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Compression packing is the oldest and still most common type of sealing device used to prevent product leakage and extend the life of pumps, valves, and other rotating equipment. For decades, most packing was just lubricated vegetable fiber inserted in the stuffing box between the body of a pump or valve and its rotating member.

The 1990 Clean Air Act (CAA), along with more stringent requirements on plant water usage and effluent discharge, changed expectations about packing's role in leak prevention and water conservation.

Industrial plants, process mills, and refineries found themselves under intense regulator pressure to comply with new water usage and CAA standards. Plant managers began taking a closer look at water usage studies and creating Leak Detection and Repair (LDAR) programs to combat the sources of pump and valve leakage.

The packing industry responded by experimenting with exotic fiber materials such as PTFE yarns, graphite yarns, carbon yarns, and GFO® yarns to create packing that not only complied with more stringent water usage standards, but was also able to withstand higher temperatures, faster shaft speeds, and wider pH ranges than ever before.

Which Packing is Right for You?

Modern fluid handling systems now have an impressive range of fibers that meet their requirements for pH, shaft speed, and temperatures. This guide will briefly explain the high performance packing fibers you should consider for most applications, as well as the selection criteria you should use to make the best packing decision.

Selection Criteria

There are three major criteria to packing selection: pH level of the fluid being pumped, fluid temperature, and shaft speed.

Why these three?

Packing is designed to expand radially against the shaft and stuffing box to create a compression seal that will control product leakage and prevent the loss of valuable process fluids.

An additional item to consider is shaft rotation. Shaft rotation generates significant frictional heat and can cause excessive sleeve wear. It's important to choose a yarn that can withstand your operating conditions and is also chemically compatible with your product.

Let's look at these selection criteria in more detail:

PH LEVEL:

You want your packing to be chemically inert relative to the process fluids in your pump, valve, or rotating equipment. That means you should choose a yarn that is compatible with your product, as well as compatible with any acidic or caustic process fluids you might use to clean your equipment. Specifying packing that can handle 0-14 pH is a good general rule to follow.

SHAFT SPEED (FT/MIN):

Most manufacturers calculate shaft speed using the Feet Per Minute formula of $FPM = (\text{Shaft or Sleeve Diameter} \times 3.14) \times \text{RPM} / 12$. Frictional heat is created where the packing is forced against the rotating equipment sleeve outside diameter to create the seal. Higher performance packing is designed to reduce friction, thus reducing heat and extending the life of your equipment. You should almost always choose packing based on the highest published FPM rating. As a general rule, any packing with a rating of 3000FPM or above will provide the most reliable service.

TEMPERATURE:

Temperature consideration is critical when the application exceeds 500F because many materials, including PTFE, tend to break down and carbonize at elevated temperatures. The key to proper selection is retention of volume. The most temperature resistant packing are carbon and graphite based. This issue is not so critical in most rotating equipment since, in most cases, flush water is utilized. Where this selection becomes critical is with high temperature valve packing in the petrochemical and power generation industries.

Other variables to consider:

CONDITION OF EQUIPMENT:

