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SURFACE VEHICLE STANDARD

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Revolutions Per Mile and Static Loaded Radius for Off-Road Tires

RATIONALE

The technical report covers technology, products, or processes which are mature and not likely to change in the foreseeable future.

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Foreword—This Document has not changed other than to put it into the new SAE Technical Standards Board format.

1. Scope—This recommended practice covers commonly used off-road tire sizes in tire type categories of E, G, and L in diagonal (bias) ply and radial ply constructions.

1.1 Purpose—The purpose of this recommended practice is to establish tire Revolutions Per Mile (RPM) and Static Loaded Radius (SLR) values to be used for calculating off-road machine dimensions and performance.

2. References

2.1 Applicable Publications—The following publications form a part of the specification to the extent specified herein. Unless otherwise indicated the lastest revision of SAE publications shall apply.

2.1.1 SAE PUBLICATION—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J751 APR86—Off-Highway Tire and Rim Classifications

3. Definitions

3.1 Static Loaded Radius (SLR)—The distance measured from the wheel center to the ground with the tire at rated load and inflation pressure (zero penetration).

3.2 Revolutions Per Mile (RPM)—The number or revolutions a tire will make when rolling one mile at rated load and inflation pressure on a non-powered wheel.

3.3 Outside Diameter (OD)—The Tire & Rim Association, Design New Tire Overall Diameter.

3.4 Nominal Rim Diameter (NRD)—The rim diameter as named in the tire size nomenclature. For example, 18.00–25 tire - the nominal rim diameter is 25 in.

3.5 Rim Flange Height (FH)—As defined in SAE J751 and as listed in the Tire & Rim Association Yearbook.

3.6 Deflection (Defl)—The difference between the unloaded radius (OD/2) and the static loaded radius (SLR) of a tire.

3.7 Deflection Factor (DF)—The ratio of the tire's deflection to its unloaded height from the top of the rim flange at rated load and inflation. Table 1 for tire industry accepted deflection factors.

3.8 Dynamic Radius (DR)—The effective distance between the rolling tire center and the ground, at zero penetration.

3.9 Slip Factor (SF)—The industry accepted ratio of the effective circumference of a rolling tire as compared to the circumference of a stationary unloaded tire.

***4. General*—**These values of RPM and SLR have been calculated based upon tire deflections and tire industry standards for overall diameter. The value of a specific manufacturer's tire may vary from those shown.

4.1 RPM—Is used for calculating dynamic performance parameters such as ground speed and tractive effort as related to power train speed.

4.2 SLR—Is used for calculating machine dimensions relative to the ground and may also be used for calculating machine performance parameters such as tractive effort at zero ground speed.

5. Calculations for SLR, RPM, DR

5.1 SLR values are calculated as follows:

$$SLR = \frac{OD}{2} - Defl$$

where: $Defl = DF \times \left(\frac{OD - NRD}{2} - FH\right)$

DF = Deflection Factor Table 1
OD = Outside Diameter (inches)
NRD = Nominal Rim Diameter (inches)
FH = Rim Flange Height (inches)

5.2 RPM values are calculated as follows:

5.2.1 Diagonal (Bias) Off-Road Tires

$$RPM = \frac{10084}{DR}$$

where:

DR = OD/2 - Defl/3

$$10084 = \frac{5280\ ft/mile \times 12\ in/ft}{2 \times \pi}$$

5.2.2 Radial Off-Road Tires

$$RPM = \frac{10084}{SF \times OD/2}$$

where:

SF = 0.96 All except "L" Type 65 series
= 0.93 "L" Type 65 series

6. *Table 1—Deflection Factor Chart*

TABLE 1—DEFLECTION FACTOR CHART

REF LOAD TABLE[1]	TYPE TIRE	DEFLECTION FACTOR (DF) DIAGONAL (BIAS)	DEFLECTION FACTOR (DF) RADIAL
30 MPH	"E" Transport (Conv.)	0.17	0.19
30 MPH	"E" Transport (Wide Base)	0.17	0.18
5 MPH	L2 & L3 Loader-Dozer	0.23	0.22
5 MPH	L4 & L5 Loader-Dozer	0.20	0.22
5 MPH	L3, L4, L5 "65" Series	0.20	0.21
25 MPH	G - Grader (Conv.)	0.20	0.17
25 MPH	G - Grader (Wide Base)	0.21	0.17

