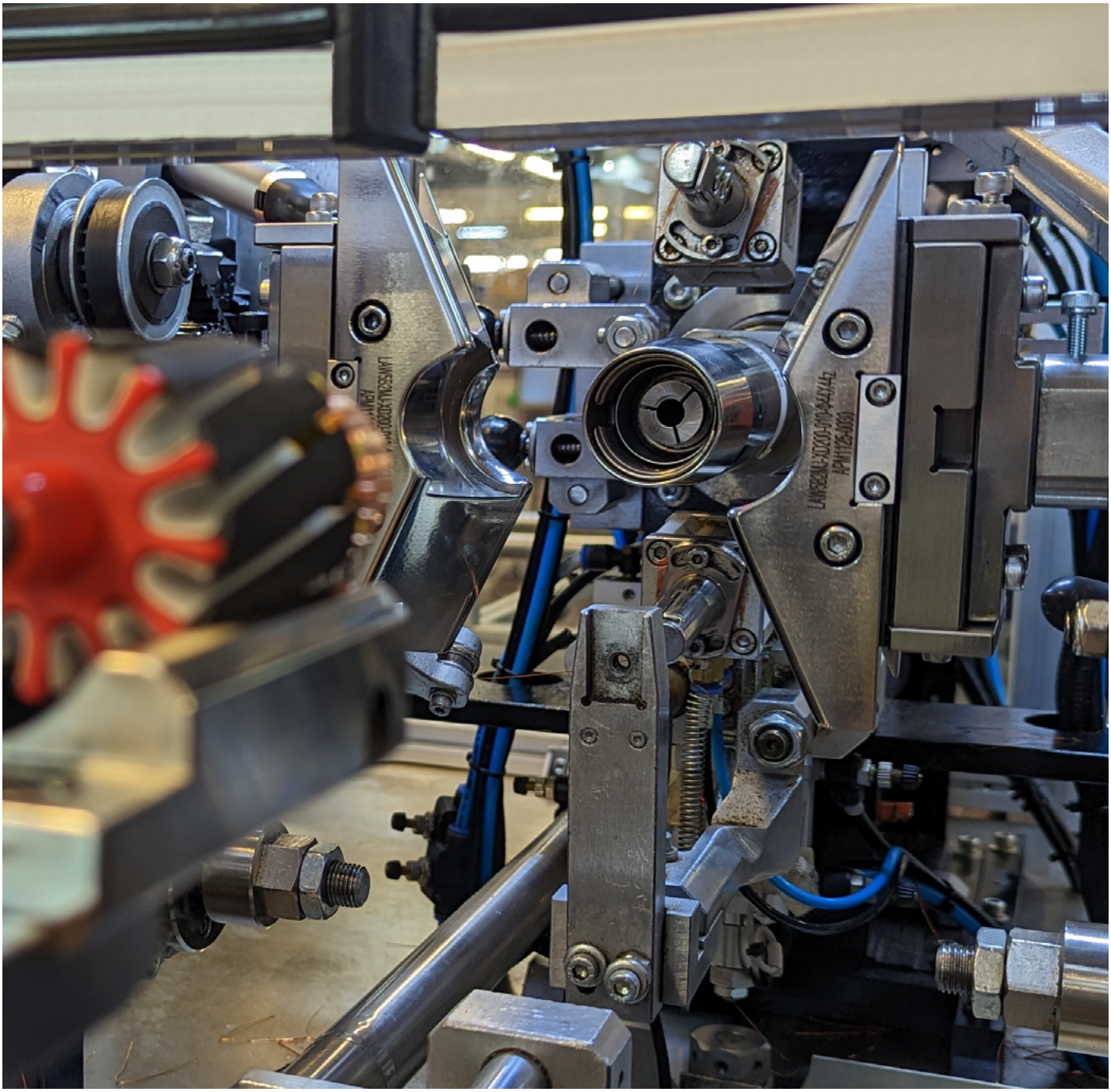
parvalux
by maxon

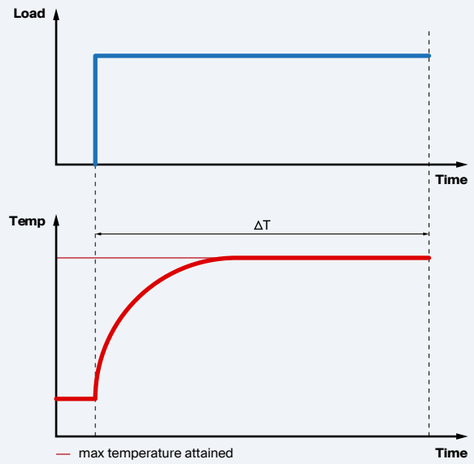
Duty cycle guide



Duty cycle guide

IEC (the International Electrotechnical Commission) uses different duty cycles designations to describe electrical motor operating conditions.

