

HYDRATECH s.r.o.



What the word “hydraulic” really means?



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Preamble

The company HYDRATECH s.r.o. (hereinafter referred as the “company”) was founded at the end of the year 2004. The company has been based on business purpose according to Slovak Commercial Code.

The company is focusing on producing, assembly and delivery of

- high pressure hoses,
- pressure hoses,
- industrial hoses,
- cable mechanic wires,
- hydraulic components and securing of the customers service.

The company produces atypism hose endings and coupling connections by observing the maximum security arrangement.

Performance: The success of the company depends on responding to client’s goals and objectives while keeping costs under control and delivering the highest quality product. The company is committed to meeting or exceeding customer expectations.

It would be a compliment for our company if you would join yourself to company’s customers and hereby you help us with creating a successful European economic place. The company looks forward to do cooperation with you and also wish you a great success in doing your own business.



ABOUT COMPANY

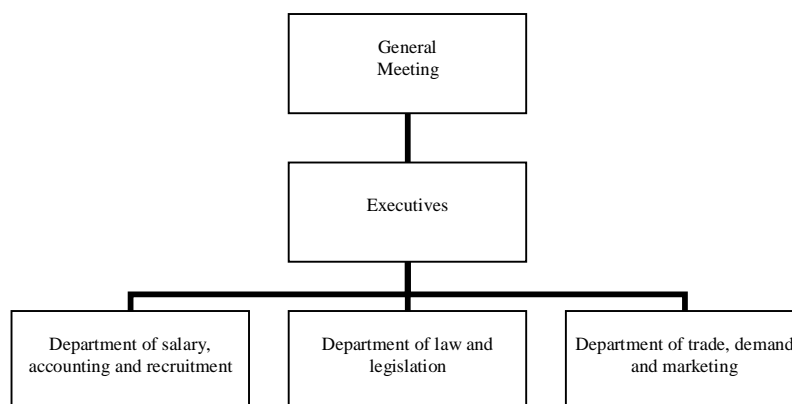
The company was founded in 2004 as a business company by joining of two entrepreneurs. Both of them have been working in industrial area for more than ten years. The company has a great experience in doing business in the field of hydraulic systems.

The company is focused on automotive, agriculture and machines industry. The company has a great experience with producing, assembly and supply of hydraulic hoses, screw engineering, cable mechanic wires and fittings.

The company is a member of The Slovak Chamber of Commerce. It is an active member who does cooperation with all Chamber's sections, e.g. mostly with industrial sections.

Some of the company's products are used in aviation industry. All products are controlled by high knowledge staff and all products are certificated in the official authorities. A statement of the safe products of the company has been issued by Institution for technical examination.

The structure of the company consists of The General meeting, Executive heads and Departments.



- The General Meeting is the supreme body of the company.
- Executives are a statutory body of the company. The executives are:

Mr. Ladislav Sarkany (1948) (languages: Slovak, Hungarian, Czech)

Mrs. Maria Sarkanyova (1951) (languages: Slovak, Hungarian, Russian)

Mr. Ladislav Sarkany (1977) (languages: Slovak, Hungarian, Czech, English, German)

Mrs. Maria Nagyova (1974) (language: Slovak, Hungarian, English)

HOSE AND HYDRAULICS

A **hose** is a hollow tube designed to carry fluids from one location to another. Hoses are also sometimes called pipes (the word *pipe* usually refers to a rigid tube, whereas a hose is usually a flexible one), or more generally *tubing*. The shape of a hose is usually cylindrical (having a circular cross section).

Hoses are used in water or other liquid environments to convey air or other gases; they are used in air or other gaseous environments to convey liquids. Hoses are used to carry fluids through fluid environments.

