Three Phase AC Induction Motors

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Motors

Motors convert Electrical energy into Mechanical energy



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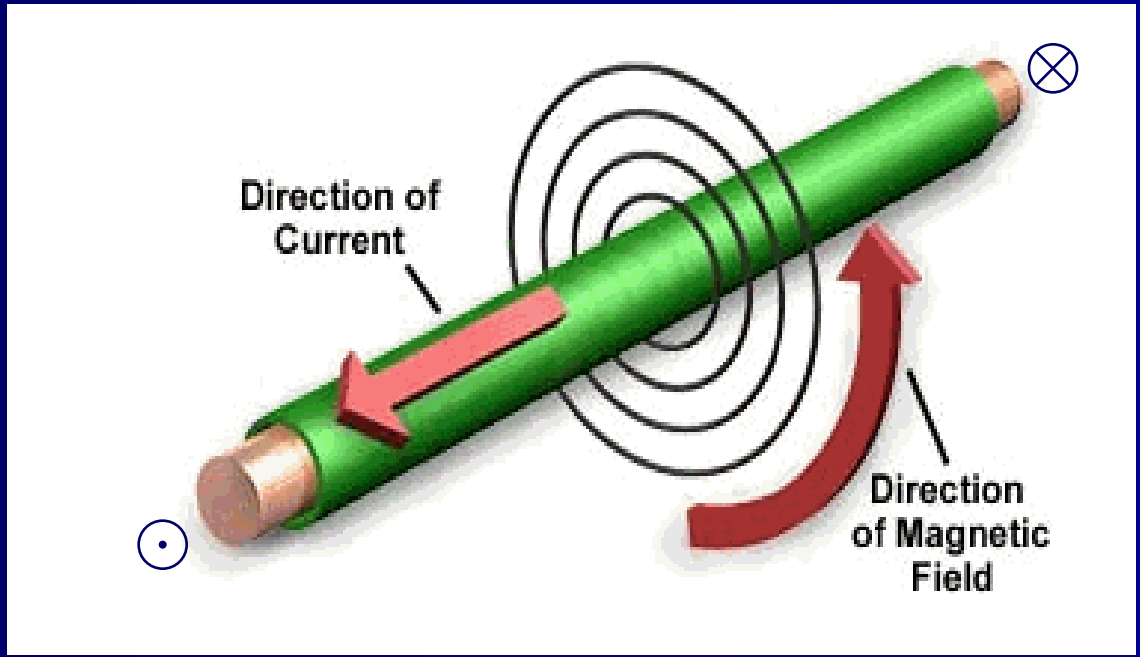
Magnetic Fields

When current flows in a conductor it produces a magnetic field about it - as shown below



Using the corkscrew rule, we can see that the field is moving in an anticlockwise direction as we look at it.

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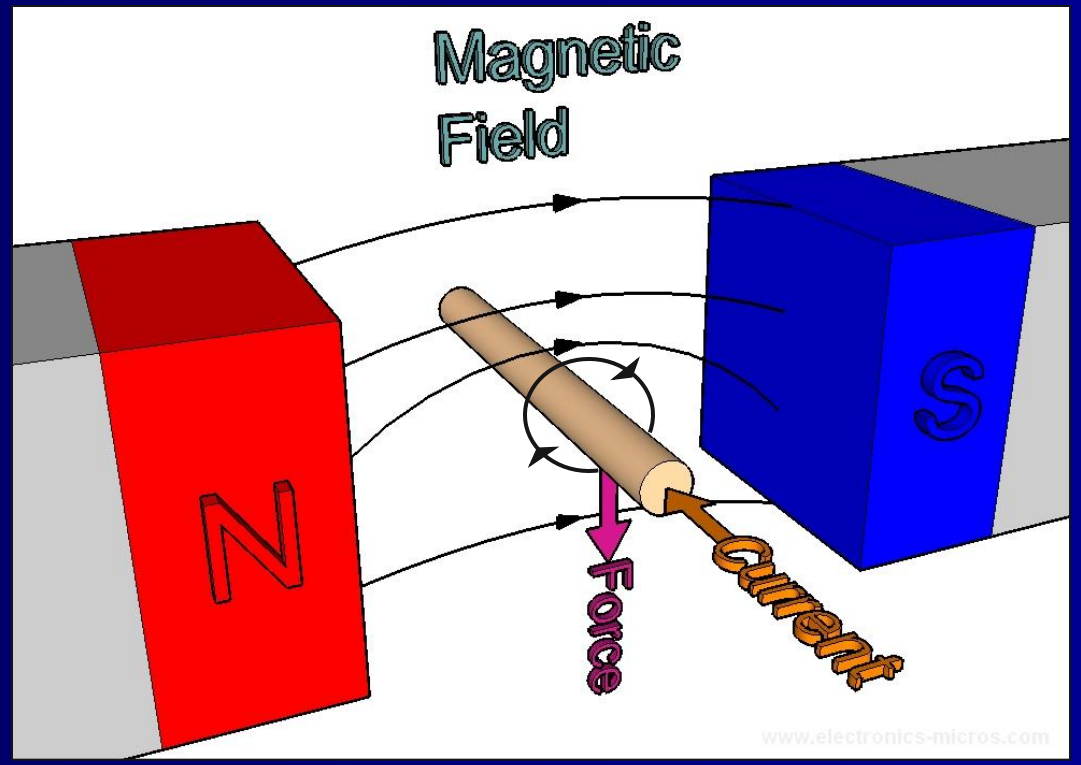
Motion

When the current-carrying conductor is placed within an external magnetic field, the two fields interact, and a force is exerted on the conductor



(Flemings Left Hand Rule)

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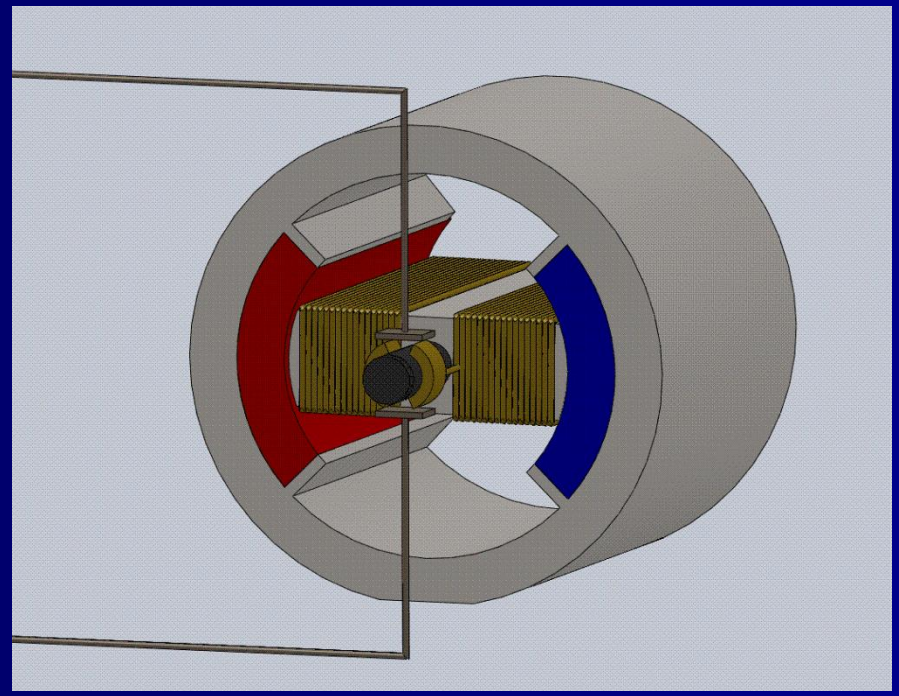
Basic DC Motor

If the current-carrying conductor is placed within an external magnetic field and coiled in a loop the conductor field can be increased in strength, the fields interact on both sides of the loop and a force is exerted on the conductors to make them rotate



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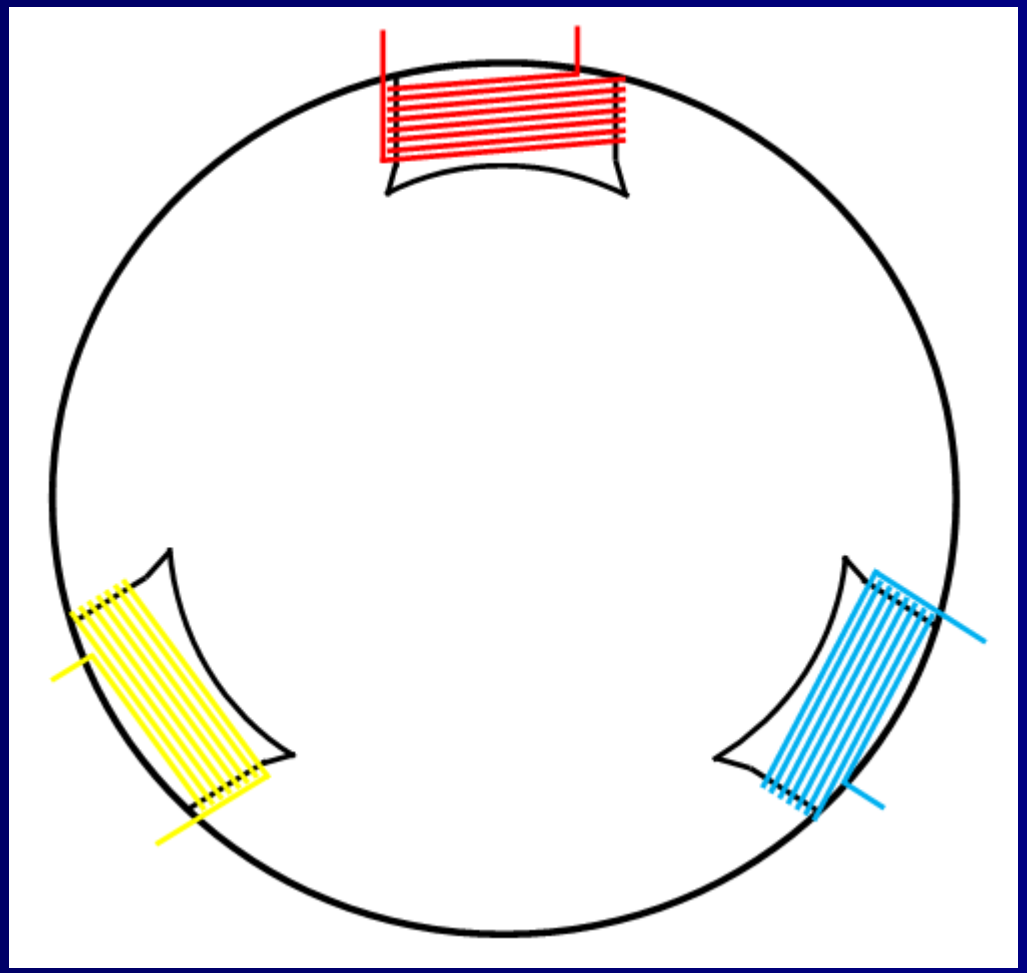
Three Phase AC Winding



With three windings we can position them 120^0 apart to give us 3 pole faces

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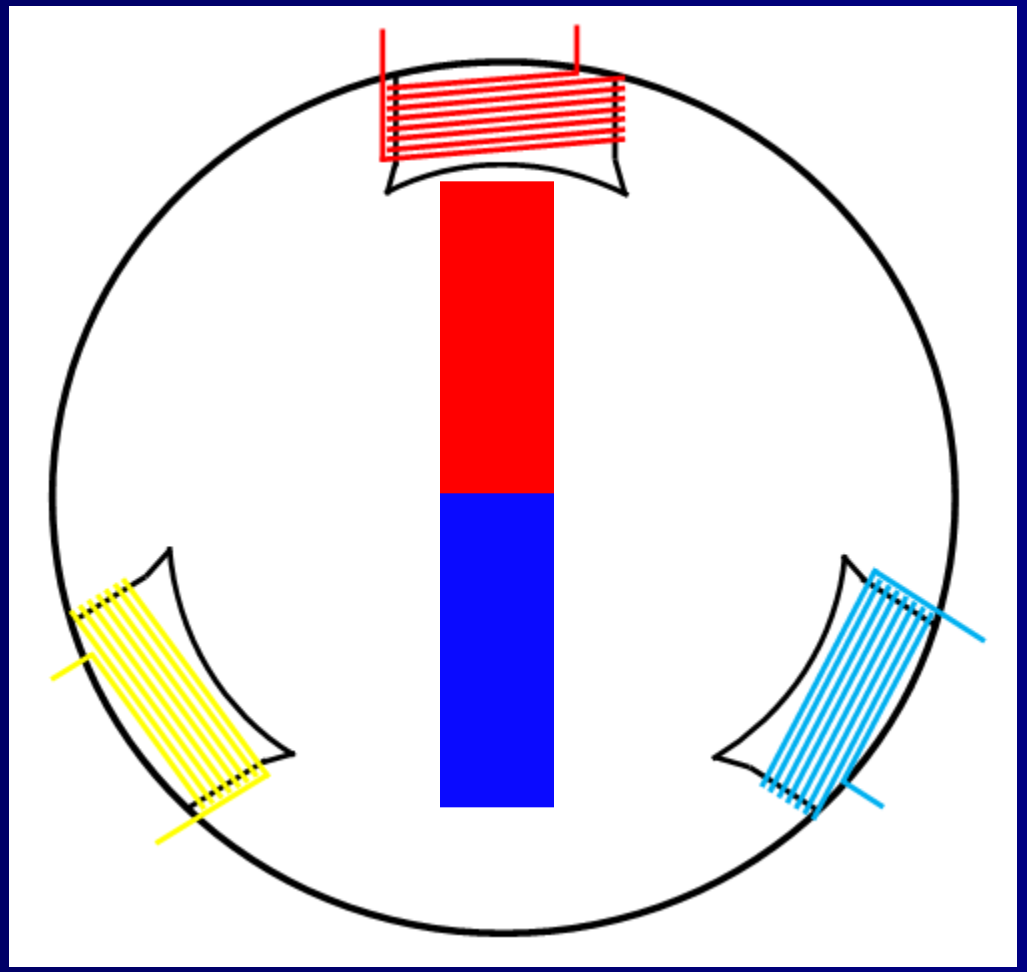
Three Phase AC Generator Windings



This is how a Generator would be configured

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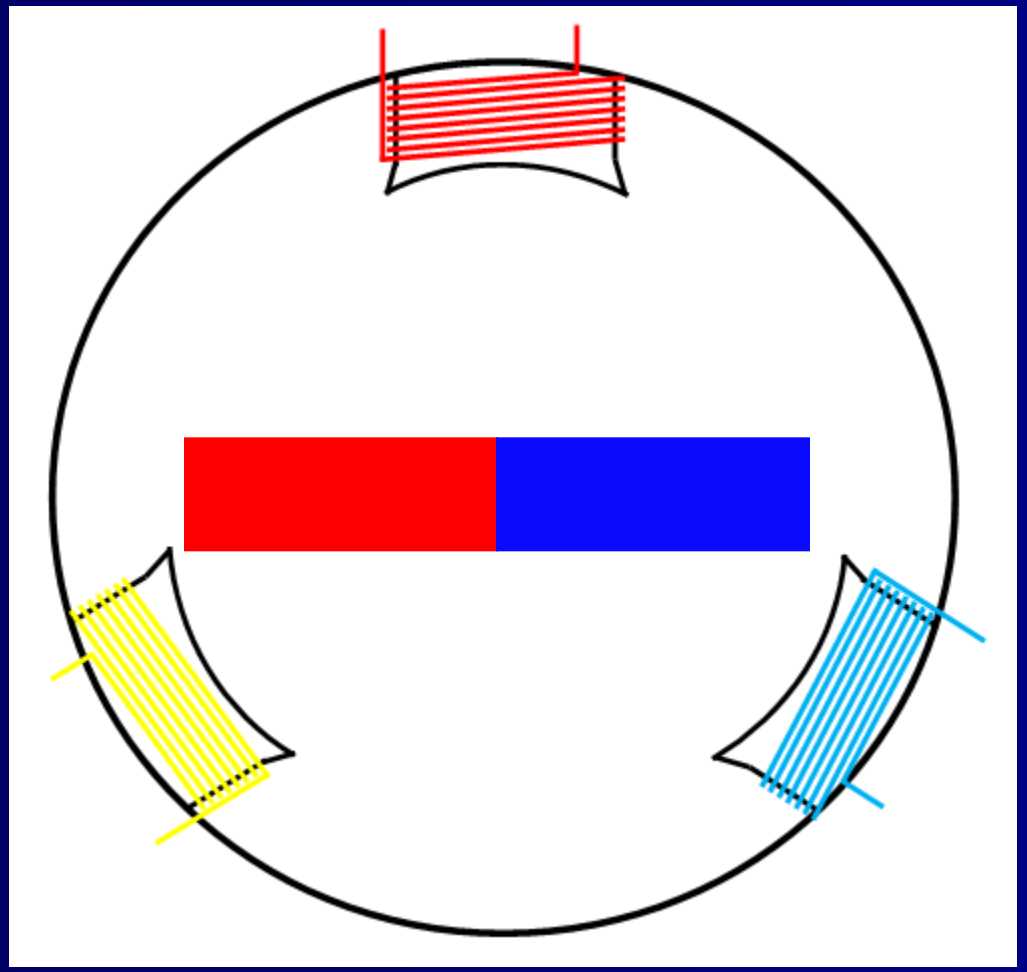
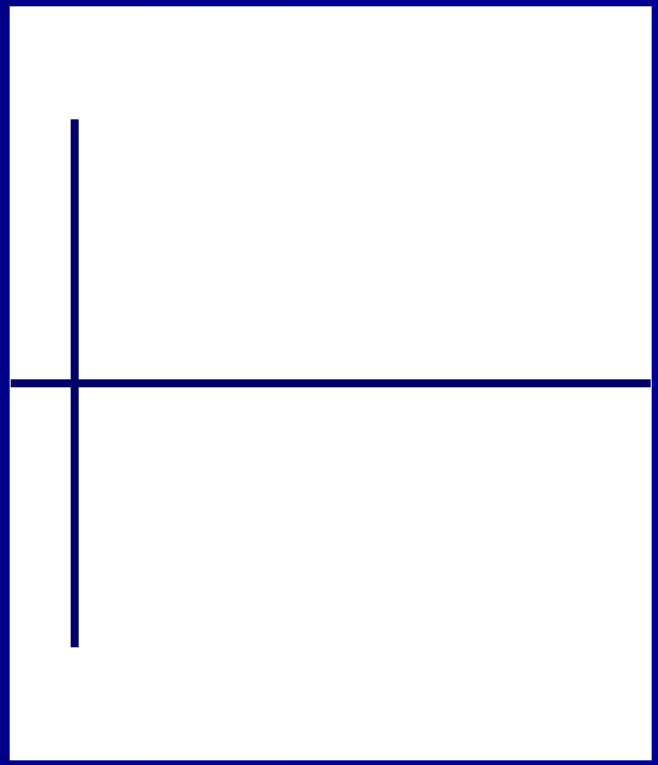
Three Phase AC Generator Windings





