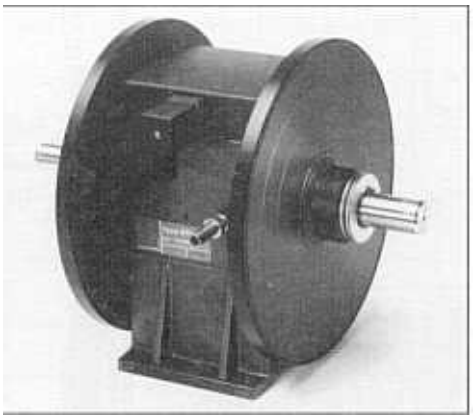
Precision
Step Systems

Precision Step Units type SRA

Data sheet 01-1997

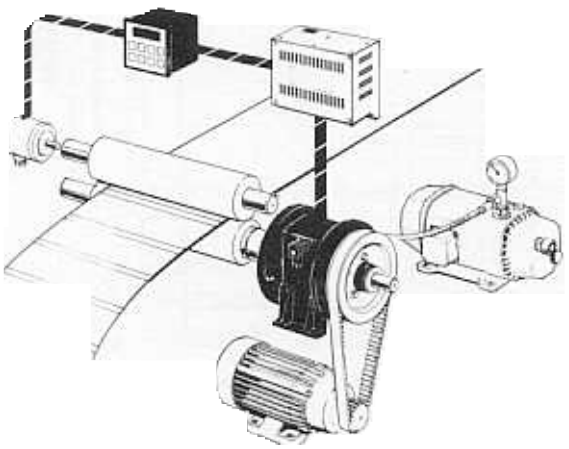
Application



The Laurence Scott & Electromotors Ltd Precision Step Unit type SRA is the ideal solution for fast and precise rotary motion control for production machinery.

The SRA is especially advantageous in applications where the following is required:
- high production output
- high automation
- high precision and uniformity in product
- great reliability
- low service costs

Typical applications are:
Labelling, dosing, cutting, packaging, label printing, box folding, thermo-forming, sorting, stamping.



The SRA Unit is part of the Laurence Scott & Electromotors Precision Step System which comprises:
- SRA mechanical unit
- SRB electronic control unit
- SRC signal sources
- SRD vacuum pump

Fig.1 shows the Precision Step System used for start-stop motion of the feed rolls. The SRA step unit, the principle component of the system, starts and stops the feed rolls extremely fast and precisely (at low load operation a max. cycling frequency of 1600 to 2500 cycles/min can be obtained).

External signal sources (proximity switches, photocells, encoders) give start and/or stop commands to electronic control units. These controls are flexible and can be adapted to perform various functions e.g. pulse counting, signal suppression, compensation of external influences etc. Complex control functions are made practicable through software.

