

Section 15 Unit Selection Procedures

▶ How to select a *Posidyne*

The selection of a **Posidyne** Clutch/Brake, PMD-2000, Multi-Speed or Reversing Drive should include the following information:

- Step 1** Control LogicSee page 15-1
- Step 2** Static Torque.....See page 15-3
- Step 3** Dynamic TorqueSee page 15-4
- Step 4** Thermal EnergySee page 15-4
- Step 5** Thermal Horsepower.....See page 15-5
- Step 6** Overhung LoadSee page 15-5

A complete selection procedure is provided in the Engineering Section.

Step 1 Control Logic

The torque transmitted by **Force Control** clutch and brake products is proportional to and controlled by the clamping force exerted by the piston on the stack. Pressure can be applied to the piston by internal springs or by externally controlled air or hydraulic pressure. The springs are generally used to engage the brake stack or to center the piston. The actuation pressure is used to (1) overcome the pressure generated by the springs, (2) furnish controlled pressure to the piston or (3) furnish additional pressure to assist the spring pressure.

This interaction of internal springs and externally applied

pressure determines how the drive unit reacts to control commands. This is called the **Torque Control Logic**.

As you can see, to exert pressure on the stack using the actuation pressure in many cases it is necessary to first overcome the internal spring pressure on the piston. The Control Logic is very important to the torque rating of the drive unit because of a maximum allowable actuation pressure, and must be known when calculating either actuation pressure for a required torque, or actual torque at a given actuation pressure.

Control Logic Availability

Logic	Description	X1	X2	X3	1.5	02	2.5	03	05	10	11	14	20	30
S	Air set clutch / Light spring set brake with air assist	X	X	X	X	X	X	X	X	X	X	X	X	X
SA	Air set clutch / Medium spring set brake with air assist	X	X	X	X	X	X	X	X	X	X	X	X	X
A	Air set clutch / Medium spring set brake	X	X	X	X	X	X	X	X	X	X	X	X	X
B	Air set clutch / Heavy spring set brake	----	----	----	X	X	X	X	X	X	X	X	X	X
C	Air set clutch / No brake	X	X	X	X	X	X	X	X	X	X	X	X	X
SCP	Spring centered piston / Air set clutch / Air set brake	----	----	----	----	----	X	X	X	X	X	X	X	X
P	Air set clutch / Air set brake / No springs	X	X	X	X	X	X	X	X	X	X	X	X	X

All clutches are air engaged. The Logic Selection is determined by the type of brake required.

S-Logic is for applications requiring a wide range of torque adjustment.

Example: Indexing conveyors typically require a very low brake torque. This is because there is a lot of friction, low back driving efficiency of worm gear reducers and the product may slip on the conveyor belt if stopped too quickly.

SA-Logic has the safety advantages of the A-Logic with an air assist to further increase brake torque if required.

Example: Lumber tilt hoist drive. The spring set brake holds the load if the air supply fails. Air assist allows operator to adjust desired operating torque.

A and B-Logic is for lifting devices or applications where adjustable brake torque is not required.

Caution: B-Logic (Heavy spring set brake) may have too much brake torque and may damage connected equipment

Example: Indexing cam operated dial table. The cam profile will stop the dial table. The **Posidyne** Brake only stops the drive train. A-Logic (Medium spring set brake) will not allow operator

to increase brake torque which could damage the cam and cam followers. Check with cam manufacturer for maximum allowable brake torque.

C-Logic is used when no brake is required. If there is very little connected load, the output shaft may rotate when the clutch is released due to residual drag

Example: Inching drive. Motor and gear reducer connected to **Posidyne** input. **Posidyne** used for jogging machine. Separate **Posidyne Clutch/Brake** used as main drive on machine. (Consider **Posidyne Multi-Speed Drive** for this application.)

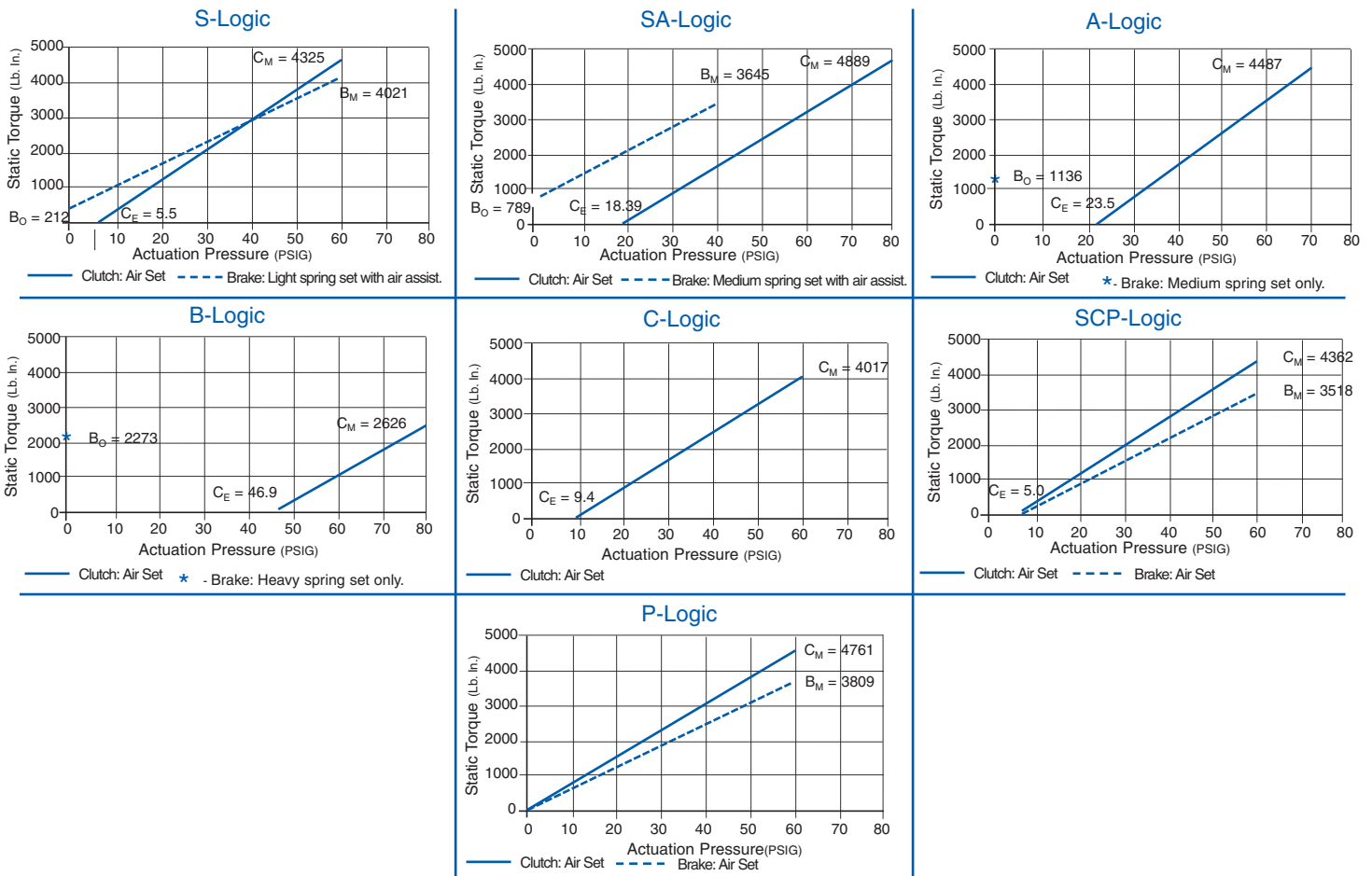
SCP-Logic is for applications that require a neutral position where neither the clutch or the brake is engaged.

