SECTION 14

OTHERS

CONTENTS

Service	TRA classification	Tread	Use
Earthmover	E-1	Rib	For front wheels of dump trucks
	E-2	Traction	For scrapers used on sandy ground and soft soil where traction is necessary.
	E-3	Rock	For dump trucks and scrapers used where resistance against external damage and abrasion is important.
	E-4	Rock Deep Tread	For scrapers and dump trucks used where resistance against external damage and abrasion is required.
	E-7	Floatation	For carry-all scrapers stronger than E3, used where only flotation is needed.
Grader	G-1	Rib	For front wheels of graders.
	G-2	Traction	For rear wheels of graders used where traction is necessary.
	G-3	Rock	For rear wheels of graders used where resistance against external necessary, rather than traction.

Service	TRA classification	Tread	Use
Loader	L-2	Traction	For loaders and dozers used on sandy ground where traction is necessary.
	L-3	Rock	For loaders and dozers used on mountain sand and on rocks where resistance against external damage and abrasion is necessary.
	L-4	Rock Deep Tread	For loaders and dozers used where resistance against external damage and abrasion is required to be stronger than those of L3.
	L-4S	Smooth Deep Tread	For loaders and dozers used where resistance against external damage and abrasion is required to be stronger than those of L-3S.
	L-5	Rock Extra-Deep Tread	For loaders and dozers used where resistance against external damage and abrasion is required to be stronger than those of L4.
	L-5S	Smooth Extra-Deep Tread	For loaders used where resistance against external damage and abrasion is required to be stronger than those of L-4S.
Compactor	C-1	Smooth Tread	For tire rollers
Log-skidder	LS-1	Intermediate	For skidder

SAE CODE		BRIDGE STONE	TOYO	GOODYEAR	FIRESTONE
Earthmover					
E 1	Rib	W Rib	R-5	Hard Rock Rib	Rib Excavator
E 2	Traction	G-Lug, Fast Grip	G-15	Earth Mover Sure-Grip	Super Ground Grip, Ground Grip G
E 3	Rock	R Lug, W-Lug	G-18, G13 G-18 Wide Base	Hard Rock Lug, Super Hard Rock Lug	Rock Grip Excavator, Super Rock Grip
E 4	Rock Deep Trend	R-Lug-X	G-18ET	Hard Rock Lug XT-8	Super Rock Lug
				Super Hard Rock Lug	Super Rock Grip Deep
E 5	Rock Intermediate HR	W-Lug, R-Lug		Hard Rock Lug Type B	Super Rock Grip Type B
E 6	Rock Maximum HR	W-Lug, R-Lug		Hard Rock Lug Type C	Super Rock Grip Super Grd. Grip High Speed
E 7	Flotation	Alligator, Sand Clipper	D-1	Earth Mover All-Weather Rib Sand Service	All Non Skid Earthmover Sand Champion
Grader					
G 1	Rib	Rib Grader		Rib Grader	Rib Road Builder
G 2	Traction	G-Lug, Fast Grip	G-15	Sure Grip Grader Rock Grader	Road Builder Low Pressure
G 3	Rock	W-Lug, R-Lug		Rock Grader	Rock Grip Road Builder
				Sure Grip Grader	Super Ground Grip
Loader & Dozer					
L 2	Traction	G-Lug, Fast Grip	G 15	Sure Grip Lug D & L Sure Grip Grader	Super Ground Grip Super Traction Duple Ground Grip Road Builder
L 3	Rock	W-Lug, R-Lug	G-18 G-18 Wile Base	Super Hard Rock Lug	Super Rock Grip
L 4	Rock Deep Tread	R-Lug-X, STM	G-18ET	Super Hard Rock Lug Xtra Tread D & L	Super Rock Grip Deep
L 5	Rock Extra Deep Tread	STM-X, D-Lug	G-25 EDT	Super Xtra Tread D & L	Super Deep Tread Loader Dozer

