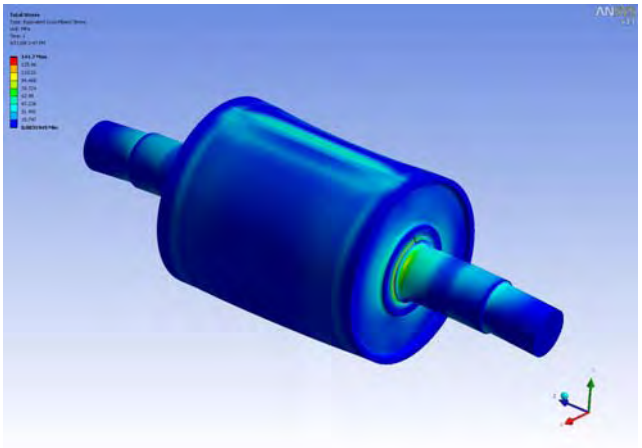
TEFCO ENGINEERING PTY LIMITED

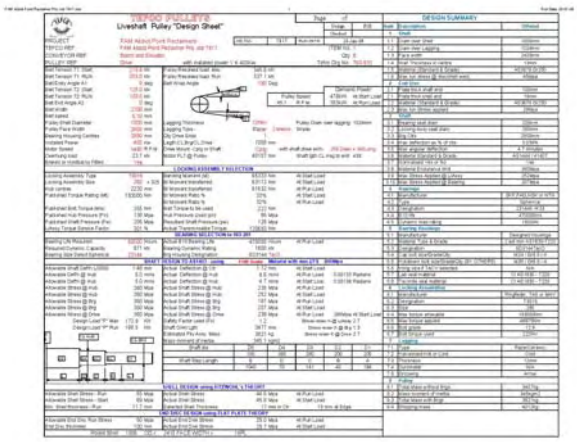
ABN 35 054 554 611

Run Date: Wednesday, 28 January 2009

TEFCO CONVEYOR PULLEYS SUPPLY STANDARDS

1. TEFCO standard design, construction and surface finish is offered as detailed below to our design sheets which have been developed over 30 years based on sound engineering practice and experience.
   We now conduct regular FEA analysis on our Ansys software to further improve our technical base, providing a more qualified design solution for pulleys which confirms our empirical design sheets shown below supplied with all quotes.

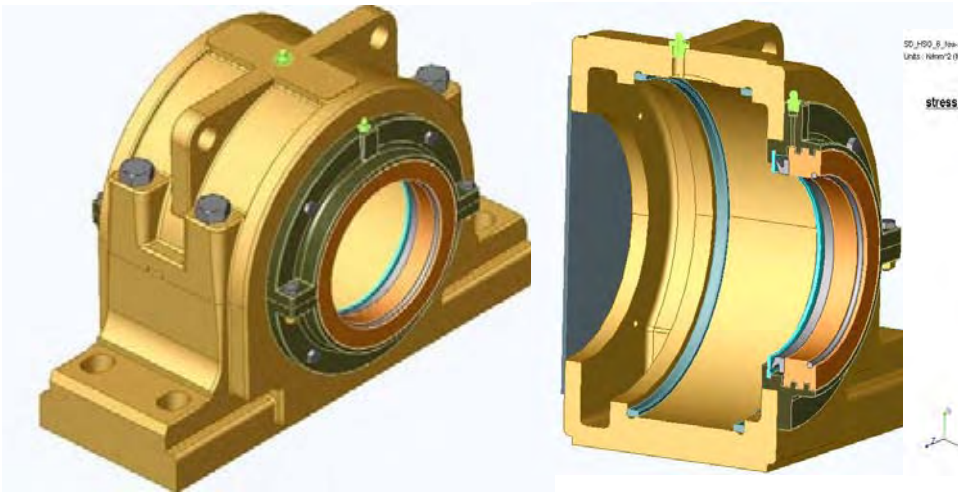


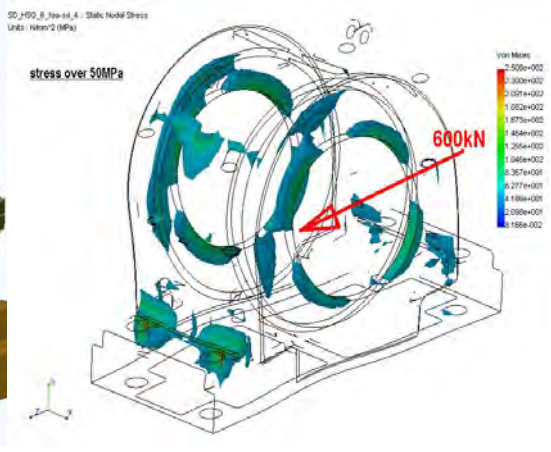


2. Bearings will be either SKF, FAG, NSK, NTN or TWB brand C3 clearance with W33 grooves & metal cages depending on price and availability at time of order.

