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INSTALLATION OF HIGH PRESSURE WATER PUMP FOR A WATER JET TECHNOLOGY - HIGH PRESSURE WATER PUMP IN NON-CONVENTIONAL TECHNOLOGIES

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ABSTRACT: The technology water jet is complex hydrodynamic process at ultrahigh pressures, which can be characterized at present days as the area of jet technologies. The process alone requires the most effective and economical utilisation of energy of water jet. It directly is connected with the most convenient determination of production - technology parameters of jet fluid, according to respect of basic physical properties of fluid as a cutting medium and the respect of hydrodynamic rule.
KEYWORDS: water jet, hydrodynamic process, ultrahigh pressures

INTRODUCTION

A water jet cutting technology is a cold cutting process. It is used for an application by which is not possible to use a chipless machining, chip machining and thermal manufacturing technologies, because they provide unsatisfactory results because of their mechanical or physical properties. For prospective customers there are very interesting advantages of high pressure cutting process by the water jet technology compared with other possibilities of manufacturing.

A basic equipment of water jet technology is a high pressure water pump. There is pressured a water on a laid out high pressure in the multiplier part which is powered by an oil pump wired in with electromotor. Power of high pressure water pump is determined according how much is possible to produce high pressure water for a minute. A water pressure is created in multiplier part on required laid out pressure.

The multiplier, which is called pressure multiplier, works on principle where a piston surface of oil part is in proportion, for example 20:1 respectively above, to a piston surface which pressures water. The oil piston works with a pressure 200 bar and by that pressure on piston surface, which pressures water, is multiplied the pressure on piston surface, which pressures water, 20 - 30 times.

There is an output water pressure 400 MPa, respectively 620 MPa. High pressure pump represents specific standard of reliability, its individual elements which subject to industry standards for hydrodynamic and hydro-abrasive using. On Figure 1 there is mentioned review of high pressure pump history of KMT Waterjet systems company.





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Figure 1. High pressure water pump
of KMT Waterjet systems company

CHARACTERISTIC OF HIGH PRESSURE PUMP

The high pressure pump is equipped by two together operated (controlled) hydraulic multipliers, pressure accumulator, drive hydraulic rising pressure oil pump, electric star panel, control sensors, solenoids, control panel and low pressure water circuit with a filter. The high pressure water pump is situated to frame with dimensions: length - 197cm, width - 91 cm and height - 144 cm. The high pressure system is properly built on a gutter box. All elements have a good accessibility at least from two sides for simplification of maintenance.

Standard equipments of high pressure water pump:

- system of low pressure water,
- hydraulic system,
- multiplier,
- pressure accumulator,
- recirculating system,
- oil cooling system,
- electric system,
- separated water and oil gutter boxes.

The maximal pressure of high pressure water is limited by a hydraulic safety valve. Pump is convenient for different requirements of production, for small or big areas too. High pressure multiplier has bipartite water piston, which is hung on oil piston which oscillates from one side to another and oppositely. High pressure water is conveyed from a multiplier or more multipliers, which parallel works, to pressure accumulator. Compress proportion is 20:1 with a maximal hydraulic pressure 214bar.

Recirculating system, for cooling and filtration of oil, runs when a main electromotor runs too. The main functional properties of high pressure water pump are:

- nominal pressure 4 150 bar (60 000 psi),
- working pressure 3 800 bar (55 000 psi).

INSTALLATION OF HIGH PRESSURE PUMP

Installation - application, installation, running and working of high pressure pump, for example SL-IV 100hp, requires complex harmonization of all details of full system.

During installation of high pressure pump there is needed to keep these rules:

- Strictly to keep requirement on installation and working of high pressure pump.
- Safety procedure and practices must be kept during installation, start working and during

normal working for maintenance and servicing of pump.

Duties of customers

A decision about installation and working of equipment requires cooperation between a prospective buyer and a provider of high pressure pump. Department of provider services normally requires than the prospective buyer fulfilled the next tasks:

- High pressure pump should be placed separately, in specific distance from cutting table.
- Provide for a required supply input power of electric energy and to prevent electric power drops with central equipment disconnecting.
- Provide for a supply of required pressure air and to prevent drops of the supply of required pressure air by handle closed valve.
- Provide for relieving and fixing holders for high pressure tube conveyances.
- Provide for required a water inflow for cutting, inflow and outflow of cooling water and outflow of water after cutting by handle closed valves.
- Provide for interconnection of accumulating outflows for waste water removing.

