A1. Introduction

A.1 References

The equations and parameters in this document are for State Plane Coordinate (SPC) systems based on the North American Datum of 1983 (NAD 83). Equations in Sections C and D are adapted from *NOAA Manual NOS NGS 5 State Plane Coordinate System of 1983,* James Stem. Variable names and conventions are as they appear in the publication. The document is on line at http://www.ngs.noaa.gov/PUBS_LIB/ManualNOSNGS5.pdf.

The last eight pages of this document are parameters for all SPC zones. They are Appendix A of NOAA Sp Pub NOS NGS 13 *The State Plane Coordinate System: History, Policy, and Future Directions*, Michael L. Dennis, 2018. It also is available online: https://geodesy.noaa.gov/library/pdfs/NOAA_SP_NOS_NGS_0013_v01_2018-03-06.pdf.

The standard unit for NAD 83 SPC is the meter; linear Zone parameters are in provided in meters. When converting to feet, use the appropriate one based on local jurisdictional requirements.

A.2 Methodology

Coordinate conversion for each projection consists of three sets of equations

1. Generating zone constants
2. Direct conversions: geodetic (ϕ,λ) to grid (N,E) coordinates
3. Inverse conversion: grid (N,E or X,Y) to geodetic (ϕ,λ) coordinates

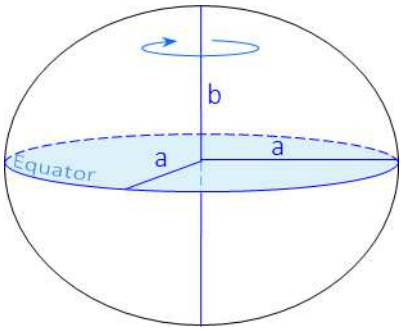
Direct and Inverse conversion equations are written to use west longitudes as positive values.

Equations for convergence and scale are given for both Direct and Inverse conversions. Scale and convergence correspond to the grid coordinate system being converted to (Direct) or from (Inverse).

The equation for Arc-to-chod correction is included in Direct conversions. Determining the actual correction requires grid coordinates of a second point.

B. Ellipsoid

B.1 Nomenclature and Geometry



a	Semi-major axis of the ellipsoid
b	Semi-minor axis of the ellipsoid
f	Flattening of the ellipsoid
e	First eccentricity of the ellipsoid
e'	Second eccentricity of the ellipsoid

Geometric relationships:

$$f = \frac{(a-b)}{a}$$

$$e^2 = \frac{(a^2-b^2)}{a^2} = (2f - f^2)$$

$$e'^2 = \frac{(a^2-b^2)}{b^2} = \frac{e^2}{(1-e^2)}$$

B.1 NAD 83

NAD 83 realizations use the GRS 80 ellipsoid. Its defining parameters are:

a = 6,378,137 m

1/f = 298.25722 21008 8

C. Lambert Conformal Conic Grid Mapping Equations

C.1 Primary Notations and Definitions

C.1.1 Zone Parameters

These fix the location and extent of the zone, They act as seed values to generate zone constants and position conversion values.

- λ_o Central meridian, longitude of the true grid origin
- ϕ_b Latitude of the grid origin
- N_b Northing value for ϕ_b at the central meridian (the grid origin), a.k.a. false northing
- E_o Easting value at the central meridian, a.k.a. false easting
- ϕ_s Northern standard latitude
- ϕ_n Southern standard latitude

C.1.2 Zone Constants

Many of these are constant for a zone, some depend on a point's location

- ϕ_o Central parallel, the latitude of the true projection origin
- N_o Northing at central meridian and central parallel intersection: true projection origin
- k_o Grid scale factor at the central parallel ϕ_o
- R_b Mapping radius at latitude ϕ_b
- R_o Mapping radius at latitude ϕ_o
- r_o Geometric mean radius of curvature at ϕ_o scaled to the grid
- K Mapping radius at the equator
- R Mapping radius at point latitude ϕ
- Q Isometric latitude

C.1.3 Position Attributes

- ϕ Latitude, positive north
- λ Longitude, positive west
- N North
- E East
- k Grid scale factor
- γ Convergence
- $\delta_{1.2}$ Arc-to-chord correction for line 1 to 2

C.2 Computing Zone Constants

Linear unit is the same as that used for ellipsoid parameters (a and b) and the grid origin (N_b and E_o).

$$Q_s = \frac{1}{2}\left[ln\left(\frac{1+\sin\phi_s}{1-\sin\phi_s}\right) - e\, ln\left(\frac{1+e\sin\phi_s}{1-e\sin\phi_s}\right)\right]$$

$$W_s = \left(1-e^2\sin^2\phi_s\right)^{1/2}$$

Similarly for Q_n, W_n, Q_b, Q_o, and W_o upon substitution of the appropriate latitude.

$$\sin\phi_o = \frac{ln\left(W_n\cos\phi_s \big/ W_s\cos\phi_n\right)}{Q_n - Q_s}$$

$$K = \frac{a\cos\phi_s\exp\left(Q_s\sin\phi_o\right)}{W_s\sin\phi_o} = \frac{a\cos\phi_n\exp\left(Q_n\sin\phi_o\right)}{W_n\sin\phi_o}$$

$\exp(x) = \varepsilon^x$
where $\varepsilon = 2.718281828...$ (the base of natural logarithms)

$$R_b = \frac{K}{\exp\left(Q_b\sin\phi_o\right)}$$

$$R_0 = \frac{K}{\exp\left(Q_o\sin\phi_o\right)}$$

$$k_o = \frac{\left(W_o\tan\phi_o R_o\right)}{a}$$

$$N_o = R_b + N_b - R_o$$

C.3 Direct Conversion

Geodetic to grid coordinates. Scale factor (k) and convergence angle (γ) are for the grid coordinate location.

