MESSENGERS FOR AERIAL CABLE

COPPERWELD - EHS, 30% CONDUCTIVITY

MES(size)CUWELD	Size	O.D.	Stranding	Breaking Strength	Wgt./Mft.
MES1/4CUWELD	1/4"	.242	7 #12	5,783 lbs.	128
MES5/16CUWELD	5/16"	.306	7 # 10	9,196 lbs.	204
MES3/8CUWELD	3/8"	.385	7 # 8	13,890 lbs.	324
MES1/2CUWELD	1/2"	.486	7 # 6	20,460 lbs.	515
MES9/16CUWELD	9/16"	.546	7 # 5	24,650 lbs.	650

GALVANIZED - EHS

MES(size)EHSGAL	Size	O.D.	Stranding	Breaking Strength	Wgt./Mft.
MES1/4EHSGAL	1/4"	.242	7 # 12	6,650 lbs.	121
MES5/16EHSGAL	5/16"	.306	7 # 10	11,200 lbs.	205
MES3/8EHSGAL	3/8"	.385	7 # 8	15,400 lbs.	273
MES1/2EHSGAL	1/2"	.486	7 # 6	26,900 lbs.	517

STAINLESS STEEL - TYPE “302”

MES(size)SS	Size	O.D.	Stranding	Breaking Strength	Wgt./Mft.
MES1/4SS	1/4"	.242	7 # 12	8,500 lbs.	135
MES3/8SS	3/8"	.385	7 # 8	18,000 lbs.	282
MES1/2SS	1/2"	.486	7 # 6	33,700 lbs.	535

NOTE: The data shown is approximate and subject to standard industry tolerances.

COLOR CODES

ICEA Method 1 ("K-1")
(Colored Compounds with Stripes)

Conductor Number	Conductor Color	Stripe Color
1	Black	-
2	White	-
3	Red	-
4	Green	-
5	Orange	-
6	Blue	-
7	White	Black
8	Red	Black
9	Green	Black
10	Orange	Black
11	Blue	Black
12	Black	White
13	Red	White
14	Green	White
15	Blue	White
16	Black	Red
17	White	Red
18	Orange	Red
19	Blue	Red
20	Red	Green
21	Orange	Green

ICEA Method 2 ("K-2")
(Colored Compounds with Stripes)

Conductor Number	Conductor Color	Stripe Color
1	Black	-
2	Red	-
3	Blue	-
4	Orange	-
5	Yellow	-
6	Brown	-
7	Red	Black
8	Blue	Black
9	Orange	Black
10	Yellow	Black
11	Brown	Black
12	Black	Red
13	Blue	Red
14	Orange	Red
15	Yellow	Red
16	Brown	Red
17	Black	Blue
18	Red	Blue
19	Orange	Blue
20	Yellow	Blue
21	Brown	Blue

ICEA Method 4
(Black Compound with Numbers)

Conductor Number	Printing	Conductor Number	Printing
1	1-One	12	12-Twelve
2	2-Two	13	13-Thirteen
3	3-Three	14	14-Fourteen
4	4-Four	15	15-Fifteen
5	5-Five	16	16-Sixteen
6	6-Six	17	17-Seventeen
7	7-Seven	18	18-Eighteen
8	8-Eight	19	19-Nineteen
9	9-Nine	20	20-Twenty
10	10-Ten	21	21-Twenty-One
11	11-Eleven		

MINIMUM BENDING RADII FOR CABLES

This section contains the minimum values for the radii to which cables may be bent for permanent training during installation. These limits do not apply to conduit bends, sheaves, or other curved surfaces around which the cable may be pulled under tension while being installed. Larger radii bends are required for such conditions. The minimum radii specified refers to the inner surface of the cable and not to the axis of the conductor.