Example: Lathe, where the chuck must be manually rotated to insert or remove the part.

P-Logic has an absence of spring bias. Both the clutch and brake are only engaged when air pressure is applied. This P Logic has the longest life since there are no springs that can fatigue and fail.

Example: Horizontal indexing belt conveyor and other applications where the torque control range is very low.

Sample Pressure vs. Torque Curves for 05 Posidyne.



Step 2 Static Torque

Static torque is the torque which can be transmitted by a clutch or brake without slipping. The static torque rating can be used to make a preliminary unit size selection using the **Quick Selection Table** following these four simple steps.

1. Determine Control Logic Type.
2. Determine Motor Horsepower.
3. Determine Speed (RPM) @ **Posidyne**.
4. Select preliminary unit size under required logic type using Horsepower vs. RPM Selection Tables below.

EXAMPLE:

- 15 HP Drive Motor.
- 1800 RPM @ **Posidyne** input.
- Adjustable Torque Control for both the clutch and brake is required.

A preliminary selection can be made from the chart under "S" Logic, 15 Horsepower and 1800 RPM. A size 03 is found.

For applications under 900 RPM and over 1800 RPM input consult the Force Control factory.

Quick Reference Posidyne Selection Tables

S, C, P and SCP Logic					B Logic					A and SA Logic				
HP	Input RPM				HP	Input RPM				HP	Input RPM			
	900	1200	1500	1800		900	1200	1500	1800		900	1200	1500	1800
1/3	X1	X1	X1	X1	1/3	---	---	---	---	1/3	X1	X1	X1	X1
1/2	X1, X2	X1	X1	X1	1/2	---	---	---	---	1/2	X1, X2	X1	X1	X1
3/4	X2, 1.5, 02	X1, X2	X1	X1	3/4	1.5	---	---	---	3/4	X2, 1.5, 02	X1, X2	X1	X1
1	X3, 1.5, 02	X2,1.5, 02	X2,1.5,02	X1, X2	1	1.5, 02	1.5, 02	1.5, 02	1.5, 02	1	X3, 1.5, 02	X2,1.5,02	X2,1.5,02	X1, X2
1 1/2	X3, 1.5, 02	X2,X3,02	X2,1.5,02	X2,1.5,02	1 1/2	1.5, 02	1.5, 02	1.5, 02	1.5, 02	1 1/2	X3, 1.5, 02	X2,X3,02	X2,1.5,02	X2,1.5,02
2	X3, 1.5, 02	X3,1.5,02	X3,1.5,02	X2,1.5,02	2	2.5	1.5, 02	1.5, 02	1.5, 02	2	X3,1.5, 02	X3,1.5,02	X3,1.5,02	X2,1.5,02
3	2.5	X3,X4,2.5	X3,1.5,02	X3,1.5,02	3	2.5	X4,2.5	2.5	1.5, 02	3	2.5	X3,X4,2.5	X3,1.5,02	X3,1.5,02
5	2.5	X4,2.5	2.5	X3, 2.5	5	03	X4,2.5	2.5	2.5	5	2.5	X4,2.5	2.5	X3, 2.5
7 1/2	03	2.5	2.5	X4,2.5	7 1/2	03	03	2.5	X4,2.5	7 1/2	03	2.5	2.5	X4,2.5
10	03	03	2.5	X4,2.5	10	05	03	03	X4,03	10	03	03	2.5	X4,2.5
15	05	03	03	03	15	10	05	05	03	15	05	03	03	03
20	10	05	05	03	20	10	10	05	05	20	10	05	03	03
25	10	05	05	05	25	11	10	10	10	25	10	05	05	05
30	10	10	05	05	30	11	10	10	10	30	10	10	05	05
40	10	10	10	10	40	14	11	11*	10	40	10	10	10	10
50	11	10	10	10	50	14	14	11*	11*	50	11	10	10	10
60	11	11	10	10	60	20	14	11*	11*	60	11	11	10	10
75	11	11	11*	10	75	20	20	14*	14*	75	14	11	11*	10
100	14	11	11*	11*	100	---	20	20	14*	100	20	14	11*	11*
125	20	14	11*	11*	125	---	---	20	20	125	30*	20	14*	14*
150	30*	20	14*	11*	150	---	---	---	20	150	30*	20	20	14*
200	30*	30*	20	14*	200	---	---	---	---	200	30*	30*	20	20
250	30*	30*	---	20	250	---	---	---	---	250	30*	30*	---	---

* Requires external cooling system.

