Selection Considerations

Application Analysis

1. Function

The process for establishing the clutch or brake function is illustrated in Step 1 on page 4. 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 33 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.

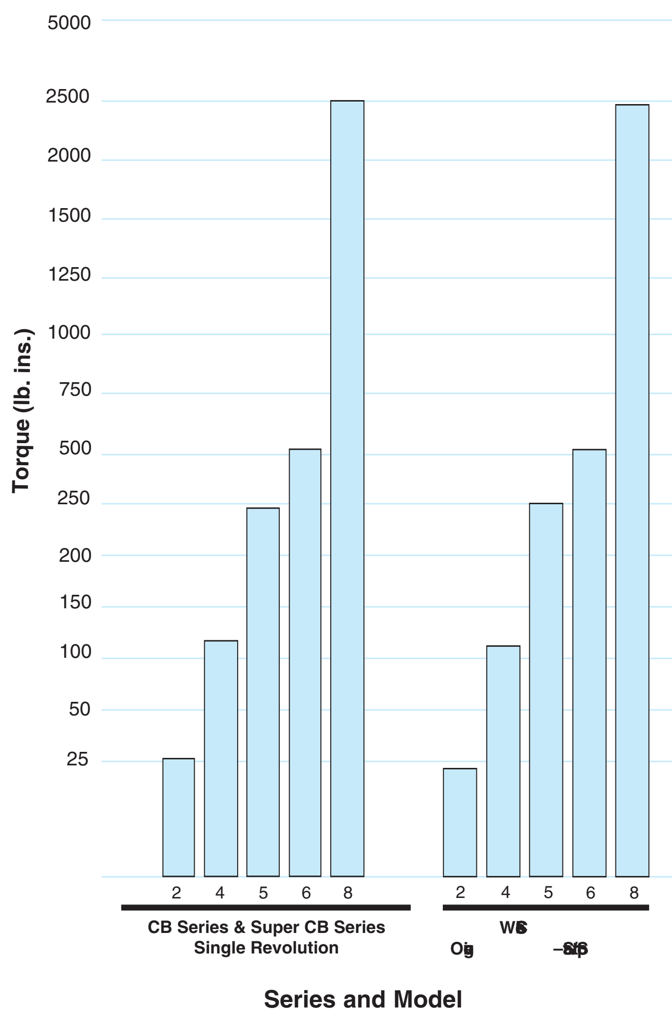
For applications involving machined parts or reflected rotational or linear inertia, please refer to the inertia discussion in the Application Engineering section of Warner Electric's Packaged Electromagnetic Clutches/Brakes Catalog, P-1234.

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 33 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



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

Dia. (in.)	WR^2 (lb.in.^{2})	Dia. (in.)	WR^2 (lb.in.^{2})	Dia. (in.)	WR^2 (lb.in.^{2})
¼	.00011	7	66.816	13	803.52
⅜	.00055	7¼	77.04	13¼	858.24
½	.00173	7½	87.984	13½	924.48
¾	.00864	7¾	100.656	13¾	995.04
1	.0288	8	113.904	14	1068.48
1¼	.072	8¼	128.88	14¼	1147.68
1½	.144	8½	144	14½	1229.75
1¾	.288	8¾	162.72	14¾	1317.6
2	.432	9	182.88	15	1404
2¼	.72	9¼	203.04	16	1815.84
2½	1.152	9½	223.2	17	2314.08
2¾	1.584	9¾	252	18	2910.24
3	2.304	10	277.92	19	3611.52
3½	4.176	10¼	306.72	20	4433.76
3¾	5.472	10½	338.4	21	5389.92
4	7.056	10¾	371.52	22	6492.96
4¼	9.072	11	407.52	23	7757.28
4½	11.376	11¼	444.96	24	9195.84
5	17.28	11½	486.72	25	10827.36
5½	25.488	11¾	529.92	26	12666.24
6	36	12	576	27	14731.2
6¼	42.624	12¼	626.4	28	17036.64
6½	49.68	12½	679.68	29	19604.16
6¾	57.888	12¾	735.84	30	22452.48

Torque & Inertia Values

Model	T_c	t	I_c
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	1.221 (0.75 in. bore) 1.138 (1.0 in. bore)
CB-8	20	0.005	9.43 (0.75 in. bore) 9.32 (1.0 in. bore) 8.15 (1.5 in. bore)

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 32.