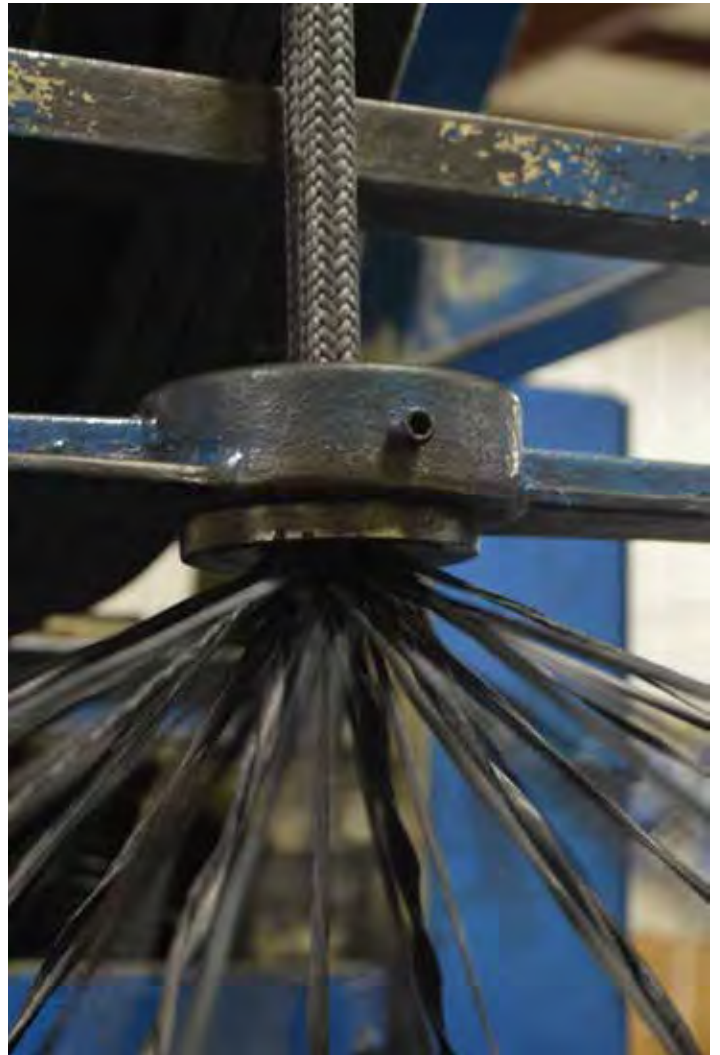
Pay attention to any mechanical component deficiencies. The most common issue is sleeve wear and shaft runout, but you should also inspect the stuffing box for corrosion or roughness, inspect the packing gland for follower wear, and make any necessary alternations to the lantern ring to ensure optimal packing life and seal performance. If deficiencies exist, properly seating and loading a set of packing will be difficult.

AVAILABILITY OF RELIABLE FLUSH WATER:

Flush water cools the packing and sleeve, as well removes solids from slurries in the stuffing box, to prevent damage to the packing. Modern packing fibers are able to withstand much higher temperatures than previous iterations – choosing higher performance packing can significantly reduce your flush water requirements.

BUDGET:

Compression packing is a wearable component and it can be tempting to choose a lower cost option since you'll just be replacing it next shutdown. But if your packing doesn't make it to next shutdown, you'll spend exponentially more to correct a premature failure that causes significant product loss or damage to your pumps or agitator's bearings.



Most Common High Performance Packing Styles

Always choose from a family of packing that will cover all of the processes in your plant while providing peace of mind performance from shutdown to shutdown. There are a handful of packing styles that cover the majority of rotating equipment applications – there's rarely a need to maintain an inventory of 20 different packing styles. Below are the five most common packing used in process industries:

STYLE ML2240

This state-of-the-art, Ultra High Speed PTFE non-contaminating white packing is a high temperature, heat dissipating style specifically formulated for packing mixers, agitators, and pumps with high shaft speed that require white braided packing. ML2240 will not glaze or harden and benefits from very low thermal expansion, making it ideal for any service that requires a white packing or food grade packing that is running up to 3300ft/min shaft speed and up to 550° F.

STYLE ML4002

ML4002 is a global award-winning style made from 100% GFO® Yarn and impregnated with finely ground particles of the highest quality inorganic graphite in a PTFE matrix to control graphite migration. ML4002 is an excellent all around packing for applications up to 4000ft/min shaft speed and up to 550° F.

STYLE ML560

ML560 is a high performance proprietary carbon fiber packing with high thermal conductivity that makes it possible to operate without flush water, making it ideal for use in pumping slurries that are prone to premature packing failure. Its high strength structure allows for high performance in equipment with severe mechanical issues and can handle a full range of pH levels, high shaft speed, and elevated temperatures..

STYLE ML4461

This proven industry performer is a high performance carbon filament packing treated with PTFE to help prevent color contamination and carbon migration. Each strand of the carbon yarn is treated and impregnated with a PTFE suspensoid, totally encapsulating the packing to prevent carbon filaments migrating into the system. ML 4461 is constructed to work best with high temperature and high shaft speed applications. Critical situations, such as digester applications are a good fit for ML4461.

STYLE ML4500

ML4500 is another pure graphite yarn that has been impregnated with a fine submicron powder of inorganic graphite, but is rated for even higher temperature. This style works best with high temperature, high shaft speed applications services, including nuclear industry and applications that require temps up to 850°F.

STYLE ML2001

This braided flexible graphite packing style is constructed with pure homogenous graphite bonded to a carrier for strength and thermal stability. It has no added lubricants or binders to cook out or become brittle. Recommended for rotating shafts where high speeds and thermal conductivity are required, including applications with 4000ft/min shaft speeds and temperatures up to 850°F.

