一、

1.前后链轮的数量 the number of sprockets in both the front and rear of the drivetrain

Gearing range

（https://en.wikipedia.org/wiki/Bicycle_gearing#:~:text=the%20number%20of%20usable%20gear,8%2C%20and%207%20gear%20ratios.）

The gearing range indicates the difference between bottom gear and top gear, and provides some measure of the range of conditions (high speed versus steep hills) with which the gears can cope; the strength, experience, and fitness level of the cyclist are also significant. A range of 300% or 3:1 means that for the same pedaling speed a cyclist could travel 3 times as fast in top gear as in bottom gear (assuming sufficient strength, etc.). Conversely, for the same pedalling effort, a cyclist could climb a much steeper hill in bottom gear than in top gear.

The overlapping ranges with derailleur gears mean that 24 or 27 speed derailleur gears may only have the same total gear range as a (much more expensive) Rohloff 14-speed hub gear. Internal hub geared bikes typically have a more restricted gear range than comparable derailleur-equipped bikes, and have fewer ratios within that range.

The approximate gear ranges which follow are merely indicative of typical gearing setups, and will vary somewhat from bicycle to bicycle.

range	transmission	usable gears	mean step
180%	3-speed hub gears	3	34.2%
250%	5-speed hub gears	5	25.7%

range	transmission	usable gears	mean step
300%	7-speed hub gears	7	20.1%
307%	8-speed hub gears	8	17.4%
327%	typical 1 chainring derailleur setup (1x10, 11-36)	10	14.1%
327%	road 1 chainring derailleur setup (1x11, 11-36)	11	12.6%
380%	NuVinci continuously variable transmission[8]	continuous	none
409%	11-speed hub gears	11	15.1%
420%	mountain 1 chainring derailleur setup (1x11, 10-42)	11	15.4%
428%	road 2 chainring derailleur setup (2x10, 50-34 x 11-32)	13	12.9%
441%	road 3 chainring derailleur setup (3x10, 52/39/30 x 11-28)	15	11.2%
500%	extreme 1 chainring derailleur setup (1x12, 10-50)	12	15.8%
518%	mountain 2 chainring derailleur setup (2x10, 38-24 x 11-36)	14	13.5%
526%	Rohloff Speedhub 14-speed hub gear	14	13.6%

range	transmission	usable gears	mean step
630%	Mountain 2x11 derailleur setup (24/36 x 10-42)[9]	14	15.2%
636%	18-speed bottom bracket gearbox[10]	18	11.5%
655%	mountain 3 chainring derailleur setup (3x10, 44-33-22 x 11-36)	16	13.3%
698%	touring 3 chainring derailleur setup (3x10, 48-34-20 x 11-32)	15	14.9%

2.前后链轮的齿数

（ https://www.britishcycling.org.uk/knowledge/article/izn20130703-Understanding-gears-0#:~:text=Depending%20on%20the%20type%20and,to%2032%20(32t)%20teeth.）

Cassette（后盘）

The cluster of sprockets on your rear wheel is known as a cassette. Depending on the type and age of your bike, it will probably have between 9 and 12 sprockets and will be referred to as 8-speed or 12-speed respectively. On a typical road bike, the smallest sprocket will typically have 11(11t) or 12 (12t) teeth and the largest 25 (25t) to 32 (32t) teeth.

Chainrings(前盘)

Attached to your cranks are your chainrings. Most road bikes will have a double chainring set-up. Chainring sizes vary but a standard road set-up will typically have 53 teeth (53t) on the outer large chainring and 39 teeth (39t) on the smaller inner one. Compact gearing, with 50t on the outer and 34t

on the inner, has become very popular for tackling hilly sportives and has largely superseded triple three chainring cranksets. An in-between “Pro or Semi-Compact” 52t outer and 36t inner are also fairly common.

3.齿轮比 the range of gear ratios available

Gear Ratios

Gear Ratio = Number of Teeth in Chainring ÷ Number of Teeth in Cassette

If you are in your larger 50t chainring and your smallest 12t sprocket, what does this mean? This 50:12 gear ratio means that every turn of your pedals is multiplied by the gear to make your wheel rotate just over four times (50÷12=4.2). This gear is your “biggest gear”, it is the hardest to push but for each pedal rotation it will give you the greatest distance.

When you hit a hill, you will need to shift down to a lower or easier gear. On really steep slopes or if your legs are really tired, you might be in your lowest gear. This would be the smaller 34t chainring and the largest 28t sprocket. This 34:28 ratio would give you just over one rotation of your wheel for every pedal stroke (34÷28=1.2) and will hopefully get you up that tough hill.

前后盘的齿比!!!!!!!

