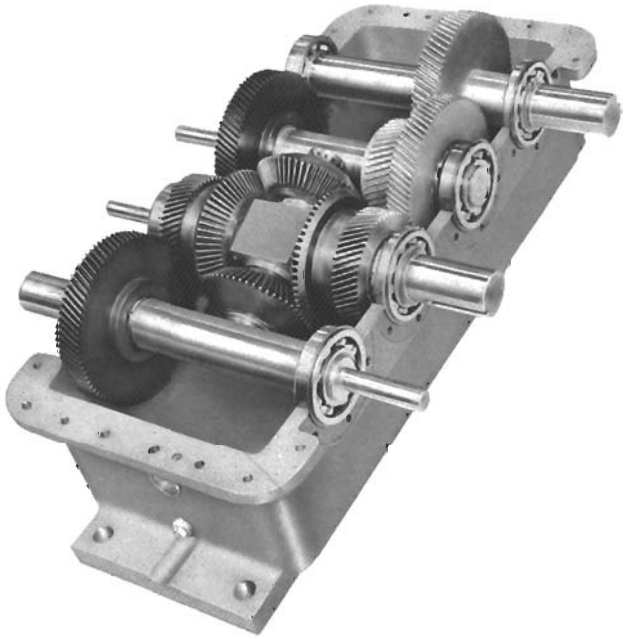
CATALOG NO. 203I

FAIRCHILD SPECON

DIFFERENTIAL TRANSMISSIONS AND DIFFERENTIAL ASSEMBLIES



APPLICATIONS

Specon Differential Transmissions and Specon Differential Assemblies are compact rugged units, engineered to give reliable service over long periods of time in a wide variety of industrial applications.

While usually supplied as either standard or special units composed of differential and associated gearing together with the necessary casing, the differential gearing alone is available as assemblies which can be incorporated in gearboxes of the user's own design.

The input and output speeds and torques are governed by the capacity of the differential assembly appropriate to any particular unit and by the sizes of the internal gearing.

The extreme values of this step up and/or step down gearing are limited only by the space available within the gear box casing. Precision gears are used throughout for internal gearing.

Bearings, component sizing, and the materials used throughout Specon units meet the performance requirements necessary to assure reliable operation for industrial applications.

FEATURES

- Thirteen basic differential transmissions and eight standard differential assemblies, rated up to 125 HP are available.
- Direct oil level windows in unit casing.
- Standard Lubrication is splash type. Optional self contained positive pressure lubrication is available.
- Right angle output available.

BENEFITS

- Allows coverage of a wide range of industrial applications.
- Allows performance of routine maintenace easily.
- Optional arrangement allows operation at low speeds for extended periods.
- Allows applications where space may be a problem.

SPECIFICATIONS

Capacities And Ratings

The range of Specon diffferential transmissions incorporates a basic differential bevel gear assembly. Gearing within the gear box is arranged to the customers requirements and ensures that power reaches the differential assembly and associated components at suitable values of speed and torque for optimum unit operation.

Because of the constant torque relationship between differential side gear and spider, the differential transmissions are rated at the spider. If these ratings are not exceeded, all other differential gearing will be within design capacity. The tables which follow indicate Torque rating for the various sizes of differential transmissions.

TABLE 1

Size	Nom H.P.	*Torque Rating	Bores
00	1.5	110	2
0	3.5	300	2
0	3.5	300	3
1	6.5	550	2
1	6.5	550	3
1	6.5	550	4
3	12	1000	3
4	25	2100	3
4	25	2100	4
5	45	3780	3
5	45	3780	4
7	75	6300	4
8	125	13100	3

* # in at spider shaft

The differential transmission can be essentially a phase shifting differential transmission (PSD) with a smaller correction ratio than a standard PSD and with the input and output ratios designed for a specific application.

Provided that the shaft speed to which the differential spider is attached does not exceed rated spider speed (750 rpm), and the relative speeds of the side gears do not exceed 1500 rpm, any shaft may be used as an input shaft and the remaining shafts can be used as output or correction shafts. In the case of the four bore unit, two of the shafts may be output shafts. (For higher relative speeds, consult the factory.)

For any arrangement (see page 8), the differential may be mounted on any shaft that will allow requirements of speed and torque to be satisfied. However, housing dimensions and clearances between the differential and other shafts may limit the choice of shafts on which the differential can be mounted.

The Differential Transmission (TD) is specifically suited for load sharing (two output shafts) or where a suitable differential draw transmission (MDD) is not available, a piggy back arrangement of TD and Varichain can be developed, (see Bulletin 201, Type C unit) which will meet requirements.

