



## Laser Certification Review

### Expanded Study Guide – Module I

Certified Laser Hair Removal Specialist  
National Council on Laser Certifications  
[www.LaserCertification.org](http://www.LaserCertification.org)

*Not All of these Slides are Narrated, but many are.*

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## Handout Material

The pdf document that you should have printed from the link on the first slide is a condensed version of this review. It contains the Review Slides with the bullet points. These are what you should concentrate on to “cram” for the exam itself.

This expanded version offers some additional narrated slides from our Computer Based Learning programs just for clarification of content.

## Review Format

**This “Expanded” Laser Certification review is NOT intended to be a primary teaching program.**

It is intended to review the key concepts covered in the NCLC Laser Certification examinations.

Those not having previous training in these areas are referred to outside courses & home study programs.

See [www.LaserTraining.org](http://www.LaserTraining.org)

## Review Format

Following each numbered “Review” slide with the “bullet list” of key points that will appear on the test, this expanded review will elaborate with a few slides from the teaching program to clarify those points.

Concentrate on each numbered “Review” slide with the bullet lists for the exam – that best reflects questions on the exam. There may be content in those expanded slides that are NOT on the exam.

## Narration and “Browsing”

None of the numbered “Review” slides are narrated, but most of the following expanded slides are.

Remember that the purpose of this program is NOT as a primary teaching course, but as an expanded review of the subject matter. With that in mind, if you’re listening to narrated slides where you’re already very familiar with content, you might want to browse through those without hearing the full narration for the sake of time.

## Review Format

Each numbered “Review” slide in this review will relate to the “Content Area” classification of a specific question on the exam, but will not be specific about the question asked, although the answer to a question will be on that slide.

Each slide will note the category of the content area covered, and it is possible that more than one question is asked within that slides content area.

## Laser Certifications



These are voluntary Professional Credentials that provide recognition to the holder of a high level of academic knowledge in that area of Certification.

Some States may require such a National Certification as part of that State's licensing process for various levels of providers.  
(Florida and Texas as of July 2015)



**The Certified Laser Hair Removal Specialist** certification is offered jointly by the NCLC & IALA (International Aesthetic & Laser Association)

See [www.LaserCertification.org](http://www.LaserCertification.org) for complete certification requirements. Download the Handbook.

## Written Examination

- 100 (CLHRS) Multiple Choice Questions  
- 1 Correct (Best) Answer
- 70% Required for Passing  
- can miss up to 30 Questions
- 3.0 Hours allotted for completion
- Closed Book. "Controlled" breaks allowed.
- A 25 question "incremental" test may be taken at a later date (or at the same time) to add the Certified Aesthetic Laser Operator designation.

## Certification Status

- Full Certification requires successful completion of the proctored examination, plus the experience and background/case requirements.
- Course participants may submit the additional materials at a later time, and have up to 5 years to complete the experience/case requirement.
- Those passing the exam but still awaiting completion of other requirements are designated a "Certification Candidate" and will receive the appropriate Certificate.

## Exam Content Areas

The examination tests for a knowledge of medical laser and energy concepts, and safety.

Specific clinical laser/IPL concepts will be tested.

## Exam Content Areas

The areas of testing for various NCLC Laser Certifications basically boil down to the areas of:

- (1) Laser Concepts
- (2) Tissue Effects, and
- (3) Safety

- as defined by the American Society for Laser Medicine & Surgery, and ANSI in their recommendations.

## Exam Content Areas

For the CLHRS Credentials:

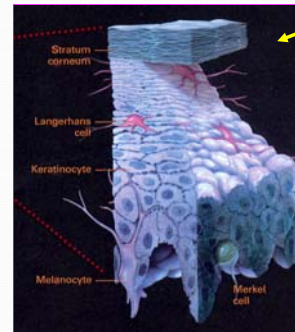
Safety –	40%	40 Q
Laser & Energy Concepts –	17%	17 Q
Tissue Interactions –	16%	16 Q
Aesthetic Questions	6%	6 Q
Anatomy & Physiology	21%	21 Q

## 1. Anatomy & Physiology

### Skin Anatomy

- Epidermis – outer layer of skin
  - Stratum Corneum – the outermost layer of the epidermis
  - Melanin – contained within the epidermis and is a major absorber of laser light – competing with the hair follicle
  - Preventing excessive heating of the epidermis (mostly because of melanin absorption) is a critical consideration in all dermatological skin procedures including laser hair removal.
  - “Renews” itself every 3-5 weeks with migrations of new cells.

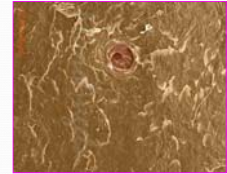
## EPIDERMIS



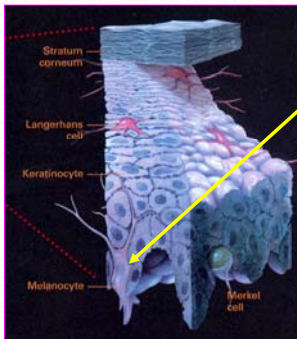
### Stratum Corneum

15-40 Layers of “flattened” cells that have migrated from below – our outer skin is renewed about once a month to two months.

This is our waterproof protective covering.



## EPIDERMIS



### Melanocyte

These cells produce the melanin pigment that give our skin color.

Melanin is one of the major absorbers of laser light, and is called a “target chromophore”

Melanin is an intended target for removal of pigmented lesions, but an unwanted obstacle in treating vascular lesions.

## EPIDERMIS



### Melanocytes

Located at the epidermal-dermal junction – they are superficial compared to hair follicles and blood vessels.

Dark skin contains many melanocytes as shown here.

[www.LaserTraining.org](http://www.LaserTraining.org)

## 2. Anatomy & Physiology

### Skin Anatomy

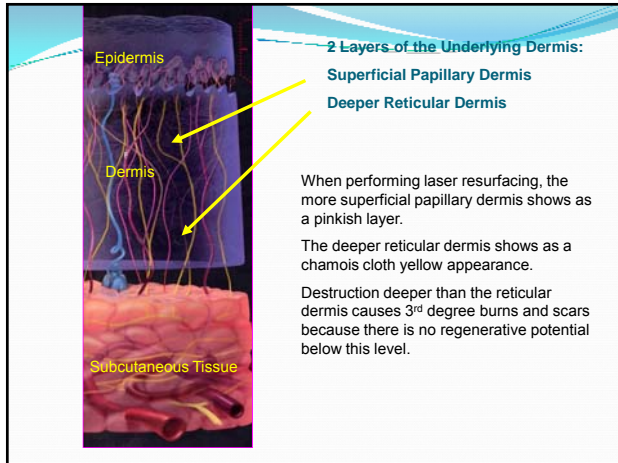
- Dermis – deeper middle layer of skin
  - 2 Layers to the Dermis:
    - Papillary Dermis – the first layer of the dermis – looks pink when doing ablative resurfacing
    - Reticular Dermis – the deepest layer of the dermis – has a yellowish “chamois cloth” appearance when doing ablative resurfacing. Never “lase” deeper than this level.

## 3. Anatomy & Physiology

### Skin Anatomy

- Dermal/Subcutaneous Fat Interface
  - below Dermis
    - separates the reticular dermis from underlying subcutaneous tissues. Ablating past this level in ablative resurfacing, or lethally heating it in laser hair removal or other procedures, causes a third degree burn and possible keloid scars since the dermis cannot regenerate.

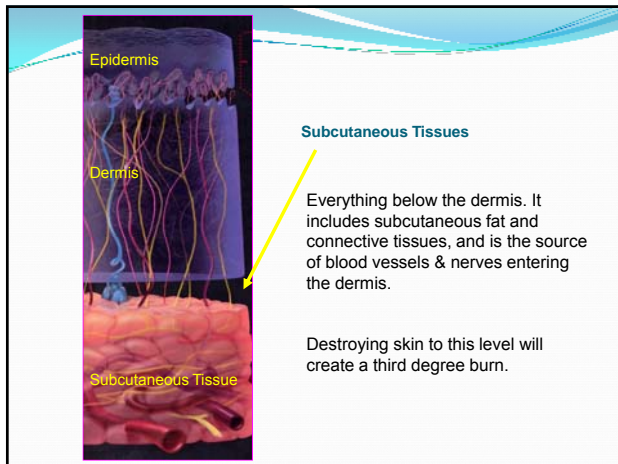




## 4. Anatomy & Physiology

### Skin Anatomy

- Subcutaneous Tissues
  - Everything below the dermis. Includes subcutaneous fat and is the source of blood vessels & nerves entering the dermis. Destroying skin to this level will create a third degree burn and possible Keloid scars.



## 5. Anatomy & Physiology

### Skin Color

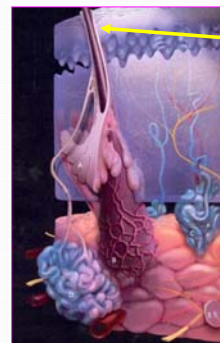
- The primary determinant is skin melanization
- Skin vascularity and thickness also serve to determine general skin color

## 6. Anatomy & Physiology

### Skin & Hair Biology - HAIR TYPES

- Terminal Hairs – Course hairs found on the scalp, eyebrows, armpits & bikini area. (this is the usual target for laser hair removal).
- Velus Hairs – fine “peach-fuzz” hair covering most of the body
- Hair growth from either arises within the hair follicle.