Manufacturers' Designation

OTHERS

TIRES

SAE CODE		UNIROYAL	GENERAL	GOODRICH	MICHELIN
Earthmover					
E 1	Rib	Super Fleetmaster Rib STR	H.C.T. Rock Type, Rock Rib LCM	Rib Service	
E 2	Traction	Earthmover Full Traction	DTL	Super Traction Power Traction	XL, G
E 3	Rock	Con-Trak-Tor Con-Track-Tor SRT	ND-LCM LCM	Rock Service Rock Service WB	XR(A), XK(A) XL-1-Ply
E 4	Rock Deep Trenc	Super Con-Trak-Tor SRT Con-Trak-Tor SRT	ND Super LCM	Rock-Service Hi-Tread, High Tread Logger	XKD-1
E 5	Rock Interme-diate HR		Hp LCM Type B		XR(B), XK(A)
E 6	Rock Maximum HR				XR(B), XK(A)
E 7	Flotation	Earthmover Free Rolling	Earthmover	Earthmover	XS Sakara Sand 1-Ply
Grader					
G 1	Rib	Road Grader Rib	Rib-Grader	Rib Tractor Grader	Grader Steering
G 2	Traction	Road Grader Grader Special	Loader Grader	Power Grader Power Traction	G
G 3	Rock	Con-Trak-Tor	LCM Grader	Rock Universal Grader Loader	XR(A)
			Loader Grader	Rock Service Power Grader	XK(A)
Loader & Dozer					
L 2	Traction	Earthmover	Loader Grader	Power Traction	XR(B)
				Super Traction	G
L 3	Rock	Con-Track-Tor	LD and LCM	Rock Service Dozer Loader	XR(A)
		Con-Track-Tor SRT		Rock Universal Rock Service	XR(B)
L 4	Rock Deep Tread	Super Con-Trak-Tor	LD, ND Super LCM	Rock Service W.B. Rock Service Dozer Loader Rock Service Hi-Tread	XKD-1
L 5	Rock Extra Deep Tread		LD250 LD250 Haf-Trac LD250 Super Smooth	Rock Service Extra Hi-Tread Dozer Loader	X Lisse

TIRE SIZE DESIGNATION

Indicating dimensions of tire:
Generally speaking the designation of tires refers to their size in inches and their ply rating (PR). The size of a tire means the width of the tire and the diameter of the rim (inside diameter of tire), while the ply rating shows the strength of the carcasss.

1. Tire width (cross-sectional width)
2. Tire height
3. Cross-sectional height
4. Rim diameter
5. Tire outside diamter

Example:

14.00-24-12PR	Normal tire
17.5-25-12PR	Wide base tire

Ply rating shows strength of tire Nominal rim diameter

Nominal tire width (cross-sectional width) However for construction vehicles, JIS (Japan Industrial Standard) regulations require the addition of OR or OFF THE ROAD after the tire designation.

Example:
14.00-24-12PR (OR)

