

Chapter 5 Table of Contents



Chain Types		Models	
Definitions & Parts Identification	5-2-5-3	Use & Specification	5-5-5-6
Width & Compatibility		Chain Service	
Chain Width Issues	5-3	Chain Lubrication	5-7
Chain Compatibility	5-4	Chain Life	5-7
Common Chain Widths	5-4	Chain Length	5-7
		Pin Design & Joining Systems	5-8
		Shimano Pins & Joining System	5-8-5-9
		Campagnolo 10-Speed Joining System	5-10
		Link-Based Joining Systems	5-10
		Chainline	
		Chainline Parameters	5-11
		Rear Chainline	5-12-5-13
		Front Chainline	5-13



Chain Types

DEFINITIONS & PARTS IDENTIFICATION

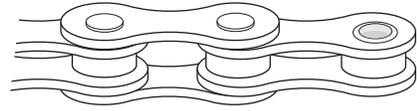
Chains fall into the following general categories:

- 1 Single-speed or multi-speed, by application;
- 2 Bushing-type or bushingless, by construction.

The general rule of thumb is that modern multi-speed chain is bushingless, whereas single-speed chain may be either bushing-type or bushingless. Most chains for industrial use have bushings.

In a bushing-type chain, the bushing locks the inner plates together rigidly. The rigid connection makes the chain stiff against side-to-side deflection. The roller of this chain, on the other hand, can spin freely. Bushing-type chain is suitable for high-RPM conditions (far beyond what a bicycle can produce) and because of its lateral stiffness, is best suited for chainrings and rear sprockets which are coplanar (share the

Bushing-type chain



same chainline) or for older derailleur shifting systems with limited deflection.

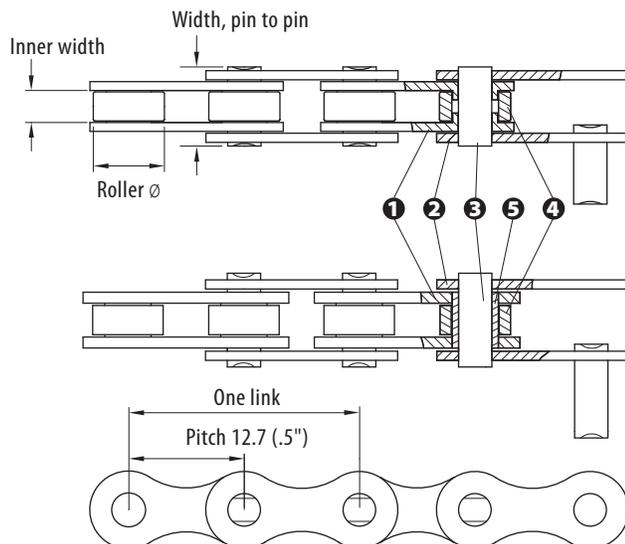
In the bushingless chain, the inner plates are forged into a shape which also serves as a pivot for the roller. As the inner plates are not constrained by a bushing, they can move relative to each other, a movement further facilitated by a loose tolerance between these plates and the pin. The hallmark of this chain is vastly increased lateral flexibility, so the chain can shift more swiftly and farther from the centerline between chainwheels and sprockets.

Chain part identification

- 1 Roller link plate (inner plate)
- 2 Pin link plate (outer plate)
- 3 Pin
- 4 Roller
- 5 Bushing

Bushingless chain

Bushing-type chain



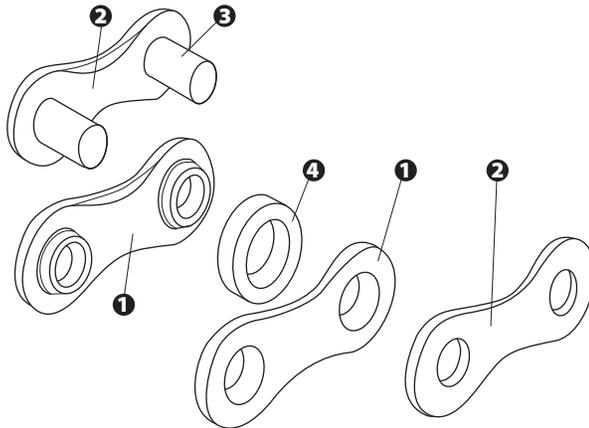
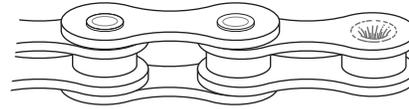


