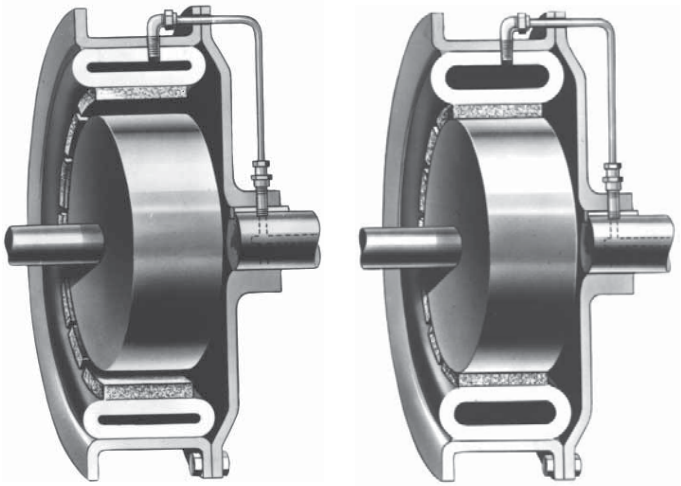
Airflex® Constricting Features

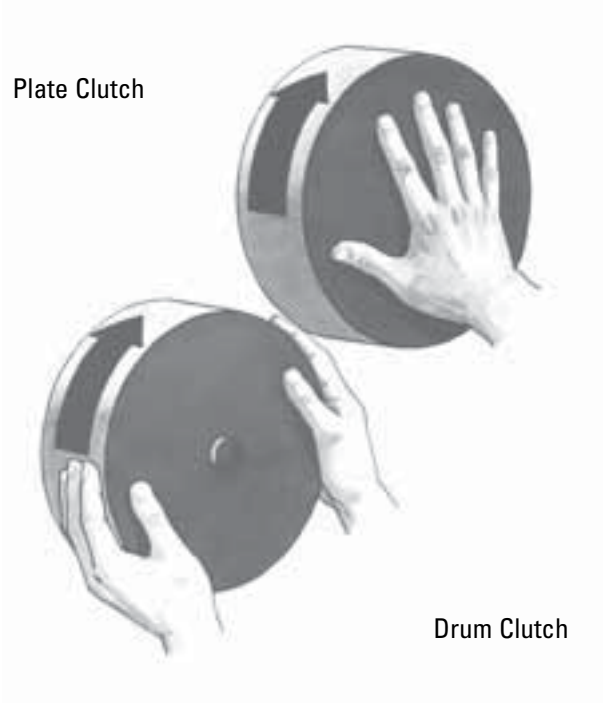
Section B



How They Work

CB, CM and VC elements utilize a rugged tire-like neoprene and cord tube that expands radially inward when pressurized. The constricting tube forces friction shoes against an outer cylindrical drum surface. The rate at which the tube is pressurized determines the rate at which element torque increases. Final tube pressure determines the element torque capacity.

Design Features

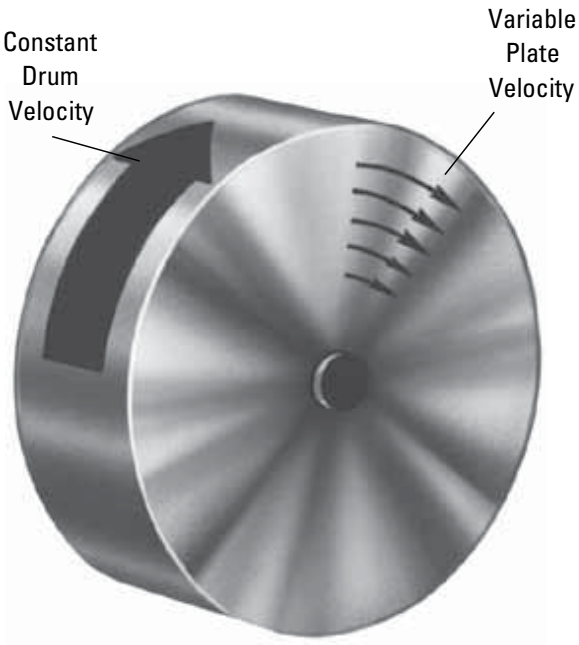


• Uniform contact velocity

Friction shoe contact occurs across the cylindrical surface of the drum where the contact velocity is constant unlike plate types where the contact velocity varies across the friction plate face.

• Force applied at maximum radius from axis

Airflex constricting elements concentrates the frictional force on the outside drum diameter thereby achieving maximum torque. The torque lever arm is the drum radius, not a reduced radius as occurs in plate clutches. Not only is the force generated at the optimum radius, it is also applied Uniformly around the drum circumference.