$$Q = \frac{1}{2}\left[ln\left(\frac{1+\sin\phi}{1-\sin\phi}\right) - e\, ln\left(\frac{1+e\sin\phi}{1-e\sin\phi}\right)\right]$$

$$R = \frac{K}{\exp\left(Q\sin\phi_o\right)}$$

$$\gamma = \left(\lambda_o - \lambda\right)\sin\phi_o$$

$$N = R_b + N_b - R\cos\gamma$$
$$E = E_o + R\sin\gamma$$
$$k = \left(1 - e^2\sin^2\phi\right)^{1/2}\frac{\left(R\sin\phi_o\right)}{\left(a\cos\phi\right)}$$

$$r_o = \frac{k_o \times a \times \left(1 - e^2\right)^{1/2}}{1 - e^2\sin^2\left(\phi_o\right)}$$
$$\delta_{1.2} = \left(N_1 - N_o + \frac{N_2 - N_1}{3}\right)\frac{\left(E_2 - E_1\right)}{2r_o^{\,2}}\left(\frac{648{,}000''}{\pi}\right)$$

C.4 Inverse Conversion

Grid to geodetic coordinates. Scale factor (k) and convergence angle (γ) are for the grid coordinate location.

$$R' = R_b - N + N_b$$
$$E' = E - E_o$$
$$\gamma = \tan^{-1}\left(E'/R'\right)$$
$$\lambda = \lambda_o - \left(\gamma/\sin\phi_o\right)$$
$$R = \left(R'^2 + E'^2\right)^{1/2}$$
$$Q = \frac{ln\left(K/R\right)}{\sin\phi_o}$$

Latitude computation is iterative. Solve as follows:

- Start with the approximation:

$$\sin\phi = \frac{\exp\left(2Q\right) - 1}{\exp\left(2Q\right) + 1}$$

- Compute a correction of (−f1/f2) from:

$$f_1 = \frac{1}{2}\left[ln\left(\frac{1 + \sin\phi}{1 - \sin\phi}\right) - e\,ln\left(\frac{1 + e\sin\phi}{1 - e\sin\phi}\right)\right] - Q$$
$$f_2 = \left(\frac{1}{1 - \sin^2\phi}\right) - \left(\frac{e^2}{1 - e^2\sin^2\phi}\right)$$

- Add the correction to sin ϕ to obtain a new sin ϕ.

- Repeat twice more (for a total of three corrections), then solve ϕ.

Grid scale is computed from:

$$k = \left(1 - e^2 \sin^2 \phi\right)^{1/2} \frac{\left(R \sin\phi_o\right)}{\left(a \cos\phi\right)}$$

D. Transverse Mercator Cylindric Mapping Equations

D.1 Primary Notations and Definitions

D.1.1 Zone Parameters

These fix the location and extent of the zone, They act as seed values to generate zone constants and position conversion values.

- λ_o Central meridian, longitude of the true grid origin
- ϕ_o Latitude of grid origin
- N_o False northing (value assigned to the latitude of grid origin).
- E_o False easting (value assigned to the central latitude).
- k_o Grid scale factor assigned to the central meridian.

D.1.2 Zone Constants

Many of these are constant for a zone, others depend on a point's location

- r_o Geometric mean radius of curvature at ϕ_o scaled to the grid
- S_o Meridional distance from equator to ϕ_o multiplied by the central meridian scale factor
- $U_0, U_2, U_4, U_6, u_2, u_4, u_6, u_8$ Ellipsoid-dependent
- $V_0, V_2, V_4, V_6, v_2, v_4, v_6, v_8$ Ellipsoid-dependent
- ω Rectifying latitude
- S Meridional distance.
- r Radius of the rectifying sphere.
- R Radius of curvature in the prime vertical.
- r_o Geometric mean radius of curvature at ϕ_o scaled to the grid

D.1.3 Position Attributes

- ϕ Geodetic latitude, positive north.
- λ Geodetic longitude, positive west.
- N Northing coordinate on the projection.

ϕ Geodetic latitude, positive north.

E Easting coordinate on the projection.

k Grid scale factor at a point.

γ Meridian convergence.

D.2 Computing Zone Constants

Linear unit is the same as that used for ellipsoid parameters (a and b) and the grid origin (N_o and E_o).

$$n = \frac{a-b}{a+b} = \frac{f}{2-f}$$

$$r = a(1-n)(1-n^2)\left(1+\frac{9n^2}{4}+\frac{225n^4}{64}\right)$$

$\eta^2 = e'^2 \cos^2\phi$ (for any latitude, ϕ)

$$u_2 = -\frac{3n}{2}+\frac{9n^3}{16}$$

$$u_4 = \frac{15n^2}{16}-\frac{15n^4}{32}$$

$$u_6 = -\frac{35n^3}{48}$$

$$u_8 = \frac{315n^4}{512}$$

$$U_0 = 2(u_2 - 2u_4 + 3u_6 - 4u_8)$$

$$U_2 = 8(u_4 - 4u_6 + 10u_8)$$

$$U_4 = 32(u_6 - 6u_8)$$

$$U_6 = 128u_8$$

$$v_2 = \frac{3n}{2}-\frac{27n^3}{32}$$

$$v_4 = \frac{21n^2}{16}-\frac{55n^4}{32}$$

$$v_6 = \frac{151n^3}{96}$$

$$v_8 = \frac{1097n^4}{512}$$

$$V_0 = 2(v_2 - 2v_4 + 3v_6 - 4v_8)$$

$$V_2 = 8(v_4 - 4v_6 + 10v_8)$$

$$V_4 = 32(v_6 - 6v_8)$$

$$V_6 = 128v_8$$

$$\omega_o = \phi_o + \sin\phi_o \cos\phi_o \left(U_0 + U_2\cos^2\phi_o + U_4\cos^4\phi_o + U_6\cos^6\phi_o\right)$$

$$S_o = k_o \omega_o r$$

D.3 Direct Conversion

Geodetic to grid coordinates. Scale factor (k) and convergence angle (γ) are for the grid coordinate location.