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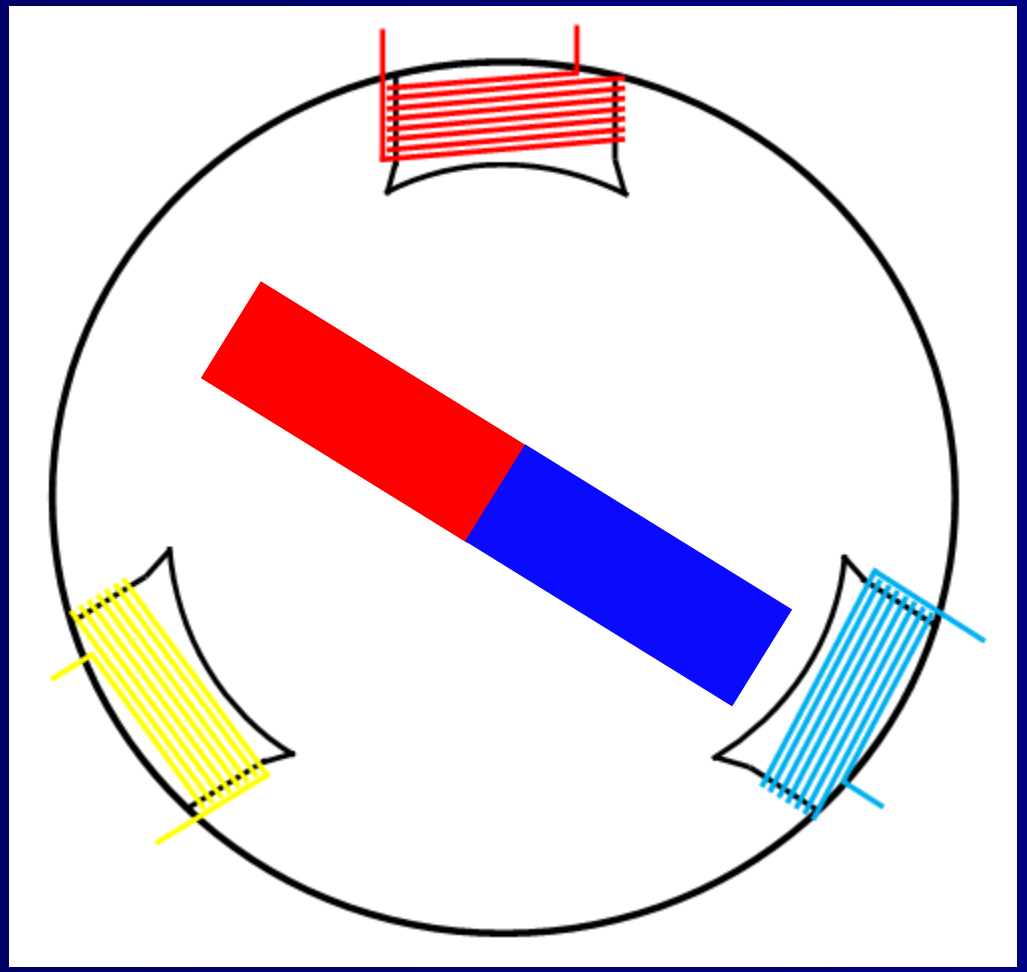
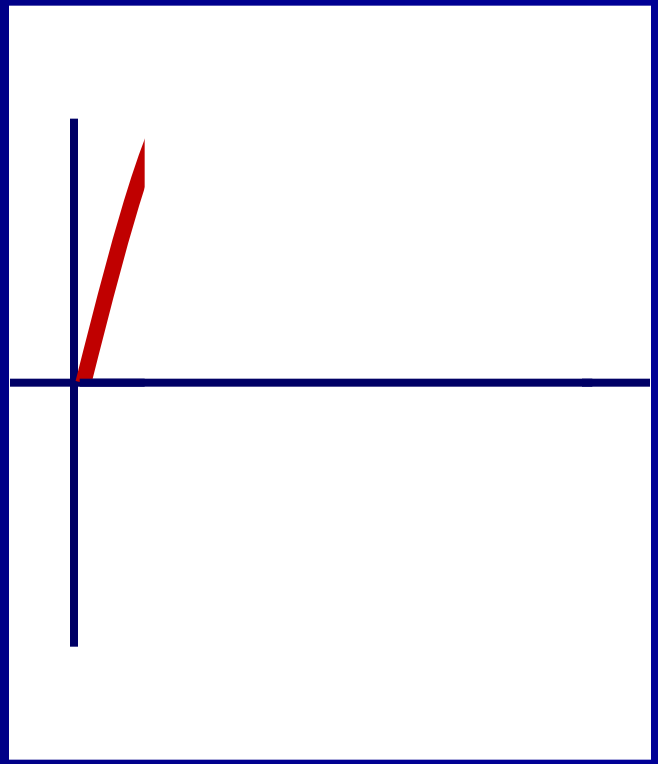
Three Phase AC Generator Windings





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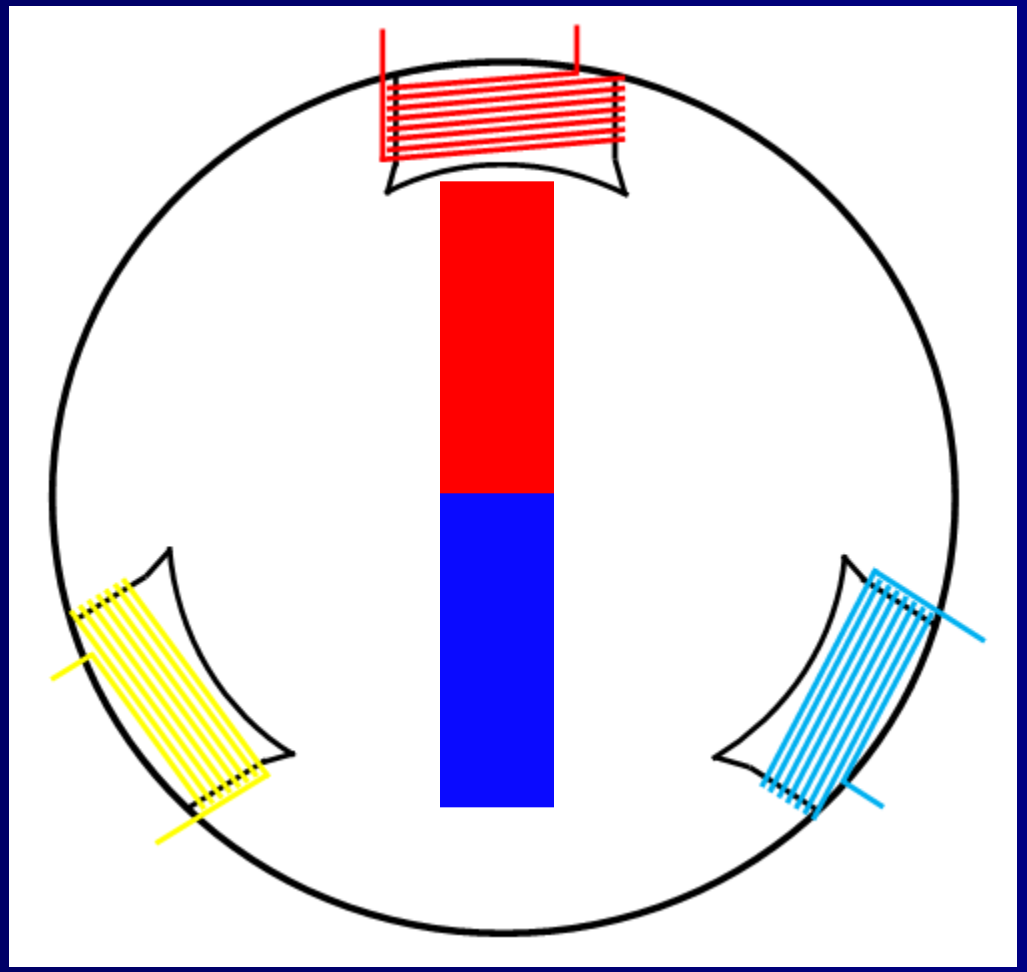
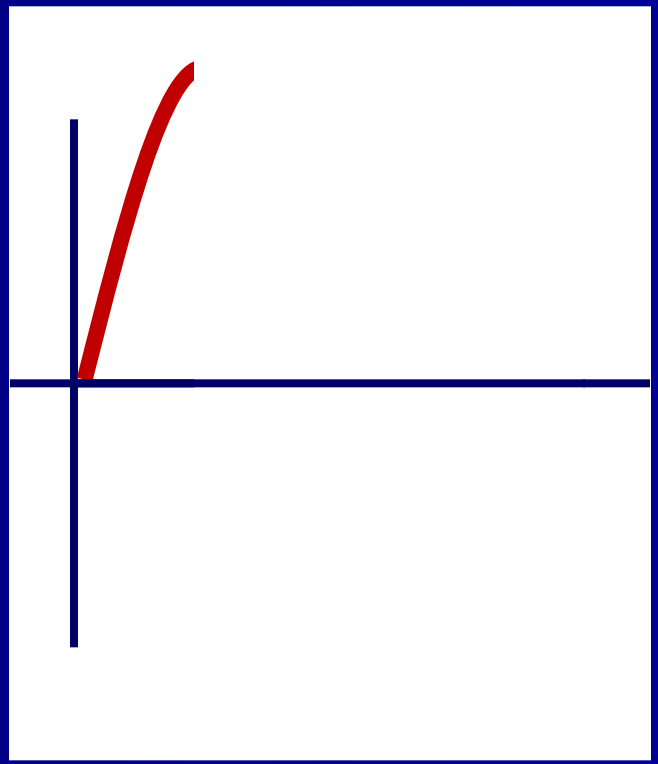
Three Phase AC Generator Windings





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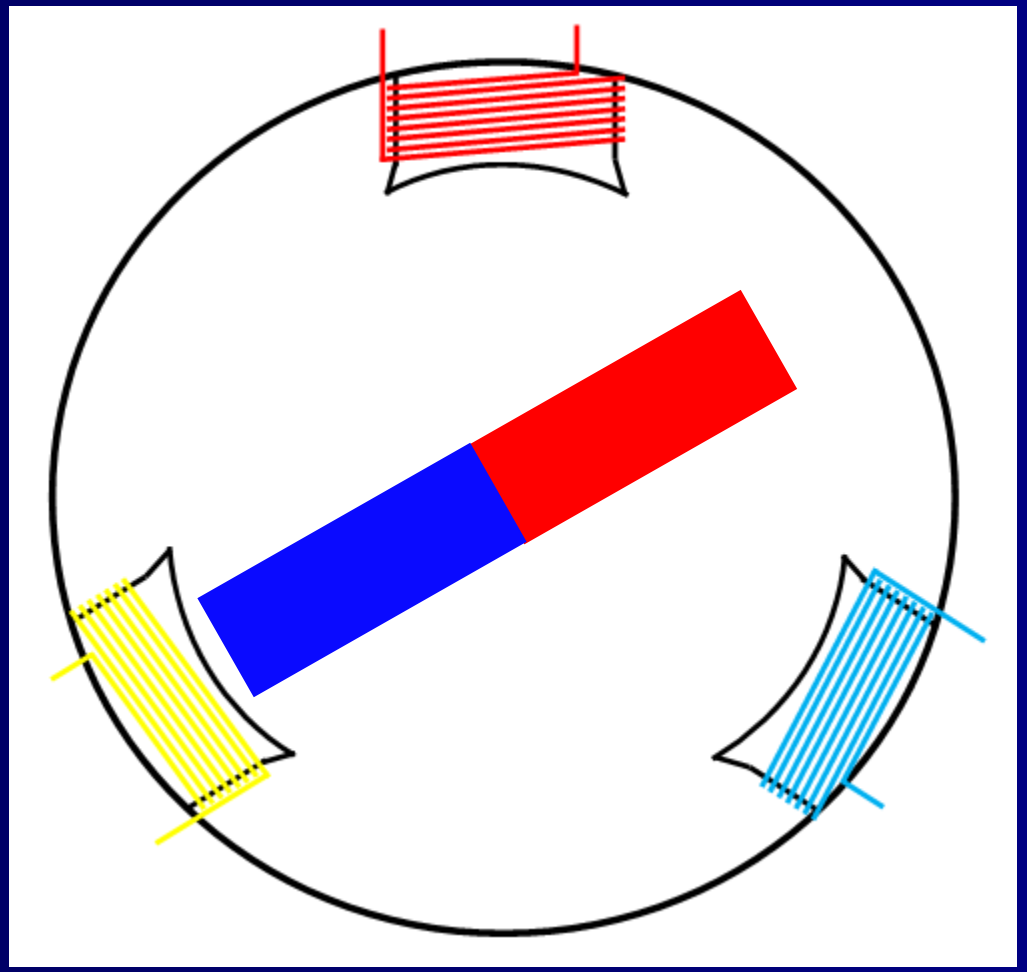
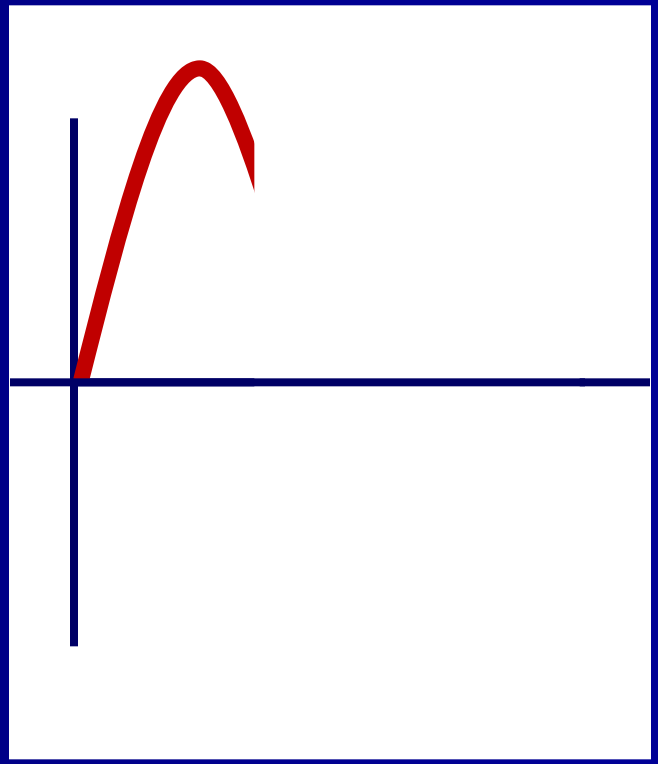
Three Phase AC Generator Windings





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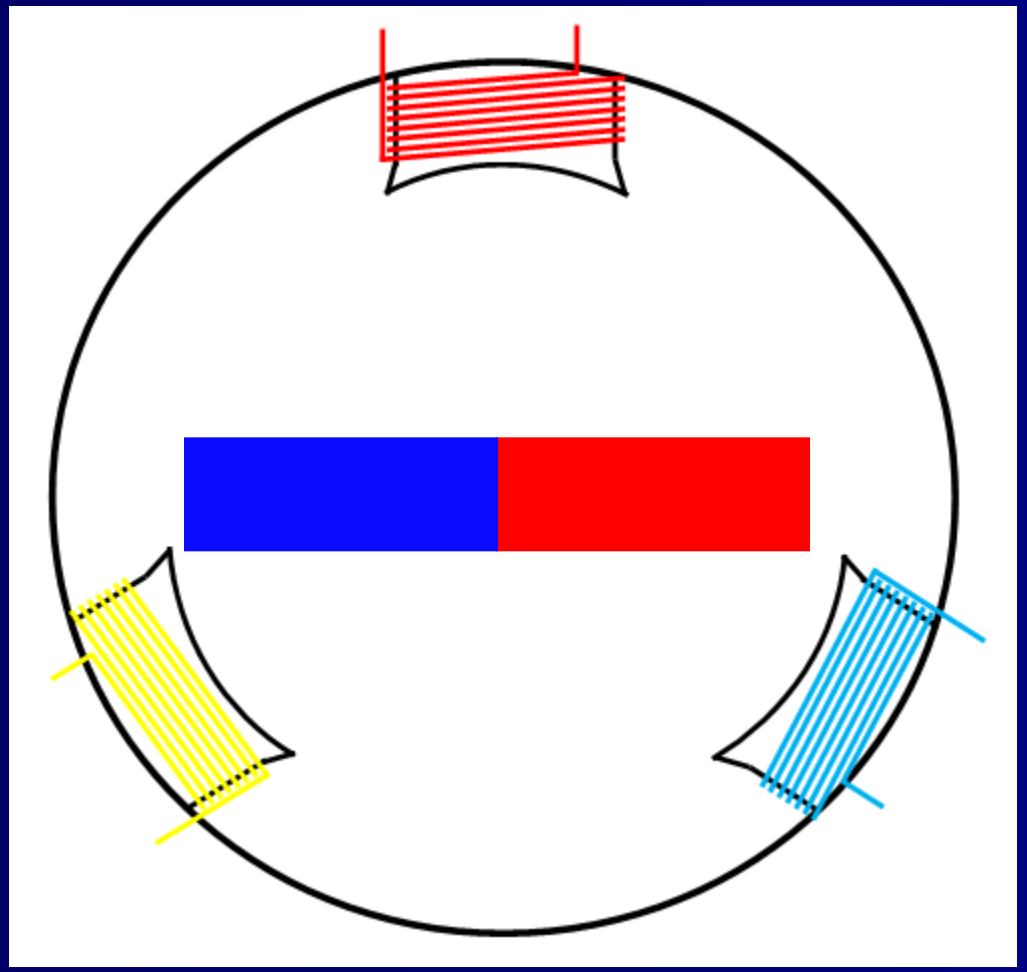
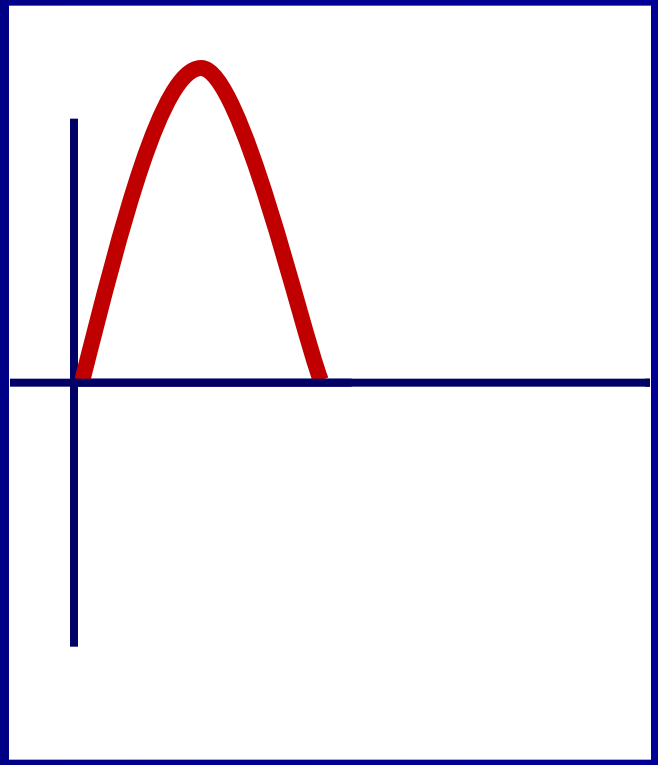
Three Phase AC Generator Windings





