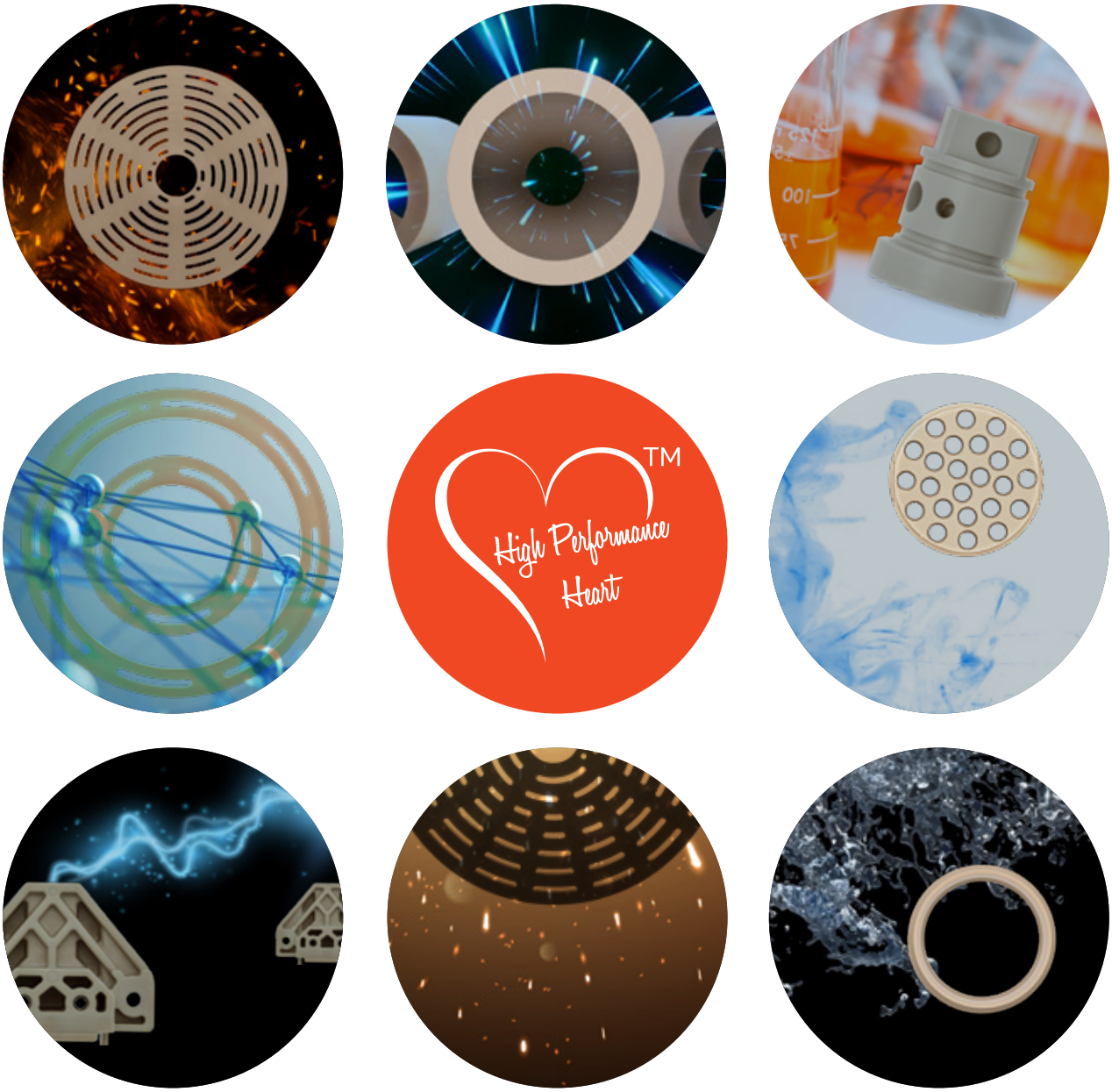


TECHNICAL HANDBOOK

F10PEEK

INJECTION / CNC / TUBING

APPROVALS AND SPECIFICATIONS

WRAS – (BS 6920)

