be used, making sure that loop does not have to deflect around any existing brake cables.**
3. [ ] **Rotate handlebars to limit (180° max.) to side that is opposite housing stop on frame that loop is being routed to.**
4. [ ] **Pull housing as it will go past the housing stop on the frame (without damaging housing), making sure housing remains inserted in housing stop on shift-control mechanism.**



31.7 *Sizing the housing loop from a bar-mounted shift control mechanism.*

5. [ ] **Mark housing at point that is even with closed end of housing stop on frame.**
6. [ ] **Remove housing from inner wire and cut housing at mark.**

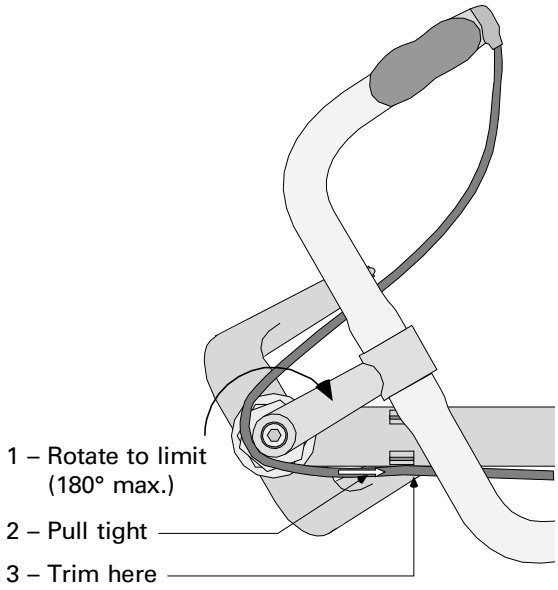
INTEGRAL SHIFT/BRAKE-LEVER LOOPS

Normal routing

In normal routing, the loop from the right shifter goes by the right side of the head-tube/stem to a housing stop on the right side of the frame, and then the inner wire stays on the right side of the bike all the way to the rear derailleur. The left side is the same, except everything is on the left.

Sizing procedure

1. [ ] **Slide piece of housing onto inner wire that comes out of shift-control mechanism.**
2. [ ] **Route housing to housing stop on frame that will be used, making sure that loop does not have to deflect around any existing brake cables.**
3. [ ] **Rotate handlebars to limit (90° max.) to side that is opposite housing stop on frame that loop is being routed to.**
4. [ ] **Pull housing as it will go past the housing stop on the frame (without damaging housing), making sure housing remains inserted in housing stop on shift-control mechanism.**

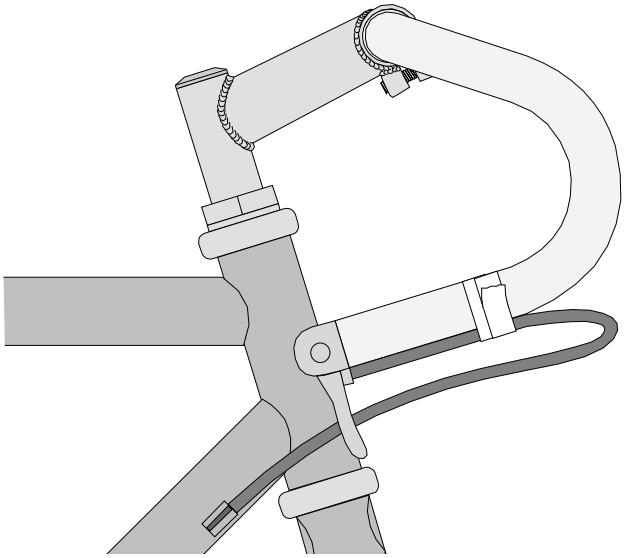


31.8 *Sizing the housing loop from an integral shift/brake lever.*

5. [ ] **Mark housing at point that is even with closed end of housing stop on frame.**
6. [ ] **Remove housing from inner wire and cut housing at mark.**

