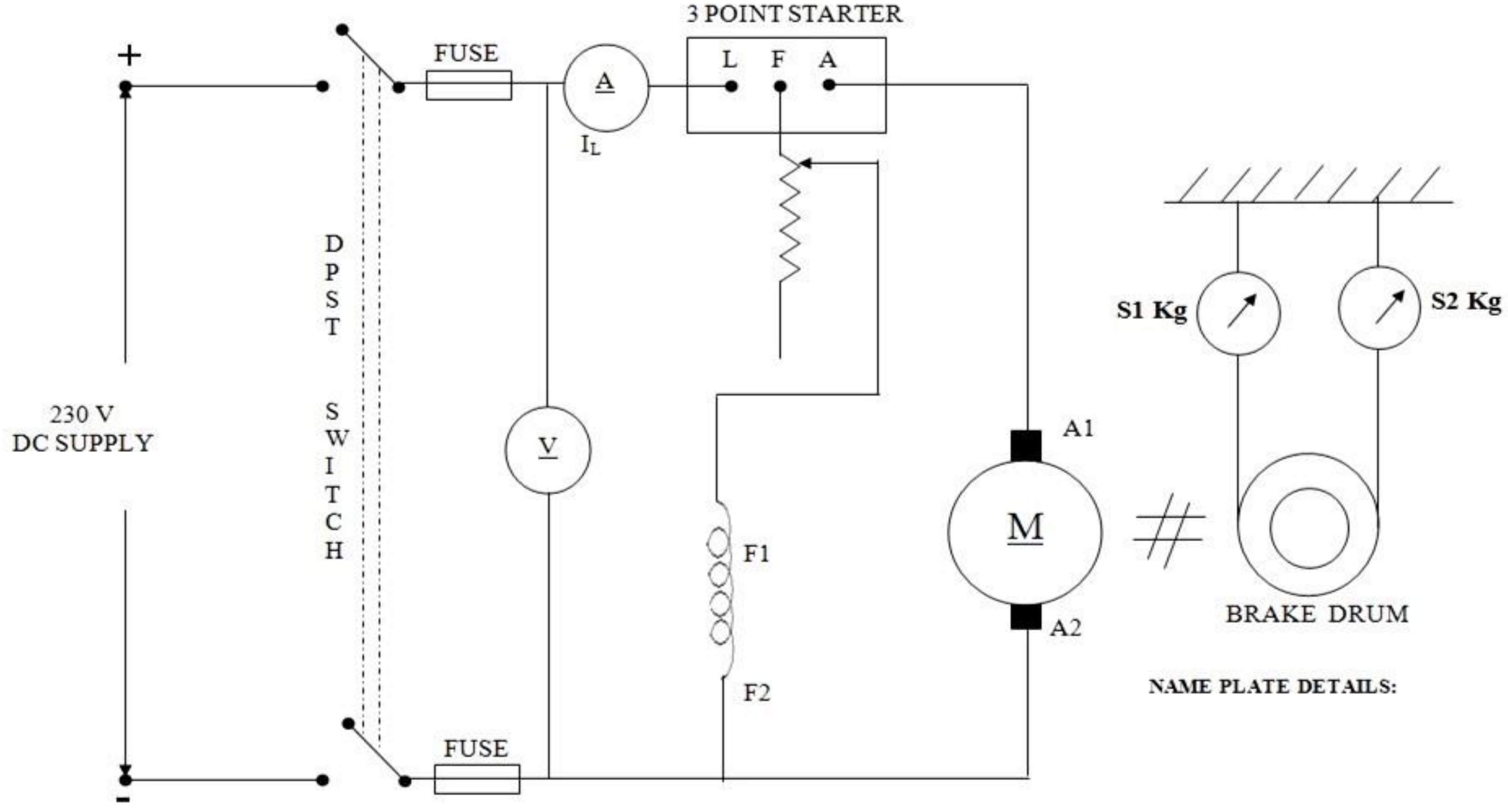
CIRCUIT DIAGRAM - LOAD TEST ON DC SHUNT MOTOR



NAME PLATE DETAILS:

Figure 1.1 - Load Test on DC Shunt Motor

Ex. No:	LOAD TEST ON DC SHUNT MOTOR
Date :	

AIM:

To draw the performance characteristics of the given DC shunt motor by conducting load test.