## DERMIS & HAIR FOLLICLE

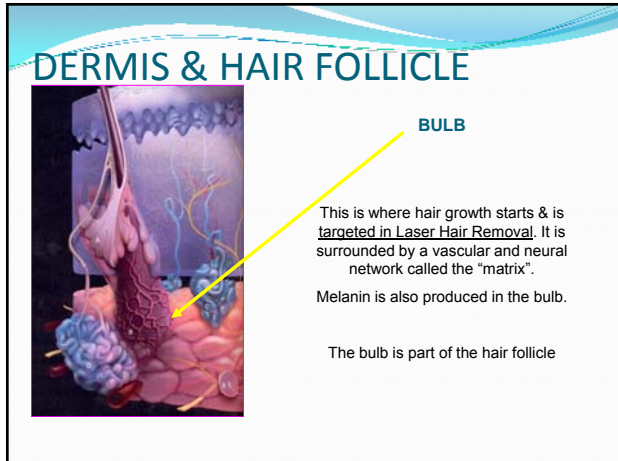


HAIR FOLLICLE

**Velus Hairs:** This is the “peach fuzz” type of fine hair throughout our body. It can be transformed into coarser hairs. Requires shorter pulse widths for laser hair removal.

**Terminal Hairs:** These are the coarser, thicker hairs on our scalps, armpits, etc. Requires longer pulse widths.

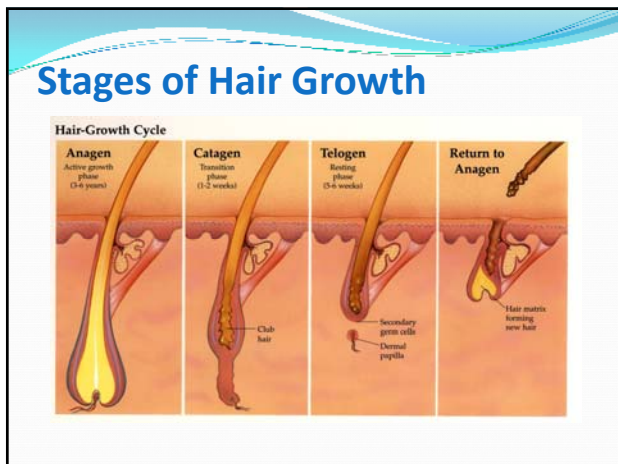
Hair & Skin color will be a major factor in Laser Hair Removal, when that topic is covered.



## 7. Anatomy & Physiology

Skin & Hair Biology  
Hair Growth Phases

- Anagen – Growth phase where it is most susceptible to laser treatments
- Catagen – Regression/atrophy phase where nourishment is cut off
- Telogen – Dormant phase where the follicle falls out (sheds at end of growth cycle). The hair bulb can survive laser treatments in this phase.



## 8. Anatomy & Physiology

Skin & Hair Biology  
Hair Growth Phases

- Different body areas have differing time periods for growing & dormant stages. These vary from 2-6 years (growth cycle) for the scalp, to 3-4 months in the bikini or axillary (armpits) area. Most are 4-12 months.

## 9. Anatomy & Physiology

Skin & Hair Biology  
Hair Growth Phases

- Not all of the hairs in any given area are in the same phase at the same time. That is why multiple laser treatments are required. If they were all in the same phase, then we would completely shed hair in that area at certain intervals.

## Hair Growth Phases

Not all hairs in any given area are in the same phase at the same time, which is why multiple treatments are required.

If they were all in the same phase then we'd routinely shed all of our hair in that area.

## Hair Growth Phases

- Different body areas have different periods for growth & dormancy
- Most areas have growth cycles that are 4-12 months
- Range from 2-6 years for the scalp, to 3-4 months for bikini & armpit.

## Treatment Schedule

- For a simplistic approach, many centers simply schedule their patients for treatment every 6-8 weeks, even though this does not necessarily coincide with new growth cycles.
- Scheduling according to the body area treated is more efficient, but more complex administratively.

## 10. Anatomy & Physiology

Fitzpatrick Skin Types I-VI

- The higher the number, generally the darker the skin, but is primarily an indication of how one burns in the sun (sunlight sensitivity). The darker the skin, the harder it is to treat by laser without burning.
- This scale is the primary determinant of choice of laser type and settings for laser hair removal
- Darker skin types generally require longer wavelengths (and pulse widths) to prevent skin burning (i.e. diode or Nd:Yag lasers), and type IV skin is where this transition starts.

## 11. Anatomy & Physiology

Fitzpatrick Skin Types I-VI

- I – Fair Transparent Skin that always burns in the sun – never tans.
- II – Fair Skin that always burns, but sometimes tans with difficulty
- III – Fair to light olive Skin that sometimes burns mildly, and tans slowly

## 11. Anatomy & Physiology

Fitzpatrick Skin Types I-VI

- IV – Olive to light brown Skin that rarely burns and tans easily
- V – Dark brown Skin that very rarely burns and always tans
- VI – Black Skin that never burns and always tans (hardest to treat because of melanin)

## Skin Color & Types

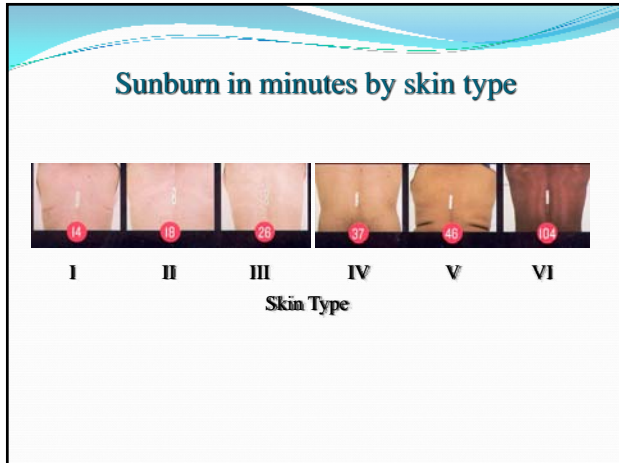


### General Rule

The darker the skin, the longer the laser wavelength required to prevent skin damage.



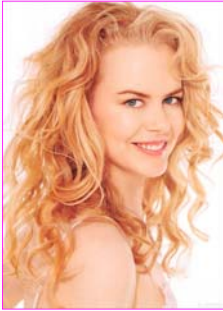




## Type I

Never Tans  
Always Burns


Any wavelength works, provided that they're not sun sensitive



Skin Type Photos  
Courtesy Radiancey

## Type II

Occasionally Tans  
Usually Burns



## Type III

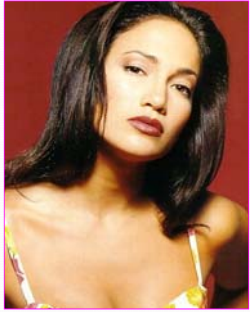
Tans on average  
Sometimes Burns



## Type IV

Usually Tans  
Rarely Burns


At Type IV, start think 810nm diodes or longer wavelengths. It's possible to use the shorter 755nm Alexandrite, but with great care and cautious testing.



## Type V

Mostly Tans  
Almost Never Burns

"Maybe" an 810nm Diode with care, but preferably a 1064nm Nd:Yag.



## Type VI

Never Burns



1064nm Nd:Yag  
Don't even THINK about an IPL

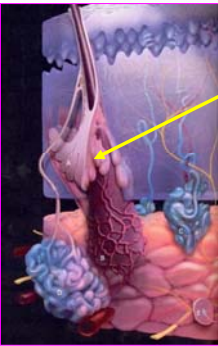
## 12. Anatomy & Physiology

### Skin Anatomy

Sebaceous Glands:

Glands in the skin responsible for production of oils for lubrication of the skin and help retain fluids. They are also the site of the P. Acne bacteria responsible for Acne.

## Sebaceous Glands



**SEBACEOUS GLANDS (OIL GLANDS)**

Help lubricate the skin and retain fluid.  
Site for bacterial infections resulting in ACNE, and the target of ACNE laser treatments.

## 13. Anatomy & Physiology

### Hair Shaft & Follicle Anatomy

The hair shaft has 3 Regions:

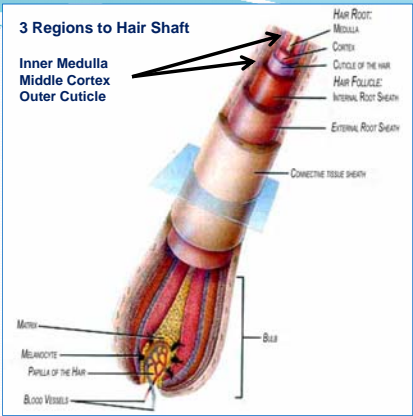
- Inner Medulla
- Middle Cortex (contains Melanin)
- Outer Cuticle

There are two sheaths to the Hair Follicle:

- Inner root sheath
- Outer root sheath

Hair shaft is comprised of dead Keratin Strands.

