The VST7 series vane pumps are low noise pumps having one or more pumping cartridge in one single pump housing. Each pump has 12 vane drop-in cartridge and driven by common shaft and is fed from the common inlet port. Each discharges from its seperate outlet port and operates only at the pressure imposed on it.

FEATURES:

- Thick housing and 12-vane design drop-in cartridge assembly contributes to LOWER NOISE LEVEL and PRESSURE PULSATION.
- Internal larger port sizes ensure better suction characteristics and higher rpm.
- Low ripple pressure reduces piping noise and increases lifetime of other components in the system.
- High pressure capacities (upto 240 bar intermittent and 210 bar continuous) depending on cartridge selection.
- High speed capability - (upto 2800 Rpm)
- High volumetric efficiency reduces heat generation and allows speeds down to 600 rpm at full pressure.
- High mechanical efficiency reduces energy consumption .
- Wide flow range and flexibility different sizes of camrings
- Mounting flange - 2 and 4-Bolt - SAE-B / SAE-C.
- Easy change of pump displacement by changing cam ring only.
- Wide range of acceptable viscosities 10 to 860 mm^2/s (cSt.)
- High resistance to particle contamination because of double lip vane - increases pump life.
- Fluid cleanliness level to be NAS 1638 class 8 or ISO 18/14 or better.

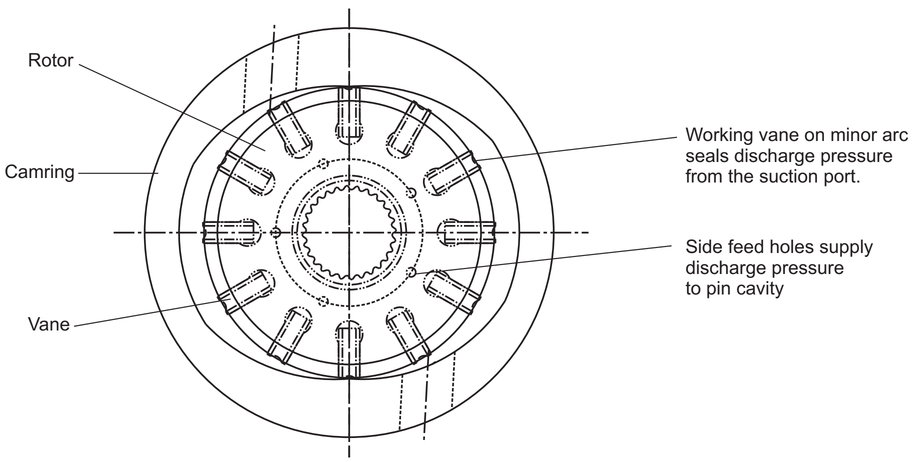


Fig.1
Pressure acts below vanes to push Vane tips against the cam ring and provides optimum sealing of vane chambers.

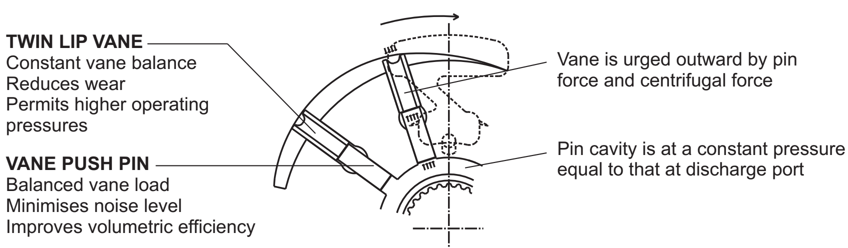
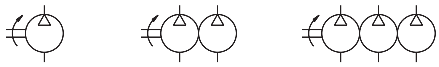


Fig.2 Shaft Rotation causes alternate quadrant shifts in delivery load pressure and inlet suction pressures.

Veljan VST7 series Vane Pumps are high-performance fixed displacement pin vane design available in Single, Double and Triple configurations. These can be driven by fixed or variable speed prime movers.