Function description

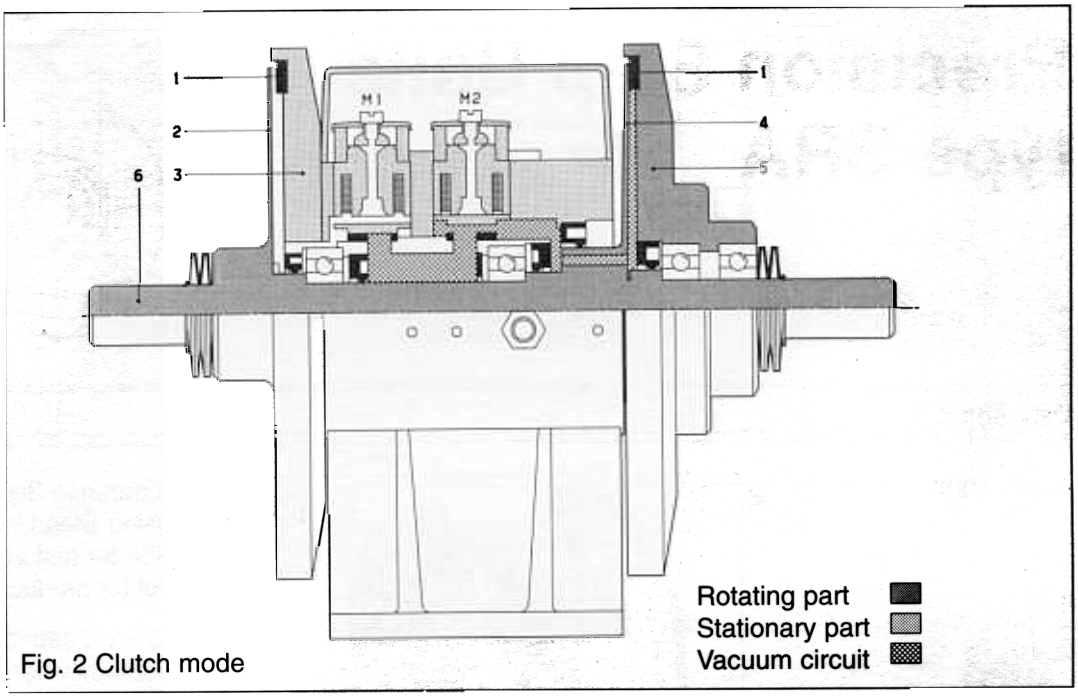


Fig. 2 Clutch mode

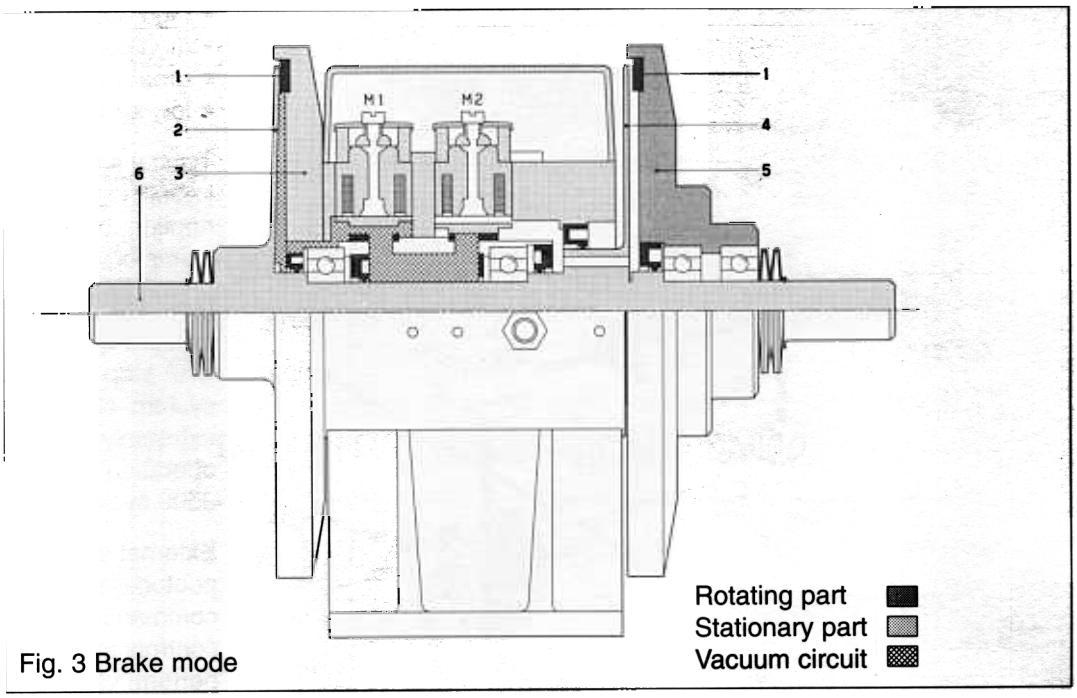


Fig. 3 Brake mode

1. Friction ring
2. Brake disc
3. Housing
4. Clutch disc
5. Input flange
6. Solid output through shaft

M1 Solenoid valve, brake side
M2 Solenoid valve, clutch side

Figs. 2 and 3 illustrate the function of the Laurence Scott & Electromotors Ltd Precision Step Unit type SRA.