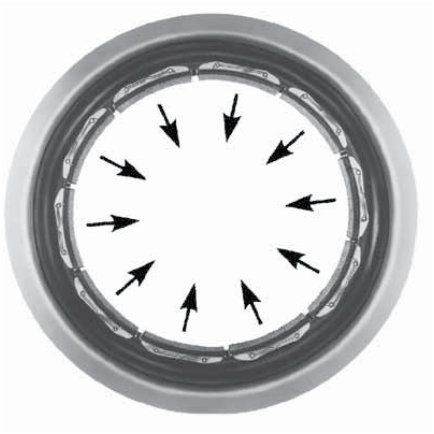


Airflex® Constricting Features

Section B

• Self-adjustment

As friction surfaces wear, the tube constricts further and compensates for the wear. Normal wear will not reduce torque capacity.

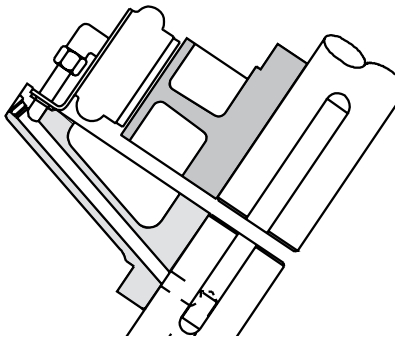


• No lubrication

There are no close fitting sliding components which require lubrication.

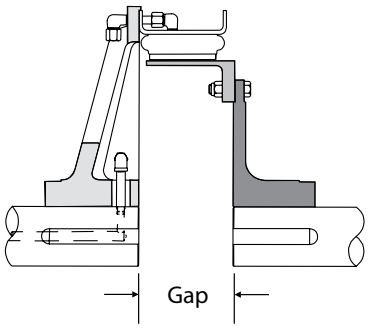
• Centrifugal force assists clutch disengagement

Upon release of tube pressure, centrifugal force, acting on the friction shoes at the rotating element, helps retract the shoes away from the drum surface. The centrifugal effect expels the tube pressurizing media and minimizes the possibility of disengaged friction shoe drag.



• Operates in any plane

The constricting design combined with centrifugal effects permits clutch operation in any plane. A plate clutch operates best in a vertical plane.



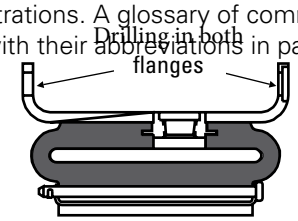
• Gap mounting

The constricting drum design allows a gap between the ends of the driving and driven shafts. This gap provides a space through which the element and drum can be removed to permit shaft alignment, clutch maintenance without disturbing existing shaft alignment and the removal of driving or driven components.

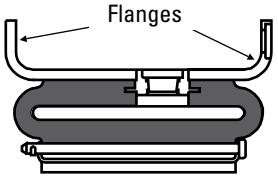
Airflex® Element Descriptions

Section B

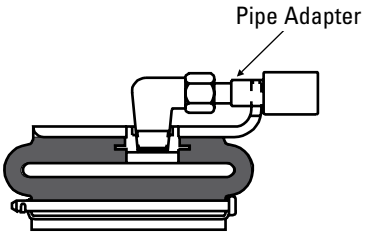
Elements are described by the number and type of fitting used to make the connection from the tube valve to the rim flange, the type of friction material and any special rim features. Since most of the special rim features pertain to CB elements only, the CB cross section has been used in the illustrations. A glossary of commonly used descriptive terms with their abbreviations in parenthesis follow:



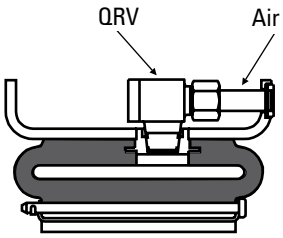
Dual drilled (DD) - Both flanges of the rim are drilled for air and/or mounting connections. Required for one of the elements used in a dual element and for air bridge mounting.



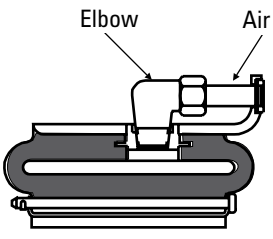
Dual flange (DFL) - A CB description for rims with two flanges. Standard on element sizes 16CB500 thru 45CB525. This description used primarily to differentiate between the single and dual flanged 12CB and 14CB elements.



Pipe adapter - An adapter to connect standard tube fittings to pipe fittings.



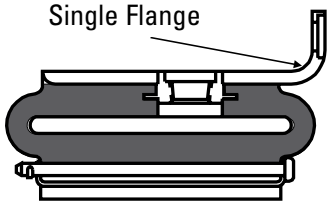
Quick release valve (QRV) - The plumbing from the valve to the rim flange incorporating a quick release valve and air tube.



