U.S. Department of Commerce
Frederick H. Mueller, *Secretary*

Coast and Geodetic Survey
H. Arnold Karo, *Director*

Publication 65-2

PLANE COORDINATE PROJECTION TABLES
PUERTO RICO
and
VIRGIN ISLANDS

WASHINGTON : 1961

Foreword

The plane coordinate system used in Puerto Rico, the Virgin Islands, and St. Croix Island is based on a Lambert conformal conic projection with two standard parallels. These areas are all included in the same basic projection. However, in order to avoid negative y coordinates for points on St. Croix, the y coordinates there have been increased by 100,000.00 feet. This is taken care of automatically in computing coordinates by using the proper constants from the tabulation immediately preceding Table I. The tables in this publication are used for the conversion of geographic positions to plane coordinates or plane coordinates to geographic positions.

The methods of computation have been designed for machine calculation, using tables of natural trigonometric functions. A table of these functions has been published by the Coast and Geodetic Survey to ten decimal places with ten-second intervals for 0° to 6° in Special Publication No. 246 and is sold for a nominal sum by the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C.

The formulas and sample computations which follow show the general methods for computing either type of coordinates.

Plane Coordinates from Geographic Positions

$$x = R \quad \sin \theta + C$$

$$y = R_b \quad - R \cos \theta$$

Grid azimuth = geodetic azimuth - θ + second term

where

R is the radius for the latitude of the station,

R_b is a constant for a zone,

θ is the mapping angle for the longitude of the station,

and

C is the value of x assigned to the Central Meridian for a zone.

The second term for the reduction of geodetic to grid azimuths may be neglected for most work. However, for lines five miles or more in length, if the same degree of accuracy is desired as is obtained by geographic computations, this term should be evaluated and used.

$$\text{Second term} = \frac{x_2 - x_1}{2\rho_0^2 \sin 1''}\left(y_1 - y_o + \frac{y_2 - y_1}{3}\right)$$

Geographic Positions from Plane Coordinates

The formulas show the method of computing R and θ from which the latitude and longitude may be obtained.

$$x' = x - C$$

$$\tan\theta = x' \div (R_b - y)$$

$$R = (R_b - y) \div \cos\theta$$

$$\Delta\lambda = \theta \div \ell$$

$$\lambda = \text{Central Meridian} - \Delta\lambda$$

where

R, R_b, θ, and C are the same as previously defined

and

ℓ is a constant for a zone.

Form 725d
(1-22-57)

U.S. DEPARTMENT OF COMMERCE COAST AND GEODETIC SURVEY

PLANE COORDINATES ON LAMBERT PROJECTION

(Condensed form for calculating-machine computation)

$X = R \sin\theta + C$
$C =$ 500,000.00

$Y = R_b - R\cos\theta$
$R_b =$ 63,687,479.44

State-Zone Puerto Rico
Grid Az. = Geod. Az. − θ

Station	Latitude / Longitude	R / θ	sin θ / cos θ	X / Y
1 Paco, 1901	18 29 07.954	63,450,655.19	−0.00321 01338	296,314.91
	67 01 16.215	−0 11 02.138762	0.99999 48475	237,151.18
	Grid azimuth to azimuth mark			° ′ ″
2 Frio (U.S.G.S.), 1934	18 18 30.947	63,514,907.82	+0.00307 60292	695,373.71
	65 52 12.191	+0 10 34.477565	0.99999 52690	172,872.11
	Grid azimuth to azimuth mark			° ′ ″
3				
	Grid azimuth to azimuth mark			° ′ ″
4				
	Grid azimuth to azimuth mark			° ′ ″

U.S. DEPARTMENT OF COMMERCE
COAST AND GEODETIC SURVEY
FORM 742b
REV. APRIL 1953

GEODETIC POSITIONS FROM LAMBERT COORDINATES

(CALCULATING MACHINE COMPUTATION)