$$L = (\lambda - \lambda_o)\cos\phi$$

$$\omega = \phi + \sin\phi\cos\phi\left(U_0 + U_2\cos^2\phi + U_4\cos^4\phi + U_6\cos^6\phi\right)$$

$$S = k_o\omega r$$

$$t = \tan\phi$$

$$\eta^2 = e'^2\cos^2\phi$$

$$R = \frac{k_o a}{\left(1 - e^2\sin^2\phi\right)^{1/2}}$$

$$A_1 = -R$$

$$A_2 = \frac{1}{2}Rt$$

$$A_3 = \frac{1}{6}\left(1 - t^2 + \eta^2\right)$$

$$A_4 = \frac{1}{12}\left[5 - t^2 + \eta^2\left(9 + 4\eta^2\right)\right]$$

$$A_5 = \frac{1}{120}\left[5 - 18t^2 + t^4 + \eta^2\left(14 - 58t^2\right)\right]$$

$$A_6 = \frac{1}{360}\left[61 - 58t^2 + t^4 + \eta^2\left(270 - 330t^2\right)\right]$$

$$A_7 = \frac{1}{5040}\left(61 - 479t^2 + 179t^4 - t^6\right)$$

$$N = S - S_o + N_o + A_2L^2\left[1 + L^2\left(A_4 + A_6L^2\right)\right]$$

$$E = E_o + A_1L\left[1 + L^2\left(A_3 + L^2\left(A_5 + A_7L^2\right)\right)\right]$$

$$C_1 = -t$$

$$C_3 = \frac{1}{3}\left(1 + 3\eta^2 + 2\eta^4\right)$$

$$C_5 = \frac{1}{15}\left(2 - t^2\right)$$

$$F_2 = \frac{1}{2}\left(1+\eta^2\right)$$
$$F_4 = \frac{1}{12}\left[5-4t^2+\eta^2\left(9-24t^2\right)\right]$$

$$\gamma = C_1 L\left[1+L^2\left(C_3+C_5L^2\right)\right]$$
$$k = k_o\left[1+F_2L^2\left(1+F_4L^2\right)\right]$$

$$r_{\circ} = \frac{k_o \times a \times \left(1-e^2\right)^{1/2}}{1-e^2\sin^2\left(\phi_o\right)}$$
$$\delta_{1.2} = -\left(\frac{\left(N_2-N_1\right)\left[2\left(E_1-E_o\right)+\left(E_2-E_o\right)\right]}{6r_o^{\,2}}\right)\left(\frac{648{,}000''}{\pi}\right)$$

D.4 Inverse Conversion

Grid to geodetic coordinates. Scale factor (k) and convergence angle (γ) are for the grid coordinate location.

$$\omega = \frac{\left(N-N_o+S_o\right)}{k_o r}$$
$$\phi_f = \omega+\left(\sin\omega\cos\omega\right)\left(V_0+V_2\cos^2\omega+V_4\cos^4\omega+V_6\cos^6\omega\right)$$
$$t_f = \tan\phi_f$$
$$\eta_f^{\,2} = e'^2\cos^2\phi_f$$
$$R_f = \frac{k_o a}{\left(1-e^2\sin^2\phi_f\right)^{1/2}}$$
$$Q = \frac{\left(E-E_o\right)}{R_f}$$

$$B_2 = -\frac{1}{2}t_f\left(1+\eta_f^{\,2}\right)$$

$$B_3 = -\frac{1}{6}\left(1+2t_f^{\,2}+\eta_f^{\,2}\right)$$

$$B_4 = -\frac{1}{12}\left[5+3t_f^{\,2}+\eta_f^{\,2}\left(1-9t_f^{\,2}\right)-4\eta_f^{\,4}\right]$$

$$B_5 = \frac{1}{120}\left[5+28t_f^{\,2}+24t_f^{\,4}+\eta_f^{\,2}\left(6+8t_f^{\,2}\right)\right]$$

$$B_6 = \frac{1}{360}\left[61+90t_f^{\,2}+45t_f^{\,4}+\eta_f^{\,2}\left(46-252t_f^{\,2}-90t_f^{\,4}\right)\right]$$

$$B_7 = -\frac{1}{5040}\left(61+662t_f^{\,2}+1320t_f^{\,4}+720t_f^{\,6}\right)$$

$$L = Q\left[1+Q^2\left(B_3+Q^2\left(B_5+B_7Q^2\right)\right)\right]$$

$$\phi = \phi_f + B_2Q^2\left[1+Q^2\left(B_4+B_6Q^2\right)\right]$$

$$\lambda = \lambda_o - \frac{L}{\cos\phi_f}$$

$$D_1 = t_f$$

$$D_3 = -\frac{1}{3}\left(1+t_f^{\,2}-\eta_f^{\,2}-2\eta_f^{\,4}\right)$$

$$D_5 = \frac{1}{15}\left(2+5t_f^{\,2}+3t_f^{\,4}\right)$$

$$G_2 = \frac{1}{2}\left(1+\eta_f^{\,2}\right)$$

$$G_4 = \frac{1}{12}\left(1+5\eta_f^{\,2}\right)$$

$$\gamma = D_1Q\left[1+Q^2\left(D_3+D_5Q^2\right)\right]$$

$$k = k_o\left[1+G_2Q^2\left(1+G_4Q^2\right)\right]$$

Appendix A. SPCS 83 Defining Parameters (125 Zones)