### 3 Regions to Hair Shaft

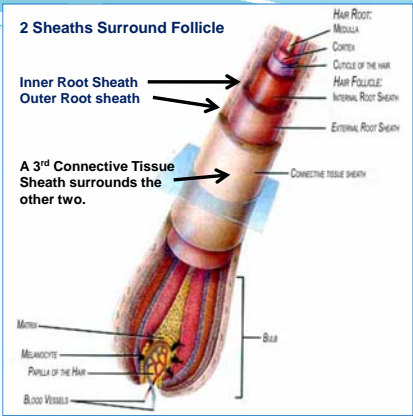


**Inner Medulla**  
**Middle Cortex**  
**Outer Cuticle**

**HAIR ROOT:** Medulla, Cortex  
**CUTICLE OF THE HAIR**  
**HAIR FOLLICLE:** Internal Root Sheath, External Root Sheath  
**CONNECTIVE TISSUE SHEATH**

**Matrix**  
**MELANOCYTE**  
**PAPILLA OF THE HAIR**  
**BLOOD VESSELS**  
**BALL**

### 2 Sheaths Surround Follicle



**Inner Root Sheath**  
**Outer Root sheath**


**A 3<sup>rd</sup> Connective Tissue Sheath surrounds the other two.**

**HAIR ROOT:** Medulla, Cortex  
**CUTICLE OF THE HAIR**  
**HAIR FOLLICLE:** Internal Root Sheath, External Root Sheath  
**CONNECTIVE TISSUE SHEATH**

**Matrix**  
**MELANOCYTE**  
**PAPILLA OF THE HAIR**  
**BLOOD VESSELS**  
**BALL**



## HAIR SHAFT



- Grows from the “bottom – up” from the bulb as a helical protein of KERATIN
- 4 helical protein twists for a PROTOFIBRIL
- 11 protofibrils twist together as a MICROFIBRIL
- microfibrils twist together as a MACROFIBRIL
- macrofibrils form the dead HAIR SHAFT

## 14. Laser & Energy Concepts

LASER ACRONYM

**L**IGHT  
**A**MPLIFICATION, by the  
**S**TIMULATED  
**E**MISSION of  
**R**ADIATION

## 15. Laser & Energy Concepts

Wavelength Identification  
 (several (not all) wavelength questions asked)

CO <sub>2</sub> – 10600nm	Er:Yag – 2940nm	Ho:Yag – 2100nm
Nd:Yag (harmonic) 1380nm	Nd:Yag – 1064nm	Krypton – 647, 568, 531
Diodes – 810 nm is typical, but available ~ 530-1500nm	Ruby – 694nm	Copper Bromide 577,510
Alexandrite – 755nm	Gold Vapor – 632nm	Pulsed Dye, 578-600nm (Vascular)
Helium Neon (HeNe) 632	CW Dye (PDT) 630	Pulsed Dye, 504nm (Lithotripsy)
KTP (& KDP) – 532nm	ArFl Excimer 193nm	
Argon – 488, 515nm	XeCl Excimer 308nm	

Also know visible color bands to make it easier to remember:  
 Blue ~ 488nm, Green ~ 504-532nm, Yellow ~ 568-585nm, Orange ~ 585-595nm, Red ~ 632-694nm

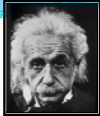
## 16. Laser & Energy Concepts

HISTORY


- Albert Einstein – theory of stimulated emission based on photovoltaic cells
- Schawlow / Townes – theoretical paper on “Optical Masers” (a laser)
- Ted Maiman – First Laser – Ruby, 1960
- Dr Leon Goldman – father of lasers in medicine & co-founder of the ASLMS

## Laser History


**Einstein** – Theory of Stimulated Emission of Radiation. c1917




**Arththur Schawlow and Charles Townes** Nobel prize for theory on “Optical Maser” based upon this theory of Stimulated Emission. c1958 (also two Russians simultaneously)



**Theodore Maiman** invented the 1<sup>st</sup> Laser – a Ruby Laser - in 1960 based upon Shawlow & Townes theory.



**Dr. Leon Goldman** began encouraging medical laser research in the early 60’s and was a co-founder of the American Society for Laser Medicine & Surgery about 1981. (visit [www.ASLMS.org](http://www.ASLMS.org))



## 17. Laser & Energy Concepts

- Power Density (PD) effects on Tissue
- Power Density Parameters
  - Spot Size (Rapid Change in PD)
  - Power (Slower Change in PD)
- Techniques of changing Power Density with different delivery devices (i.e. focusing or collimated handpieces, bare fibers, waveguides)
- In aesthetics too High a PD can create burns & blistering. (also applies to excessive fluence)
- In aesthetics too Low a PD is generally safe, but ineffective for the treatment. (low fluence too)

## ENERGY TERMS

### Watts/CM<sup>2</sup>

- **IRRADIANCE** is the correct term, but commonly called the **POWER DENSITY**.
- This shows the concentration of power in space (spot size of the beam)
- This is the intensity of the delivered beam.
- Once you add the time component (i.e. a 40 millisecond pulse) it converts this into the treatment parameter of Joules/cm<sup>2</sup> – this is done automatically by the laser.

www.LaserTraining.org

## Irradiance (Power Density)

- Spot Size & Power (Watts/cm<sup>2</sup>)
- Spot Size creates the most rapid change
- Power Density is primarily changed by altering spot size – which depends on the delivery system – focusing handpieces, bare fibers, collimated aesthetic handpieces, etc.
- In aesthetics, too high a power density leads to burns and blistering
- In aesthetics, too low a power density does no harm, but is just not effective

## 18. Laser & Energy Concepts

### Physics: Radiant Exposure

This is a measurement of the “dose” of light in energy per surface area, or Joules/cm<sup>2</sup>. This is the correct term, but in medicine / aesthetic laser use it is more commonly referred to as “Energy Density” or “Fluence” of the laser spot.

## ENERGY TERMS

### Joules/cm<sup>2</sup>

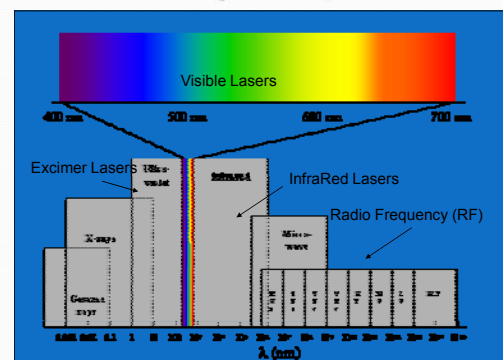
- **RADIANT EXPOSURE** is the correct term, but **FLUENCE** or **ENERGY DENSITY** commonly used
- Energy per unit area (Larger spots require more Energy)
- Treatment parameter for Aesthetic Procedures
- Aesthetic device settings are in J/cm<sup>2</sup>
- Technicians use protocols as guidelines for treatment parameters, which are supplied by the manufacturers, and generally reviewed by a Medical Director.

## 19. Laser & Energy Concepts

### Physics: Light Wavelengths

- Approx 400 (Blue) to 700+ (Red) nm Visible
- Infrared ~800+ nm
- Ultraviolet – below ~351nm

## Electromagnetic Spectrum



## 20. Laser & Energy Concepts

Equipment Considerations:  
Laser Settings for patient treatment

- Lasers for most aesthetic procedures are set to a targeted energy density expressed in Joules/cm<sup>2</sup>
- This includes pulsed dye lasers for vascular; hair removal lasers such as alexandrite, diode or Nd:Yag; and others.

## Radiant Exposure - Fluence

### Joules/cm<sup>2</sup>

Most aesthetic laser equipment display their energy density in Joules/cm<sup>2</sup> as simply a “Joules” setting. Understand that these are really two different concepts.

## 21. Laser & Energy Concepts

Pulsed Laser Emission

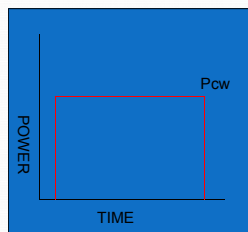
- A compression of laser energy which emits power (watts) at a higher rate than is otherwise attainable in CW (Continuous Wave) mode
- This is different than a simple “timer” on a CW beam, which is sometimes called a “Gated Pulse”
- Is more thermally “precise” on tissues than CW mode

## Modes of Laser Operation

- Continuous Wave emission (CW)
- Pulsed emission (and average powers)  
This delivers high Flux energy delivery
- The Difference between true Mode of Operation and Control Panel labeling

**Aesthetic Lasers are primarily PULSED LASERS**

## Continuous Wave Emission - CW

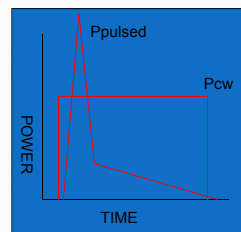


You may emit a CW for short periods of time by “gating” the shutter or electronics. This is then called the “Exposure Duration”.

Continuous Wave (CW) is a steady state delivery of laser energy. It's peak powers are usually lower than pulsed lasers, but can deliver large blocks of energy.