STATE—ZONE Puerto Rico $l =$ 0.31288 82281

Station Paco, 1901

C	500,000.00	R_b	63,687,479.44
x	296,314.91	y	237,151.18
$x' = x - C$	−203,685.09	$R_b - y$	63,450,328.26
$\tan\theta = x' \div (R_b - y)$	−0.00321 01503	θ	−662″.1388
θ	−0° 11′ 02″.1388	$\Delta\lambda = \theta \div l$	−2116″.2151
$\cos\theta$	0.99999 48475	$\Delta\lambda$	−0° 35′ 16″.2151
$R = (R_b - y) \div \cos\theta$	63,450,655.19	Central Meridian	66° 26′ 00″.0000
ϕ	18° 29′ 07″.9540	$\lambda = \text{C. M.} - \Delta\lambda$	67° 01′ 16″.2151

Station Frio (U.S.G.S.), 1934

C	500,000.00	R_b	63,687,479.44
x	695,373.71	y	172,872.11
$x' = x - C$	+195,373.71	$R_b - y$	63,514,607.33
$\tan\theta = x' \div (R_b - y)$	+0.00307 60437	θ	+634″.4776
θ	+0° 10′ 34″.4776	$\Delta\lambda = \theta \div l$	+2027″.8091
$\cos\theta$	0.99999 52690	$\Delta\lambda$	+0° 33′ 47″.8091
$R = (R_b - y) \div \cos\theta$	63,514,907.82	Central Meridian	66° 26′ 00″.0000
ϕ	18° 18′ 30″.9470	$\lambda = \text{C. M.} - \Delta\lambda$	65° 52′ 12″.1909

Constants

Constant	Zone 1 Puerto Rico & Virgin Islands (except St. Croix)	Zone 2 St. Croix Island
C	500,000.00 ft.	500,000.00 ft.
Central Meridian	66° 26' 00".000	66° 26' 00".000
R_b	63,687,479.44 ft.	63,787,479.44 ft.
y_o	145,257.78 ft.	245,257.78 ft.
ℓ	0.31288 82281	0.31288 82281
$\frac{1}{2\rho_o^2 \sin 1''}$	2.368×10^{-10}	2.368×10^{-10}
$\log \frac{1}{2\rho_o^2 \sin 1''}$	0.374 4035 - 10	0.374 4035 - 10
$\log \ell$	9.49538 92238 - 10	9.49538 92238 - 10
log K	7.84676 66905	7.84676 66905

Puerto Rico and Virgin Islands (except St. Croix)

Table I

Lat.		R (feet)	y' (y value on central meridian) (feet)	Tabular difference for 1 sec. of lat. (feet)	Scale in units of 7th place of logs	Scale expressed as a ratio
17°	50'	63,687,479.44	0	100.86250	+78.9	1.00001817
	51	63,681,427.69	6,051.75	100.86233	+70.3	1.00001619
	52	63,675,375.95	12,103.49	100.86250	+62.1	1.00001430
	53	63,669,324.20	18,155.24	100.86233	+54.3	1.00001250
	54	63,663,272.46	24,206.98	100.86250	+46.8	1.00001078
	55	63,657,220.71	30,258.73	100.86233	+39.7	1.00000914
17	56	63,651,168.97	36,310.47	100.86250	+32.9	1.00000758
	57	63,645,117.22	42,362.22	100.86250	+26.5	1.00000610
	58	63,639,065.47	48,413.97	100.86250	+20.5	1.00000472
	59	63,633,013.72	54,465.72	100.86250	+14.8	1.00000341
18	00	63,626,961.97	60,517.47	100.86267	+ 9.5	1.00000219
18	01	63,620,910.21	66,569.23	100.86267	+ 4.6	1.00000106
	02	63,614,858.45	72,620.99	100.86283	0.0	1.00000000
	03	63,608,806.68	78,672.76	100.86283	- 4.2	0.99999903
	04	63,602,754.91	84,724.53	100.86300	- 8.0	0.99999816
	05	63,596,703.13	90,776.31	100.86300	-11.5	0.99999735
18	06	63,590,651.35	96,828.09	100.86317	-14.6	0.99999664
	07	63,584,599.56	102,879.88	100.86333	-17.3	0.99999602
	08	63,578,547.76	108,931.68	100.86350	-19.7	0.99999546
	09	63,572,495.95	114,983.49	100.86350	-21.7	0.99999500
	10	63,566,444.14	121,035.30	100.86367	-23.4	0.99999462
18	11	63,560,392.32	127,087.12	100.86383	-24.7	0.99999431
	12	63,554,340.49	133,138.95	100.86400	-25.6	0.99999411
	13	63,548,288.65	139,190.79	100.86417	-26.1	0.99999399
	14	63,542,236.80	145,242.64	100.86433	-26.3	0.99999394
	15	63,536,184.94	151,294.50	100.86450	-26.1	0.99999399
18	16	63,530,133.07	157,346.37	100.86467	-25.6	0.99999411
	17	63,524,081.19	163,398.25	100.86500	-24.7	0.99999431
	18	63,518,029.29	169,450.15	100.86517	-23.4	0.99999462
	19	63,511,977.38	175,502.06	100.86533	-21.7	0.99999500
	20	63,505,925.46	181,553.98	100.86550	-19.7	0.99999546
18	21	63,499,873.53	187,605.91	100.86583	-17.3	0.99999602
	22	63,493,821.58	193,657.86	100.86600	-14.6	0.99999664
	23	63,487,769.62	199,709.82	100.86633	-11.5	0.99999735
	24	63,481,717.64	205,761.80	100.86667	- 8.0	0.99999816
	25	63,475,665.64	211,813.80	100.86683	- 4.2	0.99999903