POWER & CONTROL CABLES WITHOUT METALLIC SHIELDING OR ARMOR

Insulation Thickness (Inches)	Overall Diameter of Cable (Inches)		
	1.000" & less	1.001" - 2.000"	2.001" & over
	MINIMUM BENDING RADIUS AS A MULTIPLE OF CABLE DIAMETER		
.169" & less	4	5	6

POWER & CONTROL CABLES WITH METALLIC SHIELDING &/OR ARMOR

Cable Description	Minimum Bending Radius as a Multiple of Cable Diameter
Interlocked Armor (with non-shielded cond.)	7
Metallic Tape Shielded (conductors or cable)	12/7 (1)

(1) 12 x individual shielded conductor diameter, or 7 x overall cable diameter, whichever is greater

Above tables per ICEA S-95-658/NEMA WC70, Appendix F

MAXIMUM PULLING TENSIONS

1. Pulling Eye

Maximum pulling tension for use with a pulling eye can be determined from the following formula:

Tmax = k x n x CA **Where:** k = .008 for copper
.006 for aluminum
n = number of conductors
CA = conductor area of one conductor, in circular mils

Tmax should not exceed 6,000 lb. for a single conductor cable.
Tmax should not exceed 10,000 lb. for 2 or more conductors.

2. Pulling Grip

Maximum pulling tension when using a basket type grip should not exceed 1,000 lb. or the value determined in the above formula, whichever is smaller.

NOTE 1: Do not exceed the load stated by the manufacturer of the pulling device.

NOTE 2: Do not consider the area of neutral or grounding conductors in cable(s) when calculating maximum pulling tensions.

NOTE 3: Pulling tensions should be reduced by 20% to 40% when several conductors are being pulled simultaneously (in parallel) since the tension will not be distributed evenly among conductors.

NOTE 4: The above procedure pertains to straight pulls, and does not consider side wall loading.

See pages 81-84 for additional details.

Sheave Selection Chart

Maximum Cable Diameter per Sheave

Sheave diameter (inches)	Single/multi Conductor power (inches)	Armor (inches)	Control Cable (inches)	Shielded 600 V Power (inches)	MV Power Shielded (inches)
6	0.375	0.214	0.150	0.107	0.125
12	0.984	0.563	0.940	0.281	0.328
18	1.750	1.000	0.700	0.500	0.583
24	2.453	1.402	0.981	0.701	0.818

Examples of Minimum Bend Radii

600 V Cable	Multiply	Sample diameter	Calcuation	Resulting Minimum Bend Radii
Less than 1 inch	4	.75 in. OD	4 x .75=	3 in. radius
1 to 2 inches	5	1.5 in. OD	5 x 1.5=	7.5 in. radius
2 in. or larger	6	3.0 in. OD	6 x 3=	18 in. radius
Interlock Armor	7	3.0 in. OD	7 x 3=	21 in. radius

Pull considerations:

1. Plan direction of cable pulls to minimize tension by putting as many bends as possible early in the pull.

2. Proper setups cost initially, but will save by creating safer and easier pulls.

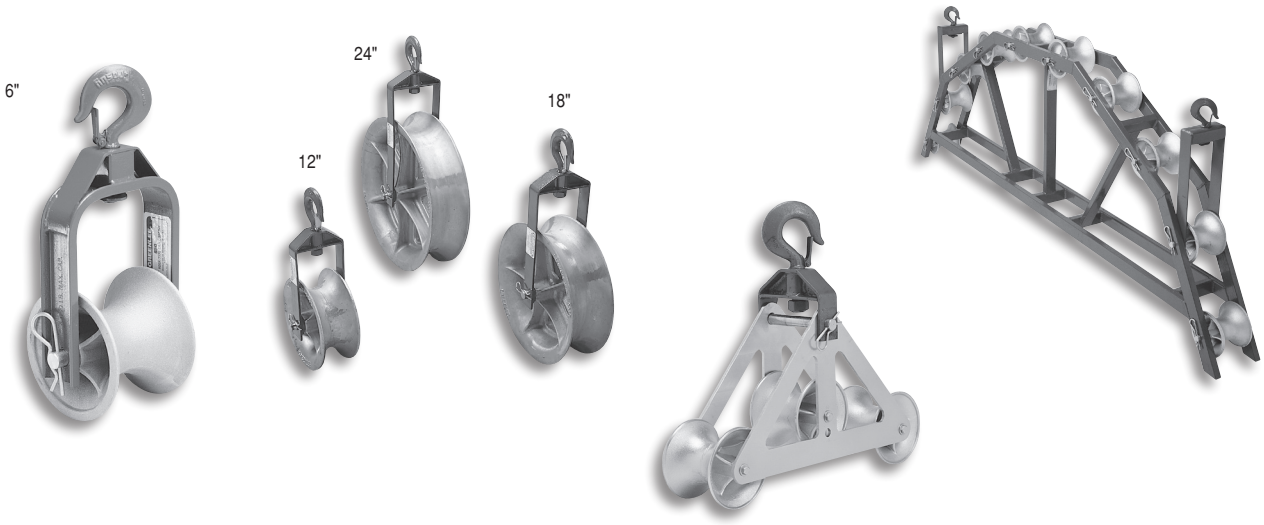
3. Published allowable conductor tensions are for STRAIGHT PULLS ONLY.

