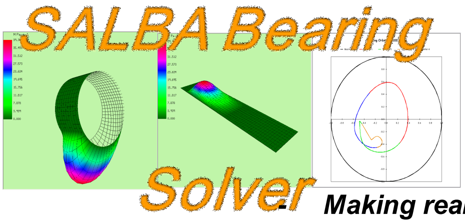
# SALBA bearing solver
Data Sheet

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## History of oil lubricated bearings

The first person to understand oil lubricated bearings was Beauchamp Towers in 1879 whilst carrying out tests on rail rolling stock axle bearings. He discovered that placing a bung over the oil feedhole caused the bung to be pushed out and he postulated this was due to pressure being exerted by oil reacting the weight of the axle. Further tests proved him correct in 1884.

Reynolds 1886 was the first person to derive a theory that described the physics of the oil film and proposed the Reynolds equation of hydrodynamic lubrication.

It did not have a solution until Sommerfeld 1904 proposed a solution for the infinitely long bearing. L/D >> 2.0

Michell 1929 and Cardullo 1930 first proposed solutions for the short bearing applied to sliding pad bearings.

Cameron and Wood 1949 used the relaxation method developed by Southwell 1946 to carry out calculations on the full journal bearing.

Ocvirk and Dubois 1953 proposed the short bearing solution. L/D < 1.0

Then in 1957 Jacob, Olson and Floberg proposed a numerical solution including the cavitated oil film for the finite bearing.

Reason and Narang 1981 proposed an analytical combination of the short and long bearing which approximates the accuracy of numerical solution RHD for plain journal bearings. It did not include squeeze.

Reason and Siew 1983 proposed a numerical solution of the finite bearing with misalignment

Since that time many workers have proposed many types of numerical solution including the RHD, EHD and TEHD methods, and these are all available from AIES.

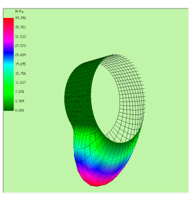
## Short and long bearing approximation – SALBA

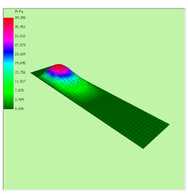
**SALBA S**hort **A**nd **L**ong **B**earing **A**pproximation after Reason and Narang is as accurate as RHD for plain bearings all eccentricity ratios, includes squeeze terms in solver but no squeeze shown here as is the IPR of AIES. Squeeze terms are required for transient and shock modelling.

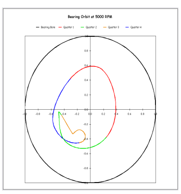
$$P_\theta = \frac{\frac{3.\eta.U}{R.C^2}.\left(\frac{L^2}{4}-y^2\right).\frac{\varepsilon.\sin\theta}{(1+\varepsilon.\cos\theta)^3}}{1+\frac{(2+\varepsilon^2)}{2R^2}.\left(\frac{L^2}{4}-y^2\right).\frac{1}{(1+\varepsilon.\cos\theta)[2+\varepsilon\cos\theta]}}$$

## Short and long bearing approximation – SALBA results

The figures below show 3-D and Isometric pressure profiles for a pi- cavitated bearing at 5,000 rpm. The RHS figure shows its orbit. Similar to SBA, cannot determine the effects of short or randomly positioned grooves and oil holes in the bearing shell or a moving oil hole in the journal.


SALBA 3D Pressure profile


SALBA Isometric Pressure profile


SALBA Bearing Orbit

## Transient solvers – many applications

- Runge Kutta Cash Karp
- Newmark Beta
- Bulirsch Stoer
- Others are under development
- Can be used in conjunction with
  - Other solvers
  - MBD
  - Rotor Dynamics

## Bearing applications - AIES Tribology solvers

**Solvers can be used for simulating**
- Dynamically loaded Engine bearings,
- Steady loaded bearings
- Instability of bearings
- Unbalance response of bearings
- Forced response over a speed sweep (range) including blade excitation
- Transient shock response of bearings

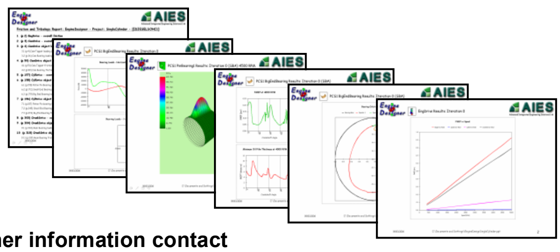
**Simulating any shape of bearing using a Profile function**
- Hence can simulate
- Assembled
- Manufactured
- Worn shape
- Offset halves, lemon and pressure dammed etc.

**Any type of loading**
- Gravity, Steady& unbalance
- Any transient load history (load against angle)
- Harmonic and Fourier loads

**Solvers can also be used to generate**
- Stiffness and Damping coefficients of bearings
  - With SBA, SALBA and RHD
- Any shape of bearing using Profile feature
  - Hence simulate Assembled, manufactured and worn shapes

## System design report

- MS PowerPoint format



**For further information contact**
**Advanced Integrated Engineering Solutions Ltd**
**37 The Ridgeway**
**Market Harborough,**
**Leicestershire**
**United Kingdom**
**LE16 7HG**
**Tel: +44 (0) 1858 414854**
**Fax: +44 (0) 1858 414885**
**Email: info@aiesl.co.uk**
**Website: www.aiesl.co.uk**