Chain Types *(continued)*

DEFINITIONS & PARTS IDENTIFICATION *(continued)*

Nowadays, almost all bicycle chain development is concentrated on bushingless design, even for single-speed applications. Elimination of the bushing reduces cost. Even though bushing chain has been better for single-speed use, designers are now busy developing a laterally stiff bushingless design, to mimic one of the bushing chain's best points.

Bushingless chain



Bushingless chain, detail

Chain part identification

- 1 Roller link plate (inner plate)
- 2 Pin link plate (outer plate)
- 3 Pin
- 4 Roller

Width & Compatibility

CHAIN WIDTH ISSUES

There are no international standards for chain widths, so when we speak of a "9-speed" or "8-speed" chain, for example, we are speaking of compatibility of drivetrain parts within a supplier standard.

Chain width is determined by sprocket thickness and the clearance between sprockets, and optimized so the chain neither falls between nor grinds against them. A Shimano 9-speed chain,

for example, is ill-suited for use on a crankset designed for the wider chains as used on the HG or IG 7-speed designs.

Each chain maker has subtle differences between models, compounding the difficulty in establishing absolute rules—but page 5-4 gives some basic guidelines. The table on page 5-5 goes into detail about brands and models.



Width & Compatibility *(continued)*

CHAIN COMPATIBILITY

Basically, you can't go wrong following a manufacturer's recommendation. For example, all Shimano 9-speed (Mega-9) chains are interchangeable, though durability varies among the individual models. The next best choice, if a manufacturer's recommendation can not be followed, is the next most similar chain.

7/8-speed IG (Intergrlide) chain can be used to replace 7/8-speed Shimano HG (Hyperglide) chains, but the reverse is not true. In particular, 7/8-speed HG chains will not work properly on drivetrains with IG-function cranks etc. *For more details go to page 7-14, Chain, footnote ‡.*

The further one strays from a recommendation, the more variables there are, particularly when using another brand. Some of the compatible chains are very good, or even superior in certain ways to OEM recommended chains, but due to the high variability, and differences in how shifting performance is judged by different people, you may need to test compatibility for yourself, or talk to people you trust.

COMMON CHAIN WIDTHS

Chain width in mm	Intended use (rear sprocket)	Typical length (links)
10.4-13 mm	1-speed (1/2" x 1/8" to 1/2" x 3/16") heavy-duty and extreme use	96-106 BMX
9.4-8.6 mm	1-speed and internal gear systems (1/2" x 1/8")	96-106 BMX, 105-112 internal gear or track
7.8 mm	1-speed (1/2" x 3/32") seen on some BMX	96-105 BMX
7.8 mm	5- or 6-speed (The 7.3–7.1 mm width chain is also widely used nowadays as a substitute. In some cases it may slip between the cogs of wide freewheels, but in most cases it probably will work well.)	108-118 Road/ATB
7.3-7.1 mm	7- or 8-speed (or narrow 6). 7.3 mm is often associated with Shimano HG, 7.1 mm with Shimano IG, though there are other factors involved in HG and IG design.	108-118 Road/ATB
6.8 mm	9-speed, associated with Campagnolo	108-116 Road
6.6 mm	9-speed, associated with Shimano	108-116 Road
6.2-6.1 mm	10-speed, associated with Campagnolo	108-116 Road
5.9 mm	10-speed, associated with Shimano	108-116 Road

Note: Tandem chain lengths are highly variable depending on overall design, but somewhere between 131-280 links.



