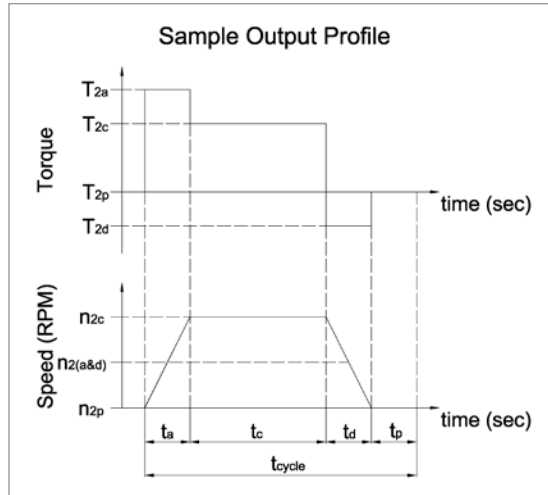## Determination of the Duty Cycle (ED)

Sample Output Profile

$$ED = \frac{t_a + t_c + t_d}{t_{cycle}}$$

If ED < 60% and $(t_a + t_c + t_d)$ < 20 minutes, perform a cycle operation selection (S5)

If ED > 60% or $(t_a + t_c + t_d)$ > 20 minutes, perform a continuous operation selection (S1)

Index	
1	Input
2	Output
a	Acceleration
B	Maximum Acceleration
c	Constant
d	Deceleration
m	Mean
max	Maximum
n	Nominal
p	Pause

Symbol	Unit	Description
ED	%	Duty Cycle
fs	-	Shock Factor
i	-	Ratio
J	kg-cm2	Moment of Inertia
n	RPM	Speed
t	s	Time
T	Nm	Torque
Zh	-	Number of Cycles
ŋ	%	Efficiency

Selection of Optimum Gearbox for a Continuous Operation (S1)

Data needed before selection can be performed:

1. Output profile
2. Desired ratio (i)

Calculations to be performed:

1. Mean Output Speed

$$\Rightarrow n_{2m} = \frac{n_{2a}t_a + n_{2c}t_c + n_{2d}t_d}{t_a + t_c + t_d} = \underline{\hspace{1cm}}$$

2. Root – Mean Output Torque

$$\Rightarrow T_{2m} = \sqrt[3]{\frac{n_{2a}t_a T_{2a}^3 + n_{2c}t_c T_{2c}^3 + n_{2d}t_d T_{2d}^3}{n_{2a}t_a + n_{2c}t_c + n_{2d}t_d}} = \underline{\hspace{1cm}}$$

Selection Criteria for Gearbox:

1. Mean Output Speed must not exceed the nominal speed rating of the gearbox.

$$n_{2m} \cdot i \leq n_{1n}$$

2. Mean Output Torque must not exceed the nominal torque rating of the gearbox.
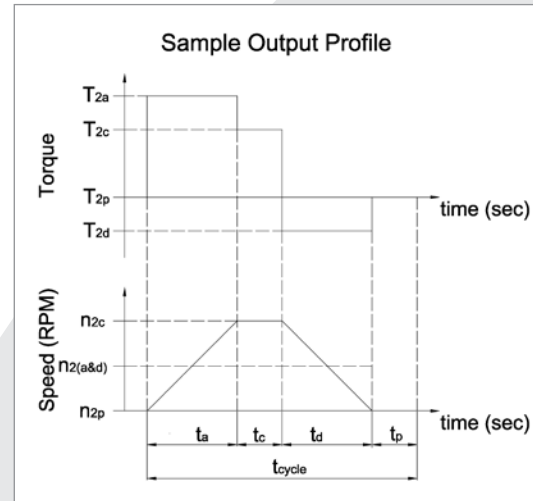
$$T_{2m} \leq T_{2n}$$

See technical data tables for values of n_{1n} and T_{2n}

Selection of Optimum Gearbox for a Cycle Operation (S5)

Data needed before selection can be performed:

1. Maximum Torque of the motor (T_{1B})
2. Output profile
3. Desired ratio (i)
4. Inertia of the load (J_L)*
5. Inertia of the motor (J_{motor})*

*optional

Sample Output Profile

Calculation to be performed:

1. Shock Factor (fs)

$$Zh = \frac{3600}{t_{cycle}}$$

		Zh	<	1000	=>	fs = 1.0
1000	<	Zh	<	1500	=>	fs = 1.1
1500	<	Zh	<	2000	=>	fs = 1.3
2000	<	Zh	<	3000	=>	fs = 1.6
3000	<	Zh	<		=>	fs = 2.0

2. Maximum Output Torque $T_{2max} = T_{1B} \cdot i \cdot fs \cdot \eta = $ _____

Selection Criteria for Gearbox:

1. Maximum Output Speed must not exceed the maximum speed rating of the gearbox.

$$n_{2c} \cdot i \leq n_{1max}$$

2. Maximum Output Torque must not exceed the maximum torque rating of the gearbox.

$$T_{2max} \leq T_{2B}$$

3. *(optional)* Match inertia of the motor to the inertia of the load.

$$J_{motor} \approx J_1 + \frac{J_L}{i^2}$$

See technical data tables for values of η, n_{1max}, T_{2B}, and J_1