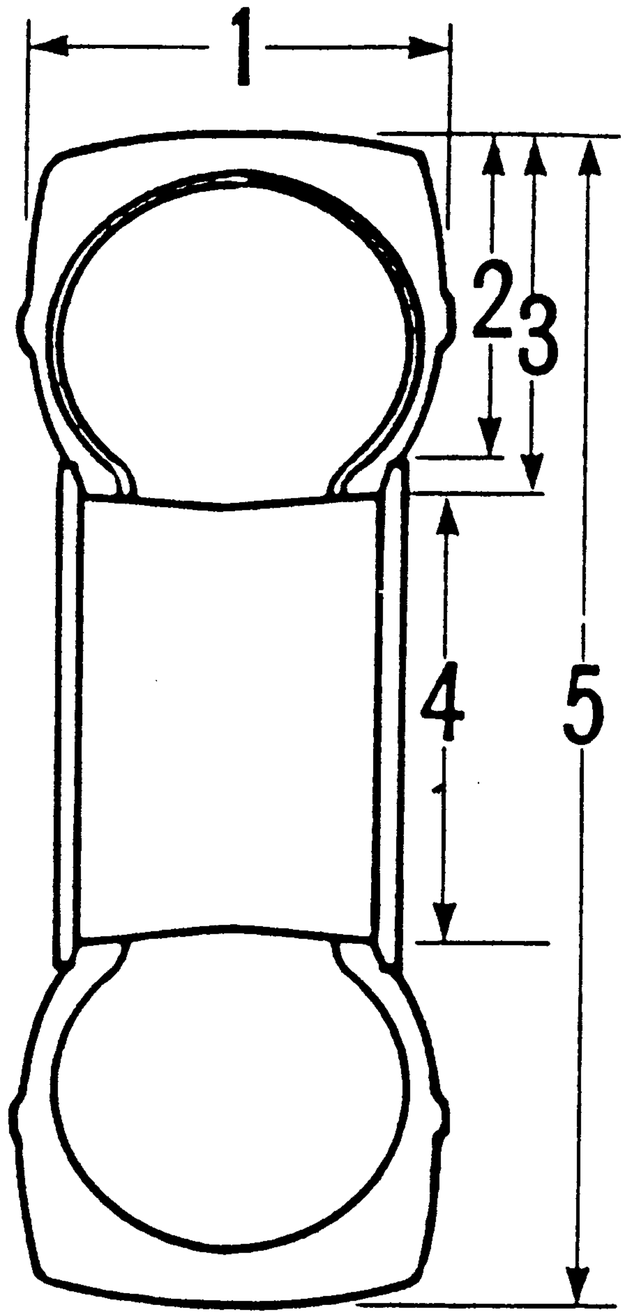


Fig. 1

Knowledge in a nutshell

Nowadays the ply rating shows the strength of the tire; it no longer shows the number of layers of cord cloth. Originally the term "ply" did in fact refer to the number of layers of cord cloth, and was therefore an indication of the tire strength. But with the development of new materials, the original cotton cord cloth changed first to rayon and has now been replaced by nylon or steel wire. This has made it possible to greatly increase the strength without increasing the number of layers of material. Consequently the term "ply rating" has come to be used to indicate the strength of the tire rather than to express the actual number of plies.

1. Conventional Tire

a) **Tread**
The tread compound used is resistant to abrasions and cuts. Tread patterns give the tire good traction, longer serviceability and higher resistant to cutting.

b) **Breaker**
Extra layers of rubber-coated cord are placed between the outer plies and the tread. They prevents cuts reaching to plycords through tread, and absorb shocks.

c) **Plies**
A tire is composed of several layers of plies, coated on both sides by a rubber compound. These maintains inflation pressure of the tires supporting load. These plies are made of high tensile nylon cord.