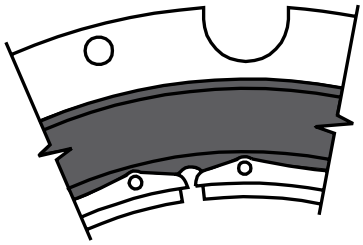
Side connection (SC) - The plumbing from the valve to the rim flange incorporating an elbow and air tube.

Airflex® Element Descriptions

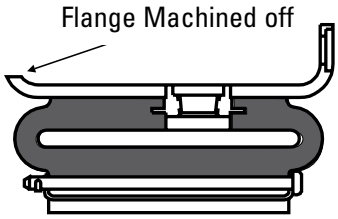
Section B



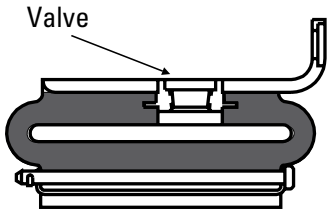
Single flange (SGL FL) - A CB description for rims having one flange. Element sizes 3CB150 thru 10CB300 have one flange. Element sizes 12CB350 and 14CB400 can be furnished single or dual flanged.



Slotted rim (SLOT) - A U-shaped cutout in the rim flange providing clearance for piping directly to the valve. Used with pipe adapter and in the small CB clutch applications which incorporate tapered bushings.



Turned down flange (TDF) - Applies to CB elements only. Element sizes 16CB500 thru 45CB525 have dual flange rims. This description is used when one flange is removed or "turned down" to provide clearance for adjacent components. Used primarily in FSPA applications.



Valve (VA or VAL or VL) - That part of the tube which permits a mechanical connection and through which the activating media enter and exhausts. Element sizes 3CB150 thru 14CB400 and 11.5VC500 can be furnished with either one or two valves; larger sizes with either one, two or four valves.

Lining (LNG or LN) or Friction lining (FR LNG) - Elements can be furnished with linings having different coefficients of friction. When no mention is made in the element description, standard linings are furnished. The lining descriptions are:

- **Standard lining -** This lining will produce the published element torque ratings.
- **Low coefficient (LO-CO) or Slip lining -** Lining that has a lower coefficient of friction than the standard lining. Used primarily for continuous slip or tensioning applications.
- **High coefficient (HI-CO) or Cork lining -** Lining that has a higher coefficient of friction than the standard lining. Used primarily in applications in which the elements operate in the engaged or locked up position for extended periods of time.
- **High coefficient with drive bar -** Lining that has a higher coefficient of friction than standard but is used in similar applications to standard.

Airflex® CM Construction and Features

Section B

The CM element provides all of the features associated with the type CB element plus greater heat dissipation characteristics. They are used in applications where moderate slippage is encountered which would shorten the operating life of a CB element.

The actuating tube of the CM element is bonded to a steel rim. The rim has male and female registers which allows the elements to be easily assembled into dual and triple arrangements. Ventilated friction shoes are attached to the tube by pins which in turn are held in position by cotter pins. Rubber lugs on the inside diameter of the actuating tube fit into recesses in the friction shoe backing plate providing a positive interface between the shoe and tube.

Element torque capacity is dependent upon the applied pressure and rotating speed. Catalog ratings are given at 75 psi (5,2 bar) and zero speed. Tube construction for the CM elements permits a higher operating pressure than that recommended for CB element. Maximum recommended pressure is 150 psi (10,3 bar). Adjustment for pressure and speed is explained under Selection Procedure.

CM elements are available in 5 sizes which are identified by the drum diameter in inches on which they constrict and the width in inches of its friction lining. For instance, size 26CM475 is designed to constrict on a 26 inch diameter drum and has a friction lining width of 4.75 inches. The smallest CM element will constrict on a 26 inch (660 mm) diameter drum and the largest on a 48 inch (1219 mm). Individual elements can be bolted together to Form dual or triple elements having twice or triple the torque capacity of a single element.

Because the rubber tube is the connecting member between the driving and driven shafts, the CM design offers the following features in addition to the constricting features described earlier in this section.

One moving component

The tube is the only moving component. There are no springs or sliding parts.

Cushioned action

The tube transmits the torque through its sidewalls, cushioning damaging shock loads thereby protecting drive components. The rubber tube construction dampens the effects of torsional vibrations.

Flexible coupling

The tube flexibility is able to compensate for minor shaft misalignment and axial movement.

Ventilated construction

Friction shoe backing plates have air passages through their entire length resulting in greater thermal capacity.