Puerto Rico and Virgin Islands (except St. Croix)

Table I (Concluded)

Lat.	R (feet)	y' (y value on central meridian) (feet)	Tabular difference for 1 sec. of lat. (feet)	Scale in units of 7th place of logs	Scale expressed as a ratio
18° 26'	63,469,613.63	217,865.81	100.86717	0.0	1.00000000
27	63,463,561.60	223,917.84	100.86733	+ 4.6	1.00000106
28	63,457,509.56	229,969.88	100.86767	+ 9.5	1.00000219
29	63,451,457.50	236,021.94	100.86817	+14.8	1.00000341
30	63,445,405.41	242,074.03	100.86833	+20.5	1.00000471
18 31	63,439,353.31	248,126.13	100.86867	+26.5	1.00000610
32	63,433,301.19	254,178.25	100.86883	+32.9	1.00000758
33	63,427,249.06	260,230.38	100.86933	+39.6	1.00000912
34	63,421,196.90	266,282.54	100.86967	+46.7	1.00001075
35	63,415,144.72	272,334.72	100.87000	+54.2	1.00001248
18 36	63,409,092.52	278,386.92	100.87050	+62.1	1.00001430
37	63,403,040.29	284,439.15	100.87083	+70.3	1.00001619
38	63,396,988.04	290,491.40	100.87117	+78.9	1.00001817
39	63,390,935.77	296,543.67	100.87150	+87.8	1.00002022
40	63,384,883.48	302,595.96		+97.1	1.00002236

St. Croix Island

Table I

Lat.	R (feet)	y' (y value on central meridian) (feet)	Tabular difference for 1 sec. of lat. (feet)	Scale in units of 7th place of logs	Scale expressed as a ratio
17° 35'	63,778,256.14	9,223.30	100.86383	+251.2	1.00005783
36	63,772,204.31	15,275.13	100.86367	+237.1	1.00005460
37	63,766,152.49	21,326.95	100.86350	+223.4	1.00005145
38	63,760,100.68	27,378.76	100.86333	+210.1	1.00004839
39	63,754,048.88	33,430.56	100.86317	+197.2	1.00004541
40	63,747,997.09	39,482.35	100.86317	+184.6	1.00004251
17 41	63,741,945.30	45,534.14	100.86300	+172.4	1.00003970
42	63,735,893.52	51,585.92	100.86300	+160.5	1.00003697
43	63,729,841.74	57,637.70	100.86283	+149.0	1.00003432
44	63,723,789.97	63,689.47	100.86283	+137.9	1.00003176
45	63,717,738.20	69,741.24	100.86267	+127.2	1.00002928
17 46	63,711,686.44	75,793.00	100.86250	+116.8	1.00002689
47	63,705,634.69	81,844.75	100.86267	+106.8	1.00002458
48	63,699,582.93	87,896.51	100.86250	+ 97.1	1.00002235
49	63,693,531.18	93,948.26	100.86233	+ 87.8	1.00002021
50	63,687,479.44	100,000.00		+ 78.9	1.00001817