Specific applications include the following:

- A garden hose is used to water plants in a garden or lawn, or to convey water to a sprinkler for the same purpose.
- A firehose is used by firefighters to convey water to the site of a fire.
- Air hoses are used in underwater diving (e.g., scuba diving) to carry air from the surface or from air tanks.
- In architecture, metal or plastic hoses (usually called *pipes*) are used to move water around a building; air ducts are used to move air around.
- Automotive hoses are used in automobiles to move fluids around for use in cooling or lubrication and in hydraulics.
- In chemistry and medicine, hoses (usually called *tubes*) are used to move liquid chemicals or gases around.

Hoses are typically used with clamps, spigots, and nozzles to control fluid flow.

HYDRAULIC MACHINERY

Hydraulic machinery are machines and tools which use fluid power to do work. Heavy equipment is a common example.

In this type of machine, hydraulic fluid is pumped to a high pressure and transmitted throughout the machine to various actuators. The hydraulic pumps are powered by engines electric motors. Pressurized fluid is controlled by the operator with control valves and distributed through hoses and tubes.

The popularity of hydraulic machinery is due to the very large amount of power that can be transferred through small tubes and flexible hoses; and the high power density and wide array of actuators that can make use of this power.



HYDRAULIC POWER

The science of fluid pressure provides some of the theory of hydraulics.

1. A force acting on a small area can create a much larger force by acting on a larger area by virtue of hydrostatic pressure.
2. A large amount of energy can be carried by a small flow of highly pressurized fluid.

Hydraulic machinery offers a large amount of power and force with relatively small components. A typical hydraulic cylinder with a 75 mm (3 inch) bore, for example, can supply 89 000 N (20,000 lbf). The power transmission in a hydraulic system is easily controlled with valves.

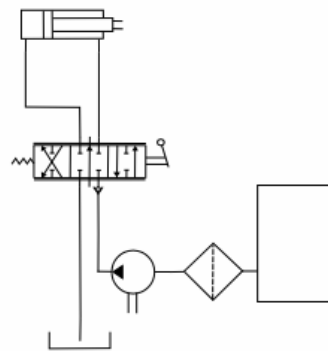
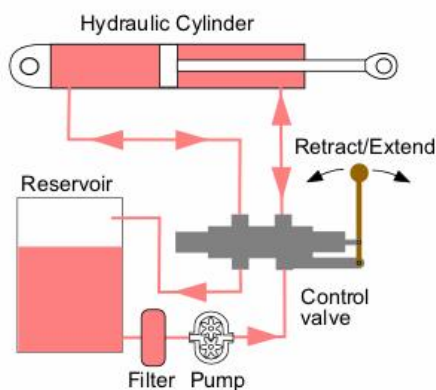
Some parts of a hydraulic system will operate at about 2000 kPa (300 psi) (pilot controls, vehicle brakes). The main hydraulic actuators (for example, cylinders or fluid motors) will typically operate in the range of 7000 - 42000 kPa (1000 - 6000 psi). With advances in materials and design, there is a trend toward higher pressure, with some systems operating to 100 000 kPa (15,000 psi). Some exotic systems with titanium hardware will operate at over 350 000 kPa (50,000 psi).

HYDRAULIC CIRCUIT

For hydraulic fluid to do work, that fluid must flow to the actuator, then return to a reservoir. The fluid is then filtered and re-pumped.

The path taken by hydraulic fluid is called a hydraulic circuit of which there are several types.

Open center circuits use pumps which supply a continuous flow. The flow is returned to *tank* through the control valve's *open center*; that is, when the control valve is centered, it provides an open return path to tank and the fluid is not pumped to a high pressure. Otherwise, if the control valve is actuated it routes fluid to and from an actuator, and then to tank. The fluid's pressure will rise to meet any resistance, since the pump has a constant output. If the pressure rises too high, fluid returns to tank through a pressure relief valve. Multiple control valves may be stacked in series. This type of circuit can use inexpensive, constant displacement pumps.



A simple *open center* hydraulic circuit.

The equivalent circuit schematic.

Closed center circuits supply full pressure to the control valves, whether any valves are actuated or not. The pumps vary their flow rate, pumping very little hydraulic fluid until the operator actuates a valve. The valve's spool therefore doesn't need an open center return path to tank. Multiple valves can be connected in a parallel arrangement and system pressure is equal for all valves.