Where Used:

- Marine Propulsion

Size	Torque Ratings	
	English	SI
	lb · in @ 75 psi	N · m @ 5, 2 bar
26CM475	132000	14920
30CM500	188000	21250
35CM500	264000	29850
40CM550	369500	41770
48CM650	613500	69360

Airflex® CM Elements

Technical Data — Sizes 26 thru 48

Section B

English		lbxin @75psi	rpm	psi/rpm²	lb · ft²	lb	in²	inches		in³	in
26CM475	146211	132000	1030	40 E-06	280	160	302	0.30	0.21	120	25.81
30CM500	146212	188000	915	48 E-06	430	190	379	0.33	0.18	210	29.81
35CM500	146207	264000	900	900 E-06	900	250	433	0.33	0.18	250	34.81
40CM550	146208	369500	900	68 E-06	1150	310	540	0.33	0.18	320	39.81
48CM650	146209	613500	900	79 E-06	900	400	752	0.33	0.18	430	47.75

Size	Part Number	❶ Mr Torque Rating	Maximum Speed	C_s Centrifugal Loss Constant	Wk² / J	Weight / Mass	Friction Area	Friction Lining Thickness		❺ Air Cavity Volume	Minimum Drum Diameter
								New	Worn		
26CM475	146211	14920	1030	2,8 E-06	11,76	72	2099	8	5	1,97	656
30CM500	146212	21250	915	3,3 E-06	18,06	86	2634	8	5	3,44	757
35CM500	146207	29850	900	4,0 E-06	31,92	113	3009	8	5	4,10	884
40CM550	146208	41770	900	4,7 E-06	48,30	140	3753	8	5	5,25	1011
48CM650	146209	69360	900	5,5 E-06	84,84	181	5226	8	5	7,05	1213
SI		**N · m @ 5, 2 bar**	**rpm**	**bar/rpm²**	**kg · m²**	**kg**	**cm²**	**millimeters**		**dm³**	**mm**

Notes:

❶ Dynamic torque shown, static torque approximately 25% greater.
Torque in each application is dependent upon air pressure and speed.

❷ Tolerance +0.000/-0.006 in (+0,00/-0,15 mm).

❸ Tolerance +0.005/-0.000 in (+0,13/-0,00 mm).

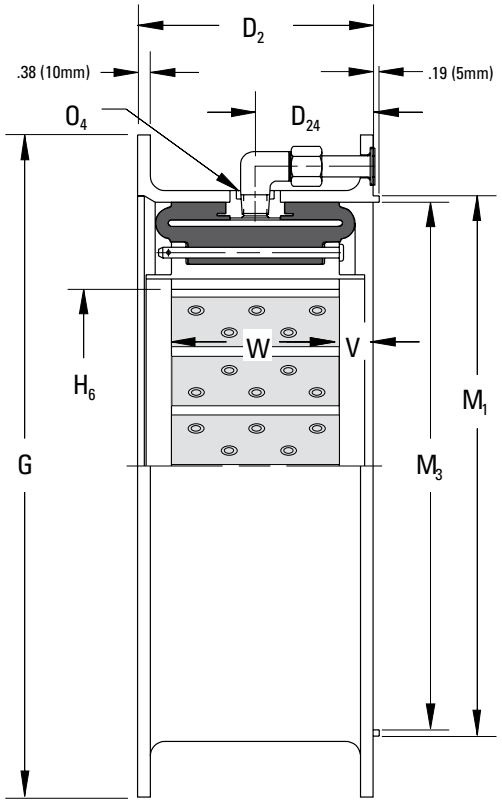
❹ American National Pipe Thread

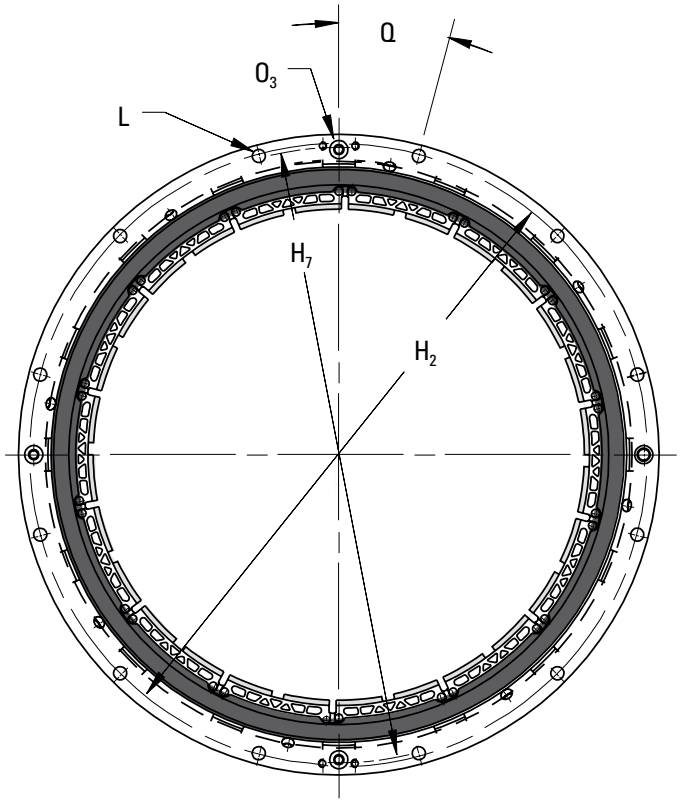
❺ Drum contact with worn shoes.