*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)

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

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

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

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 32 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 the clutch—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

Bore Size	Voltage	Rotation	Stops 1	Stops 2	Stops 4
CB-2					
0.25"	24 VDC	CW	302-17-001	• 302-17-002	• 302-17-003
		CCW	302-27-001	302-27-011	302-27-003
0.25"	115 VAC	CW	• 302-17-007	302-17-008	302-17-009
		CCW	302-27-007	302-27-008	302-27-009
CB-4					
0.375"	24 VDC	CW	• 304-17-001	• 304-17-011	304-17-007
		CCW	• 304-27-001	• 304-27-007	304-27-026
0.375"	115 VAC	CW	• 304-17-003	• 304-17-008	• 304-17-018
		CCW	• 304-27-003	304-27-015	• 304-27-025
CB-5					
0.5"	24 VDC	CW	• 305-17-001	• 305-17-002	305-17-003
		CCW	• 305-27-001	305-27-002	305-27-003
0.5"	115 VAC	CW	• 305-17-007	305-17-008	305-17-009
		CCW	• 305-27-007	• 305-27-008	• 305-27-009
CB-6					
0.75"	24 VDC	CW	• 306-17-051	• 306-17-074	306-17-162
		CCW	• 306-27-029	• 306-27-046	• 306-27-134
0.75"	115 VAC	CW	• 306-17-053	• 306-17-060	• 306-17-073
		CCW	• 306-27-031	• 306-27-039	• 306-27-045
1.0"	24 VDC	CW	• 306-17-057	306-17-061	306-17-031
		CCW	• 306-27-032	306-27-147	306-27-150
1.0"	115 VAC	CW	• 306-17-059	306-17-062	306-17-075
		CCW	• 306-27-034	• 306-27-044	• 306-27-037
CB-8					
1.25"	24 VDC	CW	• 308-17-101	• 308-17-102	308-17-103
		CCW	• 308-27-101	308-27-102	308-27-103
1.25"	115 VAC	CW	• 308-17-107	308-17-108	308-17-109
		CCW	• 308-27-107	• 308-27-108	308-27-109
1.5"	24 VDC	CW	• 308-17-119	308-17-120	308-17-121
		CCW	308-27-119	308-27-120	308-27-121
1.5"	115 VAC	CW	• 308-17-125	• 308-17-126	308-17-127
		CCW	• 308-27-125	308-27-126	308-27-127
SCB-5					
0.5"	24 VDC	CW	• 325-17-001	325-17-002	325-17-003
		CCW	325-27-001	325-27-002	325-27-003
0.5"	115 VAC	CW	• 325-17-004	325-17-005	325-17-006
		CCW	• 325-27-004	325-27-005	325-27-006
SCB-6					
0.75"	24 VDC	CW	• 326-17-007	• 326-17-008	326-17-009
		CCW	• 326-27-007	326-27-008	326-27-009
0.75"	115 VAC	CW	• 326-17-019	• 326-17-020	326-17-021
		CCW	• 326-27-019	• 326-27-020	326-27-021
1.0"	24 VDC	CW	• 326-17-010	326-17-011	• 326-17-012
		CCW	• 326-27-010	326-27-011	• 326-27-012
1.0"	115 VAC	CW	• 326-17-022	326-17-023	326-17-024
		CCW	• 326-27-022	326-27-023	326-27-024

Control Part #'s
One Shot, 150 Ohms • 901-00-014
One Shot, Octal Socket • 901-00-019