Materials of Construction

Many plant customers simply ask us to supply them with a PTFE packing or graphite packing. What seems like a straightforward request often translates into us probing them for more information about their application. We're not trying to be difficult – we're trying to save you money!

There are likely multiple fibers that are compatible with your application – let's take a look at what fibers work best for which applications.



FLAX YARN

Flax is an economical solution used to construct packing for brine, cold water, and cold oils. Flax packing can be impregnated with PTFE that acts as a surface leveler that fills in voids in the packing. The PTFE prevents wicking and forms a protective shield around the flax fibers.

Specifications

Temperature: 220° F

pH range: 5-9

Shaft Speed: 1885 Feet per minute (fpm)

Cost: \$

Applications

Serves the shipping industry in stern tubes and some power generation in hydroelectric turbines.

Examples of Flax Yarn

#2 (tallow wax lubed)

219 (TFE Lubrication)

2GR (Grease/Graphite Lubed)



ACRYLIC YARN

Acrylic yarn is good general service packing that is commonly referred to as “Teflon” or “Graphite” by many end-users. This yarn is used for constructing packing for mild acids/alkaline, brine and oil. Optional TFE coatings protect the yarns from chemical attack and assure good break-in characteristics.

Specifications

Temperature: 450° F

pH range: 4-10

Shaft Speed: 1885 Feet per minute (fpm)

Cost: \$

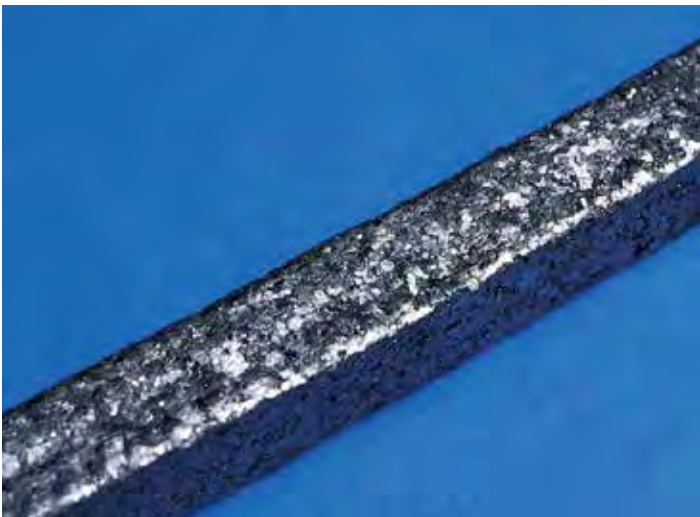
Applications

Used as a low cost general service packing for rotary and reciprocating pumps and agitators in utilities and industry.

Examples of Acrylic Yarn

ML2225 (TFE Coated)

ML402 (Grease/Graphite Coated)



NOVOLOID YARN

One of the most popular fibers, Novoloid (or Kynol®) is an excellent all around packing that exhibits good thermal conductivity characteristics and results in higher speed shaft FRM ratings. Novoloid contains no silicon, sulfur, or wax, making it an excellent alternative to graphite packing.

Specifications

Temperature: 500° F

pH range: 1-13 (except concentrated or hot sulfuric or nitric acid)

Shaft Speed: 1800 Feet per minute (fpm)

Cost: \$

Applications

Primarily used within the chemical and pulp and paper industry for applications where graphite is unacceptable.

Examples of Novoloid Yarn

ML2400



ARAMID YARN

Aramid is a great performer in extreme abrasive environments. Aramid fiber strands can be individually treated with a PTFE coating and a light, inert oil to improve resistance to caustics, mild acids, chemicals, air, oil gases, and solvents.

Specifications

Temperature: 500° F

pH range: 3-11

Shaft Speed: 1800 Feet per minute (fpm)

Cost: \$\$

Applications

Used in abrasive services and as a “bull” ring (anti-extrusion).

Examples of Aramid Yarn

ML4800 (TFE lubed)

ML6225 (TFE lubed spun yarn)

ML6402 (Graphite lubed spun yarn)

ML4700 (Nomex Yarn)

PTFE YARN

PTFE yarn has a high resistance to chemicals and low levels of friction and adhesion. PTFE yarns can be pre-lubricated to create a softer, more flexible packing with improved peripheral speed characteristics and exothermic properties. PTFE has excellent performance in corrosive environments and can be coated with graphite lubricants to improve thermal conductivity.