OUTLINE DIMENSIONS

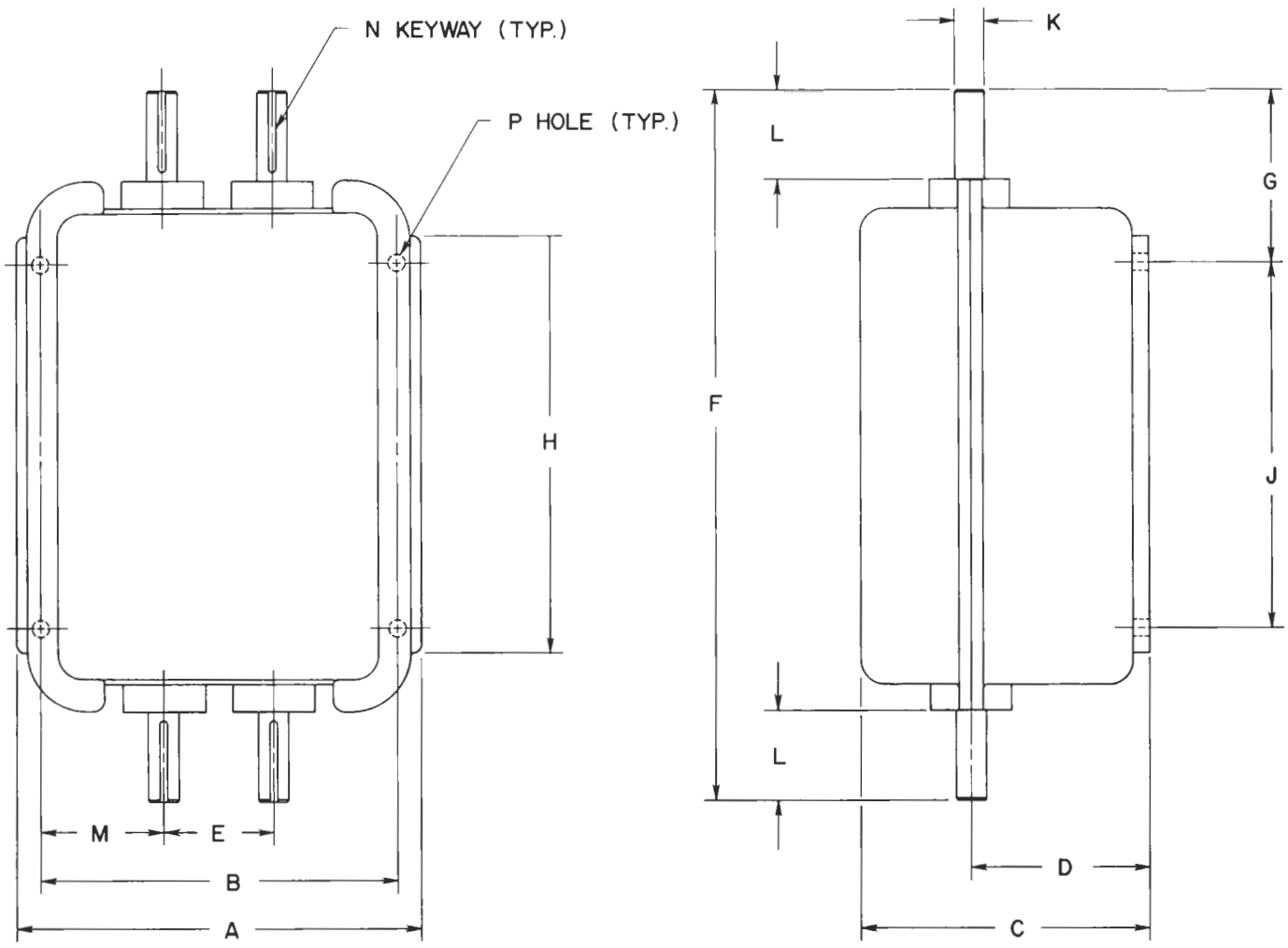


FIGURE 1 2 BORES

SIZE	A	B	C	D	E	F	G	H	J	K**	L	M	N	P
00	9¾	8¾	5¼	2¾	2⅝	13⅜	3 11/16	7	6	9/16	1¾	3 1/16	1/8 × 1/16	13/32
0	10¾	9¼	7½	4½	2¾	19¼	5⅛	10½	9	¾	2½	3¼	3/16 × 3/32	17/32
1	12	10½	8½	5¼	3¼	21¾	5½	12¼	10¾	1⅛	3	3⅝	¼ × ⅛	17/32

NOTE

Three shaft extensions are minimum

More than three shaft extensions can be provided where the application requires. Refer to typical arrangement layouts on Page 8 for shaft position designations.

