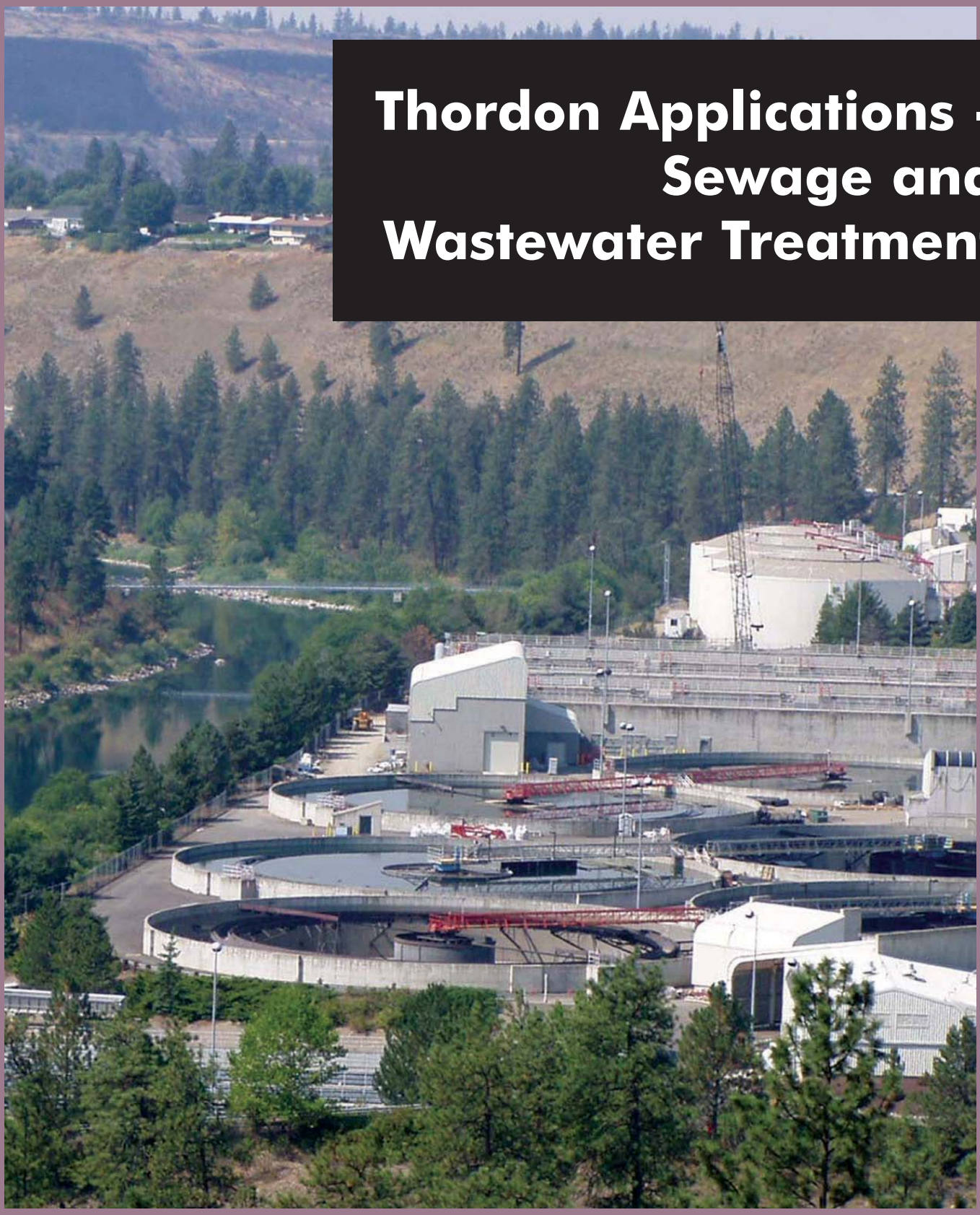
THORDON

THORDON BEARINGS INC.

Thordon Applications - Sewage and Wastewater Treatment



SWW2009.1

THORDON

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The information contained in this document is based on Thordon's many years of experience manufacturing and installing Thordon bearings worldwide.

This information is offered as part of our service to customers. It is intended for use by persons having technical training and skill, at their discretion and risk.

The company reserves the right to change or amend any specification without notice.

THORDON

Company Profile

Thordon Bearings Inc., a member of the Thomson-Gordon Group of Burlington, Ontario, Canada, designs and manufactures a complete range of high performance, environmentally friendly industrial and marine bearings. Recognized internationally for superior performance in industrial and marine applications, Thordon bearings are sold in over 50 countries throughout the world.

Utilizing Thordon, a unique polymer alloy as the bearing wear surface, Thordon bearing systems offer excellent abrasive resistance, exceptional wear life, a low coefficient of friction and can be easily machined on site. In-house design engineers consult with customers to provide innovative bearing system designs that meet or exceed the customer's technical requirements.

Since the turn of the century Thordon Bearings' parent company, the Thomson-Gordon Group, has recognized the importance of superior products, precision manufacturing and application engineering support. Thordon Bearings' engineering and quality focus has earned worldwide recognition. Quality procedures are certified to the ISO 9001 Quality System - the most rigorous system in the world. Thordon bearing systems are proven, cost effective, environmentally positive solutions for both industrial and marine applications. Thordon bearings are available worldwide from distributors whose factory trained specialists work with customers from establishing specifications to ensuring correct field installation.

THORDON

SECTION B

THORDON GRADES AND CONFIGURATIONS

Thordon is the proven value and performance choice for sewage and waste water treatment bearing, sliding wear pad and structural elastomer component applications. Thordon's unique elastomeric polymer alloys offer user benefits not found in other materials. In particular Thordon's abrasive resistance and toughness is superior to other bearing materials commonly used in these applications.

Thordon XL
- low coefficient of friction
- high resistance to shock loading and vibration
- highly abrasion resistant

Thordon SXL
- lower coefficient of friction than XL
- high resistance to shock loading and vibration
- highly abrasion resistant
- dry start-up capability as a vertical pump bearing

Thordon HPSXL
- lowest dry coefficient of friction
- resistance to shock loading and vibration
- moderately abrasion resistant
- highest loading rating

Thordon SXL & HPSXL TRAXL
- offers characteristics of SXL and HPSXL polymers in a bronze backed configuration for high pressure applications

THORDON GRADES AND CONFIGURATIONS (cont'd.)

Thordon Composite
- lower coefficient of friction than rubber
- higher resilience and stiffness than rubber
- available with either polymer or metal bearing shells
- provides outstanding pump bearing wear life in abrasive operating conditions

Thor-Flex
- high performance elastomer for non-bearing applications
- highest abrasion resistance
- very tough – tear and cut resistant
- lightweight replacement for metals
- reduced noise and high vibration resistance/shock absorption compared to metals
- can be bonded to metal and other polymers
- can be custom formulated to specific applications

Thordon's bearings and high performance elastomer polymers deliver significant savings over traditional materials on a life cycle cost basis.

SECTION C

(i) SEWAGE AND WASTEWATER APPLICATIONS

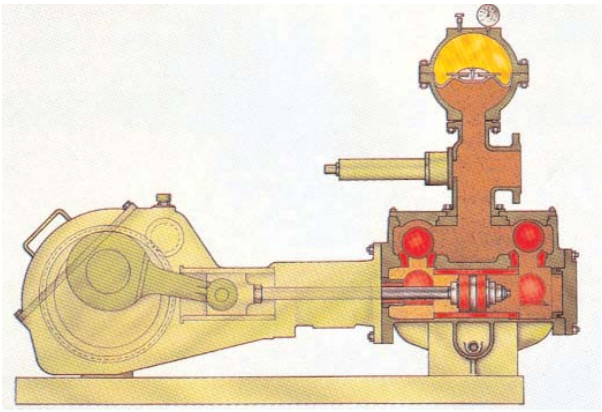
Sewage and wastewater treatment processes all involve treatment of dirty, abrasive-laden fluids. A variety of mechanical operations utilizing specialized equipment ranging from pumps to screens to various types of conveyors are used. All the moving components of this equipment are exposed to operating conditions which, at best, can be described as extreme - highly abrasive and corrosive. Thordon bearings and bushings as well as Thor-Flex wear pads and structural wear components offer proven solutions that significantly reduce maintenance costs and related down time compared to traditional solutions.

PUMP BEARINGS

Once the influent arrives at the treatment plant, the slurry is moved through the treatment process using a variety of pumps. The type of pump used is primarily determined by the degree of solid content of the liquid and the head and volume required. Due to the high degree of grit and other solids typically contained in the slurry, abrasive wear of the pump bearings, shaft and pump housing is inevitable. Installation of Thordon bearings and Thor-Flex wear components, however, will provide optimum wear life and significantly reduce maintenance costs and downtime.

Piston Pumps

Single acting piston pumps are commonly used throughout treatment plants and all parts in contact with the slurry or sludge suffer from high rates of abrasive wear. In particular, the cast iron pistons and check valve balls wear quickly and benefit from an upgrade to Thordon or Thor-Flex. The cast iron pistons can be renewed by machining the outside diameter of the piston down and facing it with Thordon SXL bonded in place. New, abrasion resistant Thor-Flex check balls provide superior wear life and are supplied moulded to size.



Crankshaft driven piston pump

Horizontal Pumps

In horizontal pumps Thordon can offer improved life by re-lining the wear rings using SXL, and in the case of split impeller pumps, the centre support bearing can be upgraded to SXL.

Vertical Pumps

Vertical pumps may be used in larger plants to move larger quantities of influent through the plant or to supply flushing water for some of the process equipment used in the plant. In abrasive slurry conditions Thordon Composite is specified for the lower pump bearing and Thordon SXL for the upper column bearings. The Composite/SXL bearing combination offers significantly improved wear life compared to bronze, phenolic or rubber bearings.

