LASER BEAM WELDING

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WHAT IS LASER BEAM?

- The term laser is an acronym for Light Amplification by Stimulated Emission of Radiation.
- A laser beam is a powerful, narrow, monochromatic and directional beam of electromagnetic radiation.
- Often, these beams are within the visible spectrum of light.
- A laser device excites the atoms in a losing medium. The electrons of these atoms move to a higher orbit, then release photons, creating a laser beam.

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Properties of Laser Beam

- A LASER beam is highly intense in nature.
- LASER beam is having strictly monochromatic.
- LASER light is highly powerful and capable of propagating over long distance & are not easily absorbed by water.
- LASER beam is also said to be highly directional.
- This beam is coherent with the wave train in phase with each other.

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Types of laser Beam

Types of lasers include gas, liquid and solid.

1. Gas lasers excite the electrons in gases, such as helium, neon, carbon dioxide and nitrogen.
2. Liquid lasers include the dye laser, which uses organic dye molecules in liquid form to produce a wavelength of radiation that can be tuned.
3. Solid lasers include the ruby laser, which uses a precious stone to produce a beam of red light.

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Laser beam welding process

- In general cases heat is required to fuse the metals for any types of welding.
- In laser beam welding process the heat is obtained from the application of a concentrated coherent light beam which is striking upon the weld metal and melts the metal, such this weld joint is obtained, this welding process is called laser welding.

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Principle of LBW

- A laser beam is produced inside of the Ruby Crystal. The Ruby Crystal is made of aluminium oxide with chromium dispersed throughout it. Which is forming about 1/2000 of crystal, this less than natural ruby. Silver coated mirrors are fitted internally in both sides of the crystal. The one side of mirror has a tiny hole, a beam comes out through this hole.
- A flash tube is placed around the Ruby Crystal, which is filled with xenon inert gas. The flash is specially designed such as which is made flash rate about thousands flashes per seconds.

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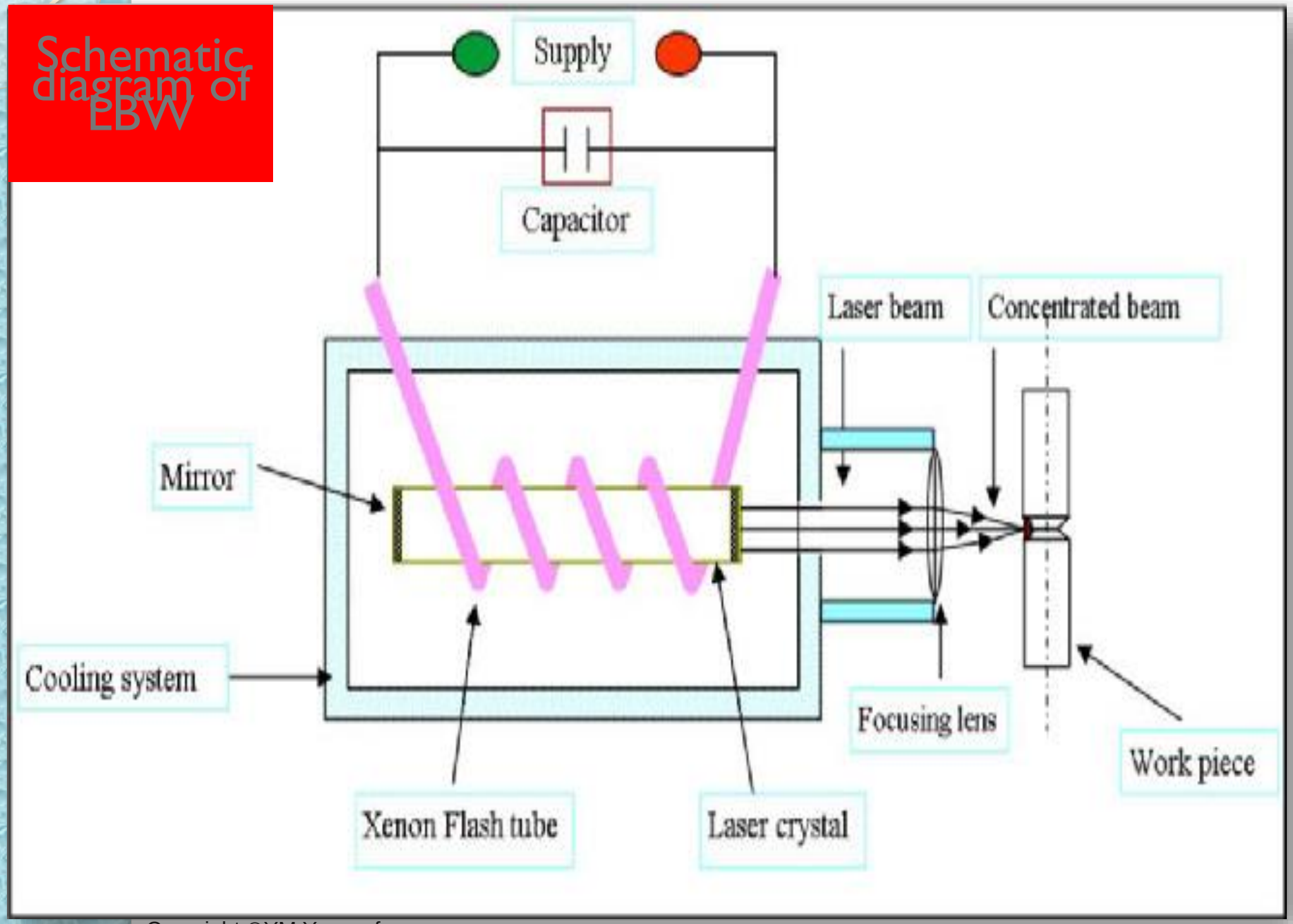
Schematic diagram of LBW