3. OH (Oil off) sleaves are offered for shafts 150mm diameter and larger.
   Tefco brand Hydraulic Nuts will be used to mount the bearings on their sleaves and these Hydraulic Nuts can be offered as maintenance tools if required.

4. Bearing housings of any type with Taconite, TS Labyrinth or other seal types can be provided to client preference.
   Unless specified we offer SNG500 series up to 90 diameter shafts, T (2 bolt) or F (4 bolt) SSNG500 series between 100 and 140 diameter and SD3100 series up to 300 diameter & CSD or AW solid housings for diameters above 300.
   The design of our SD3100 series housings has been considerably enhanced over the industry standard offered by others. Some of the features include;
   The basic shape has been modified to drastically strengthen the housing, primarily due to the outer “hoops” and increased mass thru the foot. FEA analysis was conducted confirming the design.
   The Tac carrier is designed to accept either oil seals or V rings with replaceable running faces at no cost extra depending on client preference.
   Lifting lugs are incorporated into the cap construction, rather then threaded eye bolts.
   Tops and ends of feet are machined as standard and all SD housing are stamped with a unique ID for dimensional and material traceability.
   The bore has a cross groove in the cap adjacent to the grease entry to ensure all grease is channelled to the bearing W33 groove regardless of where the floating bearing is located.





Manufacturers of quality engineered components for Industry using the latest CNC machining technology

5. The initial grease fill of bearings and housings is included using Shell Alvania EP2 or equivalent.

6. No housing hold down bolts or shims are included unless specifically nominated.

7. Pulleys are fabricated with AS3678 grade 250 plate for shells and end discs except where pipe sizes are available we offer API 5LB grade pipe which has a higher UTS than grade 250 plate.
   Shell and end disc stress is limited to 55Mpa at maximum run condition and 69Mpa under worst condition.
   Tefco also uses the thesis of Sitzwohl adding his k1 factor as recognition that angles of belt wrap less than 180 degrees can generate significantly higher stress in the shell.
   Our end disc to shell welds are pre-qualified full penetration with internal welds done before the external fill runs are completed using the latest Lincoln "Power Wave AC/DC" Submerged Arc technology.
   End disc to shell welding is done to Tefco weld procedures which conform to AS1554.1 SP. We also offer welding to AS1554.5 for special high stress applications.
   Tefco's welding procedure is proprietary and commercial in confidence and will not be submitted for review.
   We ultrasonic test all welds to AS2207 Level 2 before the pulley bodies are thermally stress relieved in our computer controlled oven prior to machining.
   Crowning of shells is not generally recommended but can be included if specified.
   Shell thickness nominated is in shell centre and will be ultrasonically checked in 3 locations.
   Diameters nominated in schedules are over shell on Pulley centre line, under lagging.

8. Shafts are designed to AS1403 and material is generally AS1442 Grade 1045 but we can provide other grades such as AS1444 Grade 4140 as requested.
   However using the much more expensive 4140 grade gains little benefit due to AS1403 requirements increasing the K factor due to higher tensile strength that nearly negates the extra allowable stress limit the 4140 grade affords over 1045.

9. Locking assembly Covers are not included unless specified, however as standard we seal the locking assembly voids with silastic before painting.

10. Design, supply and fitting of coupling halves to pulley shafts can be included.
    We can also offer to design and supply or finish machine and fit free issued couplings if required.
    Drive keys are not included unless nominated in our offer.

11. Shaft Locking Assemblies are usually TAS 3006 series or MAV equivalent 1061 series or the wider TAS 3015 series or MAV equivalent 1008 series for higher torque requirements and we offer TAS 3012 series for extreme duties.
    These series offer the following advantages over the "Traditional" Ringfeder 7012 series
    a) The T3006 & T3015 series are self centring, whereas the 7012 type requires considerable skill on assembly to achieve an acceptable TIR.
    b) The 7012 require a stress raising backing ring be welded to the end disc to help shaft location.
    c) The 7012 have very high localised edge stresses due to very thin section thickness at the edges of the 4 angular contact faces. This can produce cold fretting on the shaft journal at the extremities of the locking assembly.
    d) The 7012 are prone to bolt breakage due to its 4 part construction and non self centring capability allowing running in settlement during initial running producing inconsistent bolt stress with some exceeding the allowable 12.9 bolt grade limits and consequently others being less than the original tightening toque.
    e) The self centring models allow the use of larger shafts between the end discs for added stiffness.
    The T3006 series is pictured below