Models

USE & SPECIFICATION

Application	Width	Models	Special pin or link
Campagnolo			
10-speed	6.1 mm	Record-10 (CN03-RE10)	Use link CN-RE200CN with tool UT-CN200*
9-speed	6.8 mm	Record-9	Standard pin installed with tool UT-VS090 set at 6.85 mark
KMC			
10-speed	6.2 mm	X10	Missing Link CL562
9-speed	6.6 mm	X9, Z9900, Z9200, Z9000	Missing Link CL366, or slotted link CL566
7/8-speed	7.1 mm	X8, Z92, Z82, Z72, Z51	Missing Link CL571, or slotted link CL371
6/7-speed	7.3 mm	Z50	Missing Link CL573, or slotted link CL373
5/6-speed	7.8 mm	Z30	—
1-speed	8.6 mm	Z410RB Z410	—
	9.4 mm	K710	—
	13.0 mm	K910, Z415H	—
Rohloff			
9-speed	6.8 mm	SLT99 9-speed Road 9-speed MTB	Standard pin using tool Revolver-2 with position 2 setting
6/7/8-speed	7.1 mm	SLT99 8-speed Road 8-speed MTB	Standard pin using tool Revolver-2 with position 3 setting
Sharp			
1-speed	13.0 mm	41	—

*This replaces the older Perma-Link system which is no longer available at the distributor level.

6

For information on chains made prior to 1996, and on older national or brand standards, refer to Sutherland's 6th Edition, pages 2-20 and 2-21.

(continued)



Models *(continued)*

USE & SPECIFICATION *(continued)*

Application	Width	Models	Special pin or link
Shimano			
Super-narrow 10-speed	5.9 mm	CN-7800	Reinforced connecting pin (silver color w/dark line)
Mega 9-speed; <i>also LinkGlide 8-speed</i>	6.6 mm	CN-7701, CN-HG93, CN-HG73, CN-HG53†	Reinforced connecting pin (silver color)
Interactive Glide 7/8-speed	7.1 mm	CN-IG90, CN-IG70, CN-IG51, CN-IG31	Reinforced connecting pin (black color)
Hyperglide 7/8-speed	7.3 mm	CN-7401, CN-HG91, CN-HG90, CN-HG70, CN-HG50	Reinforced connecting pin (black color)
Uniglide 6-speed	7.3 mm	CN-UG50, CN-UG51‡	—
SRAM			
9-speed	6.9 mm	PC-99, PC-89R	Powerlink Gold
9-speed	6.9 mm	PC-69, PC-59, PC-49	Powerlink Gold or pin
7/8-speed	7.1 mm	PC-68, PC-58, PC-48	Powerlink Silver or pin
	6.8 mm	PC-48	Powerlink Silver or pin
5/7-speed	6.9 mm	PC-38, PC-10	Powerlink Gray or pin
1-speed	7.8 mm	PC-1, PC-1 nickel	Snap-Link connector or pin
	8.1 mm	PC-7X	Standard 3-piece connector
Sunrace			
9-speed	6.6 mm	CN99	Easylink
7/8-speed	7.1 mm	CN91, CN51	Easylink
Wipperman–ConneX			
10-speed	6.2 mm	10X1, 1008	10-speed stainless steel link
9-speed	6.8 mm	9X1, 908, 904, 900	9-speed stainless steel link
6/7/8-speed	7.2 mm	8X1, 808, 804, 800	8-speed stainless steel link
5/6/7-speed	7.8 mm	707, 721, 700	ConneX link
1-speed	9.2 mm	152, IZ1, 132	Spring clip #11
	13.0 mm	iG8	IG8 link

† These chains are correct for Shimano 9-speed cassettes, and also for the new Shimano LinkGlide 8-speed cassettes used in various Nexave groups.

‡ UG chain needs a chain tool which can match the profile of the protruding outer plates.