Single Pump Double Pump Triple Pump

LONG SERVICE LIFE
Due to hydraulic pressure compensation and a rigid bearing arrangement, an outstanding operational life can be achieved by using Veljan Vane Pumps.

HIGHER PRESSURE
High pressure capability upto 3500 psi (240 bar).

LARGE POWER RANGE
Veljan Vane Pumps offer a comprehensive range of Single, Double and Triple Vane Pumps in a large variety of pump sizes. Based on the individual maximum operating pressures, the corresponding power range varies. All pumps are light - weight and compact in design, resulting in an exceptional power-to-weight ratio.

GREATER FLOW RANGE
Within the frame size of a pump, greater flow is achieved by increased displacement cam rings. "B" - 14 gpm,"C" - 25 gpm, "D" - 61, "E" - 85 gpm.

LOW NOISE LEVEL
Reduced noise levels well within the acceptable limits of the industry. Large size cartridge displacements optimize operation for the lowest noise level in the smallest envelope. Unidirectional cartridge pumps are more quiet in operation in comparison to bi-directional cartridge pumps.

MOUNTING FLEXIBILITY
Flexible and economical installation inlet and outlet ports can be arranged in different configurations, 4 positions for single Pumps,16 for Double Pumps, 16 for Triple Pumps..

RELIABILITY
Excellent cold start capability and superior resistance to seizure make Veljan Vane Pumps highly reliable and efficient.

MAXIMUM SPEED RATINGS
Speeds are influenced by specific gravity, viscosity and suction head. Maximum speed rating: 2500 rpm. Minimum speed rating: 400 rpm for mobile and 600 rpm for industrial applications. For specific speed, flow and pressure ratings of each series, please refer the general characteristics of Vane Pumps.

CARTRIDGE DESIGN
Veljan Vane Pumps feature pre-assembled cartridge kits which can be easily and quickly replaced without any major disassembly. The displacement of the pump within the same series can be changed by changing the camring or cartridge.

HIGH EFFICIENCY
High volumetric efficiency (typically 94)) reduces heat generation, allows low speeds at full pressure and high mechanical efficiency (typically 94)) reduces energy consumption. Better efficiency under load increases productivity.

WIDER RANGE OF ACCEPTABLE VISCOSITIES
Viscosities from 2000 to 10 cst, permit colder starts and hotter running. The balanced design compensates for wear and temperature changes. Optimum operating viscosity of the oil should be between 16 cst (80 SUS) and 40 cst (180 SUS).

VERSATILE APPLICATIONS
Veljan Vane Pumps are used in all industrial and mobile applications of the industry and can be operated with mineral oils as well as fire resistant fluids.

FIRE RESISTANT FLUIDS
Phosphate esters, chlorinated hydrocarbons, water glycols and invert emulsions may be pumped at high pressures and with longer service life by these pumps.

ADVANTAGES

- Low ripple pressure reduces piping noise and increases life of other components in the circuit
- High resistance to particle contamination because of double lip vane increases pump life.
- Large variety of options (cam displacement, shaft, port- positions) allows customized installation.
- Low speed, low pressure, high viscosity allows application in cold environments with minimum energy consumption and without risk of seizure.
- Camrings are dry lubricant coated and suitable for severe duty applications. This special coating helps in lubrication of the cam surface, especially during cold starts as also while in operation. Additionally this reduces wear which in turn extends life of the pump.
- Side feed holes reduce internal leakage, helps balance internal pressures, improves lubrication and provide a cooling effect.
- Vane loading pins load the vane against the cam ring.
- Loading is in direct proportion to pump discharge pressure, which minimizes wear and prevents overshoot pressure and vane blow-off.
- The shaft option T (SAE J718c), allows direct drive (at 540 or 1000 RPM) on tractors.