The term duty defines the load cycle to which the machine is subjected, including, if applicable, starting, electric braking, no-load and rest de-energized periods, and including their durations and sequence in time.



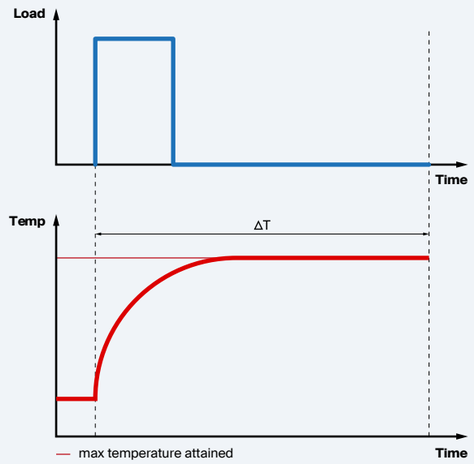
S1 Continuous running duty

The duty type S1 can be defined as operation at a constant load maintained for sufficient time to allow the machine to reach thermal equilibrium.

For a motor suitable to this duty type, the rating at which the machine may be operated for an unlimited period is specified.

This class of rating corresponds to the duty type whose appropriate abbreviation is S1.

Figure 1 - Continuous running duty: Duty type S1
ΔT Time sufficient to allow the machine to reach thermal equilibrium



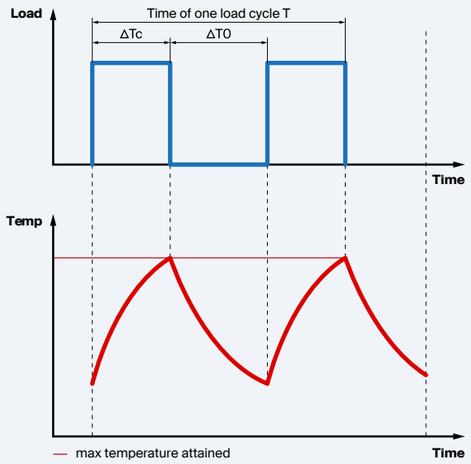
S2 Short time duty

The duty type S2 can be defined as operation at constant load for a given time, less than that required to reach thermal equilibrium, followed by a time de-energized and at rest of sufficient duration to re-establish the equilibrium between the machine temperature and that of the coolant temperature.

For a motor suitable to this duty type, the rating at which the machine, starting at ambient temperature, may be operated for a limited period is specified. This class of rating corresponds to the duty type whose appropriate abbreviation is S2.

A complete designation provides the abbreviation of the duty type followed by an indication of the duration of the duty (S2 40 minutes).

Figure 2 – Short-time duty: Duty type S2
ΔTc Operation time at constant load
ΔT0 Time de-energize



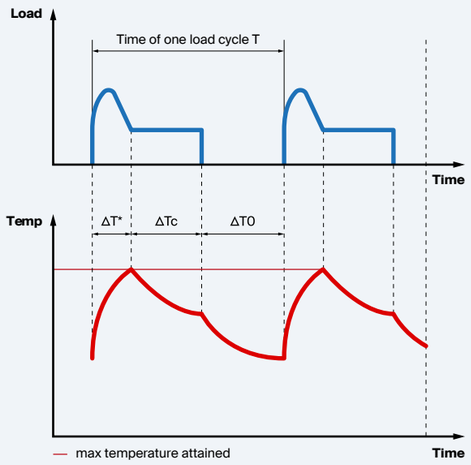
S3 Intermittent periodic duty

The duty type S3 is defined as a sequence of identical duty cycles, each including a time of operation at constant load and a time de-energized and at rest. The contribution to the temperature-rise given by the starting phase is negligible.

A complete designation provides the abbreviation of the duty type followed by the indication of the cyclic duration factor (S3 30%).

Figure 3 – Intermittent periodic duty: Duty type S3
ΔTc Operation time at constant load
ΔT0 Time de-energized and at rest

Cyclic duration factor = ΔTc/T



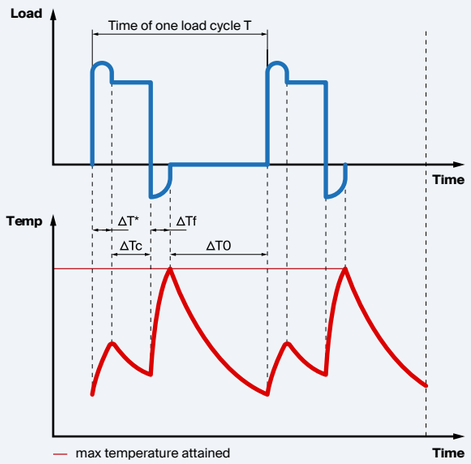
S4 Intermittent periodic duty with starting

The duty type S4 is defined as a sequence of identical duty cycles, each cycle including a significant starting time, a time of operation at constant load and a time de-energized and at a rest.