Chain Service

CHAIN LUBRICATION

Chains are immersed at the factory in a special melted grease which then dries hard. The difficulty in the shop is finding a way to clean a chain and apply replacement lube which penetrates equally well and deeply into the chain and has lubriplating characteristics.

The most effective lubricants for shop use may be dry and/or Teflon-based sprays. There is no one standard or really good foolproof recommendation, though Shimano, Campagnolo, etc., have individual recommendations which may be followed.

CHAIN LIFE

Chains work in a very demanding environment. As the pins and side plates wear, chains lengthen—they do not “stretch.” More expensive chains are generally made of better-wearing materials. A new chain may jump forward over an old sprocket after the old, elongated chain has worn “hooks” on the load-bearing faces of the sprocket’s teeth—the shorter links of the new chain snag on the crowns of the teeth. One or more of the chain wear indicators sold by various suppliers may give an idea of remaining chain life, although there is no universal standard for how much elongation is too much.

CHAIN LENGTH

1 To measure for a replacement chain, remove the old chain, lay the new one next to it and cut it to the same number of links.

2 If the bicycle has no chain, the general formula (for multi-speed bikes) is to install the chain loosely on the bike and check its position

in both of the extreme crossover gears, then cut and pin the chain. Ensure that the chain is not so short (taut) as to prevent it from getting into the extreme big front to big rear combination. Except on a bicycle with a very wide range of sprocket and chainwheel sizes, it will then still be under tension in the extreme small front to small rear combination—which should in any case not be regularly used. Beyond this general information, each company (e.g., Shimano) has specific service guides for its various derailleur models.

3 For single-speed bikes, loosely install the chain with the rear wheel axle midway in the dropout slots. Check the estimated cut point to achieve a good fit (snug but not tight) and cut the chain. Next, slide the wheel forward in the dropout and install and pin the cut chain. Finally, slide the wheel backward until the chain has only a very slight amount of slack, then tighten the rear axle nuts lightly. Due to some eccentricity in chainrings and freewheels, expect tight spots in rotation. Pedal through several rotations to find these, re-adjust the chain at the tight point, then finish tightening the axle nuts. A good way to loosen a too-tight chain slightly is to tap on it halfway between the chainwheel and sprocket, using the handle of your wrench with the axle nuts slightly loose.





Chain Service *(continued)*

PIN DESIGN & JOINING SYSTEMS

The fit of the pins in the outer link plates keeps the chain together. Traditionally, the pin has been installed to a press fit (interference fit) standard, with simple chain tools. Press fit works over a narrow range of tightness without fatiguing or cracking the outer plates. Modern demands for quicker shifting through more gears have dramatically increased force on the pins. Better materials have improved the tensile strength of modern chain, and the reshaping of the link plates and sprockets has eased shifting under high pressure, but for the very narrowest chains, fundamental pin design has also had to

adjust. One answer has been in mushrooming or peening the heads to prevent the pin from pulling out. This is easy to accomplish at the factory. But when a pin is extracted, it can deform the outer link, which must be discarded and replaced with another link, for example, KMC's Missing Link. Shimano has its own way to address the problem, special replacement pins to join opened chains, though never on the same link twice. Shimano makes such pins in 3 widths, which can be distinguished by color. Campagnolo has yet another system.

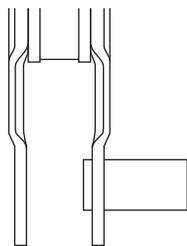
SHIMANO PINS & JOINING SYSTEM

SHIMANO TOOLS & INSTALLATION

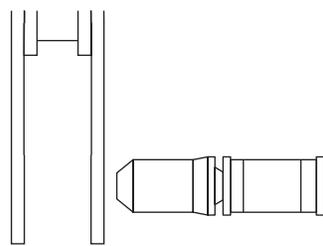
Pin color	Use	Tools*
Black	7/8-speed narrow chain such as CN-HG50 / CN-IG51	TL-CN31/TL-CN22 and TL-CN30/TL-CN21†
Silver	9-speed extra narrow chain such as CN-7701 / CN-HG93	TL-CN32/TL-CN23†
Silver with line	10-speed super narrow chain such as CN-7800	TL-CN32/TL-CN23†

* Third-party chain tools can work fine if designed to accept Shimano-shaped outer links.