Vertical Industrial Turbine Pump

Screw Lift Pumps

The “Achilles heel” of a screw lift pump is the bottom bearing. Not only is the bottom bearing typically fairly highly loaded, but it also operates totally submerged in the abrasive slurry medium being pumped. The seals on conventional greased bearings usually fail in a short time and the result is rapid bearing and shaft wear. Installation of Thordon SXL bearings provides greatly improved wear life and somewhat reduced shaft wear. Shaft wear can be minimized if the grease line to the greased bearing is converted to a clean water flush line using Thordon.

Screw lift pump with bottom bearing submerged in abrasive slurry

SCREENS

Screens are used initially where the influent enters the plant to remove large debris such as sticks, cans, plastic bottles etc. that could damage or plug downstream equipment. Various types of screens are used depending on the process involved, but they all have elements that slide or rotate in a wet abrasive environment where an upgrade to Thordon or Thor-Flex will pay maintenance dividends.

Bar or Fixed Screens

Bar screens are fixed in position but are cleaned using a mechanical rake that moves slowly from the bottom of the screen to the top collecting the solids as it moves. At the top the solids fall off the rake and are flushed away into a settling area. Thordon SXL is recommended for the bushing applications on the rake.

Bar Screen with Rake

Band or Travelling Screens

A band or travelling screen consists of a head and tail shaft with either a steel conveyor belt or segmented screen sections attached to a chain driven by sprockets on the head shaft. Thordon HPSXL, which can be operated without grease, is recommended for the upper pillow blocks and SXL for the lower idler bearings.

Disc Screens

Rotating disc screens are used to remove fine solids from relatively shallow water in settling areas. As the disc screen rotates the solids are lifted above the water surface where they are washed into a collecting trough and directed for further processing. Thordon SXL is recommended for the bearings on the disc shaft, particularly the bottom one, which operates in very dirty conditions.

Drum Screens/Scum Collectors

Drum screens and scum collectors rotate horizontally and at right angles to the liquid flow in the tank area. As the drum rotates, the solids are carried above the liquid level where they can be removed by scrapers, brushes or backwashing. Thordon SXL bearings are recommended for the main shaft bearings and Thor-Flex can be used to extend the life of scraper blades if they are being used. Thor-Flex can also be used as chute liners.

Scum Collector with travelling conveyor

Vacuum Drum Filter

Vacuum drum filters are large rotating finely screened drums which use vacuum to pull water through the screen leaving the solids on the outside of the screen where they can be removed by a doctor blade or scraper onto a conveyor belt for disposal as solid waste. Thordon SXL is recommended for the main shaft bearings and Thor-Flex is an ideal replacement for rubber or stainless steel doctor blades.

SHREDDERS

Powered shredder units are used to chop items which pass through the influent screens to a smaller size that can be handled by the plant's equipment. Thordon SXL is recommended for the shredder main shaft bearings.

CONVEYORS

Chain, belt and screw conveyors are typically used to move solids or semi-solids through the treatment plant. All of these conveyors operate in areas where there is maximum exposure to abrasives and solids. Conveyor bearing wear life has improved significantly after conversion to Thordon or Thor-Flex components.

Chain Conveyors

Chain conveyors are often used to remove grit and heavy solids from the bottom of sedimentation tanks (grit chambers). Two chains are run between a pair of shafts with slats, plows or paddles spaced at intervals between them to scrape the solids to one end of the tank where they can be removed. Thordon SXL is recommended for the shaft and idler sprocket bearings and Thor-Flex for the plow wear shoes and slides under the chain.

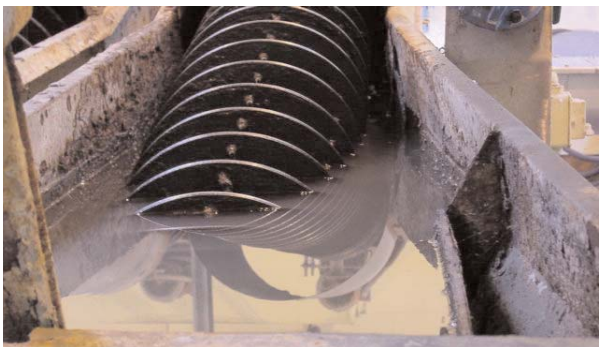
2 systems of grit chamber scraper apparatus applications

Belt Conveyors

Belt conveyors are commonly used to transport solids throughout the plant. Thordon SXL bearings are recommended for shaft and idler roller bearing applications. Thordon HPSXL is recommended for serpentine belt conveyors which can see higher bearing loads. Thor-Flex can be used to increase the life of belt guides and wear strips.

Screw Conveyors and Arcamedian Screws

Screw conveyors are a simple reliable means of moving solids. Thordon SXL bearings are recommended for the hangar bearings of a screw conveyor and the bottom bearing of a vertical Arcamedian screw conveyor. Greasing can be eliminated and if bronze bushings have been replaced there is also a significant reduction in noise. The screw conveyor trough can be protected from abrasion by bonding or mechanically attaching a Thor-Flex lining.

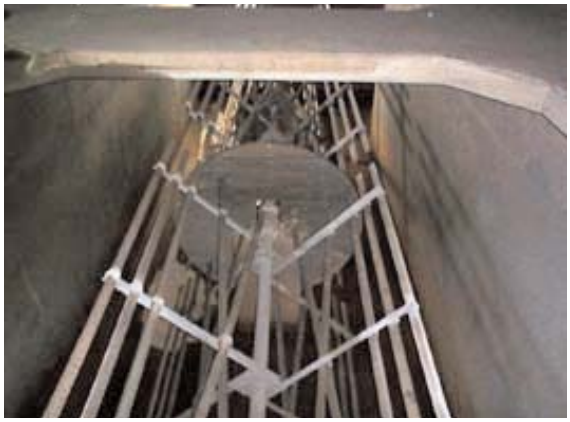


Screw Conveyors used for Grit Removal

AGITATORS

Agitators are used in the bottom of settling tanks to encourage further break down of solids. Thor-Flex is recommended for the agitator shaft bushings which operate submerged in very dirty abrasive conditions at the bottom of the tanks.

In flocculation system, the coagulating solids are slowly mixed in concrete tanks by large paddle wheels that rotate slowly encouraging them to form larger, heavier particles called “floc”. Paddle wheel designs vary, but there are usually 2 to 4 Thordon SXL bearings per shaft.

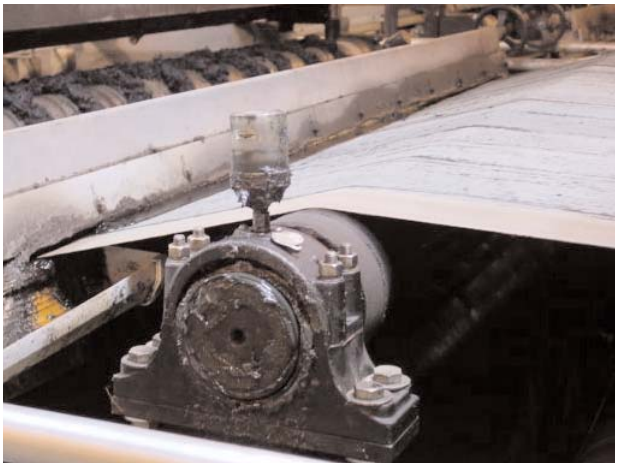


Flocculator paddle wheel

FILTER PRESS

The filter press consists of a number of rollers with an endless fabric blanket running around the rollers. Raw sludge is picked up on the blanket and carried through the rollers where the liquid is squeezed out. The de-watered sludge is then deposited onto a belt conveyor or into a screw conveyor and loaded on trucks for disposal. Thordon SXL is recommended for use on the roller shaft bearings.

De-watering filter press



Pillow block bearing on filter press

FLOATING TANK COVER ROLLERS

Floating tank covers are commonly used for Flocculation or other tanks in the plant where the liquid level is not held at a constant level. Thor-Flex or SXL is recommended for the rollers that are used to allow the tank covers to move up and down freely without jamming.

Floating Tank Cover

SXL Floating Tank Cover Rollers

SECTION C

(ii) EQUIPMENT BY PROCESS AREA

Influent Entry

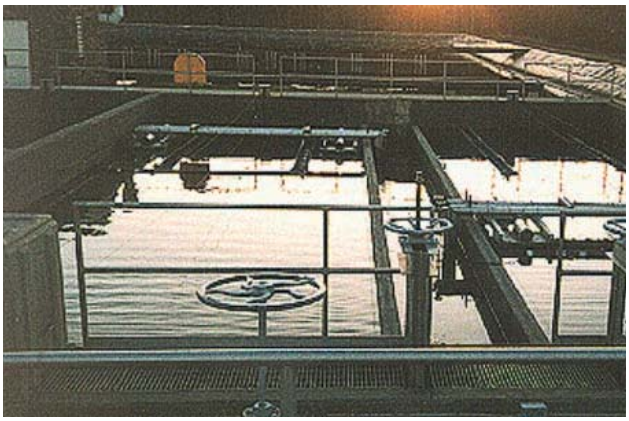
As influent enters the plant it passes through **bar screens** and then a **shredder** to further process larger particles.

Grit Removal

From the shredder the wastewater flows into a collector well before being **pumped** to the grit removal area where the flow is delayed to allow heavier particles of grit and sand to settle. **Chain and/or screw conveyors** are used to remove the grit.

Primary Settling

From the grit chambers the wastewater flows to the primary settling tanks where removal of the organic materials begins. **Agitators** are commonly used in the bottom of the tank to promote further breakdown of the solids for easier transfer. **Chain conveyors** are used to remove the solids that settle to the bottom. Lighter surface scum is removed by a **drum screen or scum collector** on a travelling **chain conveyor**.