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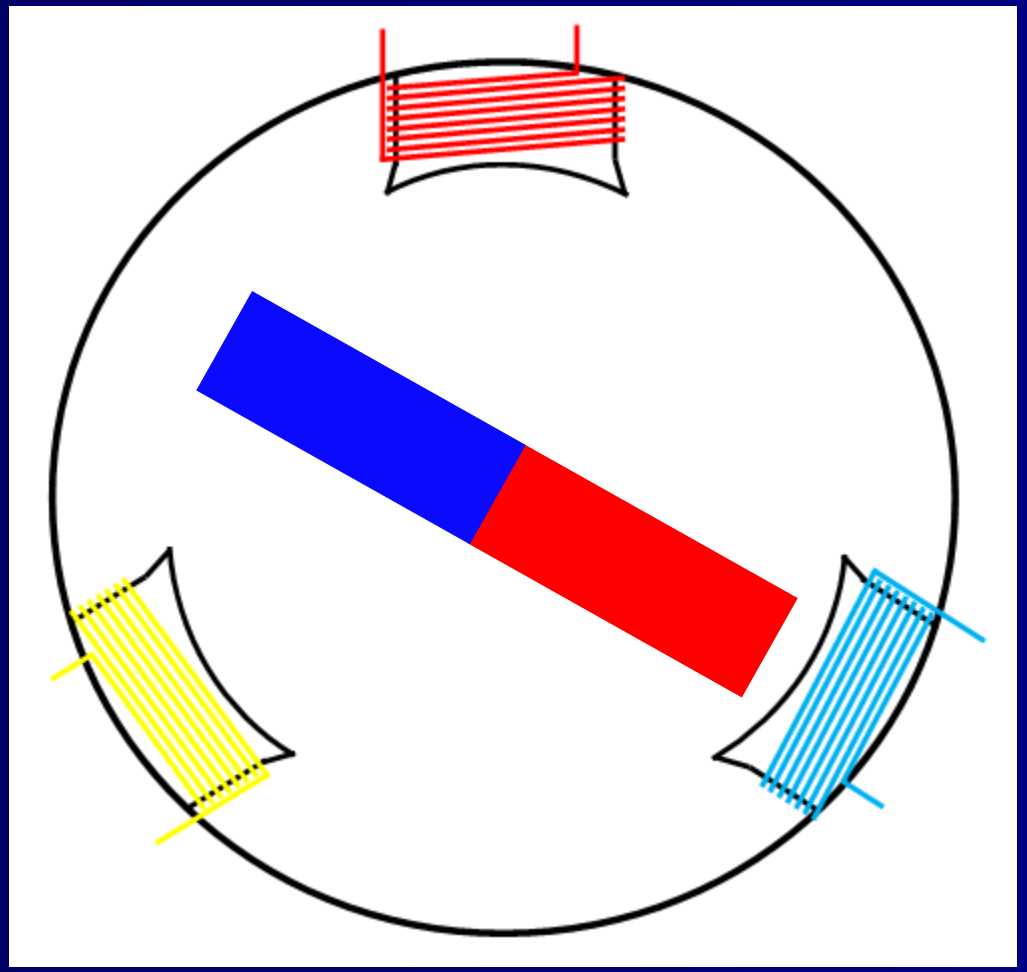
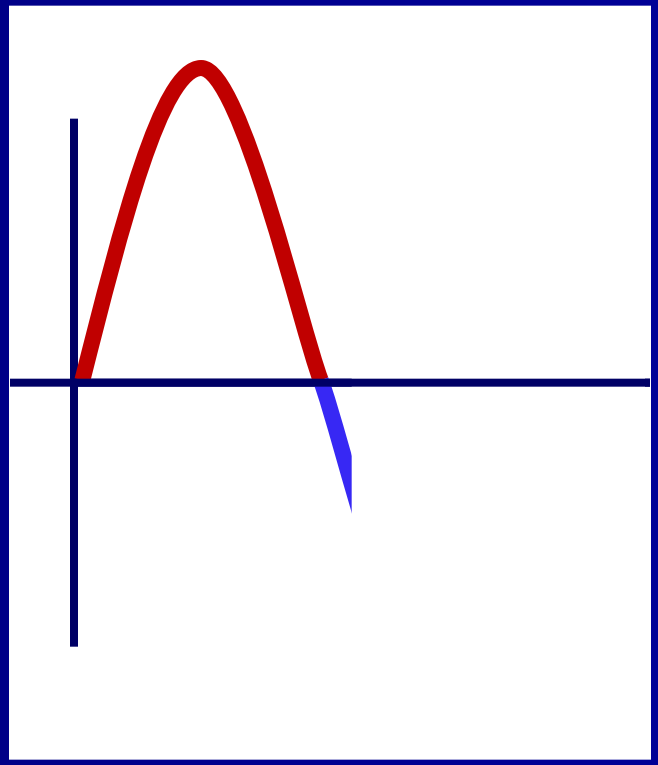
Three Phase AC Generator Windings





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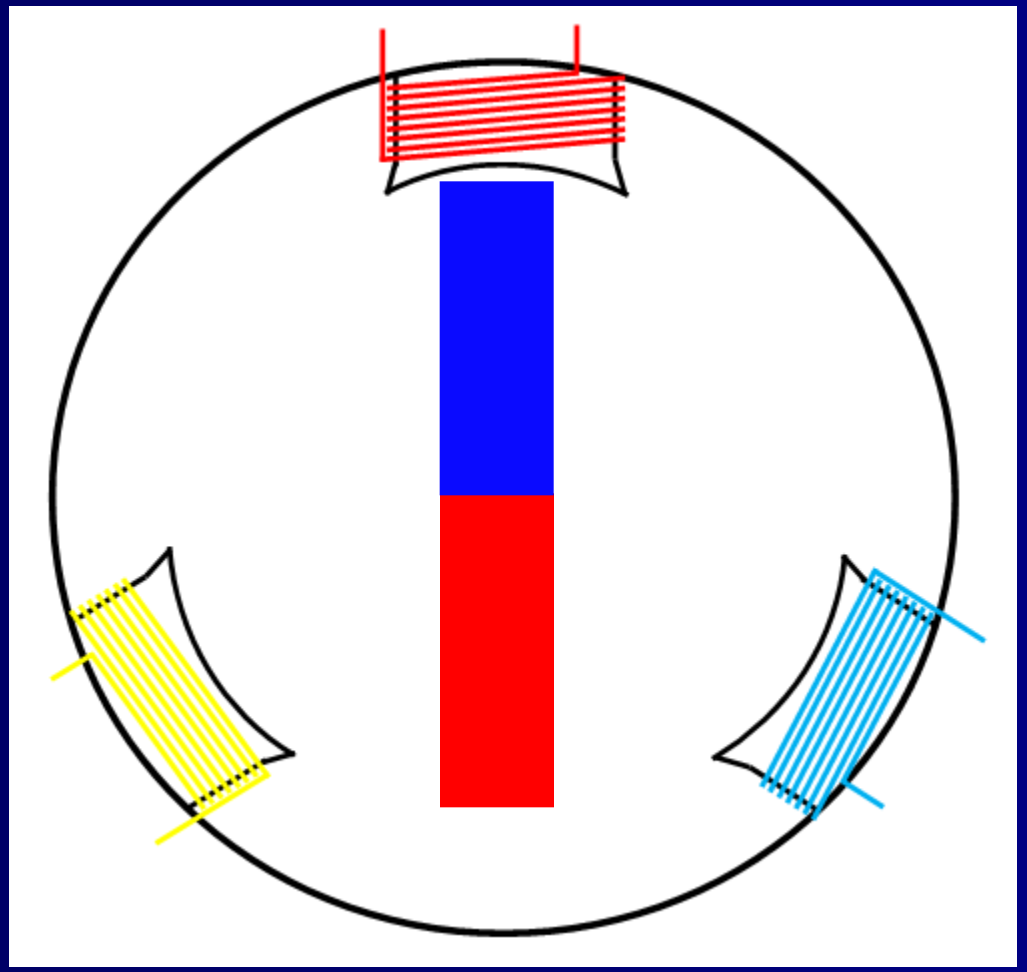
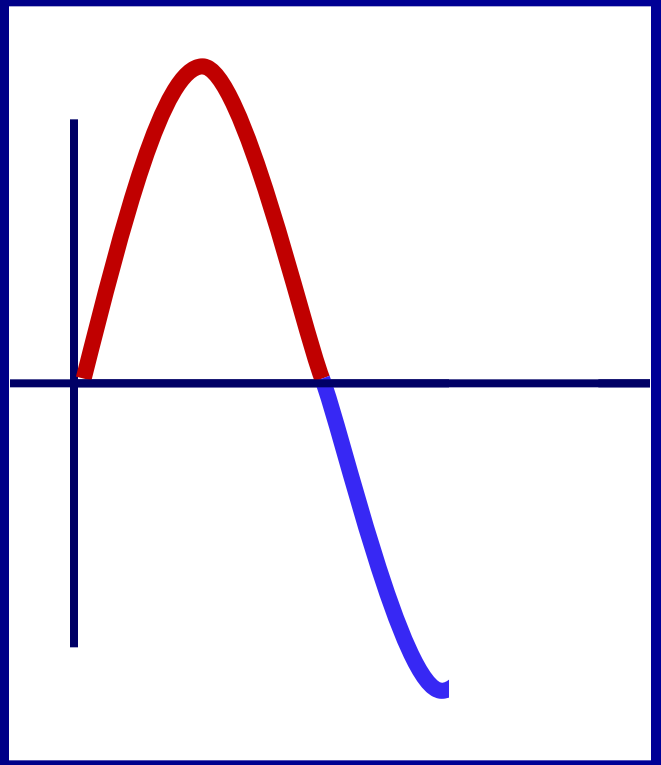
Three Phase AC Generator Windings





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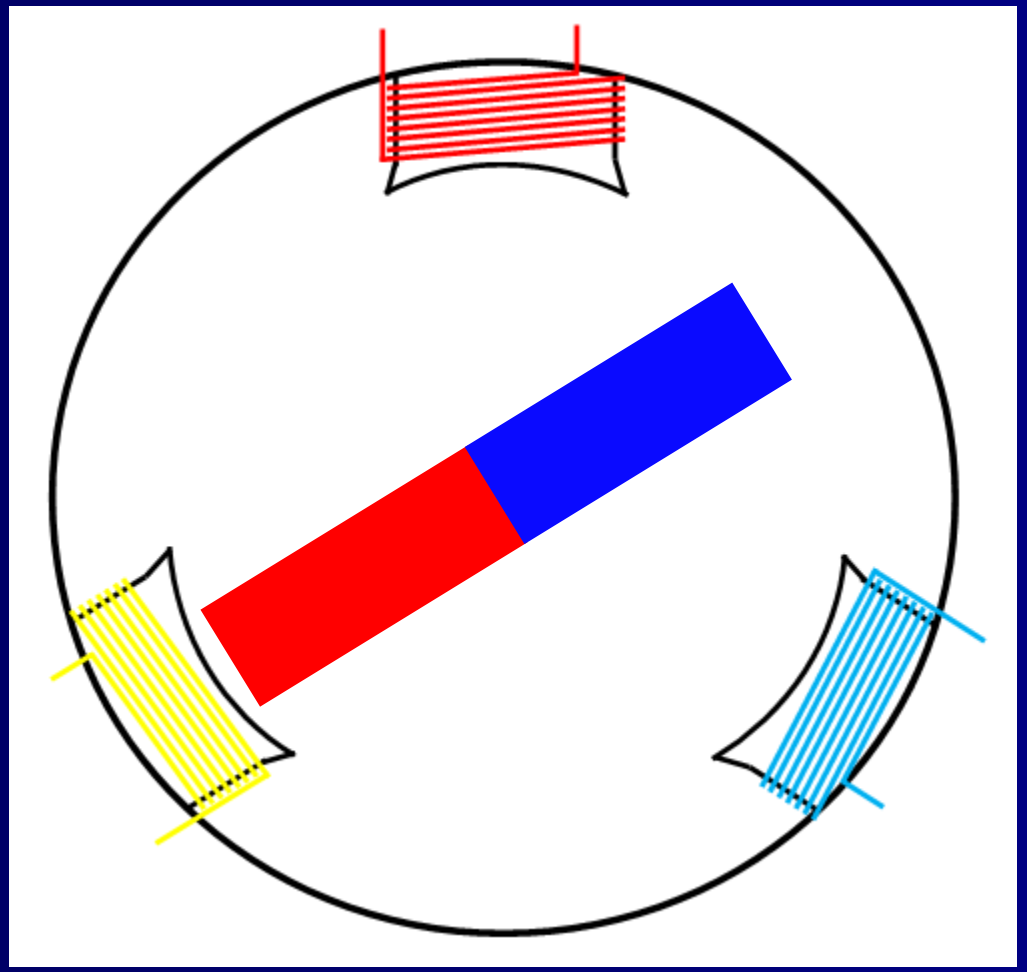
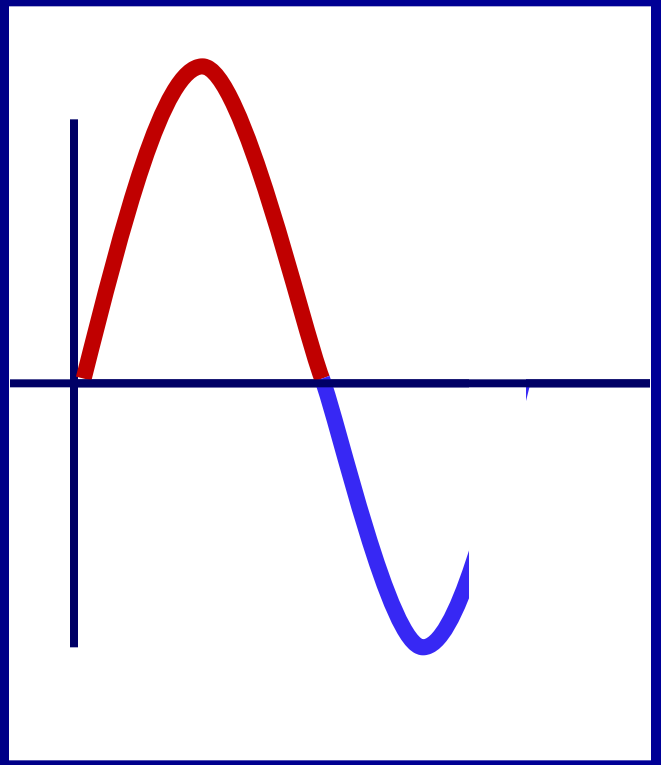
Three Phase AC Generator Windings





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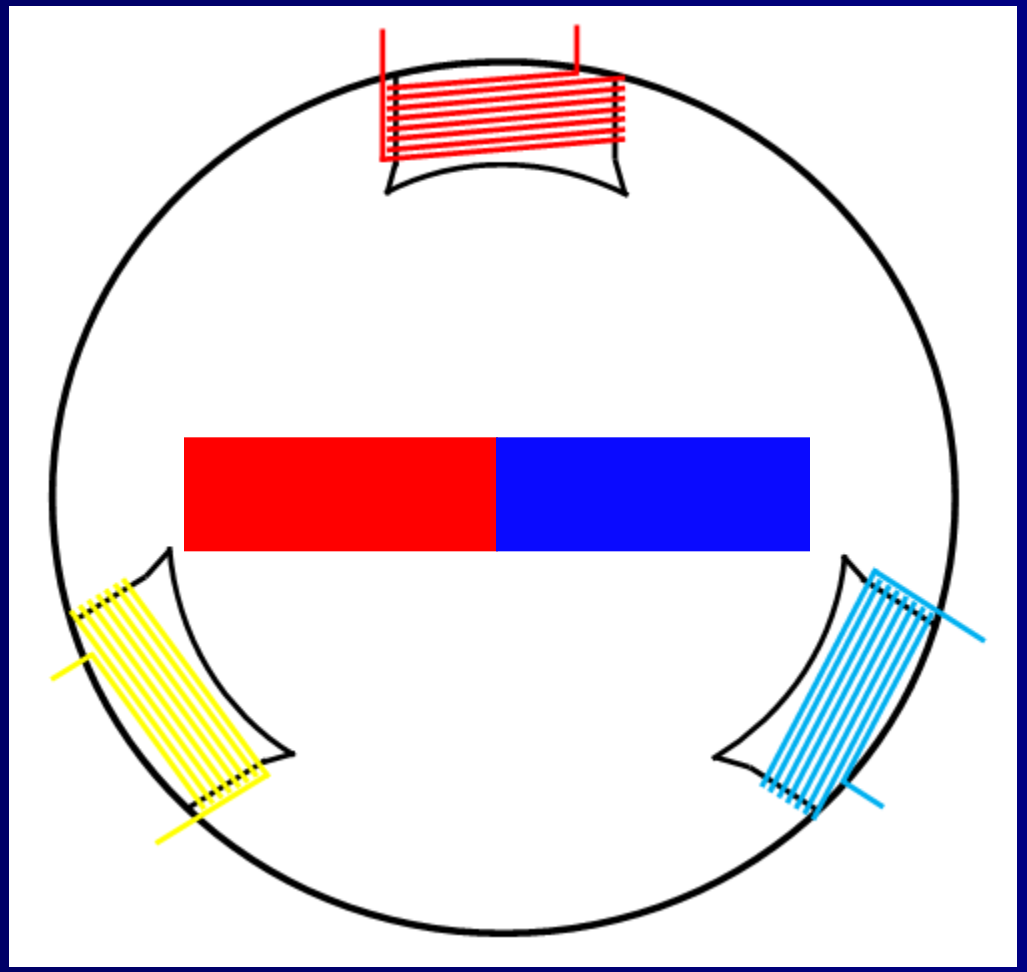
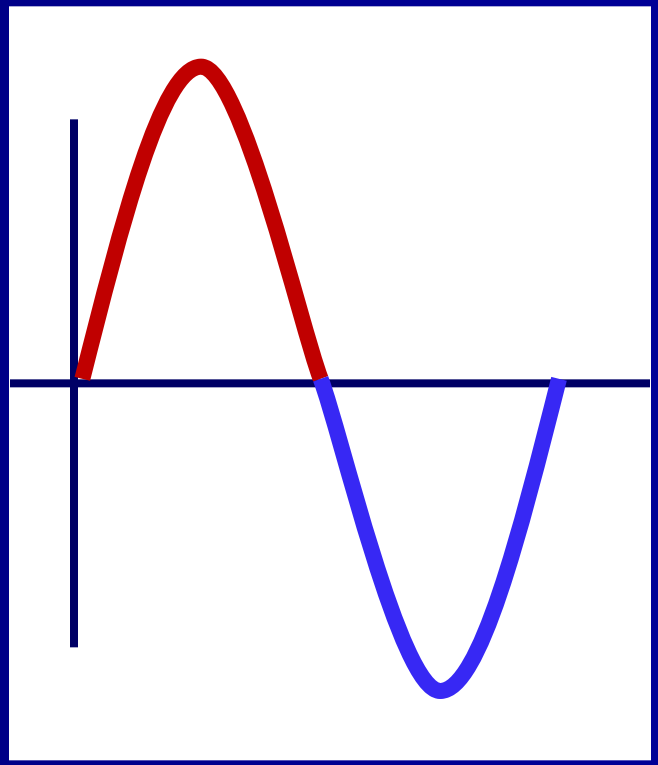
Three Phase AC Generator Windings





