



Industrial Devices' TS Series rod-type cylinders are ideally suited for automated motion applications requiring very high load and duty cycle, precise positioning, or full torque at rest with an open loop system. The TS Series can answer a variety of motion control needs, including open or closed loop positioning, simple or very complex motion profiling, PLC or computer interfacing, and multi-operation programs.

As a replacement for troublesome hydraulic and pneumatics, TS Series systems are cleaner and easier to maintain, and are often less expensive.

These rod-type cylinders incorporate a 6 pitch (6 turns per inch) acme screw, or a 1 or 4 pitch ball bearing screw to provide a variety of speed and thrust capabilities with a maintenance free 1.8° hybrid step motor as the mechanical power source. Ball screw models are used in applications that require higher speed and duty cycles. Acme screw models generally perform best in applications with up to 60% duty cycle, and where backdrive is not acceptable. Acme screws also provide faster stopping because of their frictional damping qualities. Because they are self locking, no movement occurs when an external force is applied. The life expectancy of a ball screw is generally better than an acme screw.

Timing belt and gear reductions between the motor and the lead screw further widen the performance

range of TS Series models. Parallel motor mounted models can have many ratios, while in-line models are always direct driven, with the motor directly coupled to the screw.

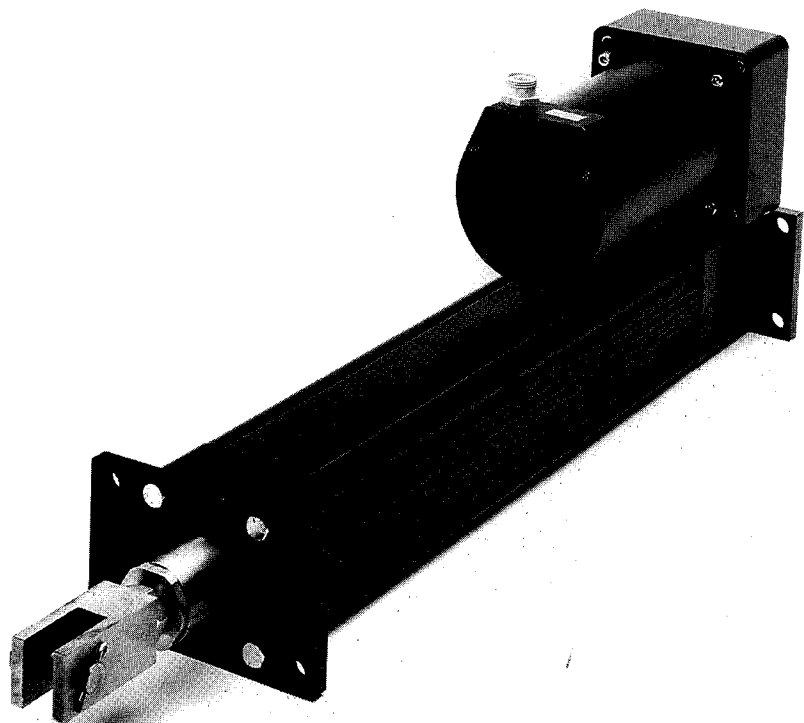
Cylinder options include a holding brake, an encoder for position feedback, and a dual rod-end bearing to increase side load capacity.

Industrial Devices will also discuss unique modifications at the customer's request.

### FEATURES

- 100% duty cycle with ball screw models
- Speed to 40 inches per second
- Thrust to 2400 lbs
- Standard travel lengths to 60 inches. Custom lengths available.
- NFPA style mounting configurations provide direct replacement for hydraulic or pneumatic cylinders

- Four rod end couplings facilitate a variety of loads
- Choice of parallel or in-line models to optimize installation space.
- Hard-coat anodized external surfaces, and stainless steel thrust tube provide corrosion protection
- Acme and ball screw models for application flexibility
- High performance step motor, size 42
- Optimized for use with S5101 and S5201 controls, offering:
  - virtually unlimited programming capability
  - very high position resolution
  - repeatability to  $\pm 0.0005$  inches
  - integral control/drive/power supply package
  - see page 193