Specifications

Temperature: 500° F

pH range: 0-14

Shaft Speed: 1200fpm (no graphite) 4900fpm (with graphite)

Cost: \$\$

Applications

Chemical processing, pumps, rotatory equipment

Examples of Teflon Yarn

ML2235

ML2236FDA

ML2254 (valve)

ML2254OX (approved for Oxygen)

ML8002 (graphite coated)



ENCAPSULATED PTFE YARN

This family of PTFE is constructed from an expanded TFE that encapsulates graphite or a proprietary lubricant. The expansion process creates a micro-structure that has a higher strength than TFE filament yarns. Encapsulated TFE yarn can be treated with special lubricants that contain no sulfur, silicone, or wax.

Specifications

Temperature: 500° F

pH range: 0-14

Shaft Speed: 1200fpm (no graphite) 4900fpm (with graphite)

Cost: \$\$

Applications

Uses include mixers, pumps, agitators, reactors, blenders

Examples of TFE Yarns

ML4002 (100% WL Gore GFO)

ML2240 (Proprietary high speed white expanded TFE)



CARBON/GRAPHITE YARNS

This proven industry performer is manufactured through a heat treatment process of a synthetic yarn. These yarns are processed through multiple heat treatments to achieve the desired carbon or graphite content. Carbon/Graphite packing can also be treated with PTFE to help prevent color contamination and carbon migration.

Specifications

Temperature: 650° F

pH range: 0-14

Shaft Speed: 4000fpm

Cost: \$\$

Applications

High pressure, high temperature, high shaft speed applications

Examples of Carbon/Graphite Yarns

ML560

ML4461

ML4460

ML4500



FLEXIBLE GRAPHITE YARNS AND TAPES

Flexible graphite tape is manufactured by exfoliating expanding and then compressing the graphite flakes into a specific density. Flexible graphite has excellent thermal properties and can be mixed with reinforcing fibers and formed into yarn.

Specifications

Temperature: 850° F

pH range: 0-14

Shaft Speed: 4000fpm

Cost: \$\$\$

Applications

High pressure, high temperature, high shaft speed applications

Examples of Graphite Yarns/Tapes

ML2001 (Braided)

BP or NP (Ribbon Rings)



Which Packing is Right for You?

Modern fluid handling systems now have an impressive range of fibers that meet their requirements for pH, shaft speed, and temperatures. The sheer amount of packing options can be overwhelming to those looking to reduce the cost of their fluid sealing program.

This table will briefly explain the high performance packing fibers you should consider for most applications, as well as the selection criteria you should use to make the best packing decision.

Vegetable	1220 fpm	5-9 pH	220 F
Acrylic	1885 fpm	3-11 pH	500 F
Aramid	1885 fpm	3-11 pH	500 F
Novoloid	1885 fpm	2-13 pH	550 F
PTFE	1500 fpm	0-14 pH	500 F
Carbon	4000 fpm	0-14 pH	650 F
GFO	4900 fpm	0-14 pH	550 F
Graphite	unlimited	0-14 pH	850 F



Packing It All Together

What is the secret to reliable packing life in rotating equipment? How do end users economically seal their stuffing boxes without breaking their budgets? No shortcuts are available to reliable packing performance. However, reliability and longer life can be expected if you follow these basic guidelines:

The correct specifications for the braided packing must be chosen with an emphasis on the chemical and thermal properties of the yarns.

You must establish some basic installation and equipment maintenance/ inspection guidelines with operational care practices.

You should partner with a pump manufacturer and a local fluid sealing representative that understands your equipment service requirements and is able to aid in simplifying the selection process and training employees on installation and basic care procedures.

What results can the user expect for a properly managed packing program? As a general rule, history has shown that achieving an average packing life of up to three years is possible! If you need more help with packing selection, installation, or just want guidelines on how to properly inspect your equipment when replacing packing, contact SEPCO.



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ABOUT SEPCO

Located in Alabaster, AL, SEPCO (Sealing Equipment Products Co., Inc.) helps industrial plants and mills reduce the total cost of their fluid sealing programs. SEPCO manufactures a high quality line of mechanical seals, compression packing, and gasketing materials that deliver shutdown-to-shutdown performance for industrial pumps, valves, and other rotating equipment. With customers in over 30 countries, SEPCO partners with plant maintenance and reliability managers to improve operational efficiency, reduce inventory, and increase equipment reliability. For more information or to schedule an equipment survey, visit WWW.SEPCO.COM.