Comm. Reg. (EU) 10/2011

FDA

GB 4806 7-2016

GMP
3A Sanitary Standard

Norsok M 710 Ed. 3

API 6A

F10PEEK
INJECTION / CNC / TUBING

OIL&GAS | INDUSTRY | FOOD | AEROSPACE | AUTOMOTIVE

F10PEEK distinguishes components in PEEK, a high-performing technopolymer, made by Fluorten Srl with manufacturing processes that boost their performances.

From injection to compression moulding and CNC manufacturing, with the latest generation equipment, Fluorten produces F10PEEK components from the granule to the finished parts, with designed and manufactured moulds in-house as a further guarantee of quality and repeatability of the final performances.

F10PEEK components offer unrivalled advantages with respect to metal and other technopolymers. With over 30 years of experience in challenging applications, F10PEEK is used in increasingly new sectors with excellent results.

PEEK (polyether ether ketone) is a colourless organic thermoplastic polymer, belonging to the family of polyaryletherketones (PAEK). With a semi-crystalline appearance, it is considered one of the highest performing thermoplastic materials in the world. Used in engineering applications, it offers exceptional performances in a wide range of temperatures and under extreme conditions.

PRODUCTION
From raw material to the finished product F10PEEK is processed by Fluorten through injection moulding, compression moulding, machining with CNC lathes and milling machines.
The moulds are designed and made internally to guarantee the continuity in time of the quality of the products, which are controlled with modern and sophisticated quality control laboratory instruments.
Specific certificates are issued on request.

PROPERTIES
- Young's modulus 3.6 GPa
- Breaking load from 90 to 100 MPa
- Glass transition temperature approx. 143°C
- Melting temperature approx. 343°C
- Working functional temperature up to 260°C
- It is attacked by halogens and strong Brønsted and Lewis acids as well as by some halogenate compounds and aliphatic hydrocarbons at high temperatures
- It is slowly soluble in concentrated sulphuric acid at ambient temperature

APPLICATION
Thanks to its high properties, F10PEEK is a high-end technopolymer, for heavy-duty applications, including:

- Ball bearings
- Piston parts
- Pumps
- Valves
- HPLC columns
- Compression plates
- Electrical insulation for cables and electrical components
- Components for ultra-high vacuum
- Components for the food industry
- Components for the chemical industry
- Medical prostheses
- Spinal fusion devices and rebars
- Extruders for 3D printers
- Seals for O&G high pressure valves (floating and trunnion)
- Components for drilling
- Components for the aerospace industry

fluorten® PTFE & Technopolymers manufacturing
High Performance Heart™

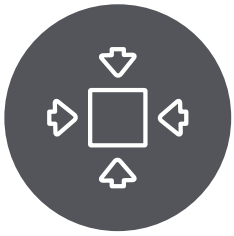
ADVANTAGES

LIGHTWEIGHT

it is 70% lighter than steels

DURABLE

the mechanical characteristics remain high even in extreme operating conditions



RESISTANT

it has excellent resistance to wear and to abrasion, with a low friction coefficient

INNOVATIVE

it is an excellent material for highly advanced projects

THERMO-RESISTANT

it has a useful operating temperature from -196 to +260°C

CHEMICAL RESISTANT

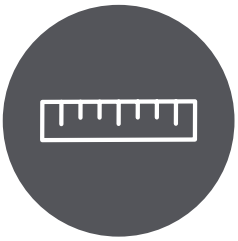
it is highly resistant to the most aggressive chemicals and natural, organic, saline and acid elements

SUSTAINABLE

it allows lighter appliances that reduce the consumption of fuel/ energy and the consequent environmental impact

LESS MAINTENANCE

it reduces the frequency of defects and the idle time of the installation thanks to its durability



