LASER MACHINING

PRODUCT REALISATION TECHNOLOGY PRACTICUM (IC-141P)

CENTRAL WORKSHOP

INDIAN INSTIUTE OF TECHNOLOGY MANDI

LASER MACHINING

1. Introduction

Laser beam machining (LBM) is a non-conventional machining process, a form of machining, in which a highly coherent, collimated, monochromatic, and high-frequency laser beam is directed on the surface of the workpiece. This process uses thermal energy to remove material from metallic or non-metallic surfaces. When laser beam having high frequency falls on the material surface then heating, melting and vaporizing of the material take place due to the impinging of photons. In this process, the melting of the material takes place in a highly controlled manner when a laser beam having high dense energy is focussed on the material surface. The process does not require vacuum. Several types of laser used are:

- CO_2 laser
- Nd: YAG (neodymium: yttrium-aluminium-garnet)
- Nd: Glass
- Excimer

2. Laser Beam Machining Set up

The LBM set up consists of laser medium (solid/gas) enclosed in an elliptical reflecting cavity. A flashlight, enclosed in the elliptical reflecting cavity, is used to pump the laser medium. The laser beam is focused on the workpiece. The trajectory of the laser beam is controlled by controlling the movement of the workpiece through computer numerical control (CNC). Upon interaction of the laser beam with the workpiece surface, the photons of the laser beam are absorbed on the surface of the laser beam. The absorption of the photons causes the temperature of the workpiece to rise. Upon sufficient heating, the workpiece melts and evaporates.

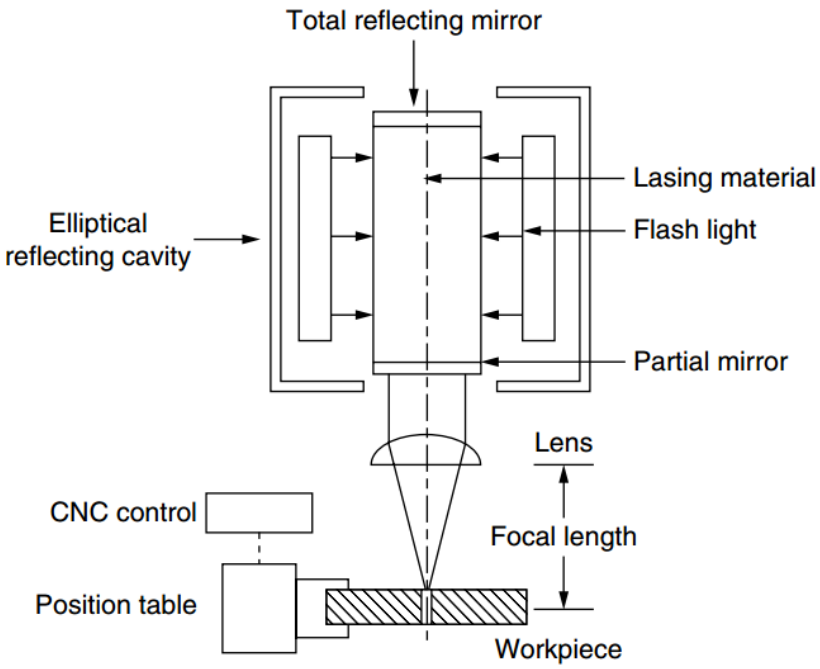


Fig. 1. Different parts of LBM machine

3. Applications of LBM

Lasers can be used for welding, cladding, marking, surface treatment, drilling, and cutting among other manufacturing processes. It is used in the automobile, shipbuilding, aerospace, steel, electronics, and medical industries for precision machining of complex parts.

Laser welding is advantageous in that it can weld at speeds of up to 100 mm/s as well as the ability to weld dissimilar metals. Laser cladding is used to coat cheap or weak parts with harder material in order to improve surface quality. Drilling and cutting with lasers are advantageous in that there is little to no wear on the cutting tool as there is no contact to cause damage.