4. average spacing between possible gear ratios

$$\boldsymbol{gear\ ratio = R_i}$$

$$average\ spacing\ netween\ gear\ ratio = \frac{R_{max} - R_{min}}{n-1} \quad (n\ is\ the\ number\ of\ possible\ gear\ ratio)$$

二、

1. Measure the chain dimensions（这个我们要去找实物测量么）

（https://www.parktool.com/blog/repair-help/chain-compatibility）

Derailleur bike chains are designed to be moved from sprocket to sprocket, and come in many different design standards. When selecting a chain, the first consideration is the number of rear sprockets. The rear cog sets have been made with 5, 6, 7, 8, 9, 10, 11, or 12 sprockets. As the number of cogs on the rear hub increases, the spacing between cogs tends to be reduced. Consequently, chains tend to get narrower as the number of rear cogs increases.

Nominally derailleur chains are called “3/32-inch chain.” However that is not a true measurement, as modern derailleur chains can vary from that sizing.

Some nominal widths measured across the rivet between chains are:

- 12 rear cogs — 5.3 mm
- 11 rear cogs — 5.5 mm
- 10 rear cogs — 6 mm
- 9 rear cogs — 6.5 to 7 mm
- 6, 7, and 8 rear cogs — 7 mm

VARIOUS DERAILLEUR CHAINS IN DIFFERENT STANDARDS

In addition to the chain working on the rear cogs and rear derailleur the chain must be compatible with the front chain rings. Front cranksets are also designated for varying “speeds” to give an indication of the right width chain to use. The spacing between front rings for a 8 or 9 speed chainring set will be relatively wide. Using a narrow 10 or 11 speed chain may result in the tendency for it to fall between the two rings during a shift.

Drivetrain manufacturers design their chains to work as a system with the derailleurs, rear sprockets, and shift levers. Chains can vary in side plate shape, sizing, and height. Differences can cause variations in shifting performance between brands and models.

DIFFERENT SHAPED SIDE PLATES AMONG VARIOUS MANUFACTURERS

Additionally, chains will vary in the quality of steel used. Better chains that are more durable and longer lasting tend to have harder rivets. Riding a bike tends to wear and thin the rivet as it is pulled against the inner plates.

2. maximum load-carrying capacity of the chain in bike

①数据分析

(https://industrialrope.com/catalog-chain/welded-chain-specifications-transport-chain-grade-70/)

Welded Chain Specifications – Transport Chain (Grade 70)

Significantly higher tensile strength for all load binding and tie-down applications, which permits you to hold a given load with the next smaller size chain than High Test. This increased strength-to-weight ratio means lower costs and a lighter chain, for easier storage and handling.

Trade Size In Inches	Working* Load Limit Lbs.	Feet Per Drum	Feet Per 1/2 Drum	Weight per Foot In Lbs.
1/4	3,150	800	400	.63
5/16	4,700	550	275	.93
3/8	6,600	400	200	1.41
1/2	11,300	200	100	2.40

* Workingload limit must not be exceeded.
** For cut lengths please add 25%; cut lengths subject to availability.
Not to be used for overhead lifting.
Boomer chains or binder chains available on request.

ALLOY STEEL CHAIN (GRADE 80)

Made from special analysis alloy steel engineered to combine strength, lightness and durability. Exceeds ASTM, NACM and all existing federal requirements.

Trade Size In Inches	Working* Load Limit Lbs.	Feet Per Drum	Feet Per 1/2 Drum	Weight per 100 Feet Lbs.
1/4	3,500	800	400	71
5/16	5,100	500	250	106
3/8	7,100	500	250	144
1/2	12,000	300	150	236
5/8	18,100	200	100	380
3/4	28,300	100	50	556
7/8	34,200	100	50	735
1	47,700	100	50	975

Trade Size In Inches	Working* Load Limit Lbs.	Feet Per Drum	Feet Per 1/2 Drum	Weight per 100 Feet Lbs.
1-1/4	72,300	60	N/A	1522

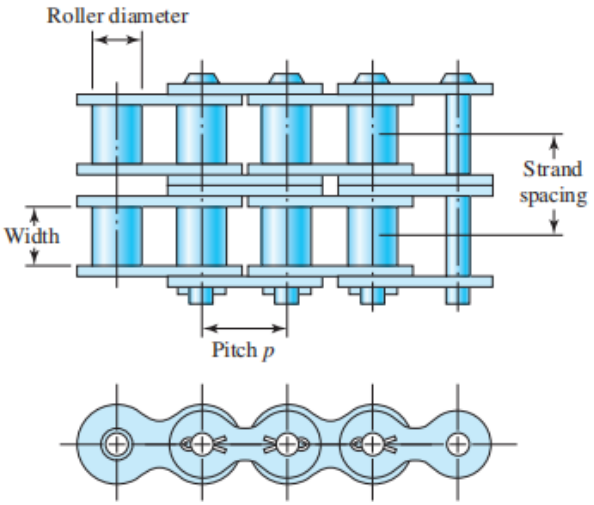
* Workingload must not be exceeded.