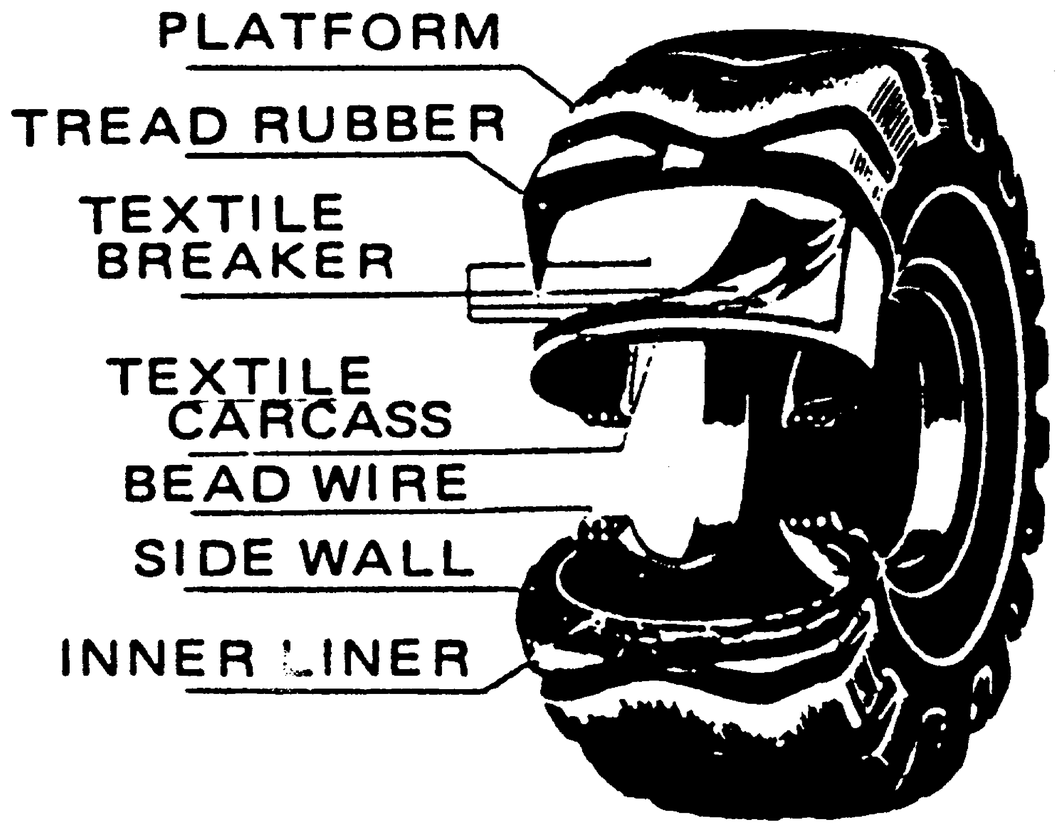


Fig. 2 Construction of Conventional tire

The term "Ply Rating", according to the Tire and Rim Association (TRA), is defined as follows:
"A given tire with its maximum recommended load when used in specific type of service. It is an index of tire strength and does not necessarily represent the number of cord plies in the tire."

d) **Inner liner**
The inner liner is a rubber layer covering the inside from bead to bead of a tubeless tire, corresponding to the tube of an ordinary tube tire. It prevents the loss of inflation pressure of the tire.

e) **Beads**
Beads are the parts which fix the tire to the rim. All plies are tied into bundles of steel wire. The beads fit on rim perfectly, preventing the tire from slipping out of the rim contour while the vehicle is in motion.

f) **O-Ring (rim packing)**
When the tire is inflated this rubber ring prevents air breaking through gaps in the rim.

g) Sidewalls

Sidewalls are covers made of a flexible rubber compound to protect the sides of the tire. Sidewalls are designed to cushion the plies from shocks and cuts, and to flex and bend without cracking, under ordinary usage.

h) Tubes and Flaps

The function of the tube is to retain air or inert gases under pressure within the cord body. The flap protects the tubc from damage by the rim and tire beads.

2. Shredded Wire Under Tread Tire

Shredded wire under tread tire has a special rubber layer strengthened by the shredded wire between the tread and breaker. The shredded wire rubber-layer has the following benefits.

(1) Protects against cuts, not only reducing repair expenses, but inproving the overall performance of vehicles.

(2) Prevents small cuts from spreading.

(3) Prevents penetration into the tire of water, dust, mud and pebbles, which can lead to cut-separation.

(4) Cut-free strength ensures a greater number of recaps.