Table A1. Complete defining parameters for the 125 zones of the State Plane Coordinate System of 1983 (SPCS 83). All projections are defined with respect to the Geodetic Reference System of 1980 (GRS 80) ellipsoid, with semi-major axis a = 6,378,137 meters (exact) and inverse geometric flattening $1/f$ = 298.257222101 (derived). Information in this table is available in digital format on the NGS website (geodesy.noaa.gov), including geodetic origins in decimal degrees. Table A2 gives additional information for the "Comments" column of this table. Note the following:

- Changes from SPCS 27. Denoted by entries in *italics*. No parameters changed for zones Alaska 1 or North Carolina.
- Projection axis scale. Ratio values for LCC zones were computed and rounded to nearest whole number. Decimal values that are not infinitely repeating are shown as exact; repeating values are rounded to nine decimal places with ellipses indicating they are not exact.
- Origin longitude. Central meridian for LCC and TM projections. A central meridian is not defined for the OM projection (the convergence angle is zero at the local origin but does not remain zero along that meridian).
- Grid origin (false eastings and northings). Given as the exact metric values used to define a zone, including the three states where the origins are not whole numbers (Colorado, Connecticut, and North Carolina), even though the metric conversion is not exact.
- Abbreviations.
  - *Projections:* LCC = Lambert Conformal Conic; TM = Transverse Mercator; OM = Oblique Mercator.
  - *Standard parallels (applies only to LCC projections):* S std = South standard; N std = North standard
  - *Linear units of grid origins:* sft = U.S. survey feet; ift = international feet

Zone abrev	Zone code	Zone designation	Type	Projection axis scale (ratio)	Projection axis scale (decimal)	Origin longitude	Origin latitude	S std parallel	N std parallel	Grid origin (meters) Easting	Grid origin (meters) Northing	Comments (see Table A2 for additional information)
Alabama (AL): SPCS 83												
AL E	0101	East	TM	1:25,000	0.999 96	85°50'W	30°30'N	—	—	*200,000*	0	
AL W	0102	West	TM	1:15,000	0.999 933 333...	87°30'W	30°00'N	—	—	*600,000*	0	
Alaska (AK): SPCS 83												
AK 1	5001	1	OM	1:10,000	0.999 9	133°40'W	57°00'N	—	—	5,000,000	-5,000,000	Skew axis azimuth = $\tan^{-1}$ (-¾)
AK 2	5002	2	TM	1:10,000	0.999 9	142°00'W	54°00'N	—	—	*500,000*	0	
AK 3	5003	3	TM	1:10,000	0.999 9	146°00'W	54°00'N	—	—	*500,000*	0	
AK 4	5004	4	TM	1:10,000	0.999 9	150°00'W	54°00'N	—	—	*500,000*	0	
AK 5	5005	5	TM	1:10,000	0.999 9	154°00'W	54°00'N	—	—	*500,000*	0	
AK 6	5006	6	TM	1:10,000	0.999 9	158°00'W	54°00'N	—	—	*500,000*	0	
AK 7	5007	7	TM	1:10,000	0.999 9	162°00'W	54°00'N	—	—	*500,000*	0	
AK 8	5008	8	TM	1:10,000	0.999 9	166°00'W	54°00'N	—	—	*500,000*	0	
AK 9	5009	9	TM	1:10,000	0.999 9	170°00'W	54°00'N	—	—	*500,000*	0	
AK10	5010	10	LCC	1:6,582	0.999 848 060...	176°00'W	51°00'N	51°50'N	53°50'N	*1,000,000*	0	

Zone abrev	Zone code	Zone designation	Type	Projection axis scale (ratio)	Projection axis scale (decimal)	Origin longitude	Origin latitude	S std parallel	N std parallel	Grid origin (meters) Easting	Grid origin (meters) Northing	Comments (see Table A2 for additional information)
Arizona (AZ): SPCS 83												
AZ E	0201	East	TM	1:10,000	0.999 9	110°10'W	31°00'N	—	—	*213,360*	0	Converted ift origin to meters
AZ C	0202	Central	TM	1:10,000	0.999 9	111°55'W	31°00'N	—	—	*213,360*	0	Converted ift origin to meters
AZ W	0203	West	TM	1:15,000	0.999 933 333...	113°45'W	31°00'N	—	—	*213,360*	0	Converted ift origin to meters
Arkansas (AR): SPCS 83												
AR N	0301	North	LCC	1:15,609	0.999 935 935...	92°00'W	34°20'N	34°56'N	36°14'N	*400,000*	0	
AR S	0302	South	LCC	1:12,265	0.999 918 470...	92°00'W	32°40'N	33°18'N	34°46'N	*400,000*	*400,000*	
California (CA): SPCS 83												
CA 1	0401	1	LCC	1:9,491	0.999 894 637...	122°00'W	39°20'N	40°00'N	41°40'N	*2,000,000*	*500,000*	
CA 2	0402	2	LCC	1:11,720	0.999 914 673...	122°00'W	37°40'N	38°20'N	39°50'N	*2,000,000*	*500,000*	
CA 3	0403	3	LCC	1:14,120	0.999 929 179...	120°30'W	36°30'N	37°04'N	38°26'N	*2,000,000*	*500,000*	
CA 4	0404	4	LCC	1:16,881	0.999 940 762...	119°00'W	35°20'N	36°00'N	37°15'N	*2,000,000*	*500,000*	
CA 5	0405	5	LCC	1:12,841	0.999 922 127...	118°00'W	33°30'N	34°02'N	35°28'N	*2,000,000*	*500,000*	Absorbed SPCS 27 zone CA 7
CA 6	0406	6	LCC	1:21,807	0.999 954 142...	116°15'W	32°10'N	32°47'N	33°53'N	*2,000,000*	*500,000*	
Colorado (CO): SPCS 83												
CO N	0501	North	LCC	1:23,173	0.999 956 846...	105°30'W	39°20'N	39°43'N	40°47'N	*914,401.8289*	*304,800.6096*	Converted sft origin to meters
CO C	0502	Central	LCC	1:15,603	0.999 935 910...	105°30'W	37°50'N	38°27'N	39°45'N	*914,401.8289*	*304,800.6096*	Converted sft origin to meters
CO S	0503	South	LCC	1:18,315	0.999 945 398...	105°30'W	36°40'N	37°14'N	38°26'N	*914,401.8289*	*304,800.6096*	Converted sft origin to meters
Connecticut (CT): SPCS 83												
CT	0600		LCC	1:59,314	0.999 983 140...	72°45'W	40°50'N	41°12'N	41°52'N	*304,800.6096*	*152,400.3048*	Converted sft origin to meters
Delaware (DE): SPCS 83												
DE	0700		TM	1:200,000	0.999 995	75°25'W	38°00'N	—	—	*200,000*	0	
Florida (FL): SPCS 83												
FL E	0901	East	TM	1:17,000	0.999 941 176...	81°00'W	24°20'N	—	—	*200,000*	0	
FL W	0902	West	TM	1:17,000	0.999 941 176...	82°00'W	24°20'N	—	—	*200,000*	0	
FL N	0903	North	LCC	1:19,392	0.999 948 433...	84°30'W	29°00'N	29°35'N	30°45'N	*600,000*	0	
Georgia (GA): SPCS 83												
GA E	1001	East	TM	1:10,000	0.999 9	82°10'W	30°00'N	—	—	*200,000*	0	
GA W	1002	West	TM	1:10,000	0.999 9	84°10'W	30°00'N	—	—	*700,000*	0	