1. Referenced Load Table per Tire & Rim Association Yearbook

TABLE 2—CONVENTIONAL DIAGONAL (BIAS) PLY TIRES
DF = 0.17

TIRE SIZE	FH	E-2 & E-3 OD	E-2 & E-3 SLR	E-2 & E-3 RPM	E-4 OD	E-4 SLR	E-4 RPM
12.00-20, 21 NHS	1.75	45.10	20.7	460	46.20	21.2	449
12.00-24, 25 NHS	1.75	49.10	22.7	421	50.20	23.2	412
13.00-24, 25 NHS	1.50	51.24	23.5	404	53.14	24.3	390
14.00-20, 21 NHS	1.50	49.84	23.0	415	51.84	23.8	401
14.00-24, 25 NHS	1.50	53.84	24.7	387	55.84	25.5	373
16.00-20, 21 NHS	2.00	54.76	24.8	380	56.96	25.7	366
16.00-25	2.00	58.76	26.9	353	60.96	27.8	341
18.00-25	2.50	63.68	29.0	326	65.88	29.9	316
18.00-33	2.50	71.68	33.0	289	73.88	33.9	281
18.00-49	2.75	87.68	41.0	235	89.88	41.9	230
21.00-25	3.00	68.90	31.2	302	70.78	32.0	294
21.00-35	3.00	78.90	36.2	263	80.78	37.0	257
21.00-49	3.00	92.90	43.2	222	94.78	44.0	218
24.00-25	3.50	73.76	33.3	282	75.64	34.1	276
24.00-29	3.50	77.76	35.3	268	79.64	36.0	261
24.00-35	3.50	83.76	38.3	248	85.64	39.1	242
24.00-49/27-56.5 (1)	3.50	97.76	45.3/45.6	211	99.64	46.1/46.4	208
27.00-33	4.00	88.28	40.1	236	90.36	41.0	230
27.00-49/30-56.5(1)	4.00	104.28	48.1/48.3	199	106.36	49.0/49.2	195
30.00-51/33-59.5(1)	4.50	112.06	51.6/51.8	185	114.34	52.6/52.7	181
33.00-51/36-59.5(1)	5.00	118.00	54.2/54.2	176	120.50	55.2/55.2	172
36.00-51/39-59.5(1)	5.00	124.60	56.9/57.0	167	127.28	58.0/58.1	163
40.00-57	6.00	133.80	61.4	155	141.48	64.6	147

1. 1.25" Flange Height

TABLE 3—WIDE BASE DIAGONAL (BIAS) PLY TIRES

TIRE SIZE	FH	OD	REGULAR TREAD DF=0.23 L-2 & L-3 SLR	REGULAR TREAD DF=0.23 L-2 & L-3 RPM	REGULAR TREAD DF=0.17 E-2 & E-3 SLR	REGULAR TREAD DF=0.17 E-2 & E-3 RPM	DEEP & EXTRA DEEP TREAD OD	DEEP & EXTRA DEEP TREAD DF=0.20 L-4 & L-5 SLR	DEEP & EXTRA DEEP TREAD DF=0.20 L-4 & L-5 RPM	DEEP & EXTRA DEEP TREAD DF=0.17 E-4 SLR	DEEP& EXTRA DEEP TREAD DF=0.17 E-4 RPM
15.5-25	1.30	50.30	22.5	415	23.2	412	52.20	23.6	399	24.0	397
17.5-25	1.50	53.08	23.6	394	24.4	390	55.08	24.8	379	25.2	377
20.5-25	2.00	58.76	25.9	357	26.9	353	60.96	27.3	343	27.8	341
23.5-25	2.50	63.68	28.0	330	29.0	326	65.88	29.4	318	29.9	316
26.5-25	3.00	68.90	30.1	306	31.2	302	70.78	31.4	296	32.0	294
26.5-29	3.00	72.90	32.1	288	33.2	285	74.78	33.4	280	34.0	278
29.5-25	3.50	73.76	32.1	286	33.3	283	75.64	33.5	277	34.1	276
29.5-29	3.50	77.66	33.9	271	35.2	268	79.64	35.5	263	36.0	262
29.5-35	3.50	83.76	37.0	250	38.2	248	85.64	38.5	244	39.0	243
33.25-29	3.50	82.28	35.7	256	37.1	253	84.36	37.3	249	38.0	247
33.25-35	3.50	88.28	38.7	238	40.1	236	90.36	40.3	231	41.0	230
33.5-33	4.00	88.28	38.7	238	40.1	236	90.36	40.2	232	41.0	230
33.5-39	4.00	94.28	41.7	222	43.1	220	96.36	43.2	217	44.0	216
37.25-35	4.00	94.60	41.1	224	42.7	221	96.34	42.8	217	43.6	216
37.5-33	4.50	94.06	41.0	224	42.6	221	96.34	42.7	218	43.6	216
37.5-39	4.50	100.06	44.0	210	45.6	208	102.34	45.7	204	46.6	203
37.5-51	4.50	112.06	50.0	187	51.6	185	114.34	51.7	182	52.6	181