Function description

The SRA unit is operated by vacuum. Optimum performance is obtained at 70 percent vacuum (20 in. Hg). Measured at the SRA unit.
The two solenoid valves of the SRA unit. M1 and M2 direct the vacuum to the clutch and brake side respectively. When both solenoid valves are de-energised, atomspheric pressure is present allowing the solid output through shaft to rotate freely.

When solenoid valve M2 is energised, vacuum is directed to the cavity between the input flange (pos. 5) and the clutch disc (pos. 4). The disc is pulled against the friction ring and the output shaft starts revolving.

The SRA is now in clutch mode, see fig. 2.

When solenoid valve M1 is energised and solenoid valve M2 is de-energised, vacuum is directed to the cavity between the brake flange and the brake disc (pos. 2). The disc is pulled against the friction ring of the housing (pos. 3). The input flange rotates freely, as atmospheric pressure is present again. The output shaft is decelerated until it stops and is locked in this position with a holding torque.

The SRA is now in brake mode, see fig. 3.

SRA timing

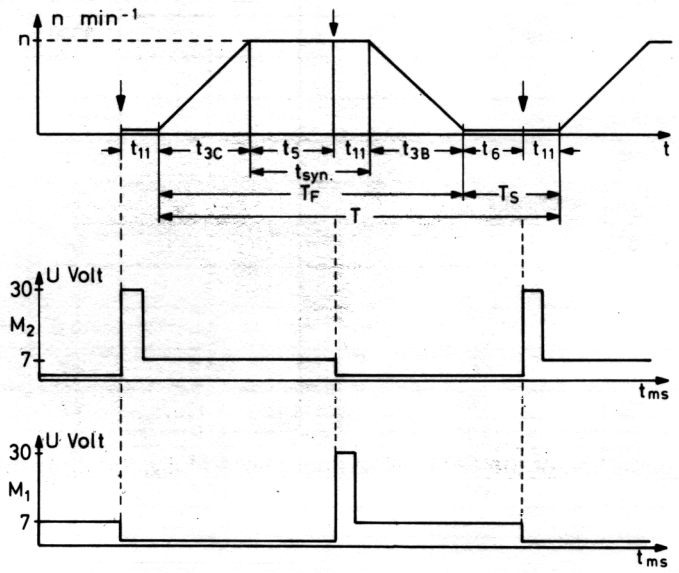


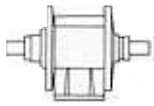
Fig. 4 Timing diagram illustrating one cycle of the SRA

T = Cycling time ($T = T_F + T_S$) [s]
t_{11} = Reaction time, time from start/stop signal to the beginning of torque increase [s]
t_{3C} = Acceleration time, time taken to reach full speed [s]
t_{syn} = Feed time at full speed ($t_{syn} = t_5 + t_{11}$) [s]
t_{3B} = Braking time, time until total stop of output shaft [s]
t_S = Standstill time ($T_S = t_6 + t_{11}$) [s]
t_F = Feed time ($T_F = t_{3C} + t_{syn} + t_{3B}$) [s]

The SRA design permits a response time of 7 to 15 ms (depending on the size of the SRA unit).

Response time: the time it takes from signal input to full rotational torque is built up, see fig. 4.

Ordering

Type		Code	Symbol
SRA 15	foot mounting	080B5001	
SRA 18		080B5002	
SRA 20		080B5003	
SRA 23		080B5004	
SRA 25		080B5011	
SRA 30		080B5012	
SRA 36		080B5013	

