

CASE STUDY TO DEVELOP A STANDARD OPERATING PROCEDURE FOR LASER MACHINES FOR METAL CUTTING

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Abstract

In metal cutting industry, laser machines are very prominent now to cut the metal sheets into desired product on which further processing will take place. Not only cutting of metals, but efficiency, effectiveness and reduced wastage are also important factors. In metal cutting industries, generally due to lack of proper standard operating procedure machine breakdown hours increase and also wastage of material increases which reduces the productivity and hence results in decreased profit and increased cost to a company. so it is desirable to make a proper S O P to operate the laser machine and also give training to operators about that standard operating procedures and direct them to follow it. This will certainly result in improvements in terms of reduced wastage and reduced machine breakdown.

Key words- SOP-standard operating procedure, breakdown hours

INTRODUCTION

Laser machines are used to cut parts of desired shape and size from a metal sheet of various thicknesses like mild steel upto 25mm, stainless steel upto 15mm, aluminium upto 12mm, brass upto 10mm, copper upto 10mm. cnc laser machines perform the cutting operation by programmed instructions automatically so a skilled person is desired to operate the machine. A laser machine of Amada company has two cutting bed of size 4070*2050*100 for sheet loading - one is termed as lower bed and other as upper bed. During cutting one bed is in cutting area or one is outside on which another sheet is loaded for cutting. Bed has skids of various shapes like triangular. Laser machine has one cutting head through which laser beam is generated and is directed to sheet for cutting. Cutting head consists of several parts like a cutting lens which converges the laser beam, a protection glass, a nozzle holder and the cutting nozzle at the bottom. Cutting nozzle hole diameter can be of different sizes according to thickness of sheet to be cut. For example 15mm mild steel sheet can be cut by a nozzle of 4mm diameter and 6-10mm mild steel sheet can be cut by nozzle of diameter 1mm. Cutting head is very critical part of laser machine. it moves according to program or shape of part to be cut. Bellows are provided for motion

of cutting head in x axis and y axis. There are mirrors to reflect the beam and to take the beam at bright path. so in all, high skill is required to operate the machine. Sometimes a person has skill to operate the machine and control the parameters for good cutting but due to lack of a standard procedure he might show carelessness. so it is necessary to develop a standard operating procedure to operate the laser machines in industry.

DESCRIPTION

After detailed analysis of laser machine for metal cutting a basic framework was made for the operating procedure in order to reduce the machine breakdown hours and reduce wastage of material. This operating procedure should be followed by operators and a daily check sheet is provided for this sop and as they follow line wise procedure they have to mark the section and after marking and following the whole procedure, operator have to sign at the bottom. This shows that the operator had followed the standard operating procedure. The procedure and description of each line is given below.

1. Cleaning of machine properly by air pressure to remove the dust.

Machine should be cleaned at the end and starting of shift. By cleaning of machine properly machine breakdown hour reduces and life of machine increases.

2. Cleaning the scarp tray and dust collector.

Scrap tray is at the bottom of machine in which cut material or scarp is collected. it should be cleaned every hour or every alternate hour so that conveyor by which bed is moving in forward and backward direction can work properly without any damage. Dust collector is a part of laser machine which sucks the dust while cutting metal in order to clean the environment. so dust collector and its filters should be cleaned regularly in order to keep the environment of the industry clean.

3. Pressure of pre mixed gas (60-85% helium, 13-15% nitrogen, 1-9% carbon dioxide) cylinder is to be kept 1.75bar-2 bar.

4. First switch on the oscillator, then machine main switch.

Oscillator is the main component of laser by which laser beam is generated. It takes time to generate laser beam that is why first switch on the oscillator after that switch on the main machine switch which consists of control panel and purge unit.

5. Check the chiller water temperature and level of water in chiller.

Chiller water is used for cooling of various components of machine. Minimum temperature of chiller water should be kept at 25deg Celsius.

6. Check the motion of bellows in all the three axis.

Bellows are compressed and expanded according to the program by which head of machine moves. Bellows are provided in both x axis and y axis to provide optical path and cover for laser beam. Bellows should be fireproof in case if beam deflects than it should not catch fire. So bellows motion should be checked.

7. Ensure that emergency switch is working properly

In all machines an emergency switch is provided to stop the machine instantly in case of an emergency. So it should be in good working conditions. If it is not working than immediately report to the maintenance person.

8. Switch on the laser shutter.

When the shutter is open, the beam travels without any disturbance and cut the material. Closing of shutter blocks the beam. During closure the energy of beam is diverted into an integral light absorbing baffle that is a heat sink. There is thus no need to power down the laser. The beam is modified only during the switching transitions that typically last hundreds of microseconds.

9. Clean the nozzle by some abrasive paper to remove the spatter and molten material from the tip.

10. Clean the sensor which sense the metal sheet's uniformity and gives alarm if discontinuity is present,

11. Clean the cutting lens and protection glass by acetone and tissue paper.

Cutting lens should be cleaned regularly. It focuses the beam. So ensure that there should be no spatter on lens. Also clean the protection glass which is placed below the lens to protect the lens. Sometimes beam is reflected back after striking some material so in that case only protection glass will get damaged and lens will be safe. Both should be cleaned by acetone and tissue paper.

12. Check the nozzle centering and if beam is not in centre then adjust the centering of beam.

Laser beam must be in centre of nozzle. If it is not in centre than one side cutting is good but one side cutting is poor. This results in need of rework. So check the nozzle centering and adjust the centering by tightening and loosening of screws placed in left and right side of cutting head.

13. Ensure that O2 gas pressure is at 8-10 bar.

14. Ensure that N2 gas pressure is at 4-6 bar.

15. Main air pressure should be 5-10 bar and make sure that air is not leaking from pipe line.

16. Check that there is no molten metal placed on the skid of laser bed on which sheet will be loaded for cutting.

Ensure that there is no molten material or scrap present on skid of bed on which sheet will be loaded for cutting. If there is some material present below sheet then it creates problem in cutting because when beam strikes and pierce the sheet then new molten material does not get space to flow down and it accumulates there resulting in poor cutting.

17. There should not be any unexpected or unusual noise coming from machine.

18. Always check the dimensions of sheet loaded (length, breadth and thickness) on the bed of machine with the help of micro meter to ensure required thickness to be cut.

19. Always change the shuttle or bed carefully.

If there are some people working around the machine then always change the shuttle manually in order to prevent accidents.

20. The cutting parameters should match with the work instructions for required sheet size.

21. Always check the quality of first part.

After cutting the first part check the quality of part like dimensions and surface finish of cut etc. If it is good than run the machine and if it is not good then change the parameters and program.

22. Check the quality of cut.

RESULTS

After developing the standard operating procedure and after giving the training to laser machine operators about this standard operating procedure results are observed and study is conducted to see the results of this standard operating procedure. The results are as follows:

1. Machine break down hours are reduced which increases the overall equipment efficiency.
2. Wastage of material reduced after following this SOP.
3. Productivity increases.
4. cost of laser machine consumables like nozzle, protection glass and lens decreases after following this SOP.

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