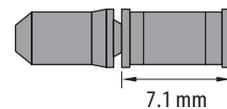
† Shimano tools TL-CN31 and TL-CN22 are being phased out by compatible TL-CN32 and TL-CN23.



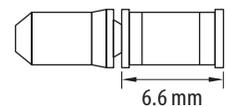
Traditional pin, older and wider chain such as UG50



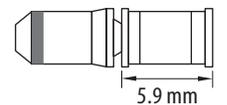
Reinforced connecting pin, modern narrow chain



Black
For 7/8-speed



Silver
For 9-speed



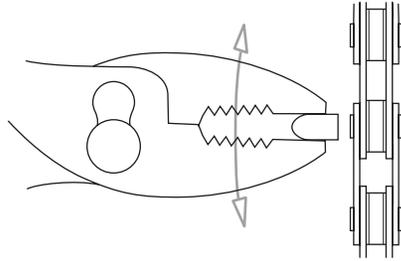
Silver with line
For 10-speed



Chain Service *(continued)*

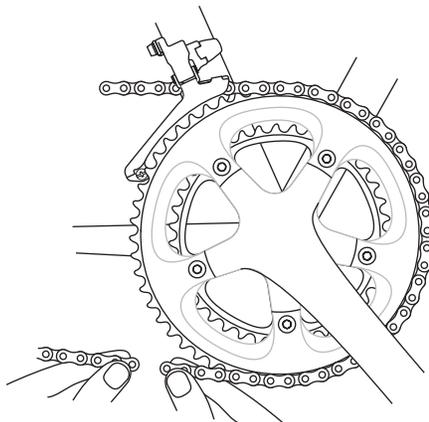
SHIMANO PINS & JOINING SYSTEM *(continued)*

Shimano pin guide removal

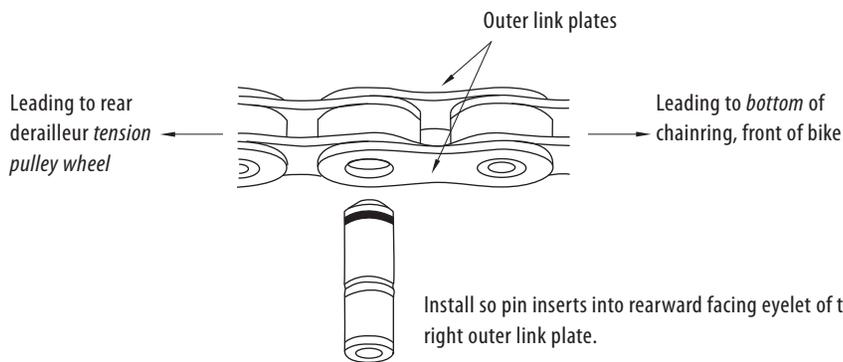


Excess part (pin guide head) broken off after joining. This applies to all 7/8/9/10-speed Shimano systems.