12. Lagging of any type can be offered, including Ceramic, Natural, FRAS, and hot cast Polyurethane.
    Rubber & Ceramic Lagging is applied in accordance with Tefco lagging procedure TWI-05 and adhesion tested to procedure TWI-06
    We generally offer Razer lagging, but can supply any brand or hot vulcanised if required.
    We offer the Razer brand because it has a number of advantages including the strips are 250mm wide in lieu of 200mm reducing the number of horizontal joins around the circumference.
    One area of concern when looking at cold pre cured lagging is the knowledge that rubber will Bloom (oxidize) and continue to bleed out oil after curing. These oils will bleed out easily from the buffed (contact) surface of the lagging. When the chemist designs a compound that will bleed to a minimum but still meet the required mechanical values it compromises the adhesion qualities of the compound.
    Razer have concentrated on a compound with very high mechanical values but to also achieve high adhesions uses a 3mm neoprene-bonding layer, which stops the bleeding mentioned above and drastically improves adhesion to the steel shell.
    Our TWI-05 adhesion test is part of our normal QA procedures and is conducted on every pulley. We have not had a result below 20 N/mm and many as high as 35 N/mm versus the industry acceptance standard of 9 N/mm.
    Concentricity over cold lagging to be within 1.5mm TIR.
    In our opinion Razer cold pre cured rubber lagging is superior to hot lagging on conveyor pulleys.
    When selecting a suitable rubber compound for pulley lagging we must ensure some important qualities.
    - Elongation should be around 500%
    - Tensile should be around 15 Mpa or higher
    - Hardness should be around 65 shore A
    - Abrasion resistance should be as low as possible on the DIN scale (Below 100)
    - Adhesion values should be around 15 N/mm or higher.

    Once a compound is mixed it has a precise curing cycle requiring precise control of temperature, time and pressure. Cold pre cured lagging is cured in a press @ 160 degC for 18 minutes @ 1100PSI. This ensures all mechanical properties above are achieved.
    Whereas to hot lag a pulley it is prepared with adhesive and the rubber is wrapped around the pulley. The lagged pulley is then spiral wrapped with a wet fabric and placed in a cold autoclave and heated which shrinks the fabric applying pressure on the rubber and the heat cures the rubber.
    The concern is the degree of pressure obtained on the rubber is variable and the time the rubber is subjected to the optimum temperature is also variable and to some extent unknown. There is also a long ramp up and down time, resulting in a curing method that is not as precise as needed compromising the mechanical properties.
    Grooving of lagging is also an important issue for the shedding of water and while Razer lagging is made in machined moulds ensuring groove patterns, depth and width are strictly toleranced, hot lagged pulleys are hand grooved after curing with a heated grooving tool that can compromise the compound and bond to the steel shell.

13. We provide the following testing by third party accredited inspectors as standard
    Ultrasonic testing of welds to AS2207 level 2
    We can also provide the following testing by third party accredited inspectors if requested
    Ultrasonic testing of shafts to AS1065 level 2
    Ultrasonic testing of steel plate to AS1710 level 2

14. Static Balancing is to TEFCO standard Work Instruction TWI-10, which is in accordance with ISO 1940-1 2003 Grade 6.3, which is the grade used for large electric motors up to 950 RPM.
    Any balance weight resulting shall exceed 2kg and not exceed 2% of pulley body mass and shall be welded to the shell overhang, not the end disc. The cavity behind any balance mass shall be sealed with a paintable filler to prevent corrosion.

15. Standard surface finish is the end discs and shell overhang are shot blast cleaned to AS1627.4 class 2.5.
    After assembly mask shaft, degrease end disc, shell overhang, exposed locking assembly, bearing housings, seal locking assembly split, fit plugs to locking assembly disassembly holes and paint with a 50um DFT prime coat of Intercure 200 zinc phosphate and finish coat with 100um DFT of Intergard 475HS (MIO) colour Y14 Safety Yellow or a colour to client preference.
    After painting the exposed shaft is coated with a heavy duty rust inhibitor such as shell ensis.

16. A stainless steel nameplate is cemented to the end disc on the fixed bearing end after painting and further secured with 4 off SS hammer drive screws 6 gauge x 1/4". The fixed housing is on drive end of single drive pulleys.

17. Manufacture is done at our premises, under our QA system that conforms to the requirements of ISO9001.

18. Packing – Pulleys are strapped to special steel stillages suitable for either crane or forklift handling for up to 4 Tonne mass, and suitable for crane lifting for masses over 4 Tonne.
    Bearings are restrained in the stillage to prevent transport brinelling problems.
    The stillages remain the property of Tefco and depending on commercial practicality we will pick them up at our cost after erection.

19. Standard warranty for design, materials and workmanship is 12 months from commissioning or 18 months from delivery whichever occurs first. Extended warranties can be agreed provided all operational data is well known.
    Notification of a claim must be in writing & agreement for rectification must also be in writing prior to any remedial works starting. Warranty is limited to repair or replacement of the product only and specifically excludes:
    Consequential damages of any kind, personal injury, loss of profits, wear of shells or lagging, bearings because of bearing B10 Parameters, costs of removing and replacing Pulleys from the conveyor, damage caused by improper use or overloading of the Pulleys, or not maintaining Pulleys in accordance with our maintenance manual or normal good practice.

20. A typical pulley drawing is shown below.