GENERAL CHARACTERISTICS

Series	Mounting Standard	Displacement (cm³/rev)	Speed		Max. Pressure		Weight (without connectors and bracket)			SAE 4-bolts J518-ISO/DIS 6162-1			Moment of Inertia	
			max	min	(psi)	(bar)	(lbs)	(kg)	suction	Pressure			lb.in²	Kg m² x 10⁻⁴
SINGLE PUMPS														
VST7B	SAE B	5.8-41.0	2500	600	3000	210	35.27	16.0	1” or 1¼”	3/4" or 5/8"			1.1	3.0
VST7C	SAE J744 SAE C	5.7 - 79.3	2200	600	3500	240	62.83	28.5	1½”	1”			2.6	7.5
VST7D	SAE J744 SAE C	43.9 - 157.9	2500	600	3500	240	77.16	35.0	2”	1¼”			5.7	19.5
VST7E	SAE J744 SAE C	132.3 - 268.7	2200	600	3500	240	131.17	59.5	2”	1¼”			21.3	61.8
DOUBLE PUMPS														
										P1	**P2**			
VST7CC	SAE J744 SAE C	P1 & P2 = 5.7 - 79.3	2200	600	3500	240	80.5	36.5	2½”	1”	¾”		5.8	14.9
VST7DB	SAE J744 SAE C	P1 = 43.9-157.9 P2 = 5.7-40.9	2500	600	3500	240	101.41	46.0	3"	1¼”	1” or ¾”		9.0	26.3
VST7DC	SAE J744 SAE C	P1 = 43.9 - 157.9 P2 = 5.7 - 79.3	2500	600	3500	240	105.82	48.0	3”	1¼”	1” or ¾”		10.4	30.4
VST7EB	SAE J744 SAE C	P1 = 132.3-268.7 P2 = 5.7-40.9	2200	600	3500	240	163.14	74.0	4"	1½"	1¼”		22.5	65.8
VST7EC	SAE J744 SAE C	P1 = 132.3 - 268.7 P2 = 5.7 - 79.3	2200	600	3500	240	176.37	80.0	3½”	1½”	1”		25.0	73.4
VST7ED	SAE J744 SAE C	P1 = 132.3 - 268.7 P2 = 43.9 - 157.9	2200	600	3500	240	195.12	88.5	4”	1½”	1¼”		27.2	78.9
TRIPLE PUMPS														
										P1	**P2**	**P3**		
VST7CBB	SAE -B	P1 = 5.7 - 79.3 P2 = 5.7 - 45.1 P3 = 5.7 - 45.1	2500	600	3500	240	88.18	40.0	2"	1”	3/4"	3/4"	--	--
VST7DBB	SAE C	P1 = 43.9-157.9 P2 = 5.7-40.9 P3 = 5.7-40.9	2500	600	3500	240	132.27	60.0	4"	1¼”	1"	1” or 3/4”	11.5	33.7
VST7DCC	SAE C	P1 = 43.9 - 157.9 P2 & P3 = 5.7 - 79.3	2500	600	3500	240	137.79	62.5	4”	1¼”	1”	1” or 3/4”	12.8	37.3
VST7ECB	ISO 3019-2 250 B4 HW	P1 = 132.3-268.7 P2 = 5.7 - 79.3 P3 = 5.7 - 40.9	2200	600	3500	240	194.00	88.0	3"	1½"	1¼”	1” or 3/4”	24.6	71.2
VST7EDB	ISO 3019-2 250 B4 HW	P1 = 132.3-268.7 P2 = 43.9-157.9 P3 = 5.7-40.9	2200	600	3500	240	213.85	97.0	3"	1½"	1¼”	1” or 3/4”	26.1	75.7
VST7EDC	ISO 3019-2 250 B4 HW	P1 = 132.3 - 268.7 P2 = 43.9 - 157.9 P3 = 5.7 - 79.3	2200	600	3500	240	229.28	104.0	3”	1½”	1¼”	1” or 3/4”	27.6	80.2

Note : All data pertaining to operating characteristics, internal leakage, noise levels etc., in the following pages are based under theoretical / lab conditions. The actual performance of the products may vary from the figures give in the catalogue

CALCULATIONS TO RESOLVE / PERFORMANCE REQUIRED

Calculations to resolve		Performance required	
Volumetric			
Displacement	Vp [cm^3/rev]	Requested flow	Q [l /min]
Available flow	Q [l/min]	Speed	n [rev/min]
Input Power	P [kw]	Pressure	p [bar]

ROUTINE

1. First calculation $Vp = \frac{1000\ Q}{n}$
2. Choice Vp of pump immediately greater (see tabulation)
3. Theoretical flow of this pump $Q_{th} = \frac{Vp \times n}{1000}$
4. Find Qs leakage function of pressure Qs = f(p) on curve at 10 or 24 cSt
5. Available flow $Q = Q_{th} - Qs$

Note: If this flow is too small or greater, other calculation must be done with other pump displacement.