Responsibilities of provider

In the case if all duties of customer are fulfilled then responsibilities of provides will be following:

- To guarantee, than interior layout of component of workstation was according to project.
- To guarantee, than electric energy was connected according to project.
- To guarantee, than conveyances for water and air distribution was according to project.
- To control the rightness of direction of electromotor rotation or eventually correct to set it.
- To test of the electric connection between high pressure pump and cutting table.
- Based on verification, to determine maximal cutting pressure.
- To install and test high pressure conveyances system, from pump to cutting head.
- To realize standard test like the guarantee of installation quality of full system of equipments and all conveyances including the high pressures conveyances.
- To teach in service staff for service, maintenance and service repairation.
- In a protocol to finish the installation, running and working verification of high pressure pump with accessories and cutting head, including to teaching of service stuff for the service of high pressure pump, head and conveyances and their maintenance and service reparations.

Requirements for installation

Requirement for installation of high pressure pump are influenced by following basic factors:

- Environment: High pressure pump (e.g. SL-IV 100hp stationary) must be installed in the interior, at which conditions of normal environment must not go over minimal or maximal values.
- Anchoring: Pump, e.g. SL-IV 100hp, is fixed by own weight (approximately 1,4 t) without anchoring

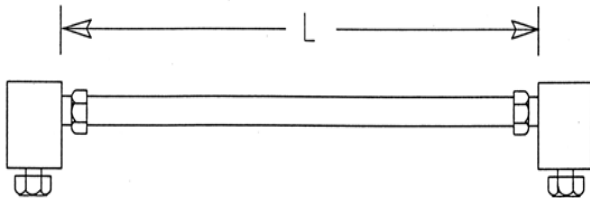
even when there is not possible to move in consequence of oscillation of multiplier.

- Space: Space around high pressure pump should be minimal 900 mm (36 inches) of free area on all sides for the free movement of service stuff.
- Electric: Electric connection of high pressure pump must be in keeping with international and local norms. Pump has 24 vdc, control system and premises for negligible flow in the control panel.

Requirements for installation of tools system. High pressure tube coning and cutting processes

Process for determination of total length of high pressure tube is following: At first there is needed to determine length of tube, distance between fitting according to Figure 2. Next there is added the effectual length two times according to Table 1. At last tube is cut on final length and sharp tube ends are removed.

High pressure conveyances of piping and fitting, for using of pressure to 138 bar (60 000 psi), must be only new without using before. The conveyances can cause the component failure, damage, personal injury or death.



Tube length = L + 2EL

Figure 2. Dimensioning of high pressure piping

Table 1. Effectual lengths of tube for connection creating

Diameter of high pressure tube (inch)	Effectual length (EL) mm (inch)
1/4"	12.7 (0.50)
3/8"	17.5 (0.69)
9/16"	21.3 (0.84)

Dimensioning of cone and thread on high pressure tube

Complex process of coning and thread cutting on end of tube, for creating connection is according to Figure 3, Table 2 and 3, by which coning and thread cutting is realized by tool on Figure 4.

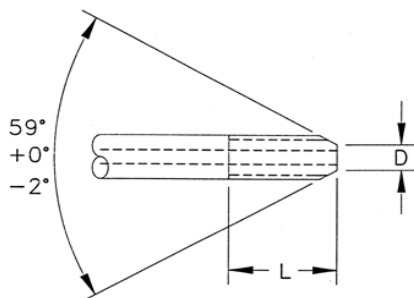


Figure 3. Cone of high pressure tube

Table 2. Cone and cutting dimensions

O.D. size mm (inch)	I.D. size mm (inch)	D (max) mm (inch)	L (max) mm (inch)	Cutting NF-LH
6.35 (1/4")	2.11 (0.083)	3.58 (0.141)	14.3 (0.562)	(1/4" - 28)
9.52 (3/8")	3.18 (0.125)	5.56 (0.219)	19.1 (0.750)	(3/8" - 24)
14.27 (9/16")	4.78 (0.188)	7.14 (0.281)	23.8 (0.938)	(9/16" - 18)

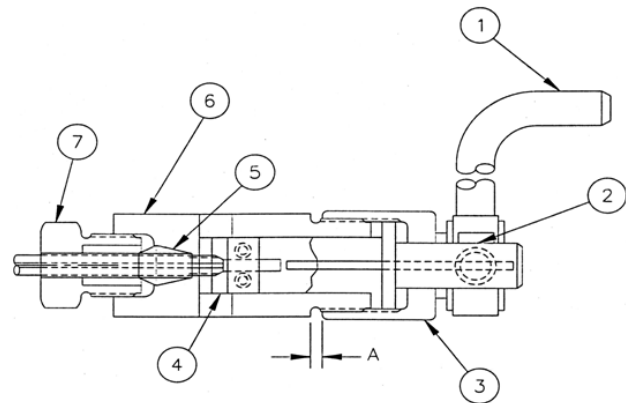


Figure 4. Coning and threading tool
1 - Cutting handpiece; 2 - Cutting support; 3 - Moving female screw; 4 - Cutting blade; 5 - Fixative insert; 6 - Coat; 7 - Closing female screw