Airflex® CM Elements

Dimensional Data — Sizes 26 thru 48

Section B



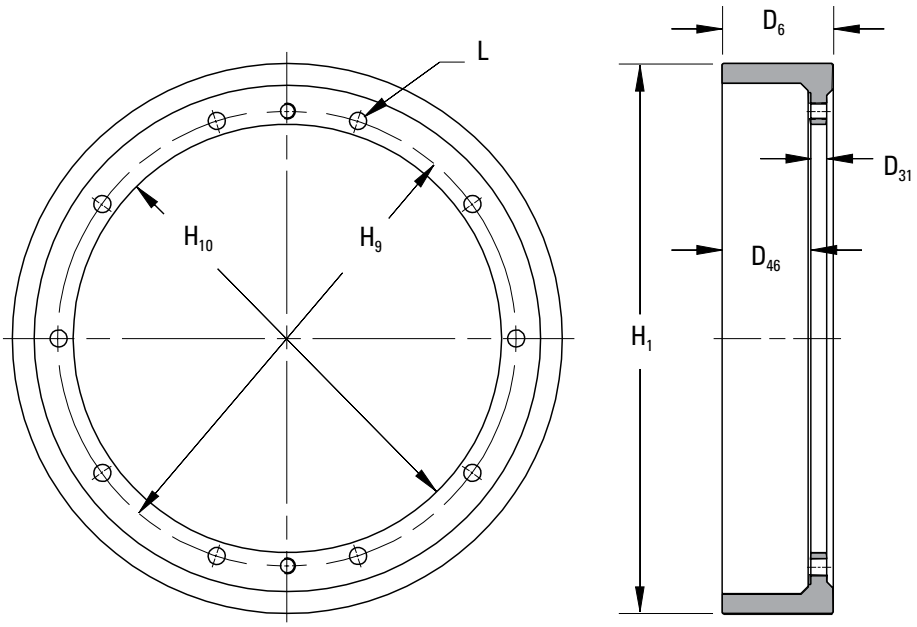


English		lb · in @ 75 psi	Dimensions in inches														
26CM475	146211	132000	6.94	3.38	34.750	33.438	26.19	32.88	12	0.69	31.500	31.125	0.38	3/8-18	15.000	1.00	4.75
30CM500	146212	188000	7.19	3.50	39.375	38.000	30.19	37.50	12	0.81	35.750	35.380	0.50	1/2-14	15.000	1.00	5.00
35CM500	146207	264000	7.69	3.75	45.875	44.375	35.19	43.75	12	0.81	42.000	41.380	0.63	3/4-14	15.000	1.25	5.00
40CM550	146208	369500	8.44	4.13	51.375	49.875	40.19	49.25	12	0.81	47.375	46.755	0.63	3/4-14	15.000	1.38	5.50
48CM650	146209	613500	9.06	4.44	59.500	58.000	48.19	57.25	16	0.81	55.375	54.760	0.63	3/4-14	11.250	1.19	6.50
Size	**❶ Mr Part Number**	**Torque Rating**	**D_2**	**D_{24}**	**❷ G**	**H_2**	**H_6**	**H_7**	**L**		**❷ M_1**	**❸ M_3**	**O_3**	**❹ O_4**	**Q (Deg)**	**V**	**W**
									No.	**Dia.**							
26CM475	146211	14920	176	86	882,7	849,3	665	835	12	18	800,1	790,6	10	3/8-18	15,000	25	121
30CM500	146212	21250	183	89	1000,1	965,2	767	953	12	21	908,1	898,7	13	1/2-14	15,000	25	127
35CM500	146207	29850	195	95	1165,2	1127,1	894	1111	12	21	1066,8	1051,1	16	3/4-14	15,000	32	127
40CM550	146208	41770	214	105	1304,9	1266,8	1021	1251	12	21	1203,3	1187,6	16	3/4-14	15,000	35	140
48CM650	146209	69360	230	113	1511,3	1473,2	1224	1454	16	21	1406,5	1390,9	16	3/4-14	11,250	30	165
SI		**N · m @ 5,2 bar**	**Dimensions in millimeters**														

Airflex® CM Mounting Components

Drums — Dimensional and Technical Data

Section B



Notes:

❶ Tolerance +0.000/-0.010 in (+0,00/-0,25 mm).