OUTLINE DIMENSIONS

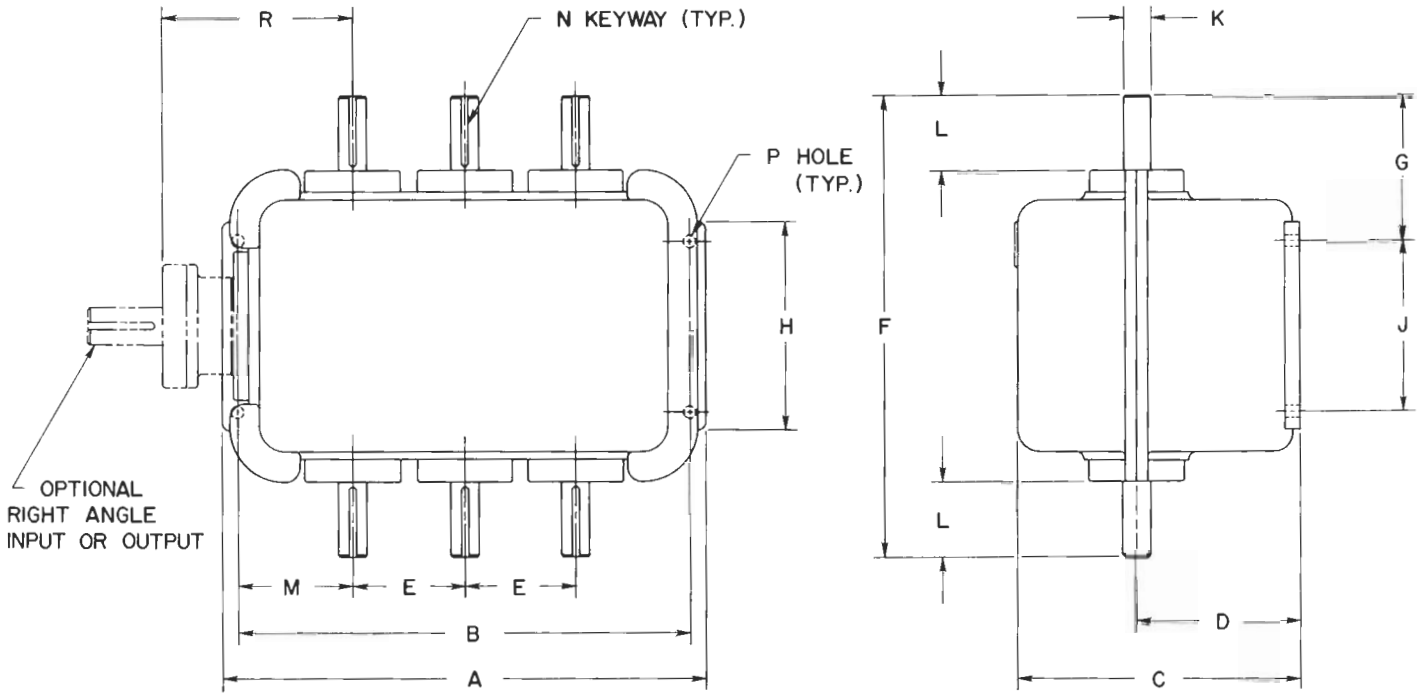


FIGURE 2 3 BORES

SIZE	A	B	C	D	E	F	G	H	J	K**	L	M	N	P	R
0	13	12	8	4½	2¾	13½	4⅜	6	4¾	¾	2¼	3¼	3/16 × 3/32	13/32	5½
1	16¼	15¼	9½	5½	3¾	15½	4⅞	7	5¾	15/16	2½	3⅞	¼ × ⅛	13/32	6⅜
3	17	16	9½	5½	3¾	18½	5⅜	9	7¾	1⅛	3	4¼	¼ × ⅛	13/32	8
4	21½	20	11½	6	4½	21	6½	10	8	1½	3	5½	⅜ × 3/16	13/16	9
**4–1	24	22½	11½	5½	5½	20	5 9/16	10⅞	8⅞	1⅜	3	5¾	5/16 × 5/32	21/32	
5	30¾	28¾	17	9½	7	32⅝	8 5/16	19	16	1¾	3½	7⅜	⅜ × 3/16	13/16	
8	55	51	28	16	13½	45½	12¾		20	3¼	6	12	⅞ × 7/16	1 3/16	