RELIABLE

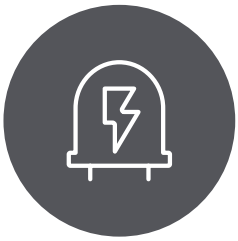
it keeps the mechanical properties and dimensional stability unchanged in the long term

FIRE-RESISTANT

it is in conformity with stringent rules of self-extinction, smoke density and toxicity

WATERPROOF

It is not permeable to fluids and gases



ELECTRICALLY STABLE

Electrical properties are kept over a wide range of frequencies and temperatures

APPLICATION

OIL&GAS

The seals in F10Peek for the O & G industry face new challenges every day to make the installations safer and more efficient, including in extreme situations due to high pressure, high and low temperatures, corrosive chemicals and abrasive materials.

The solutions in F10Peek for O & G

- Maximize the productive efficiency of the installations: this is a critical factor in a sector where production and exploration costs are very high
- They allow producing high quality and more solid instrumentation and monitoring equipment that can transmit accurate data in real time
- They allow safer and more reliable operations, in a sector where environmental and government pressure lay down increasingly stringent regulations
- They continue to perform even in conditions of high corrosiveness and temperature
- They allow better traceability and predictability
- They offer stable performances at temperatures between -196°C and 260°C and pressure up to 207 MPa
- They can withstand extreme pressure indexes and wear (4.5 MPa at 220°C)
- They keep 100% of their tensile strength in seawater, 100% of their tensile strength in fluids of aromatic hydrocarbons used for Norsok certification and over 75% of their tensile stress in H2S at a concentration of 100%

INDUSTRY

Components made in F10PEEK can easily replace metals both in environments with the presence of heat and in corrosive ones, increasing their operability and eliminating the use of lubricants. Furthermore, the possibility of obtaining injection-moulded parts generates a considerable reduction of costs.

F10PEEK solutions for industry

- Increase the life of components
- Eliminate lubrication
- Reduce maintenance costs
- Increase the performances of the parts
- Reduce the weight of components

FOOD

Components made in F10PEEK respect the most stringent standards in the food and water treatment sector. They can meet the main FDA, 3-A, EU, KTW, WRAS standards and others.

The solutions in F10PEEK for the food industry:

- Reduction of intervals of maintenance
- No contamination due to the use of lubricants or metal components
- No deterioration caused by steam or chemicals, including aggressive ones
- Practically unlimited possibility of use, both due to the possibility of obtaining injection-moulded parts and from mechanical manufacturing

AEROSPACE

The F10PEEK components are on average 70% lighter than those made of steel. Thanks to them, considerably lighter aircraft are made, which are more efficient from the consumption point of view and therefore more sustainable for the environment. Thanks to the manufacturing processes, complex geometries can be obtained more easily than with metals, such as aluminium, reducing the costs with equal, or even greater, performances. They are therefore cheaper as well as totally reliable and durable.

AUTOMOTIVE

The F10PEEK components, thanks to their lightness and
resistance allow better efficiency in consumption, duration and driving comfort.
Faster acceleration and less noise lead to a more enjoyable driving experience. More durable and reliable, they guarantee greater safety, longer guarantees and lower maintenance costs.

- The F10PEEK vacuum pumps are intrinsically self-lubricating and reduce parasite losses, fostering the production of more ecological cars (with reduced CO2 emissions)
- Thanks to mechanisms in F10PEEK it is possible to reduce the dB) acoustic level of vibrations and harshness
- F10PEEK discs and valves are five times cheaper than stainless steel thanks to the simplification of the production process - with a longer duration of the nozzles than those in polyamide and without any deterioration
- Guide rings and nozzles in F10PEEK have a longer life than, for example, PTFE for seals. and bushes in F10PEEK last longer than PTFE for seals, for example

