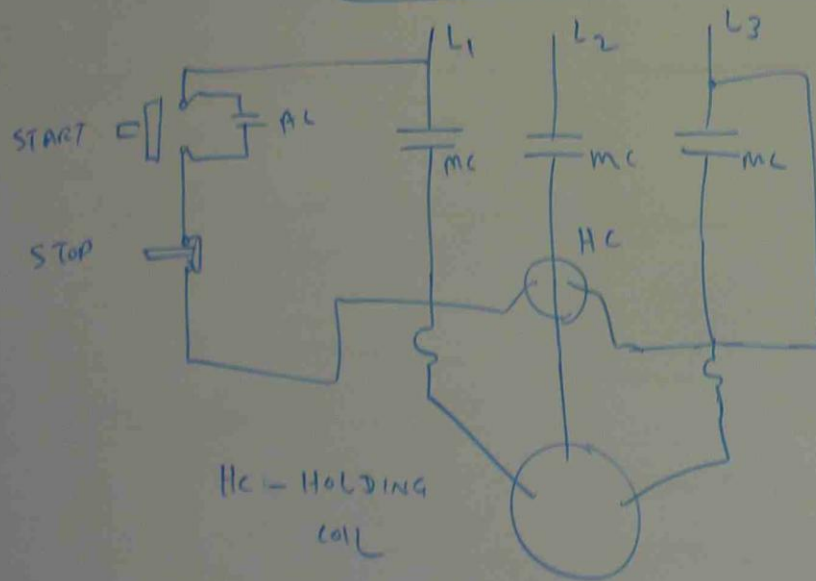


## MOTOR STARTING

3 $\phi$  SQUIRREL CAGE MOTORS ARE NORMALLY STARTED DIRECT ON LINE. THIS MAY CAUSE A CURRENT DEMAND OF UP TO 6 TIMES NORMAL CURRENT