# TS SERIES CYLINDERS

## COMMON SPECIFICATIONS

Thrust Load	2400 lbs max
Speed	40 in/sec max, at no load
System Backlash	0.015 inch
Thrust Tube	
Side Load Moment	See load curves on page 257
Rotation	Does not rotate. Note: applying a rotation torque to the thrust tube may damage unit
Standard Travel Lengths	4, 6, 8, 12, 18, 24, 36, 48 and 60 inches

## CONSTRUCTION MATERIALS

Bearing Housings	6601 T-6 aluminum, hard-coat anodized
Cylinder Housing	6063 T-6 aluminum, hard-coated anodized and teflon impregnated
Thrust Tube	Type 304 stainless steel, 1/4 hard, ground and polished
Wiper Seal	Polyurethane
Lead Screw	
Support Bearings	Angular contact, high thrust ball bearing
Acme Screw; drive nut	1.0 inch diameter, alloy steel screw; lubricated bronze plastic drive nut
Ball Screw; drive nut	1.0 inch diameter, hardened alloy steel screw; alloy steel, heat treated ball nut

## WEIGHT (approximate, without options)

6 inch stroke unit 36 lbs, add 0.75 lbs per additional inch of stroke

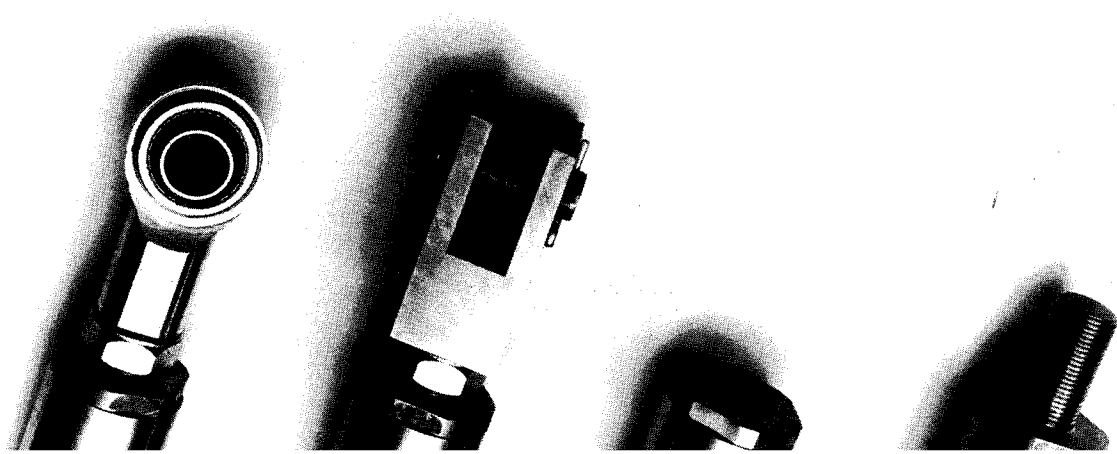
## MOTOR SPECIFICATIONS

Type	1.8° permanent magnet hybrid step motor
Inductance	S4V: 9.8 mH
HIPOT breakdown	750 VAC
Static Torque	800 oz-in max
Connections	Quick disconnect: 5 contact receptacle in anodized aluminum shell, includes 12 ft cable with molded plug
Temperature	212°F (100°C) Maximum allowable motor case temperature Actual motor case temperature is ambient, duty cycle and speed dependent. Refer to speed vs. thrust performance curves for system duty ratings.

## ENVIRONMENTAL OPERATION

For applications beyond standard allowable environmental conditions, see the Options and Accessories section.