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Principle of LBW

- The electrical energy is converted into light energy, this is worked by flash tube.
- The capacitor is provided for storage the electrical energy and supply the high voltage to flash tube for performed appropriately.
- The electrical energy discharged from capacitor and xenon transforms the high energy into white flash light rate of 1/1000 per second.

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Principle of LBW

- The chromium atoms of Ruby Crystals are excited and pumped into high energy. Due to heat generating some of this energy is lost. But some light energy reflected mirror to mirror and again chromium atoms are excited until loss of their extra energy simultaneously to form a narrow beam of coherent light. This comes out through the one end tiny hole of crystal's mirror.
- This narrow beam is focused by an optical focusing lens to produce a small intense laser beam on the workpiece.

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MECHANICS OF LBW

- Laser beam welding (LBW) is a welding process which produces coalescence of materials with the heat obtained from the application of a concentrate coherent light beam impinging upon the surfaces to be joined.
- It is achieved through following phases:

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MECHANICS OF LBW

1. Interaction of laser beam with workpiece material.
2. Heat conduction and temperature rise.
3. Melting vaporization and joining : When using the laser beam for welding, the electromagnetic radiation impinges on the surface of the base metal with such a concentration of energy that the temperature of the surface is melted vapor and melts of the metal below are formed.

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Parameters of LBW

1. Medium — Normal atmosphere
2. Tool — High power laser beam
3. Critical parameters — Beam intensity, beam diameter, and melting temperature.
4. Materials application — All materials

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LBW Process Advantages:

- Works with high alloy metals without difficulty
- Can be used in open air
- Can be transmitted over long distances with a minimal loss of power
- Narrow heat affected zone (HAZ)
- Low total thermal input
- Welds dissimilar metals
- No filler metals necessary

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Advantages contd.

- No secondary finishing is necessary
- Extremely accurate
- Produces deep and narrow welds
- Low distortion in welds
- High quality welds
- Can weld small, thin components
- No direct contact with materials

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LIMITATIONS

- Rapid cooling rate may cause cracking in some metals
- High capital cost for equipment
- Optical surfaces of the laser are easily damaged
- High maintenance costs
- The maximum joint thickness that can be welded by laser beam is somewhat limited. Thus weld penetrations of larger than 19 mms are difficult to weld.

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