Selection Considerations

Application Analysis

1. Function
The process for establishing the clutch or brake function is illustrated in Step 1 on page 6. In review, the three functions and the appropriate series selections are noted below.

Overrunning (One Way Clutch)
Unidirectional torque transmission with free wheeling in opposite direction.

Selection
WSC (Model O)

Start/Coast-to-Stop (Random Positioning)
Engage/disengage with random stop position.

Selection
WSC (Model SS)

Start/Stop (Single Revolution)
Accurate stop position in single or fraction revolution cycles.

Selection
WSC (Model S)
Standard CB
Super CB

2. Calculate load inertia (WR²)
Use the inertia chart on page 37 to determine the inertia of the application components. To determine WR^2 of a given shaft or disc, multiply the WR^2 from the chart by the length of shaft or thickness of disc in inches. Note: For hollow shafts, subtract WR^2 of the I.D. from the WR^2 of the O.D. and multiply by length.

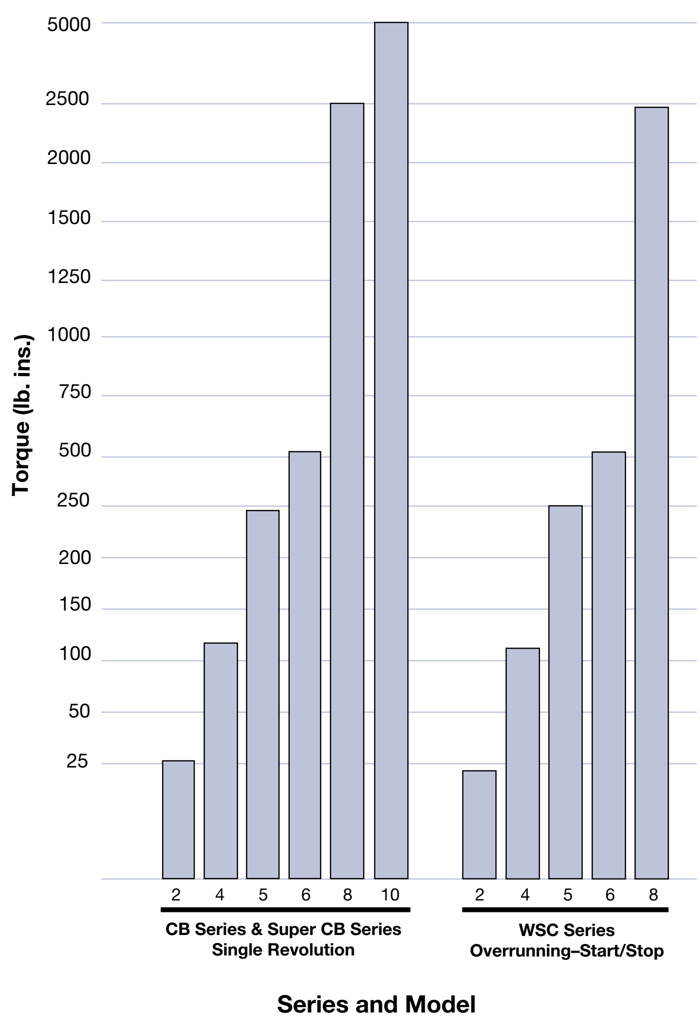
In order to calculate the inertias of components which are made of material other than steel, use the multipliers found in the conversion chart (right) to establish the inertias of these components.

For applications involving machined parts or reflected rotational or linear inertia, please refer to the inertia discussion in the Application Engineering section of Warner Electric's Packaged Electromagnetic Clutches/Brakes Catalog, P-1234.

Inertia Conversion Chart
In order to determine the inertia of a rotating member (shaft, disc, etc.) of a material other than steel, multiply the inertia of the appropriate steel diameter from the chart on page 37 by:

Material	Multiplier
Bronze	1.05
Steel	1.00
Iron	.92
Powdered Metal Bronze	.79
Powdered Metal Iron	.88
Aluminum	.35
Nylon	.17

Torque vs. Model Comparison



Selection Considerations

Inertia of Steel Shafting (Per Inch of Length or Thickness)