Temperature Range	-20° to 140°F, -F sub-freezing option required to operate acme screw models below 32°F
Moisture	Humid, but not direct moisture contact
Contaminants	-W water resistant option allows some direct moisture contact Non-corrosive, non-abrasive



## INDIVIDUAL MODEL SPECIFICATIONS—BALL SCREW MODELS

Drive Type	TS4V991B				TS4V994B					
	TS4V101B	TS4V151B	TS4V201B	TS4V501B	TS4V1001B	TS4V104B	TS4V154B	TS4V204B	TS4V504B	TS4V1004B
In-Line Timing Belt	In-Line Timing Belt	Timing Belt	Timing Belt	Helical Gear	Helical Gear	In-Line Belt	Timing Belt	Timing Belt	Helical Gear	Helical Gear
Drive Ratio (motor:screw)	1:1	1.5:1	2:1	5:1	10:1	1:1	1.5:1	2:1	5:1	10:1
Screw Pitch (rev/inch)	1	1	1	1	1	4	4	4	4	4
Load before back driving (lbs)	30	40	45	100	200	120	160	180	450	900

### SYSTEM PERFORMANCE USING S5101 OR S5201 CONTROL

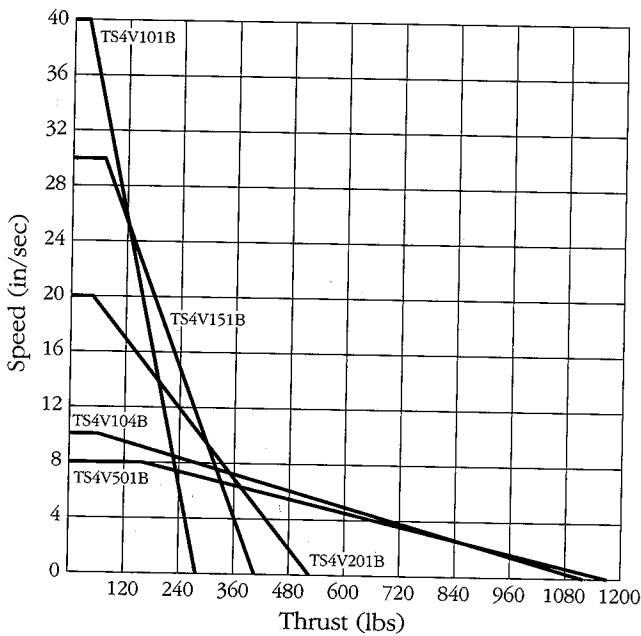
Maximum Speed (ips at no load)	Stroke	40	27	20	8	4	10	6.7	5	2	1
	12-36 in	<b>35</b>	27	20	8	4	<b>9</b>	6.7	5	2	1
	48	<b>23</b>	27	20	8	4	<b>6</b>	6.7	5	2	1
	60	<b>23</b>	<b>23</b>	20	8	4	<b>6</b>	<b>6</b>	5	2	1

When applying TS cylinders with greater than 36 inch stroke, maximum speed may be limited by critical screw speed, as shown here in bold. The individual model performance curves shown on the following pages have been qualified (horizontal black lines) for critical speed limitations in 48 and 60 inch lengths.

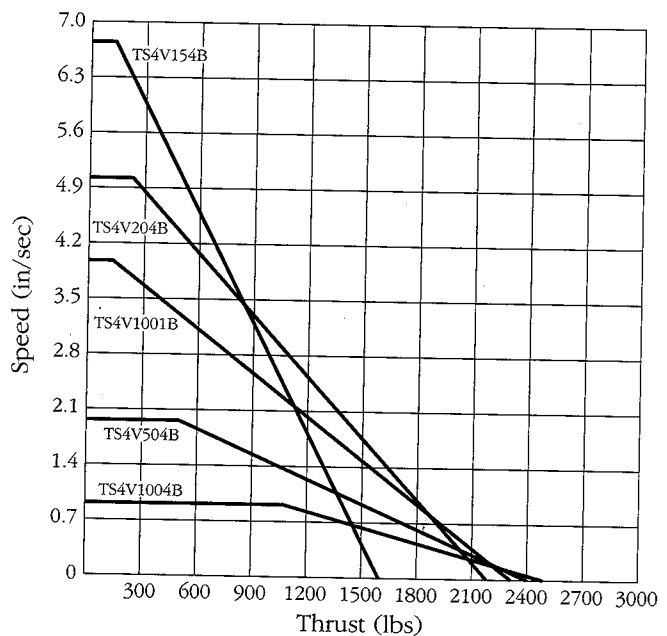
Maximum Thrust (lbs at rest)	260	400	530	1,160	2,270	1,070	1,600	2,200	2,400	2,400
Repeatability (inches)	Repeatability values achievable with S5000 controls in open-loop configuration									
	± 0.001	± 0.001	± 0.001	± 0.001	± 0.001	± 0.001	± 0.001	± 0.001	± 0.001	± 0.001

### A COMPARISON OF SPEED VS. THRUST PERFORMANCE

Approximate performance using S5101 or S5201 control, see detailed curves on page 166.



