

I.2: Maintenance of CNC water jet cutting machine

Computer Numerical Control (CNC) Water Jet Cutting Machine (CWJCM) was installed and commissioned in Design and Manufacturing Technology Division of the Centre in December 2015 [Vol. 29 Issue 1, 2016, p35] Figure I.2.1 is the front view of the CWJCM. The main advantage of this water jet cutting machine is that it can be used for cutting/machining large size features in two dimensional (2D) profile on any metal/ non-metal, conducting/ non-conducting, hard/ soft material like ceramics, glass, stone or even leather and papers. It is based on the principle of non-conventional cutting where the material is removed by mechanical erosion, hence the cutting forces and the heat affected zone is negligible.



Fig. I.2.1: Front view of CWJCM.

Maintenance of leakage from intensifier of CWJCM

Intensifier unit of the CWJCM is required to generate the required pressure - of the order of 4000 bars - in the cutting water jet. Top view of the intensifier unit is shown in Figure I.2.2. Changing of High Pressure (HP) seals, as shown in Figure I.2.3, of the intensifier unit is a highly skilled job, since the line pressure inside the intensifier is very high. This maintenance work was done in-house and was completed in only two working shifts. Each and every activity of the maintenance work was planned beforehand and executed as per the prepared schedule. Following is a brief explanation of the complexity in the maintenance work and how it was achieved in a short time frame.

In the HP cylinders, plunger is fitted with HP seals. HP seals wear out after ~400 hours of working and needs replacement along with “O” rings in the dumb bell. Whenever HP seals

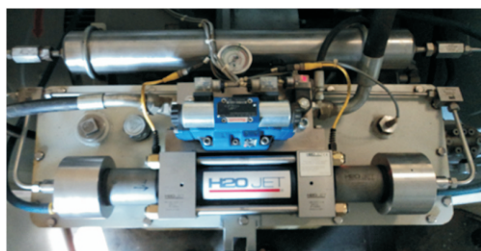


Fig. I.2.2: Top view of intensifier.

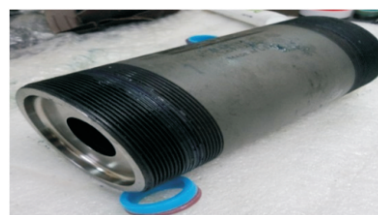


Fig. I.2.3: Photograph of the HP cylinder and seals.

wear out, leakage of water in the form of drops start trickling from the peep hole of the cylinder. This is treated as a warning signal and shutdown for its maintenance is to be planned. The sequence of various activities in the maintenance work are as follows:

i) Removal of old damaged HP seal assembly

The first step is to switch off the power supply to the machine, followed by cutting off the water supply and de-pressurisation of HP lines. Then HP gland fittings and pipe lines are loosened and removed. This allows access to sealing area, which is then cleaned thoroughly with a cotton cloth piece. Then removal of the low pressure lines and fittings is performed followed by removal of the end caps and sealing assembly by using vice and other tools. Girth grip wrench is used to remove the high pressure assembly from the intensifier. To remove extraneous dirt and dust, cleaning of the cylinder bore threads is completed, followed by inspection of the threading area. For lubrication, goop is applied in the threaded area. Finally, HP seals, are removed using a special tool kit supplied with the machine.

ii) Fitting of the new HP seal assembly

New HP seals are fitted in the HP cylinder using the supplied tool kit after carrying out its alignment with the HP cylinder. This is followed by fitting of the HP assembly with the intensifier unit, after application of goop on the threading surface. Afterwards, end caps are fitted followed by fitting of the assembly of HP, LP lines. These steps are repeated for the other side of intensifier. Then the orifice is removed from the cutting head and the machine is run in no load condition for some time. Finally, the orifice is fitted to the cutting head assembly and the machine is ready for trial and testing.

iii) Trial and testing of the machine

After replacement of HP seals, the machine was tested in dry run mode, by running it continuously at 90% of the maximum pressure. Checks for water leakage are performed on HP lines and the intensifier unit. Satisfactory results were obtained. Some important cutting jobs cut after the maintenance work are the cutting of parts of bending magnet assembly, yoke, sensor mounting rings of 2700 numbers of magnets for the Agricultural Radiation Processing Facility (ARPF) project of the Centre.

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