6. Theoretical Input power $P_{th} = \frac{Q_{th} \times p}{600}$
7. Find Ps hydrodynamic power loss on curve.
8. Calculation of necessary Input Power $P = P_{th} + Ps$
9. Results

   These calculations steps must be followed for each application

Examples

Q = 60
n = 1500
p = 150

$$Vp = \frac{1000 \times 60}{1500} = 40\ cm^3 / rev$$

VST7C B14 Vp = 45.1 cm^3 / rev

$$Q_{th} = \frac{45.1 \times 1500}{1000} = 67.65\ l/min$$

VST7C : Qs = 5 l/min at 150 bar, 24 Cst
Q = 67.65 - 5 = 62.65 l/min

$$P_{th} = \frac{67.65 \times 150}{600} = 16.91\ kW$$

VSTC : Ps at 1500 rev/min, 150 bar = 1.5 kW
P = 16.91 + 1.5 = 18.41 kW

V = 45.1 cm^3/rev
Q = 62.65 l/min
P = 18.41 kW
} VST7C B14

INTERMITTENT PRESSURE RATING

VST7 units may be operated intermittently at pressures higher than the recommended continuous rating when the time weighted average of pressure is less than or equal to the continuous duty pressure rating.

This intermittent pressure rating calculation is only valid if other parameters; speed, fluid, viscosity and contamination level are respected.

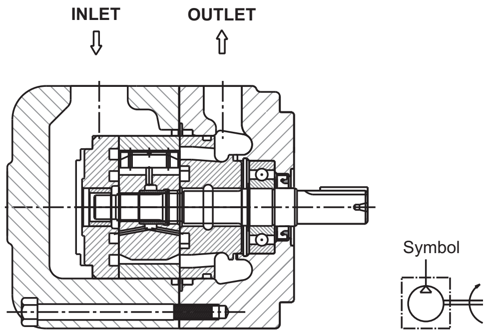
For total cycle time more than 15 minutes please consult your VELJAN representative.

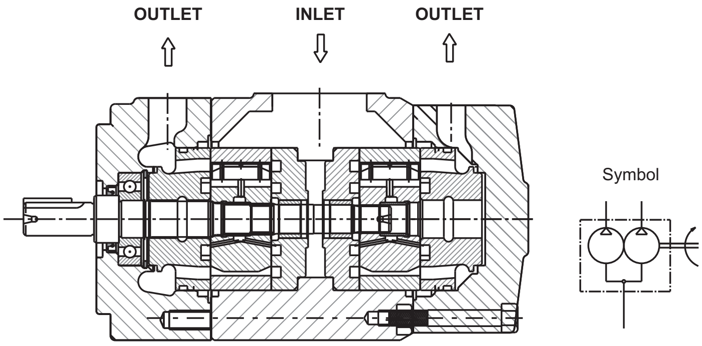
Example : VSTC-B14

Duty cycle 4 min. at 240 bar
1 min. at 35 bar
5 min. at 210 bar

$$\frac{(4 \times 240) + (1 \times 35) + (5 \times 210)}{10} = 204.5\ bar$$

204.5 bar is lower than 240 bar allowed as continuous pressure for VST7C-B14 with HF-O Fluid.