Technical data

Type			SRA 15	SRA 18	SRA 20	SRA 23	SRA 25	SRA 30	SRA 36
Static torque, [ft.lbs.]			12	20	31	45	60	108	175
Dynamic torque, [ft.lbs.]			8	14	24	32	42	75	123
Max. speed, [RPM]			1200	1040	920	800	760	600	500
Max. heat load, P_{max}, [ft.lbs./min]			4000	5000	6000	7000	8000	12000	20000
Rotating Assy. WR^2_{SRA}, [lb,ft^2]			0.016	0.026	0.044	0.070	0.173	0.351	0.738
Max. clamping frequency, [cycles/min]			3000	2700	2500	2100	1875	1700	1600
Response time t_1/t_2, [ms]			7	7	8	9	10	11	15
Obtainable repeat accuracy, Δt, [ms]			±0.1	±0.1	±0.1	±0.1	±0.1	±0.1	±0.1
Ambient temperature* [°F]			32-104	32-104	32-104	32-104	32-104	32-104	32-104
Vacuum consumption V_{SRA}, [ft^3/cycle] x 10^{-4}			18	28	37	41	44	58	81
Nominal work, [ft.lbf] x 10^8			86	124	171	177	268	401	545
Shaft diameter, [in]			1.0	1.0	1.0	1.0	1.5	1.5	1.5
Weight, [lbs.]			16.8	18.5	20.6	22.5	44.0	49.8	59.5
Max. MP (static)			2.7	4.1	5.4	7.0	8.6	12.3	16.7
Max, HP (dynamic)			1.8	2.9	4.2	5.0	6.0	8.5	11.7

*Only at optimum utilisation of the SRA. When not utilised fully, the ambient temperature might be higher.

Technical data
Permissible shaft loads

SRA 15-36

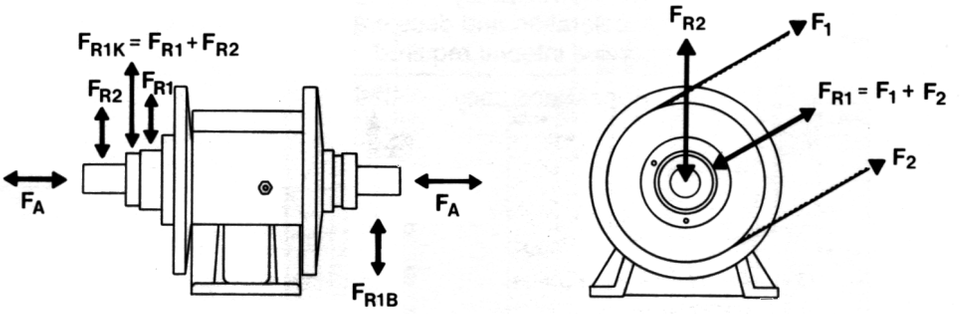
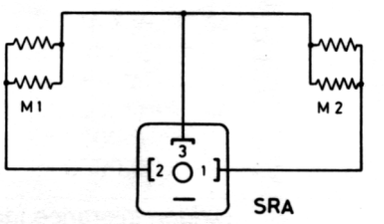


Fig. 5

SRA	F_A [lb.]	F_{RIK}max[lb.]	F_{RIB}max[lb.}
15	150	100	200
18	150	100	200
20	150	200	200
23	150	200	200
25	800	400	400
30	800	400	400
36	800	400	400

Electrical connections
SRA 15-36



1: Solenoid valve, brake side
2: Solenoid valve, clutch side
3: Common
R = 9 Ω/coil
L = 63 mH/coil

Calculation and sizing

To obtain optimum utilization of the SRA specifications, it is necessary to specify the operation parameters as precisely as possible. The selected SRA unit for an application is based on calculating the necessary dynamic torque.

