Course Objectives:

– To familiarize you with the basics of laser hazards and their control.
– Following this training you are encouraged to talk to your supervisor or safety officer.
– Also, if you work with lasers or come into contact with lasers, talk with the operators and review manufacturers information.
Laser Safety Awareness

Introduction: Laser Safety

• Welcome
  – Laser applications, hazards, controls and other safety practices.
  – Estimated Length: 15 minutes
  – Audience: Foremen, Supervisors, Workers
  – References: 29 CFR 1926.54
Laser Safety Awareness

What Does Laser Stand For?

• Light
• Amplification by
• Stimulated
• Emission of
• Radiation
Laser Safety Awareness

Laser Applications
• Lasers are used in:
  – **Scientific research**
  – **Chemistry**
  – **Medicine** (eye and other surgeries)
  – **Industry** (cutting and welding)
  – **Commercial** (supermarket checkout scanners)
  – **Military** (angles and distances)
  – **Construction** (angles, boundaries and elevations)
Laser Basics

- Laser light is different than ordinary light.
- Laser light is:
  - Monochromatic
  - Directional
  - Coherent
- Laser light can be a hazard because it can focus a high-energy light beam onto a small area.
Characteristics

- **Laser Design Elements**
  - *Lasing Medium* (gas, liquid, solid, or semiconductor)
  - *Excitation Mechanism* (power supply, flashlamp, energy from another laser.
  - *Feedback Mechanism* (reflect light - mirrors)
  - *Output Mechanism* (allows light to leave the lasing medium)
Laser Types

• Types of lasers:
• Lasing Medium
  • Gas, liquid, solid state, semiconductor, or dye
    – Duration of laser light emission:
      • Continuous Wave
      • Pulsed
      • Q-switched
Laser Hazards

- The dangers of lasers can be divided into four major categories:
- (1) Eye hazards (retinal or corneal burns)
- (2) Skin hazards (burns)
- (3) Electrical hazards from high voltage equipment
- (4) Fire hazards
Laser Damage

- Causes:
  - Thermal or heating effects caused by the intense laser beam power.
  - Acoustical effects caused by the minute shockwaves in tissue which causes the tissues to tear.
  - Photochemical effects caused by the laser light making changes in the chemistry of the cells.
Eye Hazards

• Characteristics:
  • The eye is extremely sensitive to laser light
    – Laser eye injury can happen quickly and painlessly
    – Magnifying glass effect = retinal burns
Other Hazards

- Characteristics:
  - Injury to the skin because of burns, especially with higher power lasers.
  - Electric shock and electrocution: Most medium and high power lasers operate on 220 or even higher AC voltages.
  - High power laser beams directed onto combustible and flammable materials can cause ignition and fires.
Laser Hazard Classification

• Several agencies and organizations classify lasers.
  – ANSI = American National Standards Institute
  – Federal Laser Product Performance Standard
  – Lasers have different hazard classes based on:
    • Wavelength
    • Power
    • Potential biological effects
Hazards

ANSI Hazard Classifications

- **Class I**: < 1 microWatt, No viewing hazard
- **Class II**: <1 milliWatts, no eyewear required
- **Class III**: 1 - 500 milliWatts, moderate eye hazard
- **Class IV**: >500 milliWatts; skin, eye and fire hazard
Hazard Control

Laser Hazard Control

• Controls:
  – Engineering (Installed by manufacturer before sale)
  – Administrative and Work Practice
  – Personal Protective Equipment (Gloves, eye protection)
Hazard Control

**Engineering Controls**
- Primary hazard control method
- Design features or devices:
  - Beam housings and shielding
    - Beam shutters
    - Attenuators
    - Remote firing controls
    - Emergency shut off
    - Grounding
- See ANSI specs (Z136.1 - 1993)
Hazard Control

Administrative/Work Practice

• Procedures and information provided to personnel
  – Safety training for operators
  – Standard operating procedures
  – Authorized persons using, maintaining, evaluating the hazard
  – Warning signs and labels
  – Medical surveillance program
Personal Protective Equipment

- Eye protection:
  - Know type of laser and the specific type of eye protection which will filter, absorb and/or reflect the specific wavelength of laser light.
  - Check the manufacturers product information to determine the specific optical density or shade of eye protection.
  - Clothing and gloves should be available and worn if the laser presents a heat or thermal hazard.
Standards and Guidelines

• Workplace safety regulations:
  – OSHA regulates lasers per ANSI standard.
    • Classification of lasers
    • Hazard evaluation of lasers
    • Controls for laser exposures
    • Duties of Laser Safety Officer
    • Non-beam hazards
OSHA Standards - Construction

- Qualifications and operator training
- Required eye protection
- Work practice controls (beam shutters or caps, beam direction)
- Signs and labels
- Laser beam shall not be directed at employees
- Restricted use in adverse weather conditions
- Output labeling
- Specified exposure levels
Conclusion

Safe Laser Work Practices
• Wear protective eyewear.
• Use minimum power for job.
• Reduce laser output with shutter attenuators, if possible.
• Terminate laser beam with beam trap.
• Use diffuse reflective screens, remote viewing systems during alignments, if possible.
• Remove unnecessary objects and personnel from vicinity of laser and beam.
• Keep beam path away from eye level.
• Do Not put any part of your body in the beam path.
Conclusion

Summary

• Lasers:
  – Are an important tool
  – Use focused light
  – Can damage the unprotected eyes and skin

• Only trained and qualified operators are permitted to operate laser equipment using engineering, work practice and personal protective equipment controls.

• Follow company and manufacturer’s safe operating requirements!