4. Published allowable equipment loading does not apply to the SWP of the cable pull.

Notes: 1.) You must select the sheave by radius NOT diameter. 2.) Sidewall limits for most cables are 500 lbs. per foot radius maximum. 3.) All tensions on a cable pull are additive.

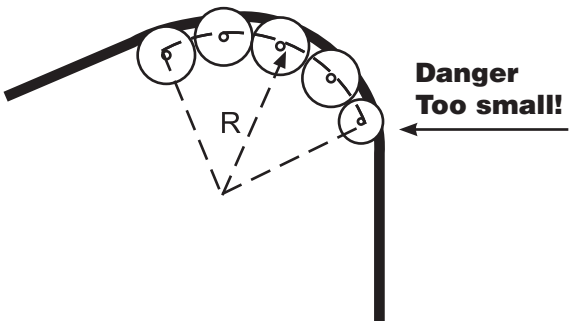
Cable Installation Tips

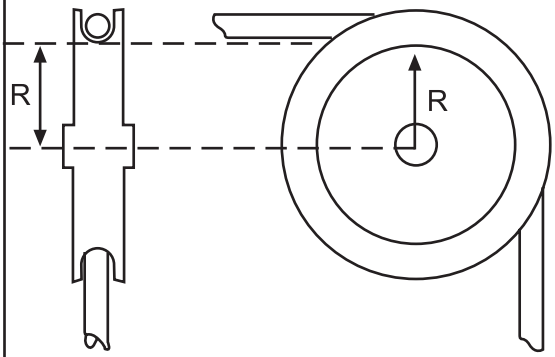
Sheave strength ratings are for straight pulls only. Always refer to allowable tensions for each radius. Most single and conveyor sheaves are rated at 4000 lbs or more, but these ratings can only be used for the pulling rope, not the cable. Single sheaves are best for guiding and supporting cable. For cable bends use conveyor sheave assemblies to control sidewall pressure.



Cable damage can occur when too small of a radius wheel is used.

NOTE: When using conveyor sheave equipment, it is critical for set up that the lead and exit sheaves not have a bending radius smaller than the center wheels. (see below left)





Don't confuse the *diameter* of the sheave with the *radius*.
The radius MUST match the cable's bending radius

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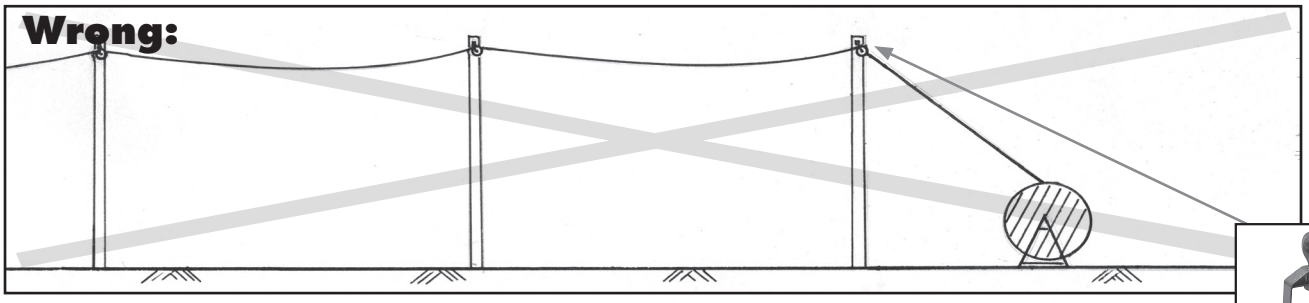
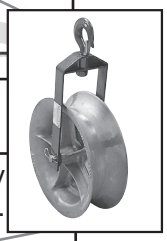
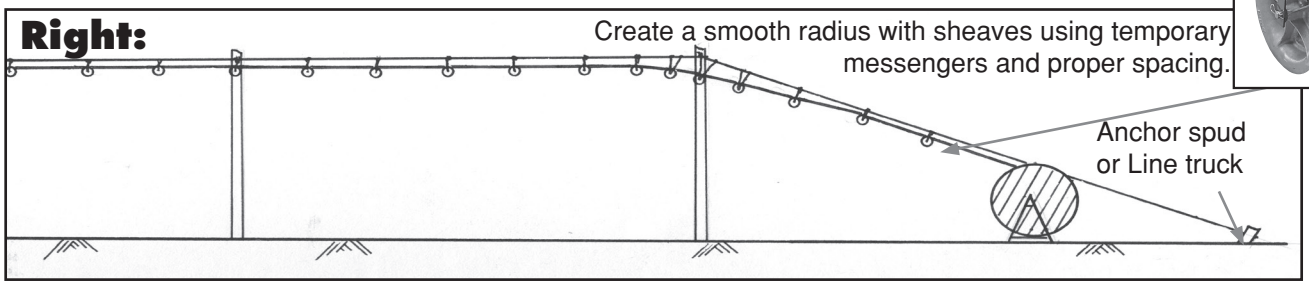
Cable Installation Tips