HIGHER SPEED MODELS



HIGHER THRUST MODELS

# TS SERIES CYLINDERS

## INDIVIDUAL MODEL SPECIFICATIONS—ACME SCREW MODELS

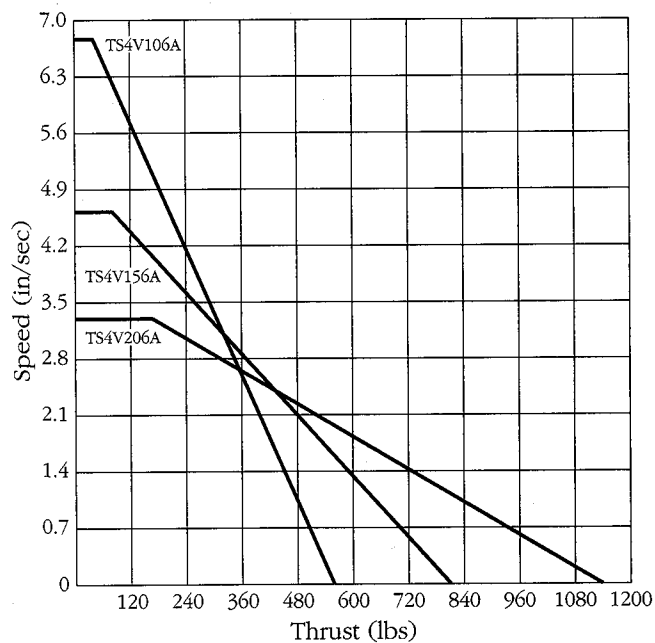
TS4V996A	TS4V106A	TS4V156A	TS4V206A	TS4V506A	TS4V1006A
In-Line Flex Coupled	Timing Belt	Timing Belt	Timing Belt	Helical Gear	Helical Gear
1:1	1:1	1.5:1	2:1	5:1	10:1
6	6	6	6	6	6
2400	2400	2400	2400	2400	2400

## SYSTEM PERFORMANCE USING S5201 OR S5101 CONTROL

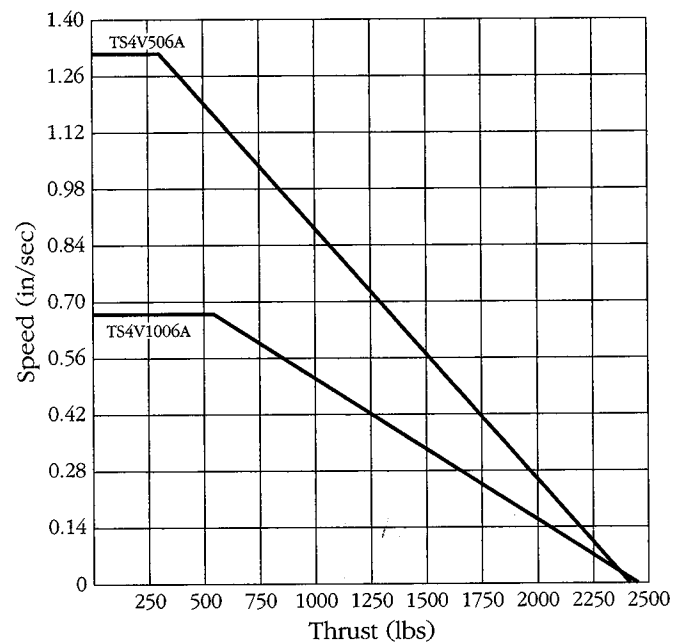
Stroke	TS4V996A	TS4V106A	TS4V156A	TS4V206A	TS4V506A	TS4V1006A
12-36 in	6.7	6.7	4.4	3.3	1.3	0.67
48	<b>5.5</b>	<b>5.5</b>	4.4	3.3	1.3	0.67
60	<b>4</b>	<b>4</b>	4	3.3	1.3	0.67
	550	550	830	1,130	2,360	2,400
	± 0.001	± 0.001	± 0.001	± 0.001	± 0.001	± 0.001

## A COMPARISON OF SPEED VS. THRUST PERFORMANCE

Approximate performance using S5101 or S5201 control, see detailed curves on page 167.