**Special unit designated 43-1

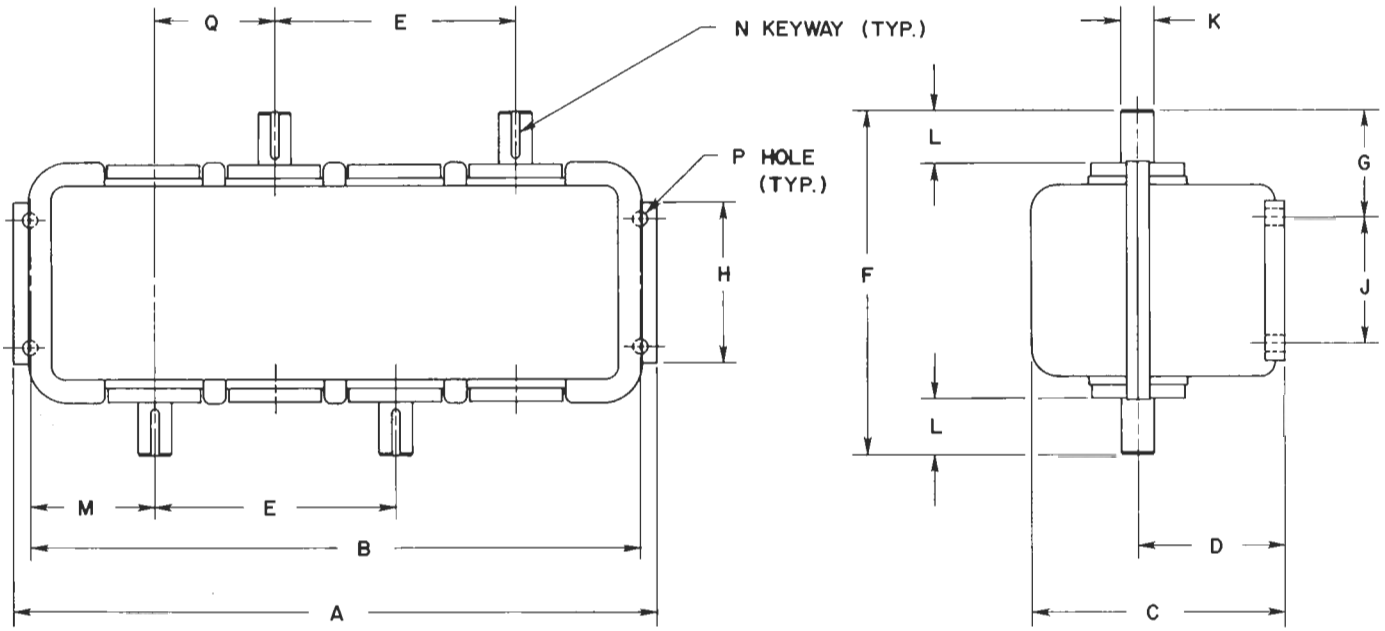


FIGURE 3 4 BORES

SIZE	A	B	C	D	E	F	G	H	J	K**	L	M	N	P	Q
1	18½	17½	9	4½	6½	15½	4⅞	7	5¾	15/16	2½	3⅞	¼ × ⅛	13/32	3¼
4	30¼	28¼	12½	6½	9	21	6½	10	8	1 9/16	3	7⅜	⅜ × 3/16	13/16	4½
5	39¾	37¼	15	8½	14	23	7¾	10	7½	1¾	3½	8⅛	⅜ × 3/16	1 1/16	7
7	48	45½	19	11	18	26⅛	8 5/16	12	9½	2½	4	9¼	5/16 × 5/16	1 3/16	9

PRINCIPLES OF OPERATION

A basic Specon differential assembly consists of three elements:

- A spider carrying a pair of bevel pinions.
- Two side bevel gears which mesh with the spider bevels.

In most Specon assemblies the spider bevel pinions are mounted on heavy duty taper roller bearings. Size 00 uses ball bearings. The side gears are mounted on deep groove, heavy duty ball bearings to take the thrust loads imposed by the bevels and by any gearing to which they may be attached.

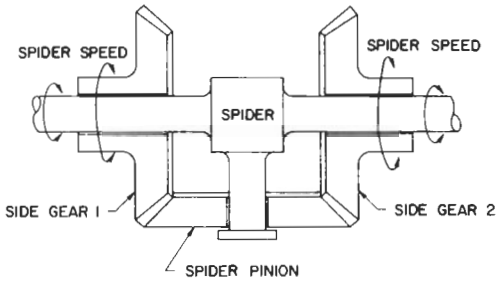


FIGURE 4 DIFFERENTIAL ASSEMBLY

In Figure 4 only one spider pinion is shown for the sake of clarity. The spider shaft and both of the side gears can absorb or deliver power.

THE SPIDER WILL ALWAYS ROTATE AT A SPEED WHICH IS ONE HALF OF THE ALGEBRAIC SUM OF THE SPEEDS OF THE TWO SIDE GEARS AS EXPRESSED BY THE FOLLOWING EQUATION:

$$\frac{\text{Speed of Side Gear 1} + \text{Speed of Side Gear 2}}{2}$$

$$= \text{Speed of Spider}$$

Spider speed is the algebraic average of the two side gear speeds. Rotation of any element in one direction is taken as positive and in the other direction as negative. The speed relationship of the spider and side gears is a function of this relationship only and is independent of the ratios of the pitch diameters of the side gears and pinions.

THUS IF THE SIDE GEARS ROTATE AT THE SAME SPEED, EG. 700 RPM, AND IN THE SAME DIRECTION, THE SPIDER WILL ROTATE AT:

$$\frac{\text{Speed of Side Gear 1} + \text{Speed of Side Gear 2}}{2}$$

$$= \frac{700 + 700}{2} = 700 \text{ R.P.M.}$$

ie., at the same speed.

If one side gear (gear 1) is held stationery and the other side gear rotates at a constant speed, e.g. 700 rpm, the spider will rotate at:

$$\frac{\text{Speed of Side Gear 1} + \text{Speed of Side Gear 2}}{2}$$

$$= \frac{0 + 700}{2} = 350 \text{ R.P.M.}$$

ie., at half the speed of Gear 2.

If the side gears rotate in opposite directions at the same speed (700 rpm), the spider will rotate at:

$$\frac{700 + (-700)}{2} = 0$$

ie., the spider will remain stationery.