Stringing Aerial cables on poles (this applies to pulling in or out)



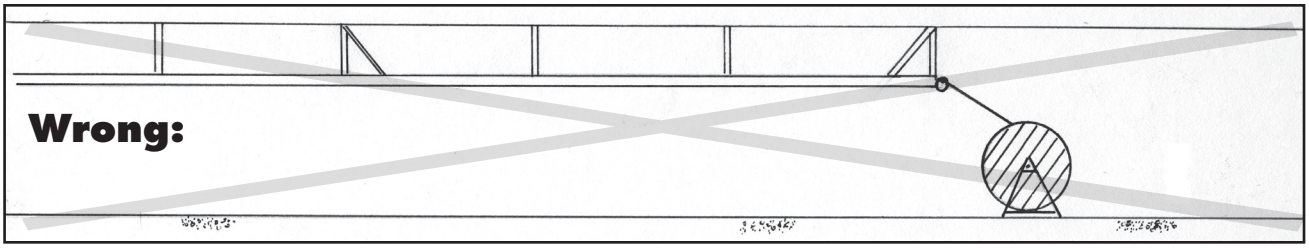


This method can cause sidewall pressure and crush the cable.

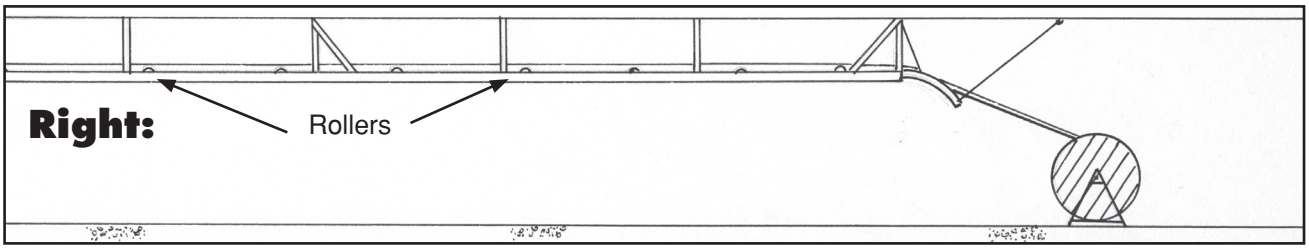


This method will support and distribute all bearing loads for successful cable installation.

Loading cable into tray



This method can cause sidewall pressure and crush the cable at the leading point. Lack of rollers will increase drag creating more tension.



Use a large multi-wheel conveyor to distribute sidewall pressure. Lead and exit wheels must meet minimum cable bend. Use tray rollers to eliminate cable drag.