Bore Size	Voltage	Rotation	Input	Stops 1	Stops 2	Stops 4
SCB-8						
1.25"	24 VDC	CW		• 328-17-019	•328-17-020	328-17-021
		CCW		• 328-27-019	328-27-020	328-27-021
1.25"	115 VAC	CW		• 328-17-043	328-17-044	328-17-045
		CCW		• 328-27-043	• 328-27-044	328-27-045
1.5"	24 VDC	CW		• 328-17-013	328-17-014	328-17-015
		CCW		328-27-013	328-27-014	328-27-015
1.5"	115 VAC	CW		328-17-037	328-17-038	328-17-039
		CCW		328-27-037	328-27-038	328-27-039
WSC-2						
0.25"	S	CW	Hub	202-10-016	202-10-009	202-10-020
0.25"	S	CCW	Hub	202-20-016	202-20-015	202-20-017
0.25"	S	CW	Shaft	202-30-011	202-30-007	202-30-015
0.25"	S	CCW	Shaft	202-40-014	202-40-008	202-40-017
WSC-4						
0.375"	S	CW	Hub	204-10-001	204-10-016	204-10-010
0.375"	S	CCW	Hub	204-20-004	204-20-008	204-20-016
0.375"	S	CW	Shaft	204-30-001	204-30-007	204-30-009
0.375"	S	CCW	Shaft	204-40-001	204-40-006	204-40-012
WSC-5						
0.5"	S	CW	Hub	205-10-001	205-10-014	205-10-017
0.5"	S	CCW	Hub	205-20-001	205-20-006	205-20-011
0.5"	S	CW	Shaft	205-30-001	205-30-014	205-30-016
0.5"	S	CCW	Shaft	205-40-004	205-40-007	205-40-016
WSC-6						
0.75"	S	CW	Hub	206-10-002	206-10-062	206-10-064
0.75"	S	CCW	Hub	206-20-002	206-20-023	206-20-058
0.75"	S	CW	Shaft	206-30-011	206-30-052	206-30-025
0.75"	S	CCW	Shaft	206-40-002	206-40-014	206-40-020
1.0"	S	CW	Hub	206-10-003	206-10-057	206-10-059
1.0"	S	CCW	Hub	206-20-003	206-20-060	206-20-013
1.0"	S	CW	Shaft	206-30-003	206-30-051	206-30-056
1.0"	S	CCW	Shaft	206-40-013	206-40-023	206-40-025
WSC-8						
1.25"	S	CW	Hub	208-10-004	208-10-027	208-10-028
1.25"	S	CCW	Hub	208-20-001	208-20-028	208-20-030
1.25"	S	CW	Shaft	208-30-001	208-30-021	—
1.25"	S	CCW	Shaft	208-40-013	208-40-015	208-40-017
1.50"	S	CW	Hub	208-10-007	208-10-025	208-10-030
1.50"	S	CCW	Hub	208-20-003	208-20-032	208-20-021
1.50"	S	CW	Shaft	208-30-003	208-30-025	208-30-027
1.50"	S	CCW	Shaft	208-40-003	208-40-020	208-40-022

For CB and SCB Series units, these are the most commonly requested parts – other voltages (such as 12VDC and 90VDC), bores and stop collars are available.

For the WSC Series, other units offering different bores, and overrunning or start/coast-to-stop operation are available.

• Denotes stock items shipped FOB Roscoe or South Beloit, Illinois

Application Data Form

Mail or Fax to:

Warner Electric
Technical Support
449 Gardner Street, South Beloit, Illinois 61080
Phone 815-389-6224 • Fax 815-389-6678 • www.warnerelectric.com
Email: techsupport@warnerelectric.com

Actuation

Mechanical ( )
Electrical ( )
Voltage AC / DC

Motion

Single Revolution ( )
Fractional Revolution ( )
Angle ( )

Accuracy

Start (ms)
Stop (±__°)

Shaft Diameter

Minimum (")
Maximum (")

Technical Data

Speed____________________________(rpm)
Inertia ____________________________(lb.in.^{2})
Friction Load Torque _______________(lb.in.)
Cycle Rate _________________ (per second)
Life Expectancy _____________ (hrs or cycles)

Environmental Consideration

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Describe the application function