VOITH

Intelligent Self-Control.
Constant-filled Fluid Coupling with Valve Control

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Voith Fluid Couplings with Valve Control: Putting Traction on the Chain

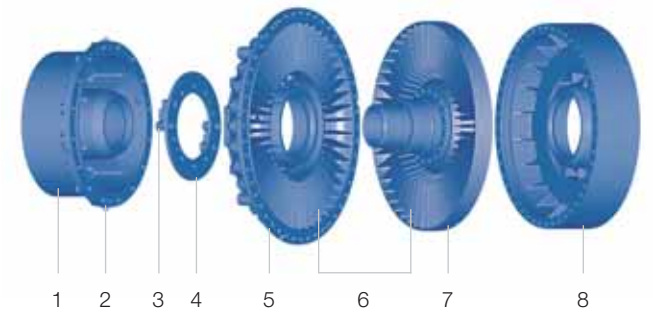
Because of the harsh operating conditions underground, AFC drives need to be extremely robust and reliable. For this reason, high break down torque squirrel cage motors are normally chosen for this severe duty. These motors often have torque-speed curves which, when combined with voltage drops, can intersect the AFC load curve (pullup torque point) creating a condition which will not produce sufficient torque to start a loaded conveyor. To break away, a loaded or overloaded conveyor frequently requires the torque to be higher than the nominal torque.

This means that a direct connected (motor to gearbox) AFC drive will have limited ability to start a loaded AFC. Also voltage drops cannot be excluded in underground power supply systems and these reduce the motor‘s torque characteristic and deteriorate the startup behavior. Voith fluid couplings with integral valve function compensate for these negative influences and enable the motor and the conveyor to be started up reliably.

1 Voith fluid couplings with speed-dependent valve control have proven their advantages in mining applications over several decades.

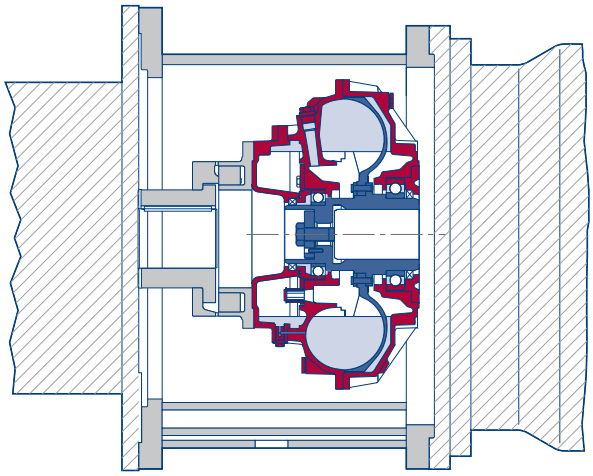
2 They work reliably in AFC and stage loader drives.

3D model, TVVFS coupling



1 Delay chamber
2 Nozzle screw
3 Centrifugal force valve
4 Valve support
5 Pump wheel
6 Working circuit
7 Turbine wheel
8 Annular chamber

TWVF coupling in lantern (tunnel) housing



The Voith drive concept

The hydrodynamic and design properties of fluid couplings with valve control are optimized for the conditions of use on AFCs and stage loaders. In conjunction with squirrel cage motors, they make up a robust drive system that is extremely reliable and protects all drive components, particularly the chain.

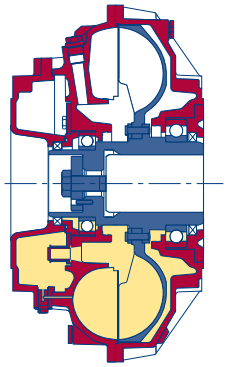
Features and advantages of fluid couplings with valve control

Features		Advantages
Hydrodynamics	Hydrodynamic power transmission based on the Föttinger principle. A rotating fluid flow creates the torque transmission between the input and output runners	• Power transmission with almost zero wear • Load-free motor run-up • Smooth build-up of starting torque • Dampening of torsional vibrations and impacts on the drive chain • Automatic load sharing in multi-motor drives • Robust and reliable drive concept with squirrel cage motors • Protection of all drive components, particularly the chain • High efficiency
Valve control	Centrifugal valves control the filling and draining of the working circuit volume as a function of motor speed, thereby influencing the torque transmission behavior of the coupling	• Relieves load on drive motor in case of voltage drops resulting in motor speeds below the break down torque point • Utilization of motor break down torque after run-up • No external control and regulating equipment necessary
Design	Compact and simple design	• Small space required • Servicing easy to carry out
	Depending on the coupling type, large chambers for the operating fluid with corresponding additional heat capacity	• High startup frequency • Startup against high breakaway torques
	Components with symmetrical rotation	• Clockwise and counter clockwise rotation with identical properties
Operating fluid	Versions available for oil, water and HFD fluids	• Environmentally friendly • Complies with offi cial requirements • Available in trade outlets worldwide
Approvals	Mining approvals obtained for a variety of countries	• Certified drive components complying with local mining regulations