HIGHER SPEED MODELS



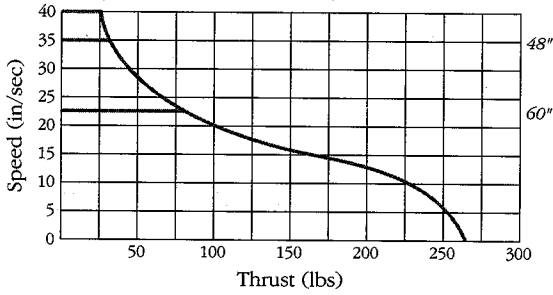
HIGHER THRUST MODELS

## THRUST VS. SPEED PERFORMANCE

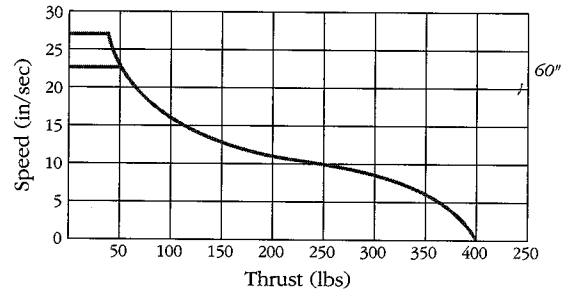
- Top speeds limited by critical screw velocity are shown as horizontal black lines.
- 100% duty cycle TS ball screw models with S5101 and S5102 controls.