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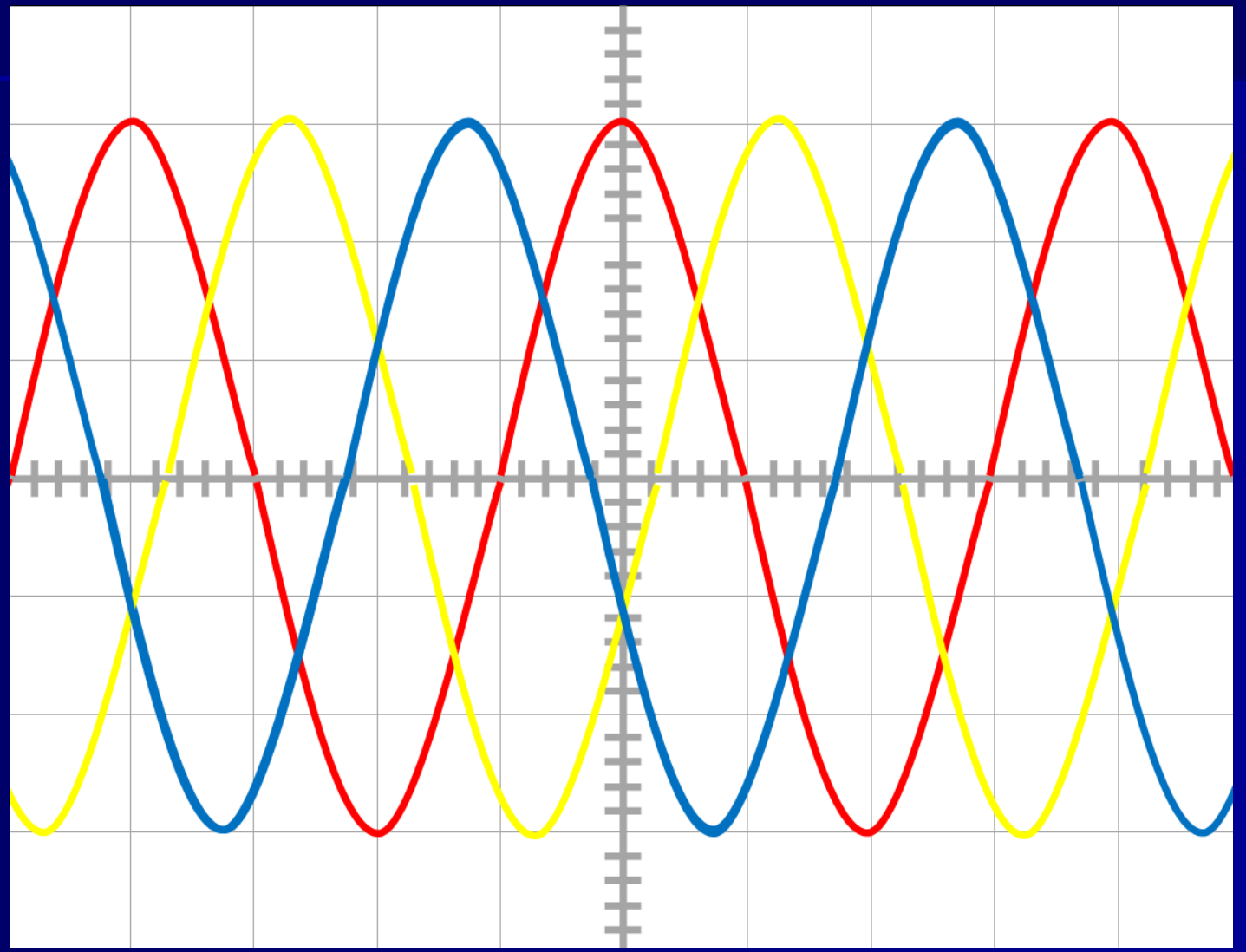
Three Phase Supply Rotation



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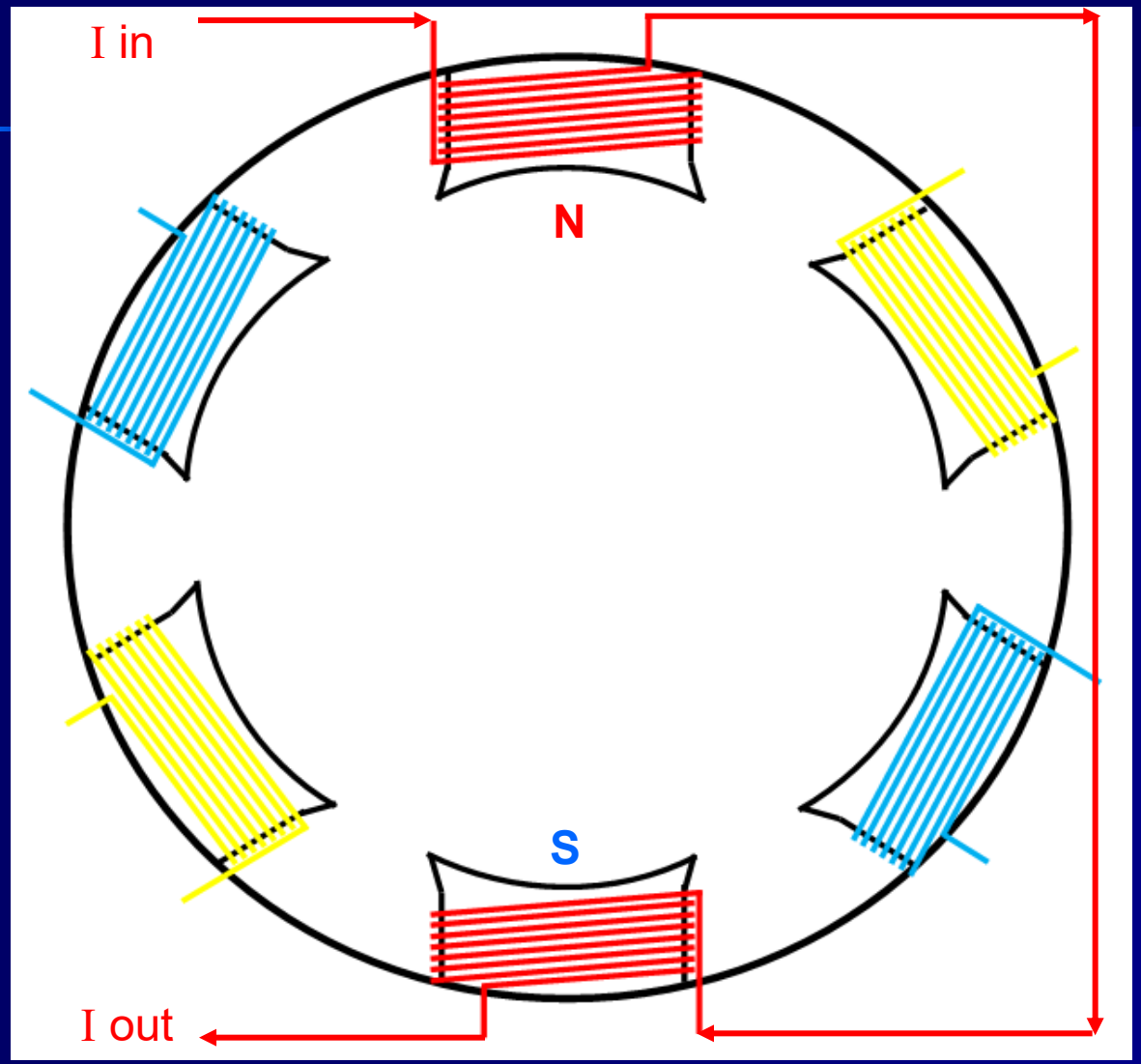
Motor Stator Windings



3Φ AC induction motors are wound to give us pole pairs, North & South for opposite pole faces. Here we have a 2-pole motor i.e., 2 poles per phase or 1 pole pair per phase

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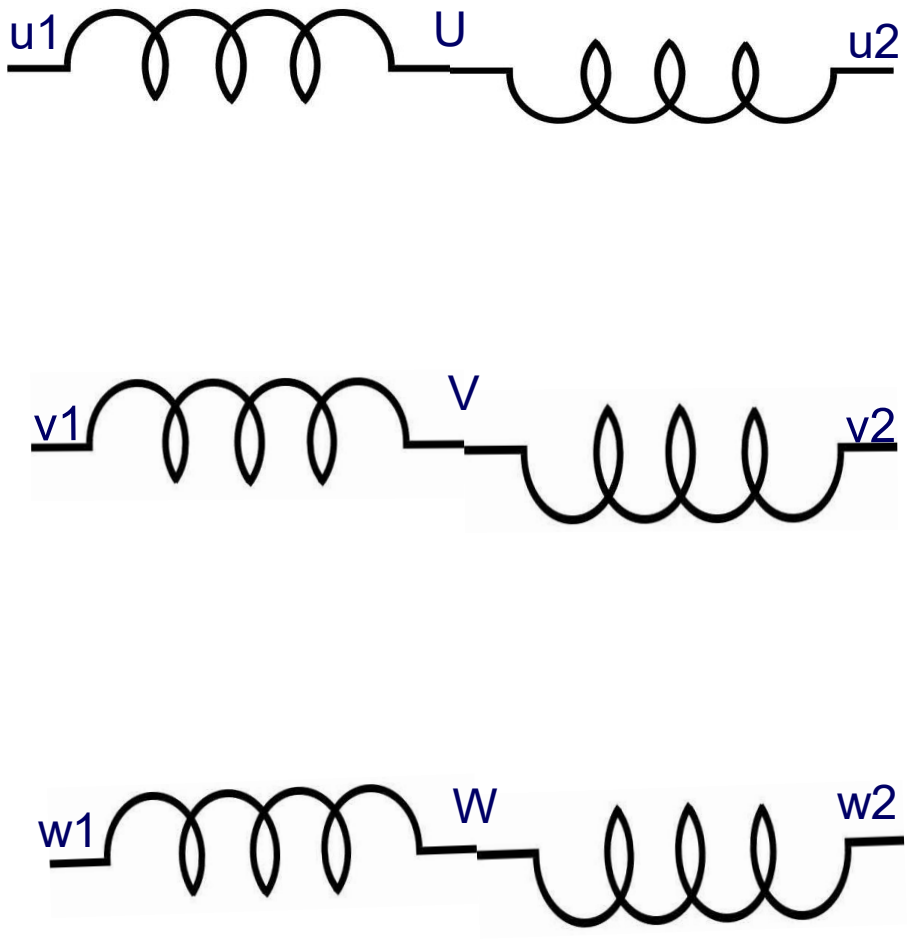

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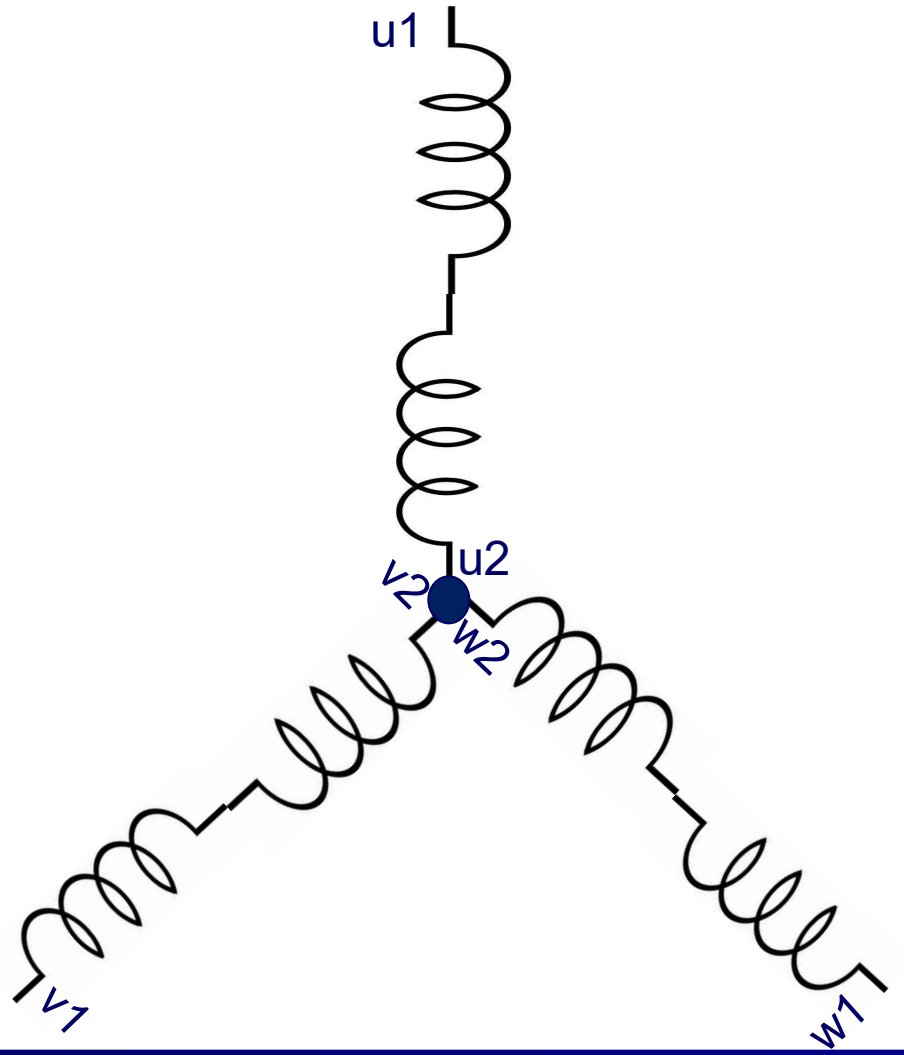
STAR CONNECTED



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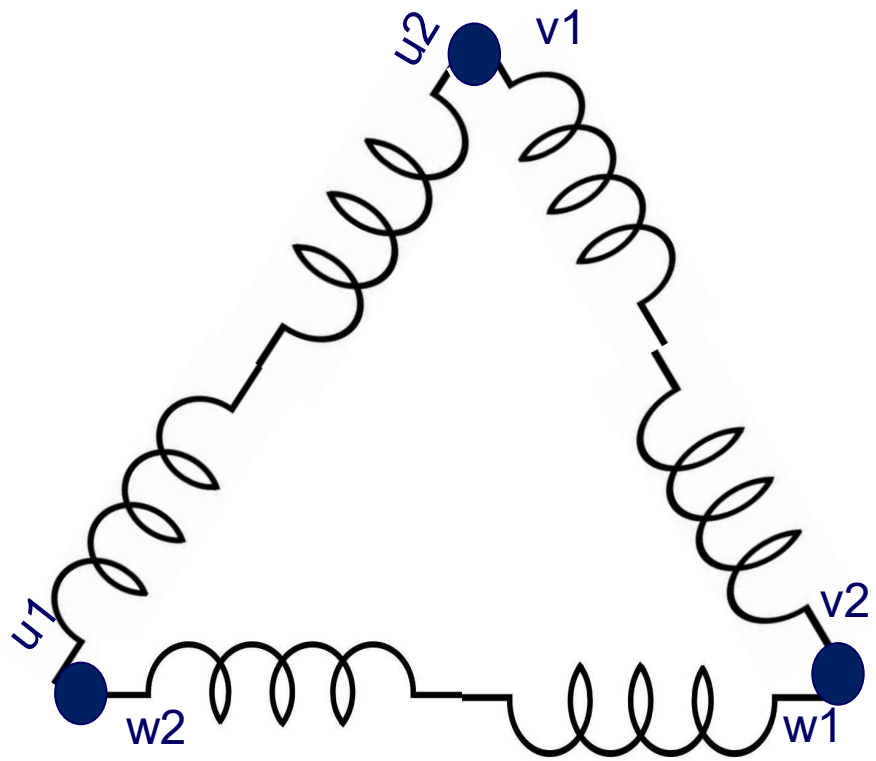