Our valve control – An intelligent idea

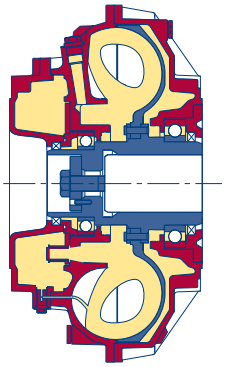
In a fluid coupling, torque is transmitted based on the hydrodynamic principle using two bladed wheels (pump and turbine wheel): the pump wheel is connected to the prime mover and the turbine wheel to the driven machine. The mechanical power is transmitted from the pump wheel to the turbine wheel by a rotating fluid flow. The coupling's torque transmission behavior can be adapted to the requirements of the drive in various ways by using additional chambers for controlling the filling and draining of the working circuit.

Idle



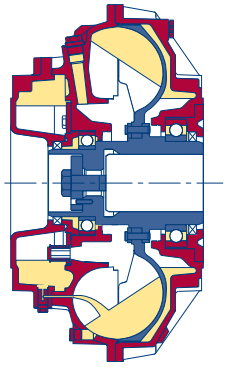
- The operating fluid is located in the lower section of the fluid coupling.
- The fluid levels in the delay chamber and the working circuit are the same.

Motor run-up (full voltage vs. reduced voltage)



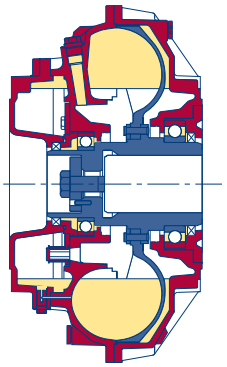
- Up to a set "switching speed", the centrifugal force valves between the working circuit and the delay chamber are open.
- Operating fluid flows through the valves from the working circuit into the delay chamber.
- This causes the coupling to transmit a lower torque and the drive motor runs up with reduced load.

Accelerating the driven machine



- Once the "switching speed" is exceeded, the centrifugal force valves close.
- Operating fluid flows from the delay chamber into the working circuit via nozzle screws.
- The torque that can be transmitted increases up to the breakaway torque and the driven machine is accelerated.

Nominal operation

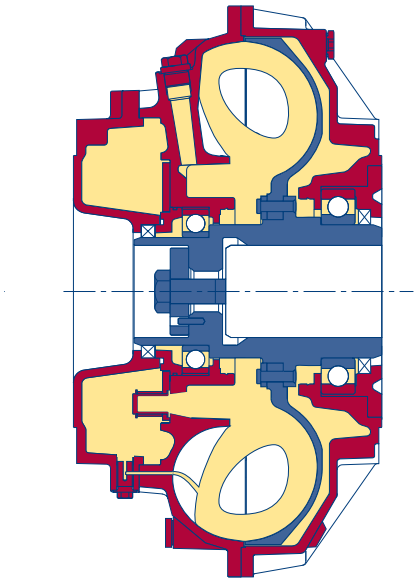


- Almost all of the operating fluid is located in the working circuit.
- The coupling has reached its full transmission capacity (nominal slip 2 – 3 %).