### BALL SCREW MODELS USING S5101 AND S5201 CONTROLS

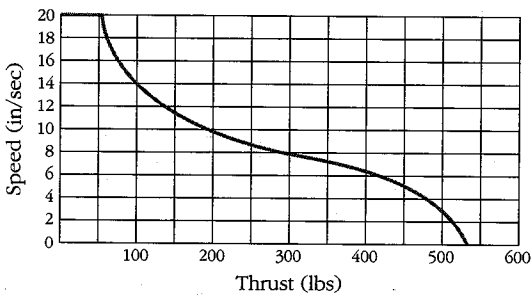
**TS4V101B and TS4V991B**



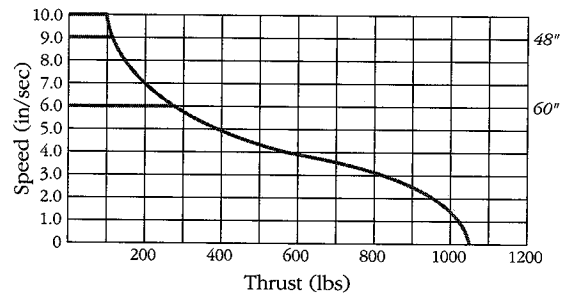
**TS4V151B**



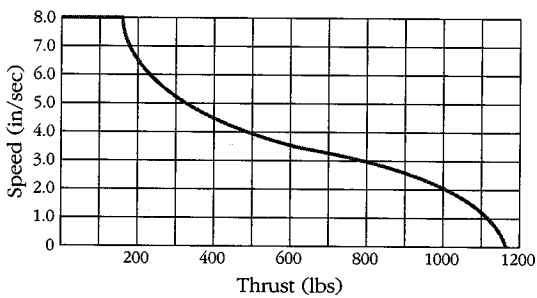
**TS4V201B**



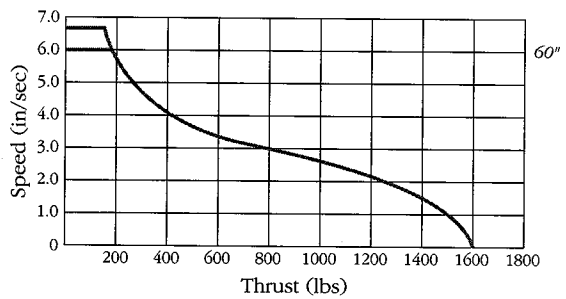
**TS4V104B and TS4V994B**



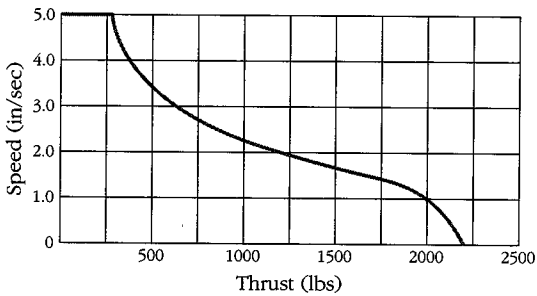
**TS4V501B**



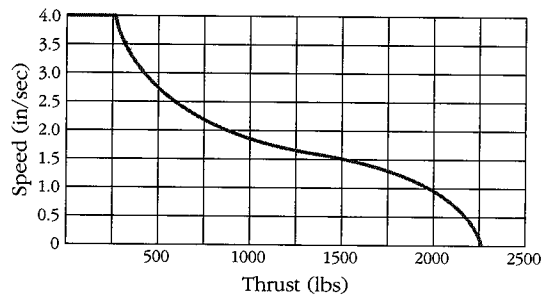
**TS4V154B**



**TS4V204B**



**TS4V1001B**

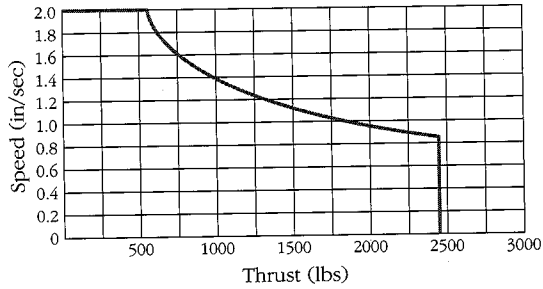


# TS SERIES CYLINDERS

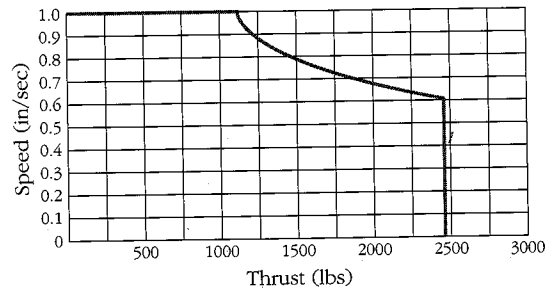
## THRUST VS. SPEED PERFORMANCE

### BALL SCREW MODELS (CONTINUED)

**TS4V504B**



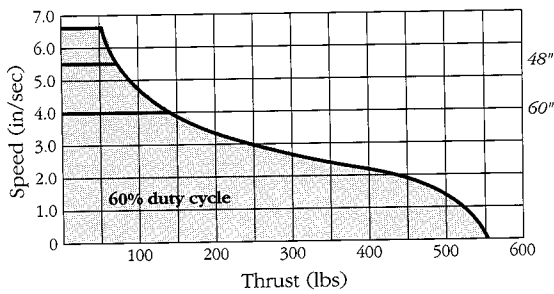
**TS4V1004B**



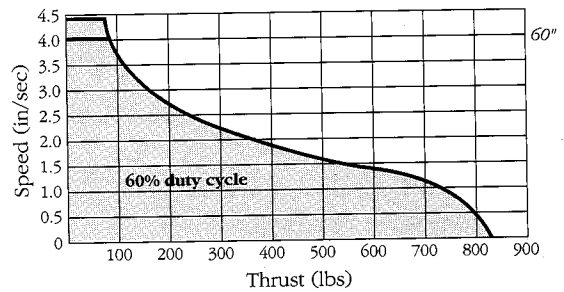
### ACME SCREW MODELS S5101 AND S5201 CONTROLS

- 60% duty cycle for TS acme screw models.