❷ Tolerance +0.003/-0.000 in (+0.08/-0.00 mm).

English	Dimensions in inches											
26CM475	0.75	26	10	0.81	5.25	3.25	16.130	14.750	5.25	4.19	21.630	20.250
30CM500	0.75	30	10	0.88	5.50	3.75	20.130	18.750	5.50	3.88	25.630	24.250
35CM500	1.00	35	10	1.00	6.50	4.25	23.505	21.875	6.69	4.25	30.005	28.375
40CM550	1.25	40	10	1.06	6.50	4.00	26.255	24.375	6.50	3.50	33.755	31.875
48CM650	1.25	48	12	1.06	7.00	3.06	37.760	35.875	7.00	4.50	42.010	40.000
Size	**D_{31}**	**❶ H_1**	**L**			**Forward Drive Drum**				**Reverse Drive Drum**		
			No.	**Dia.**	**D_6**	**D_{46}**	**H_9 ❶**	**H_{10} ❷**	**D_6**	**D_{46}**	**H_9 ❶**	**H_{10} ❷**
26CM475	19	660	10	21	133	83	409,7	374,7	133	106	549,4	514,4
30CM500	19	762	10	22	140	95	511,3	476,3	140	99	651,0	616,0
35CM500	25	889	10	25	165	108	597,0	555,6	170	108	762,1	720,7
40CM550	32	1016	10	27	165	102	666,9	619,1	165	89	857,4	809,6
48CM650	32	1219	12	27	178	78	959,1	911,2	178	114	1067,1	1016,0
SI	**Dimensions in millimeters**											

Forward Drive Drum

Size	Part Number	English		SI	
		Weight lb	Wk^2 lb · ft^2	Mass kg	J kg · m^2
26CM475	512239	190	170	86	7,14
30CM500	512349	210	280	95	11,76
35CM500	512241	310	570	140	23,94
40CM550	512243	460	990	208	41,58
48CM650	512245	590	1970	267	82,74

Reverse Drive Drum

Size	Part Number	English		SI	
		Weight lb	Wk^2 lb · ft^2	Mass kg	J kg · m^2
26CM475	512240	145	150	66	6,30
30CM500	512350	175	250	79	10,50
35CM500	512242	245	490	111	20,58
40CM550	512244	350	830	159	34,86
48CM650	512246	500	1750	227	73,50

Airflex® Selection Procedure

Element Torque Calculations

Section B

General

Technical Section Y of the catalog contains useful inFormation pertaining to the selection, mounting, alignment and control of clutches and brakes in general. Formulas, symbols and units are also identified. It is recommended that Section Y be reviewed before attempting to size a specific product for an application.

Element Torque Adjustment

The catalog element torque ratings $\mathbf{M_r}$ are based upon an effective pressure $\mathbf{p_r}$ of 75 psi (5,2 bar). Torque ratings must be adjusted for operating pressure $\mathbf{p_o}$, parasitic loss $\mathbf{p_p}$ and operating speed **n.**

Maximum allowable operating pressure is dependent upon element construction and frequency of engagement. In general, the pressures listed in the following table should not be exceeded.

Maximum Allowable Pressure

Model	English	SI
	psi	bar
CB	110	7,6
CM	150	10,3
VC	125	8,6

The elements have an inherent parasitic pressure $\mathbf{p_p}$ required to cause friction shoe contact with its drum which represents the pressure to overcome resiliency of the actuating tube and, for the VC elements, the pressure to overcome friction shoe release springs. Parasitic pressures are given in the following table and must be deducted from the operating pressure.

Parasitic Pressure p_p

Size	English	SI
	psi	bar
3CB	20	1,38
4 and 5CB	15	1,03
6 and 8CB	5	0,34
10 thru 45CB	2	0,14
All CM's	5	0,34
All VC's	4	0,28

A rotating element must have its torque rating adjusted to compensate for the centrifugal force acting on its friction shoes. The method used is to calculate a compensating pressure $\mathbf{p_c}$ and deduct its value from the operating pressure.

$p_c = C_S \bullet n^2$

where p_c= compensating pressure (psi or bar)

C_s= speed constant obtained from element catalog page (psi/rpm^2 or bar/rpm^2)

n= element rpm

Adjusted element torque $\mathbf{M_e}$ is then calculated from:

$$Me = \frac{p_o - p_p - p_c}{p_r} \cdot M_r$$

The adjusted element torque $\mathbf{M_e}$ must then be equal to or greater than the required clutch torque $\mathbf{M_c}$ or brake torque $\mathbf{M_b}$.

