

## SELECTION CHART

		CENTERLINE RADIUS TO O.D. FACTOR ("D" OF BEND)							
	WALL FACTOR	1	1.25	1.50	2	2.50	3	4	5
	10	F	F	F	F	P	P		
SEE NOTE 1	15	M1W	M1W	M1	M1	P	P		
	20	M2W	M1W	M1W	M1	F	F	P	
	25	M3W	M2W	M1W	M1W	M1	F	F	
	30	M3W	M3W	M2W	M2W	M1W	M1	F	F
	35	M3W	M3W	M3W	M2W	M2W	M2W	M2	M1
	40	M4W	M3W	M3W	M3W	M3W	M3W	M2W	M2
	45	M4W	M3W	M3W	M3W	M3W	M3W	M2W	M2W
	50	M4W	M3W	M3W	M3W	M3W	M3W	M2W	M2W
	60	M4W	M4W	M3W	M3W	M3W	M3W	M2W	M2W
SEE NOTE 2	70	M5W	M5W	M5W	M3W	M3W	M3W	M3W	M2W
	80	M5W	M5W	M5W	M5W	M3W	M3W	M3W	M2W
	90	M5W	M5W	M5W	M5W	M3W	M3W	M3W	M3W
	100	M5W	M5W	M5W	M5W	M5W	M3W	M3W	M3W
	125	M5W	M5W	M5W	M5W	M5W	M5W	M4W	M4W
	150	M6W	M6W	M6W	M6W	M5W	M5W	M4W	M4W
SEE NOTE 3	175	M6W	M7W	M8W	M7W	M7W	M6W	M6W	M6W
	200	M6W	M8W	M10W	M10W	M9W	M9W	M8W	M8W
	225		M9W	M10W	M10W	M10W	M10W	M10W	M10W
	250			M10W	M10W	M10W	M10W	M10W	M10W
	275			M10W	M10W	M10W	M10W	M10W	M10W

Add (1) ball for over 90 degree bending

Double wall factor for calculating square or rectangular tube

Add (1) ball when bending brass.

**This chart is your guide** to determining when a mandrel or wiper die is generally required, plus the mandrel type and number of balls recommended for high quality, wrinkle-free bends with maximum 2½% flattening.

### KEY TO CHART

$$\text{Wall Factor} = \frac{\text{Tube Outside Diameter}}{\text{Wall Thickness}}$$

$$\text{Radius to O.D. Factor} = \frac{\text{Bend Centerline Radius}}{\text{Tube Outside Diameter}}$$

Tooling Identification:

- P = Plug Mandrel
- F = Form Mandrel
- M = Ball Mandrel
- Figure—Number of Balls on Mandrel

Example: Bend 3" O.D. Tube with .049" wall on 6" C.L. Radius

$$\text{Wall Factor} = \frac{3}{.049} = 61.2$$

$$\text{Radius to O.D. Factor} = \frac{6}{3} = 2$$

Read down to closest wall factor (60), across to fourth column (2D).

Answer:

M 3 W  
Wiper Die  
Three Ball OR:  
Mandrel

Three ball mandrel with wiper die.

- NOTE:**
1. Light shaded area at top of table—No wiper die is required when bending brass or copper.
  2. Light shaded area, factors 70 to 175—Use Thin Wall type mandrel.
  3. Darker shaded area, factors 200 to 275—Use Super-Thin Wall type mandrel.