* Requires external cooling system.

* Requires external cooling system.

Selections on the above Tables are based on static torque only and were calculated from the following Formula:

$$\text{Static Torque} = \frac{\text{HP} \times 63,000}{\text{N}} \times 3.00$$

Where: Torque = In. Lbs.

HP = Rated motor horsepower.

N = RPM @ **Posidyne** input

3.00 = Approximate stall torque of motor.

Step 3 Dynamic Torque

Dynamic Torque is the torque required during engagement to accelerate or decelerate the rotating mass (Inertia) and overcome friction (Efficiency) and load torque within a specified time period. Each of these can have a positive or negative effect on the required dynamic torque capacity of the clutch or the brake and will not necessarily effect both in the same way. Therefore it is necessary to calculate both the **Clutch Dynamic Torque** and the **Brake Dynamic Torque** separately. For a complete explanation of Dynamic Torque, Load Torque and Inertia refer to Engineering Information on page 16.1.

Clutch

$$T_{dc} = \left\{ \frac{WK^2 \times N \times 12}{308 \times t_a} + T_L \right\} \times \frac{1}{E}$$

Example:
Calculate required dynamic torque for the clutch.

$$T_{dc} = \left\{ \frac{7.7 \times 1800 \times 12}{308 \times 0.75} + 330 \right\} \times \frac{1}{0.91} = 1154 \text{ lb in.}$$

Brake

$$T_{db} = \left\{ \frac{WK^2 \times N \times 12}{308 \times t_d} - T_L \right\} \times E$$

Example:
Calculate required dynamic torque for the brake.

$$T_{db} = \left\{ \frac{7.7 \times 1800 \times 12}{308 \times 0.75} - 330 \right\} \times 0.91 = 355 \text{ lb in.}$$

- Where:**
- T_{dc} = Clutch Dynamic Torque required (Lb. In.)
 - T_{db} = Brake Dynamic Torque required (Lb. In.)
 - WK^2 = Inertia. (Lb. Ft.²)
 - N = RPM @ **Posidyne**.
 - t_a = Acceleration time. (Sec.)
 - t_d = Deceleration time. (Sec.)
 - E = Efficiency of drive train.
 - * T_L = Load torque. (Lb. In.)

Select a unit size with dynamic ratings exceeding the values calculated.

Step 4 Thermal Energy per Engagement

Thermal Energy per Engagement is the amount of energy to be dissipated by the Posidyne during each engagement and/ or brake. This thermal energy requirement may be calculated using the following formula only if the beginning RPM of the clutch and the ending RPM of the brake is zero (0) RPM. For additional information on all beginning and ending speeds see Engineering Information on page 16.8.

Clutch

$$TE_c = 1.7 \times WK^2 \times \left\{ \frac{N}{100} \right\}^2 \times \frac{T_{dc}}{T_{dc} - T_L}$$

Example:
Calculate total required energy per engagement capacity for the clutch.

$$TE_c = 1.7 \times 7.7 \times \left\{ \frac{1800}{100} \right\}^2 \times \frac{1144}{1144-330} = 5,961 \text{ ft lbs}$$

Brake

$$TE_b = 1.7 \times WK^2 \times \left\{ \frac{N}{100} \right\}^2 \times \frac{T_{db}}{T_{db} + T_L}$$

Example:
Calculate total required energy per engagement capacity for the brake.

$$TE_b = 1.7 \times 7.7 \times \left\{ \frac{1800}{100} \right\}^2 \times \frac{346}{346+330} = 2,171 \text{ ft lbs}$$

- Where:**
- TE_c = Clutch Thermal Energy per Engagement (Ft. Lbs.)
 - TE_b = Brake Thermal Energy per Engagement (Ft. Lbs.)
 - 1.7 = Constant
 - WK^2 = Inertia. (Lb. Ft.²)
 - N = RPM @ **Posidyne**.
 - T_{dc} = Clutch Dynamic Torque (Lb. In.)
 - T_{db} = Brake Dynamic Torque (Lb. In.)
 - * T_L = Load torque. (Lb. In.)
(System friction, inclined or vertical loads, etc.)

NOTE: For additional information to calculate WK^2 see Engineering Information on Page 16.3.

***NOTE:** Be sure to use the proper sign (+ -). Usually it is a positive number for the clutch calculation and a negative number for the brake calculation.

Step 5 Thermal Horsepower

Posidynes are also rated on Average Thermal Horsepower capacity which is the amount of thermal energy the units can dissipate continually (1 THP = 42.2 BTU = 33,000 Ft. Lbs.) based on the type of cooling - basic, fan, water or forced lube. The average thermal horsepower rating required can be calculated using the following formula.

$$THP = \frac{[TE_b + TE_c] \times CPM}{33,000}$$

Example:

Calculate thermal horsepower capacity required.

$$THP = \frac{(5,961 + 2,171) \times 6}{33,000} = 1.48 THP$$

Where: THP = Average Thermal Horsepower

TE_c = Thermal Energy per Engagement (Clutch)

TE_b = Thermal Energy per Engagement (Brake)

CPM = Cycles per Minute

33,000 = Constant

A cooling method must be specified that provides an Average Thermal Horsepower rating exceeding the values calculated.

Step 6 Overhung Load

Overhung Load is the load attribute to the pull of the chain or belt drive on the input or output shafts. Larger diameter pulleys or sprockets will decrease overhung load but will increase the WK² in the preceding calculations. The required Overhung Load capacity can be calculated from the following formula.

$$P = \frac{126,000 \times HP \times K}{N \times D}$$

Example:

Calculate overhung load capacity required for the input shaft.

$$P = \frac{126,000 \times 15 \times 1.25}{1800 \times 4} = 328 \text{ Lbs.}$$

Where:

P = Overhung Load. (Lbs.)

HP = Horsepower.

N = RPM @ **Posidyne** Input.

D = Pitch diameter of the Pulley or Sprocket. (In.)

K = 1.1 for the Chain.

K = 1.25 for the gearbelt.