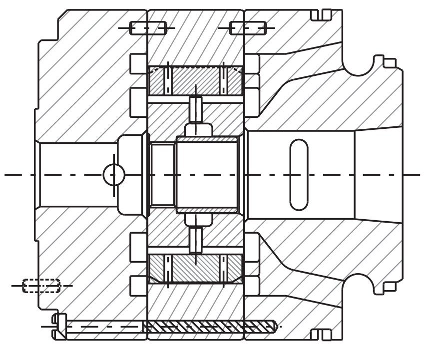


PUMP DESCRIPTION
Veljan Vane Pumps have a hydrostatically balanced cartridge which offers flexibility in pump sizes within a single series. A firm but light force against the vane is provided by the pin in order to follow the contour of the cam ring. All pumps can be supplied with flange or foot bracket mounting.

CHARACTERISTICS
Due to hydrostatic balance, the rotor carries no radial forces and, therefore, only transmits the torque generated by the operating pressure. Leakage is reduced to a minimum since the floating port plate is loaded by system pressure.

A wide viscosity range allows for operation under extreme temperature conditions. Longer service life, however, can be achieved by observing the recommended operating viscosity. The ambient temperature normally has no influence on the functional safety of the vane pumps.

PRINCIPLE OF OPERATION
The operating principle of a vane pump is illustrated in the figure above. A slotted rotor is driven within the cam ring by the shaft, coupled to a power source. As the rotor turns, vanes fitted in the radial slots of rotor follow the inner contour of the cam ring and provide two complete suction and pressure cycles during one revolution. Because of the eccentric design of the cam ring from the centre line of the rotor, the rotor is loaded by the vanes only when they are on the major and minor arcs of the cam contour.



Pump Cartridge

The displacement of the pump depends on the size of the cam ring and rotor and on the maximum distance the vane is allowed to extend from the rotor surface to the cam ring surface.

The components of the cartridge are an elliptical cam ring, a slotted rotor, two port plates, vanes and vane pins fitted into the rotor slots. The inlet flow feeds through ports on both sides of the cartridge as well as through a large port through the cam ring at each suction ramp. This further permits greater displacement within the series, reduces wear and allows higher speed operation. As the outlet section is approached, the chamber volume decreases and the fluid is forced out into the system. System pressure is fed under the vanes, assuring their sealing contact against the cam ring during normal operation.

The pressure in the over-vane areas is equalized by the radial holes through the vanes. A firm but light force against the vane is provided by the pin subjected to the steady pin cavity pressure. This force assures smooth cam tracking by the vane. Thus in a light but steady contact, the vanes are held outward against the fluid film which separates them from the cam ring. Their radial position changes to follow the cam to adjust for fluid viscosity, contaminants and component wear.

The fluid film separates the rotor from the side port plates. The side port plates are clamped axially by an over balance of the internal pressure forces in the pumping cartridge. They accommodate dimensional changes due to temperature and pressure. Axial and radial running clearances, along with the lubricating oil film on the rotor and vanes, are optimized over the entire operating pressure range.

Rugged design and premium material selection, as well as the minimum number of rotating parts, contribute to the low noise levels and long efficient service life of Veljan Vane Pumps.

HYDRAULIC FORMULA

FORMULA FOR	LETTER FORMULA	WORD FORMULA
FLUID PRESSURE, P (lbs/in^2)	$\text{PRESSURE} = \frac{\text{Force (lbs)}}{\text{Area (in}^2)}$	$P = \frac{F}{A}$
CYLINDER AREA (in^2)	$\text{AREA} = \frac{\pi}{4} \times \text{diameter}^2\text{(in)} \text{ or } \pi \times \text{radius}^2\text{(in)}$	$A = \frac{\pi D^2}{4}$ or $.785 D^2$ or πr^2
FORCE (PUSH OR PULL)	$\text{FORCE} = \text{Pressure (psi)} \times \text{AREA (in}^2)$	F = P.A
PUMP INPUT POWER, HP	$\text{HORSEPOWER} = \frac{\text{Flow (gpm)} \times \text{Pressure (psi)}}{1714 \times \text{Overall Efficiency}}$	$HP = \frac{Q.P}{1714\eta_o}$
VELOCITY or SPEED (ft./sec)	$\text{VELOCITY} = \frac{231 \times \text{Flow Rate (gpm)}}{12 \times 60 \times \text{Area (sq. inches)}}$	$V = \frac{231\,Q}{720\,A}$
VOLUME, V (gpm)	$\text{VOLUME} = \frac{\pi \times \text{Radius}^2\text{(inches)} \times \text{Stroke (inches)}}{231}$	$V = \frac{\pi r^2 L}{231}$
FLOW, Q (gpm)	$\text{FLOW} = \frac{\text{Displacement (in}^3\text{/rev)} \times \text{speed (rpm)}}{231}$	$Q = \frac{d.n}{231}$
VOLUMETRIC EFFICIENCY η_v (PUMP)	$\text{Vol. Eff} = \frac{\text{Output (gpm)}}{\text{Theoritical (gpm)}} \times 100$	
OVERALL EFFICIENCY, η_o	$\text{Ove. Eff} = \frac{\text{Output HP}}{\text{Input HP}} \times 100$	
MOTOR TORQUE, T (inlbs / psi)	$\text{TORQUE} = \frac{\text{Pressure (psi)} \times \text{Motor Displacement (in}^3\text{/rev)}}{2\pi}$	$T = \frac{Pd}{2\pi}$