### DIRECT ON LINE STARTER

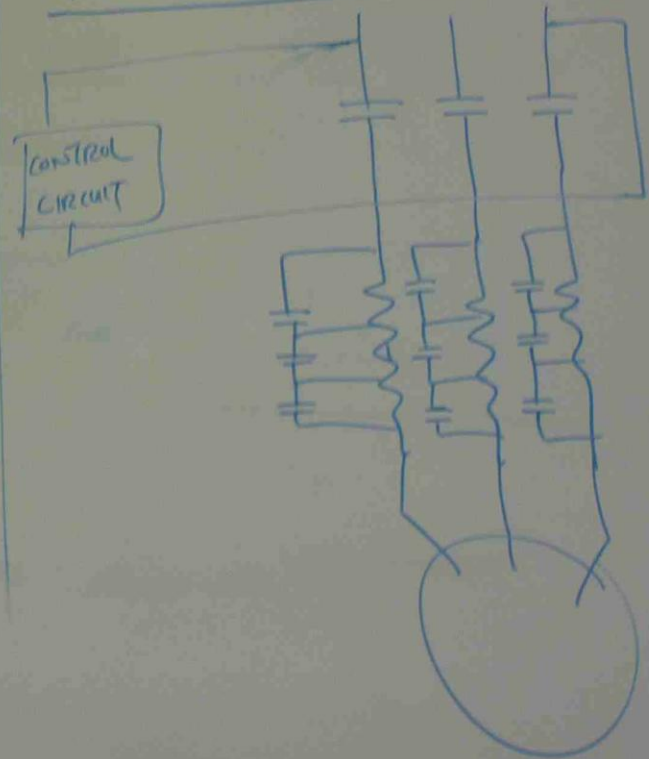


HC - HOLDING  
coil

MC - MAIN CONTACT

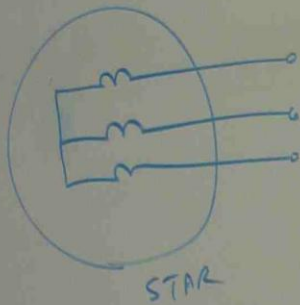
AL - AUXILIARY CONTACT

### PRIMARY RESISTANCE STARTER

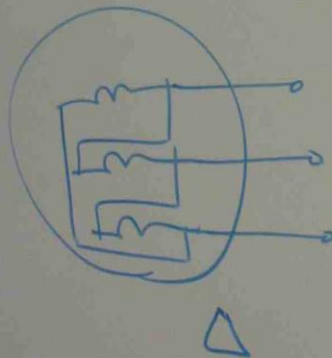


## STAR DELTA STARTER

STARTING

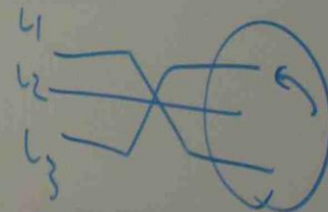
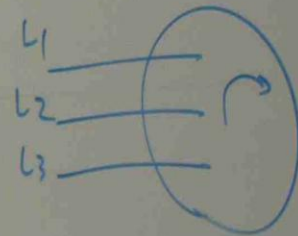
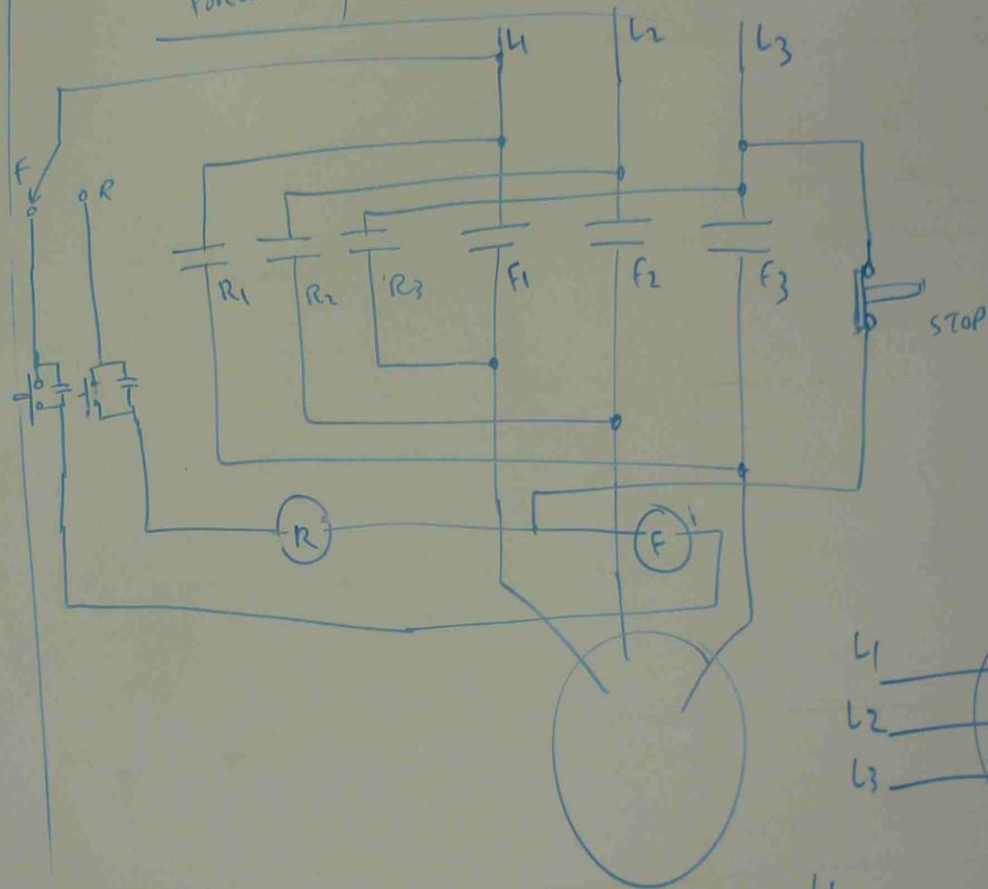