The basic formula can be expressed graphically by means of a nomograph (Figure 5). The three vertical lines are equally spaced and represent the rotational speeds of the elements of the differential. The speeds of the side gears are represented by the two lines at opposite sides of the nomograph, and that of the spider to the same scale, by the center line. A straight line connecting the known speeds of any two elements will give the speed of the third element at the point where it intersects the third line.

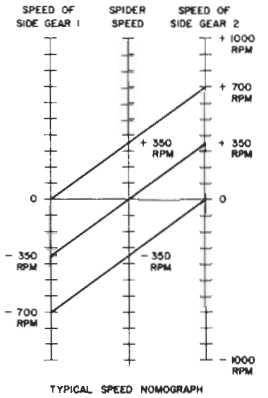


FIGURE 5

The merit of the differential is apparent. If the speeds of any two of its elements are controlled, the speed of the third can be varied progressively from a designed maximum in one direction, through zero to a designed maximum in the other direction.

THE TORQUES TRANSMITTED AT EITHER SIDE GEAR ARE ALWAYS EQUAL, AND THE TORQUE TRANSMITTED AT THE SPIDER IS ALWAYS TWICE THAT AMOUNT. EXPRESSED AS AN EQUATION, THIS BECOMES:

$$\frac{T_s}{2} = T_{\text{side gear 1}}$$

$$= T_{\text{side gear 2}}$$

This relationship is fixed and constant and is also independent of the pitch diameters of the various gears.

THE POWER DELIVERED BY A DIFFERENTIAL GEAR SYSTEM, IGNORING FRICTIONAL LOSSES, IS EQUAL TO THE POWER INPUT, AS IN ANY GEAR TRAIN. SINCE POWER IS A FUNCTION OF TORQUE AND SPEED, THE POWER DISTRIBUTION THROUGH THE ELEMENTS OF A DIFFERENTIAL CAN BE CALCULATED IF THE TORQUE AT ANY ONE ELEMENT AND THE SPEEDS OF ANY TWO ELEMENTS ARE KNOWN.