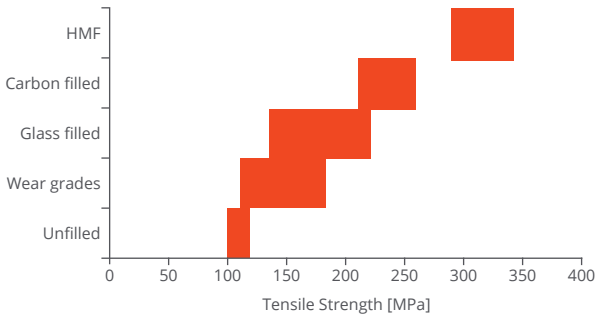


Figure 1: Ranges of tensile strength of F10PEEK materials

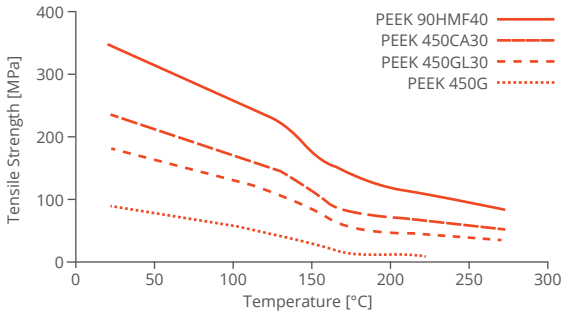


Figure 2: Tensile strength versus temperature of various F10PEEK materials

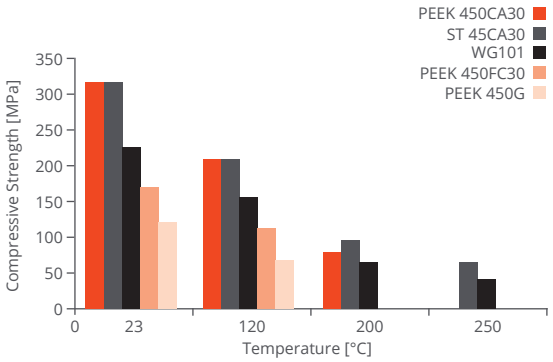


Figure 3: Compressive strength versus temperature of a range of F10PEEK materials

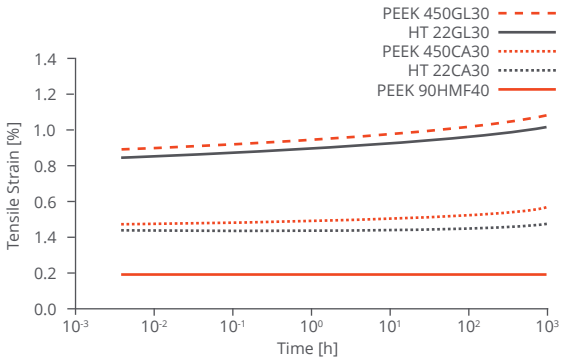


Figure 4: Tensile creep of PEEK and HT compounds at 23°C and constant stress of 90MPa

MECHANICAL PROPERTIES

F10PEEK materials are considered the highest performing thermoplastic polymers with good preservation of the mechanical properties in a wide range of temperatures and conditions.

TENSILE PROPERTIES
The addition of loads increases the strength and the rigidity of F10PEEK. The materials typically loaded do not show a point of yield strength and therefore break in a fragile way. The lengthening, tensile modulus and strength vary significantly depending on the type of load and its content in percentage.

FLEXURAL PROPERTIES
F10PEEK materials show exceptional flexural properties in a wide interval of temperatures.

COMPRESSIVE PROPERTIES
Compressive strength has been evaluated at temperatures of up to 250°C. Figure 3 shows the compressive strength depending on the temperature for a range of F10PEEK materials with attention to the degrees typically used in applications of wear and high pressure, taking the F10-15 type as the material of reference.