RUNNING

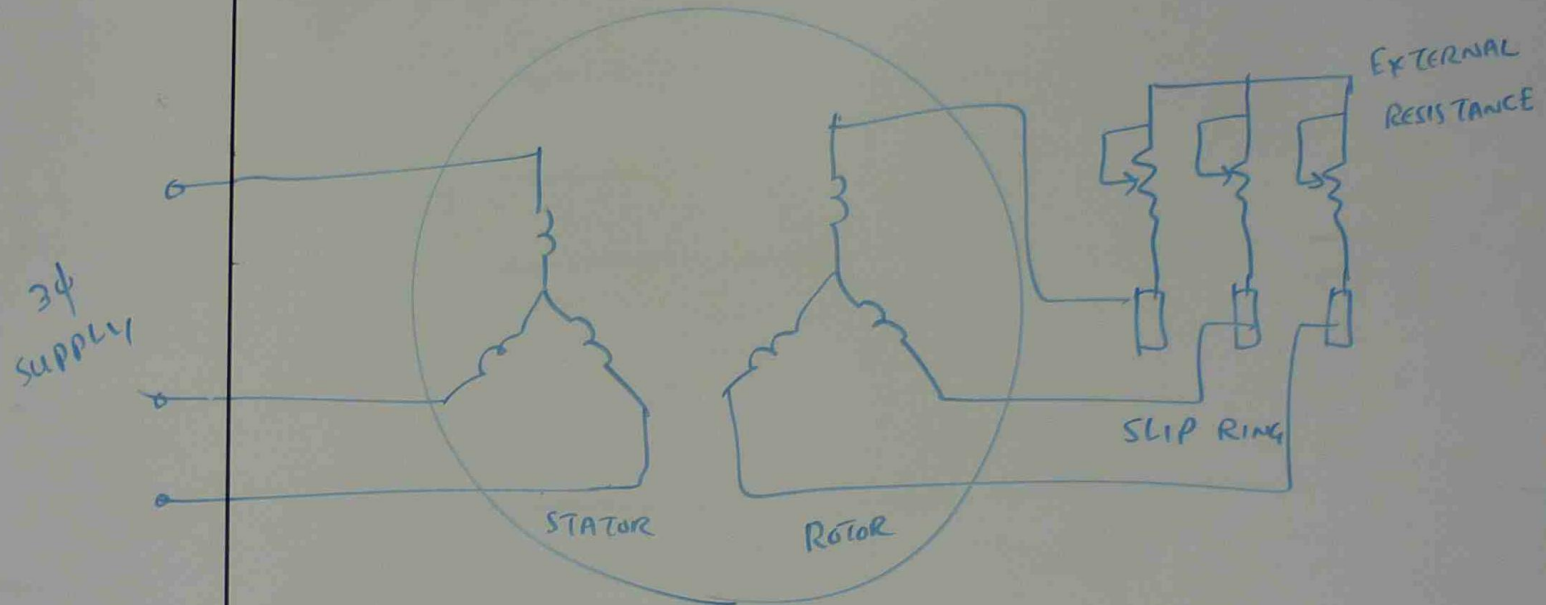


## MOTOR REVERSAL

FORWARD | REVERSE STARTER



## Wound Rotor motor

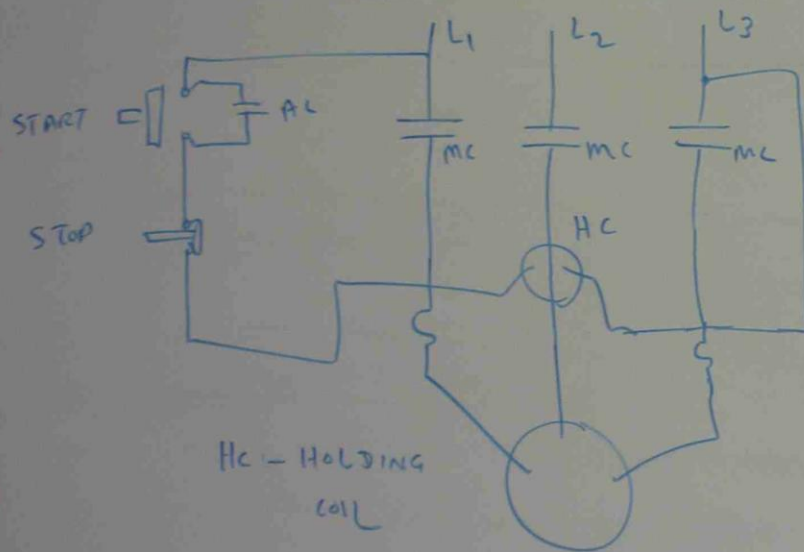


By adjusting the external resistors,  
the speed of wound rotor motor can be  
adjusted.

## MOTOR STARTING

3 $\phi$  SQUIRREL CAGE MOTORS ARE NORMALLY STARTED DIRECT ON LINE. THIS MAY CAUSE A CURRENT DEMAND OF UP TO 6 TIMES NORMAL CURRENT