K = 1.5 for a V-Belt.

The unit size selected must have overhung load ratings exceeding the values calculated.

Example: Indexing Conveyor Drive

Cyclic WK²

Reflected Load WK² = Load x (Radius)² x $\left(\frac{1}{\text{Ratio}}\right)^2 \div 144$

$$= 10,000 \times (6'')^2 \times \left(\frac{1}{2 \times 10}\right)^2 \div 144 = 6.25 \text{ Lb. Ft.}^2$$

Reflected Conveyor = Chain x (Radius)² x $\left(\frac{1}{\text{Ratio}}\right)^2 \div 144$

$$\text{Chain WK}^2 = 1,000 \times (6'')^2 \times \left(\frac{1}{2 \times 10}\right)^2 \div 144 = 0.63 \text{ Lb. Ft.}^2$$

Reducer WK² = Vender Information = 0.51 Lb. Ft.²

Coupling WK² = Vender Information = 0.11 Lb. Ft.²

03 *Posidyne* WK² = From Table on Page 1-11 = 0.20 Lb. Ft.²

Total Cyclic WK² @ *Posidyne* = 7.7

Efficiency of Drive Train

E = Chain Drive Efficiency x Reducer Efficiency = .98 x .93 = .91 Efficiency

Total Load Torque

$$T_L = [(10,000 \text{ Lbs.} + 1,000 \text{ Lbs.}) \times .1_f] \times 6'' \text{ Rad.} \div 20:1 = \mathbf{330 \text{ Lb. In.}}$$

Data Required for Proper Selection...

Logic Type = S

CPM = 6 Cycles per Minute

t_a (Accel. Time) = .75 Seconds

t_d (Decel. Time) = .75 Seconds

K (Gearbelt Drive) = 1.25

Selection

Referring to the **Posidyne** selection tables we find under S- logic that the size 03 (1864 Lb.In. @ 60 PSI) is required to meet the Dynamic Torque requirements of the clutch. The rating for the brake (1485 Lb. In. @ 60 PSI) exceeds the Dynamic Brake requirement. The average Thermal Horsepower rating indicates the need for fan cooling. A check of the Overhung Load rating for the 03 (1150 Lbs.) in the Overhung Load table on page 2.16 is satisfactory.

The proper **Posidyne** selection is a size 03, fan cooled and S-logic. Using the Ordering System Chart in Section 2 page 2.17 the Ordering Number is developed.

03-1S1-H-5

If a piggyback is required the Ordering Number becomes:

03-7S7-H-5 (254 T-Frame)

Posidyne® Logic Specifications

Pressure vs. Static Torque Chart

(X Class Posidyne Clutch/Brake)

Size	Logic	Clutch				Brake				
		C _M		C _E	C _T	B _O	B _M		B _S	B _T
		Max. Clutch Static Torque (Lb.In.)	Max. Air Actuation Pressure (PSIG)	Clutch Engmt. Air Pr. Req'd. (PSIG)	Clutch Net Torque (Lb. In./ PSIG)	Spring Set Only-Torque w/o Air Assist (Lb.In.)	Max. Brake Static Torque (Lb.In.)	Max. Brake Actuation Pressure (PSIG)	Brake Spring Bias (PSIG)	Brake Net Torque (Lb. In./ PSIG)
X1	S	99	70	16	1.83	24	106	45	13.1	1.83
	SA	90	80	31		49	104	30	26.8	1.83
	A	90	80	31		49	-----		----	-----
	C	99	70	16		----	-----		----	-----
	P	110	60	3		----	110	60	-----	1.83
X2	S	198	70	16	3.86	48	213	45	13.1	3.66
	SA	179	80	31		98	208	30	26.8	3.66
	A	179	80	31		98	-----		----	-----
	C	198	70	16		----	-----		----	-----
	P	220	60	3		----	220	60	-----	3.66
X3	S	468	80	16	7.32	93	531	60	12.6	7.32
	SA	359	80	31		189	480	40	25.6	7.72
	A	359	80	31		189	-----		----	-----
	C	468	80	16		----	-----		----	-----
	P	512	70	3		----	512	70	-----	7.32

NOTES:

1. For Dynamic torque ratings multiply static torque ratings above by .846 for all X Class Posidyne Clutch/Brakes.
2. "S", "SA" and "C" logics are not standard.

Posidyne® Logic Specifications

Pressure vs. Static Torque Chart

(Sizes 1.5-05 Posidyne Clutch/Brake)

Size	Logic	Clutch				Brake				
		C _M		C _E	C _T	B _O	B _M		B _S	B _T
		Max. Clutch Static Torque (Lb.In.)	Max. Air Actuation Pressure (PSIG)	Clutch Engmt. Air Pr. Req'd. (PSIG)	Clutch Net Torque (Lb. In./ PSIG)	Spring Set Only-Torque w/o Air Assist (Lb.In.)	Max. Brake Static Torque (Lb.In.)	Max. Brake Actuation Pressure (PSIG)	Brake Spring Bias (PSIG)	Brake Net Torque (Lb. In./ PSIG)
1.5	S	427	60	4.2	7.6	32	484	60	3.3	7.6
	SA	387	70	18.8		110	492	70	15.0	7.6
	A	387	70	18.8		110	-----	-----	-----	-----
	B	240	70	37.6		220	-----	-----	-----	-----
	C	427	60	4.2		----	-----	-----	-----	-----
	P	464	70	3.0		----	464	70	0	7.6
02	S	518	60	7.30	9.8	48	553	60	5.7	8.4
	SA	542	80	24.9		164	501	40	19.5	8.4
	A	503	80	20.0	8.4	126	-----	-----	-----	-----
	B	386	80	40.0		252	-----	-----	-----	-----
	C	335	60	20.0		----	-----	-----	-----	-----
	P	590	60	3.0	9.8	----	505	60	0	8.4
2.5	S	1,331	60	6.6	25	113	1,396	60	5.3	21.4
	SA	1,482	80	21.9		512	1,663	40	18.0	28.5
	A	1,451	80	20.6		476	-----	-----	-----	-----
	B	968	80	41.2		952	-----	-----	-----	-----
	C	1,270	60	9.1		----	-----	-----	-----	-----
	SCP	1,234	60	2.5		----	1,051	60	-3.5	21.4
	P	1,497	60	3.0		----	1,283	60	0	21.4
03	S	2,574	60	6.0	47.6	144	2,049	60	4.5	31.7
	SA	2,790	80	21.4		651	2,238	40	16.4	39.7
	A	2,852	80	20.0		602	-----	-----	-----	-----
	B	1,895	80	40.2		1203	-----	-----	-----	-----
	C	2,474	60	8.0		----	-----	-----	-----	-----
	SCP	2,668	60	4.0		----	1,833	60	-2.0	31.7
	P	2,857	60	3.0		----	1,905	60	0	31.7
05	S	4,325	60	5.5	79.4	212	4,021	60	3.3	63.5
	SA	4,889	80	18.4		789	3,645	40	11.0	71.42
	A	4,487	80	23.5		1,196	-----	-----	-----	-----
	B	2,626	80	46.9		2,273	-----	-----	-----	-----
	C	4,017	60	9.4		----	-----	-----	-----	-----
	SCP	4,362	60	5.0		----	3,518	60	-4.6	63.5
	P	4,761	60	3.0		----	3,809	60	0	63.5