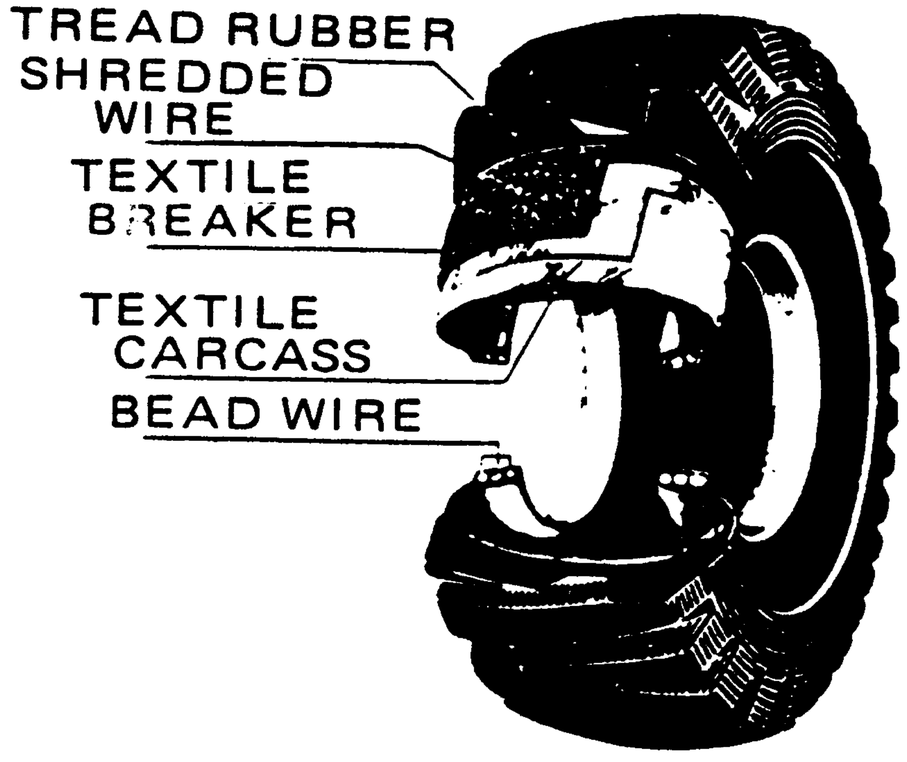


Fig. 3 Construction of shredded wire under tread tire

3. Steel Breaker Tire

Steel breaker tires feature breaker material of the rock pattern which changed from nylon to steel in order to resist cuts and cut bursts. Steel breaker tires have the following advantages.

(1) Tread cuts do not extend to bursting.

(2) Puncturing of tires is reduced.

(3) There is less carcass damage to the tire so that tires can be retreaded many times.

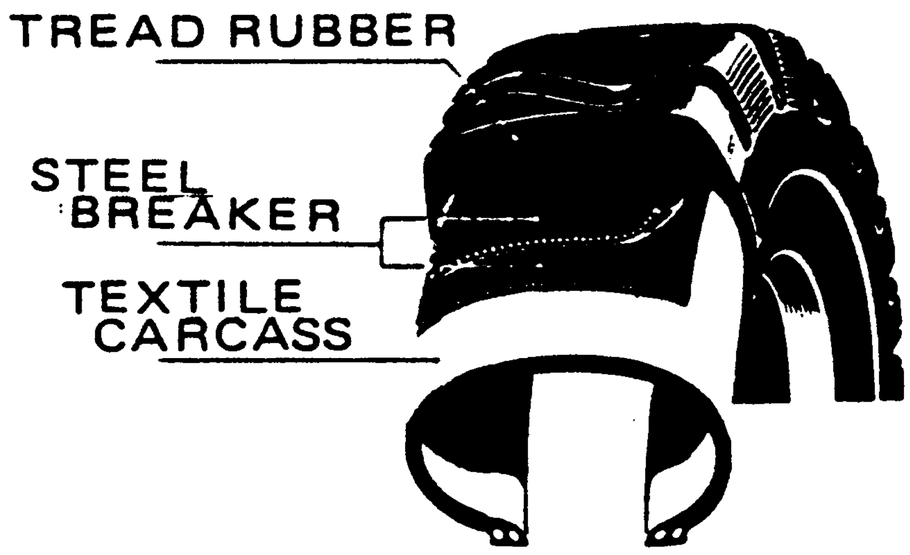


Fig. 4 Construction of steel breaker tire

4. Side Steel Breaker Tire

In this tire the steel breaker is extended to the side-wall of the tire to protect it against side damage. The construction is similar to that described above.