### DIRECT ON LINE STARTER

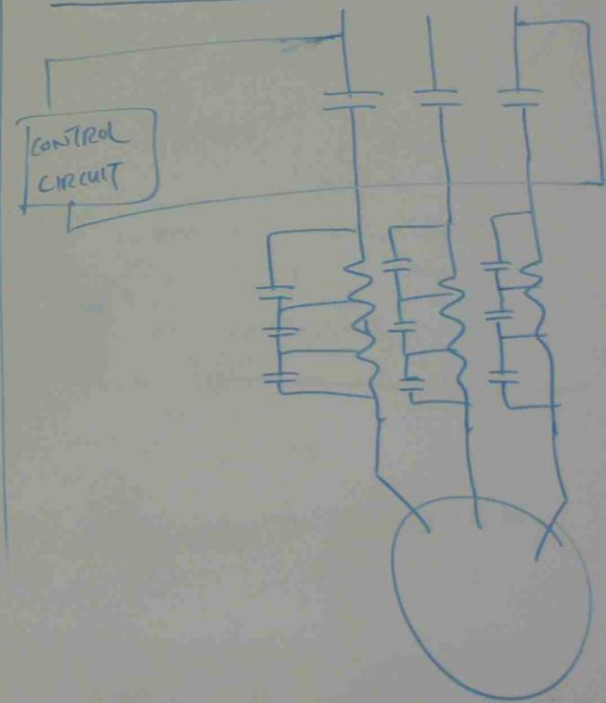


HC - HOLDING  
coil

$M_C$  - MAIN CONTACT

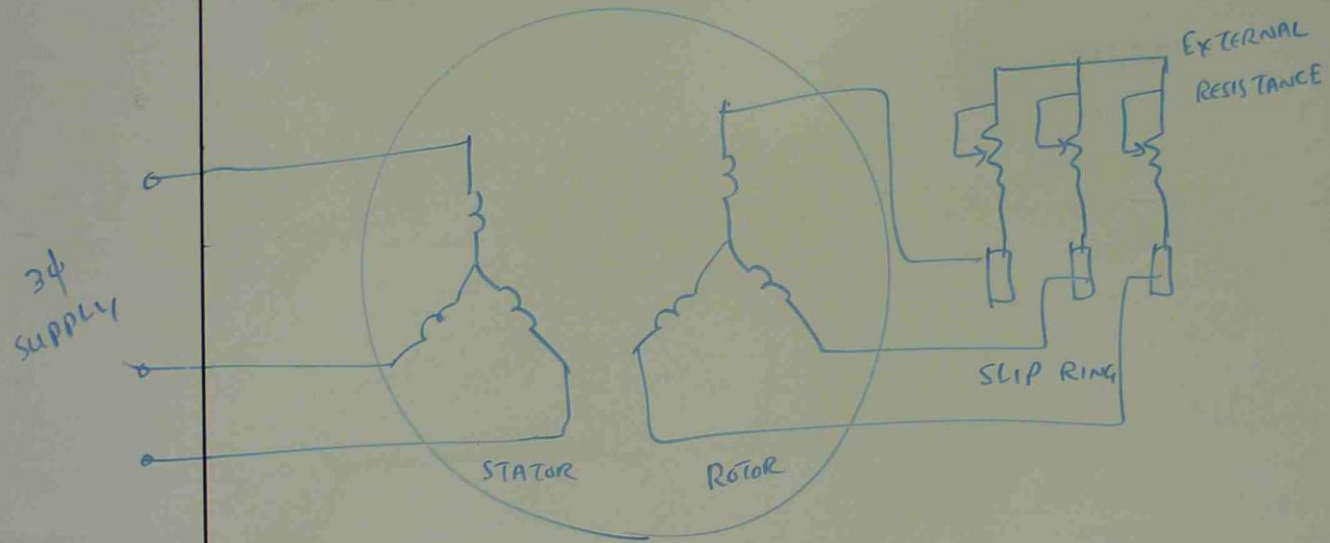
AC - AUXILIARY CONTACT

### PRIMARY RESISTANCE STARTER

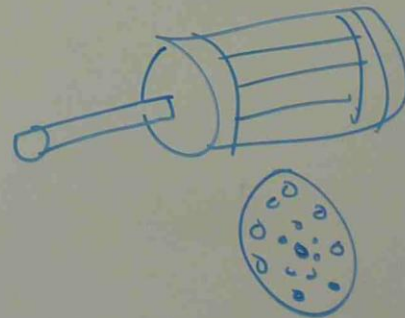




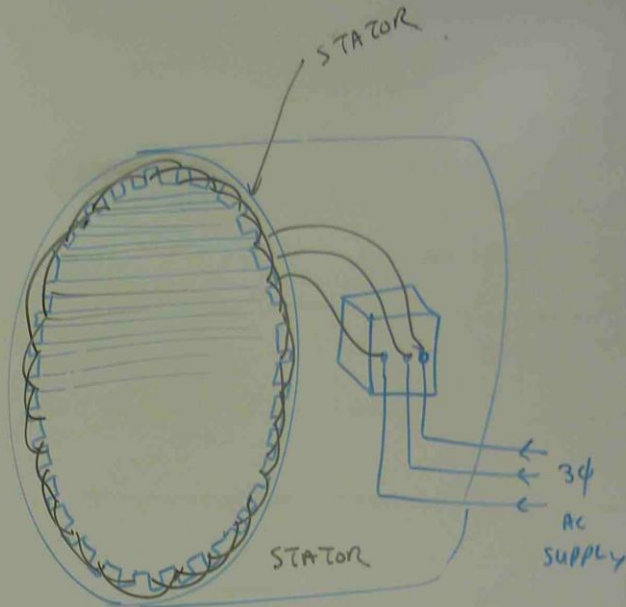
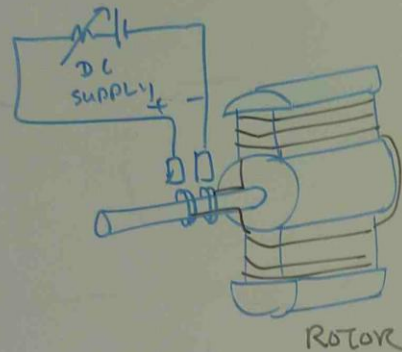
## Wound Rotor motor



By adjusting the external resistors,  
the speed of wound rotor motor can be  
adjusted.



## SYNCHRONOUS MOTOR



THE SYNCHRONOUS MOTOR HAS A ROTATING MAGNETIC FIELD PROVIDED BY THE STATOR AS THE INDUCTION MOTOR.