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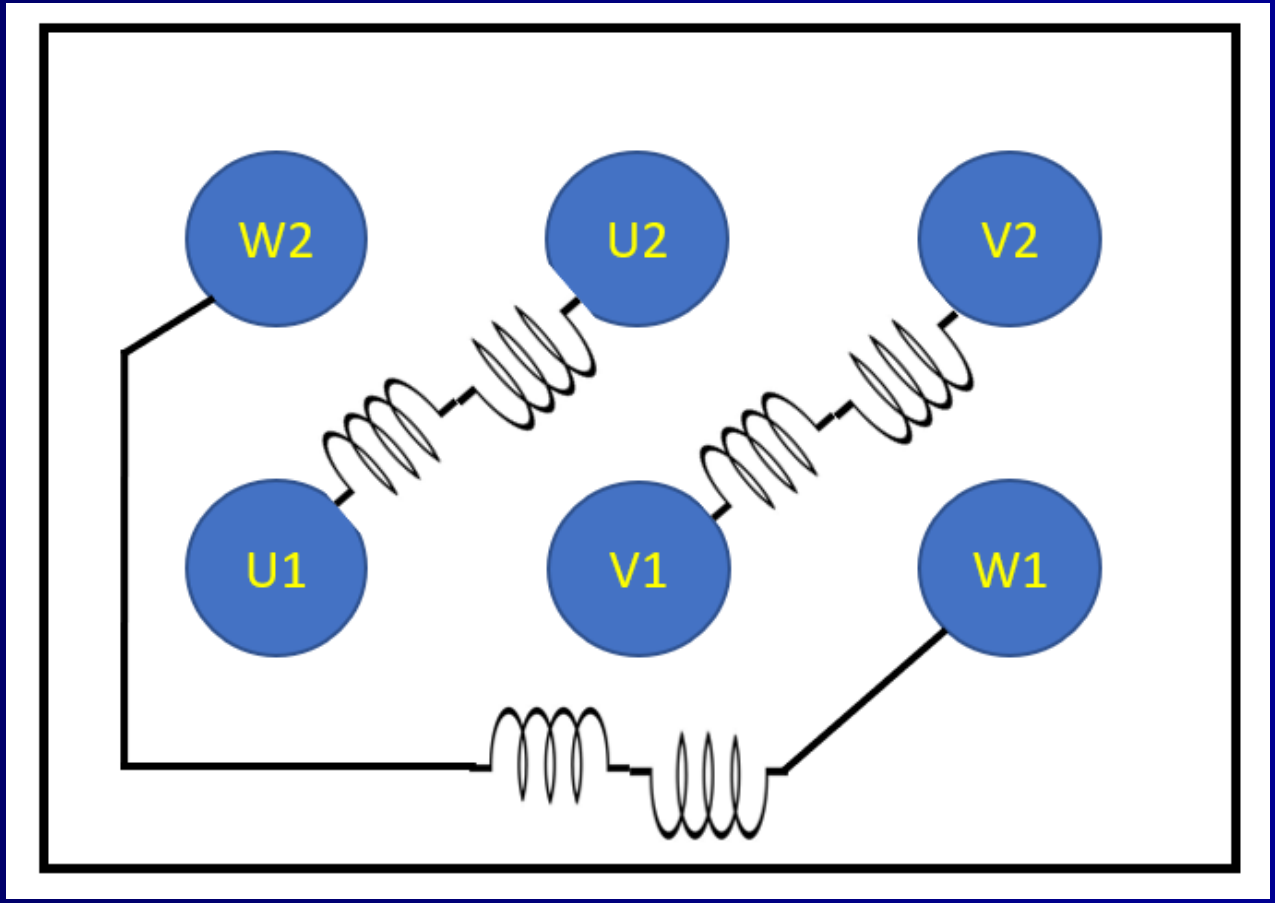
Terminal Box Configuration



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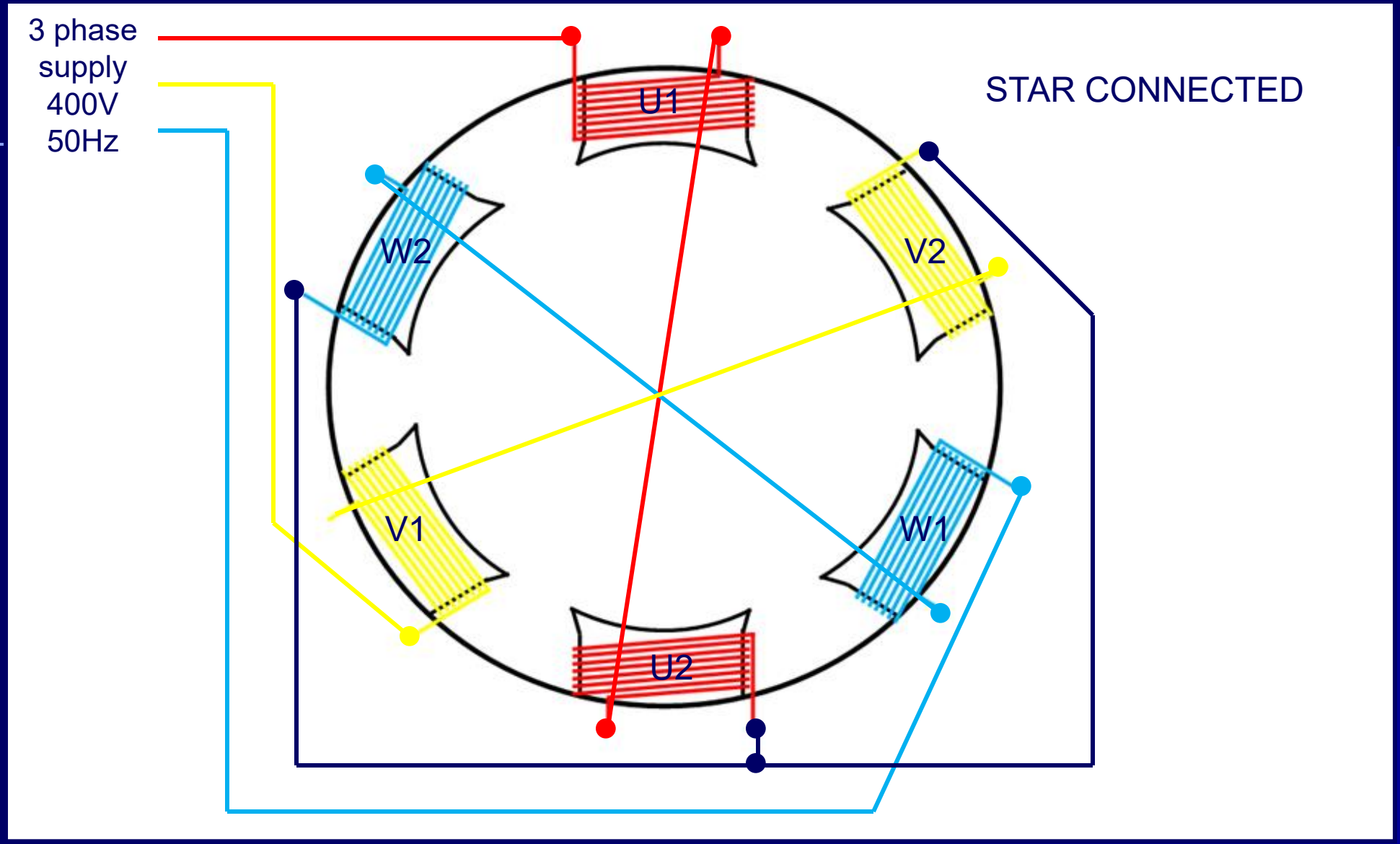

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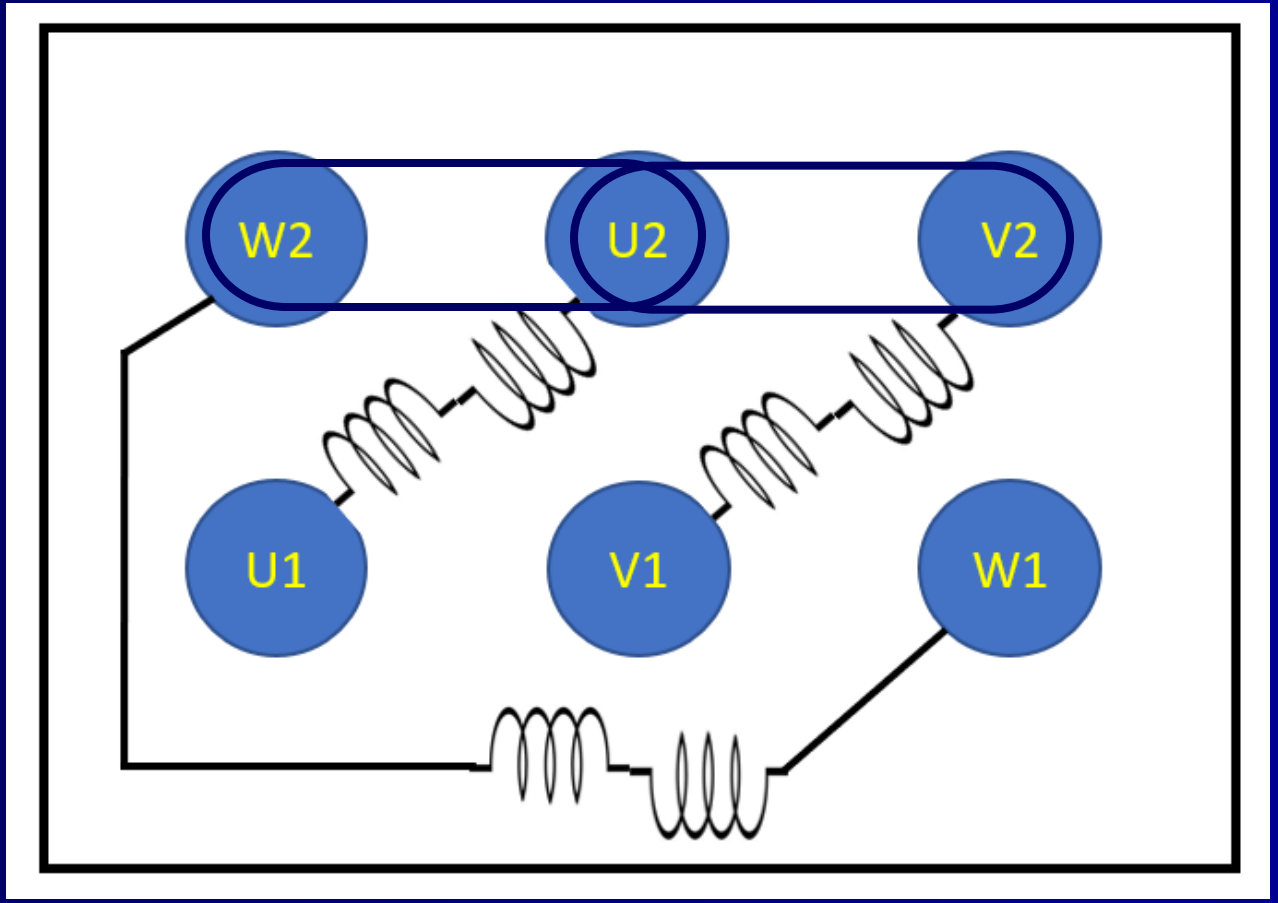
Terminal Box Star linked for Star



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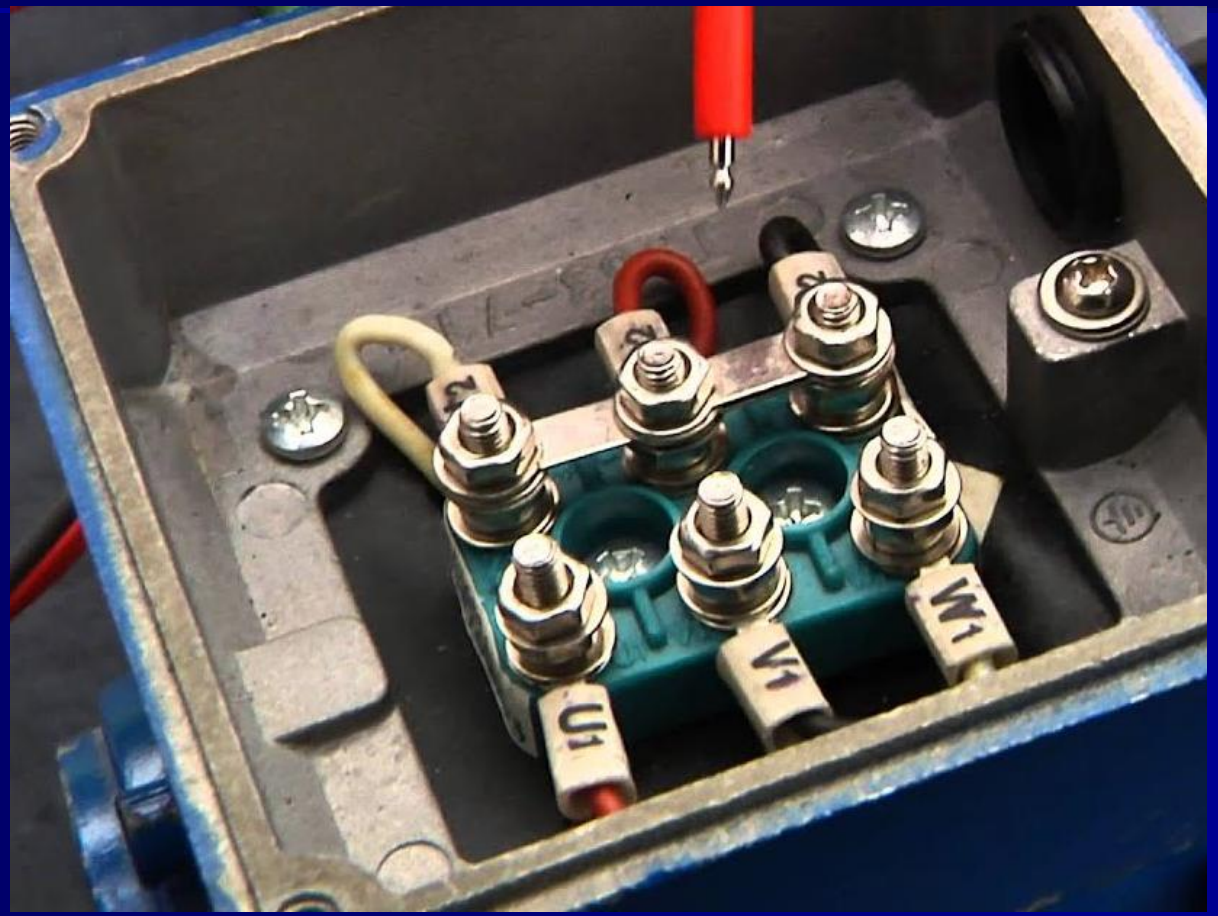
Motor Links



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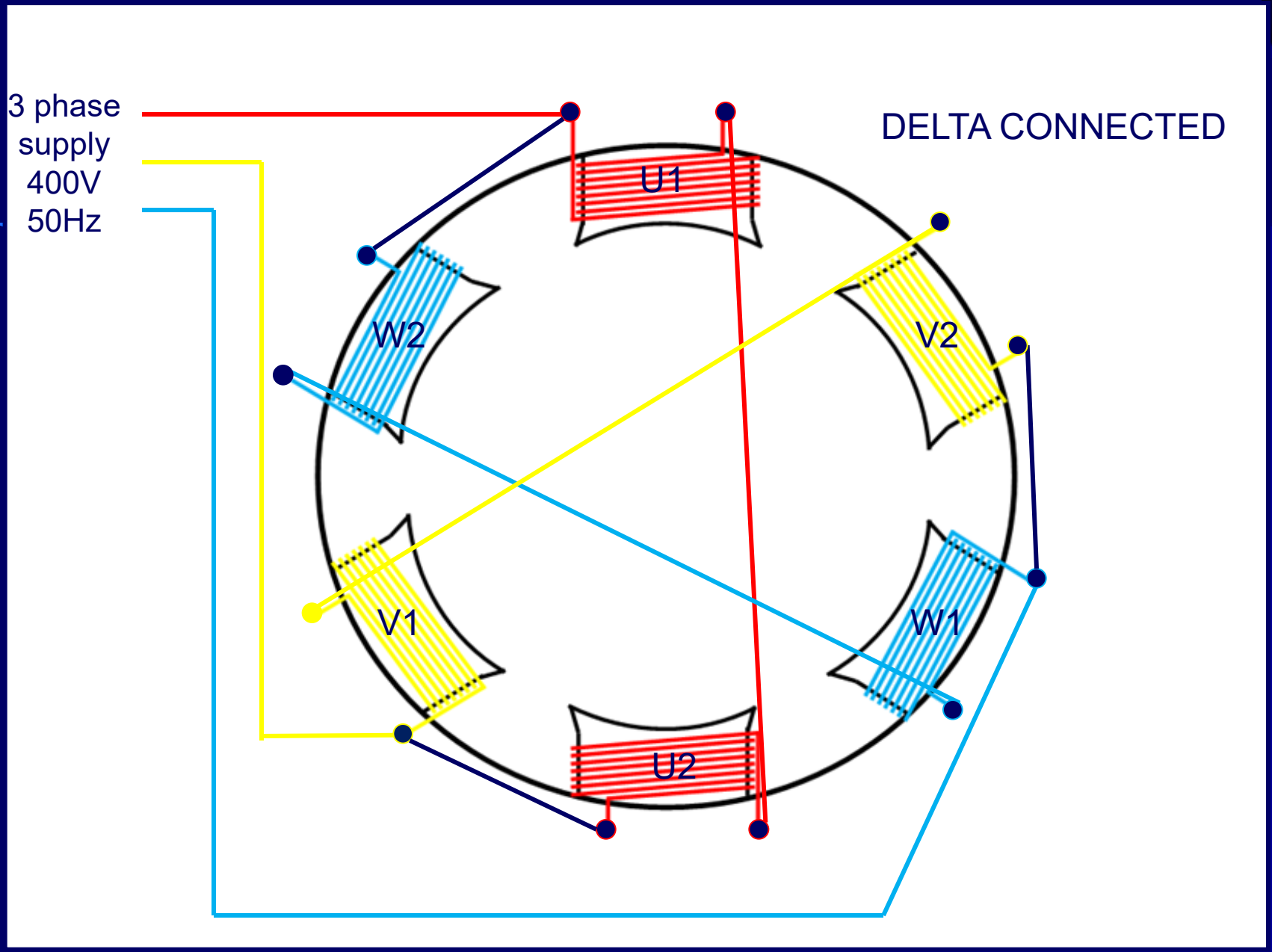