The calculation must include:
- the masses to be accelerated and decelerated (rotating assy. WR^2)
- revolutions/minute
- cycling frequency
- acceleration and deceleration time required
- service interval required

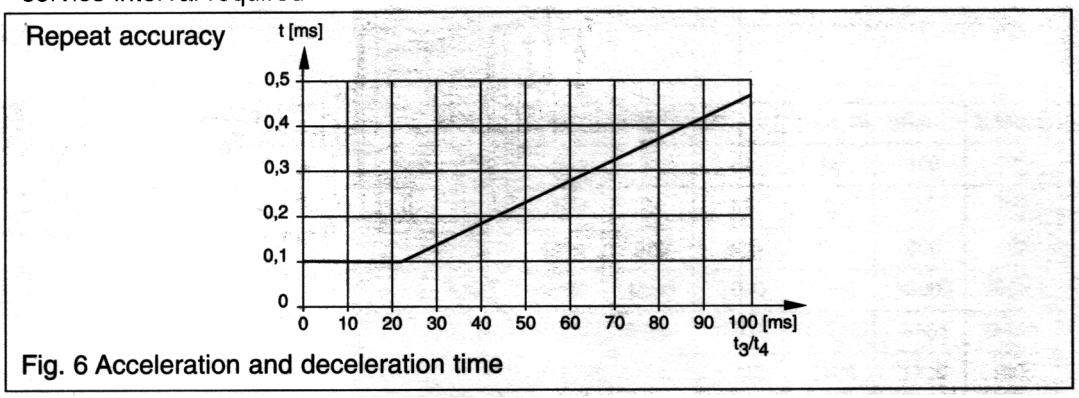


Fig. 6 Acceleration and deceleration time

The obtainable repeat accuracy of the SRA step unit depends on the actual acceleration or deceleration time. The relation between acceleration or deceleration time and repeat accuracy is shown in fig. 6.

Sizing of SRA unit

To select the correct SRA size the following must be known:
n = revolutions/minute [RPM]
I = rotating assy. WR^2 [lb.ft^2]
t = acceleration or deceleration time [s] (max. 0.025 s when high repeat accuracy is required)
F = frictional force [lb.]
r = radius of feeding roller [ft.]

Calculation of these data is made on the basis of plant specifications such as measurements of feed rollers, chains etc, cycling frequency, max. feeding length or turning angle and time available per cycle.
The sizing is made according to the torque formula:

$$T = \frac{\Sigma 1 \times n}{308 \times t} + (F \times r) \text{ [ft.lbs.]}$$

Repeat accuracy of the SRA is expressed by the time ms. The tolerance of the required feeding length is the length to be reached in ±0.1 ms e.g.:

$\Delta s = v \times \Delta t$
$v = 3$ ft./sec
$\Delta t = \pm 0.001$ sec
$\Delta s = (3 \times 0.0001)$ ft.
$= 0.0003$ ft. x 12
$= 0.0036$ in.

Hidden tolerance factors that might appear cannot be accumulated in the repeat accuracy calculation.
Sizing examples are available from Laurence Scott & Electromotors Ltd and the Laurence Scott & Electromotors Ltd sales engineers are at your service with any required calculation as well as their application experience.