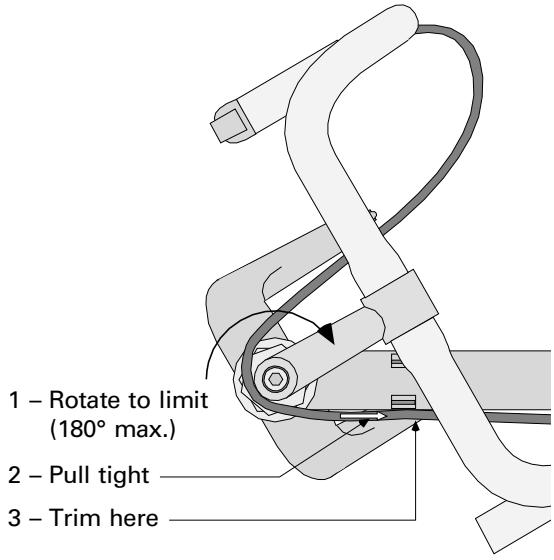
BAR-END-CONTROL LOOPS

Housing loops from bar-end controls on drop-style handlebars are run under the handlebar tape where the housing leaves the shifter. The housing comes out of the handlebar tape where the curve of the bar starts up toward the brake lever.



31.9 *Routing of the housing loop from a bar-end control.*

1. [ ] **Slide piece of housing onto inner wire that comes out of shift-control mechanism.**
2. [ ] **Temporarily retain housing to handlebar only to point bar begins to curve upward, with adhesive tape or ties.**
3. [ ] **Route housing to housing stop on frame that will be used, making sure that loop does not have to deflect around any existing brake cables.**
4. [ ] **Rotate handlebars to limit (180° max.) to side that is opposite housing stop on frame that loop is being routed to.**
5. [ ] **Pull housing as it will go past the housing stop on the frame (without damaging housing), making sure housing remains inserted in housing stop on shift-control mechanism and does not pull out of tape or tie on handlebar.**



31.10 *Sizing the housing loop from the handlebar to the frame.*

6. [ ] **Mark housing at point that is even with closed end of housing stop on frame.**
7. [ ] **Remove housing from inner wire and cut housing at mark.**

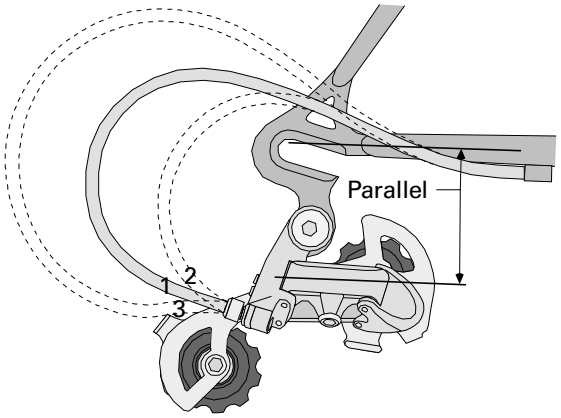
STEM-SHIFTER LOOPS

1. [ ] **Slide piece of housing onto inner wire that comes out of shift-control mechanism.**
2. [ ] **Route housing to the housing stop on the frame that will be used, making sure that loop does not have to deflect around any existing brake cables.**
3. [ ] **Rotate handlebars to limit (180° max.) to side that is opposite housing stop on frame that loop is being routed to.**
4. [ ] **Pull housing as it will go past the housing stop on the frame (without damaging housing), making sure housing remains inserted in housing stop on shift-control mechanism.**
5. [ ] **Mark housing at point that is even with closed end of housing stop on frame.**
6. [ ] **Remove housing from inner wire and cut housing at mark.**

REAR-DERAILLEUR LOOP

Sizing the cable-housing loop for the rear derailleur is a somewhat subjective process. Consistantly factories set this loop up too short, resulting in frequent kinking of the housing or housing ferrule where it comes out of the adjusting barrel. This factory setup leads to mechanics getting used to seeing *too short* as normal. Consequently, when setting the loop length up by the following rules, it is likely to look too long to an experienced mechanic.

The key to setting the length of the loop to the rear derailleur is to just focus on the entry of the housing into the cable-adjusting barrel. As the housing loop gets longer and shorter, the end of the housing in the adjusting barrel will twist up and down, and not come straight out of the adjusting barrel. When it is not twisted up or down, the length is correct.