Examples 1, 2 & 3 at the end of this section illustrates the use of the above Formulas.

Airflex® Selection Procedure

Thermal Capacities

Section B

Continuous Thermal Capacity

Constricting elements are generally not recommended for continuous slip applications. This type of application is best handled by the expanding, caliper and water-cooled product lines (see Sections C, H and I).

Non-Cyclic Thermal Capacity

Non-cyclic thermal capacity is determined by the element's friction area, drum mass, heat capacity and thermal conductivity. The properties of our standard gray iron drums result in the limits indicated in the Non-Cyclic Energy Capacity Graph. An explanation on the use of this graph follows.

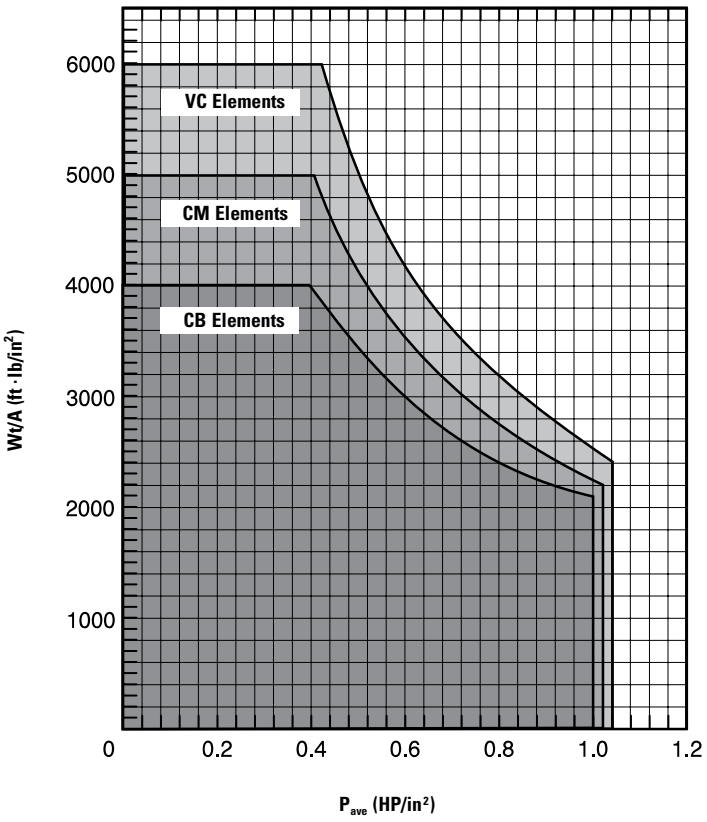
The thermal energy calculated for the load is adjusted to include the energy associated with accelerating or decelerating the components of the tentative clutch and/or brake selection. The adjusted thermal energy $\mathbf{W_t}$ is divided by the element's friction area **A.** Next, the average power loading $\mathbf{P_{ave}}$ is calculated from:

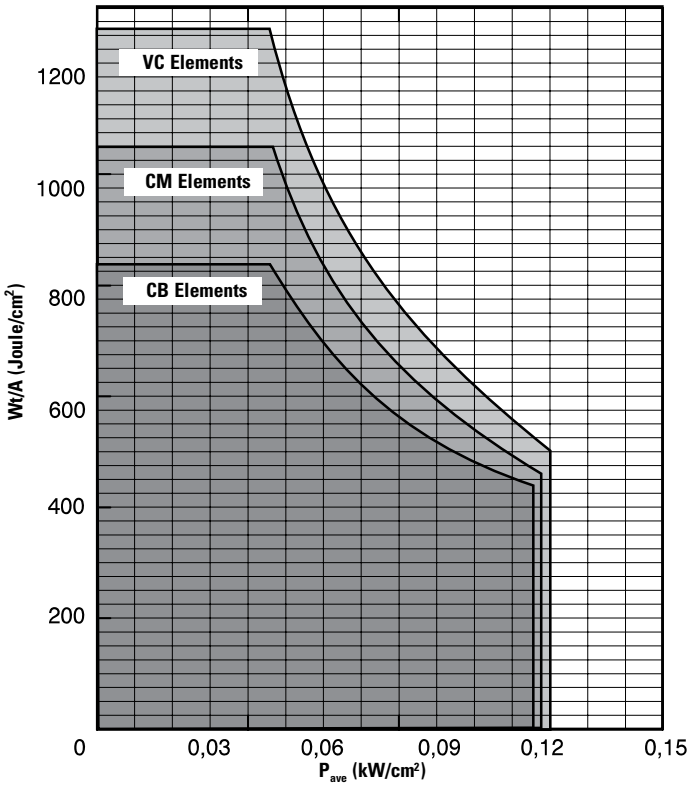
$$P_{ave} = \frac{P_t}{A}$$

The point $\mathbf{(W_t/A, P_{ave})}$ is plotted on the graph. If the point falls below the appropriate product limit line, the selection will handle the thermal load. If it does not, an element having a greater friction area is required.