Primary Clarifier/Settling Tank

Aeration Section

The primary effluent next flows into the aeration tanks where bacteria are used to oxidize most of the remaining organic matter. A **drum screen or scum collector** may be used to take lighter solids off the top and **agitators** are used in combination with compressed air to keep the solids in suspension.

Aeration Tanks

Final Settling

After aeration the discharge flows to the final settling tanks where the bacterially activated sludge is allowed to settle. A **chain conveyor** is used to collect the settled sludge, which is then moved by **screw or belt conveyor** and/or pumped, via a **piston pump** either back to the aeration section as bacterial “seed” or to the digesters.

Chlorination/Flocculation

Chemicals are mixed with the effluent in these chambers to provide further treatment to kill bacteria and/or neutralize certain chemicals such as phosphates. Flocculators keep the solids grouped and suspended for processing. **Agitation** is required to keep the particles suspended. Various types of **conveyors** are used to remove the neutralized precipitate solids.

Digestion

Raw sludge from the primary settling tanks and excess activated sludge are **pumped** or **conveyed** to the digesters for further treatment in two stages. In the first stage, **agitators** are used to encourage anaerobic bacterial action. In the second stage, settling is encouraged and the solids are removed by **conveyor** to be de-watered via **vacuum filtration** or **filter press**.

De-watering

A **vacuum filter drum** or a **filter press** is used to separate as much water from the sludge as possible. The solid sludge is **conveyed** to a holding area or loaded on trucks for disposal. The liquids remaining are **pumped** back into the liquid effluent side of the system for further treatment.

Belt filter press

Thordon Bearings
Sewage Treatment and Wastewater Application References

01-Jul-03

END USER	COUNTRY	APPLICATION	MATERIAL	INSTALL. DATE
City of Chicago Water Purification Plant	USA	Chain conveyor plow wear shoes	Thor-Flex	2002
City of Chicago Water Purification Plant	USA	Paddle wheel bearings	SXL	2002
City of Guelph	Canada	Trough Liners	Thor-Flex	2001
Miami-Dade Water & Sewer Dept.	USA	Grit bucket wear shoes	Thor-Flex	1997
Miami-Dade Water & Sewer Dept.	USA	Screw conveyor bearings	SXL	1997
Miami-Dade Water & Sewer Dept.	USA	Grit conveyor wear strips	Thor-Flex	1997
Miami-Dade Water & Sewer Dept.	USA	Digestor Tank Rollers	SXL	1997
Miami-Dade Water & Sewer Dept.	USA	Pump bearings		
Rhode Island Waste Water Dept.	USA	Grit chamber bushings		
Rhode Island Waste Water Dept.	USA	Grit chamber wear pads	SXL	
Rhode Island Waste Water Dept.	USA	Aeration tank bushings	SXL	
Rhode Island Waste Water Dept.	USA	Incline screw bushings		
Detroit Water and Sewage	USA	Belt scrapers		
Detroit Water and Sewage	USA	Serpentine belt guides		
Detroit Water and Sewage	USA	Sweep bearings		
Detroit Water and Sewage	USA	Piston liners	Thor-Flex	
Detroit Water and Sewage	USA	Check valve balls	Thor-Flex	
Rochester (NY) Pure Water Districts	USA	Screw conveyor busings - dewatering plant		
City of Toledo (OH) -Div. of Waste Water	USA	Piston pump liners	SXL	2001
Dept. of Public Works - New South Wales	Australia	Rotor shaft support bearings - aeration unit	XL	1979
Toronto - Lakeview Sewage Plant	Canada	Head shaft suppot bearings - band screens	SXL	1980
Toronto - Lakeview Sewage Plant	Canada	Piston pump liners	Regular	1980
City of Hamilton Sewage Treatment Plant	Canada	Sproket bearings in clarifier	Regular	
City of Hamilton Sewage Treatment Plant	Canada	Piston pump liners	Regular	1980
City of Hamilton Soild Waste Reduction	Canada	Fly ash conveyor bearings	Regular	1980
Sydney Water Board	Australia	Dewatering and screw conveyors bushings	XL	1990
Melbourne Sewage Treatment Plant	Australia	Bottom bearings - main sewer chain	SXL	
Gleneig Wastewater Treatment Plant, SA	Australia	Screw conveyors, main pump bearings	SXL	
City of Indianapolis	USA	Serpentine belt guides	SXL	
City of Indianapolis	USA	Solids conveyor head bearings	SXL	
City of Indianapolis	USA	Sproket bearings in clarifier		
City of Winnipeg Water & Waste Water	Canada	Flight wear pads		
City of Winnipeg Water & Waste Water	Canada	Chain wear pads		
City of Winnipeg Water & Waste Water	Canada	Sprocket bushings		
City of Winnipeg Water & Waste Water	Canada	Sweep bushings		
Edmonton	Canada	Wear Pads		
Edmonton	Canada	Pump Bearings		
Nashville	USA	Wheels on rotating bridge	Thor-Flex	

CITY OF CHICAGO
JAMES W. JARDINE WATER PURIFICATION PLANT

Challenge

The Jardine Water Purification Plant in Chicago is the one of the world's largest water purification plants. Treating water from Lake Michigan, the plant pumps over 700 million gallons of water per day. In 2000, the plant engineer contacted Thordon to discuss a bearing problem in the flocculation system. He had formerly worked with the US Army Corps of Engineers and had previous experience with Thordon bearings.

The flocculation system consists of large concrete tanks filled with water that is agitated by large paddle wheels that rotate very slowly (approx. 3 rpm). Alum, a very abrasive coagulent is added to the water. The abrasive environment was causing premature wear on the 2-4 phenolic laminate shaft bearings of the large paddle wheels that slowly mixed the water. There are over 500 paddle wheels at the Jardine Treatment Plant.

Flocculator Paddle Wheel

Solution

After Thordon reviewed the operating conditions and environment, Thordon SXL bearings were recommended. SXL bearings offer:

- Low friction suited to slow speed shaft operating conditions
- Excellent resistance to abrasion
- Performs well in wet environment

Thordon SXL paddle wheel bearing

The City of Chicago did not tender the contract until October 2001. After reviewing Thordon references from other installations, the City of Chicago awarded the contract to Thordon for SXL paddle wheels.

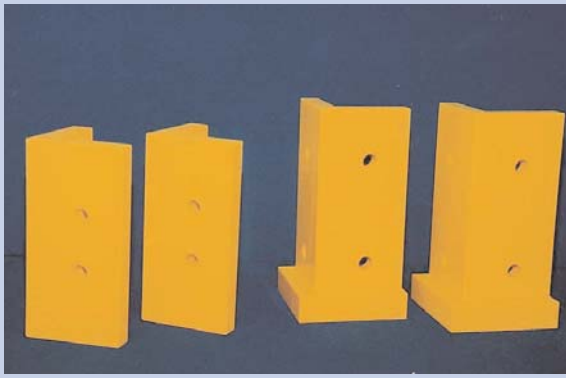
The initial meetings also led to another problem area in the water purification plant. Grit Chambers are large settling tanks where the removal of organic solids takes place. The large tanks have chains and sprocket systems with scrapers or flytes spaced at intervals between them. Scum is removed from the top and the grit and settled solids are scraped to one end of the bottom of the grit chamber for removal. The existing UHMWPE wear shoes are the wear surface for the slow moving scrapers and have been problematic for this application. There are over 14,000 wear shoes at this plant in 3 different sizes.

Conveyor Scrapers in Grit Chambers

Thordon recommended Thor-Flex Chain Conveyor Scraper Wear Shoes. Thor-Flex offers:

- Excellent wear resistance in low speed sliding wear pad applications
- Much greater cut and gouge resistance than UHMWPE
- Longer wear life as proven by other sewage and waste water plant references

Thor-Flex chain conveyor scraper wear shoes



The City of Chicago awarded the contract to Thordon to convert all chain conveyor scraper wear shoes to Thor-Flex.

THORDON

INDUSTRIAL BEARINGS

THORDON

Thordon Bearings is recognized as a pioneer in high performance, yet environmentally friendly, innovative bearing system designs. Thordon provides reliable, cost effective non-metallic bearing solutions for a wide variety of industrial applications including pump, hydropower, sewage, water treatment, mining, sugar cane, marine and pulp / paper / forestry industries. Originally developed in 1967 as a high performance, water lubricated pump bearing, Thordon bearings offer excellent wear life, reduced noise and low operating friction while providing a dependable, long-lasting, environmentally friendly alternative to grease and oil lubricated bearings.

PROVEN BENEFITS FOR PLANT SUPERVISORS AND MAINTENANCE ENGINEERS

Thordon non-metallic bearings have been used in a wide range of industries and various applications such as in pumps, pivot points, screw conveyors, hydro turbine wicket gates, agitators and flocculator paddle wheels.
Thordon bearings are designed to work under the most extreme conditions: abrasive, corrosive, high impact load, high humidity and infrequent maintenance periods.