31.11 *Sizing the housing loop at the rear derailleur.*

1. **[ ] Install inner wire into housing piece, but do not route inner wire through housing stop on frame.**
2. **[ ] Install a ferrule on one end of housing piece, then insert that end into cable-adjusting barrel, with inner wire going into adjusting barrel, as well.**
3. **[ ] Hold other end of housing piece adjacent to housing stop on frame.**
4. **[ ] Position derailleur so parallelogram body is roughly parallel to line from axle to center of bottom bracket, or pointing *slightly* down.**
5. **[ ] Move housing back and forth at housing stop at frame and stop at point housing ferrule in adjusting barrel is not twisted up or down in adjusting-barrel socket.**
6. **[ ] Mark housing at point that is even with closed end of housing stop on frame.**
7. **[ ] Remove housing from inner wire and cut housing at mark.**

FRONT-DERAILLEUR LOOP

Most front derailleurs do not have housing going to the front derailleur. When they do, try to make the loop a simple curve without any abrupt bends or double bends at the points the housing enters a housing stop.

PREPARATION AND INSTALLATION OF THE CABLE SYSTEM

HOUSING-END FINISH

Compressionless housing

Compressionless housing should be cut with an *enclosing* style of cable cutter, such as the Shimano TL-CT10. Careful alignment and stabilization of the tool and housing will insure a relatively square cut. If cutting the housing makes it out-of-round, a gentle squeeze between the handles of the tool or pliers will make it round again.

The inner liner often gets closed when the housing is cut. A push pin or similar sharp object can be used to open up the liner again.

Unlike wound housing, *compressionless housing should never be filed or ground flat on the end!*

Wound housing

Wound housing is used much more on brake systems than it is on derailleurs. Discussion of the proper finishing of wound housings is covered in the ***BRAKE CABLE SYSTEMS*** chapter (page 35-9).

INSTALLING FERRULES

It is critical to use ferrules *anytime they will fit*. Fit a ferrule onto the housing and check if the ferrule will install into the housing stop or adjusting barrel. If it fits without jamming, it must be used.

Ferrules for compressionless housing

There are ferrules made for wound housing that will fit onto compressionless housing, but are not suitable. Compressionless-housing ferrules are specially reinforced at the closed end to resist corruption from the ends of the wires that are part of the compressionless housing. If the wrong ferrule is used, the housing wires will force themselves though the hole in the ferrule where the inner wire comes

out. Pre-sized pieces of compressionless housing come with appropriate ferrules installed. Most packages of bulk compressionless-housing come with a supply of suitable ferrules. When purchasing separate ferrules that are suitable for use with compressionless housing, they are more likely to be described as fitting *Shimano SIS housing* than as fitting compressionless housing. In any case, to identify a compressionless-housing-compatible ferrule, look at the hole at the end where the inner wire comes out. If the material is obviously more than .5mm thick, the ferrule is compressionless-housing compatible.

Reusing ferrules

Factory ferrules that are on compressionless housing can be reused when installing new housing if there are no new compatible ferrules available.

1. **[ ] Put old housing in vise about 1/2" from end of jaws, with end of ferrule sticking up above vise about 3/4".**
2. **[ ] Gently grasp housing with needle-nose pliers just below ferrule.**
3. **[ ] Lever pliers down against vise to lift ferrule off end of housing.**
4. **[ ] Place ferrule(s) on new housing.**
5. **[ ] Insert old derailleur inner wire through a ferrule until inner-wire head is against ferrule.**
6. **[ ] Use cable fourth-hand tool to draw inner wire through housing, simultaneously pressing both ferrules onto housing.**

Crimping ferrules onto housing

Ferrules come from the factory crimped onto the housing so that they won't get lost in transit. Once a cable is installed on a bike, there is no advantage to having the ferrules crimped on. Crimping is a waste of time, and it complicates reusing ferrules. Crimping on ferrules is not recommended.

LUBRICATION

Any housing used for derailleur systems should be lined with a plastic sheath. Performance will always be improved by dripping or spraying oil into the housing before installing the cable system. Oil will reduce the friction caused by dirt that gets into the housing, and will reduce the tendency for the inner wire to rust. Grease should not be used because it can congeal when it gets cold or old, which will lower the performance of the cable system.