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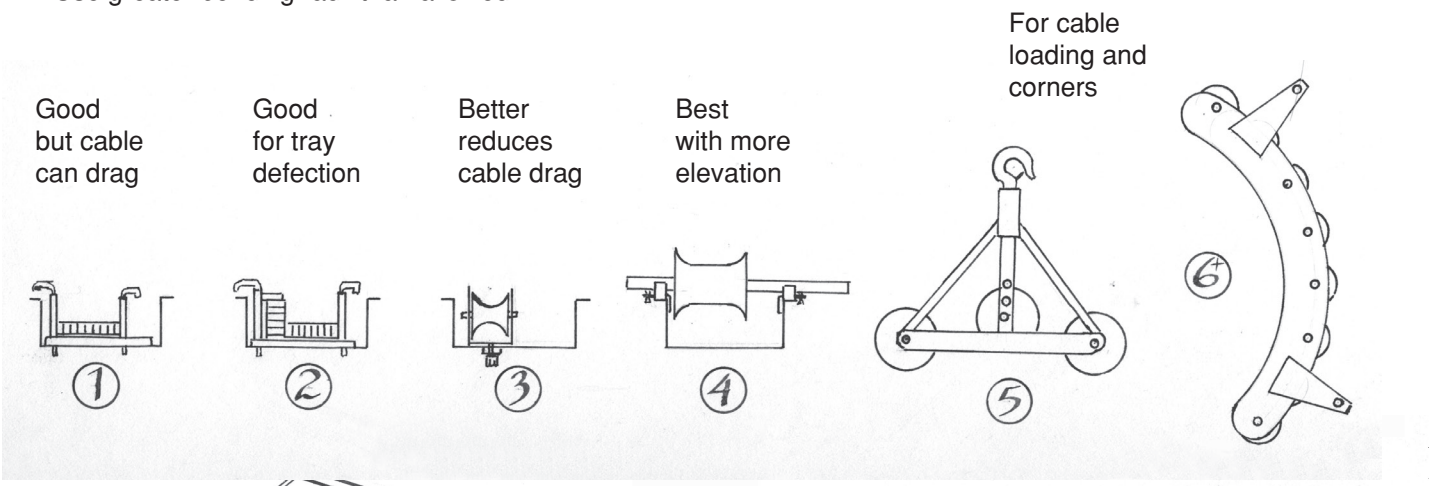
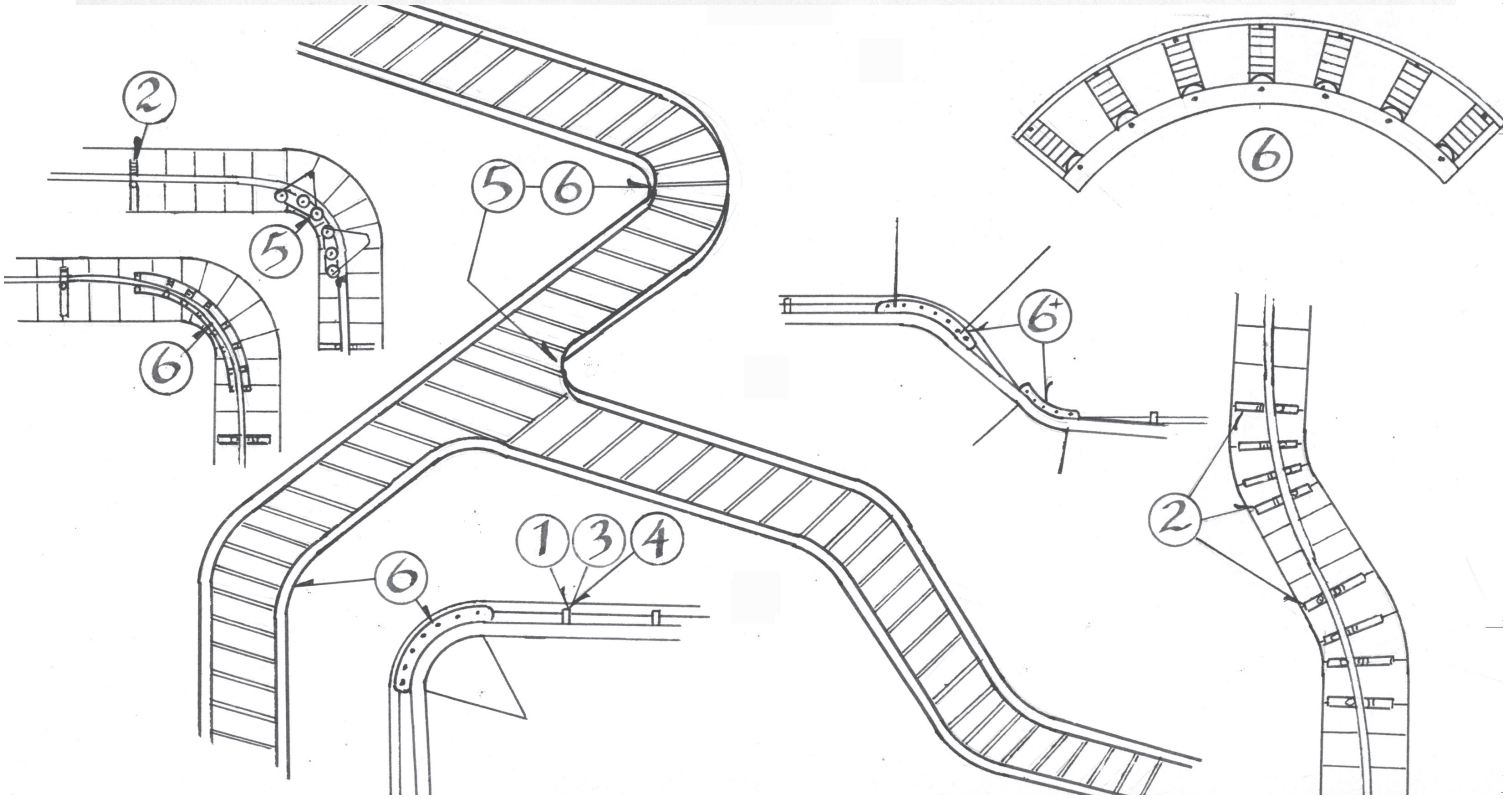
Tray Roller Assembly