THE STATOR IS SUPPLIED WITH AC VOLTAGE AND ROTOR IS SUPPLIED WITH DC VOLTAGE.

DC VOLTAGE IS SUPPLIED BY EXCITER, A SMALL DC GENERATOR MOUNTED ON THE SAME SHAFT.

THE INTERACTION BETWEEN DC AND AC FIELD BRINGS THE MOTOR TO SPEED UP.

## MOTOR CONSTRUCTION

ELECTRIC MOTORS ARE GENERALLY CONSTRUCTED TO NEMA (OR) IEEE STANDARDS THIS ENSURES SIZE, PERFORMANCE, LABELLING AND COMPATIBILITY.

OPEN - THE MOTOR HAS OPENINGS FOR FREE AIR COOLING.

DRIP PROOF - OPEN TYPE THAT PREVENTS THE DROP OF LIQUID THAT ARE 15° OR LESS FROM ENTERING THE MOTOR

GUARDED - VENTILATED OPENINGS THAT ARE DESIGNED TO PREVENT THE DROPS OF LIQUID

TOTALLY ENCLOSED - PREVENT FREE AIR EXCHANGE BUT NOT AIRTIGHT.

3  $\phi$  MOTOR DESIGNS ARE CLASSIFIED BY GROUPS TO SUIT INDUSTRIAL NEEDS. NEMA CLASSES ARE A, B, C AND D.

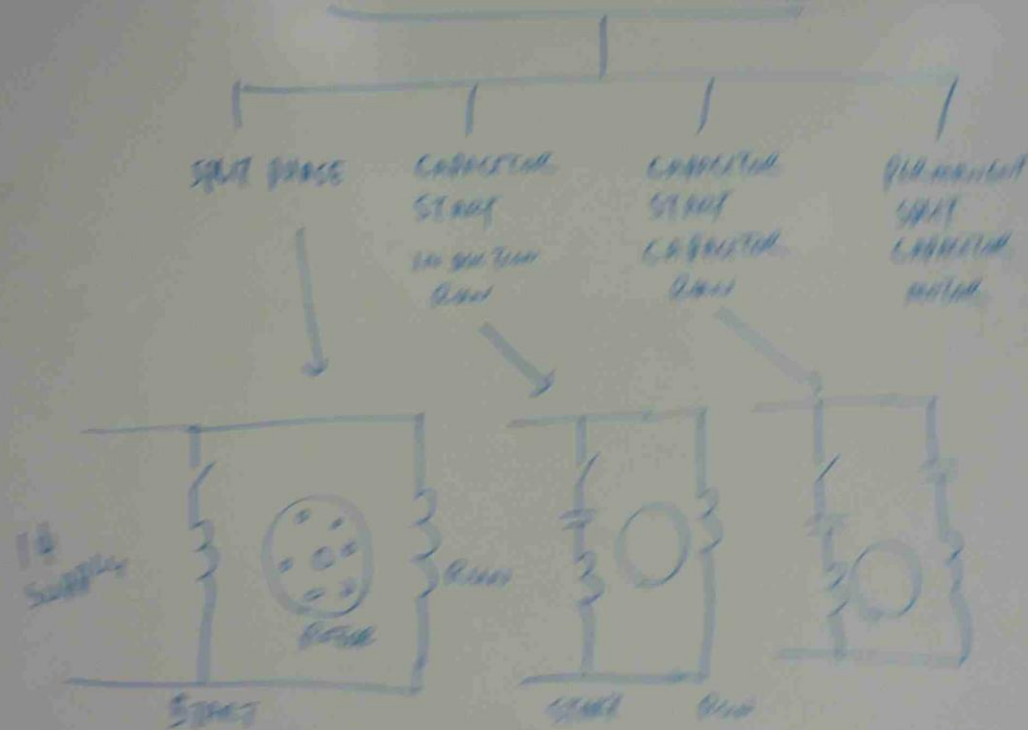
CLASS (A) - GENERAL PURPOSE MOTOR, STARTING CURRENT  $5 \rightarrow 7$  TIMES RATED CURRENT  
STARTING TORQUE 150%.