**Mostly Surgical Lasers**

## Pulsed Laser Emission



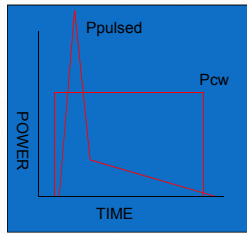
Pulsed Lasers emit light in very short pulse durations which are of much higher peak powers than are possible in the CW mode.

**Most Aesthetic Lasers**

The Pulse “Compresses” the same amount of energy to deliver it in a much shorter period of time – usually microseconds or nanoseconds. This is then called the “Pulse Width”. (A Higher “Flux” energy delivery)



## Pulsed Laser Emission



A pulsed laser such as the LightSheer Diode for hair removal for instance may go to 1600 watts of power in 30 milliseconds, and deliver up to 100 joules/cm<sup>2</sup> of energy in a 9mm spot.



## Pulsing Terminology

- Q-Switch (very high peak power pulse delivered in nanoseconds)
- Pulse Repetition Rate (PRR) – times per second
- Hertz (Hz) – times per second
- Pulse Width – used when discussing pulsed lasers
- Exposure Duration – used when discussing CW lasers

## REMINDER

You're about a third the way through this review!  
(Only 127 more slides to go)

Just a reminder to concentrate on those review slides with the bullet points, and don't overly fixate on the expanded slides.

THIS IS THE END OF THIS MODULE.

CONTINUE ON WITH MODULE II to start with Review Slide 22 .



## Laser Certification Review

*Expanded Study Guide – Module II*

Certified Laser Hair Removal Specialist

National Council on Laser Certifications

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## 22. Laser & Energy Concepts

### FLUX

- Concept of delivering more energy in shorter time periods, in a pulse, to reduce thermal spread.
- 1W at .2s (.2J) is lower flux than 2W at .1s (.2J) still).
- Look at the concept, and balance the power and time settings to see which is a higher fluence.

## FLUX

Joules of Energy = Watts x Seconds

**Concentration of Energy in Time**

F  
L  
U  
X



• 50 millijoules (mj) = 100 watts for 0.0005 sec

• 50 millijoules (mj) = 50 watts for .001 sec

• 50 millijoules (mj) = 5 watts for .01 sec

• 50 millijoules (mj) = 1 watt for .05 sec

**- Hot & Fast – or Low & Slow -**

Just get the concept – don't worry about the term.  
It's better to deliver energy quickly so heat does not spread.

## FLUX

Joules Energy = Watts x Seconds

### Concentration of Energy in Time (Bolus of Light)

- The concept of MORE Energy in a SHORTER time
- 1W @ 0.2s = 0.2J
- 2W @ 0.1s = 0.2J (This is the higher flux)
- 25J/cm<sup>2</sup> @ 40ms
- 25J/cm<sup>2</sup> @ 5 ms (This is the higher flux)

*Higher Flux pulses result in less thermal spread and are required for very small structures such as Velus hair or small capillary's*

## 23. Laser & Energy Concepts

Typical Power/Energy Display & Measurement:

In addition to the Energy "Joules" orientation, most aesthetic lasers are set to J/cm<sup>2</sup> which is the Radiant exposure and include aesthetic and hair removal lasers such as"

- Alexandrite
- Diode
- Nd:Yag, and others

## Power/Energy Displays

As a General Rule:

- CW Lasers are set and measured in WATTS (rate of energy delivery)
- Pulsed Lasers (most aesthetic lasers) are set and measured in JOULES (total energy delivered)
- Many manufacturers set the display so that JOULES is automatically converted to J/cm<sup>2</sup>

## Power/Energy Displays

Watts or Milliwatts:

- CO<sub>2</sub>, CW Nd:Yag, CW Dye, Argon, Many Surgical Diodes – Watts
- Ophthalmic Diode Laser - Milliwatts

Joules or Millijoules:

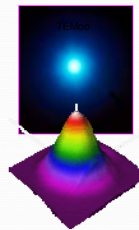
- Ho:Yag, Alexandrite, Ruby, Pulsed Dye for vascular, Q-Switched Tattoo Nd:Yag – Joules
- Q-Switched Ophthalmic Nd:Yag, Pulsed Dye for lithotripsy - Millijoules

## 24. Laser & Energy Concepts

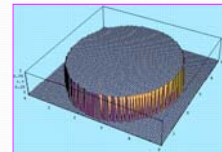
Optics Principles - Beam shapes

- Sinusoidal "TEM<sub>00</sub>" best for sharp incisions and ablations
- "Flat Top" or "Top Hat" type modes preferred for aesthetic procedures including laser hair removal

## Energy Distribution in Large Spots



Sinusoidal "TEM<sub>00</sub>" best for sharp incisions and ablations



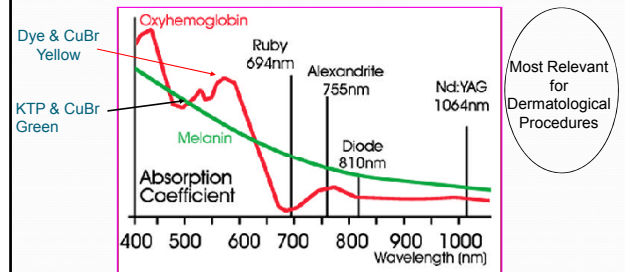
"Flat Top" or "Top Hat" mode preferred for Aesthetic Laser Procedures for even distribution within the spot.

## 25. Tissue Interactions

### Chromophore

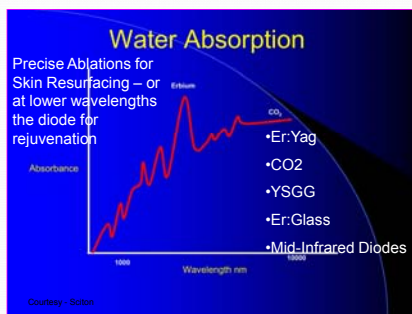
- Refers to the object that absorbs that particular wavelength of light. In dermatological laser procedures the two primary competing chromophores are melanin in skin and oxyhemoglobin in blood vessels

## Simplified Tissue Absorption



- Longer wavelengths are less absorbed by melanin (safer for dark skin)
- Longer wavelengths penetrate more deeply into skin (deep vessels)
- Red blood vessels absorb best in the yellow to orange range (safest)

## Water Absorption



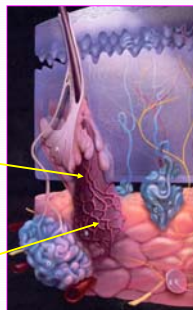
## 26. Tissue Interactions

### Laser Hair Removal

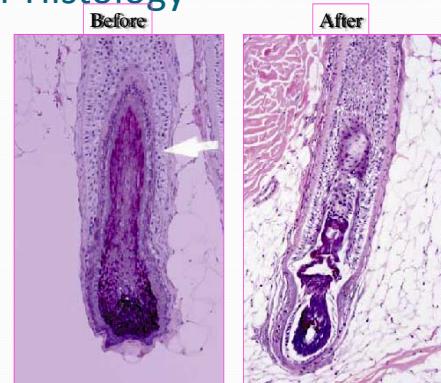
- Target is the hair follicle – the bulb and “bulge” of the hair follicle, and the matrix of nerves and vessels surrounding the hair bulb. Melanin around the follicle is the target chromophore.
- Laser Hair Removal works by selectively heating these targets to lethal temperatures
- Steps must be taken to prevent overheating of the skin at the same time

## Target for Laser Hair Removal

- ↪ Hair bulge
  - ↪ Thickened area of root sheath above bulb. Contains cells that can regenerate entire hair follicle.
- ↪ Hair bulb
  - ↪ Deepest structure in hair
  - ↪ Melanin responsible for hair pigmentation



## Hair Histology





## Strategic Skin Cooling

Active skin cooling must be used to prevent bad outcomes, and to increase client comfort:

- Cooling Gels
- Cryogen Sprays (Dynamic Cooling Devices)
- Cold Air Chiller
- Contact Cooling (cold sapphire & metal plates)
- Post treatment cooling packs

## 27. Tissue Interactions

### Laser Hair Removal

- Treatment regime of 5-7 treatments may be required. (sometimes more)
- FDA defines “permanent” hair removal as a long term stable reduction in the number of hairs regrowing after a treatment regime.

## What is Permanent Hair Removal?

The FDA defines this as a long term stable reduction in the number of hairs regrowing after a treatment regime.

Laser / IPL can do a good job, but the patient can't be promised that all of the hair in the treated area will go away forever. Most are very pleased with the results however, and some is truly permanent.

## 28. Tissue Interactions

### Hair Color

- “Pheomelanin” in Red and Blond hair does not respond well to wavelengths above 740nm.
- Red and blond hair may respond better to IPL wavelengths below 740nm, or Ruby lasers at 694nm.
- Regardless of device, Red and Blond hairs are among the most difficult to treat (aside from Gray or White which are worse).