Example 4 at the end of this section illustrates the use of the graph.

Non-Cyclic Thermal Capacities (Gray iron drums)





Cyclic Thermal Capacity

The cyclic thermal capacity of a clutch or brake is dependent upon the design and arrangement of the mounting components and their operating speed. Components with the smaller inertias should be mounted on the shaft which is started and/or stopped with each cycle. Protective guards should be designed to assure adequate air circulation.

Cyclic thermal capacities $\mathbf{P_c}$ for CB and VC elements are determined from the following graphs. CM elements are not recommended for cyclic duty because the thermal requirement can be handled more efficiently by a smaller diameter VC element. The capacities are for applications having the drum and hub on the driven side of the installation. Elements should have the maximum number of tube inlets. The capacities $\mathbf{P_g}$ obtained from these graphs must be multiplied by the appropriate arrangement factor $\mathbf{K_t}$ given in the table.

$$P_c = P_g \cdot K_t$$

The element's cyclic thermal capacity $\mathbf{P_c}$ must be greater than or equal to the thermal power requirement.

Example 5 at the end of this section illustrates the use of these graphs.

Arrangement Factors K_t

Arrangement	Single Element	Dual Element
Spider	1.0	1.6
Ventilated Adapter	1.67	2.67
Brake	0.5	0.8

Componenl Peripheral Velocities

Component velocities must be below the values given in the table. In some applications,components may be required to freewheel at speeds much faster than their engaged running speeds. This must be taken into consideration when calculating their velocities. Velocities are calculated by:

v (fpm) = 0.262 nD

v (mps) = 5,236E.05 nD

where D = outside diameter of component (in or mm).

Maximum Peripheral Speed

Component	fpm	mps
Spider	8500	43
Drum	8500	43
Hub	8500	43
Ventilated Adapter	6500	33

Selection Method

Two selection procedures are discussed in section Y. The analytical method results in an optimum selection for the drive whereas the service factor method may result in an under or over sized unit. Whenever possible, the analytical method should be used. The procedure to follow for constricting products is discussed below followed by the service factor procedure procedures.

Procedures for specialized machines or equipement used in a particular industries are given in Section X.

Analytical Method

The steps to follow are:

1. Determine the torque requirement.

2. Determine the thermal requirement.

3. Determine the mounting arrangement, mounting space and shaft diameters.

4. Make a tentative selection from saps 1,2 and 3.

5. Adjust the torque rating of the tentative selection to reflect the operating pressure and speed and determine if it still-meets the requrement.

6. Adjustthethermal requirement to include the energyof the clutch ano'orblEke componenls which are acceleratedor decelerated anddetermine if il ls '1ithin the tentativeselection's capacity.

7. Check drum and spider peripheral velocltles to determineif theyare withInthe componentsoperational fimils given inthe table.

Refer10 catalog sectionsXandYto determine the requirements for Step 1and2.Step3reQuiressome measurementsbemade to ensure the arrnngement does notinterfere with the surroundings. ~ thetentativeselectiondoes not meet therequirements of Step 5, 6 and 7, a largerelement or asmaller dual element-should beconsdered.Steps 4 thru7 shouldthenberepeated for thenewselection. ~ thenew selection stilldoesnotmeet therequirements of steps5 and 6, adifferentproduct fine should be considered . ~ theselectiondoesnotmeet 1he reQUirementsof Step 7, itmay bepossibleto fabricatethe components ofothermalerials whichcanwithstand the stresses associated with fast operating speeds.

Service Factor Selection Method

Obtaintheservice factor SF fromtheservice FactorTablegiven inSection Yo If the machine or equlpment lsnotlistedusetheservice factor for amachinewhichperForms asimilar function. Multiply theprimemover power P, by theservice factor 10 obtain the designpowerPD'

Pn p, SF

Fo r clutch appficationsope rating at 75 psi (5,2 bar), usethedesignpowergraphs to select an element 'ihichhas the designpowercapacityat theelement's operating speed . hese graphs are for single clutch elements. Dual clutch elements have twice1hecapaclty shown. Fo r clutch appflCationsoperating at otherpressures, ortor stationary brakeelements the service factor isappfied to theprimemover's torqueM, referred 10 theclutch orbrakeshaft. Therequired clutch torque II'\: or the required braketorqueMb is used tomakea tentativeelement selection. The elementtorqueliltingM, is adjusted foroperatingspeedandpressu re as eJqJlained earliet The adjusted elementtorque M., must beequal to or greater than Me or I~~ .