TIRE CHARACTERISTICS

The optimum tires should be selected for their applicable operating or job and terrain conditions depending on the cutting (wear) resistance and heat resistance. These resistant qualities are indicated as follows:

(1) CR (cutting resistance)
Excellent durability against cuts and wear due to excess road crown, imbedded or loose rocks, sharp objects, etc.

(2) HR (Heat resistance)
A resistant quality against the internal heat generation makes a machine suitable for long hauls.

(3) GP (General purpose)
Tires medium in degree of the above resistant qualities, CR and HR.

(4) Shredded wire under tread and steel breaker types
These types of tires are made more durable against cuts than the CR with special precautions to limit tire wear and cutting by incorporating the layer of steel cord between tread and casing, or by providing a cord-reinforced rubber interlay between the tire cover and plies to shield the plies against penetration by sharp objects.

TMPH

The primary task of heavy-duty tires is to haul heavy loads faster and over longer distances. This heavy load hauling inevitably results in heat built-up inside the tires, and tires have limitation of temperature. If this limitation is reached, deterioration of the tire will begin at an early stage of operation. Accordingly, it is necessary when selecting tires, to determine the amount of work which will keep the tire within a safe range to avoid over-heating when a vehicle is operated under given conditions.
The amount of work done under the given conditions and within a safe range is shown as the "TON-MILE-PER-HOUR" which can be determined by the following formula:

TMPH = (Average tire load) x (Average speed)

Average tire load

= ½ (tire load when vehicle carries empty load + tire load when vehicle is loaded)

Average speed

$$= \frac{\text{round trip distance} \times \text{number of job cycles per day}}{\text{total hours of operation per day}}$$

* Total hours of operation include the recess and dead time.

CONVERSION FACTORS

a. Length

Centimeter (cm)	Meter (m)	Inch (in)	Foot (ft)	Yard (yd)	Mile (M)	Kilometer (km)
1	0.01	0.393 7	0.032 81	0.010 94	1	1.609 3
100	1	39.37	3.281	1.093 6	0.621 4	1
2.540	0.025 4	1	0.083 33	0.027 78		
30.48	0.304 8	12	1	0.333 3		
91.44	0.914 4	36	3	1		

b. Space

Sq. meter (m^2)	Sq. inch (in^2)	Sq. foot (ft^2)	Sq. yard (yd^2)
1	1 550	10.764	1.196 0
0.0_3 645 2	1	0.0_2 6 944	0.0_3 771 6
0.092 90	144	1	0.111 11
0.836 1	1 296	9	1

c. Volume

Cu. meter (m^3)	Cu. inch (in^3)	Cu. foot (ft^3)	Cu. yard (yd^3)	Imperial Gal	U.S. Gal	Cu. inch	Liter
1	61 024	35.31	1.3079	1	1.201	177.4	4.546
0.0_4 16 39	1	0.0_3 578 7	0.0_4 21 43	0.832 7	1	231	3.785
0.028 32	1 728	1	0.037 037	0.0_2 3 605	0.0_2 4 329	1	0.016 39
0.764 55	46 656	27	1	0.220 0	0.264 2	61.02	1

d. Weight

Kilogram (kg)	Pound (lb)	Metric Ton (French Ton)	Short Ton (U.S. Ton)	Long Ton (English Ton)
1	2.2046	0.001	0.0011023	0.0_3 9842
0.4536	1	0.0_3 4536	0.0_3 5	0.0_3 4464
1000	2204.6	1	1.1023	0.9842
907.1	2000	0.9072	1	0.8929
1016	2240	1.016	1.120	1