## Pigmentation of Hair

### ↕ Eumelanin

- ↪ Brown, black – any laser works

### ↕ Pheomelanin

- ↪ Red, Blond
- ↪ Does not respond much above 740nm, so the Ruby or short wavelength (640-740nm) IPL's are the only ones effective

### ↕ Gray Hair

- ↪ Mixture of normal hair follicle and those with no color

## 29. Laser & Energy Concepts

### Equipment Considerations - Skin Cooling

Multiple methods may be used for skin cooling to prevent burns & include:

- Cooling Gels (maybe least effective, but common and adequate)
- Cryogen sprays
- Contact Cooling - Chilled Crystal windows such as sapphire plates used for contact cooling of the skin (chilled circulating fluids keep the plate cool), or cold metal rollers.
- Cold Air Chillers to blow refrigerated air on skin

## 31. Laser Safety

### Safety Practices - Skin Cooling

Overcooling of the skin could make treatments like laser hair removal less effective, but appropriate skin cooling is always provided in order to:

- Reduce the risk of blistering and burns (or scars)
- Reduce swelling & inflammation
- Reduce patient discomfort

## 32. Laser Safety

### Safety Practices - Skin Cooling

“Forgetting” to use or to activate the skin cooling system, or failure of the system during a case, can result in burns or blistering of the patient.

Always monitor the skin cooling system.

## 33. Laser Safety

### Safety Practices

- Excessive Heating of Skin
  - Developing strategies to prevent or control excessive skin heating is critical to all dermatological laser procedures.
  - Blistering can potentially lead to infections.
  - Scarring, including Keloids, or hypo or hyperpigmentation can also result.

## Protective Skin Cooling

(Applies to All Aesthetic Laser Procedures)

- Cooling Gels
- Cryogen sprays
- Chilled Crystal windows such as sapphire plates used for contact cooling of the skin (also metal rollers)
- Cold Air Chillers to blow refrigerated air on skin

## Protective Skin Cooling

(Applies to All Aesthetic Laser Procedures)

Overcooling of the skin could make treatments like laser hair removal less effective, but appropriate skin cooling is always provided in order to:

- Reduce the risk of blistering and burns
- Reduce swelling & inflammation
- Reduce patient discomfort

## CONTACT COOLING

- Water circulates around the tip of the hand piece to cool the skin.
- Condensation builds up on the tip and technician needs to keep cleaning it.
- Cools only when the tip is in contact with the skin. Ensure that it IS in contact before firing, and hold it there momentarily afterward.



**Very Effective**

## Cryogen Spray

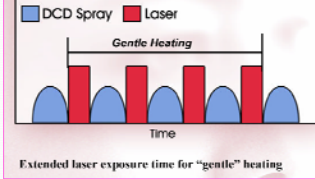
DCD (Dynamic Cooling Device)

It was originally designed to cool the skin because the laser pulse duration (3msec) is harsh on the skin. Developed by Candela Laser

It is very effective, but care must be taken not to lose the "triangulation" of the laser and cryogen spray, and not apply excessive spray times.



## LASR PROCESS



Laser without using cryogen



Laser using cryogen

## 34. Tissue Interactions

Laser Hair Removal

- Ideal patient has light skin, dark hair, and is not overly sun sensitive.
- Difficult or impossible to treat would be gray or white hair – especially on dark skin. This is a relative contra-indication.
- Other methods for treating light hair include Photodynamic Therapy or Radio Frequency Electrical methods (aside from electrolysis)

## Laser Hair Removal

- Ideal patient is light skin with dark hair, and no sun sensitivity
- Difficult or impossible is gray or white hair, especially on dark skin. This is a relative contraindication.
- Other methods for light hair include electrolysis, radio frequency or photodynamic therapy (future use).

## Gray & White Hair Problems



## Gray & White Hair Problems



### Options:

- Electrolysis – Most effective
- RF Plus Light (i.e. ELOS – Syneron)
- Meladine Dye
- VERY aggressive settings IF they are very light complected (Type I or II)
- Discretion is the better part of Valor – leave well enough alone and don't bother



\* PDT was shown in the 1980's to kill hair follicles of any color – including white.



## 35. Aesthetic Procedures

### Laser Hair Removal, Tissue Effects

Ensuring first that no blistering or burning is created on skin, good indications of the clinical end point for laser hair removal can include ejection of the hair shaft from inside the follicle, or redness & swelling around the hair follicle (perifollicular edema).

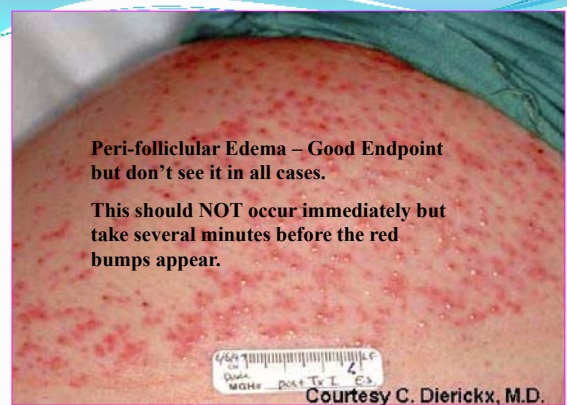
## Clinical End Points

- Look for laser-tissue interaction, don't just depend on written parameters and the starting point protocols.
- End-points that indicate fluence and/or pulsewidth must be changed:
  - skin graying
  - skin separation
  - Immediate erythema or stronger reaction

## Clinical Endpoints

(first ensure no burns or blisters)

- Slight erythema response seen 5-20 minutes post test spot / treatment
- Follicular edema is seen 10-20 minutes post treatment. (perifollicular edema)
- Immediate ejection of the hair shaft stub
- **Caution:** immediate erythema / purpura could be an indication of recent sun exposure, tan or too high energy



## Clinical Endpoints

(first ensure no burns or blisters)

- Singed hair:
  - hair from follicle ejected or vaporized
  - can see singed hair on skin or on tip
  - gel becomes brownish
  - odor of singed hair present

Another less pronounced example of perifollicular edema several minutes after the treatment.



## 36. Laser Safety

### Safety Practices:

#### Skin prep for Laser Hair Removal

- If area is tweezed or waxed, or had electrolysis, then you've removed the primary target for the laser to generate heat at the follicle, and the laser treatments will be ineffective. If performing electrolysis first, the same applies, but there is no reason for laser treatments after electrolysis.

### Pretreatment for Laser Hair Removal

- ✦ Shave the day of, or the night before the treatment
- ✦ Discontinue waxing / electrolysis, depilatories etc. once treatments start
- ✦ SPF 15 sunscreen for 4 - 6 weeks prior to treatment if sun exposure can't be avoided.
- ✦ Avoid sun exposure, tanning booths or creams
- ✦ Caffeine can make skin more sensitive

### Pretreatment for Laser Hair Removal

- **SHAVING** - If area is not shaved the energy will be wasted on the exposed hair shaft. The vaporizing hair shaft can also contribute to skin burns, or burn the delivery device such as contact windows or IPL filters. In addition the extra odor is unnecessary.

## 37. Laser Safety

Safety Practices - Laser Hair Removal

Stronger relative contra-indications may include:

- Photosensitizing medications – (i.e. accutane)  
VERY Strong contraindication
- Active Infections such as herpes, cold sores, etc.  
(one of the stronger contraindications)
- Dark Tan in a Caucasian (send them away until the tan fades, or sometimes can use bleaching creams to speed the process)
- History of Keloid scarring in family

## Photosensitizers

**A very wide range of foods and drugs can cause exaggerated reactions to laser & IPL treatments.**

Some of the major of these include NSAIDS (i.e. Ibuprofens), Antibiotics, Anti-Arrhythmics, Birth Control Pills, Retin-A<sup>®</sup>, Premarin, Anti-depressants, Chemotherapy agents, Corticosteroids, Endometriosis Management, Erectile Dysfunction (i.e. Viagra), Appetite suppressants, some sunscreens, fragrances & perfumes, and many others.

## Photosensitizers

**More In-Depth Resources:**

[www.LaserTraining.org](http://www.LaserTraining.org).

then choose "Resources",

then choose "Photosensitizers"

**Articles, Lists and Links.**

## Contraindications

The following slides indicate some typical contra-indications.

The determination of what actually constitutes contra-indications though should be left up to the medical director of the practice. This can be affected by many variables unique to each patient.

## Contraindications

- ↘ Sunlight Sensitivity  
(can be balanced with settings and test shots)
- ↘ Recent Sun Exposed Skin
- ↘ Sun Tan
- ↘ Photosensitizing Medicine, Foods & Ointments.
- ↘ Seizure Disorders Triggered by Light
- ↘ Suspicious lesions (refer for assessment)

## Contraindications

- ↘ Accutane, (Claravis, Sotret & Amnesteem generics) – or other Photosensitizers.
- ↘ Active Infections – Herpetic, cold sores, shingles, etc.  
(place on anti-viral medication pre-treatment)
- ↘ Electrolysis, waxing or tweezing in last 6 weeks  
(target has been removed)
- ↘ History of Family Keloid Scarring

## Contraindications

- Absolute -

**DO NOT LASER OR IPL OVER TATTOOS!**  
(but can treat around them)

The longer a person has had a tattoo the farther you need to stay away with the laser (granules migrate).

The ink can spread out as far as 3mm and become a target for the laser.