TABLE 4—65 SERIES DIAGONAL (BIAS) PLY TIRES DF = 0.20

TIRE SIZE	FH	L-2 & L-3 OD	L-2 & L-3 SLR	L-2 & L-3 RPM	L-4 & L-5 OD	L-4 & L-5 SLR	L-4 & L-5 PRM
30/65-29	3.00	69.20	31.2	301	70.92	31.9	294
35/65.33	3.50	79.90	36.0	261	81.78	36.7	255
40/65-39	4.00	92.60	41.7	225	94.68	42.6	220
45/65-45	4.50	105.30	47.5	198	107.58	48.4	194
50/65-51	4.50	118.00	53.2	177	120.50	54.2	173
41.25/70-39	4.50	96.52	43.4	216	98.80	44.3	211

TABLE 5—TRACTOR GRADER DIAGONAL (BIAS) PLY TIRES

Conventional sizes G-1, G-2 & G-3 DF=0.20 TIRE SIZE	Conventional sizes G-1, G-2 & G-3 DF=0.20 FH	Conventional sizes G-1, G-3 & G-3 DF=0.20 OD	Conventional sizes G-1, G-2 & G-3 DF=0.20 SLR	Conventional sizes G-1, G-2 & G-3 DF=0.20 RPM
10.00–24 TG	1.41	45.32	20.8	457
12.00–24 TG	1.41	48.26	22.0	431
13.00–24 TG	1.41/1.70	50.30	22.8/22.9	414
14.00–20 TG	1.41	49.08	21.9	426
14.00–24 TG	1.41/1.70	53.08	23.9/24.0	393
16.00–24 TG	1.70	57.46	25.7	364
18.00–25	2.50	63.68	28.5	328
18.00–26	1.125	63.94	28.4	328

WIDE BASE SIZES L-2 & L-3
DF = 0.21

TIRE SIZE	FH	OD	SLR	RPM
15.5–25	1.30	50.30	22.8	414
17.5–25	1.50	53.08	23.9	393
20.5–25	2.00	58.76	26.3	356
23.5–25	2.50	63.68	28.3	329

TABLE 6—CONVENTIONAL RADIAL PLY TIRES

SF = 0.96 DF = 0.19 TIRE SIZE	SF = 0.96 DF = 0.19 FH	SF = 0.96 DF = 0.19 E-3 OD	SF = 0.96 DF = 0.19 E-3 SLR	SF = 0.96 DF = 0.19 E-3 RPM	SF = 0.96 DF = 0.19 E-4 OD	SF = 0.96 DF = 0.19 E-4 OD	SF = 0.96 DF = 0.19 E-4 RPM
12.00R20, 21 NHS	1.75	45.10	20.5	466	46.20	20.9	455
12.00R24, 25 NHS	1.75	49.10	22.5	428	50.20	22.9	418
13.00R24, 25 NHS	1.50	51.24	23.3	410	53.14	24.1	395
14.00R20, 21 NHS	1.50	49.84	22.4	469	51.84	23.2	405
14.00R24, 25 NHS	1.50	53.84	24.4	390	55.84	25.2	376
16.00R20, 21 NHS	2.00	54.76	24.5	384	56.96	25.3	369
16.00R25	2.00	58.76	26.6	358	60.96	27.4	345
18.00R25	2.50	63.68	28.6	330	65.88	29.5	319
18.00R33	2.50	71.68	32.6	293	73.88	33.5	284
18.00R49	2.75	87.68	40.7	240	89.88	41.6	234
21.00R25	3.00	68.90	30.8	305	70.78	31.6	297
21.00R35	3.00	78.90	35.8	266	80.78	36.6	260
21.00R49	3.00	92.90	42.8	226	94.78	43.6	222
24.00R25	3.50	73.76	32.9	285	75.64	33.7	278
24.00R29	3.50	77.76	34.9	270	79.64	35.7	264
24.00R35	3.50	83.76	37.9	251	85.64	38.7	245
24.00R49	3.50	97.76	44.9	215	99.64	45.7	211
27.00R33	4.00	88.28	39.6	238	90.36	40.5	232
27.00R49	4.00	104.28	47.6	201	106.36	48.5	198
30.00R51	4.50	112.06	51.1	187	114.34	52.0	184
33.00R51	5.00	118.00	53.6	178	120.50	54.6	174
36.00R51	5.00	124.60	56.3	169	127.28	57.3	165
40.00R57	6.00	133.80	60.7	157	140.48	63.9	148