Notes for Shimano 10-speed chain installation direction



Detail view below



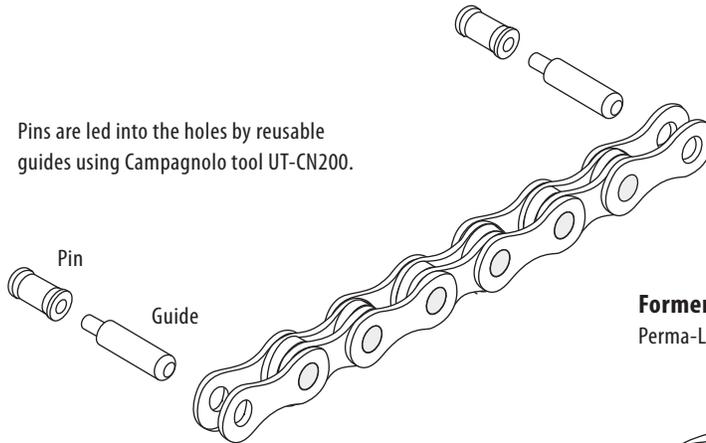


Chain Service *(continued)*

CAMPAGNOLO 10-SPEED JOINING SYSTEM

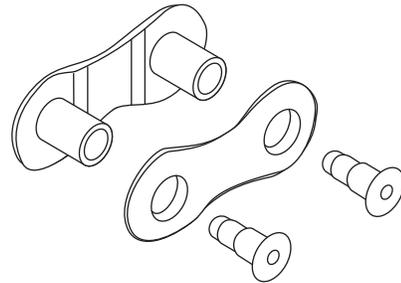
Campagnolo 10-speed chain and pin joining system

Pins are led into the holes by reusable guides using Campagnolo tool UT-CN200.



Former Campagnolo 10-speed joining system

Perma-Link, using tool UT-CS050, not shown.



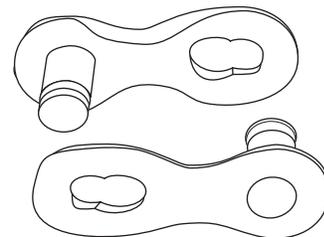
Campagnolo 9-speed chain and link joining system is more traditional, using the recommended tool UT-VS090.

LINK-BASED JOINING SYSTEMS

The key point in joining modern high-stress chain is a good link union. To this end, there are several systems, either “toolless” and/or using various snap mechanisms to prevent links from pulling out. Each is different, making generalizations difficult, except to say that they are usually reusable and do not require separate or special pins (such as the Shimano type). Use the correct brand and width for the chain you are joining. Most brands have several models to cope with the different chain widths.

Common examples

- KMC Missing Link
- Sunrace EXZ-Link
- SRAM Powerlink
- ConneX Link



Drawing of a link system (SRAM Powerlink in this case) which does not use typical chain tools.



Chainline

CHAINLINE PARAMETERS

The front chainline (chainring centerline) and rear chainline (rear cogset centerline) need to be coordinated for functionality.

On bicycles with single chainrings and rear sprockets, the front and rear chainring should match within 1 or 2 mm, to reduce the likelihood of derailment and to decrease wear. The chainline may be altered by adding or subtracting spacers behind the rear sprocket, moving the washers and spacers on the rear hub axle, or changing the BB axle length.

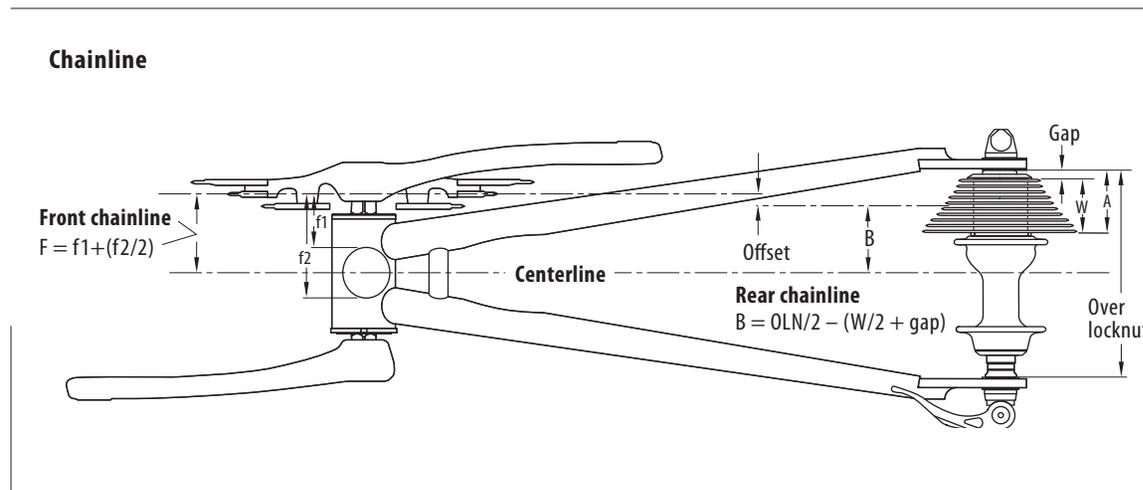
On multi-speed bicycles, the rear chainline is typically closer to the bicycle's centerline than the front chainline in order to prevent the chain from rubbing on the next larger chainring when using a small, inner chainring with a rear outer sprocket. Offset is typically greatest with a triple crankset and/or suspension rear triangle.