②建模分析

sizes are listed in Table 17–19.

Figure 17–16

Portion of a double-strand roller chain.



Driven sprockets are not made in standard sizes over 120 teeth, because the pitch elongation will eventually cause the chain to "ride" high long before the chain is worn out. The most successful drives have velocity ratios up to 6:1, but higher ratios may be used at the sacrifice of chain life.

Table 17–19

Dimensions of American Standard Roller Chains—Single Strand

Source: Compiled from ANSI B29.1-1975.

ANSI Chain Number	Pitch, in (mm)	Width, in (mm)	Minimum Tensile Strength, lbf (N)	Average Weight, lbf/ft (N/m)	Roller Diameter, in (mm)	Multiple-Strand Spacing, in (mm)
25	0.250 (6.35)	0.125 (3.18)	780 (3 470)	0.09 (1.31)	0.130 (3.30)	0.252 (6.40)
35	0.375 (9.52)	0.188 (4.76)	1 760 (7 830)	0.21 (3.06)	0.200 (5.08)	0.399 (10.13)
41	0.500 (12.70)	0.25 (6.35)	1 500 (6 670)	0.25 (3.65)	0.306 (7.77)	— —
40	0.500 (12.70)	0.312 (7.94)	3 130 (13 920)	0.42 (6.13)	0.312 (7.92)	0.566 (14.38)
50	0.625 (15.88)	0.375 (9.52)	4 880 (21 700)	0.69 (10.1)	0.400 (10.16)	0.713 (18.11)
60	0.750 (19.05)	0.500 (12.7)	7 030 (31 300)	1.00 (14.6)	0.469 (11.91)	0.897 (22.78)
80	1.000 (25.40)	0.625 (15.88)	12 500 (55 600)	1.71 (25.0)	0.625 (15.87)	1.153 (29.29)
100	1.250 (31.75)	0.750 (19.05)	19 500 (86 700)	2.58 (37.7)	0.750 (19.05)	1.409 (35.76)
120	1.500 (38.10)	1.000 (25.40)	28 000 (124 500)	3.87 (56.5)	0.875 (22.22)	1.789 (45.44)
140	1.750 (44.45)	1.000 (25.40)	38 000 (169 000)	4.95 (72.2)	1.000 (25.40)	1.924 (48.87)
160	2.000 (50.80)	1.250 (31.75)	50 000 (222 000)	6.61 (96.5)	1.125 (28.57)	2.305 (58.55)
180	2.250 (57.15)	1.406 (35.71)	63 000 (280 000)	9.06 (132.2)	1.406 (35.71)	2.592 (65.84)
200	2.500 (63.50)	1.500 (38.10)	78 000 (347 000)	10.96 (159.9)	1.562 (39.67)	2.817 (71.55)
240	3.00 (76.70)	1.875 (47.63)	112 000 (498 000)	16.4 (239)	1.875 (47.62)	3.458 (87.83)

Chain velocity:

$$V = \frac{Npn}{12}$$

where N = number of sprocket teeth
p = chain pitch, in
n = sprocket speed, rev/min

The American Chain Association (ACA) publication *Chains for Power Transmission and Materials Handling* (1982) gives

Power

for single-strand chain, the nominal power H_1, link-plate limited

$$H_1 = 0.004N_1^{1.08}n_1^{0.9}p^{3-0.07p} \quad hp$$

the nominal power H_2, roller-limited

$$H_2 = \frac{1000K_r N_1^{1.5}p^{0.8}}{n_1^{1.5}} \quad hp$$

where N_1 = number of teeth in the smaller sprocket
n_1 = sprocket speed, rev/min
p = pitch of the chain, in
K_r = 29 for chain numbers 25, 35; 3.4 for chain 41; and 17 for chains 40–240

Chain tension and speed

The maximum speed (rev/min) for a chain drive is limited by galling between the pin and the bushing. Tests suggest

$$n_1 \le 1000\left[\frac{82.5}{7.95^p 1.0278^{N_1} 1.323^{\frac{F}{1000}}}\right]^{\frac{1}{1.59\log p+1.873}} \quad rev/min$$

where F is the chain tension in lbf.

Chain life

$$\frac{H_2^{2.5}h}{N_1^{3.75}L_p} = \text{constant}$$

where L_p is the chain length in pitches and h is the chain life in hours.