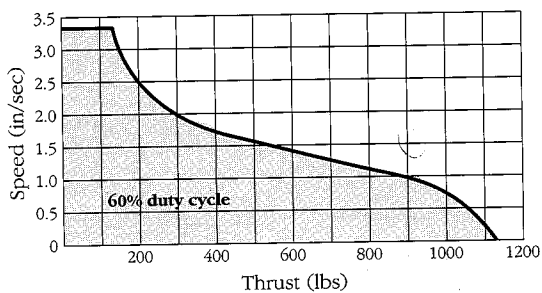
**TS4V106A and TS4V996A**



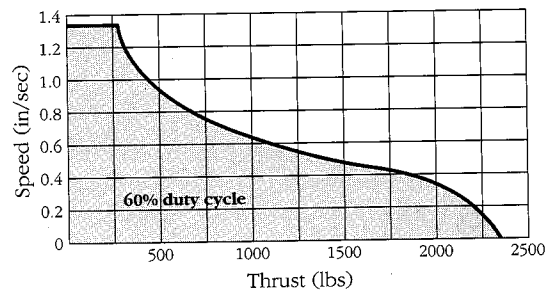
**TS4V156A**



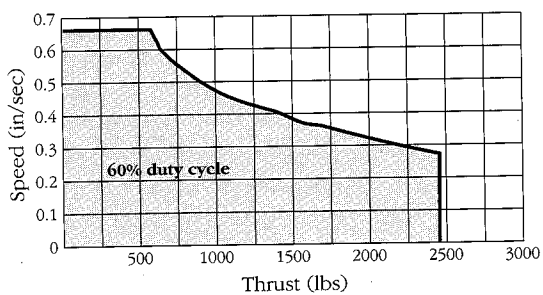
**TS4V206A**



**TS4V506A**



**TS4V1006A**



## SEVEN STEPS TO ORDERING A COMPLETE TS SYSTEM

For help:

- Complete the Application Data Form on page 26 and 27.
- Refer to the Engineering Section for selection assistance.
- Consult your local Industrial Devices distributor, or call the factory.

### 1. BASE MODEL NUMBER

Select the TS model which provides sufficient thrust and speed for the application, with a comfortable margin of safety. **IDC recommends at least 30% reserve thrust for step motor driven systems.** Available thrust will be consumed by acceleration, friction, pushing/pulling against an external force, and in the case of a vertical application, supporting the load against gravity.

TS cylinders with gear or timing belt drive reductions have the motor mounted parallel to the lead screw. With in-line units, the motor is always coupled directly to the screw shaft, with no reduction.

Refer to the TS Speed vs. Thrust curves and specifications in this section when making this selection.

All TS Series cylinders include a male quick disconnect receptacle, and a 12 foot motor cable with molded quick disconnect plug.

### 2. STROKE LENGTH

Nine standard travel lengths are available from 4 to 60 inches. Longer lengths and custom in-between lengths also are available. Consult your IDC distributor or the factory for details.

To maximize cylinder life, the cylinder should not impact either physical end of stroke during normal operation. Extra travel length is needed to decelerate the carriage to a stop when an end-of-travel limit switch is encountered. This extra travel distance depends on load and speed.

*Industrial Devices recommends the -DB option for TS cylinders above 36 inch stroke when positioning an unguided load.*

① BASE MODEL NUMBER				② STROKE LENGTH	③ CYLINDER MOUNTING	④ ROD END	⑤ OPTIONS
Rod-type Cylinder	Motor	Drive Ratio	Screw Pitch, Type				
<b>T</b>	<b>S4V</b>						
<b>Parallel Models</b> Ball Screw    Acme Screw    1    1B TS4V101B    TS4V106A    1.5    4B TS4V151B    TS4V156A    2    6A TS4V201B    TS4V206A    5 TS4V501B    TS4V506A    10 TS4V1001B    TS4V1006A    99* TS1V104B TS4V154B TS4V204B TS4V504B TS4V1004B				4 6 8 12 18 24 36 48 60  Custom lengths available	MF1 Front Flange MF2 Rear Flange MF3 Front & Rear Flange MP2 Rear Clevis MS2 Side Lugs MS6 Side tapped holes MT2 Trunnion (In-line models only)	FC2 Clevis FS2 Spherical joint FT1 Female thread MT1 Male thread	-BS -EM -DB -F (acme models only) -W
<b>In-Line Models</b> * direct drive TS4V991B    TS4V996A TS4V994B							