- It is important that these assemblies be aligned and secure.
- Shifting of roller assemblies can cause the cable to climb over sheave edge and cut the cable.
- All rollers to be free rolling to eliminate friction.
- Space tray rollers to minimize cable drag.
- Use greater bending radii than allowed.





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USEFUL CONVERSION FACTORS

AWG to METRIC

			DIAMETER
AWG	MM^2	CMIL	INCHES
22	0.32	640	0.029
20	0.52	1020	0.036
18	0.82	1620	0.046
16	1.31	2580	0.058
14	2.08	4110	0.073
12	3.31	6530	0.092
10	5.26	10380	0.116
9	6.63	13090	0.130
8	13.20	16510	0.146
6	13.20	26240	0.184
4	21.20	41740	0.232
3	26.70	52620	0.260
2	33.60	66360	0.292
1	42.40	83690	0.332
1/0	53.50	105600	0.373
2/0	67.40	133100	0.419
3/0	85.00	167800	0.470
4/0	107.00	211600	0.528

			DIAMETER
KCMIL	MM^2	CMIL	INCHES
250	126	250000	0.575
300	152	300000	0.630
350	177	350000	0.681
400	202	400000	0.728
500	253	500000	0.813
550	278	550000	0.855
600	304	600000	0.893
700	354	700000	0.964
750	380	750000	0.998
900	456	900000	1.094
1000	506	1000000	1.152

MISCELLANEOUS CONVERSIONS

UNIT	MULTIPLY BY	TO GET
Centimeters	0.3937	Inches
Circular Mils	0.7854	Square Mils
	5.0671×10^{-4}	Square Millimeters
Cubic Centimeters	0.0610	Cubic Inches
Cubic Inches	16.386	Cubic Centimeters
Inches	2.54	Centimeters
Kilograms	2.2046	Pounds
Kilograms/Kilometers	0.6720	Pounds/1000ft.
Kilometers	0.6214	Miles
	3280.8	Feet
Meters	3.2808	Feet
Mils	0.001	Inches
	0.0254	Millimeters
Miles	0.03937	Kilometers
Millimeters	0.03037	Inches
Ohms/Kilometer	0.3048	Ohms/1000ft.
Ohms/1000ft.	3.2808	Ohms/Kilometer
Pounds	0.4536	Kilograms
Pounds/1000ft.	1.4881	Kilograms/Kilometer
Square Centimeters	1.55×10^5	Square Mils
	1.97×10^5	Circular Mils
Square Inches	1.2732×10^6	Circular Mils
	645.16	Square Millimeter
Square Millimeter	1973.5	Circular Mils

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