TYPICAL INDUSTRIAL APPLICATIONS:

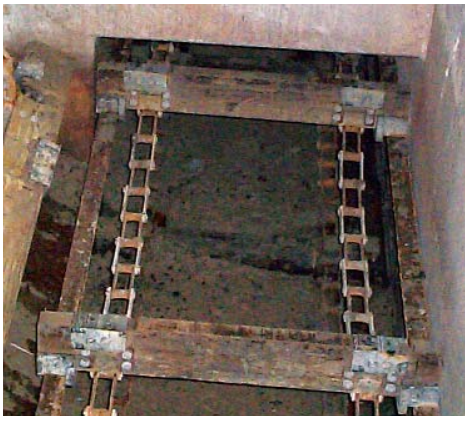
- **WASTE WATER AND SEWAGE TREATMENT** (aerators, traveling screen, drum screens, scum collectors, chain conveyors)
- **GRAPPLES OR GRABS** (pivot linkage bushings)
- **VERTICAL PUMP BEARINGS**
- **HYDRO TURBINE BEARINGS** (operating mechanism bearings, wicket gate bearings, main guide bearings)
- **MINING** (crushers and feeders, materials handling bearings, mine car rocker arm and wheel bearings, skip pivots)
- **BUTTERFLY VALVES**
- **LOCK AND DAM GATE BEARINGS**
- **AGRICULTURE** (conveyor shaft bearings, sugar cane harvesting and processing equipment bearings, fish farm bearings)
- **PULP & PAPER/FORESTRY** (doctor bushings, mixer bushings, grapple bearings, roller chain bushings)
- **CRANES AND HOISTS** (boom slides, sheave wheel bushings)
- **STACKERS**
- **RECLAIMERS AND BUCKET SCOOPS**
- **GATE AND DOOR BUSHINGS**
- **MARINE DECK EQUIPMENT BEARINGS**

SELF-LUBRICATING

With a low inherent coefficient of friction, Thordon bearings typically do not require grease lubrication. This results in reduced maintenance costs and safety issues. Environmental and product contamination concerns associated with grease lubrication are eliminated. Thordon bearings are homogeneous polymers with built-in lubricants. The lubricants, being dispersed throughout the bearing material, continue to provide low friction throughout the life of the bearings.

LONG WEAR LIFE

Based on over 40 years experience supplying bearings to industry, Thordon bearings have been proven to provide longer wear life than the bearings they replace. Longer life in any one specific application may be the result of Thordon's low friction, superior abrasion resistance, high resilience and impact resistance or a combination of several of the above. The end result, however, is the same... improved reliability and reduced life cycle costs.



HIGH RESILIENCE AND IMPACT RESISTANCE

Elastomeric Thordon bearings exhibit a Modulus of Resilience many times that of bronze. As a result, Thordon elastomeric bearings can absorb impact or shock loads encountered during operation without permanent deformation to a much greater degree than bronze or other non-metallic bearings.

LOW OPERATING FRICTION

Thordon bearings have lower static and dynamic coefficients of friction than most other materials commonly used for industrial bearings. This is the case whether the bearing is dry or submerged in liquid. A low bearing coefficient of friction is important in minimizing adhesive bearing wear and providing smooth, stick-slip free start-up and operation.

CORROSION RESISTANCE

Thordon's corrosion resistance is superior to metallic bearing materials commonly used in industrial applications. As an electrical insulator, Thordon will not participate in a galvanic reaction.

NOISE REDUCTION

A quieter workplace can be one of the added bonuses of specifying Thordon bearings. Thordon bearings tend to dampen and reduce operating noise compared to metallic bearings, which can transmit, and even amplify, noise.

HIGH TEMPERATURE AND IMPROVED CHEMICAL RESISTANCE

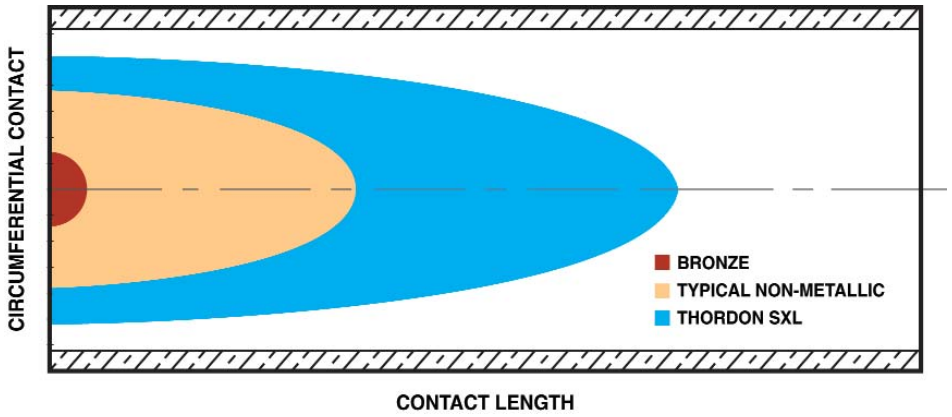
ThorPlas bearings can be used in industrial applications with water temperatures up to 80°C (176°F) extending the temperature range from other Thordon grades. ThorPlas has improved chemical resistance versus Thordon elastomers and performs well where minimal initial running clearances are required.

EASILY MACHINED TO SIZE

Thordon bearings can be easily machined to exact finished dimensions in the field. Costly sleeve or shaft replacement can often be avoided by machining the bearing to compensate for existing wear or damage.

This is not possible with many competitive bearings that are moulded to 'standard' sizes and do not provide overbuild for machining on site as required. Plant and Maintenance Managers find that machining bearings to size from pre-grooved or standard Thordon tubes reduces their industrial bearing inventory and repair turn around times. The Thordon Bearing Sizing Calculation Program offers easy computer-based dimension calculations.

TYPICAL EDGE LOADING PROFILE



HIGH ABRASION RESISTANCE

When operating in abrasives, Thordon's elastomeric grades offer superior wear life due to their elastomeric nature. Thordon rejects abrasive particles allowing them to pass through the running clearance between the shaft and the bearing without becoming embedded. Wear of the bearing and shaft due to third particle abrasion is minimal. For severely abrasive applications, Thordon Composite operating with continuous lubrication is recommended. It will often outwear other bearings by a factor of two or more.

ACCOMMODATES EDGE LOADING

Edge loading conditions often occur as a result of minor misalignment or shaft deflection. Thordon elastomeric grades deflect slightly, effectively spreading the load. The localized bearing pressure is reduced as a result, and wiping of the bearing, a common occurrence with more rigid bearing materials, is eliminated.

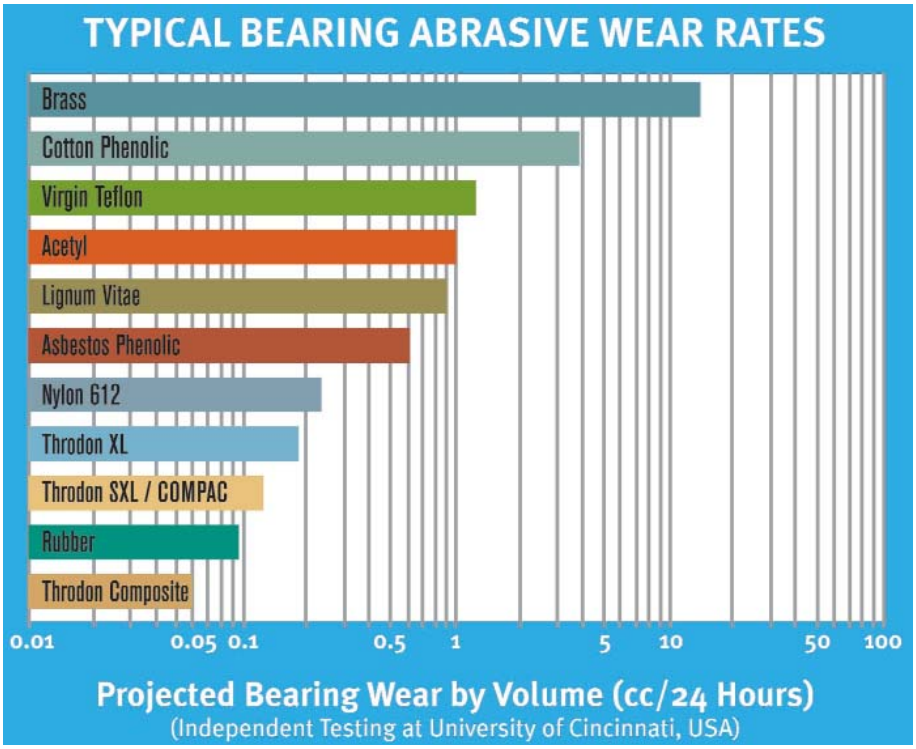
CONVERSION OF EXISTING BEARINGS

Worn metallic or metal backed bearings can be re-lined with Thordon elastomeric bearings. Field bonding Thordon into the metal shell of the worn bearing can often reduce cost. Fitting of the re-lined bearing remains unchanged.

EASILY INSTALLED

After machining to the proper dimensions for an interference fit, Thordon bearings can be easily fit into place by press or freeze fitting. Thordon elastomeric bearings may be cooled in dry ice or liquid nitrogen. ThorPlas bearings may be cooled with dry ice, but must **not** be immersed in liquid nitrogen. Once the bearings are placed in position and warm they will assume the design interference fit. Expensive and labour intensive pressing equipment and fixtures are not necessary.

TYPICAL BEARING ABRASIVE WEAR RATES



NOTE: Wet third particle abrasion.
Shaft material: carbon steel; Bearing I.D.: 2.5cm (1"); Abrasive slurry mixture: 2% bentonite, 6% sand, 6% clay; 86%water

THORDON GRADES AND CONFIGURATIONS

ThorPlas® (blue) is a non-elastomeric, homogeneous material developed by Thordon specifically as a full form high pressure bearing.

- maximum dynamic working pressure to 31.0 MPa (4500 psi); static pressures to 45.0 MPa (6500 psi)
- easily machined without affecting low coefficient of friction (typically 0.10 – 0.17)
- very low wear in non-abrasive environments
- maximum continuous service temperatures of 80°C (176°F) in water and 110°C (230°F) dry
- excellent dry start capability as a vertical pump bearing
- reasonable abrasion resistance - less than Thordon elastomer grades, but better than bronze, epoxy phenolics and many other non-metallic bearing materials
- improved chemical resistance in most chemical product categories compared to elastomeric grades

Thordon SXL (off-white) has excellent dry start capability and a lower coefficient of friction than the other Thordon elastomeric grades.