## 38. Tissue Interactions

### Thermal Relaxation Time (TRT)

- Amount of time required for a target to dissipate heat (time to return to ½ of peak temperature)
- Smaller objects have shorter TRT's – will get hotter, faster than larger objects, and then lose their heat more quickly

## Thermal Relaxation Time (TRT)

This is the time that it takes for a “wave” of heat to start flowing out of a structure. All organic structures have their own thermal relaxation times.

Smaller structures will both get hot and lose their heat in a shorter time than larger structures.

## Thermal Relaxation Time (trt)

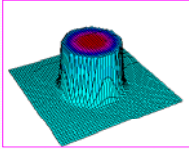
- ↘ The time necessary for the target to cool down 50%, through the transfer of its heat to surrounding tissue via thermal diffusion.
- ↘ The thermal relaxation time (tr) is directly related to the size of the target and its composition.
- ↘ Smaller objects of the same material will get hotter faster, and lose heat at a much faster rate than Larger objects. Smaller objects require shorter pulse widths to destroy the target.



## Thermal Relaxation (TRT)

Example: Temperature rise in Hair Bulb

A short Pulse Width "beats" the TRT of the hair bulb allowing a lethal temperature rise to 70°C or more.



The same energy applied over a longer pulse width loses the race with heat leaking out, and the temperature does not rise sufficiently to kill the hair bulb.

Graphics courtesy of Sciton

## Thermal Relaxation Time

Small diameter hairs respond best to very short pulse widths at the same fluence, while larger hairs do best with longer pulse widths.

All other things being equal, shorter pulse widths at the same energy density are more painful to the patient and "riskier" for darker skin. Can be balanced with aggressive cooling.

The same principle applies to vessel sizes in things like telangiectasia or portwine stains.

## REMINDER

You're about two thirds the way through this review!  
(Only 75 more slides to go)

**Just a reminder to concentrate on those slides with the bullet points, and don't overly fixate on the expanded slides.**

THIS IS THE END OF THIS MODULE.

CONTINUE ON WITH MODULE III to start with Review Slide 39 .



## Laser Certification Review

*Expanded Study Guide – Module III*

Certified Laser Hair Removal Provider  
National Council on Laser Certifications  
[www.LaserCertification.org](http://www.LaserCertification.org)

*Not All of these Slides are Narrated, but many are.*

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## 39. Tissue Interactions

### Adverse Reactions


- Recent Sun Exposure is the most common reason for unexplained adverse reactions (rashes, redness, blisters) in the middle of a treatment series.
- Photosensitivity due to drugs/food/etc. would be the second most common reason.

## Suntans

Suntans create a much higher risk of patient injury.

Generally patients are encouraged to stay out of the sun for a few weeks prior to treatment, and/or use skin lighteners.

All other things being equal, it is usually safer to treat Asian, Latino or light black (brown) skin, than it is to treat Caucasian skin that is tanned. (Also depends on the wavelength of the Laser)



## Sun (U.V.) Exposure



It is critically important that clients understand the importance of avoiding sun exposure prior to, or just after Laser & IPL treatments. This includes the use of tanning beds or tanning agents.

Such exposure can result in the skin overreacting to the treatment with resulting bad outcomes.

We try to explain to clients that there are many other ways to get significant sun exposure without necessarily trying to get a tan. Sun exposure does not just mean laying out by the pool or on the beach to get a tan.

## 40. Tissue Interactions

### Thermal Relaxation Time (TRT)

- To “kill” an object with heat (i.e. hair follicle), the clinically effective dose of light must be delivered in a time shorter than its TRT – otherwise it will shed the heat and survive.

## 41. Tissue Interactions

### Thermal Relaxation Time (TRT)

- To spare adjacent structures that also might absorb the light (epidermis), the time period should be longer than its TRT – so that it can dissipate the heat and survive.

## Scientific Basis for Hair Removal using Thermokinetic Selectivity

- “Ideally the laser pulse duration would lie between the thermal relaxation times for the epidermis (about 3 to 10 msec) and the target follicles (40 to 100 msec).” \*
- Thus, a pulse duration of approximately 10 to 40 msec will damage hair follicles with minimal epidermal injury.

\*Grossman et. al. J. Amer. Acad. of Derm. December, 1996

## 42. Tissue Interactions

### Typical Thermal Relaxation Times

- Hair Follicle – 40-100 milliseconds  
*larger follicles have longer times*
- Epidermis – 3-10 milliseconds

**Therefore a theoretically ideal laser pulse (at clinically effective doses) for hair removal would be from 10-40 milliseconds**

## 43. Tissue Interaction

### Laser Pulsing

- Repetition Rates (frequency) of the laser pulse (usually in pulses per second) relate mostly to convenience for the user, and comfort for the patient. Slower repetition rates take longer, but allow for better heat dissipation so that it usually is less painful for the patient and better tolerated.

## Pulsed Laser Emission

### Think HEAT!

Pulses spaced closely together in either timing or distance will allow heat to accumulate faster than if you space them apart.

Pulses applied rapidly may treat an area faster, but the heat level and pain level will increase ( and sometimes the potential for blistering).

Slower pulse repetition rates take longer, but are generally better tolerated by the patients.

Overlapping pulses is sometimes recommended by manufacturers for a variety of reasons, but be aware that such practices, particularly at higher fluences (ie leg vein removal) may create significant heat damage. This is sometimes called "Pulse Stacking".

## 44. Laser Safety

Applicability of ANSI Z136.3 Standards

Applies to ALL Health Care Settings Including

- Hospitals & Surgery Centers
- Small medical clinics & offices
- Mobile laser vans & services
- Medical Spas & Cosmetic Centers
- Anywhere a laser is used on a person

## Non – Regulatory

(but De-Facto standard)

### American National Standards Institute



ANSI Z136.1



ANSI Z136.3

136.3 – Safe Use of Lasers in Health Care Facilities

## Laser Safety Program

to Assess & Control Potential Laser Hazards

- Each Facility (including offices & spas) **MUST** appoint a Laser Safety Officer (LSO) to manage a safety program.
- A formal Safety program, including policies and procedures, **MUST** be in place in each institution.
- You **MUST** review the specific policies and procedures for each facility. Based on ANSI.

## 45. Laser Safety

### Medical Laser Safety Officer

- Appointed by the facility administration
- Administers the facility's Laser Safety Program
- May or may not run actual equipment
- No particular background nor education required
- Utilizes many different resources in order to manage the Laser Safety Program
- Required by ANSI in all health care facilities that utilize lasers. (Including medical spas & offices)

## Laser Safety Officer

- No specific "Certification" or background requirements.
- "Experience, training and resources" from many sources to complete this job.
- May or may not be the person in the Laser Room (Laser Assistant or Operator).

Medical Laser Safety Officer Certification (CMLSO) is a professional credential that is voluntary, but may serve as evidence of proper training & qualification.



## Laser Safety Officer

**The Evaluation of the Total Hazard by the LSO is dependent upon:**

- Ability of the Energy to injure personnel or patient
- Personnel who may be exposed in the NHZ
- Type of delivery system used.



*"Pucker Factor"*

## 46. Laser Safety

Medical vs. Industrial/Scientific LSO's

- Both are required by ANSI to be appointed by their respective facilities
- Industrial/Scientific based upon ANSI 136.1
- Medical based upon ANSI 136.3
- Need for measurements and calculations to determine NHZ and Laser Classification for Medical LSO's is minimized because of manufacturer preclassification and information.

## 47. Laser Safety

### Administrative Controls

LSO responsibilities:

It is for overall management of the safety program to include education of staff, protective measures implemented (safety glasses), program monitoring, etc.

It is NOT to establish or enforce clinical treatment parameters or protocols – they implement those established by their medical director.

## LSO Establishes Controls

- **Administrative Controls**
  - Documentation, training programs, etc.
- **Procedural Controls**
  - Policies, Safety Glasses, Signs, etc.
- **Engineering Controls (by Mfg)**
  - Interlocks, standby, emission indicators

## 48. Laser Safety

Laser Treatment Controlled Area (LTCA)

- The entire laser room, or a designated area in a very large room
- Signs required on all entryways
- Safety glasses provided, but are not required to be worn until within the NHZ
- Occupied only by authorized personnel trained in Laser Safety

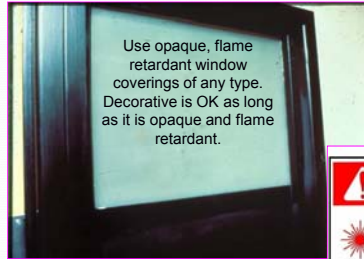
## Laser Treatment Controlled Area (LTCA)



In small treatment rooms such as for Aesthetic Laser Procedures, the NHZ and LTCA will be one and the same.

- This is the entire room where the procedure is performed
- Signs are required on doors.
- Glasses required to be made available but not worn until in NHZ.
- Controlled access by trained personnel only

## Window Coverings & Signs

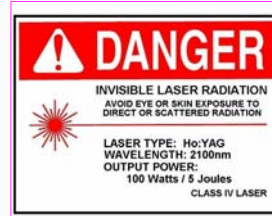


ANSI says the windows must be covered only when they are in the NHZ.

