

I.2: Installation & commissioning of CNC water jet cutting machine (CWJCM)

Computer Numerical Control (CNC) water jet cutting machine (CWJCM) has been successfully installed and commissioned in Accelerator Components Design & Fabrication Section (ACDFS). It will be used for cutting any type of 2D profile on metal/nonmetal sheets of thickness up to 150 mm.



Photograph showing front view of CWJCM

Principles of water jet cutting:

It is a non-traditional machining process in which material is removed by mechanical erosion of material. Pressurized water is forced through diamond/ sapphire orifice which enters a carbide nozzle where partial vacuum is created. Abrasive garnet is mixed with dry compressed air and then introduced into the nozzle. Partial vacuum in the mixing chamber creating a dragging effect on the abrasives. Abrasives along with the water stream strikes the job with high velocity which results in cutting. Abrasive cutting is typically used on materials such as stainless steel, aluminium, stone, ceramics & composite materials.

Advantages of water jet cutting machine are: (i) It can cut any material, metal non-metal, hard soft, conducting, non-conducting etc. (ii) Heat affected zone is almost zero hence no distortion, no change in mechanical and metallurgical properties. (iii) Very high accuracy and good surface finish, hence in most cases the job can be used as final finish product, or in some cases very small machining is required, which is also very easy as the surface is smooth and without acquired hardness.

Movement of cutting head is controlled by a CNC controller. This gives accuracy and repeatability. The CNC controller is programmed by first drawing the part to be manufactured using Computer Aided Design (CAD), and then converting this drawing into a G code format - CNC language

Feed stock used includes water, abrasives and air of special quality. Abrasives used are clean garnet, size-80 mesh.

Properties of the water used for cutting is TDS~150, total hardness~10, electrical conductivity ~ 150 μ S/cm and pH value 6.5-8.5 and Turbidity \leq 5. Air used is dry compressed clean air at pressure of 8 bar.

Steps involved in Installation and commissioning of CWJCM:

- Repair of plasma shed which includes floor making, roof repair, electrical input power connection etc. which was completed with the help of C&S Division.
- Fitting and installation of air & water line in the plasma shed.
- Preparation of layout in the shed and placing and connecting different components of water jet cutting machine.
- Leveling of CNC gantry side bridges and then connecting cross bridge for mounting the cutting head.
- Making required electrical wiring connections in the CNC gantry, fitting of controller and connecting with operator panel/ monitor.
- Connecting electrical power with High Pressure pump of 50HP, CNC gantry and chiller.

Trial and Testing of the installed machine:

Endurance test: Machine tested for dry run for several hours continuously with 90% of maximum pressure
Results:

1. Machine did not trip.
2. Steady state oil temperature ranged between 35 to 40 °C.
3. Chiller and booster pump worked satisfactorily.

Cutting of test piece:

- SS304L: 50mm thick plate cut at a speed of 25mm/min.
- SS304: 150mm thick job cut at a speed of 5mm/min.

Results: Cut results are satisfactory.



Photograph showing a sample of cut job performed using the machine

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