Extreme offset does increase chain wear and make shifting less precise.

After confirming that the frame is in good alignment, determine the offset by either:

- 1 Sighting over the chainrings toward the rear wheel and sprockets
- 2 Extending a straightedge such as the Stein tool across the crankset and to the rear cogs
- 3 Taking measurements and calculations as shown in the illustration.

Poor shifting, chain rub or frequent chain derailment may indicate poor chainline—or a bent rear triangle or derailleur hanger—so make the correct diagnosis before proceeding with any action. Our tables give the front and rear chainlines of all the common designs.





Chainline *(continued)*

REAR CHAINLINE

Rear cogset	Over locknut	Dimension A*	Cogset width W	Calculated chainline B	Typical use
Single	110	21	—	43.5~45	<i>BMX</i>
	110	—	—	42	<i>Coaster type</i>
	120	25	—	42.5~43.5	<i>Track</i>
5-speed	120–121	29–30	25	43–43.5	<i>Example: 60s/70s Campagnolo</i>
	124	34	25	40.5	<i>~70s vintage Oriental production</i>
6-speed	126	36.5	31	42	<i>Example: Shimano C90</i>
	130	36.5	31	44	
6-speed narrow	120	31	27	42.5	<i>Example: 70s Suntour Superbe Pro</i>
	126	34	27	42.5	
7-speed narrow	126	37.8	32	42.2	<i>Example: 7-speed Ultegra, 105</i>
	130	37.8	32	43.2	<i>Example: 7-speed Deore LX, Exage</i>
	135	37.8	32	45.7	
8-speed narrow	130	40.5	35.4 [†]	42.2	<i>Example: 8-speed Ultegra, 105</i>
	135	40.5	35.4 [†]	44.7	<i>Example: 8-speed XTR</i>
9-speed narrow	130	40.5	36.5	42.6	<i>Example: 9-speed Dura-Ace</i>
	135	41	36.5	44.75	<i>Example: 9-speed XTR</i>
10-speed narrow	130	41	36.5	42.6	<i>Example: 10-speed Dura-Ace</i>

* Some variation. Example: 8 to 10-speed hubs range between 40.5 and 41 mm.

† Some older 8-speed cogsets including SRAM may have 36.4 mm overall width.



Chainline (continued)

REAR CHAINLINE (continued)

Rear cogset	Over locknut	Dimension A	Cogset width W	Calculated chainline B	Typical use
Campagnolo					
8-speed	130	41.5	37.2	42.1	Any 8-speed Campagnolo
9-speed	130	42.5	38.5	41.75	Any 9-speed Campagnolo
10-speed	130	42.5	38.5	41.75	Any 10-speed Campagnolo

FRONT CHAINLINE

Crankset	Calculated chainline F	Typical use
1 chainring	42–43	Coaster brake
	43.5–45	BMX
	42.5, 43.5	Track 110/120 OLN
2 chainrings	43.5	Road
3 chainrings	45	Road
	46.5	Campagnolo Record only
	47.5	Road seat tube \varnothing 34.9 (Campagnolo)
	47.5	MTB seat tube \varnothing 28.6–34.9 (Shimano)
	50*	

* Especially for wider BB shells and/or suspension frames. Front shifting may be less precise.