NOTE: For Dynamic torque ratings multiply static torque ratings above by .846.

Pressure vs. Static Torque Chart

(Sizes 10-30 Posidyne Clutch/Brake)

Size	Logic	Clutch				Brake				
		C _M		C _E	C _T	B _O	B _M		B _S	B _T
		Max. Clutch Static Torque (Lb.In.)	Max. Air Actuation Pressure (PSIG)	Clutch Engmt. Air Pr. Req'd. (PSIG)	Clutch Net Torque (Lb. In./ PSIG)	Spring Set Only-Torque w/o Air Assist (Lb.In.)	Max. Brake Static Torque (Lb.In.)	Max. Brake Actuation Pressure (PSIG)	Brake Spring Bias (PSIG)	Brake Net Torque (Lb. In./ PSIG)
10	S	9,832	60	7.3	186.6	691	10,489	60	4.2	163.3
	SA	9,471	80	29.2		2,766	9,297	40	16.9	163.3
	A	10,031	80	26.3		2,797	-----	-----	-----	-----
	B	5,097	80	52.7		5,593	-----	-----	-----	-----
	C	9,228	60	10.5		-----	-----	-----	-----	-----
	SCP	9,936	60	6.7		-----	8,621	60	-7.3	163.3
	P	11,197	60	3.0		-----	9,797	60	0	163.3
11	S	18,045	80	8.0	250.7	888	14,926	80	5.0	175.5
	SA	13,358	80	27.0		2,961	9,980	40	16.9	175.5
	A	14,036	80	24.0		2,661	-----	-----	-----	-----
	B	8,019	80	48.0		5,322	-----	-----	-----	-----
	C	18,045	80	8.0		-----	-----	-----	-----	-----
	SCP	17,833	80	9.0		-----	17,833	80	-4.6	175.5
	P	20,054	80	3.0		-----	14,038	80	0	175.5
14	S	22,989	80	9.4	325.8	1,681	23,737	80	6.0	275.7
	SA	16,484	80	29.4		5,237	16,264	40	19.0	275.7
	A	17,576	80	26.0		4,660	-----	-----	-----	-----
	B	10,783	80	47.0		8,352	-----	-----	-----	-----
	C	23,453	80	8.0		-----	-----	-----	-----	-----
	SCP	26,066	80	8.8		0	20,793	80	-4.6	275.7
	P	24,279	80	4.3		0	22,056	80	-----	275.7
20	S	31,082	80	8.0	432.2	2,018	32,274	80	5.3	378.2
	SA	25,837	80	20.2		5,045	20,173	40	13.3	378.2
	A	26,332	80	19.0		4,759	-----	-----	-----	-----
	B	18,087	80	38.0		9,518	-----	-----	-----	-----
	C	30,455	80	9.5		-----	-----	-----	-----	-----
	SCP	32,737	80	4.8		-----	28,115	80	-6.2	378.2
	P	34,578	80	3.0		-----	30,256	80	0	378.2
30	S	78,857	50	7.9	1871.7	8,010	72,185	40	5.0	1604.4
	SA	75,478	60	19.7		20,026	68,157	30	12.5	1604.4
	A	75,478	60	19.7		20,026	-----	-----	-----	-----
	C	78,857	50	7.9		-----	-----	-----	-----	-----
	SCP	76,600	45	4.0		-----	65,657	45	4.1	1604.4
	P	74,871	40	3.0		-----	64,175	40	0	1604.4

NOTE: For Dynamic torque ratings multiply static torque ratings above by .846 for all sizes.

To find Torque Developed at a given Actuation Pressure.

To find Actuation Pressure needed for Req'd. Torque.

$$\text{Clutch Torque} = (\text{PSI} - C_E) \times C_T$$

$$\text{Brake Torque} = (\text{PSI} + B_S) \times B_T$$

$$\text{Clutch PSI} = (T_R / C_T) + C_E$$

$$\text{Brake PSI} = (T_R / B_T) - B_S$$

How to Select the Correct Posistop

Selecting the correct **Posistop Brake** is very similar to the selection procedures used for the brake component selection of the **Posidyne**. **Note:** One major difference is that Torque Ratings are in **Lb. Ft.** rather than **Lb. Ins.**

Selection of the **Posistop** products vary slightly with the different types.

Motor Mounted

The **Motor Mounted Posistop** is spring set, air release. The initial selection for a motor brake should be made based on the frame size of the motor. It is important to check the shaft diameter, shaft length, pilot diameter and bolt circle to select the proper size **Posistop**. This selection should be checked against the Torque and Thermal Requirements. The formulas are provided for this purpose.

Flange Mounted

The **Flange Mounted Posistop** is spring set, air release and comes in the same Torque Ratings as the Motor Mounted Brakes. The flanges and hubs are typically designed to fit various machine faces and shaft extensions.