Table 3. Sizes of high pressure conveyances

Tube size (inch)	1/4"	3/8"	9/16"
A mm (inch)	3.30 (0.13)	4.07 (0.16)	7.11 (0.28)
Cone tool (IR part)	10079556	10097418	10079663
Cutting tool (IR part)	10079697	10097434	10097442

Coning process:

- Coning tool is placed so that a lubricant could flow through lubricant blades.
- To set moving female screw and to place it according to dimensions A.
- Plug-in tube trough fixative insert to the end conection of cutting blades and tighten the closing female screw than tube was closed again.
- To rotate moving female screw counterclockwise to the back cutting tools, outside of tube and and tighten the closing female screw by spanner.
- Cutting oil is needed to deposit through the open cone tool. There is good oil with high content of Sulphur. Oil is used during cutting.
- To rotate moving female screw in the clockwise until cutting blades do no hit on the tube end.
- To rotate cutting handpiece and moving female screw together in the clockwise so that cutting blades reduced only thin chip.
- To continue in rotation of cutting handpiece until moving female screw to hit bottom of coat, then to rotate cutting handpiece by higher rotational speeds until to hit cone coil.
- To unscrew the female screw and to reverse cutting support from cone tool. To release fixative insert, to move tube on the coat. In the case if it will be wide-spread approximately on 4 inches then to permit fixative insert.

Process of thread cutting:

- To place cutting tool with suitable size on cone end of tube, to use pressure on the start of cutting and to rotate the holder counterclockwise until the length of cutting thread is not the same as size according to cone and thread table.

High pressure end tube connection - normal connection

This type of connection is for general applications, is called normal connection too, and where loading on tube is only form inside pressure reason. Process connection based on Figure 5 is following:

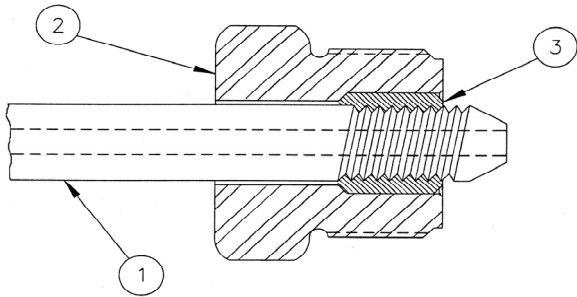


Figure 5. High pressure connection - normal

1. To shift closing female screw (2) on tube (1) according to figure, and to lubricate thread by high clean past. Plug-in thread hoop (3) on tube (1), unless one up-to two threads are visible between hoop and tube cone.
2. To lubricate outside thread of handpiece with high clean paste. To insert tube to fitting, plug-in handpiece screw and take through inch isolator.
3. To take through filling to the specified rotate moments according to table of norms of rotate moment.

High pressure end tube connection - antivibration connection

If the tube is subject to vibrations, rotating, movement and both side loading (e.g. whipping tube), must be used this type of connection. In the case threads are lubricated like it was mentioned.

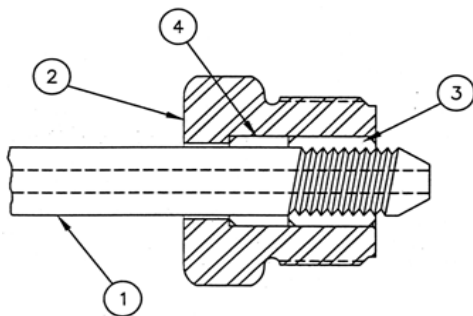


Figure 6. High pressure connection and antivibration
1 - tube; 2 - closing screw;
3 - thread hoop; 4 - fixative insert

There is important to secure suitable piping delivery and rail. Process of connection according to Figure 6, is following:

1. To shift closing screw (2) and fixative insert (4) on tube (1) and thread hoop (3), unless one up-to two thread is visible between hoop and cone tube.
2. To lubricate outside threads of closing screw with high clean paste. To insert tube to the fitting, plug-in closing screw and finalization of inch isolator.
3. Based on table of suggested moment values in this area, finalization closed screw do the standard rotate moment.

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