A complete designation provides the abbreviation of the duty type followed by the indication of the cyclic duration factor, by the moment of inertia of the motor JM and by the moment of inertia of the load JL, both referred to the motor shaft (S4 20% JM = 0.15 kg m2 JL = 0.7 kg m2).

Figure 4 – Intermittent periodic duty with starting: Duty type S4
ΔT* Starting/accelerating time
ΔTc Operation time at constant load
ΔT0 Time de-energized and at rest

Cyclic duration factor = (ΔT* + ΔTc)/ T



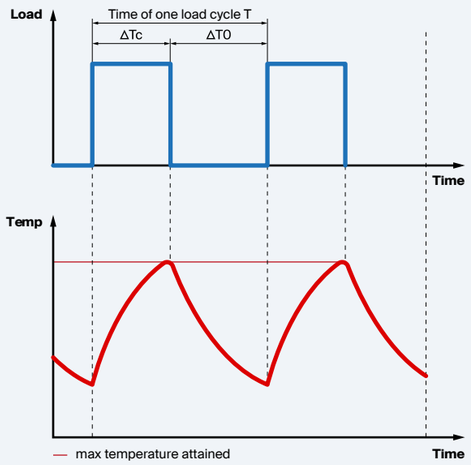
S5 Intermittent periodic duty with electric braking

The duty type S5 is defined as a sequence of identical duty cycles, each cycle consisting of a starting time, a time of operation at constant load, a time of electric braking and a time de-energized and at a rest.

A complete designation refers to the duty type and gives the same type of indication of the previous case.

Figure 5 – Intermittent periodic duty with electric braking: Duty type S5
ΔT* Starting/accelerating time
ΔTc Operation time at constant load
ΔTf Time of electric braking
ΔT0 Time de-energized and at rest

Cyclic duration factor = (ΔT* + ΔTc + ΔTf)/ T



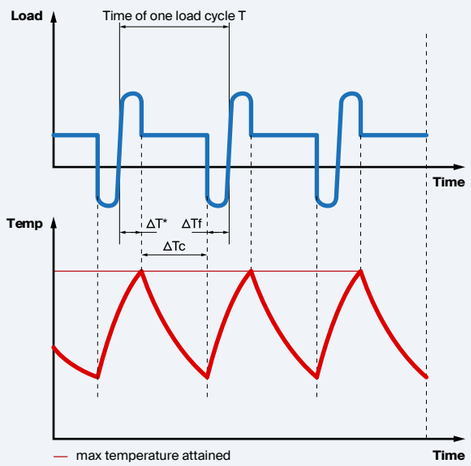
S6 Continuous operation periodic duty

The duty type S6 is defined as a sequence of identical duty cycles, each cycle consisting of a time of operation at constant load and a time of operation at no-load. There is no time de-energized and at rest.

A complete designation provides the abbreviation of the duty type followed by the indication of the cyclic duration factor (S6 30%).

Figure 6 – Continuous-operation periodic duty: Duty type S6
ΔT* Operation time at constant load
ΔT0 Operation time at no load

Cyclic duration factor = ΔTc/ΔT0



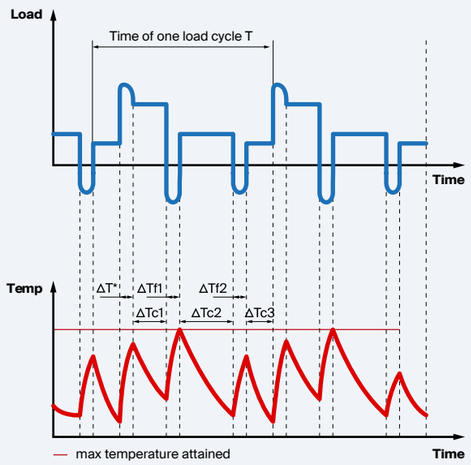
S7 Continuous-operation periodic duty with electric braking

The duty type S7 is defined as a sequence of identical duty cycles, each cycle consisting of a starting time, time of operation at constant load and a time of electric braking. There is no time de-energized and at rest.