Foot Mounted

The **Foot Mounted Posistop** comes both as spring set, air release (Type A and B Logics) and as an adjustable unit with air set, spring release (Type S Logic). The Control Logic must be determined before a selection can be made.

The following formulas can be used to calculate the required Torque and Thermal Ratings.

Static Torque

The **Static Torque Ratings** of the **Posistop** units represent the **Holding Torque Capacity** with the actuation pressure noted in the "S" Logic units or when zero release pressure is supplied, i.e., multiple springs fully engaging the brake stack in the "A" or "B" Logic units.

Static Torque may be determined by the following formula:

$$T_s = \frac{HP \times 5250 \times 2}{N}$$

Where: T_s = Torque (Lb. Ft.)
 HP = Horse Power of Motor
 N = RPM @ Brake
 2 = Constant for moderate inertial loads.
 (Consult factory for hoist type applications)

Select a motor brake with a Static Torque Rating equal to or greater than the Torque Value determined above.

Dynamic Torque

For applications requiring precise stopping action, it becomes necessary to consider the torque available to decelerate the load.

$$T_{db} = \text{Torque (Lb. Ft.)} = \left\{ \frac{WK^2 \times N}{308 \times t} + T_L \right\} \times E$$

WK^2 = Lb. Ft.² (Total Cyclic Inertia)

N = RPM

t = Stopping Time required in seconds

308 = Constant

T_L = Load Torque (Lb. Ft.)

E = Efficiency

The Torque figure in the preceding formula is considered to be average torque available during deceleration. Select a Brake with a Dynamic Torque Rating equal to or greater than the Torque determined above.

Thermal Dissipation-Cyclic Drive

The considerations for Heat Dissipation requirements are based on the following formula:

$$TE_b = 1.7 \times WK^2 \times \left\{ \frac{N}{100} \right\}^2 \times \frac{T_{db}}{T_{db} - T_L}$$

TE_b = Thermal Energy per Engagement (Ft. Lbs.)

1.7 = Constant

WK^2 = Total Cyclic Inertia (Lb. Ft.²)

N = RPM @ Brake

T_{db} = Dynamic Torque (Lb. Ft.)

T_L = Load Torque (Lb. Ft.)

This formula gives the **Thermal Energy absorbed by the brake in any one engagement**, providing all factors remain constant for the application. **Force Control Posistop** units are rated thermally in terms of **Horsepower / Seconds per Minute**.

$$1 \text{ HP Sec. /Min.} = 0.7 \text{ BTU} = 550 \text{ Ft. Lbs./Min.}$$

Horsepower Seconds per Minute is a continuous rating based on the cyclic rate of the application and the kinetic energy to be absorbed per stop.

$$\text{HP Sec. /Min.} = \frac{TE_b \times CPM}{500}$$

HP Sec./Min. = Thermal Load (Continuous)

CPM = Cycles per Minute

500 = Constant

Select a **Posistop Brake** with a Thermal Rating equal to or greater than the Thermal Load (Continuous) determined above.

How to Select Your Positorq Absorber Brake

Dynamometer Application

In a **Dynamometer Application** normally a **Positorq Brake** is used to resist rotation of a shaft at some torque load. It can be used to absorb energy continuously as in product life testing, or for a short time for maximum load carrying capability. It can also be used to lock-up the shaft for destructive testing.

The **Positorq Brake** size is based primarily on torque and thermal horsepower. Sizing of the **Positorq Brake** should be done by application engineers at **Force Control**, however the following information will be required for sizing and determining cooling systems.

1. The first step is to determine the **maximum continuous slip torque** required at any speed. This is the torque at which the **Positorq Brake** is required to slip, absorbing energy continuously.

2. The next step is to determine the **lock-up or holding torque** required. This could be used for destructive testing or maximum load carrying ability.

3. Next determine the **maximum heat load (Thermal Horsepower)** to be dissipated. This can usually be determined by the maximum horsepower of the input driver. It can also be calculated by using torque and speed.

4. Determine the **maximum speed** in RPM required at the **Positorq Brake**.

5. Determine the **minimum torque** required at the maximum speed. Due to residual drag in the **Positorq Brake**, zero torque is not available depending on speed and **Positorq** size. Minimum torque is affected by brake size, number of discs, RPM, fluid flow and temperature.

<p>BASIC FORMULA TORQUE (Lb. Ft.)</p> $TORQUE = \frac{(HP) (5250)}{RPM}$ $THP = \frac{(Torque) (RPM)}{5250}$ $RPM = \frac{(THP) (5250)}{Torque}$	<p>HP = Prime mover horsepower less efficiency and work losses in system or device being tested.</p> <p>RPM = Speed at brake shaft.</p> <p>THP = Thermal horsepower to be dissipated. (Continuous)</p> <p>Torque = Lb. Ft.</p>
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NOTE: Please consult factory for your particular application. There are many options available that are not shown in this catalog.

How to Select Your *Positorq* Absorber Brake

Tension Application

The *Positorq* can be used for two major types of applications:

- (1) To supply constant tension for unwind applications in industries such as paper, foil, steel, coating, plating, etc.
- (2) As an energy absorber (Dynamometer) to create a known controlled load on a system, usually for testing purposes.

The selection of a *Positorq* for a tension control application will vary depending on the type of tension application. The most common types of applications are:

- (1) **Constant Rewind** - The parent roll is continuously unwound as for plating, coating, laminating, etc.
- (2) **Rewinding in Sets** - The parent roll is wound onto several smaller rolls. In this application the parent roll will need to be stopped several times during the operation to change the smaller rolls.

For a Constant Rewind application the two Torque Requirements to be considered are:

- (1) The Torque to maintain constant tension.
- (2) The Torque to stop the inertia of the roll for a **panic stop**.

When Rewinding in Sets, there are three Torque Requirements to be considered.

- (1) The Torque to maintain constant tension.
- (2) The Torque to stop the roll Inertia only, (E-Stop).
- (3) The Total Torque to stop the roll Inertia and overcome tension at the first set stop.