$$P_{in} = P_{out}$$

TYPICAL DIFFERENTIAL ASSEMBLY LOCATION

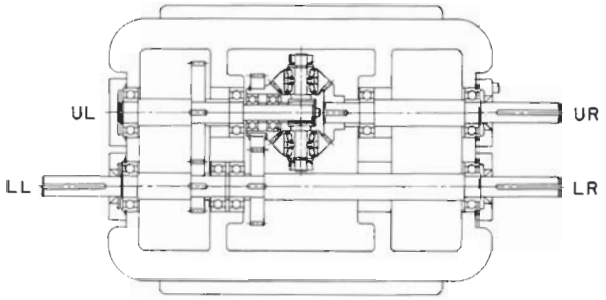


FIGURE 6 2 BORE

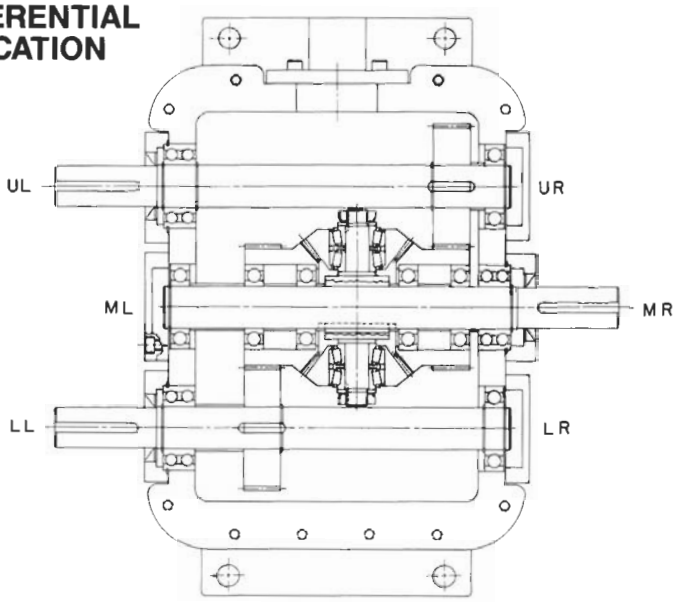


FIGURE 8 3 BORE

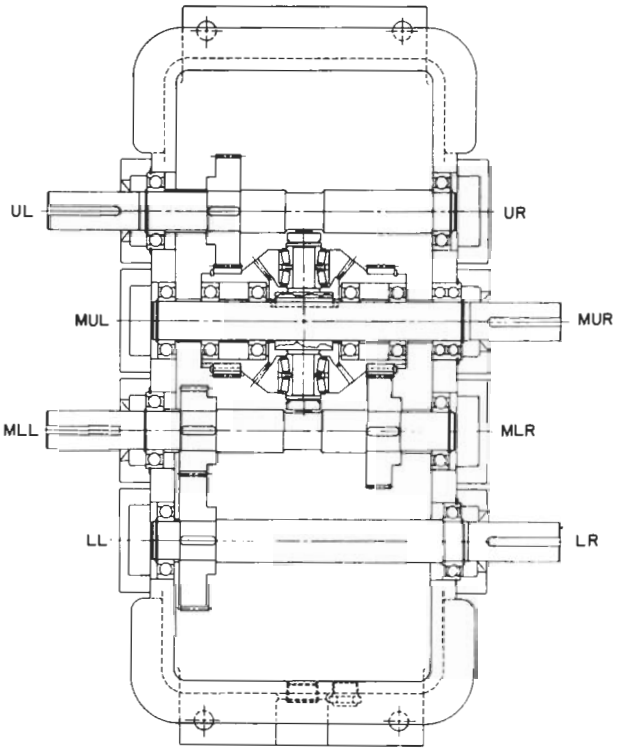


FIGURE 7 4 BORE

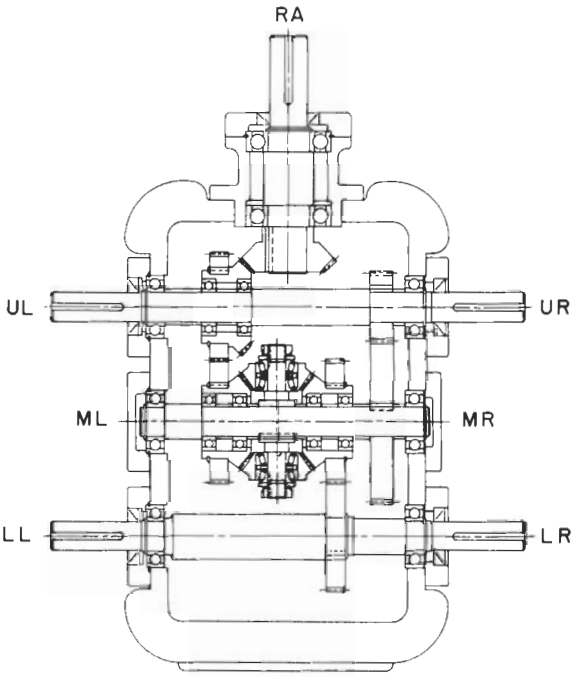


FIGURE 9 RIGHT ANGLE 3 BORE

Typical Internal Arrangements

Specon Transmissions are available in a range of sizes and configurations.

Typical layouts of gearing in two, three, and four bore housings are illustrated, but any arrangement subject to the dimensions of the housings and the ratings of the appropriate differential assemblies can be supplied. Shaft positions are designated by the letters UL, UR, etc., where

UL — Upper Left
UR — Upper Right
MR — Middle Right

Table 2 DIFFERENTIAL ASSEMBLY SIZE

TRANSMISSION SIZE TD–	DIFFERENTIAL ASSEMBLY SIZE							
	00	0	1	3	4	5	7	8
002*	x							
02,03		x						
12,14,13,13R			x					
33,33R				x				
44,43,43 – 1, 43 – R					x			
53,54						x		
74							x	
83								x