Pipe volume varies as the square of the diameter; volume in gallons = $0.0034\,D^2L$

where D = inside diameter of pipe in inches

L = length in inches

$$\text{Velocity in feet per second} = \frac{0.408 \times \text{flow (gpm)}}{D}$$

where D = inside diameter of pipe in inches

Specific gravity of oil is approximately 0.85

Thermal expansion of oil is about 1 cu. in. per 1 gallon per 10^0 F rise in temperature

Conversion Factors :

1 HP = 0.746 kw hr   1 bar = 14.5053 psi   1 kg = 2.2045 lbs

1 US gallon = 231 cubic inches. 3.8 lpm

1 kg = 9.8066 N

APPLICATION GUIDE FOR VANE PRODUCTS

PRIMING AT STARING

When the pump is set into operation for the first time, it must be primed at the lowest possible speed and pressure. When pressure relief valve is used at the outlet, it should be backed off to minimize return pressure. When possible an air bleed off should be provided in the circuit to facilitate purging of system air. Never operate pump shaft at top speed and pressure without checking the pump priming is completed.

PUMP START-UP

The pump should be always started on no load condition. Start the engine and run the pump in idle condition for approximately five minutes. Once the pump is started, it should prime and pump within a few seconds. If it does not, check for no restrictions between the reservoir and the inlet of the pump and no leaks in the inlet line and connections. Also ensure that trapped air can escape from the outlet.

After smooth run of the pump, start operating the controls of the system. Extend all actuators to maximum safe limit to completely fill the system with fluid.

Ensure that the fluid level is not below the "LOW" limit. In case it is low, add fluid to the reservoir to bring the fluid to the normal fill level.

COLD START

When operating with SAE 10 W oil in the 860 to 54 cSt (4000 to 250 SUS) range, the pressure should be limited to half or less of its rated value until the system is warmed up. For mobile applications, the speed should be also limited to half or less. While starting pumps with fluids greater the 860 cSt (4000 SUS), extreme care should be taken to warm up the entire system including cylinders and motors.

OPERATING TEMPERATURES

Viscosities must not be less than the minimum values shown in the table below. Temperatures should not exceed 90° C because the expected life of cartridge kits, seals and gaskets will decrease considerably. For operation at high temperatures, consult Veljan Representative for additional information.

ROTATION

Pumps are offered for clockwise (right hand) rotation or counter clockwise (left hand) rotation. Rotation is viewed from the shaft end of the pump. Irrespective of the direction of rotation, the inlet and outlet ports of the pump remain same.

SEALS

Nitrile seals are standard and suitable for use with petroleum, water-glycol, water-in oil emulsion and high water base fluids. Phosphate ester fluids require the use of special seals.

FLUID SELECTION

Fluid in a hydraulic system performs the multiple functions of transmission of power, lubrication of components and cooling. If is essential in a hydraulic system and proper selection is a necessity for satisfactory operation and life of components.

The basic requirements of a good petroleum oil for hydraulic systems are.