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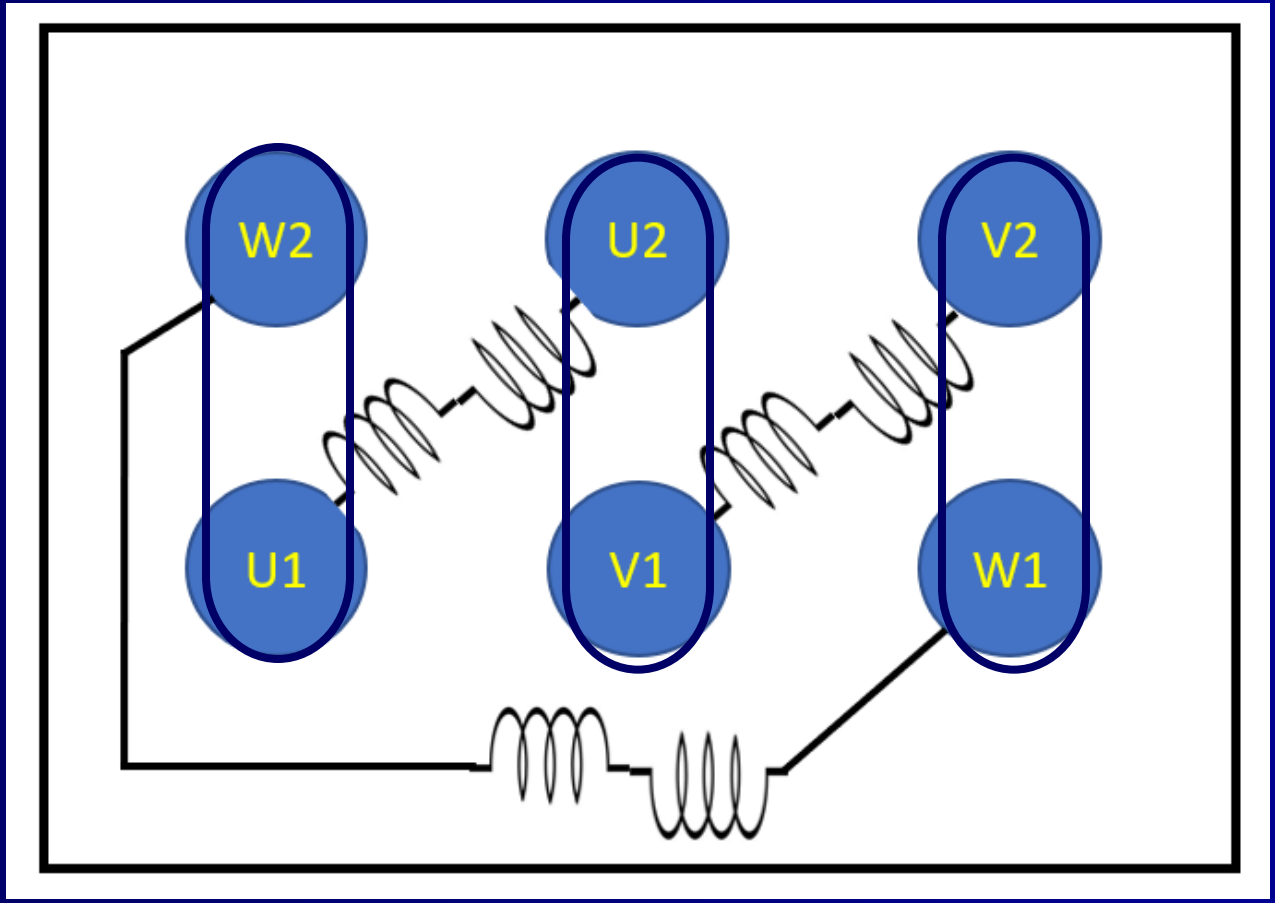
Terminal Box linked for Delta



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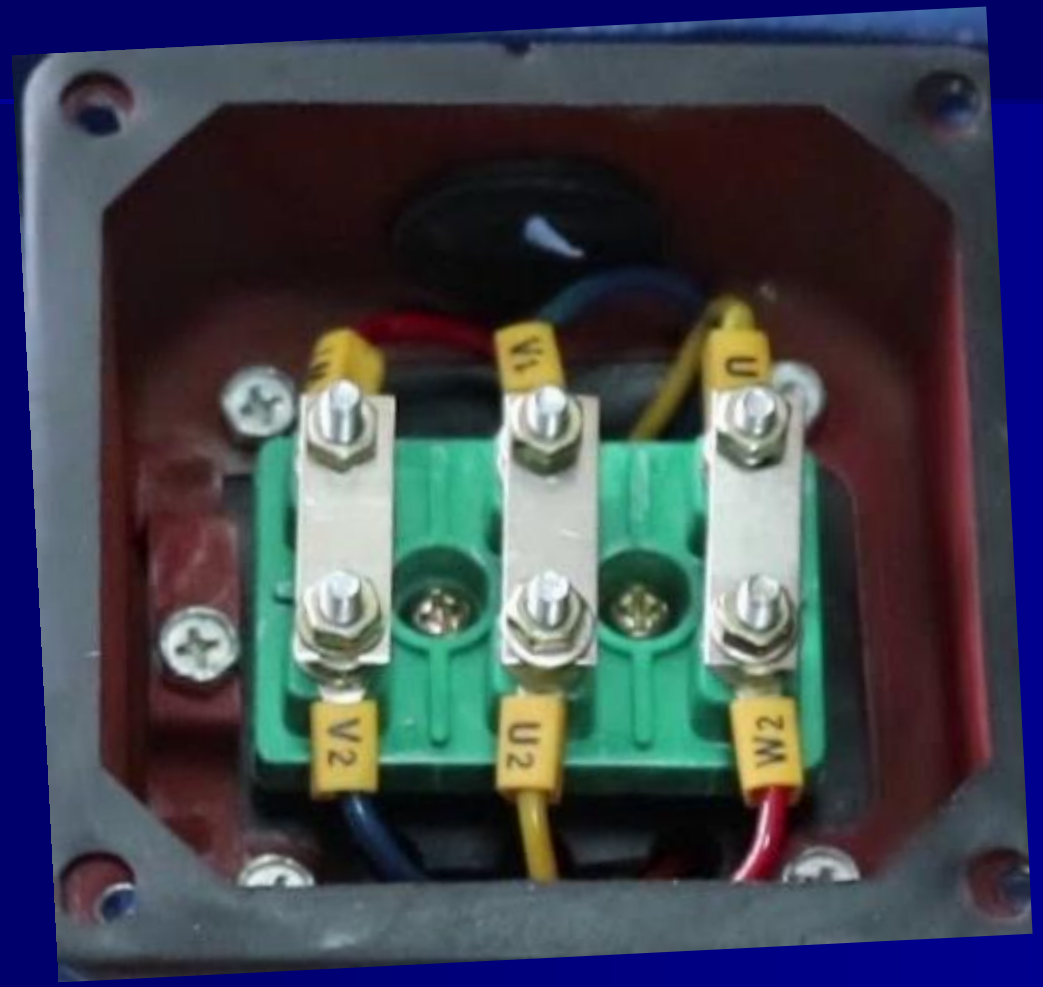
Motor Links



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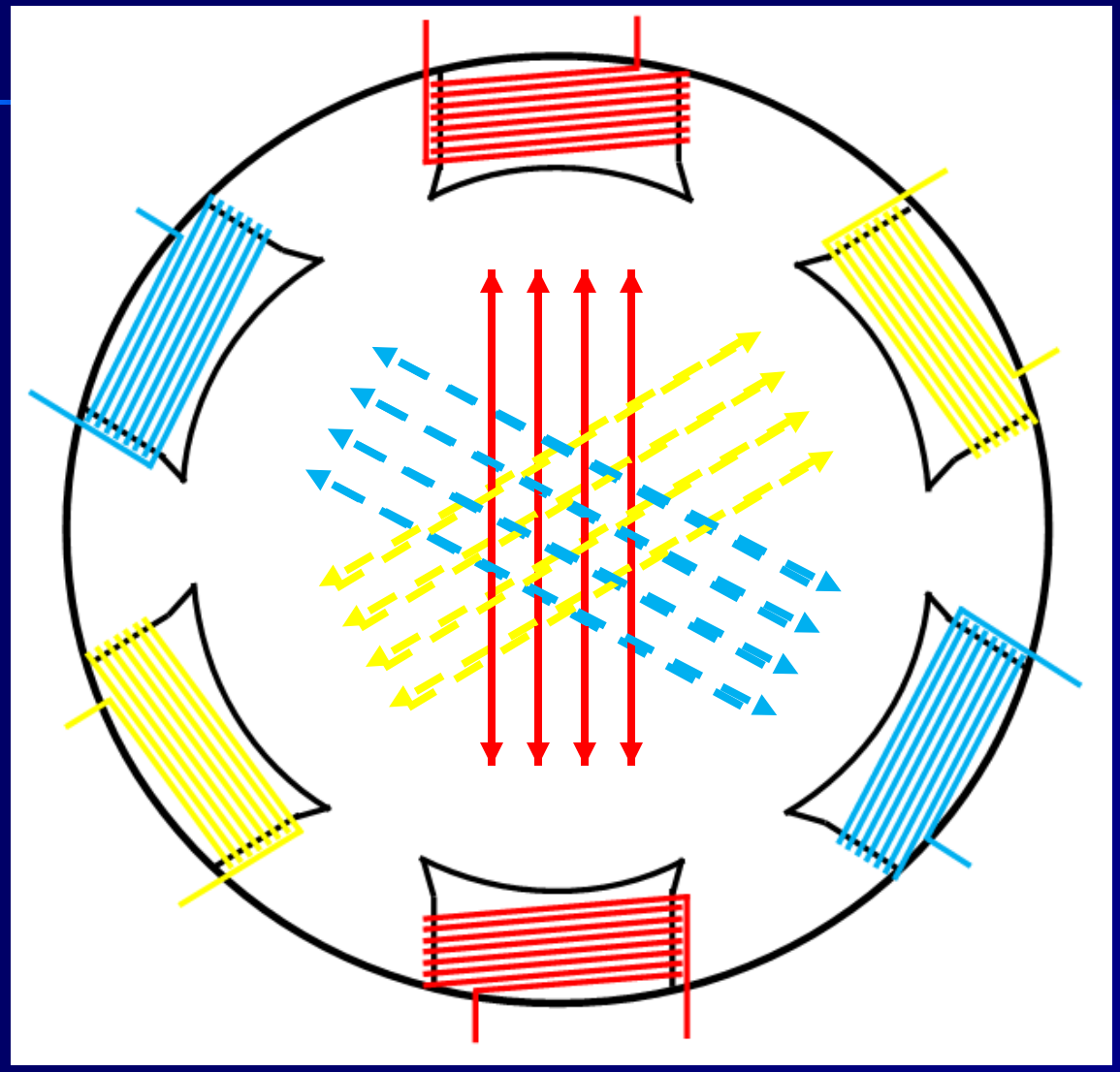
Three Phase Stator Windings



With the three windings now configured for STAR or DELTA we can create pole faces that concentrate the magnetic fields as each phase peaks

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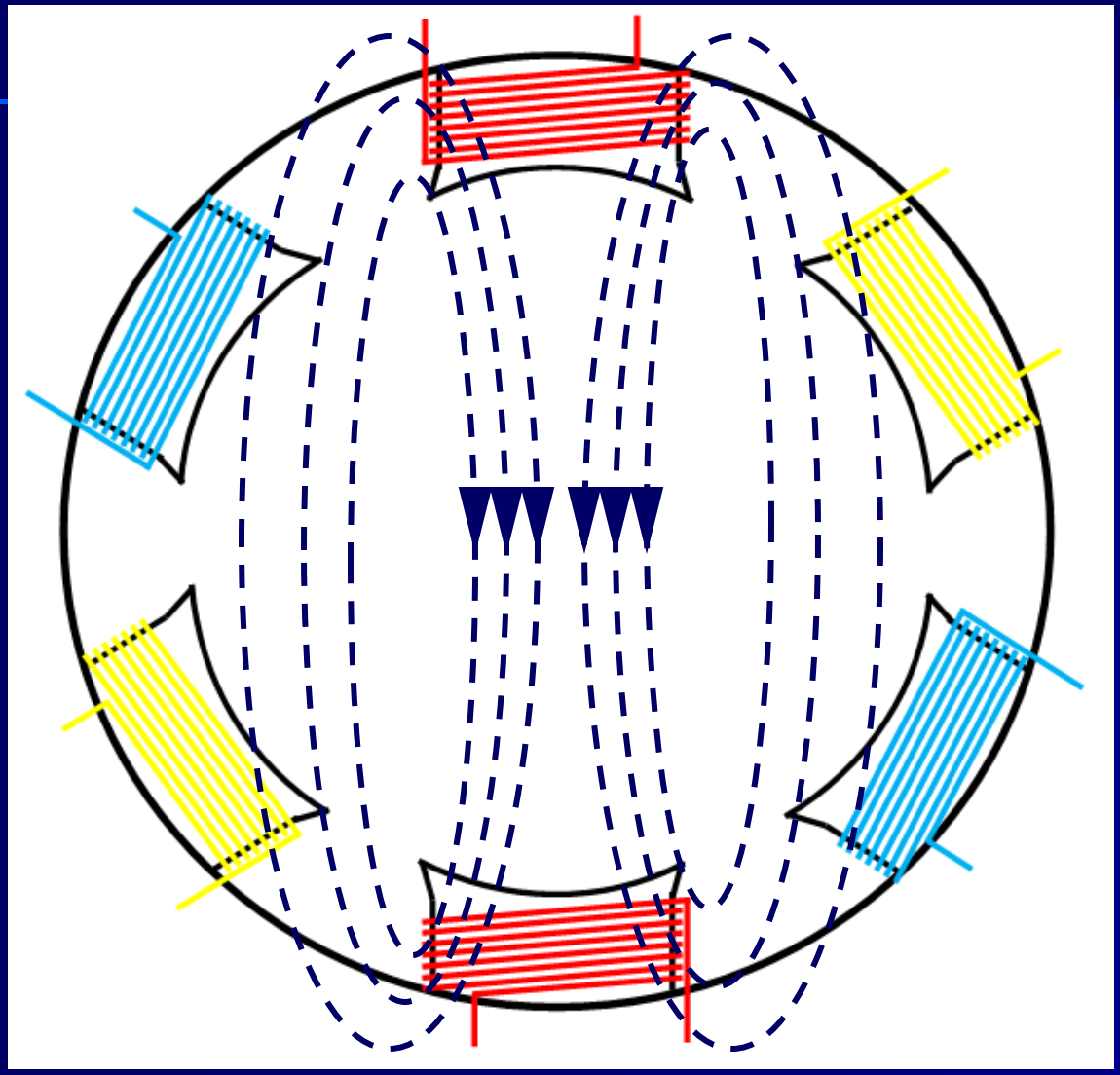
Three Phase Stator Windings



The magnetic field will adopt the standard pattern created by a solenoid and due to phase rotation, it will appear to rotate

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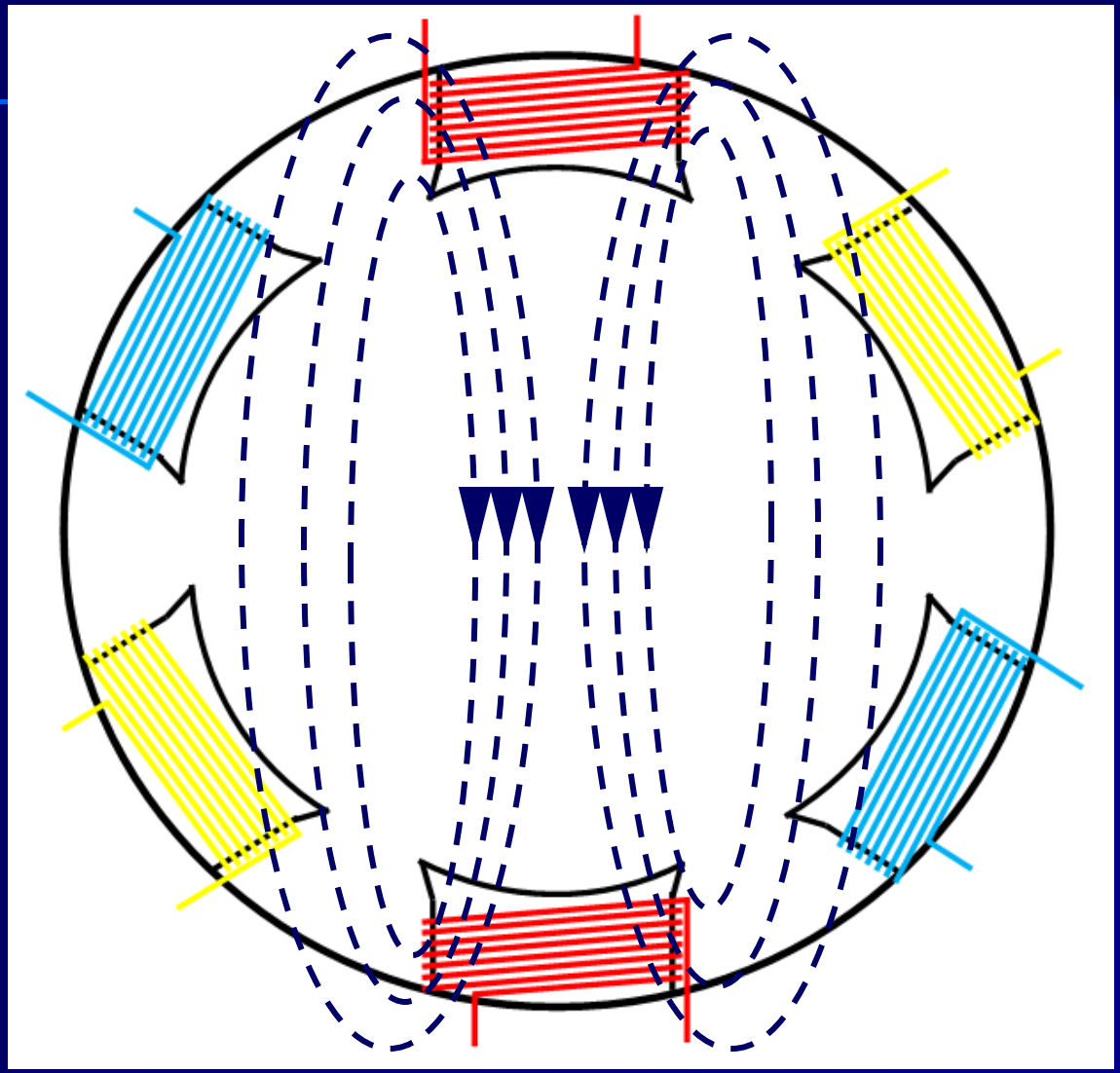
Three Phase Stator Windings



The magnetic field will adopt the standard pattern created by a solenoid and due to phase rotation, it will appear to rotate

UK once every 20 milliseconds (50Hz)

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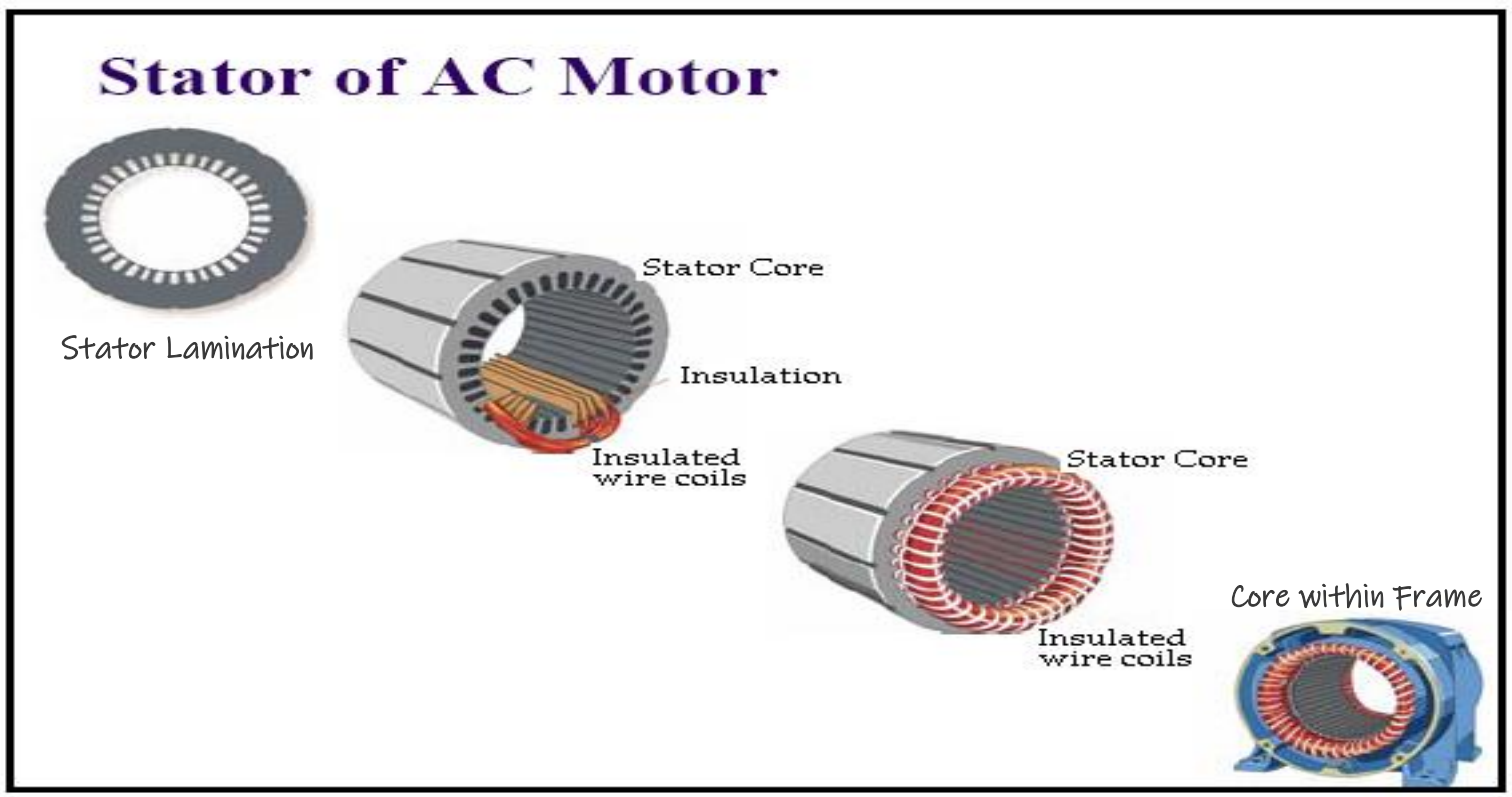
AC Cage Induction Motor

This machine uses the same basic principles of motors but also utilises some of the technology of generators and is essentially consisting of two main parts.