Zone abrev	Zone code	Zone designation	Type	Projection axis scale (ratio)	Projection axis scale (decimal)	Origin longitude	Origin latitude	S std parallel	N std parallel	Grid origin (meters) Easting	Grid origin (meters) Northing	Comments (see Table A2 for additional information)
Hawaii (HI): SPCS 83												
HI 1	5101	1	TM	1:30,000	0.999 966 667...	155°30'W	18°50'N	—	—	*500,000*	0	
HI 2	5102	2	TM	1:30,000	0.999 966 667...	156°40'W	20°20'N	—	—	*500,000*	0	
HI 3	5103	3	TM	1:100,000	0.999 99	158°00'W	21°10'N	—	—	*500,000*	0	
HI 4	5104	4	TM	1:100,000	0.999 99	159°30'W	21°50'N	—	—	*500,000*	0	
HI 5	5105	5	TM	Exact	1	160°10'W	21°40'N	—	—	*500,000*	0	
Idaho (ID): SPCS 83												
ID E	1101	East	TM	1:19,000	0.999 947 368...	112°10'W	41°40'N	—	—	*200,000*	0	
ID C	1102	Central	TM	1:19,000	0.999 947 368...	114°00'W	41°40'N	—	—	*500,000*	0	
ID W	1103	West	TM	1:15,000	0.999 933 333...	115°45'W	41°40'N	—	—	*800,000*	0	
Illinois (IL): SPCS 83												
IL E	1201	East	TM	1:40,000	0.999 975	88°20'W	36°40'N	—	—	*300,000*	0	
IL W	1202	West	TM	1:17,000	0.999 941 176...	90°10'W	36°40'N	—	—	*700,000*	0	
Indiana (IN): SPCS 83												
IN E	1301	East	TM	1:30,000	0.999 966 667...	85°40'W	37°30'N	—	—	*100,000*	*250,000*	
IN W	1302	West	TM	1:30,000	0.999 966 667...	87°05'W	37°30'N	—	—	*900,000*	*250,000*	
Iowa (IA): SPCS 83												
IA N	1401	North	LCC	1:18,304	0.999 945 368...	93°30'W	41°30'N	42°04'N	43°16'N	*1,500,000*	*1,000,000*	
IA S	1402	South	LCC	1:19,368	0.999 948 370...	93°30'W	40°00'N	40°37'N	41°47'N	*500,000*	0	
Kansas (KS): SPCS 83												
KS N	1501	North	LCC	1:23,176	0.999 956 851...	98°00'W	38°20'N	38°43'N	39°47'N	*400,000*	0	
KS S	1502	South	LCC	1:15,605	0.999 935 918...	98°30'W	36°40'N	37°16'N	38°34'N	*400,000*	*400,000*	
Kentucky (KY): SPCS 83												
KY1Z	1600	One	LCC	1:10,520	0.999 904 942...	85°45'W	36°20'N	37°05'N	38°40'N	1,500,000	1,000,000	Statewide zone added in 2001
KY N	1601	North	LCC	1:26,371	0.999 962 080...	84°15'W	37°30'N	37°58'N	38°58'N	*500,000*	0	
KY S	1602	South	LCC	1:18,316	0.999 945 402...	85°45'W	36°20'N	36°44'N	37°56'N	*500,000*	*500,000*	
Louisiana (LA): SPCS 83												
LA N	1701	North	LCC	1:11,729	0.999 914 741...	92°30'W	*30°30'N*	31°10'N	32°40'N	*1,000,000*	0	
LA S	1702	South	LCC	1:13,467	0.999 925 745...	91°20'W	*28°30'N*	29°18'N	30°42'N	*1,000,000*	0	
LASH	1703	Offshore	LCC	1:9,505	0.999 894 794...	91°20'W	*25°30'N*	26°10'N	27°50'N	*1,000,000*	0	