# TS SERIES CYLINDERS

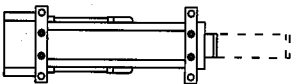
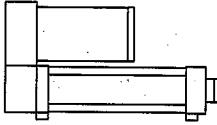
## 3. CYLINDER MOUNTING

Specify any one of these cylinder mounting options. Dimensional drawings start on page 171.

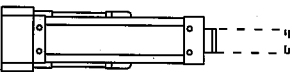
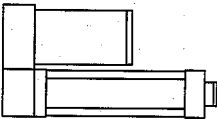
*Cylinder base mount options*

*-MP2, -MF2 and -MF3 cannot be ordered with in-line models.*

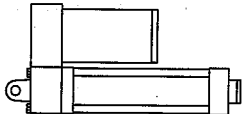
### MS2 Side Lugs



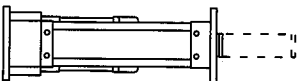
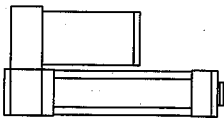
### MS6 Side Tapped Holes



### MP2 Rear Clevis

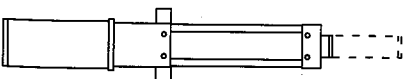
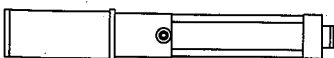


### MF1,2,3 Rectangular Flange



- MF1 Front Flange
- MF2 Rear Flange
- MF3 Both Flanges

### MT2 Trunnion (In-line Models Only).



## 4. ROD END

IDC offers 4 rod end options for TS Series cylinders. Carefully consider the best method of attaching the load to provide optimum performance and long life, by preventing excessive backlash, side load moments, rod end rotation, and misalignment. To determine overall cylinder length, be sure to include the rod end dimensions, see page 170.

- FT1 Female thread
- MT1 Male thread
- FS2 Spherical joint
- FC2 Clevis

## 5. OPTIONS

IDC offers several TS Series cylinder options to satisfy unique application requirements. **See the Options and Accessories section for complete specifications of these options.**

- BS Holding Brake  
75 in-lb holding brake mounted on the rear lead screw shaft extension. *Not available on in-line models or with cylinder base mount options (-MF2, -MF3, MP2).*
- EM Encoder  
500 line incremental encoder mounted on the rear shaft of the motor.
- DB Dual Rod End Bearing  
Dual rod-end bearings increase side moment load rating. See page 257 in the Engineering Section for details. *This option reduces actual stroke length by 1.5 inches.*
- F Sub-freezing Environment  
Increased acme nut clearances allow for contraction when operating an acme screw model below 32°F. Recommended operating range with -F option is -20°F to 105°F. *Increases system backlash to 0.025 inches max.*
- W Water Resistant Option  
Provides protection from light moisture contact with cylinder.

## 6. ACCESSORIES

Accessories are ordered as separate items, with separate model numbers. **Details can be found in the Options and Accessories section.**

### Magnetic Position Sensors

Position sensors are available for stopping position indication, for changing direction or speed, etc. using user supplied controls.

The S5201 Drive/Control and 851 Indexer use a normally open switch (RP1 or RPS-1) for home positioning, and normally closed switches (RP2 or RPS-2) for end-of-travel limit sensing. **To maximize cylinder life, IDC recommends the use of end-of-travel limit switches with all cylinders.**

- RP1 Normally open Hall-effect switch
- RP2 Normally closed Hall-effect switch
- RPS-1 Normally open reed contact switch
- RPS-2 Normally closed reed contact switch

## 7. S5000 SERIES CONTROLS

To complete the system, Industrial Devices offers controls which are optimized to run TS Series cylinders. See page 193.