Load-sensing circuits pumps can reduce both flow and pressure to match the load requirements. This results in a much more efficient system when partially loaded.

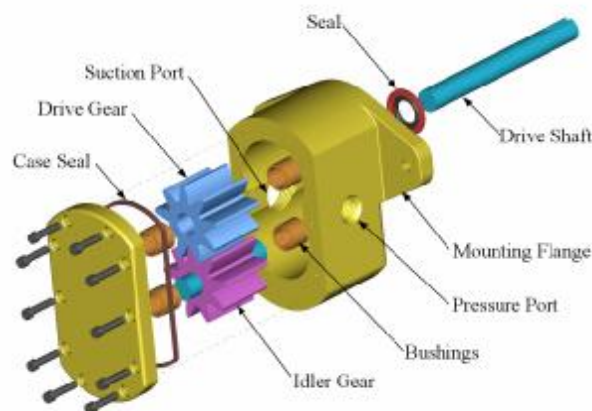
PUMPS

Hydraulic pumps supply fluid to the components in the system. Pressure in the system develops in reaction to the load. Hence, a pump rated for 5,000 psi is capable of maintaining flow against a load of 5,000 psi.

Pumps have a power density about ten times greater than an electric motor (by volume). They are powered by an electric motor or an engine, connected through gears, belts, or a flexible elastomeric coupling to reduce vibration.

Common types of hydraulic pumps for hydraulic machinery applications are;

- Gear pump: cheap, durable, simple. Less efficient, because they are constant displacement, and suitable for, largely, pressures below 200 Bar (3000 psi).
- Vane pump: cheap and simple, reliable (especially in g-rotor form). Good for higher-flow low-pressure output.
- Axial piston pump: many designed with a variable displacement mechanism, to vary output flow for automatic control of pressure. There are various axial piston pump designs, including swashplate (sometimes referred to as a valveplate pump) and checkball (sometimes referred to as a wobble plate pump). The most common is the swashplate pump. A variable-angle swash plate causes the pistons to reciprocate. Piston pumps are more expensive than gear or vane pumps, but provide longer life operating at higher pressure, with difficult fluids and longer continuous duty cycles. Piston pumps make up one half of a hydrostatic transmission.



CONTROL VALVES

Directional control valves route the fluid to the desired actuator. They usually consist of a spool inside a cast iron or steel housing. The spool slides to different positions in the housing, intersecting grooves and channels route the fluid based on the spool's position.

The spool has a central (neutral) position maintained with springs; in this position the supply fluid is blocked, or returned to tank. Sliding the spool to one side routes the hydraulic fluid to an actuator and provides a return path from the actuator to tank. When the spool is moved to the opposite direction the supply and return paths are switched. When the spool is allowed to return to neutral (center) position the actuator fluid paths are blocked, locking it in position.

Directional control valves are usually designed to be stackable, with one valve for each hydraulic cylinder, and one fluid input supplying all the valves in the stack.

Tolerances are very tight in order to handle the high pressure and avoid leaking, spools typically have a clearance with the housing of less than a thousandth of an inch. The valve block will be mounted to the machine's frame with a *three point* pattern to avoid distorting the valve block and jamming the valve's sensitive components.

The spool position may be actuated by mechanical levers, hydraulic *pilot* pressure, or solenoids which push the spool left or right. A seal allows part of the spool to protrude outside the housing, where it is accessible to the actuator.

The main valve block is usually a stack of *off the shelf* directional control valves chosen by flow capacity and performance. Some valves are designed to be proportional (flow rate proportional to valve position), while others may be simply on-off. The control valve is one of the most expensive and sensitive parts of a hydraulic circuit.

Pressure relief valves are used in several places in hydraulic machinery; on the return circuit to maintain a small amount of pressure for brakes, pilot lines, etc... On hydraulic cylinders, to prevent overloading and hydraulic line/seal rupture. On the hydraulic reservoir, to maintain a small positive pressure which excludes moisture and contamination.