Startup or overload – TV…F… couplings are adaptable

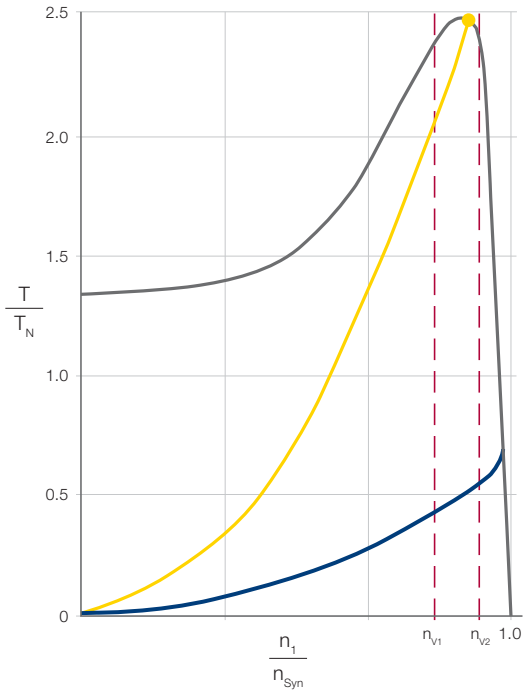
If there is a voltage drop in the power supply system, the motor torque reduces. This has a particularly unfavorable effect during a startup procedure. Without a Voith coupling with valve control, the power consumption and the available torque deteriorate significantly. In many cases, it is no longer possible to start up the conveyor. This results in thermal overload of the motor and / or the coupling.

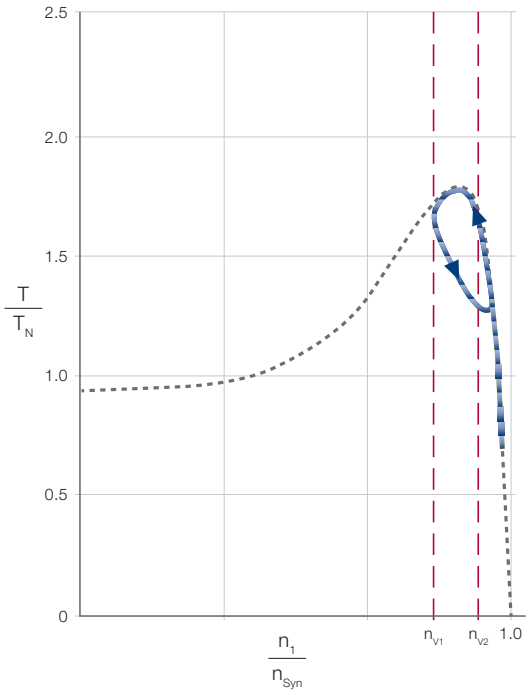
Motor overload



- Motor overloads resulting from voltage drops or excessive load will result in the motor speed reducing below the break down torque speed point. The centrifugal force valves react to this condition and open when a defined switching speed is reached (n_{V2}).
- Operating fluid flows from the working circuit back into the delay chamber and the coupling's transmittable torque is reduced.
- The load on the motor is relieved and it re-accelerates to full speed.
- When the switching speed is reached (n_{V1}), the centrifugal valves close.
- Operating fluid flows from the delay chamber into the working circuit via the nozzle screws and the transmittable torque increases.
- This cyclic operation is repeated until the conveyor restarts after the voltage is stabilized or a thermal fuse plug in the system responds.

Valve function with hysteresis behavior





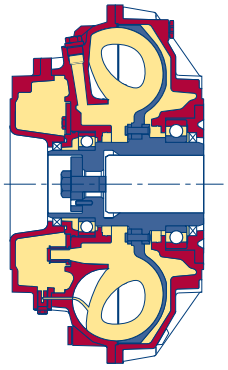
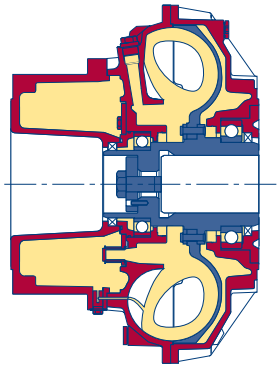
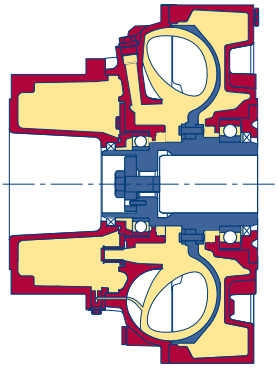
- Original motor characteristic
- Maximum torque with 100 % slip
- Starting torque with 100 % slip
- Motor characteristic with 15 % voltage drop
- Cyclic operation

T	Motor torque
T_N	Nominal motor torque
n_1	Input speed
n_{Syn}	Synchronous speed
n_{V1}, n_{V2}	Valve switching speeds

The right coupling for every drive

The critical factors in the design of a fluid coupling are the power and speed of the drive motor. Other factors include startup frequency, maximum transmittable torque and the time-dependent build-up of the starting torque. When it comes to choosing the most suitable fluid coupling for your drive, you can rely on our sales engineers‘ decades of experience. We will be happy to advise you.