- low coefficient of friction (typically 0.10-0.20)
- higher dry PV (Pressure Velocity) rating than XL
- higher resistance to abrasion than XL in wet applications; good abrasion resistance operating dry
- dry start-up capability as a vertical pump bearing
- high resistance to shock loading and vibration

NOTE: *When SXL is used in vertical pumps where dry startup is a consideration, consult with Thordon Bearings regarding bearing design. Thordon will recommend a maximum dry running time based on the peripheral velocity of the shaft and the load on the bearing.*

Thordon XL (black) is used in a variety of industrial applications and has similar abrasion resistance compared to SXL.

- low coefficient of friction (typically 0.20-0.25)
- high resistance to abrasion in dry applications
- high resistance to shock loading and vibration

Thordon HPSXL (grey) is designed for higher pressure applications as the bearing component in HPSXL TRAXL bearings (HPSXL bonded in a metallic shell).

- maximum dynamic working pressure to 15.0 MPa (2175 psi) in limited motion as a homogeneous material
- HPSXL TRAXL has maximum dynamic working pressure to 55.0 MPa (8000 psi) in limited motion
- lowest coefficient of friction (typically 0.06-0.12)
- moderately abrasion resistant (lower abrasion resistance than XL or SXL)
- high resistance to shock loading and vibration

Thordon Composite (yellow shell, black wear surface is GM2401) is a two-component bearing formulated specifically for use in very abrasive environments.

- used in rotating applications in abrasive water conditions such as pump and dredge bearings
- outstanding abrasion resistance - two or more times that of rubber
- significantly lower coefficient of friction than rubber
- higher resilience and stiffness than rubber
- available with either yellow polymer or metal bearing shells

APPLICATION AND DESIGN INFORMATION

The success of any bearing application depends not only on the selection of superior products but also on the correct design and use of such materials for each specific application. A set of guidelines, found in the table below, has been prepared to assist designers in choosing the best Thordon material for the application at hand. Some of the application and design considerations to take into account when specifying Thordon for any industrial bearings include:

FLUID COMPATIBILITY

Thordon bearings can be used in a wide range of chemicals and process products that would typically affect metallic bearings. A comprehensive chemical compatibility chart for both Thordon elastomeric and thermoplastic materials is available to determine the best bearing product for the application.

TEMPERATURE

For Thordon elastomeric grades, the maximum operating temperature in water is 60°C (140°F). The thermoplastic ThorPlas material has an operating limit of 80°C (176°F) in water.

ENVIRONMENT

The choice of material and the configuration of the bearing are highly dependent on the operating conditions to which the bearing is exposed. All Thordon bearings (except Composite) can be installed with or without axial grooves (all Composite bearings are grooved). The grooves are recommended whenever a bearing is operating in a flow of liquid (as in a vertical pump). Grooves facilitate flow of the fluid through the bearing to provide cooling and removal of abrasive particles, thus extending life of both bearing and shaft. Grooves are not required when there is no flow of fluid past the bearing. For high pressure bearings which may be exposed to dirty environments, especially those with oscillating motion and no flow of fluid, Thordon recommends the use of tough Thorseal lip seals in recessed grooves near the ends of the bearing to prevent abrasive ingress. Other environmental factors such as intermittent exposure to higher temperatures, chemicals, restriction on flow, dry running, etc. should also be considered when designing a Thordon bearing.

BEARING DESIGN

Engineering manuals and a computer-based bearing sizing calculation program are available to assist in the design of Thordon bearings. The input information required, whether using manual calculations or the computer program, includes housing diameter (maximum & minimum), shaft diameter, operating temperatures (maximum, minimum and machine shop ambient), type of lubrication, shaft RPM and the duration for dry start period for vertical pump bearings, if applicable. Accurate input information ensures that the final bearing design is optimal. Some of the bearing parameters to consider during the design stages include:

• **Minimum Installed Clearances** This value is the sum of the bearing running clearance (based on shaft diameter), the thermal allowance and absorption allowance. The latter two are dependent on wall thickness. Minimum installed clearances can be reduced by using different grades of Thordon or by choosing a bonded bearing configuration that allows reduction of the wall thickness. The Thordon Bearing Sizing Program can be used to determine which configuration achieves the required installed clearance.

• **L/D Ratios** Typical ratios for length to diameter when using Thordon bearings can range from 1 to 1.5. The bearing length can be reduced by up to 50% compared to rubber bearings because Thordon grades have a higher load carrying capability.

• **Type of Installation** Thordon bearings can be freeze or press fitted. Elastomeric grades may be bonded to the clean surface of an existing or new metal shell. Where possible, bonded installations can reduce the bearing wall thickness allowing for tighter installed clearances.

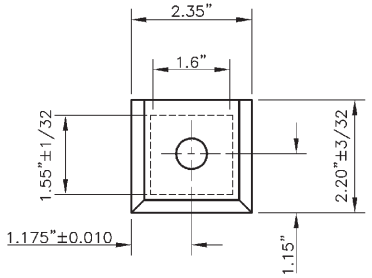
NOTE: *For more detailed information on bearing design parameters, please refer to the Thordon Engineering Manual or the ThorPlas Bearing Engineering Manual.*

THORDON MATERIAL SELECTION GUIDE FOR INDUSTRIAL APPLICATIONS

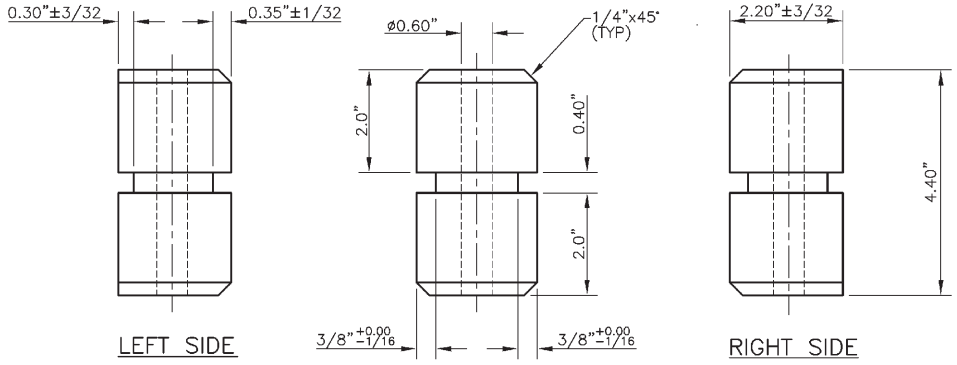
LUBRICATION/ OPERATING PRESSURE	RECOMMENDED THORDON GRADES		
DRY (sealed or minimal abrasives)	★★★★★	★★★★	★★★
0-10 MPa (0-1450 psi)	SXL	ThorPlas®	
10-15 MPa (1450-2175 psi)	HPSXL	ThorPlas®	
15-31 MPa (2175-4500 psi)	HPSXL TRAXL	ThorPlas®	
31-55 MPa (4500-8000 psi)	HPSXL TRAXL		
DRY (abrasives present)			
0-5.5 MPa (0-800 psi)	XL	SXL	ThorPlas®
5.5-10 MPa (800-1450 psi)	SXL	ThorPlas®	
10-15 MPa (1450-2175 psi)	HPSXL	ThorPlas®	
15-31 MPa (2175-4500 psi)	ThorPlas®		
WET (sealed or minimal abrasives)			
0-10 MPa (0-1450 psi)	SXL	ThorPlas®	
10-15 MPa (1450-2175 psi)	HPSXL	ThorPlas®	
15-31 MPa (2175-4500 psi)	HPSXL TRAXL	ThorPlas®	
31-55 MPa (4500-8000 psi)	HPSXL TRAXL		
WET (abrasives present)			
0-3 MPa (0-500 psi)	GM2401	SXL	ThorPlas®
3-10 MPa (500-1450 psi)	SXL	ThorPlas®	
10-15 MPa (1450-2175 psi)	HPSXL	ThorPlas®	
15-31 MPa (2175-4500 psi)	ThorPlas®		

NOTE: *The maximum pressures given for the various products are based on maximum dynamic working pressures for intermittent, limited motion. For applications involving continuous rotary motion, PV limits of the materials will significantly reduce the maximum allowable pressures stated above.*

This is a general guide for technical reference only. Other critical applications that are close to pressure or temperature limits, or subjected to non-standard environments should also be reviewed and approved by Thordon Bearings.



PLAN



LEFT SIDE

ELEVATION

RIGHT SIDE

GENERAL NOTES :

1) MAT'L – THORFLEX K–207HA
2) ALL DIMENSIONS ARE EXPRESSED IN INCHES UNLESS OTHERWISE SPECIFIED.
3) DO NOT SCALE THIS DRAWING. WORK TO DIMENSIONS SPECIFIED.
4) TOLERANCES FOR ALL DIMENSIONS SHALL BE NONCUMULATIVE.
5) BREAK ALL CORNERS AND DEBURR ALL SHARP EDGES.
6) ALL FILLET, RADII AND CHAMFER DIMENSIONS ARE NOMINAL UNLESS OTHERWISE SPECIFIED.