Puerto Rico and Virgin Islands, including St. Croix

Table II

1" of Long. = 0".31288823 of θ

Long.	θ	Long.	θ	Long.	θ
64°01'	+0°45'22".127585	64°36'	+0°34'25".062306	65°11'	+0°23'27".997027
02	+0 45 03.354291	37	+0 34 06.289012	12	+0 23 09.223733
03	+0 44 44.580998	38	+0 33 47.515719	13	+0 22 50.450439
04	+0 44 25.807704	39	+0 33 28.742425	14	+0 22 31.677146
05	+0 44 07.034410	40	+0 33 09.969131	15	+0 22 12.903852
64 06	+0 43 48.261117	64 41	+0 32 51.195837	65 16	+0 21 54.130558
07	+0 43 29.487823	42	+0 32 32.422544	17	+0 21 35.357265
08	+0 43 10.714529	43	+0 32 13.649250	18	+0 21 16.583971
09	+0 42 51.941236	44	+0 31 54.875956	19	+0 20 57.810677
10	+0 42 33.167942	45	+0 31 36.102663	20	+0 20 39.037384
64 11	+0 42 14.394648	64 46	+0 31 17.329369	65 21	+0 20 20.264090
12	+0 41 55.621354	47	+0 30 58.556075	22	+0 20 01.490796
13	+0 41 36.848061	48	+0 30 39.782782	23	+0 19 42.717502
14	+0 41 18.074767	49	+0 30 21.009488	24	+0 19 23.944209
15	+0 40 59.301473	50	+0 30 02.236194	25	+0 19 05.170915
64 16	+0 40 40.528180	64 51	+0 29 43.462901	65 26	+0 18 46.397621
17	+0 40 21.754886	52	+0 29 24.689607	27	+0 18 27.624328
18	+0 40 02.981592	53	+0 29 05.916313	28	+0 18 08.851034
19	+0 39 44.208299	54	+0 28 47.143019	29	+0 17 50.077740
20	+0 39 25.435005	55	+0 28 28.369726	30	+0 17 31.304447
64 21	+0 39 06.661711	64 56	+0 28 09.596432	65 31	+0 17 12.531153
22	+0 38 47.888418	57	+0 27 50.823138	32	+0 16 53.757859
23	+0 38 29.115124	58	+0 27 32.049845	33	+0 16 34.984566
24	+0 38 10.341830	59	+0 27 13.276551	34	+0 16 16.211272
25	+0 37 51.568536	65 00	+0 26 54.503257	35	+0 15 57.437978
64 26	+0 37 32.795243	65 01	+0 26 35.729964	65 36	+0 15 38.664684
27	+0 37 14.021949	02	+0 26 16.956670	37	+0 15 19.891391
28	+0 36 55.248655	03	+0 25 58.183376	38	+0 15 01.118097
29	+0 36 36.475362	04	+0 25 39.410083	39	+0 14 42.344803
30	+0 36 17.702068	05	+0 25 20.636789	40	+0 14 23.571510
64 31	+0 35 58.928774	65 06	+0 25 01.863495	65 41	+0 14 04.798216
32	+0 35 40.155481	07	+0 24 43.090202	42	+0 13 46.024922
33	+0 35 21.382187	08	+0 24 24.316908	43	+0 13 27.251629
34	+0 35 02.608893	09	+0 24 05.543614	44	+0 13 08.478335
35	+0 34 43.835600	10	+0 23 46.770320	45	+0 12 49.705041

Puerto Rico and Virgin Islands, including St. Croix

Table II (Concluded)