Pressure reducing valves reduce the supply pressure as needed for various circuits.

Counterbalance valves supply resistance to flow under certain conditions, to help a forklift maintain position of a load, for example.

Sequence valves control the sequence of hydraulic circuits; to insure that one hydraulic cylinder is fully extended before another starts its stroke, for example.

Shuttle valves provide a logical or function.

Check valves are one way valves, allowing an accumulator to charge and maintain its pressure after the machine is turned off, for example.

Cartridge valves are *off the shelf* components with a standardized envelope, making them easy to populate a proprietary valve block. They are available in many configurations; on/off, proportional, pressure relief, etc. They generally screw into a valve block and are electrically controlled to provide logic and automated functions.

Hydraulic fuses are in-line safety devices designed to automatically seal off a hydraulic line if it rapidly loses pressure.

Auxiliary valves. Complex hydraulic systems will usually have auxiliary valve blocks to handle various duties unseen to the operator, such as accumulator charging, cooling fan operation, air conditioning power, etc... They are usually custom valves designed for the particular machine, and may consist of a metal block with ports and channels drilled. Cartridge valves are threaded into the ports and may be electrically controlled by switches or a microprocessor to route fluid power as needed.

ACTUATORS

- Hydraulic cylinder
- Rotary actuator (hydraulic)
- Motor (a pump plumbed in reverse)
- Hydrostatic transmission
- Brakes

RESERVOIR

The hydraulic fluid reservoir holds excess hydraulic fluid to accommodate volume changes from: cylinder extension and contraction, temperature driven expansion and contraction, and leaks. The reservoir is also designed to aid in separation of air from the fluid. Design engineers are always pressured to reduce the size of hydraulic reservoirs, while equipment operators always appreciate larger reservoirs.

Some designs include dynamic flow channels on the fluid's return path that allow for a smaller reservoir.

ACCUMULATORS

Accumulators are a common part of hydraulic machinery, they store energy by using pressurized gas. One type is a tube with a floating piston. On one side of the piston is a charge of pressurized gas, on the other side is the fluid. Bladders are used in other designs.

Examples of accumulator uses are backup power for steering or brakes, or to act as a shock absorber for the hydraulic circuit.

HYDRAULIC FLUID

Also known as *tractor fluid*, hydraulic fluid is the life of the hydraulic circuit. It is usually petroleum oil with various additives. Some hydraulic machines require fire resistant fluids, depending on their applications.

In addition to transferring energy, hydraulic fluid needs to lubricate components, suspend contaminants and metal filings for transport to the filter, and to function well to several hundred degrees Fahrenheit or Celsius.

Hydraulic fluids are a large group of liquids made of many kinds of chemicals. They are used in automobile, automatic transmission, brakes, and power steering; forklift trucks; tractors; bulldozers; industrial machinery; and aircraft. The three most common types of hydraulic fluids are mineral oil, organophosphate ester, and polyalphaolefin. Others are based on glycol esters and ethers, castor oil, or silicone. Some of the trade names for hydraulic fluids include Durad®, Fyrquel®, Skydrol®, Houghton-Safe®, Pydraul®, Reofos®, Reolube®, Hydraunycoil®, and Quintolubric®.

Brake fluid is a subtype of **hydraulic fluid** with high boiling point and low freezing point.

Hydraulic systems, like the ones mentioned above, will work efficiently if the hydraulic fluid used has low compressibility.

Some hydraulic fluids have a bland, oily smell and others have no smell; some will burn and some will not burn. Certain hydraulic fluids are produced from crude oil and others are manufactured by many companies.

Hydraulic fluids can contain a wide range of various chemical compounds; oils, butanols, esters (e.g. phthalates, like DEHP, and adipate, like bis(2-ethylhexyl adipate), polyalkylene glycols (PAG), phosphate esters (e.g. tributylphosphate), silicones, alkylated aromatic hydrocarbons, polyalphaolefins (PAO) (e.g. polyisobutenes), corrosion inhibitors, etc.

