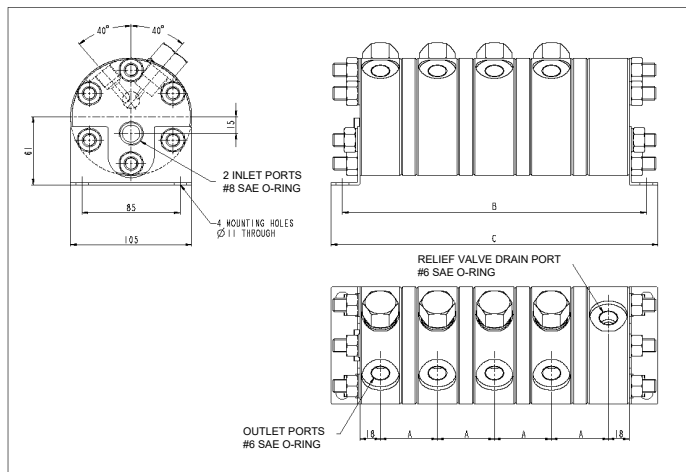


SLACK & PARR HYDRAULICS LIMITED

ROTARY GEARED FLOW DIVIDER TYPE FDR



ORDER CODE	No. OF ELEMENTS/ OUTLETS	ELEMENT CAPACITY	INPUT FLOW			DIM A (MM)	DIM B (MM)	DIM C (MM)
			MINIMUM @ 750 RPM	STANDARD @ 1500 RPM	MAXIMUM @ 3000 RPM			
			CC/REV	LPM	LPM	LPM		
FDR 2/2	2	2	3	6	12	42.6	151.0	171.0
FDR 2/4	2	4	6	12	24	49.3	164.3	184.3
FDR 2/6	2	6	9	18	36	55.9	177.6	197.6
FDR 2/9	2	9	13.5	27	54	65.9	197.7	217.7
FDR 3/2	3	2	4.5	9	18	42.6	193.5	213.5
FDR 3/4	3	4	9	18	36	49.3	213.6	233.6
FDR 3/6	3	6	13.5	27	54	55.9	233.5	253.5
FDR 3/9	3	9	20.2	40.5	81	65.9	263.6	283.6
FDR 4/2	4	2	6	12	24	42.6	236.1	256.1
FDR 4/4	4	4	12	24	48	49.3	262.8	282.8
FDR 4/6	4	6	18	36	72	55.9	289.4	309.4
FDR 4/9	4	9	27	54	91	65.9	329.5	349.5
FDR 5/2	5	2	7.5	15	30	42.6	278.7	298.7
FDR 5/4	5	4	15	30	60	49.3	312.0	332.0
FDR 5/6	5	6	22.5	45	90	55.9	345.3	365.3
FDR 5/9	5	9	33.7	67.5	91	65.9	395.4	415.4
FDR 6/2	6	2	9	18	36	42.6	321.2	341.2
FDR 6/4	6	4	18	36	72	49.3	361.2	381.2
FDR 6/6	6	6	27	54	91	55.9	401.2	421.2
FDR 6/9	6	9	40.5	81	91	65.9	461.3	481.3

Maximum pressure 345 bar.

ORDERING CODE	DISPLACEMENT PER SECTION	MINIMUM INLET PER SECTION LPM	MAXIMUM INLET PER SECTION LMP
FDR ---/2	2CC/REV	1.5	6
FDR ---/4	4CC/REV	3	12
FDR ---/6	6CC/REV	4.5	18
FDR ---/9	9CC/REV	6.75	27

Ordering Code Example for Unequal Flow Divider: FDR 4/2.4.4.9
 This is a 4 section unit with; one 2cc section, two 4cc sections and one 9cc section.
 Total Input flow @ 1500 rpm—28.5 litre/min. Four Output Flows 1500 rpm of 3, 6, 6 & 13.litre/min.

General Information

Selecting a flow divider - Although speed of rotation can be as low as 750 rpm and the maximum is 3000 rpm, a flow divider should be selected which will pass the required flows in the range 1000 to 2000 rpm for maximum efficiency.

Equal flow divider - Having decided on the separate flow ratio the sum of which will give total input flow, refer to the table "Equal Element Units" to select a divider which will pass these flow rates at or near to 1500 rpm. If the flow is variable, calculate speed of rotation which will occur at both maximum and minimum input and ensure that these speeds fall within 750 to 3000 rpm.