CREEP PROPERTIES
F10PEEK materials have excellent creep strength and can withstand strong stress with slight deformations in time. Creep is defined as the deformation of a material under a constant stress. Tensile deformation has been evaluated according to ISO 899 at 23°C for a period of 1000 hours.
Better mechanical performances, like strength and rigidity, and creep performances, increase variably depending on the loads added.
F10-105 which has the highest properties of resistance and rigidity of all the F10PEEK materials, shows extraordinary creep strength.

*Data source:
Victrex Material Properties brochure found on www.victrex.com
PEEK 90HMF40 our F10-105
PEEK 450CA30 our F10-16
PEEK 450GL30 our F10-34
PEEK 450G our F10-15
WG101 our F10-93
PEEK 450FC30 our F10-20

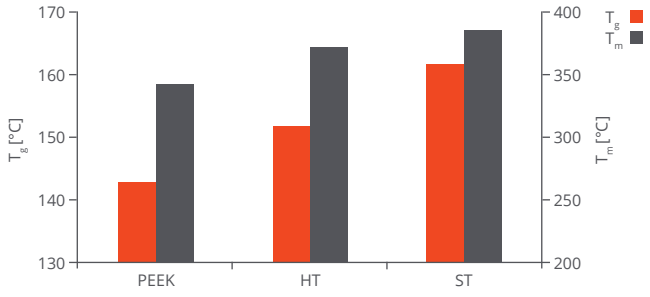


Figure 5: The glass transition (Tg) and crystalline melting temperatures (Tm) for F10PEEK polymers determined by DSC

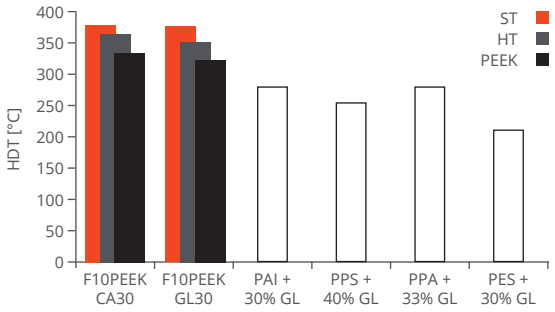


Figure 6: Heat deflection temperature (at 1.8 MPa) for F10PEEK materials and other high performance polymers

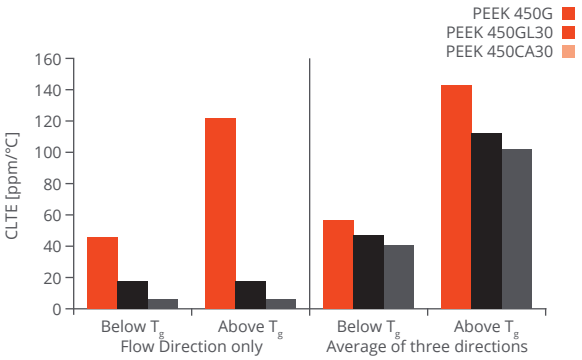


Figure 7: Coefficient of linear thermal expansion (CLTE) for various F10PEEK materials below and above Tg

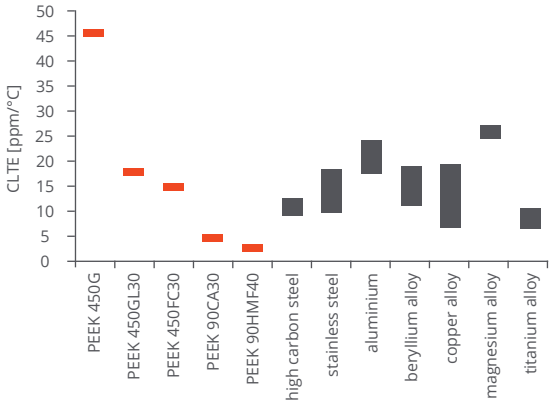


Figure 8: Coefficient of linear thermal expansion (CLTE) for various F10PEEK materials versus metals (flow direction, below Tg)

THERMAL PROPERTIES

F10PEEK polymers have glass melting (Tg) and crystalline melting (Tm) temperatures in the interval shown in Figure 5. Thanks to the semi-crystalline nature of these polymers, the mechanical properties are kept at high values even close to their melting temperatures.