Zone abrev	Zone code	Zone designation	Type	Projection axis scale (ratio)	Projection axis scale (decimal)	Origin longitude	Origin latitude	S std parallel	N std parallel	Grid origin (meters) Easting	Grid origin (meters) Northing	Comments (see Table A2 for additional information)
Maine (ME): SPCS 83												
ME E	1801	East	TM	1:10,000	0.999 9	68°30'W	*43°40'N*	—	—	*300,000*	0	
ME W	1802	West	TM	1:30,000	0.999 966 667...	70°10'W	42°50'N	—	—	*900,000*	0	
Maryland (MD): SPCS 83												
MD	1900		LCC	1:19,939	0.999 949 848...	77°00'W	*37°40'N*	38°18'N	39°27'N	*400,000*	0	
Massachusetts (MA): SPCS 83												
MA M	2001	Mainland	LCC	1:28,209	0.999 964 550...	71°30'W	41°00'N	41°43'N	42°41'N	*200,000*	*750,000*	
MA I	2002	Island	LCC	1:659,052	0.999 998 483...	70°30'W	41°00'N	41°17'N	41°29'N	*500,000*	0	
Michigan (MI): SPCS 83												
MI N	2111	North	LCC	1:10,292	0.999 902 834...	87°00'W	44°47'N	45°29'N	47°05'N	*8,000,000*	0	SPCS 27 used scaled ellipsoid
MI C	2112	Central	LCC	1:11,456	0.999 912 706...	*84°22'W*	43°19'N	44°11'N	45°42'N	*6,000,000*	0	SPCS 27 used scaled ellipsoid
MI S	2113	South	LCC	1:10,739	0.999 906 878...	*84°22'W*	41°30'N	42°06'N	43°40'N	*4,000,000*	0	SPCS 27 used scaled ellipsoid
Minnesota (MN): SPCS 83												
MN N	2201	North	LCC	1:10,290	0.999 902 817...	93°06'W	46°30'N	47°02'N	48°38'N	*800,000*	*100,000*	
MN C	2202	Central	LCC	1:12,824	0.999 922 023...	94°15'W	45°00'N	45°37'N	47°03'N	*800,000*	*100,000*	
MN S	2203	South	LCC	1:12,827	0.999 922 040...	94°00'W	43°00'N	43°47'N	45°13'N	*800,000*	*100,000*	
Mississippi (MS): SPCS 83												
MS E	2301	East	TM	*1:20,000*	*0.999 95*	88°50'W	*29°30'N*	—	—	*300,000*	0	
MS W	2302	West	TM	*1:20,000*	*0.999 95*	90°20'W	*29°30'N*	—	—	*700,000*	0	
Missouri (MO): SPCS 83												
MO E	2401	East	TM	1:15,000	0.999 933 333...	90°30'W	35°50'N	—	—	*250,000*	0	
MO C	2402	Central	TM	1:15,000	0.999 933 333...	92°30'W	35°50'N	—	—	*500,000*	0	
MO W	2403	West	TM	1:17,000	0.999 941 176...	94°30'W	36°10'N	—	—	*850,000*	0	
Montana (MT): SPCS 83												
MT	*2500*		LCC	*1:1,646*	*0.999 392 636...*	109°30'W	*44°15'N*	*45°00'N*	*49°00'N*	*600,000*	0	Used 3 zones for SPCS 27
Nebraska (NE): SPCS 83												
NE	*2600*		LCC	*1:2,929*	*0.999 658 595...*	*100°00'W*	*39°50'N*	*40°00'N*	*43°00'N*	*500,000*	0	Used 2 zones for SPCS 27
Nevada (NV): SPCS 83												
NV E	2701	East	TM	1:10,000	0.999 9	115°35'W	34°45'N	—	—	*200,000*	*8,000,000*	
NV C	2702	Central	TM	1:10,000	0.999 9	116°40'W	34°45'N	—	—	*500,000*	*6,000,000*	
NV W	2703	West	TM	1:10,000	0.999 9	118°35'W	34°45'N	—	—	*800,000*	*4,000,000*	