FILTERS

Filters are a very important part of hydraulic machinery. Metal filings are continually produced by mechanical components and need to be removed, along with other contamination.

Filters may be positioned in a variety of locations. The filter may be located between the reservoir and the pump intake. Blockage of the filter will cause cavitation and possibly failure of the pump. Sometimes the filter is located after the pump, and before the control valves. This arrangement is more expensive, since the filter housing is pressurized, but eliminates cavitation problems and protects the control valve from pump failures. The third common filter location is just before the return line enters the reservoir. This location is relatively insensitive to blockage and does not require a pressurized housing, but any contaminants that may enter the reservoir (from external sources) are not filtered until they pass through the system at least once.

HOSE, TUBES AND PIPES

Hydraulic hose is graded by pressure, temperature, and fluid compatibility. A rubber interior is surrounded by multiple layers of woven wire and rubber. The exterior is designed for abrasion resistance. The bend radius of hydraulic hose is carefully designed into the machine, since hose failures can be deadly, and violating the hose's minimum bend radius will cause failure. Hydraulic hoses generally have steel fittings swaged on the ends.



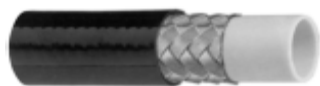
Hose with 1 layer of woven wire



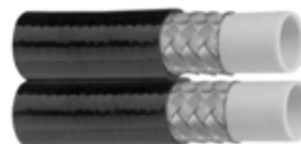
Hose with 2 layers of woven wire



Hose with 4 layers of woven wire



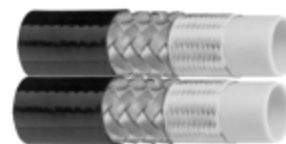
Polyuretan hose with 1 layer
of woven wire



Double Polyuretan hose with 1 layer
of woven wire



Polyuretan hose with 2 layers
of woven wire



Double Polyuretan hose with 2 layers
of woven wire

ENDINGS USED AT HYDRAULIC MACHINERIES

There are a lot of end pieces used for hydraulic industry. Most of end pieces are made according to international or national standards. Some of them are made according to customers demand by observing the maximum security arrangement. End pieces are divided into two categories:

- the first is composed of two components (sheath and plug). Mostly it is used in Continental countries.



- the second is composed of one component (sheath and plug is made altogether). Mostly it is used in USA.



End pieces are made of steel or stainless steel. All kind of hoses are edged with demanded kind of special endings.

There are many kinds of end pieces made with metrical windings. For hydraulic systems joining with slot angle rings used for tightly made pipe lines are made according to DIN standards. Therefore the size of end pieces depends not only on windings size but also on the internal diameter of the tube concerning to given materials. This is the fact why end pieces exists in 2 lines

- slight line
- heavy line

The budget sheet compares the differences between mentioned lines

Windings size (mm)	hose size (mm)	
	Slight line	Heavy line
M 12x1,5	6	-
M 14x1,5	8	6
M 16x1,5	10	8
M 18x1,5	12	10
M 20x1,5	-	12
M 22x1,5	15	14
M 24x1,5	-	16
M 26x1,5	18	-
M 30x2	22	20
M 36x2	28	25
M 42x2	-	30
M 45x2	35	-
M 52x2	42	38

Hydraulic pipe is thick enough to have threads cut into it for connections. It is rarely used for high pressure systems, which prefer tubes or hoses. Pipe lends itself to weldments and can be used to fabricate manifolds. Steel suppliers carry black pipe, which is non-galvanized and suitable for welding.



Hydraulic tubes are preferred over hoses whenever possible, since they are more durable. They are also preferred to pipe since they weigh less. Hydraulic tubes usually have flared ends and captive nuts to make connections. They may also be steel weldments with floating nuts and face seal fittings on the ends. Tubes can be fabricated to a high degree of complexity.