CONDITIONS – UNLESS OTHERWISE SPECIFIED:/CONDITIONS – SAUF INDICATION CONTRAIRE:

DIMENSIONS ARE IN/DIMENSIONS SONT EN — IN
ORIGINAL SCALE/ECHELLE ORIGINALE — NTS

TOLERANCES	IMP. (in)	MET. (mm)
SURFACE FINISH/FINIS DE SUEFACES	125	3.2
DECIMAL/DECIMALE – 1 PLACE (X.X)	± 0.1	
DECIMAL/DECIMALE – 2 PLACE (X.XX)	± 0.01	TABLE A
DECIMAL/DECIMALE – 3 PLACE (X.XXX)	± 0.005	
FRACTIONAL	± 1/64	
ANGULAR DECIMAL/ANGULAR DECIMALE	± 0.5°	± 0.5°
HOLE SIZES/DIM DE TROUS	± 1/64	± 0.4
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING FLAMME DECOUPAGE, CISAILLER, POINTE, FORGEAGE ET SOUDURE AUTOGENE	± 1/16	± 1.6

TABLE A

DIMENSIONS ABOVE AU–DELA DE	DIMENSIONS THROUGH JUSQU'A	TOLERANCE (mm)
	6	± 0.1
6	30	± 0.2
30	100	± 0.3
100	300	± 0.5
300	1000	± 0.8
1000	2000	± 1.2
2000	4000	± 2
4000	8000	± 3
8000	12000	± 4
12000	16000	± 5

PROPOSAL

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CET DESSIN CE N'EST PAS CONSIDERE APPROUVE A MOINS QUE SOIT ESTAMPE' PAR THORDON BEARINGS INC. EN ENCRE ROUGE ET SIGNE'.

ZONE	LTR LET	REVISION	DATE	DWN DES	CKD VER	APPVL APP
	A1	TOLERANCES ADDED	JAN 24/96	S.C.	R.G.	J.B.

THORDON BEARINGS INC.
BURLINGTON, ONTARIO, CANADA

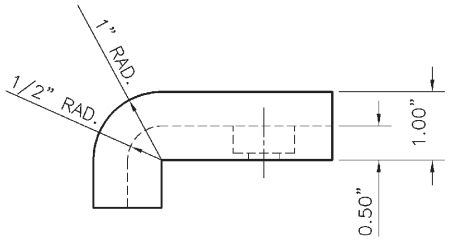
DWN/DESS CKD/VER	SIGNATURE	APPVL/APP	SIGNATURE
V. POWER		J. BUTT	

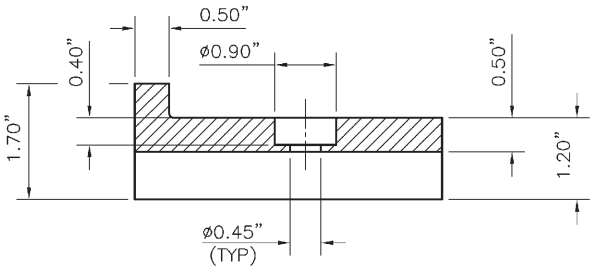
CUSTOMER/CLIENT	DRAWING DATE DATE DU DESSIN	MRP NO.	SIZE
COPPEDGE MARINE	DEC 14/95	E156650004	B

TITLE/TITRE	DRAWING NO. DU DESSIN	REV.
WEAR SHOE	TG–12882	A

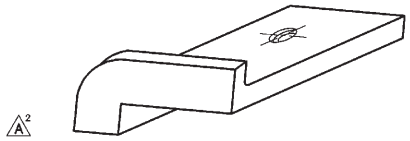
SHEET FEUILLE 1 OF DE 1

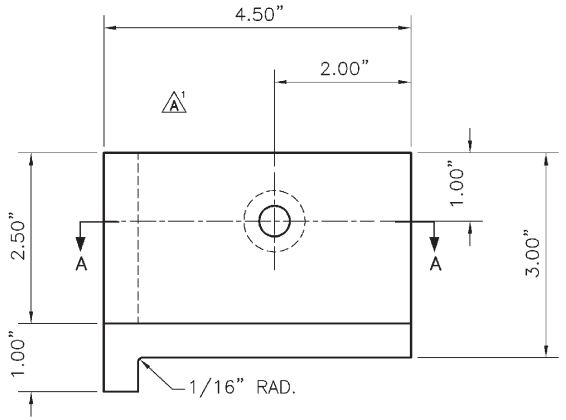
Millimeters/Millimetres
Centimeters/Centimetres





SECTION A–A





GENERAL NOTES :

1) MAT'L – THORFLEX 70D
2) ALL DIMENSIONS ARE EXPRESSED IN INCHES UNLESS OTHERWISE SPECIFIED.
3) DO NOT SCALE THIS DRAWING. WORK TO DIMENSIONS SPECIFIED.
4) TOLERANCES FOR ALL DIMENSIONS SHALL BE NONCUMULATIVE.
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CONDITIONS – UNLESS OTHERWISE SPECIFIED:/CONDITIONS – SAUF INDICATION CONTRAIRE:

DIMENSIONS ARE IN/DIMENSIONS SONT EN — IN.
ORIGINAL SCALE/ECHELLE ORIGINALE — NTS

TOLERANCES	IMP. (in)	MET. (mm)
SURFACE FINISH/FINIS DE SUEFACES	125	3.2
DECIMAL/DECIMALE – 1 PLACE (X.X)	± 0.1	
DECIMAL/DECIMALE – 2 PLACE (X.XX)	± 0.01	TABLE A
DECIMAL/DECIMALE – 3 PLACE (X.XXX)	± 0.005	
FRACTIONAL	± 1/64	
ANGULAR DECIMAL/ANGULAR DECIMALE		
HOLE SIZES/DIM DE TROUS	± 1/64	± 0.4
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING FLAMME DECOUPAGE, CISAILLER, POINTE, FORGEAGE ET SOUDURE AUTOGÈNE	± 1/16	± 1.6

TABLE A

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	6	± 0.1
6	30	± 0.2
30	100	± 0.3
100	300	± 0.5
300	1000	± 0.8
1000	2000	± 1.2
2000	4000	± 2
4000	8000	± 3
8000	12000	± 4
12000	16000	± 5

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ZONE	LTR LET	REVISION	DATE	DWN DES	CKD VER	APPVL APP
A3	A2	PROJECTED VIEW ADDED	JUL 06/99	G.C.	G.C.	R.G.
B2	A1	HOLES REMOVED	JUL 06/99	G.C.	G.C.	R.G.

THORDON BEARINGS INC.
BURLINGTON, ONTARIO, CANADA

DWN/DESS	SIGN.	CKD/VER	SIGN.	APPVL/APP	SIGN.
S. CLOUGH		S. CLOUGH		J. BUTT	

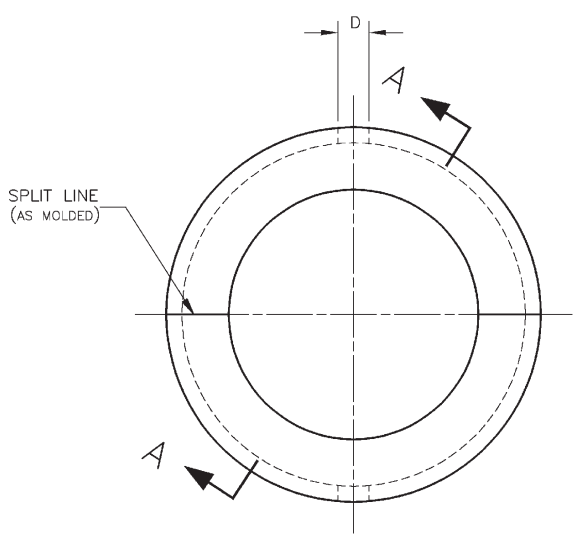
CUSTOMER/CLIENT	DRAWING DATE DATE DU DESSIN	MRP NO.	SIZE
COPPEDGE MARINE INC.	JAN 18/96		B

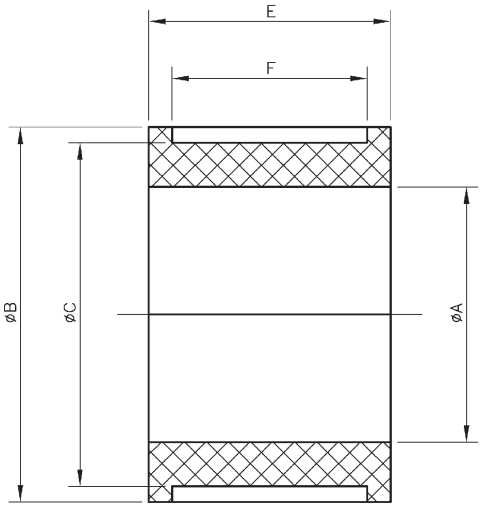
TITLE/TITRE	DRAWING NO. DU DESSIN	REV.
THORFLEX WEAR SHOE RIGHT HAND SIDE	TG–12920	A
	SHEET FEUILLE 2	OF DE 2

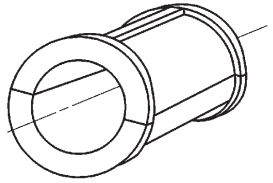
Millimetres/Millimetres
Centimetres/Centimetres

'A' NOMINAL SIZE	B	C	D	E	F
1"	1-7/8"	1-1/2"	3/16"	1-7/8"	1-1/16"
1-1/2"	2-1/2"	2-1/8"	3/16"	1-15/16"	1-9/16"
2"	3"	2-3/4"	1/4"	1-15/16"	1-9/16"
2-7/16"	3-3/4"	3-1/4"	5/16"	2-15/16"	2-3/8"
3"	4-1/2"	4"	5/16"	2-15/16"	2-3/8"
3-7/16"	5-1/4"	4-3/4"	5/16"	3-15/16"	3-1/8"
3-15/16"	5-3/4"	5-1/4"	3/8"	3-15/16"	3-7/32"

△A1







SECTION A–A

GENERAL NOTES :

1) MAT'L – THORDON
2) ALL DIMENSIONS ARE EXPRESSED IN INCHES UNLESS OTHERWISE SPECIFIED.
3) DO NOT SCALE THIS DRAWING. WORK TO DIMENSIONS SPECIFIED.
4) TOLERANCES FOR ALL DIMENSIONS SHALL BE NONCUMULATIVE.
5) BREAK ALL CORNERS AND DEBURR ALL SHARP EDGES.
6) ALL FILLET, RADII AND CHAMFER DIMENSIONS ARE NOMINAL UNLESS OTHERWISE SPECIFIED.