The Total Torque Required when stopping at the first set stop is: (1) the total of the torque to maintain tension plus (2) the torque to stop the roll.

The larger of (1) The Total Torque required at set stop or (2) The Torque required for a Panic Stop, should be used for selection purposes.

Determining Torque Capacity...

The following formulas are used to find the required torque capacity. Calculating the torque of a full roll and that at set stop is the same except for the difference in WK^2 and RPM.

<p>(1) Tension Torque</p> <p>1. Torque required to maintain constant tension.</p> $T_t = \frac{D \times W \times (PLI) \text{ or } (PSI \times t)}{2 \times 12}$ <p>T_t = Torque (Lb.Ft.) to maintain tension. D = Dia. of Roll. (Inches) W = Width of Roll. (Inches) PLI = Tension (Lb./Linear Inch) PSI = Tension (Lb./Sq. Inch) t = Thickness</p>	<p>(2) Stopping Torque</p> <p>2. Torque required to stop roll.</p> $T_s = \frac{WK^2 \times RPM}{308 \times t}$ <p>T_s = Torque for panic or set stop. (Lb.Ft.) WK^2 = Inertia of roll when stopping. RPM = Speed of roll when stopping. 308 = Constant t = Time to decelerate.</p>	<p>(3) Total Torque</p> <p>3. Total Torque required at set stop.</p> $TT = T_t + T_s$ <p>TT = Total Torque at set stop. (Lb.Ft.) T_t = Constant Tension Torque at set stop. (Lb.Ft.) T_s = Stopping Torque at set stop. (Lb.Ft.)</p>
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Thermal Horsepower to maintain tension

$$THP_t = \frac{W \times PLI \times FPM}{33,000}$$

THP_t = Thermal Horsepower (Tension)
 W = Width (Inches)
 PLI = Tension (Lb. per Linear Inch)
 FPM = Feet per Minute
 $33,000$ = Constant

The correct *Positorq* unit is then selected based on the highest torque requirement and thermal horsepower rating. The Cooling Unit is selected based on Thermal Horsepower.

Thermal Horsepower relates to the amount of energy that must be absorbed, and is used to size the cooling system. Usually the thermal horsepower absorbed to maintain tension is satisfactory for calculating **Cooling System Capacity**, however in some cases where a very small PLI is required the thermal energy to stop the roll may be the limiting factor. The following formula can be used to determine the Thermal Horsepower. Refer to the Engineering Section for further information if selection of Stopping Thermal Horsepower is required.

*** **Tension Brake Selection for Unwind Applications**

The primary function of the *Positorq* unit in **Unwind Applications** is to provide a controlled resistance to the parent roll so the web tension remains constant as the roll diameter changes. Constant web tension is required to produce a satisfactory roll that has uniform hardness. For this to occur the torque reaction of the Brake will vary proportionally to the change in roll size as it unwinds. The angular

velocity of the roll, however, varies inversely to the change in its size when web speed is held constant. These requirements produce a constant horsepower condition. In other words, as the torque requirement for the brake decreases, the speed of the roll increases such that the product of the torque and speed is a constant.

Unwind Applications can be broken down into two typical categories.

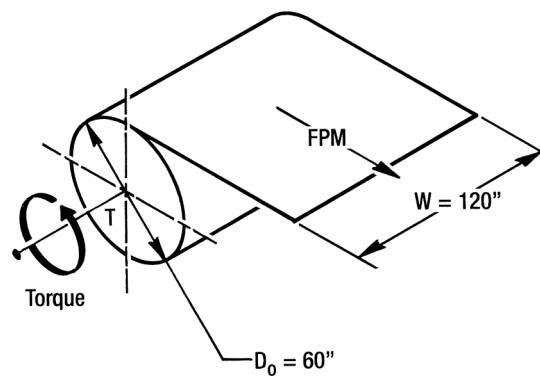
1. Constant Rewind Applications

When the Parent Roll is being rewound for processing or storage and the process is not interrupted. This condition is common to applications found in the steel industry

2. Rewind Applications with Multiple Sets

When a parent roll is being rewound into several smaller rolls for shipment or storage. This condition is common to applications found in the paper industry.

There are small but important differences between the applications. The following example is used to illustrate them. **The two parameters on which the proper selection is made in both applications is torque and horsepower requirements**



Unwind Example

Required Information

- 1. Web Speed = FPM = 6000
- 2. Web Tension = PLI = 5
- 3. Web Width = W = 120 Inches
- * 4. Specific Weight of Paper = 45 Lbs./Ft.³ (80 Lb. paper x .007" thick)
- 5. Max. Diameter = D_0 = 60 Inches
- **6. Number of Set = 4
- 7. Deceleration Time between Sets = t_s = 30 Sec.
- 8. Panic Stop Time = t_p = 15 sec.
- 9. Core Diameter = D_c = 10 Inches

NOTES:

* Paper is normally specified by a "base weight" (i.e. 500 sheets having an area of 6 Ft.² equals a certain weight.) In order to determine the specific weight of the paper the thickness or caliper of the paper has to be obtained

Example: 80 Lb. paper that is .007" Thick

$$\text{Specific Weight} = \frac{80 \text{ Lbs.}}{[3000] \times [.007/12]} = 45 \text{ Lbs. Ft.}^3$$

** Sets - Number of rolls that the parent roll will be wound.

*** The above selection procedure is valid for applications of web speeds no greater than 6000 FPM and with web tension of 5 PLI or greater.

Consult our Factory Sales Engineering Department for applications outside these limits.

Torque Requirements...Tension Brake (Positorq) Selection

The Maximum Torque Requirement for an Unwind Tension Application can be determined by evaluating the following (3) categories:

1. Torque Required at Constant Speed Operation

For **Steady State Operation** this value is simply found by using the following equation:

$$T_C = \frac{D \times W \times PLI}{2} \times \frac{1}{12}$$

Using the example on the previous page.

$$T_C = \frac{60 \times 120 \times 5}{2} \times \frac{1}{12} = \mathbf{1500 \text{ Ft. Lbs.}}$$

A torque reaction of 1500 Ft. Lbs. is required for Steady State Operation at full roll.