CLASS (B) - GENERAL PURPOSE, STARTING CURRENT  $5 \rightarrow 7$  TIMES, STARTING TORQUE 150%.

CLASS (C) - DOUBLE CAGE, STARTING CURRENT  $4.5 \rightarrow 5$  TIMES, STARTING TORQUE 225%.

CLASS (D) - GENERAL PURPOSE, STARTING CURRENT  $4 \rightarrow 4.5$  TIMES, STARTING  
TORQUE 275%.

# SINGLE PHASE INDUCTION MOTORS



THE SINGLE PHASE INDUCTION MOTOR CONTAINS

TWO WINDINGS, WHICH ARE, STARTING WINDING, AND

RUNNING WINDING. THE MOTOR FIRST PICKS UP

BY STARTING AND RUNNING WINDING SPEEDS

UP THE MOTOR. THE CAPACITOR IS PROVIDED TO

IMPROVE THE STARTING & RUNNING CHARACTERISTICS.



## MOTOR APPLICATIONS SUMMARY

| MOTOR TYPE          | STARTING TORQUE | SPEED REGULATION                            | SPEED CONTROL                   | REVERSAL                               | APPLICATION   |
|---------------------|-----------------|---|---------------------------------|--|---|
| DC PERMANENT MAGNET | 200%            | MEDIUM                                      | VOLTAGE (OR) PULSE              | REVERSE POLARITY                       | SMALL MACHINES<br>SMALL INSTRUMENTS                 |
| DC SHUNT            | 250%            | GOOD  | FIELD CONTROL (OR)<br>VOLTAGE   | REVERSE CURRENT IN<br>ARMATURE / FIELD | GENERAL PURPOSE                                     |
| DC SERIES           | 500%            | POOR  | VOLTAGE (OR) PULSE              | REVERSE CURRENT IN<br>ARMATURE / FIELD | WINCHES, CRANES<br>TRAIN                            |
| DC COMPOUND         | 350%            | MEDIUM                                      | VOLTAGE (OR)<br>PULSE           | REVERSE CURRENT IN<br>ARMATURE / FIELD | ELEVATOR, ROLLING<br>MILLS, METAL<br>SHEAR          |
| UNIVERSAL AC/DC     | 500%            | POOR  | VOLTAGE (OR)<br>PULSE           | REVERSE CURRENT IN<br>ARMATURE / FIELD | POWER TOOLS   |
| CAGE INDUCTION      | 250%            | GOOD  | NONE                            | REVERSE ANY TWO<br>PHASE CONNECTION    | INDUSTRIAL<br>MACHINERY                             |
| WOUND ROTOR         | 500%            | POOR AT LOW SPEED<br>GOOD AT RATED<br>SPEED | BY VARIABLE<br>ROTOR RESISTANCE | REVERSE ANY TWO<br>PHASE CONNECTIONS   | LOW CURRENT, HIGH<br>TORQUE START                   |
| SYNCHRONOUS         | 50% → 200%      | EXCELLENT                                   | NONE                            | REVERSE ANY TWO<br>PHASE CONNECTION    | FIXED SPEED MACHINERY<br>POWER FACTOR<br>CORRECTION |

## MOTOR POWER RATING

$$\text{Power} = \sqrt{\frac{\sum_{i=1}^n P_i^2 \times t}{\sum_{i=1}^n t_i}}$$

Ex 50 HP for 10 sec  
150 HP for 5 sec  
130 HP for 25 sec  
No Load for 20 sec  
CALCULATE RATING.

$$\text{Power} = \sqrt{\frac{50^2 \times 10 + 150^2 \times 5 + 130^2 \times 25 + 0^2 \times 20}{10 + 5 + 25 + 20}}$$

$$= 96.6 \text{ HP}$$