Shaft dimensions SRA 15-36

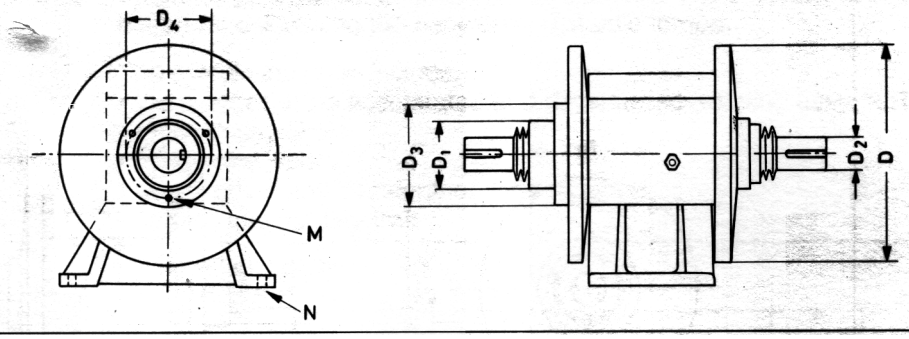


Fig. 9

Type	Inches						
	sD	sD_1	sD_2	sD_3	sD_4	M	N
SRA 15	AVAILABLE IN METRIC DIMENSIONS ONLY						
SRA 18	7.323	2.732 $^{0}_{-0.003}$	1.0 $^{-0.005}_{-0.0010}$	3.872	3 5/16	3 x 5/16-18 UNC 120°	4 x ø 0.437
SRA 20	AVAILABLE IN METRIC DIMENSIONS ONLY						
SRA 23	9.331	2.732 $^{0}_{-0.003}$	1.0 $^{-0.005}_{-0.0010}$	3.872	3 5/16	3 x 5/16-18 UNC 120°	4 x ø 0.437
SRA 25	AVAILABLE IN METRIC DIMENSIONS ONLY						
SRA 30	12.402	3.250 $^{0}_{-0.003}$	1.5 $^{-0.002}_{-0.005}$	4.624	4.0	3 x 3/8-16 UNC 120°	4 x ø 0.531
SRA 36	14.409	3.250 $^{0}_{-0.003}$	1.5 $^{-0.002}_{-0.005}$	4.624	4.0	3 x 3/8-16 UNC 120°	4 x ø 0.531

Precision Step Systems

A trading name of Laurence, Scott & Electromotors Ltd. Norwich, England
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Dimensions SRA 15-36

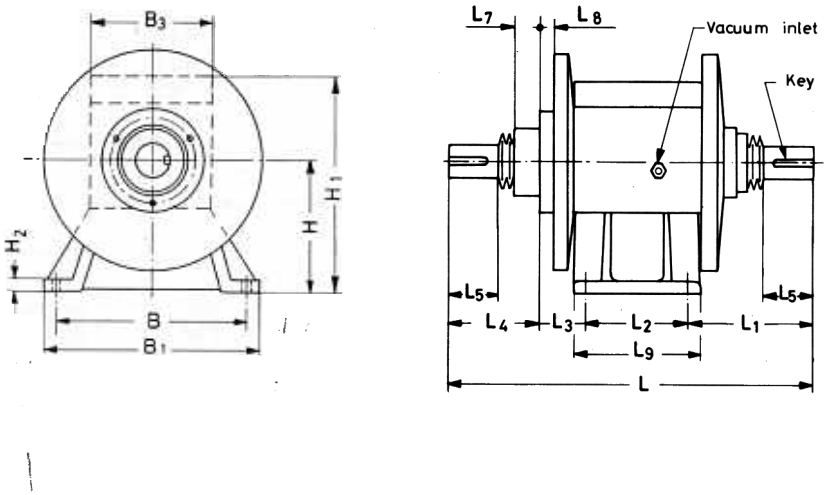

Fig. 8

Type				SRA 15	SRA 18	SRA 20	SRA 23	SRA 25	SRA 30	SRA 36
H	±0.006			AVAILABLE IN METRIC DIMENSIONS ONLY	3.750	AVAILABLE IN METRIC DIMENSIONS ONLY	4.750	AVAILABLE IN METRIC DIMENSIONS ONLY	6.500	7.500
H_1					7,470		8.470		10.811	11.811
H_2	±0.004				0.945		0.945		1.260	1.260
B	±0.004				5.250		5.250		7.000	7.000
B_1					5.984		5.984		8.110	8.110
B_3					3.937		3.937		4.921	4.921
L	±0.008				12.835		12.835		17.205	17.205
L_1					4.432		4.432		5.827	5.827
L_2	±0.02				3.500		3.500		5.000	5.000
L_3	±0.02				1.990		1.900		2.244	2.244
L_4	±0.02				2.913		2.913		4.134	4.134
L_5	±0.008				1.496		1.496		2.283	2.283
L_7	±0.004				0.748		0.748		1.063	1.063
L_8					0.552		0.552		0.650	0.650
L_9					4.484		4.484		6.181	6.181
Key					1/4 x 1 1/4		1/4 x 1 1/4		3/8 x 1 7/8	3/8 x 1 7/8
Vacuum inlet					3/8 ID		3/8 ID		3/8 ID	3/8 ID