*Number following ( ) indicates number of bores or number of parallel shafts

**Number in ( ) indicates differential size.

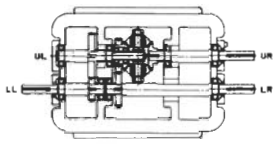


FIGURE 10 TD–( )2**

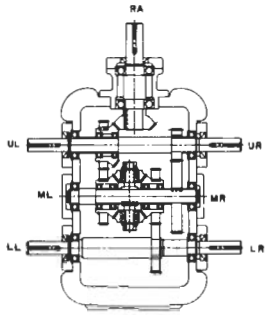


FIGURE 11 TD–( )3R

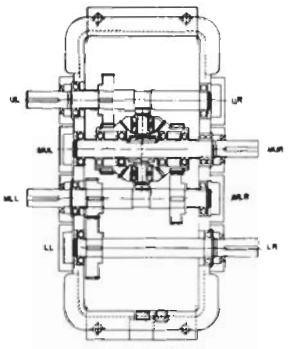


FIGURE 12 TD–( )4

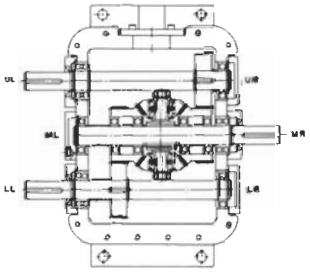
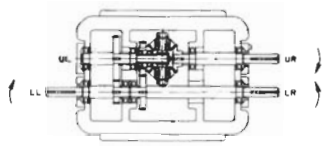
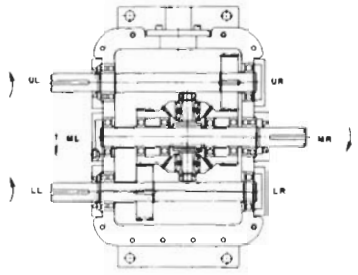
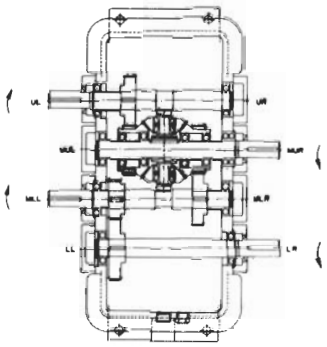
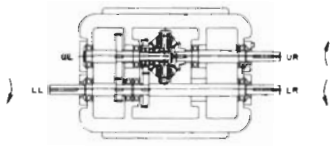
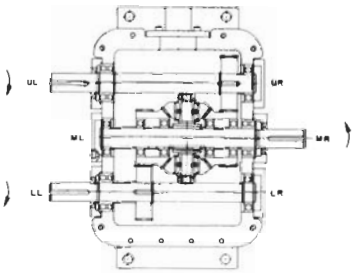
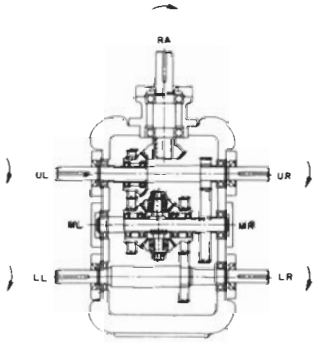
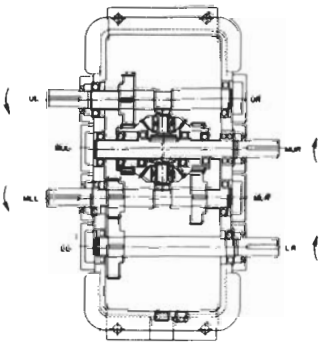
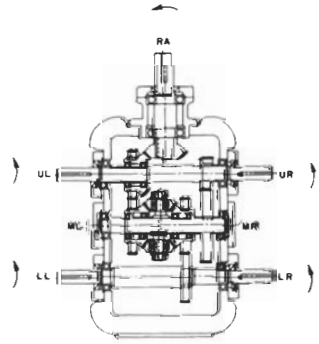


FIGURE 13 TD–( )3

TABLE 3 TD CHARACTERISTICS

BORES	FIG. NO.	NO. CONSTANT SPEED SHAFTS	NO. VARIABLE SPEED SHAFTS	CONNECTING GEARING	REL SHAFT ROTATE I/O	NO. OUTPUTS
2	4	1	2	1 set	Same for in line, opposite for adjacent bores	Primary and correction shafts
3	5	1	2	1 set	Same for upper and lower shafts, opposite for adjacent bores	Primary and correction shaft
4	8	1	2	up to 2 sets	for end shafts — opposite rotation for middle shafts — opposite rotation	up to 2 output shafts and 1 correction shaft

RELATIVE SHAFT ROTATION (TYPICAL) REFERENCE TABLE 3

2 BORE	3 BORE	4 BORE
 FIGURE A	 FIGURE C	 FIGURE G
 FIGURE B	 FIGURE D	
	 FIGURE E	 FIGURE H
	 FIGURE F	

NOTE: A SHAFT USED FOR CORRECTION IS USUALLY BIDIRECTIONAL

SELECTION

In selecting a Specon transmission, the speed and torque requirements of the driven machine should first be fixed in order to determine the nominal power requirement. Considering the character of the load and duty factor, determine the SERVICE FACTOR from the following table.

OPERATING HRS/DAY	NATURE OF LOAD	SERVICE FACTOR
8–10	Uniform	1.0
8–10	Moderate	1.25
8–10	Heavy	1.75
10–24	Uniform	1.25
10–24	Moderate	1.50
10–24	Heavy	2.0

Multiply the previously determined nominal power requirement by the appropriate service factor and determine the required power rating of the Specon transmission or differential gear assembly. For example, if the driven machine demands 14 HP and is operated 8–10 hours per day under heavy shock load conditions, the service factor would be 1.75 and the required power rating would be 25 HP. Thus, a number 4 differential assembly in a TD43, TD43R, TD43–1 or TD44 transmission should be specified.

The selection of the transmission configuration depends on the physical requirements of the application and the required input and output shaft locations. It should be emphasized that the location of the differential assembly as shown is not fixed but can generally be located on any shaft as dictated by the application requirements.

The speed of the differential spider in any transmission should not exceed the nominal spider speed shown in the rating table. In determining other connecting gear ratios to the differential side gears and their input or output speeds, it is good practice to limit the maximum algebraic difference in side gear speeds to less than twice the actual maximum spider speed.

ORDERING INFORMATION

1 — Specify Model Number (example TD-13R)
2 — Choose figure letter in the Arrangements Section and specify shaft location, torque in pound, inches, speed and relative rotation (example Figure F). Based on these requirements, Fairchild engineers will select a gear set to meet the requirements or will inform the Customer of any limitations that may occur as a result of the specification requirements.

TYPICAL EXAMPLE
REQUIREMENTS SEE FIG. F

Loc.	Function	Torque	Speed	Shaft Rotation
RA	Output	329 # in constant	720 – 1800 rpm	
LR	Input	230 # in	1800	
LL	Ouput	98.6 # in constant	0–1800	Same as LR
	Input	98.6 # in constant	0–1800	Opposite to LR

SERVICE INFORMATION

A list of replacement parts and instructions for servicing the Differential Transmission (TD) is available in the Installation, Operation and Maintenance Instructions Bulletin 203-IOM.

