



Motor Development For Electric Drive Systems

Tutorial 4

Linear motors with tooth-wound coils

A permanent magnet linear motor can also be designed using tooth-wound coils (see also "modular synchronous machine", "fractional slot windings"):

In this tutorial we consider a tooth wound linear motor with the following specification:

number of slots per pole and phase	$q = 2/7$
air gap	$\delta = 2 \text{ mm}$
rated current	$I_r = 13 \text{ A}$
maximum current	$I_{\max} = 40 \text{ A}$
rated speed	$v_r = 2 \text{ m/s}$
number of turns per coil	$N_C = 150$
number of parallel paths	$a = 2$
wire cross section	0.83 mm
number of poles	$2p = 14$
magnet height	$h_m = 5 \text{ mm}$
magnet width	11 mm (2 magnets per pole)
remanence flux density	$B_R = 1.2 \text{ T}$
relative magnet permeability	$\mu_r = 1.05$
pole pitch factor	$\alpha_e = 100 \%$
slot-/pole pitch:	26.8/23 mm
open rectangular slots:	
slot width:	11.8 mm
slot height:	23 mm
stator slots skewed by one slot pitch.	
water jacket cooling	

- 1) Calculate the winding factor of the fundamental harmonic.
- 2) Calculate the rated normal force and the rated thrust.
- 3) Calculate the ohmic losses and the efficiency at rated speed v_r . Is the motor protected against permanent demagnetisation if maximum current is employed?