△A2

DO NOT SCALE THIS DRAWING. WORK TO DIMENSIONS SPECIFIED

UNLESS SHOWN OTHERWISE, MACHINING TOLERANCES ARE:

LINEAR UP TO 1m(40") ±0.5mm(±0.020")
OVER 1m(40") ±1.0mm(±0.040")

ANGULAR ±0.25°

SURFACE FINISH 3.2μmRa (125μinch)

THORDON MATERIAL SURFACE FINISH TO BE DETERMINED ONLY BY USE OF COMPARITOR

ZONE	LTR LET	REVISION	DATE	DWN DES	CKD VER	APPVL APP
A2	A2	TOLERANCE TABLE MODIFIED	JUNE 04/01	VP	CP	IE
B2	A1	ROW ADDED TO TABLE	JUNE 04/01	VP	CP	IE

THORDON BEARINGS INC.
BURLINGTON, ONTARIO, CANADA

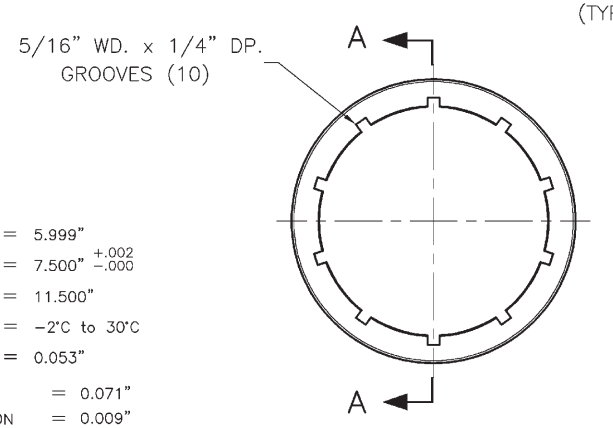
DWN/DESS	SIGN.	CKD/VER	SIGN.	APPVL/APP	SIGN.
G. CONNORS		V. POWER		D. PATTON	

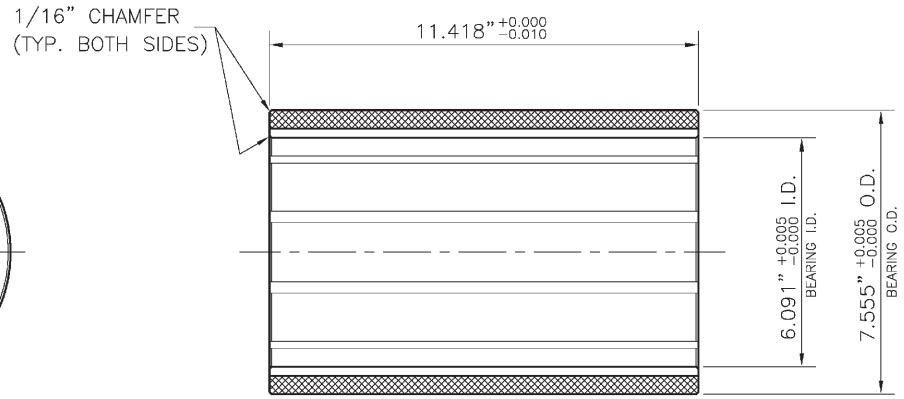
CUSTOMER/CLIENT	DRAWING DATE DATE DU DESSIN	MRP NO.	SIZE
T.B.I.	OCT 14/98		B

TITLE/TITRE: HANGER BEARING (TYPE 226 & 326)

DRAWING NO. DU DESSIN: TG-14021 REV.: A

SHEET FEUILLE 1 OF DE 1





SECTION A–A

MAXIMUM SHAFT DIA.	=	5.999"
HOUSING DIA.	=	7.500" +.002 −.000
HOUSING LENGTH	=	11.500"
TEMPERATURE RANGE	=	−2°C to 30°C
INTERFERENCE	=	0.053"
BORE CLOSURE	=	0.071"
WATER ABSORPTION	=	0.009"
RUNNING CLEARANCE	=	0.009"
THERMAL EXPANSION	=	0.003"

GENERAL NOTES :

1) MAT'L – THORDON SXL
2) ALL DIMENSIONS ARE EXPRESSED IN INCHES UNLESS OTHERWISE SPECIFIED.
3) DO NOT SCALE THIS DRAWING. WORK TO DIMENSIONS SPECIFIED.
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CONDITIONS – UNLESS OTHERWISE SPECIFIED:/CONDITIONS – SAUF INDICATION CONTRAIRE:

DIMENSIONS ARE IN/DIMENSIONS SONT EN ORIGINAL SCALE/ECHELLE ORIGINALE — IN N.T.S.

TOLERANCES	IMP. (in)	MET. (mm)
SURFACE FINISH/FINIS DE SUEFACES	125	3.2
DECIMAL/DECIMALE – 1 PLACE (X.X)	± 0.1	
DECIMAL/DECIMALE – 2 PLACE (X.XX)	± 0.01	TABLE A
DECIMAL/DECIMALE – 3 PLACE (X.XXX)	± 0.005	
FRACTIONAL	± 1/64	
ANGULAR DECIMAL/ANGULAR DECIMALE	± 0.5°	± 0.5°
HOLE SIZES/DIM DE TROUS	± 1/64	± 0.4
FLAME CUTTING, SHEARING, NIBBLING, FORMING AND WELDING FLAMME DECOUPAGE, CISAILLER, POINTE, FORGEAGE ET SOUDURE AUTOGENE	± 1/16	± 1.6

TABLE A

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	6	± 0.1
6	30	± 0.2
30	100	± 0.3
100	300	± 0.5
300	1000	± 0.8
1000	2000	± 1.2
2000	4000	± 2
4000	8000	± 3
8000	12000	± 4
12000	16000	± 5

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ZONE	LTR LET	REVISION	DATE	DWN DES	CKD VER	APPVL APP

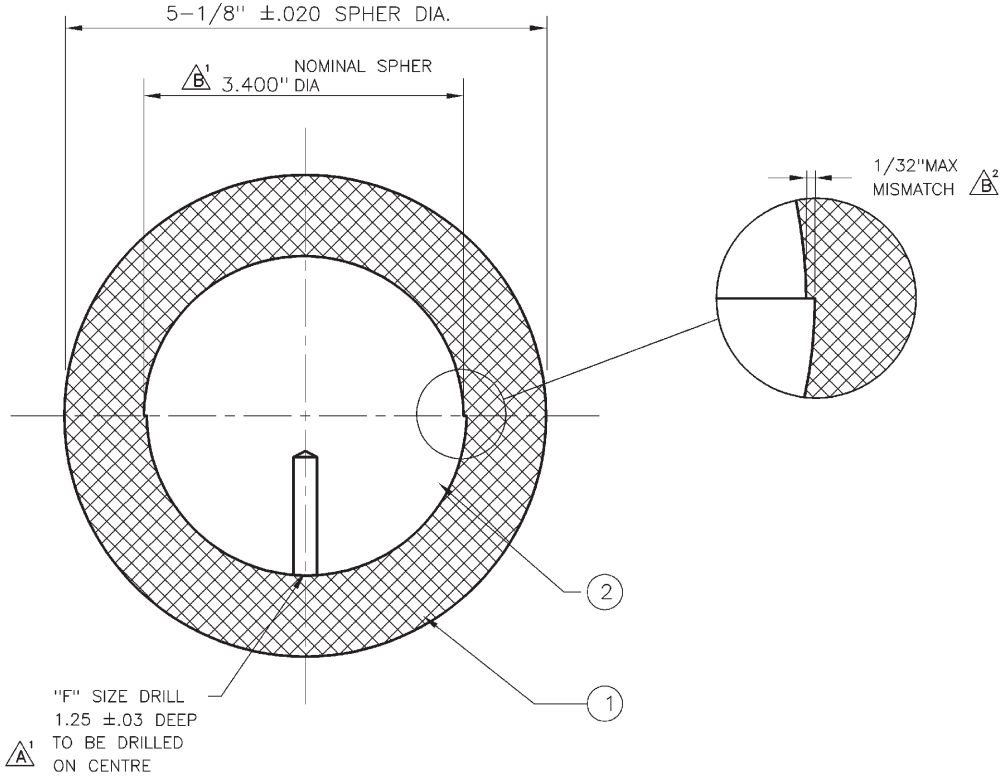
THORDON BEARINGS INC.
BURLINGTON, ONTARIO, CANADA

DWN/DESS CKD/VER	SIGNATURE	APPVL/APP	SIGNATURE
S. CLOUGH		J. BUTT	

CUSTOMER/CLIENT	DRAWING DATE DATE DU DESSIN	MRP NO.	SIZE
MARINE INDUSTRIES	FEB 01/96		B

TITLE/TITRE	DRAWING NO. DU DESSIN	REV.
SXL PUMP BEARING	TG–12935	
	SHEET FEUILLE 1	OF DE 1

Eighths Huitiemes 0 1 2 3 4 5 6 7 8 9 10 Tenths Dixiemes
Millimeters/Millimetres 0 1 2 3 4 5 6 7 8 9 10
Centimeters/Centimetres
4 3 2 1
A B



BILL OF MATERIAL	
ITEM	DESCRIPTION
1	K–109F THORFLEX GRADE 109T BLACK (TG PART NO. E13194115)
2 B4	CAST IRON SPHERICAL INSERT (CANRON, ST. THOMAS PART NO. E13FE4115) WEIGHT: 5.3 TO 5.85LBS

NOTE: FINISH WEIGTH 7.75 ±.250 LBS.
INSERT CORE WEIGHT 5.3 TO 5.8 LBS B3

REV.	DESCRIPTION	DATE
B4	WEIGHT NOW 5.3 TO 5.85	MAY 10 96
B3	CORE WEIGHT NOW 5.3 TO 5.8LBS	MAY 10 96
B2	WAS 1/64"	MAY 10 96
B1	WAS 3.126 ±.030 SPHER DIA	MAY 10 96
A1	WAS 0.713 DP	SEPT 19 88

THIRD ANGLE PROJECTION

DRAWN BY: R.G.