DIFFERENTIAL GEARING

Note: Size 8 is a spiral bevel differential. All others are coniflex bevel differentials.

NOM. SIZE AND HP		NOM. SPIDER SPEED RPM	SPIDER TORQUE CAP. LB. IN.
00	1.5	900	110
0	3.5	750	300
1	6.5	750	550
3	12	750	1000
4	25	750	2100
5	45	750	3780
7	75	750	6300
8	125	600	13100

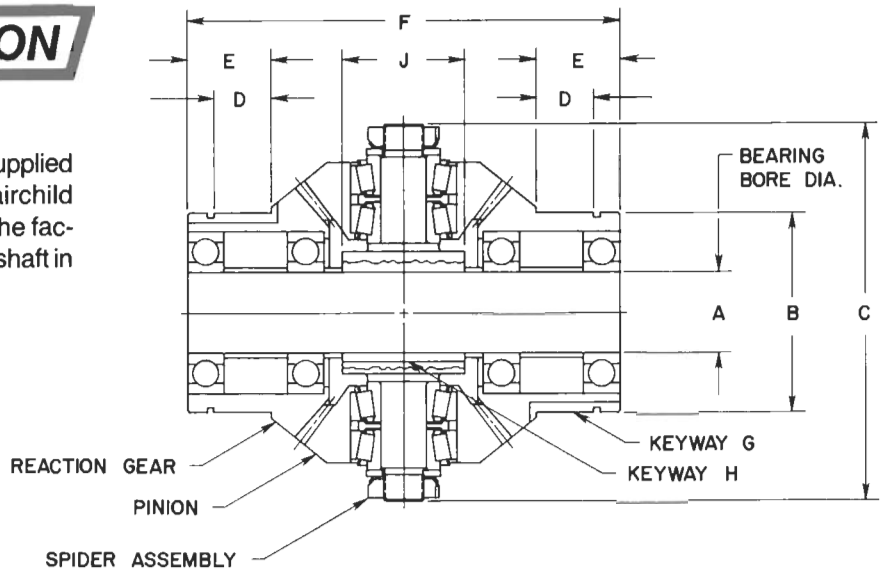
In selecting a Specon differential assembly, the speed and torque requirements of the driven machine should first be fixed in order to determine the nominal power requirement. Considering the character of the load and duty factor, determine the service factor from the following table:

OPERATING HRS/DAY	NATURE OF LOAD	SERVICE FACTOR
8–10	Uniform	1.0
8–10	Moderate	1.25
8–10	Heavy	1.75
10–24	Uniform	1.25
10–24	Moderate	1.50
10–24	Heavy	2.0

Multiply the previously determined nominal power requirement by the appropriate service factor and determine the required power rating of the Specon transmission or differential gear assembly. For example, if the driven machine demands 14 HP and is operated 8–10 hours per day under heavy shock load conditions, the service factor would be 1.75 and the required power rating would be 25 HP. Thus, a number 4 differential assembly would be specified.

ORDERING INFORMATION

Note: The Specon differential Assembly can be supplied mounted on a shaft of the customers design. Fairchild or the customer can supply the shaft. Consult the factory for price addition if Fairchild is to provide the shaft in accord with customer design.



SIZE	Dimensions								
	A	B	C	D	E	F	G	H	J
00	.4721 .4724	1.7505 1.7500	3 7/8	3/8	33/64	2.83	3/16	1/8	11/16
0	.5904 .5909	1.7505 1.7500	4 3/8	1/2	21/32	4.07	3/16	1/8	1
1	.7873 .7878	2.3755 2.3750	5	5/8	7/8	4.93	3/16	3/16	1 7/32
3	.9839 .9843	3.2505 3.2500	6 5/8	7/8	1 3/32	5.68	1/4	1/4	1 5/8
4	1.5743 1.5748	3.8755 3.8750	7 5/16	1 1/8	1 5/8	8.37	3/8	3/8	2 3/8
5	1.5743 1.5748	4.5005 4.5000	9	1 3/4	2 1/16	9.99	3/8	3/8	2 15/16
7	2.1648 2.1654	5.7505 5.7500	11 1/4	1 3/4	2 1/8	11.56	5/8	1/2	3 3/4
8	3.3465 3.3472	8.501 8.500	15 1/2	3	3 11/16	24 3/8	7/8	7/8	4 3/4

Note: Two spacers are provided to control backlash and dimension F(minimum). Outside keepers must be provided to control dimension F(Maximum).

FAIRCHILD
INDUSTRIAL PRODUCTS COMPANY
3920 WEST POINT BLVD. • WINSTON-SALEM, NC 27103-6708 • USA
TELEPHONE 910/659-3400 FAX 910/659-9323

FOR TOTAL CONTROL WHEN THE PRESSURES ON

MECHANICAL & ELECTRO – MECHANICAL POWER TRANSMISSION EQUIPMENT

SPECON

ISO 9002 Certified

MEMBER OF AGMA

PTDA

PTDA ALLIED MEMBER

REGISTERED FIRM

FM NO. 25571

Litho in U.S.A.
Rev. A 4-94