4. Advantages of LBM

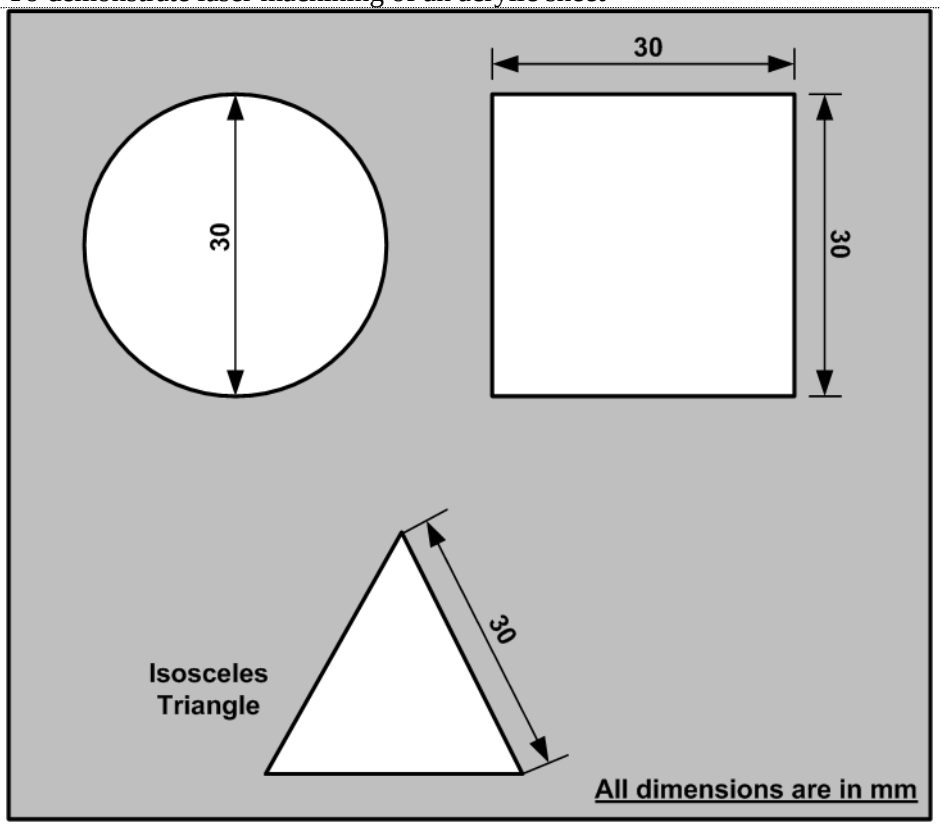
- Since the rays of a laser beam are monochromatic and parallel (i.e. zero etendue) it can be focused to a small diameter and can produce as much as 100 MW of power for a square millimeter of area.
- Laser beam machining has the ability to engrave or cut nearly all materials, where traditional cutting methods may fall short.
- There are several types of lasers, and each has different uses.
- The cost of maintaining lasers is moderately low due to the low rate of wear and tear, as there is no physical contact between the tool and the workpiece.

- The machining provided by laser beams is high precision, and most of these processes do not require additional finishing.
- Laser beams can be paired with gases to help the cutting process be more efficient, help minimize oxidization of surfaces, and/or keep the workpiece surface free from melted or vaporized material.

5. Limitations of LBM

- The initial cost of acquiring a laser beam is moderately high. There are many accessories that aid in the machining process, and as most of these accessories are as important as the laser beam itself the start-up cost of machining is raised further.
- Handling and maintaining the machining requires highly trained individuals. Operating the laser beam is comparatively technical, and services from an expert may be required.
- Laser beams are not designed to produce mass metal processes.
- Laser beam machining consumes a lot of energy.
- Deep cuts are difficult with workpieces with high melting points and usually cause a taper.

Laser Machining

Aim	To demonstrate laser machining of an acrylic sheet
Drawing	
Material required	Acrylic sheet 100 × 100 mm
Equipment and tools required	• Laser machining equipment • Desktop computer (to program cutting trajectory)
Sequence of operations	• Setting the laser machine parameter • Setting the reference point • Loading the acrylic sheet on the cutting platform
Procedure	• Start the water chillier. • Turn on the laser of power machine. • Put the workpiece in position, and fix up the focal length. • Start the machine cycle
Precautions	• Do not try to start the machine without trained operator. • The machine does not start without the cooling system and proper grounding. • Ensure the water shilling is running