HEAT DEFLECTION TEMPERATURE
The short-term thermal performances can be characterized by determining the heat deflection temperature at which a deformation is observed in a sample to which a constant stress is applied (1.8 MPa) at a constant speed of heating. The F10PEEK materials have an excellent rigidity at high temperatures and consequently present high HDT values, if compared to other high performance polymers.

ENVIRONMENTAL RESISTANCE

RESISTANCE TO HYDROLYSIS
The high performance F10PEEK polymers are not attacked by prolonged exposure to water, seawater or steam. This makes them the ideal choice for use in applications such as medical components, submarine equipment and valve components.

PERMEATION OF GAS AND LIQUIDS
F10PEEK provides an efficient barrier to the permeation of fluids and gases. The solubility of fluids and gases, the spread and permeation of F10PEEK polymer are several times lower than in other commonly used polymers.

CHEMICAL RESISTANCE
F10PEEK has excellent resistance to a very wide range of chemicals in an interval of temperature, keeping high levels of mechanical properties and generally with little expansion.

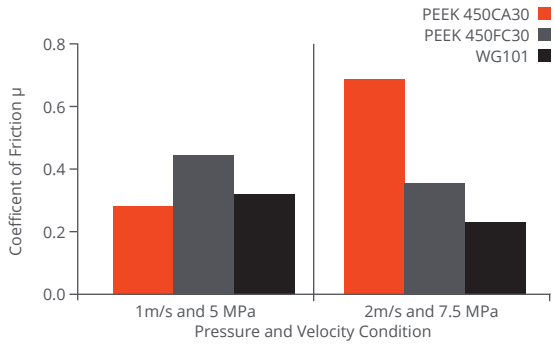


Figure 9: Coefficient of Friction of various F10PEEK materials tested using the Block on Ring method

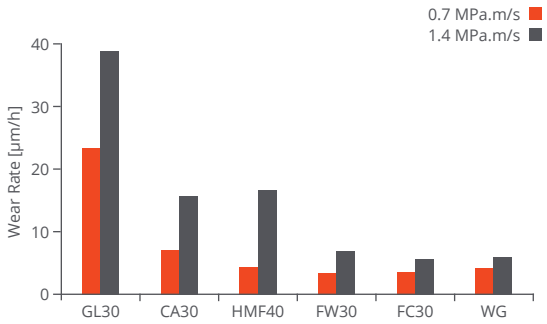


Figure 10: Average wear rates at low PV levels of various F10PEEK materials tested using the Thrust Washer method

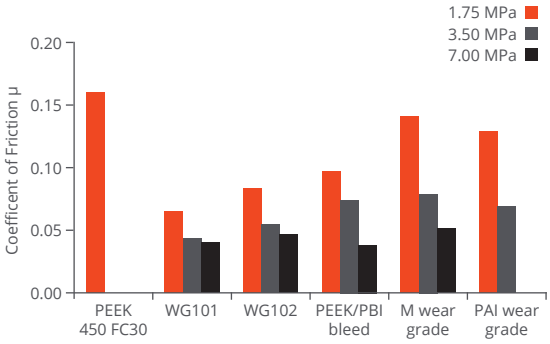


Figure 11: Coefficient of friction of various F10PEEK materials compared to other high performance materials tested using the Thrust Washer method at 1m/s test speed

TRIBOLOGY

Tribology is the branch of engineering that studies the interaction between the friction, the lubrication and the wear of interacting surfaces in relative motion under an applied load.