Tubes and pipes for hydraulic applications traditionally have not been plated or painted, since the oil and temperature they operate under drive away moisture and reduce rusting. Anti corrosion coatings, such as zinc chromate, are becoming more popular.



Hose used for convey of fluid products



Air hose



Hose used at robotic machines



INDUSTRIAL HOSES

Industrial hoses are the most frequented hoses used in industry, agriculture and chemical industry. This kind of hoses serves for convey fluids (oil, water), steam, agrarian products, chemicals, food products, pharmaceutical products etc.

Generally industrial hoses are divided into some categories. Hoses have categories as hoses for

- universal usage,
- convey water and air,
- convey hot water and steam,
- convey food products,
- convey chemicals,
- convey oil substances,
- convey gases and gas substances,
- convey exhaustion,
- convey extra hot fluids – Teflon hoses, silicon hoses, composite hoses.

Hoses for general usage



Hose used for convey water or air



Hose used for pneumatic and hydraulic sets

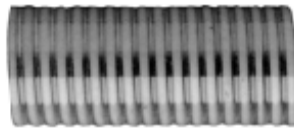


Hose used for light chemicals

Hoses used convey water or air



Hose used for convey water or air, hot water and steam



Hose used for convey feculence



Hose used for convey artificial snow

Hoses used for convey food and other products



Hose used for convey chemicals, pharmaceutical agricultural and cosmetic products



Hose used for convey wine, beer, juices etc.



Hose used for convey substances without smell. It is mostly used for convey milk products.



Hose used for convey drinking water, vegetable oil and other food products.



Hose used for convey fish products



Hose used for convey spirit products

Hose used for convey chemicals



Hose used for convey aggressive chemicals



Hose used for convey liquid chemicals



Hose used for convey hydrocarbon products

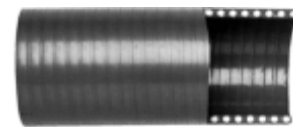
Hose used for convey oil substances



Hose used for convey fluid products of petrochemical industry



Hose used for convey hydraulic oil and fuel



Hose used for convey mineral oil



Hose used for convey fuel and air condition fluids



Hose used for convey asphalt



Hose used convey liquid asphalt

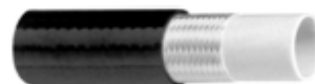
Hoses used for convey gases and gas substances



Hose used for convey inflammable gases



Hose used for welding



Hose used in air condition industry

Hoses used for convey exhaustion



Hose used for drawing off Acids



Hose used for convey powdery products



Hose used for convey fumes

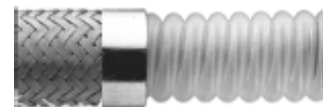
Hoses used for convey extra hot liquids – Teflon hoses, silicon hoses, composite hoses



Teflon hose used for convey extra hot products



Hose used for convey extra hot steam and extra hot gases



Hose used for convey extra hot products and vibration immune

SEALS, FITTINGS AND CONNECTIONS

In general, valves, cylinders and pumps have female threaded bosses for the fluid connection, and hoses have female ends with captive nuts. A male-male fitting is chosen to connect the two. Many standardized systems are in use.

Fittings serve several purposes;

1. To bridge different standards; O-ring boss to JIC (hydraulic), or pipe threads to face seal, for example.
2. To allow proper orientation of components, a 90°, 45°, straight, or swivel fitting is chosen as needed. They are designed to be positioned in the correct orientation and then tightened.
3. To incorporate bulkhead hardware.
4. A *quick disconnect* fitting may be added to a machine without modification of hoses or valves

A typical piece of heavy equipment may have thousands of sealed connection points and several different types of seals, below are some of the most common types;

- Pipe fittings, the fitting is screwed in until tight, difficult to orient an angled fitting correctly without over or under tightening.
- O-ring boss, the fitting is screwed into a boss and orientated as needed, an additional nut tightens the fitting, washer and o-ring in place.
- Flare seal, a metal to metal compression seal with a cone and flare mating.
- Face seal, metal flanges with a groove and o-ring are fastened together.
- Beam seal, an expensive metal to metal seal used mostly for aircraft.
- Swaged seals, tubes are connected with fittings that are swaged in place (non-serviceable). Primarily used in aircraft.