Signs must be on the door for the LTCA.



## ANSI NEW LASER SIGNS



"New" as of 2005

Old Signs – should be replaced



### New Signs:

Download free copy at [www.LaserTraining.org](http://www.LaserTraining.org) on the "Free Material" page

Courtesy of Dan Little

## 49. Laser Safety

Pregnancy in workers or patients

- Laser "Radiation" is electromagnetic but not ionizing like X-Rays, and is of no actual risk to women in any stage of pregnancy – whether the patient or a technician running the equipment.
- In spite of this "no risk", most services will NOT treat women with lasers for elective laser procedures because a certain percentage will abort anyway, and the practice does not want to be exposed to the potential liability.

## Pregnancy

Lasers DO NOT present any risk to either the mother or fetus in pregnancy.

Most Laser "Experts" however discourage treatment of pregnant women for the simple reason that many will spontaneously abort anyway, and the laser treatment facility may then face litigation.



## 50. Laser Safety

Eye – Skin Hazards


- Hazard levels for eyes are determined by a value known as the MPE – Maximum Permissible Exposure (MPE) level for the cornea or retina.
- Safety Glasses Optical Density value is designed to keep the MPE below the hazard level.
- Laser Safety Glasses do NOT guarantee protection from direct impacts of the laser into the eyes through the glasses (reflections only).

## Laser Safety Eyewear



- Must be labeled according to the wavelength  $\lambda$  for which they are offer protection.
- Must be labeled according to the Optical Density (O.D.) of the material. 4-7 O.D. is OK for most medical lasers

## Laser Safety Eyewear



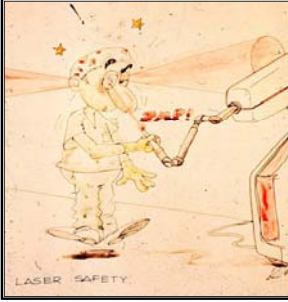
- Optical Density is the attenuation measured on a logarithmic scale. I.E.  $10^4$  power of attenuation is an O.D. of 4.0. That means that an O.D. difference between 4.0 and 6.0 is a factor of 100.

• Must be labeled according to the wavelength  $\lambda$  for which they offer protection.

• Must be labeled according to the Optical Density O.D. of the material. (4-7 O.D. OK for most medical lasers)

**Protection vs. Ability to See & Work**

## Laser Eye Hazards



- Safety glasses **DO NOT** guarantee protection against direct laser impacts

They would be of some help, but cannot be relied upon to prevent eye damage from direct impacts through the glasses.

## 51. Laser Safety

Eye – (MPE)  
Maximum Permissible Exposure Limits

- Exposure limit used in skin & eye safety calculations.
- Where the MPE is exceeded, that defines the Nominal Hazard Zone (NHZ).
- For wavelengths that transmit into the eye, the exposure to the surface is multiplied by 100,000 times to compare to the MPE.

## Nominal Hazard Zone (NHZ)

This is the actual area where one could get hurt (burned) with the laser. It is determined solely by the LSO.

**In small offices and clinics where laser hair removal and other aesthetic laser procedures are performed, the NHZ should generally be the entire treatment room.**

Please take note that this requirement to establish the NHZ and wear safety eyewear within it does NOT apply to IPL's – but it remains good practice with IPL anyway.


## Nominal Hazard Zone (NHZ)

The NHZ is determined *solely* by the LSO utilizing recommendations from the manufacturer or other suitable analysis, but measurements *are not* required to be made by a Medical Laser Safety Officer.



## Nominal Hazard Zone (NHZ)

Because of the relatively small size of treatment rooms in most aesthetic practices, the entire room is usually designated as the NHZ – but this is neither a “law” nor ANSI requirement.





## 52. Laser Safety

Retinal Hazards – Depends on Wavelength

- All wavelengths which pass through fluid
- Incorporates all visible light lasers
- Between approximately 400-1400nm
- Practical difference between hazards of visible vs. infrared. (Because of aversion response)
- Ho:Yag on up are Retina Safe, & Ar:Fl on down
- Lens of eye increases power density on Retina by 100,000 times.

## Laser Eye Hazards



- Lasers present either retinal, or surface burn hazards.
- Hazards are present ONLY within the Nominal Hazard Zone (NHZ)
- Safety glasses DO NOT protect against direct laser impacts

## Retinal vs. Surface Eye Hazards Photo-Thermal

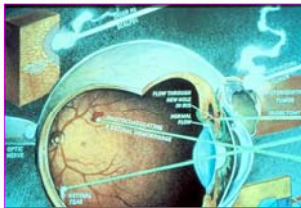
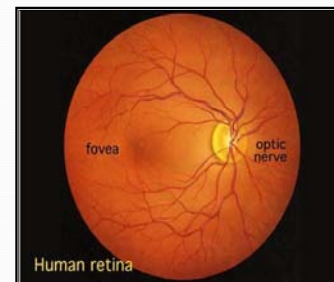


Photo-Chemical Injury (cataracts) may occur with Chronic Exposure to Ultraviolet Lasers starting about 351nm. These are NOT hair removal lasers.

- **Surface of the Eye Hazards – distance & power density are determinants.**
- **Retinal Eye Hazards – are NOT directly power density nor distance related. 400-1400nm**

## Laser Eye Hazards

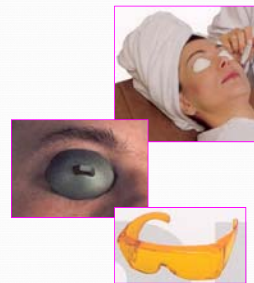


## 53. Laser Safety

Patient Eye Protection

- Corneal Shields (anodized metal shields) used when working within the bony orbit of the eye. (ANSI recommendation) – most secure protection.
- Alternative Patient Eye protection depending on type of laser use:
  - Laser Safety Glasses
  - External Eye shields of some type
    - Plastic "Laser Resistant" goggles
    - Metal Eshields (best)
    - Disposable adhesive laser eye protection

## Patient Eye Protection



- Determined by LSO
- Should be provided & documented for all patients.
- "Real" vs. "Administrative" precautions

## Working Around the Eyes & Face



All metal eye-shields are the best and the safest.



Plastic sun-tanning goggles are not recommended because they can melt and burn when impacted with a laser. (But disposable Laser Shields are fine)



## Working Around the Eyes





**Special corneal shields** are recommended when working directly on or near the eyelids. (Bony Orbit of the Eye)

Although it is not difficult to safely place these corneal shields on the eye after a few drops of a dilute lidocaine solution are made, these are probably best left to a medical setting or performed by a Nurse or Physician because of the sensitivity of the area.

## Eyebrows

Most "experts" discourage laser hair removal on the brow for a variety of potential liability areas, but not because of a direct laser eye injury (if shields are used).



If performing treatments around the brow or the cheek bones, advise the patient that they may see "flashes" of light, even with infrared lasers. These are harmless.

## 54. Laser Safety

### Aversion Response

- The body's reaction to "jerk" away from bright light sources (aversion to bright light)
- Considered to be 0.25s
- Those visible lasers that cannot exceed the MPE (Maximum Permissible Exposure level) within this time are considered eye-safe
- The aversion response time is not fast enough to guarantee protection from Class IV lasers, but it would reduce one's exposure

## Aversion Response

- Reflexive action of the body to "jerk" away from bright light in 0.25 seconds or less.
- Lasers that cannot exceed the MPE within 0.25s are considered "Eye-Safe" (Class 2 Lasers)
- Class 4 Lasers are NOT Eye-Safe
- HOWEVER – The aversion response to Class 4 visible light laser reflections (not direct impact) does provide a significant added safety factor over invisible lasers.

## 55. Laser Safety

### Corneal Hazards – Depends on Wavelength

- All wavelengths which do NOT pass through fluid
- From 1400nm on up, and 400nm on down
- Includes CO<sub>2</sub>, Er:Yag, Ho:Yag and Ar:Fl excimer as corneal hazards.

## Laser Eye Hazards - Corneal

Surface Burns:  
> 1400 nm

CO<sub>2</sub>  
Erbium:Yag  
YSGG  
Erbium:Glass

## Laser Eye Hazards

CO<sub>2</sub> Laser  
Corneal Burn

Occurred during a  
Blepharoplasty.  
(skin tightening around the  
eye).

Courtesy  
Oculoplastik

## Laser Eye Hazards

CO<sub>2</sub>  
Er:Yag  
YSGG  
Ho:Yag  
Er:Glass  
Ar:FL

Various Diodes  
Nd:Yag  
Intense Pulsed Light

CO<sub>2</sub> Laser  
Corneal

ARGON LASER  
EYE INJURY

ND:YAG LASER  
EYE INJURY

All Visible Light  
Lasers & IPL

AESTHETIC LASERS -  
RETINAL

Relative Risks

## 56. Laser Safety

### Laser Protective Eyewear

- Should always be worn within the NHZ
- Does NOT guarantee protection from direct impacts from the laser beam for retinal hazards (It is MOST IMPORTANT to not allow the beam to be directed toward one's face)
- Must be labeled according to the Wavelengths & Optical Density (O.D. or degree of protection).
- O.D. is a logarithm. I.E 10<sup>4</sup> = OD 4, so a change from 4-7 is a 1000 fold increase in attenuation. (tenfold for each unit of O.D.) Higher numbers offer more protection.