Stator



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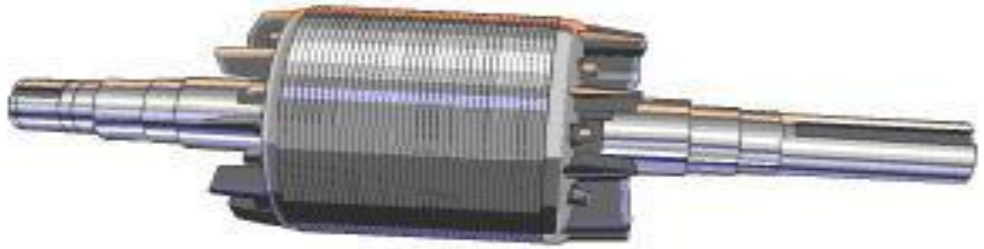
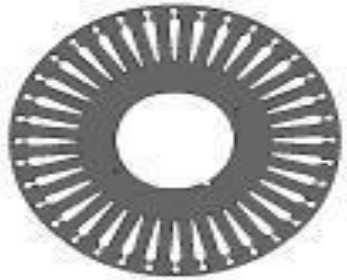
AC Cage Induction Motor

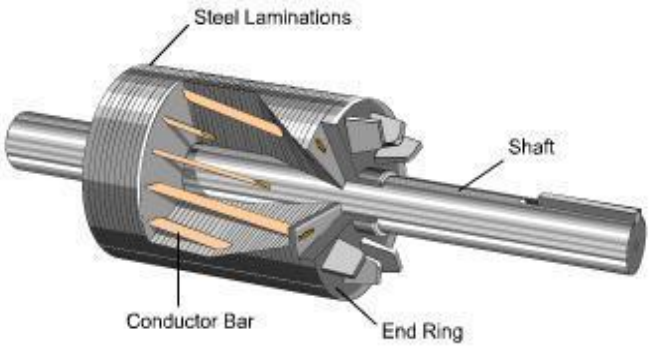
Cage Rotor



Rotor



Rotor Lamination



Cutaway View of Rotor



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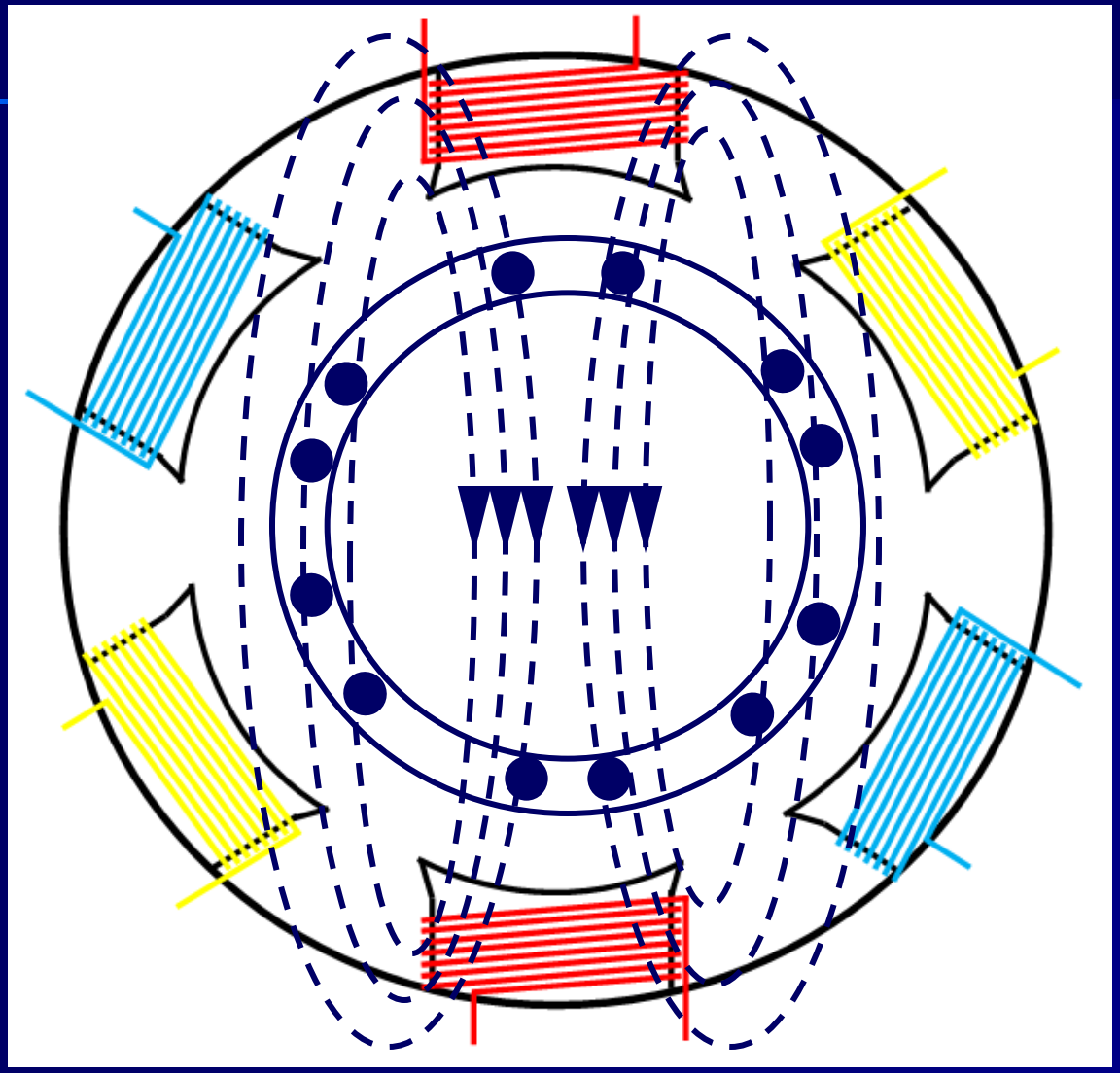
Induction into Rotor



If we now place the cage rotor inside the rotating field of the stator that rotating field will induce a current into the bars of the cage as they are closed loops

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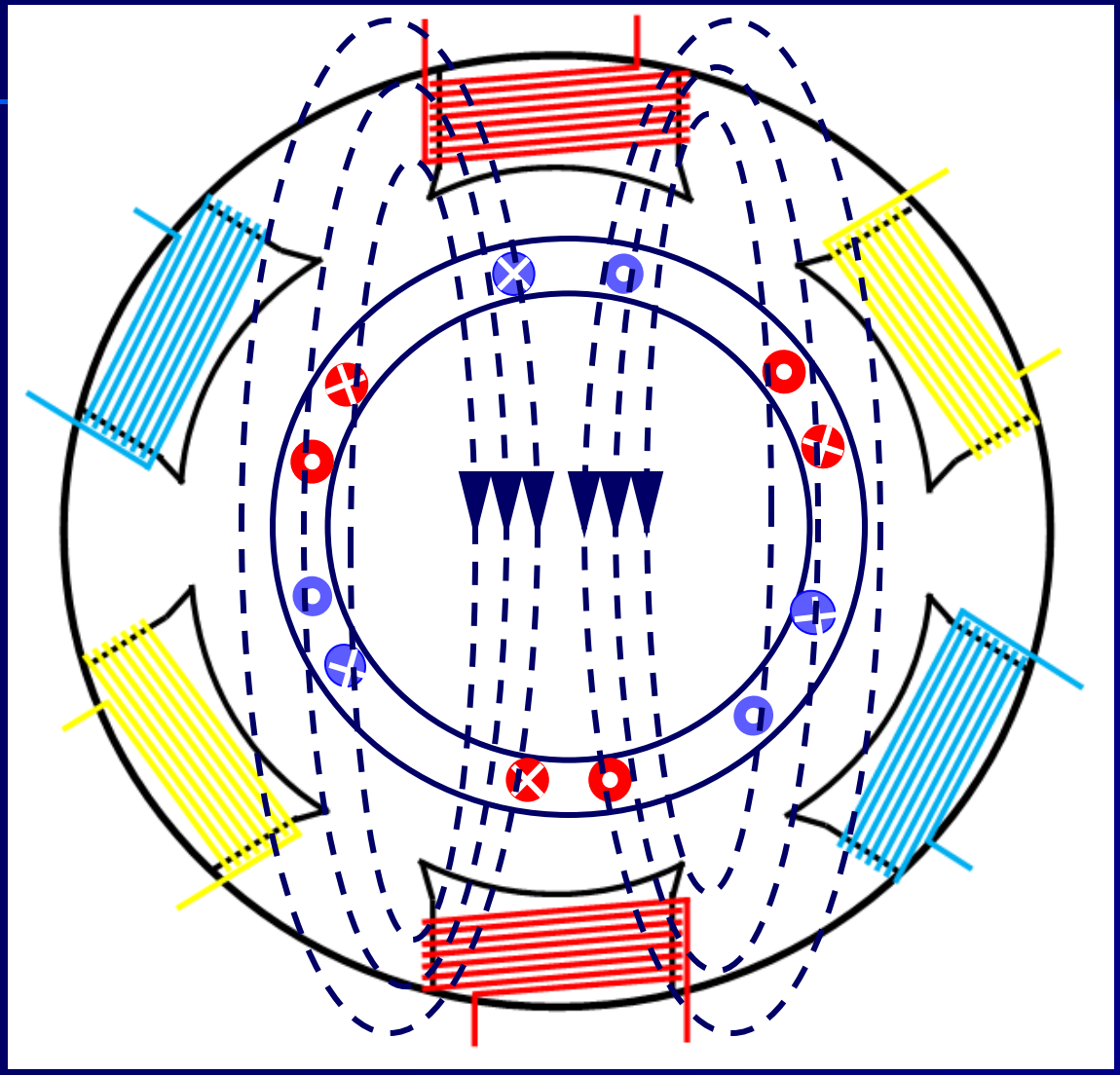
Induction into Rotor



These individual loop currents will create their own fields which will try to lock on to the rotating stator field therefore the rotor will rotate in the direction of the rotating field

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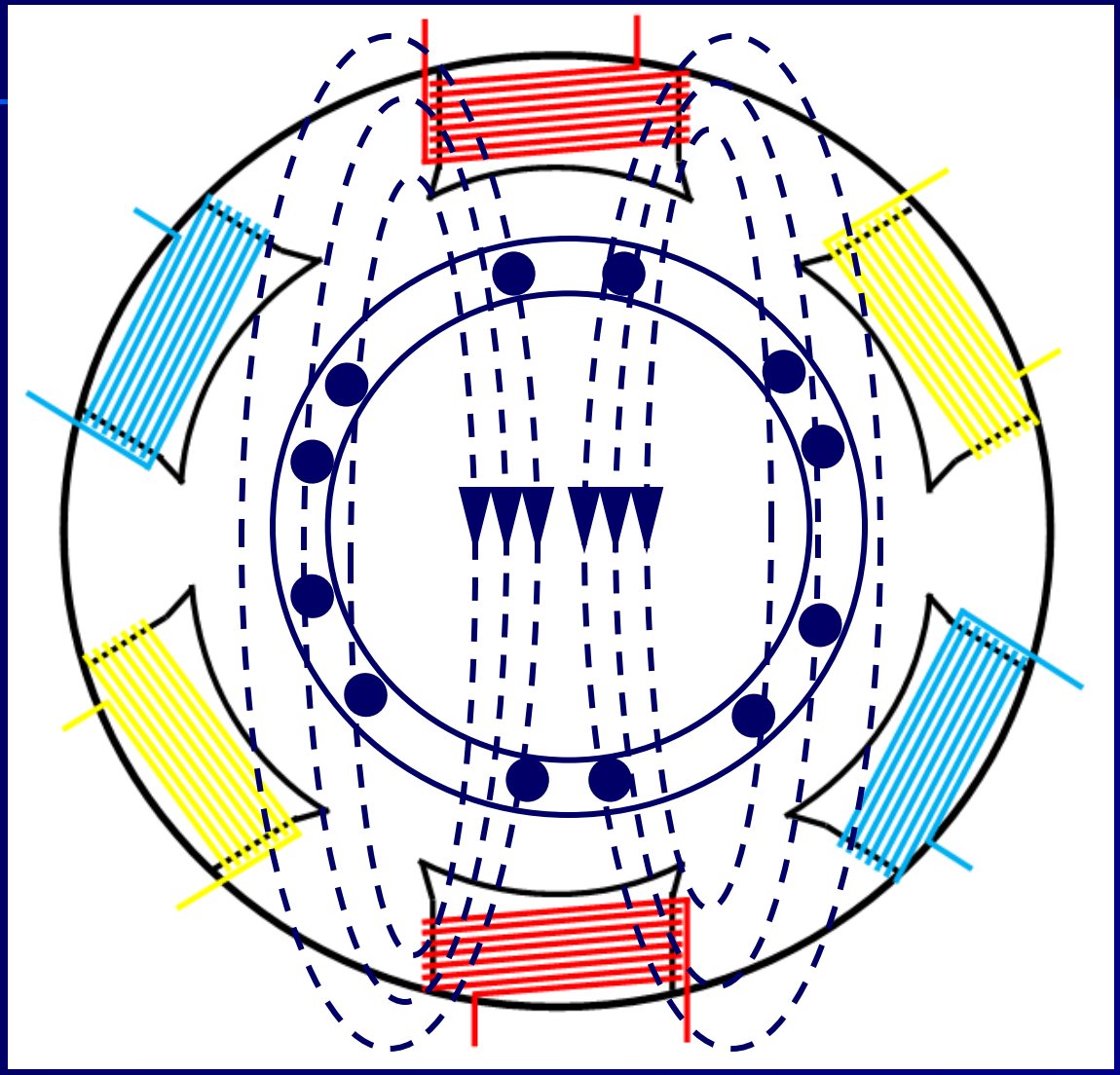
Induction into Rotor



If the rotor catches up to the stator, they will become **synchronous**, and no current will be induced into the rotor bars, and it will slow down

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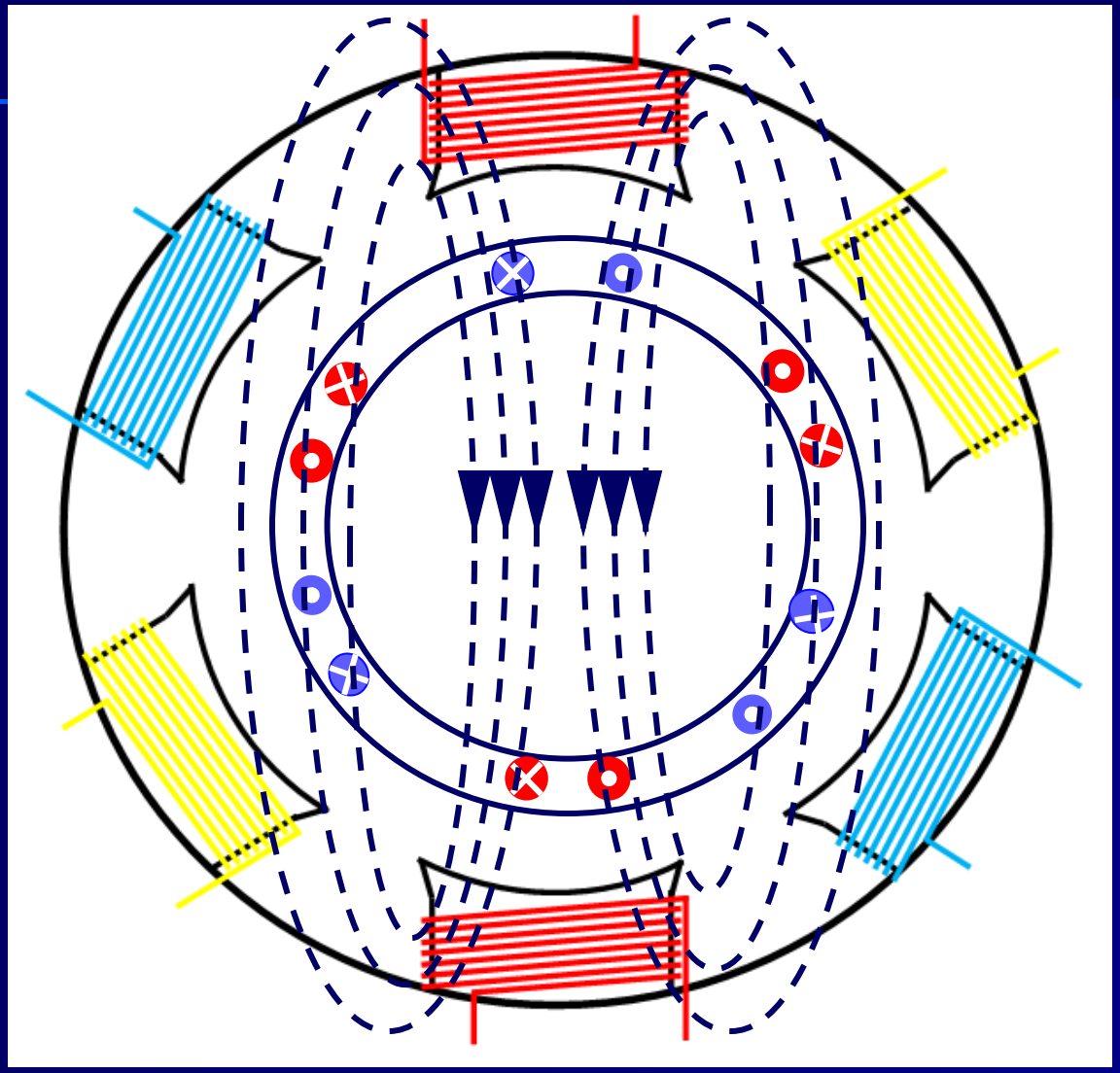
Induction into Rotor