DATE: FEB. 2/88

APP'D BY:

SCALE: 1.2:1

THOMSON–GORDON LTD.
BURLINGTON, ONTARIO, CANADA

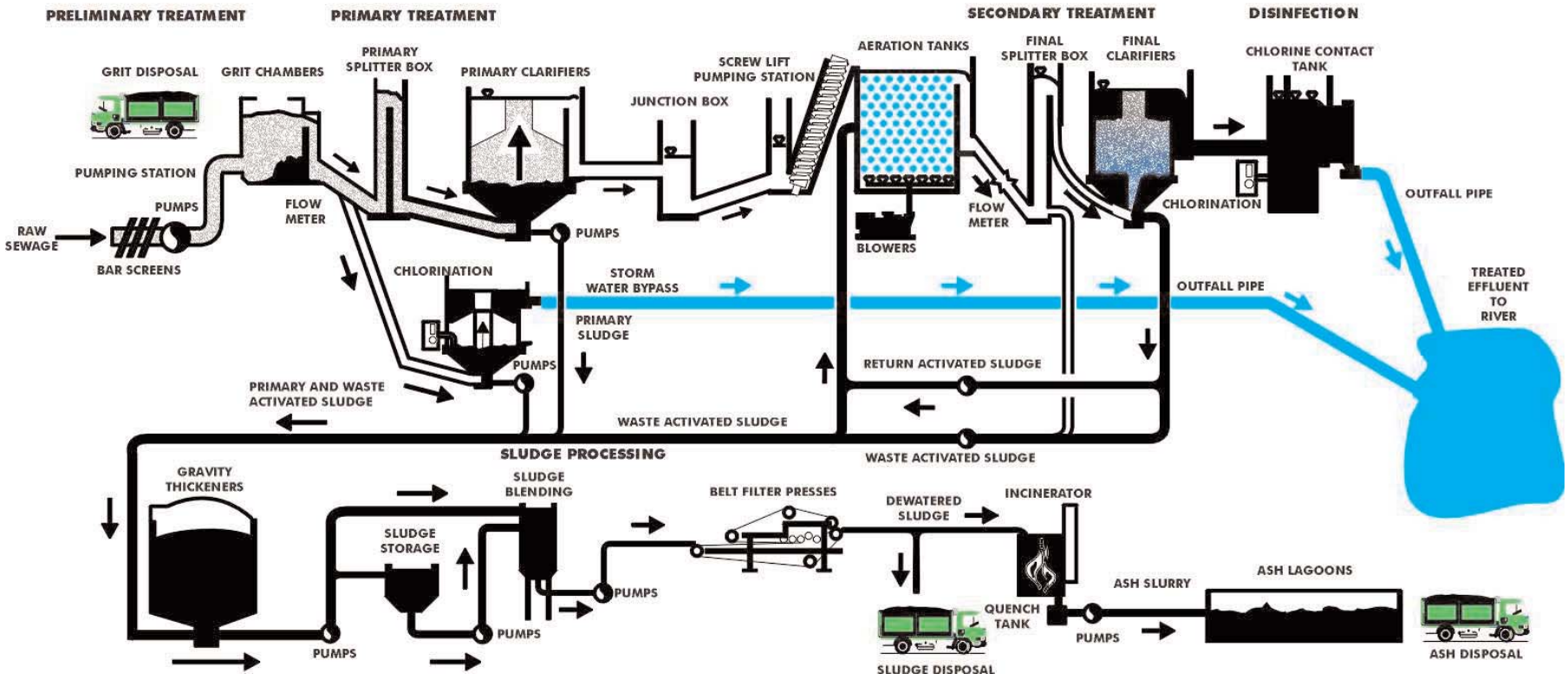
PRODUCT: TG PART NO. E13194115

TITLE: SEWAGE PUMP CHECK BALL

CUSTOMER: T.G.

DRAWING NO.: TG–10610 REV. B

Typical Waste Water and Sewage Treatment Flow Diagram



SECTION G

TYPICAL SEWAGE/WASTEWATER TREATMENT PROCESS

Although there can be some differences in treatment processes and the equipment used from one installation to another, most sewage/wastewater treatment facilities are quite similar.

The major challenges for all of these treatment plants are:

a) separation of solids from the liquid

b) oxidation treatment of the liquid by aerobic bacteria

c) chemical treatment (usually chlorination) of the liquid

d) digestion of the solids by anaerobic bacteria

The general process used to deal with the challenges listed above is described below.

Influent Entry

The municipal wastewater enters the water pollution control plant through influent channels located under the influent building.

Upon entering the channels it passes through screens and shredding devices. The screens prevent entry of large objects which may damage equipment and the shredding devices cut the larger particles to a size suitable for handling in the treatment processes which follow.

Grit Removal

From the shredder, the wastewater flows into a collector well; from there it is pumped up to the grit removal facilities located adjacent to the building housing the influent entry.

The grit removal facilities receive and delay the flow long enough to allow the heavier particles of grit and sand to settle to the bottom of the tanks for removal. This material, if not removed, interferes with the operation of the digesters and could damage machinery in the treatment units following.

Periodically, the settled grit and sand is removed and taken to a disposal area.

Primary Settling

From the grit chambers, the wastewater flows into the primary settling tanks. It is here that the removal of organic materials begins. These tanks reduce the velocity of the flow, and allow the heavier organic matter to settle to the bottom.

It takes up to two hours for the wastewater to pass through these tanks. This retention period settles out about 60% of the solids. The settled material, called “raw sludge”, is drawn from the bottom of the tanks and delivered to the digesters for further treatment.

Surface scum is removed by a skimming mechanism and delivered to the digesters. The partially treated wastewater now called the “primary effluent”, flows out from the tanks over a barrier into a collector channel. From here it flows into the next section of the plant for further treatment.

Aeration Section

The primary effluent flows into another set of tanks, called “aeration” tanks, where the finely divided, suspended and collodial organic material remaining in the wastewater is oxidized by aerobic bacteria.

The aeration tanks retain the primary effluent long enough to allow the bacteria to assimilate (oxidize) most of the remaining organic matter. To do this, the bacteria require an abundance of oxygen which the wastewater does not normally have at this point. Air compressors are used to feed a steady stream of air into the tanks to supply the needed oxygen. The air creates enough agitation in the tanks to prevent material from settling.

As bacteria assimilate the organic matter, a light sludge floc is formed which is the vehicle in and upon which the bacteria grow. This sludge floc is called “activated sludge”.

Final Settling

The discharge from the aeration section flows into the final settling tanks and is retained for about three hours to allow the activated sludge to settle. The sludge is then removed and pumped back into the aeration section to be mixed with the primary effluent. This transfer “seeds” the primary effluent and maintains the bacteriological process. Any unwanted activated sludge is transferred to the digesters.

At this point from 90% - 95% of the solids contained in the raw wastewater have been removed. The settled water, called the “final effluent”, flows out from the tanks over a wall into collector channels, which deliver it to the next stage.

Chemical Treatment (Chlorination/Flocculation)

In the chlorine contact chamber, a chlorine solution is mixed with the final effluent to destroy any bacteria which may remain after treatment. An outfall sewer carries the disinfected effluent from this chamber to the receiving waterway.

At some water pollution control plants, a nutrient removal stage has been incorporated. Nutrient removal is achieved by the addition of ferric chloride to the treatment process. This chemical reacts with phosphates in the sewage and forms as insoluble iron phosphate which also settles out in the clarifier and helps reduce the amount of phosphorus being discharged into the receiving waters. Some plants also have Flocculation chambers where alum or a similar agent is added to encourage suspended particles to collide and grow into solids which will settle out of suspension and can be removed.

Digestion

The raw sludge removed form the primary settling tanks, the surface scum and any excess activated sludge are delivered to the digesters for further treatment.

Sludge digestion at this point is carried out in two stages. In the first stage, primary digestion, anaerobic bacteria partially break down the sludge into various substances.

The contents are constantly mixed to ensure overall treatment.

The second stage, secondary digestion, receives the partially digested sludges and completes the process. The contents are not agitated to encourage settling.

During the digestion process gas is produced, mainly methane, which is collected in the top of the digesters. This gas is used as a fuel for the plant boilers which heat the building and to maintain a constant temperature, of about 32°C (90°F) within the digesters. Excess gas is burned off by a waster gas burner.

De-watering

Due to the large quantities of sludge produced at some plants, the water content of the sludge is reduced to cut down the volume which must be trucked away to a disposal area.

The de-watering is accomplished using vacuum filters and/or filter presses. A vacuum filter consists of a large drum covered with closely spaced steel coils or a cloth blanket passing through a trough and picking up the chemically pre-conditioned digested sludge. A vacuum is created within the drum, and atmospheric pressure pushes water through the digested sludge to the drum, leaving a “sludge cake” on the surface. As

the sludge cake is formed a scraper separates it from the surface, and it is dropped

De-watering (cont'd.)

onto a conveyor and carrier to a holding area. A filter press consists of an endless cloth running through a series of rollers. The raw sludge is picked up on the cloth and the water is squeezed out as the cloth passes through the rollers.

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