Zone abrev	Zone code	Zone designation	Type	Projection axis scale (ratio)	Projection axis scale (decimal)	Origin longitude	Origin latitude	S std parallel	N std parallel	Grid origin (meters) Easting	Grid origin (meters) Northing	Comments (see Table A2 for additional information)
New Hampshire (NH): SPCS 83												
NH	2800		TM	1:30,000	0.999 966 667...	71°40'W	42°30'N	—	—	*300,000*	0	
New Jersey (NJ): SPCS 83												
NJ	2900		TM	*1:10,000*	*0.999 9*	*74°30'W*	38°50'N	—	—	*150,000*	0	Identical to NY E zone (3101)
New Mexico (NM): SPCS 83												
NM E	3001	East	TM	1:11,000	0.999 909 091...	104°20'W	31°00'N	—	—	*165,000*	0	
NM C	3002	Central	TM	1:10,000	0.999 9	106°15'W	31°00'N	—	—	*500,000*	0	Changed SPCS 27 zone boundary (Cibola County)
NM W	3003	West	TM	1:12,000	0.999 916 667...	107°50'W	31°00'N	—	—	*830,000*	0	
New York (NY): SPCS 83												
NY E	3101	East	TM	*1:10,000*	*0.999 9*	*74°30'W*	*38°50'N*	—	—	*150,000*	0	Identical to NJ zone (2900)
NY C	3102	Central	TM	1:16,000	0.999 937 5	76°35'W	40°00'N	—	—	*250,000*	0	
NY W	3103	West	TM	1:16,000	0.999 937 5	78°35'W	40°00'N	—	—	*350,000*	0	
NY L	3104	Long Island	LCC	1:196,094	0.999 994 900...	74°00'W	*40°10'N*	40°40'N	41°02'N	*300,000*	*0*	
North Carolina (NC): SPCS 83												
NC	3200		LCC	1:7,849	0.999 872 592...	79°00'W	33°45'N	34°20'N	36°10'N	609,601.22	0	Converted sft origin to meters
North Dakota (ND): SPCS 83												
ND N	3301	North	LCC	1:15,587	0.999 935 842...	100°30'W	47°00'N	47°26'N	48°44'N	*600,000*	0	
ND S	3302	South	LCC	1:15,589	0.999 935 852...	100°30'W	45°40'N	46°11'N	47°29'N	*600,000*	0	
Ohio (OH): SPCS 83												
OH N	3401	North	LCC	1:16,431	0.999 939 140...	82°30'W	39°40'N	40°26'N	41°42'N	*600,000*	0	
OH S	3402	South	LCC	1:15,602	0.999 935 908...	82°30'W	38°00'N	38°44'N	40°02'N	*600,000*	0	
Oklahoma (OK): SPCS 83												
OK N	3501	North	LCC	1:18,318	0.999 945 409...	98°00'W	35°00'N	35°34'N	36°46'N	*600,000*	0	
OK S	3502	South	LCC	1:15,611	0.999 935 942...	98°00'W	33°20'N	33°56'N	35°14'N	*600,000*	0	
Oregon (OR): SPCS 83												
OR N	3601	North	LCC	1:9,486	0.999 894 583...	120°30'W	43°40'N	44°20'N	46°00'N	*2,500,000*	0	
OR S	3602	South	LCC	1:9,488	0.999 894 608...	120°30'W	41°40'N	42°20'N	44°00'N	*1,500,000*	0	
Pennsylvania (PA): SPCS 83												
PA N	3701	North	LCC	1:23,170	0.999 956 840...	77°45'W	40°10'N	40°53'N	41°57'N	*600,000*	0	
PA S	3702	South	LCC	1:24,691	0.999 959 500...	77°45'W	39°20'N	39°56'N	40°58'N	*600,000*	0	

Zone abrev	Zone code	Zone designation	Type	Projection axis scale (ratio)	Projection axis scale (decimal)	Origin longitude	Origin latitude	S std parallel	N std parallel	Grid origin (meters) Easting	Grid origin (meters) Northing	Comments (see Table A2 for additional information)
Rhode Island (RI): SPCS 83												
RI	3800		TM	1:160,000	0.999 993 75	71°30'W	41°05'N	—	—	*100,000*	0	
South Carolina (SC): SPCS 83												
SC	*3900*		LCC	*1:4,846*	*0.999 793 657...*	81°00'W	*31°50'N*	*32°30'N*	*34°50'N*	*609,600*	0	Used 2 zones for SPCS 27
South Dakota (SD): SPCS 83												
SD N	4001	North	LCC	1:16,424	0.999 939 112...	100°00'W	43°50'N	44°25'N	45°41'N	*600,000*	0	
SD S	4002	South	LCC	1:10,738	0.999 906 870...	100°20'W	42°20'N	42°50'N	44°24'N	*600,000*	0	
Tennessee (TN): SPCS 83												
TN	4100		LCC	1:19,380	0.999 948 401...	86°00'W	*34°20'N*	35°15'N	36°25'N	*600,000*	*0*	
Texas (TX): SPCS 83												
TX N	4201	North	LCC	1:11,220	0.999 910 876...	101°30'W	34°00'N	34°39'N	36°11'N	*200,000*	*1,000,000*	
TXNC	4202	North Central	LCC	1:7,851	0.999 872 623...	*98°30'W*	31°40'N	32°08'N	33°58'N	*600,000*	*2,000,000*	
TX C	4203	Central	LCC	1:8,456	0.999 881 744...	100°20'W	29°40'N	30°07'N	31°53'N	*700,000*	*3,000,000*	
TXSC	4204	South Central	LCC	1:7,312	0.999 863 244...	99°00'W	27°50'N	28°23'N	30°17'N	*600,000*	*4,000,000*	
TX S	4205	South	LCC	1:9,505	0.999 894 794...	98°30'W	25°40'N	26°10'N	27°50'N	*300,000*	*5,000,000*	
Utah (UT): SPCS 83												
UT N	4301	North	LCC	1:23,170	0.999 956 841...	111°30'W	40°20'N	40°43'N	41°47'N	*500,000*	*1,000,000*	
UT C	4302	Central	LCC	1:9,883	0.999 898 821...	111°30'W	38°20'N	39°01'N	40°39'N	*500,000*	*2,000,000*	
UT S	4303	South	LCC	1:20,533	0.999 951 297...	111°30'W	36°40'N	37°13'N	38°21'N	*500,000*	*3,000,000*	
Vermont (VT): SPCS 83												
VT	4400		TM	1:28,000	0.999 964 286...	72°30'W	42°30'N	—	—	*500,000*	0	
Virginia (VA): SPCS 83												
VA N	4501	North	LCC	1:19,374	0.999 948 385...	78°30'W	37°40'N	38°02'N	39°12'N	*3,500,000*	*2,000,000*	
VA S	4502	South	LCC	1:18,315	0.999 945 401...	78°30'W	36°20'N	36°46'N	37°58'N	*3,500,000*	*1,000,000*	
Washington (WA): SPCS 83												
WA N	4601	North	LCC	1:17,317	0.999 942 253...	120°50'W	47°00'N	47°30'N	48°44'N	*500,000*	0	Changed SPCS 27 zone boundary (Grant County)
WA S	4602	South	LCC	1:11,709	0.999 914 598...	120°30'W	45°20'N	45°50'N	47°20'N	*500,000*	0	
West Virginia (WV): SPCS 83												
WV N	4701	North	LCC	1:16,875	0.999 940 741...	79°30'W	38°30'N	39°00'N	40°15'N	*600,000*	0	
WV S	4702	South	LCC	1:13,455	0.999 925 678...	81°00'W	37°00'N	37°29'N	38°53'N	*600,000*	0	