A complete designation provides the abbreviation of the duty type followed by the indication of both the moment of inertia of the motor JM and the moment of inertia of the load JL (S7 JM = 0.4 kg m2 JL = 7.5 kg m2).

Figure 7 – Continuous-operation periodic duty with electric braking: Duty type S7
ΔT* Starting/accelerating time
ΔTc Operation time at constant load
ΔTf Time of electric braking

Cyclic duration factor = 1



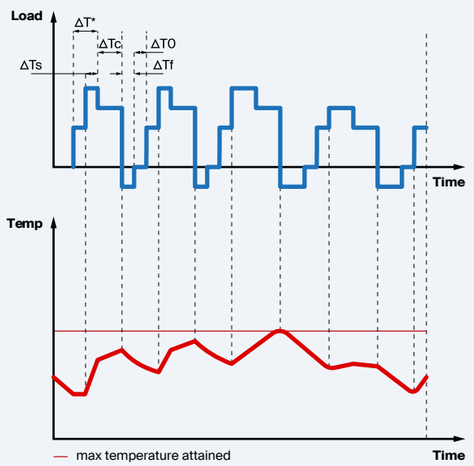
S8 Continuous-operation periodic duty with related load/speed

The duty type S8 is defined as a sequence of identical duty cycles, each consisting of a time of operation at constant load corresponding to a predetermined speed of rotation, followed by one or more times of operation at other constant loads corresponding to different speeds of rotation.

A complete designation provides the abbreviation of the duty type followed by the indication of the moment of inertia of the motor JM and by the moment of inertia of the load JL, together with the load, speed and cyclic duration factor, for each speed condition (S8 JM = 0.7 kg m2JL = 8kgm2 25kW 800rpm 25% 40kW 1250rpm 20% 25 kW 1000 rpm 55%).

Figure 8 – Continuous-operation periodic duty with related load/speed: Duty type S8
ΔT* Starting/accelerating time
ΔTc1; ΔTc2; ΔTc3 Operation time at constant load
ΔTf1; ΔTf2 Time of electric braking

Cyclic duration factor = (ΔT*+ΔTc1)/T; (ΔTf1+ΔTc2)/T; (ΔTf2+ΔTc3)/T

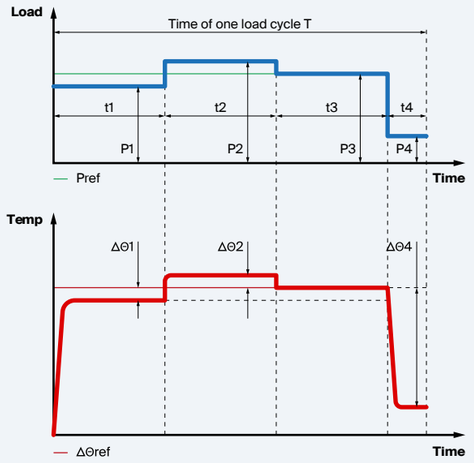


S9 Duty with non-periodic load and speed variations

The duty type S9 is defined as a duty in which generally load and speed vary non-periodically within the permissible operating range. This duty includes frequently appplied overloads which may greatly exceed the reference load.

For a motor suitable to this duty type, the rating at which the machine may be operated non-periodically is specified. This class of rating corresponds to the duty type whose appropriate abbreviation is S9.

Figure 9 – Duty with non-periodic load and speed variations: Duty type S9
ΔT* Starting / accelerating time
ΔTs Time under overload
ΔTc Operation time at constant load
ΔTf Time of electric braking
ΔT0 Time de-energized and at rest



S10 Duty with discrete constant loads and speeds

The duty type S10 is defined as the operation characterized by a specific number of discrete values of load maintained for a sufficient time to allow the machine to reach thermal equilibrium. The minimum load during a duty cycle may have value zero and be relevant to a no- load or rest condition.

A complete designation provides the abbreviation of duty type followed by the indication of the per unit quantities p/Δt for the partial load and its duration, and by the indication of the per unit quantity TL which represents the thermal life expectancy of the insulation system related to thermal life expectancy in case of duty type S1 with rated output, and by quantity r which indicates load for a time de-energized and at rest (S10 p/Δt = 1.1/0.4; 1/0.3; 0.9/0.2; r/0.1 TL = 0.6).

Figure 10 – Duty with discrete constant loads and speeds: Duty type S10

ΔΘ1; ΔΘ2; ΔΘ2 Difference between the temperature rise of the winding at each of the various loads within one cycle and the temperature rise based on duty cycle S1

ΔΘref Temperature at reference load based on duty type S1 t1; t2; t3; t4: time of a constant load within a cycle P1; P2; P3; P4: time of one load cycle

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