OBJECTIVES:

1. To determine the efficiency of the given DC shunt motor by conducting load test.
2. To find the various parameters such as torque, input power, output power etc.
3. To obtain the electrical and mechanical characteristics for the given DC shunt motor.

APPARATUS REQUIRED:

S.NO	APPARATUS NAME	RANGE	TYPE	QUANTITY
01.	Voltmeter			
02.	Ammeter			
03.	Rheostat			
04.	Tachometer			

FORMULA:

1. Torque (T) =($S_1 \sim S_2$) x R x 9.81 Nm

   Where

   S_1, S_2 – Spring balance readings in kg

   R – Radius of brake drum in m

2. Input power (P_i) = V_L x I_L watts

   Where

   V_L – line voltage in Volts

   I_L – load current in A

3. Output power (P_0) = $\frac{2\Pi NT}{60}$ watts

   Where

   N – Speed of motor in rpm

   T – Torque in Nm

Table 1.1 **LOAD TEST ON DC SHUNT MOTOR**

Circumference of brake drum $2 \pi r$ = m

Radius of brake drum r = m

S.No	LINE VOLTAGE (V_L) (Volts)	LOAD CURRENT (I_L) (A)	SPRING BALANCE READINGS			SPEED (N) (RPM)	TORQUE (T) (Nm)	INPUT POWER (P_i) (Watts)	OUTPUT POWER (P_o) (Watts)	% EFFICIENCY (η)
			S_1 in Kg	S_2 in Kg	$S_1 \sim S_2$ in Kg					

4. % Efficiency (η) = $\frac{p_o}{p_i}$ *100

Where

P_0 - Output power in watts

P_i - Input power in watts

PRECAUTIONS:

1. The fuse is selected such that the current rating is 120% of rated current of the motor.
2. It is ensured that the starter handle is in OFF position.
3. The motor field rheostat should be kept at minimum resistance position at the time of starting.
4. Heat produced due to friction between belt and brake drum is reduced by pouring water inside the brake drum periodically.

PROCEDURE:

1. Circuit connections are made as per the circuit diagram shown in figure.
2. The supply is given by closing DPST switch.
3. The motor is started using 3 point starter.
4. The motor field rheostat is adjusted from its minimum resistance position to get the rated speed.
5. The no load readings of the voltmeter and spring balance are noted.
6. The load is increased and voltmeter, ammeter, spring balance readings & speed for various load currents up to the rated current are noted.
7. Performance characteristics are drawn from the tabulated readings & calculated values.

MODEL GRAPH:

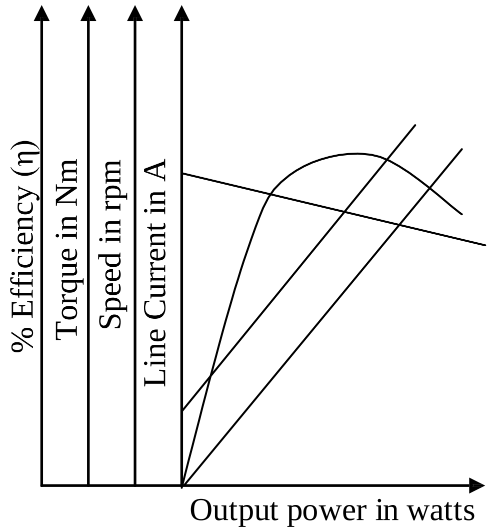


Figure 1.2 Performance Characteristic

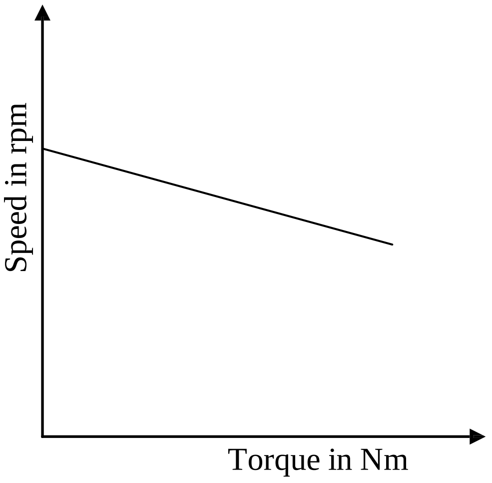


Figure 1.3 Mechanical Characteristic

MODEL CALCULATION:

31.1 Brake Test

It is a direct method and consists of applying a brake to a water-cooled pulley mounted on the motor shaft as shown in Fig. 31.1. The brake band is fixed with the help of wooden blocks gripping the pulley. One end of the band is fixed to earth via a spring balance S and the other is connected to a suspended weight W_1. The motor is running and the load on the motor is adjusted till it carries its full load current.

Motor shaft

Let W_1 = suspended weight in kg

W_2 = reading on spring balance in kg-wt

The net pull on the band due to friction at the pulley is $(W_1 - W_2)$ kg. wt. or $9.81\,(W_1 - W_2)$ newton.

If R = radius of the pulley in metre

and N = motor or pulley speed in r.p.s.

Then , shaft torque T_{sh} developed by the motor

$= (W_1 - W_2)\,R$ kg-m $= 9.81\,(W_1 - W_2)\,R$ N-m

Motor output power $= T_{sh} \times 2\pi\, N$ watt

$= 2\pi \times 9.81\, N\,(W_1 - W_2)\,R$ watt

$= 61.68\, N\,(W_1 - W_2)\,R$ watt

Let V = supply voltage ; I = full-load current taken by the motor.

Then, input power = VI watt

$$\therefore \qquad \eta = \frac{\text{Output}}{\text{Input}} = \frac{61.68\; N(W_1 - W_2)R}{VI}$$

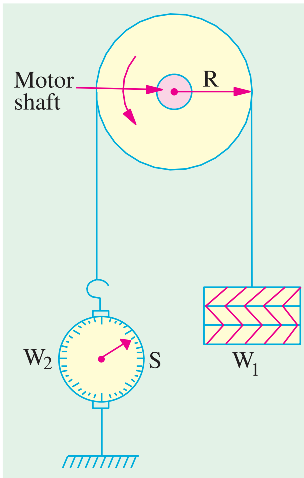


Fig. 31.1

The simple brake test described above can be used for small motors only, because in the case of large motors, it is difficult to dissipate the large amount of heat generated at the brake.

Another simple method of measuring motor output is by the use of poney brake one form of which is shown in Fig. 31.2 (*a*). A rope is wound round the pulley and its two ends are attached to two spring balances S_1 and S_2. The tension of the rope can be adjusted with the help of swivels. Obviously, the force acting tangentially on the pulley is equal to the difference between the readings of the two spring balances. If R is the pulley radius, the torque at the pulley is $T_{sh} = (S_1 - S_2)R$. If $\omega\ (= 2\pi N)$ is the angular velocity of the pulley, then

motor output $= T_{sh} \times \omega = 2\,\pi\, N\,(S_1 - S_2)R$ m-kg. wt. $= 9.81 \times 2\pi N\,(S_1 - S_2)\,R$ watt.

The motor input may be measured as shown in Fig. 31.2 (*b*). Efficiency may, as usual, be found by using the relation η = output/input.

Example 31.1. *In a brake test the effective load on the branch pulley was 38.1 kg, the effective diameter of the pulley 63.5 cm and speed 12 r.p.s. The motor took 49 A at 220 V. Calculate the output power and the efficiency at this load.*

Solution. Effective load $(W_1 - W_2) = 38.1$ kg. wt ; radius $= 0.635/2 = 0.3175$ m

Shaft torque $= 38.1 \times 0.3175$ kg-m $= 9.81 \times 38.1 \times 0.3175 = 118.6$ N-m

Power output = torque × angular velocity in rad/s $= 118.6 \times 2\pi \times 12 =$ **8,945 W**

Now, motor input $= 49 \times 220$ W $\quad \therefore \quad$ Motor $\eta = \dfrac{8,945}{49 \times 220} =$ **0.83** or **83%**