Zone abrev	Zone code	Zone designation	Type	Projection axis scale (ratio)	Projection axis scale (decimal)	Origin longitude	Origin latitude	S std parallel	N std parallel	Grid origin (meters) Easting	Grid origin (meters) Northing	Comments (see Table A2 for additional information)
Wisconsin (WI): SPCS 83												
WI N	4801	North	LCC	1:18,297	0.999 945 345...	90°00'W	45°10'N	45°34'N	46°46'N	*600,000*	0	
WI C	4802	Central	LCC	1:16,865	0.999 940 705...	90°00'W	43°50'N	44°15'N	45°30'N	*600,000*	0	
WI S	4803	South	LCC	1:14,825	0.999 932 547...	90°00'W	42°00'N	42°44'N	44°04'N	*600,000*	0	
Wyoming (WY): SPCS 83												
WY E	4901	*East*	TM	*1:16,000*	*0.999 937 5*	105°10'W	*40°30'N*	—	—	*200,000*	0	
WYEC	4902	*East Central*	TM	*1:16,000*	*0.999 937 5*	107°20'W	*40°30'N*	—	—	*400,000*	*100,000*	
WYWC	4903	*West Central*	TM	*1:16,000*	*0.999 937 5*	108°45'W	*40°30'N*	—	—	*600,000*	0	
WY W	4904	*West*	TM	*1:16,000*	*0.999 937 5*	110°05'W	*40°30'N*	—	—	*800,000*	*100,000*	
United States Territories												
Puerto Rico and U.S. Virgin Islands (PR and VI): SPCS 83												
PRVI	*5200*		LCC	1:165,138	0.999 993 944...	66°26'W	17°50'N	18°02'N	18°26'N	*200,000*	*200,000*	Used 2 zones for SPCS 27
Guam (GU): SPCS 83												
GU	5400		*TM*	*Exact*	*1*	*215°15'W (144°45'E)*	*13°30'N*	—	—	*100,000*	*200,000*	Zone added in 1995

Table A2. Additional information for "Comments" column of Table A1 for SPCS 83 zones.

State or Territory	Zones	Additional information
Alaska	AK 1	Skew axis azimuth = $\tan^{-1}$ (-¾) = -36°52'11.6315250385". The grid origin is defined at the "natural" origin on the equator of the "aposphere", an intermediate surface of rotation with constant total curvature derived from the ellipsoid at the central point (local origin) of the projection. The ellipsoid is conformally projected onto the aposphere before final projection onto the plane. See NGS (1986) and Snyder (1987).
Arizona (all zones)	AZ E, C, W	False easting is exact metric conversion of 700,000 international feet, as defined by Arizona state law.
California	CA 5	Includes Los Angeles County, which was zone CA Zone 7 in SPCS 27 (see tables B1 and B2).
Colorado (all zones)	CO N, C, S	Grid origin is non-exact conversion of U.S. survey feet to meters: false easting = 3,000,000.000 316 sft and false northing = 999,999.999 996 sft (note discrepancy for false easting at fourth decimal place).
Connecticut	CT	Grid origin is non-exact conversion of U.S. survey feet to meters: false easting = 999,999.999 996 sft and false northing = 499,999.999 998 sft (note coordinate discrepancy at sixth decimal place).
Kentucky	KY1Z	Statewide zone added in 2001, after publication of SPCS 83 manual (Stem, 1990). Coexists with KY North and South zones.
Michigan (all zones)	MI N, C, S	Final version of SPCS 27 used LCC zones created in 1964 by scaling Clarke 1866 ellipsoid semi-major axis by a factor of exactly 1.0000382 with its flattening held constant (see tables B1 and B2). The SPCS 83 version of these zones are based on the GRS 80 ellipsoid without any modification.
Montana	MT	Three zones used for SPCS 27 combined into a single zone for SPCS 83.
Nebraska	NE	Two zones used for SPCS 27 combined into a single zone for SPCS 83.
New Jersey	NJ	All projection parameters are identical to NY E zone.
New Mexico (two zones)	NM C, W	Changed SPCS 27 zone boundary because Cibola County created from westernmost four-fifths of the formerly much larger Valencia in 1981, with Cibola County in West zone and Valencia County in Central zone.
New York	NY E	All projection parameters are identical to NJ zone.
North Carolina	NC	False easting is non-exact conversion of U.S. survey feet to meters: false easting = 2,000,000.0026 sft (note coordinate discrepancy is at third decimal place).
South Carolina	SC	Two zones used for SPCS 27 combined into single zone for SPCS 83. False easting is exact metric conversion from 2,000,000 international feet = 1,999,996 sft (exact), which differs from SPCS 27 false easting of 2,000,000 sft by only 4 feet (exact).
Washington (both zones)	WA N, S	Changed SPCS 27 zone boundary in Grant County by having it follow latitude 47°30'N rather than the county boundary.
Puerto Rico & Virgin Is.	PRVI	Two zones used for SPCS 27 combined into a single zone for SPCS 83 (SPCS 27 zones identical except for false northing).
Guam	GU	Zone added in 1995, after publication of SPCS 83 manual (Stem, 1990), per Guam Annotated Code (Guam Compiler of Laws, 2017).