Elastomeric seals (O-ring boss and face seal) are the most common types of seals in heavy equipment and are capable of reliably sealing 6000+ psi (41368+ kPa) of fluid pressure.

COUPLING CONNECTIONS

This device is used to connect two shafts together at their ends for the purpose of transmitting power. Couplings do not allow connection or disconnection of shafts during operation at operator's will.

There are two main types of couplings:

- **Rigid couplings** are used when precise shaft alignment is required; shaft misalignment will affect the coupling's performance as well as its life,
- **Flexible couplings** are designed to transmit torque while permitting some radial and axial and angular misalignment. Flexible coupling can accommodate angular misalignment up to $\pm 3^\circ$, parallel misalignment up to 0.15 to 0.75 and axial misalignment up to 0.75 mm.



STORZ COUPLING

A "quarter turn coupling", or "sexless coupling", commonly used to connect to fire hydrants, easy to connect, no particular male or female end, locks are on inside of coupling.

**NAKAJIMA COUPLING**

Another "quarter turn" or "sexless" coupling, similar to Storz coupling, but not used as often. Main difference between these and Storz are that this has locks on the outside.

NST COUPLING

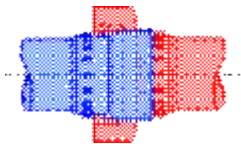
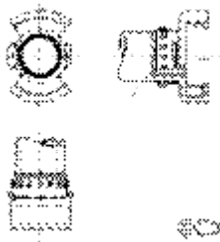
The most common type of coupling. The male and female threads screw together.

GUILLEIM SYMMETRICAL CLUTCH

The Guillemin symmetrical clutch is widely used in France. It is the coupling used by the french firefighters.

It can be fastened by hand, but it is also possible to use a tricoise wrech. It is also "quarter turn" and "sexless" (symmetrical).

Each end have a ring with two protuberances outside; when the ring turns, the protuberances get inside the hook of the other hose.



BOWDEN CABLE /WIRE/

Invented by Frank Bowden, a **bowden cable /wire/** is a type of flexible cable used to transmit mechanical force or energy by the movement of an inner cable (most commonly of steel or stainless steel) relative to a hollow outer cable housing. The cable housing is generally of composite construction, consisting of a spiral steel wire, often coated with plastic, and with a plastic outer sheath.

The linear movement of the inner cable is generally used to transmit a pulling force, although for very light applications over shorter distances (such as the index shifting system on a bicycle, or the remote shutter release cables on mechanical film cameras) a push may also be used. Usually provision is made for adjusting the cable tension using an inline hollow screw (often called a "barrel adjuster"), which lengthens or shortens the cable housing relative to a fixed anchor point. Lengthening the housing (turning the barrel adjuster out) tightens the cable; shortening the housing (turning the barrel adjuster in) loosens the cable.



Cable mechanic wires used in automotive – hand brake wires
Bowdens with steel wire and special endings

CONCLUSION

We mention that the basic information about “hydraulic” is essential at using all kind of hydraulic machinery. That was the reason why our team has decided to issue the booklet about hydraulic and hydraulic systems. We hope that information adduced in this booklet will be useful for you and help you at using hydraulic systems and its components.

If you have any question about hydraulic please do not hesitate ant contact us. Our high knowledge staff will give you professional advice and suggest the best solution to settle your hydraulic matter.

We emphasize that this booklet is being issued only for information purposes. Should you be interested we remain at your entire disposal for all complementary information.

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Spoločnosť je zapísaná v Obchodnom registri Okresného súdu Trnava, oddiel Sro, vložka č. 15610/T
The company is signed in the Companies register of The District Court Trnava, section Sro, insert No: 15610/T