1" of Long. = 0".31288823 of θ

Long.	θ	Long.	θ	Long.	θ
65°46'	+0°12'30".931748	66°21'	+0°01'33".866468	66°56'	-0°09'23".198811
47	+0 12 12.158454	22	+0 01 15.093175	57	-0 09 41.972104
48	+0 11 53.385160	23	+0 00 56.319881	58	-0 10 00.745398
49	+0 11 34.611867	24	+0 00 37.546587	59	-0 10 19.518692
50	+0 11 15.838573	25	+0 00 18.773294	67 00	-0 10 38.291985
65 51	+0 10 57.065279	66 26	0 00 00.000000	67 01	-0 10 57.065279
52	+0 10 38.291985	27	-0 00 18.773294	02	-0 11 15.838573
53	+0 10 19.518692	28	-0 00 37.546587	03	-0 11 34.611867
54	+0 10 00.745398	29	-0 00 56.319881	04	-0 11 53.385160
55	+0 09 41.972104	30	-0 01 15.093175	05	-0 12 12.158454
65 56	+0 09 23.198811	66 31	-0 01 33.866468	67 06	-0 12 30.931748
57	+0 09 04.425517	32	-0 01 52.639762	07	-0 12 49.705041
58	+0 08 45.652223	33	-0 02 11.413056	08	-0 13 08.478335
59	+0 08 26.878930	34	-0 02 30.186350	09	-0 13 27.251629
66 00	+0 08 08.105636	35	-0 02 48.959643	10	-0 13 46.024922
66 01	+0 07 49.332342	66 36	-0 03 07.732937	67 11	-0 14 04.798216
02	+0 07 30.559049	37	-0 03 26.506231	12	-0 14 23.571510
03	+0 07 11.785755	38	-0 03 45.279524	13	-0 14 42.344803
04	+0 06 53.012461	39	-0 04 04.052818	14	-0 15 01.118097
05	+0 06 34.239167	40	-0 04 22.826112	15	-0 15 19.891391
66 06	+0 06 15.465874	66 41	-0 04 41.599405	67 16	-0 15 38.664684
07	+0 05 56.692580	42	-0 05 00.372699	17	-0 15 57.437978
08	+0 05 37.919286	43	-0 05 19.145993	18	-0 16 16.211272
09	+0 05 19.145993	44	-0 05 37.919286	19	-0 16 34.984566
10	+0 05 00.372699	45	-0 05 56.692580	20	-0 16 53.757859
66 11	+0 04 41.599405	66 46	-0 06 15.465874		
12	+0 04 22.826112	47	-0 06 34.239167		
13	+0 04 04.052818	48	-0 06 53.012461		
14	+0 03 45.279524	49	-0 07 11.785755		
15	+0 03 26.506231	50	-0 07 30.559049		
66 16	+0 03 07.732937	66 51	-0 07 49.332342		
17	+0 02 48.959643	52	-0 08 08.105636		
18	+0 02 30.186350	53	-0 08 26.878930		
19	+0 02 11.413056	54	-0 08 45.652223		
20	+0 01 52.639762	55	-0 09 04.425517		

E 224.634
W 224.361

CORRECTIONS TO NATURAL SCALE RATIOS*
(in units of the 7th decimal place)

For Lambert Projection

$\Delta\phi'$ as argument

$\Delta\phi'$	Corr'n (Plus)	$\Delta\phi'$	Corr'n (Plus)
1	0	31	34
2	0	32	36
3	0	33	38
4	1	34	40
5	1	35	43
6	1	36	45
7	2	37	48
8	2	38	51
9	3	39	53
10	4	40	56
11	4	41	59
12	5	42	62
13	6	43	65
14	7	44	68
15	8	45	71
16	9	46	74
17	10	47	77
18	11	48	81
19	13	49	84
20	14	50	88
21	15	51	91
22	17	52	95
23	19	53	98
24	20	54	102
25	22	55	106
26	24	56	110
27	26	57	114
28	27	58	118
29	29	59	122
30	32	60	126

$\Delta\phi'$ is the difference in latitude in minutes of the ends of the line.

For Lambert or transverse Mercator Projection

Δy or Δx	Corr'n (Plus)
10,000	0
20,000	0
30,000	1
40,000	2
50,000	2
60,000	3
70,000	5
80,000	6
90,000	8
100,000	10
110,000	11
120,000	14
130,000	16
140,000	19
150,000	21
160,000	24
170,000	27
180,000	31
190,000	34
200,000	38
210,000	42
220,000	46
230,000	50
240,000	55
250,000	59
260,000	64
270,000	69
280,000	74
290,000	80
300,000	86
310,000	91
320,000	97
330,000	103
340,000	110
350,000	116

*Scale ratio interpolated for mean latitude or mean x' of the ends of a line and corrected by the above table is a true mean value accurate to within one in the seventh decimal place.

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