The slowing down of the Rotor speed to less than the Stator field speed re induces current into the Rotor bars and the motor would speed up again

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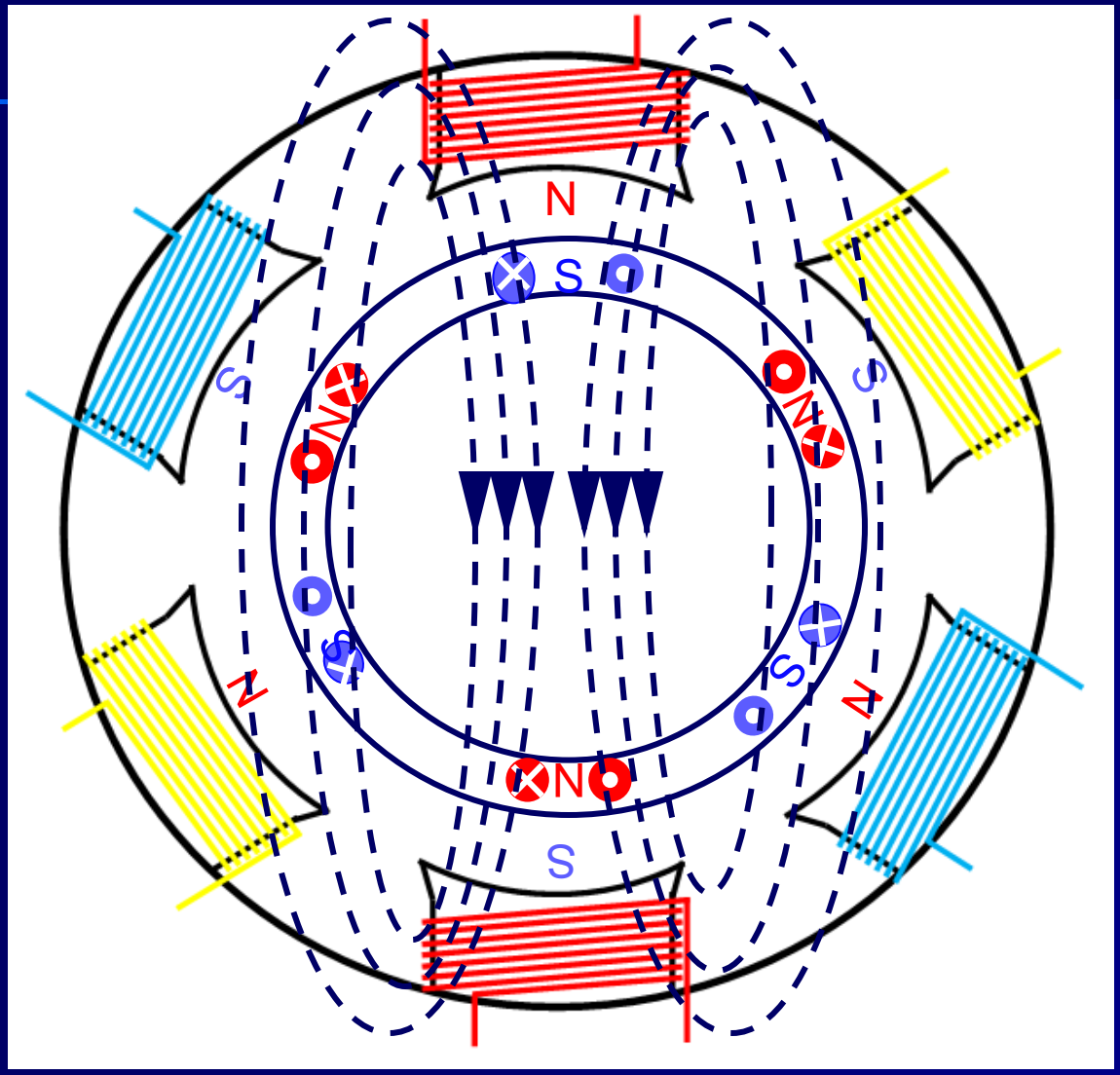
Induction into Rotor



We clearly don't want the motor speeding up and slowing down so the Rotor is designed to run at slip speed (*asynchronous*) so, there is always interaction between the Rotor and the Stator

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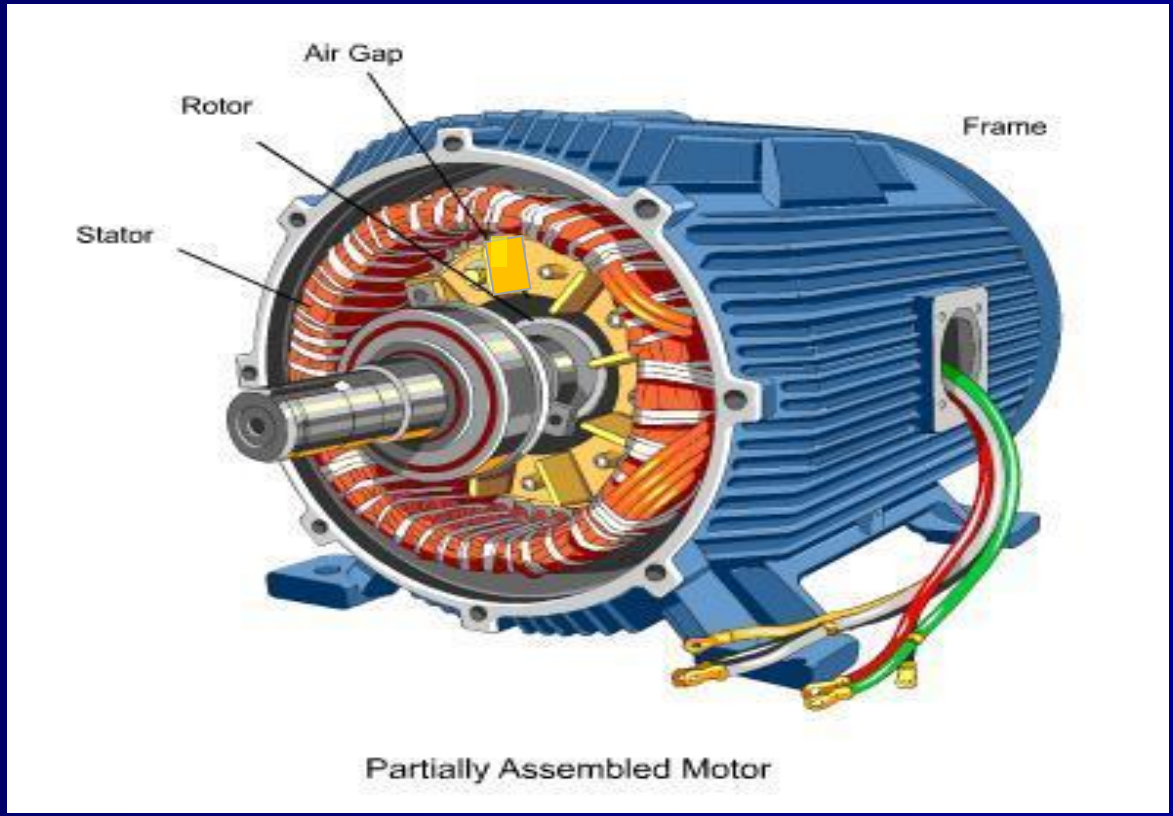
Three Phase AC Motor

- It has three pairs of electromagnets, connected to each of the three phases of the power supply.
- It provides a lot higher power that a single-phase motor can deliver.



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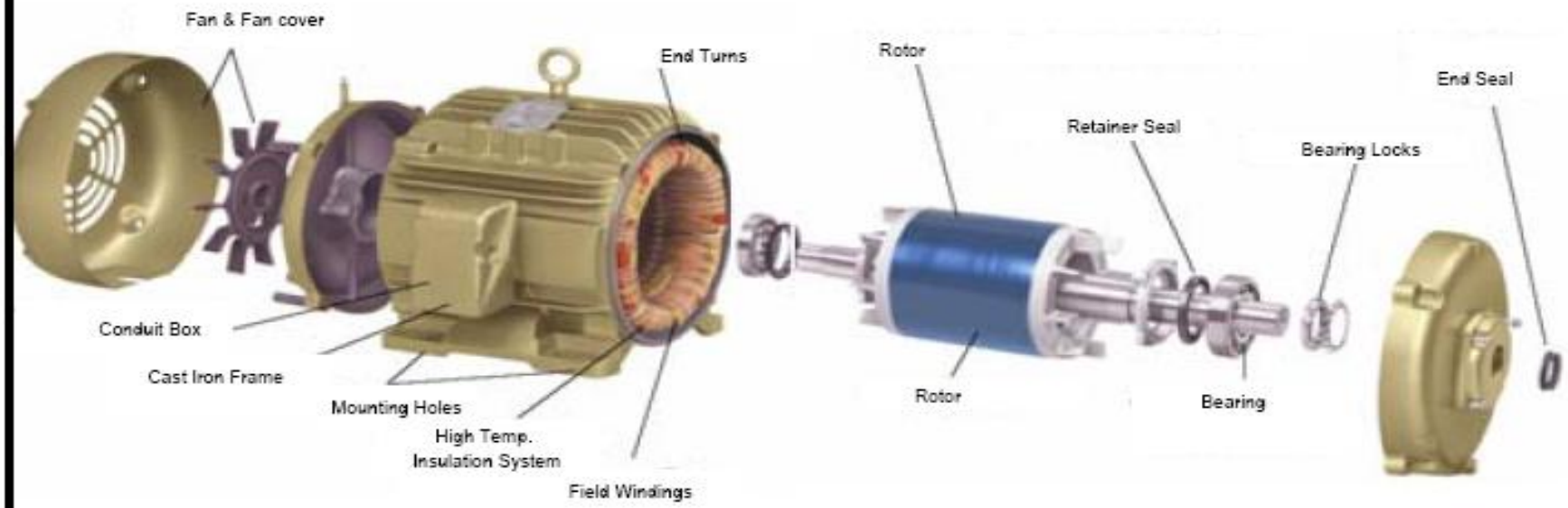
Parts of AC Motor



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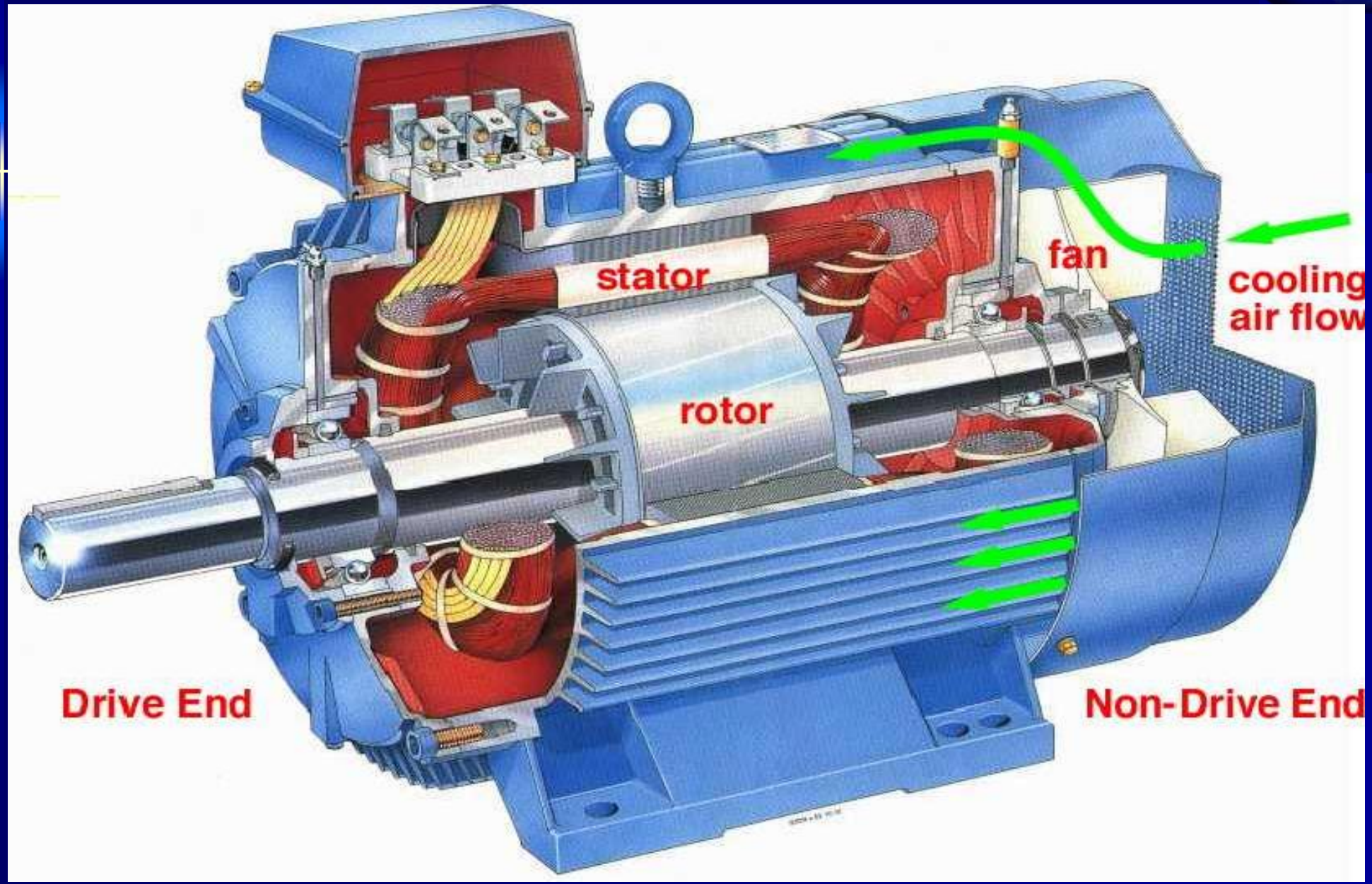

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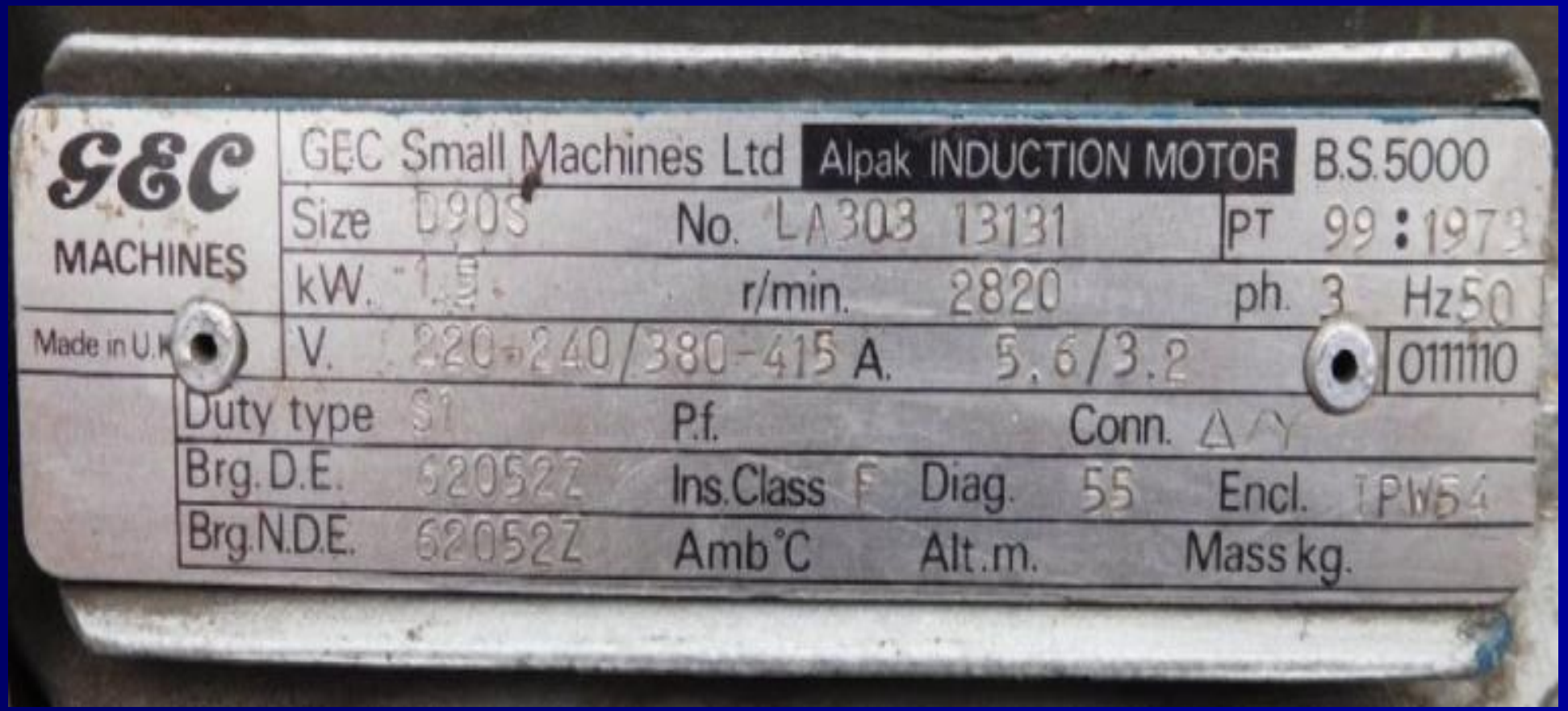
AC Motor Data Plate

Each motor has a plate mounted on its frame, with electrical and mechanical information.



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