# Winding Pitch, Distribution and Winding Factors

Slots per pole per phase, slot angle, pitch factor, distribution factor and winding factor of a three-phase AC winding, for the fundamental or a harmonic.

**Method:** AC winding pitch and distribution factors

## Input parameters

Unit system: SI

| Parameter | Value | Unit |
|---|---|---|
| Number of slots | 36.000 | |
| Number of poles | 4.0000 | |
| Number of phases | 3.0000 | |
| Coil span (slots) | 8.0000 | |
| Harmonic order | 1.0000 | |

## Calculated results

| Parameter | Value | Unit |
|---|---|---|
| Slots per pole per phase | 3.0000 | |
| Slot angle (electrical) | 20.000 | ° |
| Short-pitch angle (electrical) | 20.000 | ° |
| Pitch factor | 0.98481 | |
| Distribution factor | 0.95980 | |
| Winding factor | 0.94521 | |

### Notes for this case

• The EMF of a winding is reduced by short pitching (coils spanning less than a pole pitch, k_p = cos(hα/2)) and by distributing each phase over q slots (k_d = sin(hqβ/2)/(q·sin(hβ/2))), where β = 180°·P/S electrical is the slot angle. The winding factor k_w = k_p·k_d multiplies the EMF equation. Chording by about one sixth of a pole pitch nearly removes the 5th and 7th harmonics while costing only a few per cent of the fundamental. Negative factors mean the harmonic reverses sign.

## Formula and method

$$k_p = \cos\frac{h\alpha}{2}, \quad k_d = \frac{\sin(hq\beta/2)}{q\sin(h\beta/2)}, \quad k_w = k_p k_d, \quad \beta = \frac{180^\circ P}{S}$$

### Variables

| | | |
|---|---|---|
| $S$ | Number of slots | - |
| $P$ | Number of poles | - |
| $m$ | Number of phases | - |
| $y$ | Coil span (slots) | - |
| $h$ | Harmonic order | - |
| $q$ | Slots per pole per phase | - |
| $\beta$ | Slot angle (electrical) | rad |
| $\alpha$ | Short-pitch angle (electrical) | rad |
| $k_p$ | Pitch factor | - |
| $k_d$ | Distribution factor | - |
| $k_w$ | Winding factor | - |

### Method and standards

Winding factors.

### Assumptions and limits

- Integral or fractional-slot windings by these formulas.

### References

AC winding pitch and distribution factors

## Report details

| | |
|---|---|
| Report reference | FCC-82TS-PTGP (the same inputs always give the same reference) |
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| Calculator | Winding Pitch, Distribution and Winding Factors |
| Method last reviewed | 17 November 2026 |
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| Release checks | 3 reference cases of this calculator, computed independently, are checked on every release |

Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

### This calculator online

https://calc.firecad.com/electrical/motors/winding-pitch-distribution-factor

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.