Unequal flow dividers - Refer to the table of individual elements to select those which will pass the desired flows at or near to 1500 rpm, bearing in mind that all the elements in a flow divider rotate at the same speed. Thus having calculated the speed of one of the elements according to its flow rate, select the other elements to provide their required flows at that speed. If this proves impractical repeat the process, starting with another of the required outputs. It is not always possible to obtain precisely all the required outputs as this would call for an infinite number of element sizes so some compromise is often required. However, in practical terms, any combination of outputs from 1.5 lpm up to a total input of 27 lpm per section can be provided for.

Calculation of Inlet Pressure

The product of inlet pressure and flow is equal to the sum of the products of outlet pressures and flows plus the pressure required to cause the flow divider to rotate.

$$\text{i.e. } PQ = P_1Q_1 + P_2Q_2 + P_3Q_3 + PR$$

when

P = inlet pressure

Q = inlet flow

P₁, P₂, P₃ etc. are outlet pressures

Q₁, Q₂, Q₃ etc. are the respective outlet flows

PR is the pressure required to rotate the flow divider

Tests have shown that PR varies slightly according to the size and number of elements, but

for practical purposes it can be assumed to be 5 bar (72.5psi) for standard ISO VG32 hydraulic fluid at 40°C

Thus if the 4 element unit shown as an ordering coding example here has output pressures of 60, 120, 25 and 50 bar respectively the inlet pressure would be:

$$\frac{60 \times 3 + 120 \times 6 + 25 \times 6 + 50 \times 13.5}{28.5} + 5 = 65.5 \text{ bar}$$

Slip Losses - Because there must be some clearance for the gears to rotate some internal leakage is inevitable and this causes some inaccuracy in flow division. The amount of "slip" is a function of flow and pressure drop through each section and is affected by viscosity.

Use of Flow Divider as a Pressure Intensifier - Using an equal element unit with two sections, pressure at one of the outlets can be approximately 2 x the inlet pressure, if the second outlet is piped to the tank. In the same way an "unequal" unit can be used to obtain higher intensification. The ratio of the displacements of the flow divider sections is a measure of the amount of intensification achieved. If a ratio of more than 4½:1 is required (i.e. a higher ratio than can be obtained with an FDR2/2.9), one or more extra sections can be added to increase the flow to tank and thereby the ratio of intensified pressure to inlet pressure.

Pressure at the intensified pressure outlet is given by:-

$$P_o = \frac{P_i \times E_1 + E_2 + E_3 \text{ etc.}}{E_1}$$

Where

P_o = Intensified Pressure

P_i = Inlet Pressure

E₁ = Element capacity of high pressure element

E₂, E₃ etc. = Element capacities of low pressure elements

The inlet pressure can be calculated as for any other flow divider, (see formula under "Calculation of Inlet Pressure") taking P_i as the intensified pressure and P₂, P₃ as the pressure drop on the tank connections of the 'by-pass' elements.

DIAGRAM 1

INTEGRAL RELIEF VALVE SET AT 0 - 207 BAR (3000PSI)

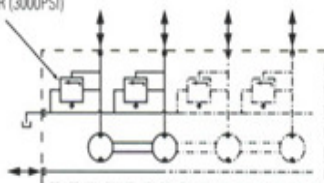
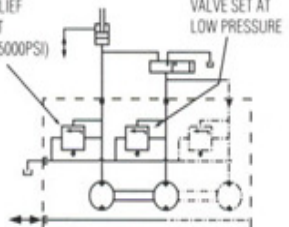


DIAGRAM 2

INTEGRAL RELIEF VALVE SET AT 0 - 345 BAR (5000PSI)



Rotary Flow Dividers split the input flow from a single supply into 2 or more outputs of equal or unequal flows.

They are used for synchronisation of rams to ensure level lifting or to operate two or more hydraulic actuators at different speeds, each with integral relief valve.

(Diagram 1) See notes here on selecting a flow divider.

Rotary Flow Dividers can also be used for pressure intensifications by dumping one or more outlets to tank. (Diagram 2) See notes here on selecting a flow divider.

All units are reversible therefore only one divider is necessary to synchronise actuators in both directions of movement. Equal and unequal outputs are available by selecting the appropriate units, banked together.

The range of flow dividers is a modular construction therefore the number of outlet elements is only restricted by maximum input of 90Lpm per section a minimum speed of 750 rpm and a maximum speed of 3000rpm. In designing a system incorporating a Rotary Flow Divider allowance must be made for the pressure required to cause it to rotate. See notes on "Calculation of Inlet Pressure" here.