Overview: TV…F… couplings for AFC drives

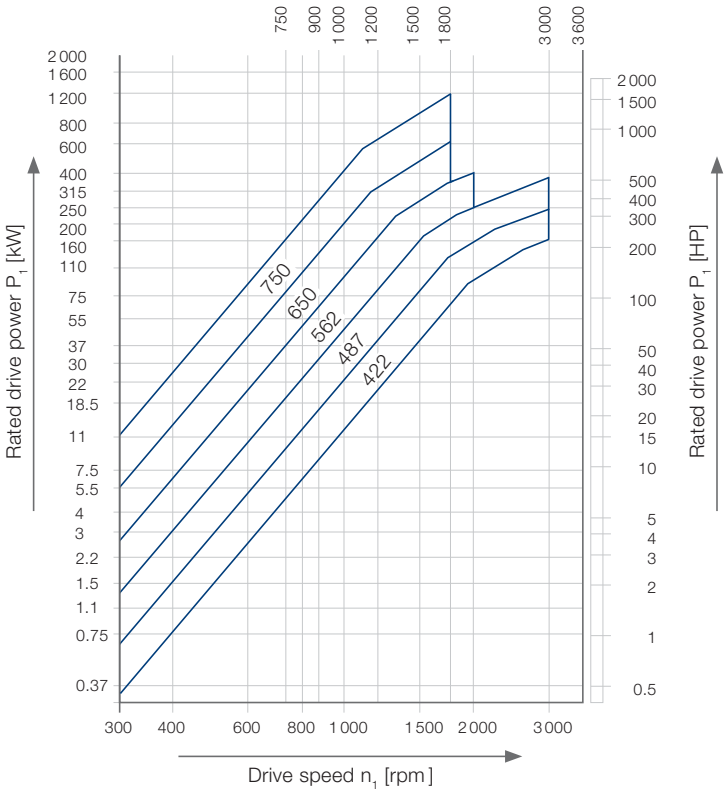
Type		TVF		TVVF		TVVFS	
							
Size, design		650 TVF	650 TUVF	650 TVVF	650 TUVVF	650 TUVVFS	750 TVVFS
Rated power in kW	@ 1 500 rpm	380	380	400	400	485	630
	@ 1 800 rpm	450	450	485	485	600	750
Max. transmittable torque in Nm		7 250	9 500	7 800	10 200	10 200	12 500
Heat capacity and load relief for motor run-up		+		++		+++	
Operating fluid	Oil	Yes					
	HFD fluids	Yes					
	Water	Possible					
Material for external parts		Silumin	Spheroidal cast iron	Silumin	Spheroidal cast iron	Spheroidal cast iron	Silumin

Demanding drives call for demanding solutions

Fluid couplings with valve control are not only used in AFC drives. Their use can be advantageous in almost any electromotive drives with moderate or weak power supply systems. Other typical applications: Drives that require effective load relief on the motor for frequently repeated startup procedures. We use different wheel profiles and adapted switching valves and nozzle screws to optimize the TV…F… couplings for the individual requirements of your application.

Power diagram with mineral oil operating fluid

Greater powers on request



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Crusher, mixer

- Operation of crushers and mixers frequently calls for a high breakaway torque.
- After running up the motor without load, the maximum available torque must be provided quickly.
- A TV…F… coupling in the drive meets these requirements. Partial draining of the working circuit via the open valves reduces the starting torque during the motor run-up.
- The subsequent rapid build-up of torque is achieved using enlarged nozzle screws.

Two speed motors

- The drive speed has a major influence on the transmission behavior of a hydrodynamic coupling. With two speed motors, the use of a fluid coupling in some applications is only possible with compromises.
- Special switching valves in the couplings allow the transmission behavior to be effectively adapted to the relevant speed.

3

Combination with soft starters

- Combining an electric soft starter with a TV…F… coupling reduces the peak power consumption depending on the load.
- The motor, power supply and compensation mechanisms can all be designed with smaller dimensions.
- Costs for peak power requirements are reduced.

1 Optimum utilization of motor power using Voith fluid couplings on an impact crusher for reducing minerals.

2 The 750 TVVF fluid coupling in a strander, which cannot be started up directly when using an electric soft starter to limit the motor current.

3 Iron ore pier in Darwin, Australia.

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