2. Torque Required for Panic Stop

The **Required Torque for a Panic Stop** is a maximum when the roll is at its largest diameter. The following equations are used to determine this required torque:

A. Determine Weight of Roll

$W_t = \text{Volume} \times \text{Specific Weight}$

$$W_t = \left[\frac{\pi D_2^2}{4} \times L \right] \times \left[\frac{1}{1728} \right] \times \text{Specific Weight}$$

$$W_t = \left[\frac{\pi 60^2}{4} \times 120 \right] \times \left[\frac{1}{1728} \right] \times 45 \text{ Lbs./Ft.}^3 = \mathbf{8835 \text{ Lbs.}}$$

B. Determine WK^2 of Roll @ Max. Dia.

$$WK^2 = \frac{WR^2}{2} \left[\frac{1}{144} \right] \text{ [Lb. Ft.}^2 \text{]}$$

$$WK^2 = \frac{8835 [30]^2}{2} \left[\frac{1}{144} \right] = \mathbf{27,609 \text{ Lb. Ft.}^2}$$

C. Determine RPM @ Max. Dia.

$$\text{RPM} = \frac{\text{FPM} \times 12}{\pi \times D}$$

$$\text{RPM} = \frac{[6000] \times [12]}{\pi \times [60]} = \mathbf{382 \text{ RPM}}$$

D. Torque Requirement

$$T_p = \frac{WK^2 \times \text{RPM}}{308 \times t_p}$$

$$T_p = \frac{27,609 \times 382}{308 \times 15} = \mathbf{2283 \text{ Lb. Ft.}}$$

3. Torque Required Between Sets

The **Maximum Torque Required between Sets** is the first set. This torque is determined as follows:

A. Determine Weight of Roll @ First Set

$$W_{t1} = W_o \left[1 - \frac{1}{N} \right] \text{ where } N = \text{Number of Sets}$$

$$W_{t1} = 8835 \left[1 - \frac{1}{4} \right] = 6,626.25 \text{ Lbs.}$$

B. Determine Dia. of Roll @ First Set

$$D_1 = \sqrt{[D_o^2 - D_c^2] \left[1 - \frac{1}{N} \right]}$$

$$D_1 = \sqrt{[60^2 - 10^2] \left[1 - \frac{1}{4} \right]} = \mathbf{51.2 \text{ Inches}}$$

C. Determine WK^2 @ First Set

$$WK^2 = \frac{WR^2}{2} \left[\frac{1}{144} \right] = \text{Lb. Ft.}^2$$

$$WK^2 = \frac{[6626][25.6]^2}{2} \left[\frac{1}{144} \right] = \mathbf{15,078 \text{ Lb. Ft.}^2}$$

D. Determine RPM @ First Set Dia.

$$\text{RPM} = \frac{\text{FPM} \times 12}{\pi \times D}$$

$$\text{RPM} = \frac{[6000] \times [12]}{\pi \times 51.2} = 448 \text{ RPM}$$

E. Determine Stopping Torque (Inertia Only)

$$T_s = \frac{WK^2 \times \text{RPM}}{308 \times t_s}$$

$$T_s = \frac{15,078 \times 448}{308 \times 30} = 731 \text{ Lb. Ft.}$$

F. Total Torque Requirement

$$T_T = \left(T_c \times \frac{D_1}{D_o} \right) + T_s$$

$$T_T = \left(1500 \times \frac{51.2}{60} \right) + 731 = 2011 \text{ Lb. Ft.}$$

From this application the torque requirement at constant speed is the limiting requirement. Model 8245 Positorq is tentatively selected based on maximum torque. See next page for sizing Thermal Horsepower Requirements.

Thermal Horsepower...Tension Brake (Positorq) Selection

The next parameter to evaluate in selecting the correct Positorq is the Thermal Horsepower Requirement. Each of the three modes of operation analyzed under Torque Requirements will have a different thermal demand. To make a proper selection each mode needs to be evaluated.

1. Thermal Power - Constant Speed

The Thermal Horsepower Requirement during this mode of operation can be determined from the following equation:

$$THP = \frac{W \times PLI \times FPM}{33,000}$$

$$THP = \frac{(120) (5) (6000)}{33,000} = 109 \text{ THP}$$

2. Thermal Power - Panic Stop

$$THP_p = \frac{T_p}{550} \left[(.1047) \text{ RPM} - \frac{T_p}{WK^2} (t) \right]$$

$$THP_p = \frac{2283}{550} \left[(.1047 \times 382) - \frac{2283}{27,609} (0) \right] = 166 \text{ THP}$$

T_p = Panic Stopping Torque = 2283 Ft. Lbs.

WK^2 = @ Maximum Diameter = 27,609 Lb. Ft.²

RPM = @ Maximum Diameter = 382

t = Time

NOTE: Thermal load is maximum at $t = 0$ and decreases linearly to zero when the system has come to rest.

3. Thermal Power - Set Stop

$$THP = \frac{T_T}{550} \left[(.1047) \text{ RPM} - \frac{T_T - T_C}{WK^2} (t) \right]$$

$$THP = \frac{2011}{550} \left[(.1047 \times 448) - \frac{2011 - 1500}{15,078} (0) \right] = 171 \text{ THP}$$

T_T = Total Torque between Sets = 2011 Lb. Ft.

WK^2 = First Set Diameter = 15,078 Lb. Ft.²

RPM = @ First Set Diameter = 448

t = Time

NOTE: Once again the Maximum Thermal Load is at the beginning of deceleration and goes to zero as the system comes to rest.

Since the thermal demand deceleration between sets is relatively transient, it would not be necessary to purchase a 200 THP Cooler. The optimum selection for the unit under consideration would be determined by finding the Thermal Capacity at which the transient load would not exceed the unit rating for more than 10 seconds.

$$THP = THP \text{ Peak} \left[1 - \frac{10}{\text{Decel Time}} \right]$$

$$= 171 \left[1 - \frac{10}{30} \right] = 114 \text{ THP}$$

15 Thermal Horsepower