Dia. (in.)	WR² (lb.in.²)	Dia. (in.)	WR² (lb.in.²)	Dia. (in.)	WR² (lb.in.²)
1⁄4	.00011	7	66.816	13	803.52
3⁄8	.00055	7-1⁄4	77.04	13-1⁄4	858.24
1⁄2	.00173	7-1⁄2	87.984	13-1⁄2	924.48
3⁄4	.00864	7-3⁄4	100.656	13-3⁄4	995.04
1	.0288	8	113.904	14	1068.48
1-1⁄4	.072	8-1⁄4	128.88	14-1⁄4	1147.68
1-1⁄2	.144	8-1⁄2	144	14-1⁄2	1229.75
1-3⁄4	.288	8-3⁄4	162.72	14-3⁄4	1317.6
2	.432	9	182.88	15	1404
2-1⁄4	.72	9-1⁄4	203.04	16	1815.84
2-1⁄2	1.152	9-1⁄2	223.2	17	2314.08
2-3⁄4	1.584	9-3⁄4	252	18	2910.24
3	2.304	10	277.92	19	3611.52
3-1⁄2	4.176	10-1⁄4	306.72	20	4433.76
3-3⁄4	5.472	10-1⁄2	338.4	21	5389.92
4	7.056	10-3⁄4	371.52	22	6492.96
4-1⁄4	9.072	11	407.52	23	7757.28
4-1⁄2	11.376	11-1⁄4	444.96	24	9195.84
5	17.28	11-1⁄2	486.72	25	10827.36
5-1⁄2	25.488	11-3⁄4	529.92	26	12666.24
6	36	12	576	27	14731.2
6-1⁄4	42.624	12-1⁄4	626.4	28	17036.64
6-1⁄2	49.68	12-1⁄2	679.68	29	19604.16
6-3⁄4	57.888	12-3⁄4	735.84	30	22452.48

Torque & Inertia Values

Model	Tc	t	Ic
CB-2	1.65	0.003	0.0116
CB-4	6.60	0.004	0.0450
CB-5	6.88	0.004	0.1663
CB-6	8.75	0.005	1.22
CB-8	20	0.005	8.1
CB-10	50	0.006	30

Selection Considerations

3. Determine clutch or brake torque value

With the inertia value calculated in Step 2, determine the torque requirement for the function determined in Step 1.

A) For Overrunning and Start-Stop (random start-stop) (WSC Models SS and O)

$$T = \frac{WR^2 \times RPM}{3700 \times t} + \text{friction torque}$$

Where—
T = Torque required from wrap spring
WR^2 = load inertia (Step 2)
RPM = shaft speed at clutch location
t = time to engagement (.003 for clutch)

B) For single revolution applications (CB and WSC Model S)

$$T = \frac{WR^2 \times RPM}{3700 \times t} - \text{friction torque*}$$

Where—

T = torque required from wrap spring
WR^2 = Load inertia (Step 2)
RPM = Shaft speed at clutch or brake location
t = time to disengagement (.0015 for brake)

Find the value of T on the Torque vs. Model Comparison Chart on page 36.

*Frictional (drag) torque is the torque necessary to overcome static friction. It may be measured by a spring-scale or by dead-weights, applied to a known moment arm so gradually as to make inertia negligible. It is that torque found just sufficient to induce motion.

4. Verify selection with unit inertia

From the individual product specifications find the unit inertia of the model selected in Step 3. Add this to the load inertia previously determined to arrive at the total torque requirement.

A) For Overrunning and On-Off (WSC Models SS and O)

$$A)\ T_t = \frac{(WR^2_{LOAD} + WR^2_{UNIT})RPM}{3700 \times t} + \text{friction torque}$$

B) For Single Revolution Start-Stop (CB, Super CB and WSC Model S)

$$B)\ T_t = \frac{(WR^2_{LOAD} + WR^2_{UNIT})RPM}{3700 \times t} - \text{friction torque}$$

Where–T_t = total system torque
(WR^2_{LOAD}) = load inertia
(WR^2_{UNIT}) = clutch inertia

Find this new torque value on the Torque vs. Model Comparison Chart on page 36 to verify the model selected in Step 3.

Minimum Load Inertia—Super CB and CB Clutch/Brakes

In order to achieve the CB accuracy capability of ±1/2°, a minimum load inertia is required to fully engage the brake spring and disengage the clutch spring. This minimum inertia (I) can be calculated from the accompanying formula and chart:

$$I = \frac{(t)\ (T_c + T_o)\ (3700)}{RPM} - I_c$$

I = Minimum inertia required to fully activate the clutch/brake—lb.in.^{2}
t = Time—Seconds
T_c = Torque required to fully activate the clutch/brake—in.lb.
T_o = Drag torque—in.lb.
RPM = Revolutions per minute
I_c = Inertia at the output side of theclutch—lb.in.^{2}

Example: CB-6 in a system running at 200 RPM with ¾” bore and 20 in.lb. drag. What inertia is required to fully activate the clutch/brake?

$$I = \frac{(0.005)\ (8.75 + 20)\ (3700)}{(200)} - 1.221 = 1.438 \text{ lb.in.}^2$$

Note: When calculated inertia is zero or negative, no further action is required. If the calculation result is positive, additional inertia equal to or exceeding the result should be added.

How to determine maximum inertia load of CBs

$$\frac{T \times 3700 \times t}{RPM} = WR^2$$

T = Clutch Torque
t = .0015