1. Sufficient anti-wear additives

2. Proper viscosity at the operating temperature

3. Adequate rust and oxidation inhibitors

A good quality fluid with high viscosity index and with anti-frothing and anti-oxidizing agents conforming to international standards (ie.APIMS, VDMA 248 18, DIN 51524 and 51525) will provide these characteristics.

The oil viscosity should be suitable to the type of hydraulic pumps and motors installed and the operating temperatures of the circuit.

Suction Pressure and Operating Temperature Requirements

Application	Recommended Operating Suction Pressure range - gauge psi (bar)	Maximum Positive Suction Pressure - gauge psi (bar)	Minimum Suction Pressure - absolute psi (bar)	Maximum Operating Temperature°C
Industrial Mobile	0 to 5.0 (0 to 0.31)	20 (1.4)	12.0 (0.83) 14.5 (1.0)	66 90

Viscosity Requirements

Application	Recommended Operating Viscosity Range cSt	Maximum Viscosity at Startup psi (bar)	Minimum Viscosity cST	
			Continuous	intermittent
Industrial Mobile	15 to 54	865	15 10	10 6.5

APPLICATION GUIDE FOR VANE PRODUCTS

FIRE RESISTANT FLUIDS (Phosphate Ester, Water Gylcol)

The mineral oils have very low ignition and self combustion temperature. When they ignite, the combustion spreads and hence the danger is more.

To prevent fire risk in case of leakage of such fluids, special materials are used which have great resistance to fire.

For Phosphate Ester Fluids, the installation should comply with :

- Suitable seals and flexible pipes (preferably Viton or PTFE)
- Inside surfaces of the reservoir and surfaces that can be in contact with the fluid need not be painted.
- Accurate and continuous filtration of the circuit due to higher fluid density.
- Ample sizing of components and pipings due to higher kinematic viscosity.

These fluids allow very high operation temperatures (even 100° C). They have high resistance and hence do not require special maintenance except frequent check of the water content.

For Water-Glycol fluids (compound mixed with water 40 to 50 and ethylene or propylene glycol or polyethylene glycol), the combustion resistance is due to water content.
The installations for water glycol fluids should comply with:

- Suitable seals
- Not painting the inside surface of the reservoir
- Bigger size of the reservoir (generally 10 times the pump delivery)
- Efficient temperature control of the oil
- Reduction of pump seed (1000 to 1200 rpm)
- Reduction of rated pressure 1000 - 1300 psi (70-90 bar)
- Limited flow speed (max 3m/sec)

FILTRATION

The filtering function must eliminate the particles and micro particles that circulate in the system to ensure maximum efficiency and long life of the components.

The selection of the characteristics of the filter is based on the operating requirements and the components that need to be protected.

The normal ratings of filtration is as under :

- For industrial plants - 25 μ rating
- For system equipped with proportional valves - min. 5μ

The location of the filter in the system should be such that they are easily accessible for periodical cleaning. Filters with visual or electric clogging indicators are generally preferred for better control.

Water-Glycol Fluids			Phospate-Easter Fluids		
Model	Max. Working Pressure bar	Max. Speed rpm	Model	Max. Working Pressure bar	Max. Speed rpm
VST7B	175	1200	VST7B	175	1200
VST7C	175	1200	VST7C	175	1200
VST7CC	175	1200	VST7CC	175	1200
VST7D	175	1200	VST7D	175	1200
VST7DB	175	1200	VST7DB	175	1200
VST7DC	175	1200	VST7DC	175	1200
VST7E	175	1200	VST7E	175	1200
VST7EB	175	1200	VST7EB	175	1200
VST7EC	175	1200	VST7EC	175	1200
VST7ED	175	1200	VST7ED	175	1200
VST7CBB	175	1200	VST7CBB	175	1200
VST7DBB	175	1200	VST7DBB	175	1200
VST7DCC	175	1200	VST7DCC	175	1200
VST7ECB	175	1200	VST7ECB	175	1200
VST7EDB	175	1200	VST7EDB	175	1200
VST7EDC	175	1200	VST7EDC	175	1200