APPENDIX C

DETAILS OF PUMPS AND OPERATING PARAMETERS
OF THE TWO-BEARING ASSEMBLY
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OF A TWO-BEARING ASSEMBLY

PUMP SPECIFICATIONS

1. Types of Pumps : Vertical Turbine Pumps
2. Quantity supplied : 14
3. Flow Rating : 58, 200 LPM
4. Net Head : 50.14 M
5. Pump Speed : 985 rpm
6. Designed, manufactured and commissioned by: M/S JYOTI LTD. BARODA 3 INDIA
7. Name of the Customer : VISHNUPURI LIFT IRRIGATION SCHEME, NEAR VILLAGE ASARJAN TA. NANDED DIST. NANDODD MAHARASTRA - INDIA

BEARING ASSEMBLY SPECIFICATIONS

1. RADIAL LOAD : 6328
2. THRUST BEARING : 29432 E
3. RADIAL LOAD ABSORPED : 360 Kg.
4. AXIAL LOAD ABSORBED : 7200 Kg.
5. BEARING SPEED : 985 rpm
6. LUBRICANT VISCOSITY : 56 CS AT 40 °C
7. AMBIENT TEMPERATURE : 25°C
8. MEAN THRUST BEARING VELOCITY : 11.9 M/s
9. COOLING METHODS : (I) FORCED AIR COOLING OVER BEARING ASSEMBLY
     OR
     (II) (I) AND WATER JACKET COOLING
10. SUMP OIL TEMPERATURE : (I) 65 °C
    (MEAN OF ALL WORKING SETS)

Power lost in bearing is calculated using the procedure given by Harris [3].

C.1 AXIAL POWER LOST IN “29432E” (HPLOS2)
A reasonable estimate of the friction torque (Mt) of the above bearing under moderate load and speed is given by the sum of the load torque (Ml) and viscous friction torque (Mv). Therefore,

\[ M_t = M_l + M_v \]  \hspace{1cm} (C.1)

C.1.1 AXIAL POWER LOST DUE TO LOAD TORQUE (HPLOS1)

\[ M_l = f_l \times F_a \times d_m \]  \hspace{1cm} (C.2)

where

\[ f_l = 0.0003 \] (bearing friction factor)
Fa = 7,200 (axial load)

d_m = 0.2295 M (bearing mean diameter)

Axial power lost due to load torque (HPLOS2_i) is given by

\[ HPLOS2_i = 2 \times \pi \times N \times M_i / 4500 \] (C.3)

On substitution,

\[ HPLOS2_i = 0.68 \] (C.4)

C.1.2 AXIAL POWER LOST DUE TO VISCOUS TORQUE (HPLOS2_v)

According to Palmgren [1], Mv is given in Ib/inch by the relation

\[ Mv = 1.42 \times 10^{-5} \times fo \times (\nu_0 N)^{2/3} \times d_m^3 \quad N > 2000 \] (C.5)

where

fo = 6 (signifies oil bath for '29432 E')

\( \nu_0 = 13 \) CS (Kinematic viscosity of oil)

N = 985 rpm

d_m = 9.05 inch (mean dia. of '29432 E')

Axial power lost due to viscous torque, HPLOS2_v, is given by

(after adjustment of units for MKS ),

\[ HPLOS2_v = 2 \times \pi \times N \times Mv \times 0.012/4500 \] (C.6)

On substitution,

\[ HPLOS2_v = 2 \times \pi \times 985 \times 1.42 \times 10^{-5} \times (13 \times 985)^{2/3} \times 9.05^3 \times 0.012/4500 \] (C.7)
HPLOS2v = .57 \quad \text{(C.8)}

On adding equations (C.5) and (C.8),

\[ \text{HPLOS2} = 1.25 \quad \text{(C.9)} \]

### C.2 RADIAL POWER LOST IN '6328' (HPLOS1)

A reasonable estimate of the friction torque \( (M_i) \) of the above bearing under moderate load and speed is the sum of \( M_f \) and \( M_r \). Therefore equation (C.1) applies.

#### C.2.1 RADIAL POWER LOST DUE TO LOAD TORQUE (HPLOS1)

According to Harris [3], \( M_i \) is given by

\[ M_i = Z \times \left( \frac{F_r}{C_a} \right)^y \times F_r \times d_m \quad \text{(C.10)} \]

where

\[ Z = 0.0007 \quad \text{(a constant for deep groove bearing)} \]

\[ y = 0.55 \quad \text{(a constant for deep groove bearing)} \]

\[ F_r = 360 \quad \text{Kg. (radial load)} \]

\[ C_a = 23,240 \quad \text{Kg. (axial load)} \]

\[ d_m = 0.22M \quad \text{(mean dia. of '6328')} \]

\[ \text{HPLOS1} = 2 \times \pi \times N \times M/4500 \quad \text{(C.11)} \]

On substitution,
C.2.2 RADIAL POWER LOST DUE TO VISCOUS TORQUE (HPLOS1v)

According to Palmgren [1], $M_v$ is given by equation (C.5).

Therefore, on substitution,

\[ HPLOS1v = 0.16 \quad (C.14) \]

Therefore,

\[ HPLOS1 = 0.167 \quad (C.15) \]