e. Pressure

BAR	Kilogram/sq.cm (kg/cm^2)	Pound/sq.in (P S I)	Long ton/sq. ft (Ton/ft^2)
1	1.0197	14.50	0.9324
0.9807	1	14.22	0.9144
0.06895	0.07031	1	0.06429
1.0725	1.0937	15.56	1

f. Velocity

m/sec	km/h	ft/sec.	MPH
1	3.6	3.281	2.237
0.2778	1	0.9113	0.6214
0.3048	1.097	1	0.6818
0.4470	1.609	1.467	1

g. Horsepower

HP	KW	kg.m/s	K. Cal
1	0.746	76.07	0.1782
1.3405	1	101.97	0.2389
0.01315	0.009807	1	0.002343
5.611	4.186	426.9	1

h. Torque

kg.m	ft.lb.
1	7.233
0.1383	1

i. Temperature

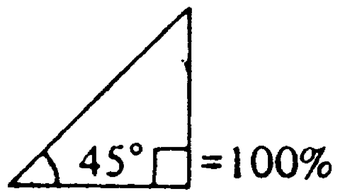
32°F = 0°C, −459.67°F = −273.15°C, 1°F = 0.555 6°C

°F	°C	°F	°C	°F	°C	°F	°C
−450	−267.78	5	−15.00	55	12.78	150	65.56
−400	−240.00	10	−12.22	60	15.56	200	93.33
−350	−212.22	15	− 9.44	65	18.33	250	121.11
−300	−184.44	20	− 6.67	70	21.11	300	148.89
−250	−156.67	25	− 3.89	75	23.89	350	176.67
−200	−128.89	30	− 1.11	80	26.67	400	204.44
−150	−101.11	35	1.67	85	29.44	450	232.22
−100	− 73.33	40	4.44	90	32.22	500	260.00
− 50	− 45.56	45	7.22	95	35.00	550	287.78
0	− 17.78	50	10.00	100	37.78	600	315.56

°F	1	2	3	4	5	6	7	8	9
°C	0.556	1.111	1.667	2.222	2.778	3.333	3.889	4.444	5

Example: To convert 92°F into °C

90°F = 32.22°C, 2°F = 1.111°C, 90°F + 2°F = 33.33°C



j. Angles of Gradient

Angles of gradient	%	Angles of gradient	%	%	Angles of gradient	%	Angles of gradient
1°	1.75	26°	48.77	1	0°34'	26	14°34'
2	3.49	27	50.95	2	1°90'	27	15°70'
3	5.24	28	53.17	3	1°43'	28	15°39'
4	6.99	29	55.43	4	2°18'	29	16°10'
5	8.75	30	57.74	5	2°52'	30	16°42'
6	10.51	31	60.09	6	3°26'	31	17°13'
7	12.28	32	62.49	7	4°00'	32	17°45'
8	14.05	33	64.94	8	4°34'	33	18°16'
9	15.84	34	67.45	9	5°90'	34	18°47
10	17.63	35	70.02	10	5°43'	35	19°17'
11	19.44	36	72.65	11	6°17'	36	19°48'
12	21.26	37	75.35	12	6°51'	37	20°18'
13	23.09	38	78.13	13	7°25'	38	20°48'
14	24.93	39	80.98	14	7°58	39	21°18'
15	26.80	40	83.91	15	8°32'	40	21°48'
16	28.67	41	86.93	16	9°50'	41	22°18'
17	30.57	42	90.04	17	9°39	42	22°47'
18	32.49	43	93.25	18	10°12'	43	23°16'
19	34.43	44	96.57	19	10°45'	44	23°45'
20	36.40	45	100.00	20	11°19'	45	24°14'
21	38.39	46	103.35	21	11°52'	46	24°42'
22	40.40	47	107.24	22	12°24'	47	25°10'
23	42.45	48	111.06	23	12°57'	48	25°39'
24	44.52	49	115.04	24	13°30'	49	26°06'
25	46.63	50	119.08	25	14°20'	50	26°34'