Data Sheet 24

Handraulic001/1_07/07

Engine Cranking Speed Calculation

1. To establish the viability of a proposed Starter application to an unknown engine or plant it is necessary to establish the theoretical cranking speed generated by the starter unit.

2. To calculate the cranking speed, certain information is required from the engine manufacturer and or plant manufacturer.

3. Calculations must be based on values applicable at the minimum plant operating temperature.

4. The engine breakaway torque must be less that the torque output of the starting system.

5. It must be assumed that the engine will have the correct grade of lube oil and fuel and be generally to the manufacturer's specifications.

6. From tests and visual observation it is assumed that the average time taken to complete the starter power stroke will be:

Starting time	Starting system	@ 293 Bar (4250 PSI)	@345 Bar (5000 PSI)
6.1	B35G	0.16 seconds	0.12 seconds
6.2	B50G	0.30 seconds	0.24 seconds

7. Torque output of the starter is:

Output torque	Starting system	@ 293 Bar (4250 PSI)	@345 Bar (5000 PSI)
7.1	B35G	773 Nm	909 Nm
7.2	B50G	2264 Nm	2663 Nm

8. Formula for calculating the cranking speed is:

$$= \frac{(T1 - T2) \times C}{I}$$

where: T1 = Starter torque (Nm)
T2 = Engine cranking torque (Nm)
I = Inertial moment of plant (kg.m²)
C = Constant
$= \frac{(\text{Time} \times 60)}{2\pi}$

= B35G = 1.528 (@ 293 Bar) or 1.146 (@ 345 Bar)
= B50G = 2.865 (@ 293 Bar) or 2.196 (@ 345 Bar)

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DATA SHEET 25 CONTINUED....

9. Where the breakaway and cranking torque are not known for the particular operating temperature required, as a useful guide, it may be assumed that:

   9.1 Breakaway torques will increase by 1 Nm / Cyl / 1°C drop.

   9.2 Cranking torques will increase by 0.333 Nm / Cyl / 1° drop.

10. Conversions:

   10.1 lbs/ft x 1.356 = Nm

   10.2 lbs.ft² x 0.04214 = Kg.m²

EXAMPLE

MTU 6V396 ENGINE WITH GENERATOR

1.1 Operating temperature = +17°C

1.2 Breakaway torque at 40°C = 300 Nm
at 17°C = 300 + (23 x 1 x 6)
= 438 Nm

1.3 Cranking torque at 40°C = 280 Nm
at 17°C = 280 + (23 x 0.333 x 6)
= 326 Nm

1.4 Inertial moment
Engine = 5.69
Coupling = 5.00 (max)
Generator = 56.13
= 66.82 kg.m²

1.5 Engine firing speed = 110 – 120 RPM

1.6 Constant (B50G) = 2.865

2. Cranking speed at 293 Bar working pressure

$$= \frac{2264 - 326}{66.82} \times 2.865$$

= 83 RPM

This is below the firing speed, therefore, a B50G application will not be viable.

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Data Sheet 25 continued....

Engine Cranking Speed Calculations

(Refer Data sheet 24)

MANUFACTURER		PLANT		
ENGINE TYPE		NO. of CYLINDERS		
BORE				
FIRING SPEED		RPM		
MIN OPERATING TEMP		°C		
BREAKAWAY TORQUE		lbs/ft		Nm
T2 CRANKING TORQUE		lbs/ft		Nm
INERTIAL MOMENT				
ENGINE		lbs.ft²		kg.m²
FLYWHEEL / COUPLING		lbs.ft²		kg.m²
PLANT		lbs.ft²		kg.m²
		lbs.ft²		kg.m²
TOTAL		lbs.ft²		kg.m²

NOTE: T1 (B35G) = 773 Nm
C = 1.528

T1 (B50G) = 2264 Nm
C = 2.865

lbs/ft x 1.356 = Nm
lbs/ft² x 0.04214 = kg.m²

$$= \frac{(T1 - T2) \times C}{I}$$

=

= RPM

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