FRICTION AND WEAR

Wear is the gradual loss of material from one of the two interacting surfaces or from both interacting surfaces in relative motion with one another due to friction.
The rate of wear is influenced by the test conditions (pressure and speed); it is therefore fundamental to know whether the wear factor comes from high speed/low pressure or from tests at low speed/high pressure.
Friction is the main cause of wear. It is an adimensional property (µ) which varies according to speed, pressure, temperature, lubrication, roughness and the nature of the interacting surface.
Heating by friction increases the temperature of the component, especially in situations where there is little possibility of removing heat from the system. When the temperature increases above the Tg, for a given material, there is a corresponding increase in the speed of wear and it is closely related to the value of PV.

PRESSURE AND SPEED LIMIT

The materials used for tribological applications are often classified according to their PV (Lpv). The PV is the highest combination of load and speed in which a component can work correctly without showing signs of breakage or wear.
The PV value is influenced by variations in the temperature, speed, load, lubrication and surface roughness, exceeding the PV Limit will lead to early wear and the subsequent failure of the component.

*Data source:
Victrex Material Properties brochure found on www.victrex.com
PEEK 90HMF40 our F10-105
PEEK 450CA30 our F10-16
PEEK 450GL30 our F10-34
PEEK 450G our F10-15
WG101 our F10-93
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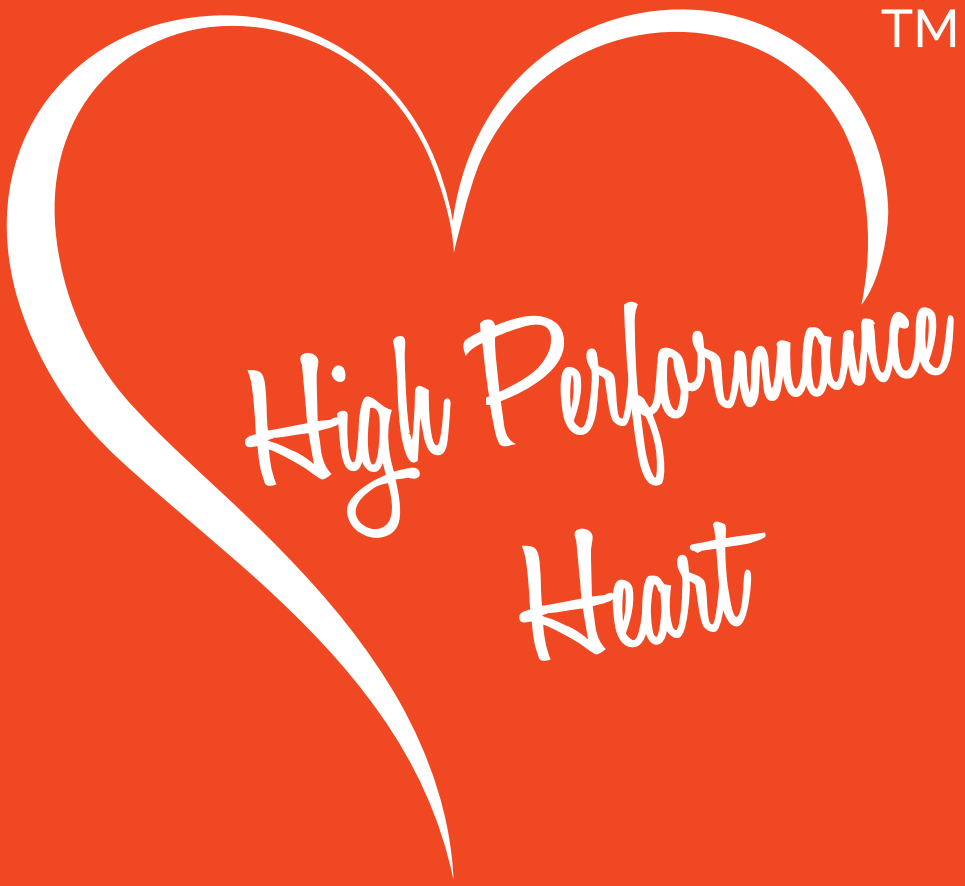

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