## 57. Laser Safety

### IPL Eye Hazards

- IPL's do NOT present the same level of risk as lasers because they are NOT point sources of light. (non-laser light source)
- However, they DO still present eye hazards and eye protection is required.
- Used for a variety of procedures including hair removal, skin rejuvenation, treatment of pigmentary and vascular issues, etc.

## Intense Pulsed Light (IPL)

IPL's are Broad Band Light Sources that span a range from about 400nm in the visible to about 1400nm in the Infrared.


Various cut-off filters may be used on the IPL to limit the lower wavelength ranges – protecting darker skin and targeting specific structures such as red blood vessels or brown spots.



## Intense Pulsed Light (IPL)

Advantages of IPL

- Cover Larger Areas (i.e. back)
- More affordable than Lasers
- More effective on Blonde & Red Hair in light skin



CAVEAT: Used primarily for LIGHT SKIN clients.  
Use in dark skin is not recommended

## Eyewear for IPL's


(Different Names, but all the same thing)

IPL

Intense Pulsed Light

AFT - Advanced Fluorescent Technology

Broad Band Light Source



All of these are non-laser, but very intense light sources.

## 58. Laser Safety

### Laser Safety Eyewear Labeling

- Must be labeled with both wavelength ranges of protection, AND Optical Density (O.D.) of degree of protection.
- O.D. is a logarithm, so the difference in each unit of O.D. is a factor of 10. In other words the difference of an O.D. of 4 to 6 is a factor of 100 in attenuation. Higher numbers are more protection.

## 59. Laser Safety

### Safety Practices

### Glass Transmission

- Lasers that don't transmit through glass include CO<sub>2</sub>, Er:Yag, Ar:Fl, and present superficial corneal burn hazards.
- Glass in optics of scopes & instruments afford protection to the viewer
- Window glass affords protection to outside viewers so that no coverings are required (for those lasers listed above)

### Medical Laser Types by Wavelength (λ)

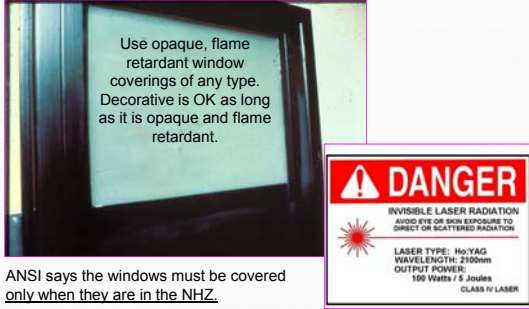
CO <sub>2</sub>	Far Infrared	10,600 nm (10.6u)	Retinal Hazards (400-1400nm)
Er:Yag	Mid Infrared	2,940 nm (2.9u)	
Ho:Yag	Mid Infrared	2,100 nm (2.1u)	
Nd:Yag	Near Infrared	1,064 nm (1.06u)	
Diode Lasers	Visible & NIR	~ 530 - 2100 nm	
Alexandrite	Deep Red	755 nm	
Ruby	Deep Red	690 nm	
Krypton	Red, Yellow, Gm	647, 588, 531 nm	
Helium Neon	Red	632 nm	
CuBr	Yellow, Gm	578, 511 nm	
Dye Lasers	Red, Yellow, Gm	632, 588, 504 nm	No Fluid Tx (Corneal Hazards)
KTP	Green	532 nm	
Argon	Blue, Green	488 & 515 nm	
XeCl Excimer	UV	308 nm	
ArFl Excimer	UV	193 nm	No glass or fluid (Corneal hazard)

## 60. Laser Safety

### Window Coverings

- Must be flame retardant when used
- Applies only to wavelengths that transmit through glass
- Required only when the window is located within the NHZ of the room.
- Any material opaque to the wavelength is sufficient
- Consideration given to use of barriers at doorways in special circumstances

## Window Coverings & Signs



Use opaque, flame retardant window coverings of any type. Decorative is OK as long as it is opaque and flame retardant.

ANSI says the windows must be covered only when they are in the NHZ.  
Signs must be on the door for the LTCA.

## 61. Laser Safety

### Safety Practices – Instrument Reflections

- Not a major practical problem, but a consideration around sensitive areas (esp. the eye).
- Ebonizing instruments just creates a black color and doesn't affect the reflection much – especially from IR lasers.
- Anodizing an instrument creates a “roughened” micro-surface on the instrument that helps to disperse the reflection.
- The major problem is reflection from a flat metal surface in close proximity to a sensitive area (i.e. eye, teeth, etc.)

## Reflections

### Anodized Instruments




**Jewelry:**

Not really an issue for Laser & IPL, unless you're going to be treating in that immediate area – then have them remove the jewelry.

Minimizes reflections

[www.LaserTraining.org](http://www.LaserTraining.org)  
-Resources & Links, then  
-Laser Links  
For a Complete Listing of Laser Safety Equipment Vendors.

## Mirrors (Reflections)



Mirrors are generally not a problem within the treatment room.

Just ensure that they're not placed close to the treatment site where you might accidentally fire into the mirror at close range.


## 62. Laser Safety

### Fire Hazards

- Water available for quenching flames (water from the sink in the room or hallway should be adequate for aesthetic laser uses)
- Fire Extinguisher immediately available (does not have to be in the room – just know where they are)

## Fire Hazards

- CO<sub>2</sub> Laser the primary Hazard, but this is used only for skin resurfacing in aesthetic medicine.
- Flammable materials.  
(Hair lines – Hair Spray, Peri-Anal)
- Aesthetic Lasers (or IPL) can present a fire hazard when fired directly into dry towels or materials. (including furniture upholstery)



## Control of Fire Hazards

- **Electrical Equipment Fire Extinguisher - position Outside Controlled Room**
- **Fire extinguisher must be Immediately Available**
- **Open water (for dousing flames)**  
sink in room or in area would suffice for aesthetics.

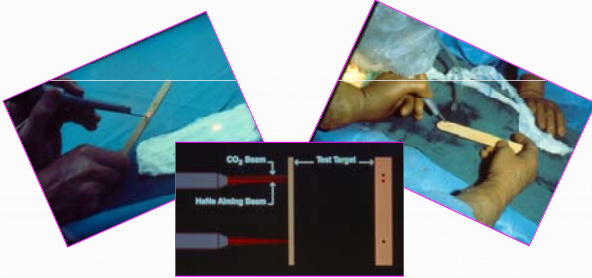
## 63. Laser Safety

### Treatment beam & Guide-Light Alignments

Some lasers are infrared and therefore invisible to the eye. These laser use visible (usually red) guide lights so that one can see where the treatment laser is aimed. ANSI standards require that the alignment of the treatment and aiming beams be checked prior to EACH case.

## Test Shots

Check the alignment of the aiming beam and treatment beam EVERY CASE



## 64. Laser Safety

### Laser Plume (smoke)

- Although Laser hair removal may produce odors, it generally does NOT produce laser plume that needs to be evacuated.
- ANSI standards require that whenever a laser plume is generated (such as ablative skin resurfacing) that "local exhaust ventilation" (smoke evacuators) be used.
- For odors generated by Laser or IPL hair removal, room electrostatic precipitators (room air cleaners) may be effective to eliminate odor.
- Masks that filter to viral sizes are generally considered by ANSI to be ineffective as the sole protection from Laser Plume.

## Laser Smoke Plume

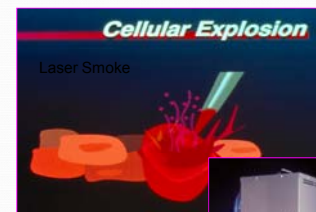
### ANSI 7.4

LGAC – Laser Generated Airborne Contaminants:

The primary measure to control LGAC ... shall be local exhaust ventilation (LEV or Smoke Evacuators). (7.4.2)

## Laser Plume (LGAC)

- Plume is "Nasty", whether or not infectious.
- ANSI requires Smoke Evacuator to be used in all "smoke" cases.



ONLY where a smoke plume is generated. Not applicable to most aesthetic procedures except ablative resurfacing.





## "Laser Masks"

•  $\mu$  Filtration Masks are Not First Line of Protection For Occupational Exposure to Surgical Smoke

• Fit Tested

• Must Be Worn and Disposed of Properly

• Effective Only When Media is Dry

• 100% Compliance for All Smoke Producing Procedures



HCF Shall Rely On Appropriate LEV As First Line Of Protection For Occupational Exposure To LGAC (ANSI)

## 65. Laser Safety

ANSI Laser Safety Practice Guidelines

- ANSI Guidelines deal SOLELY with a laser safe environment for personnel.
- ANSI Guidelines DO NOT deal with ANY clinical treatment safety practices nor treatment guidelines.



## Laser Safety Hazards versus Patient Treatment Hazards

## 66. Laser Safety

ANSI Guidelines – Laser Safety Training

- Provided to ALL health care personnel responsible for ALL perioperative activities related to laser.
- Essentially this means that anyone that might be in the laser room, or even might HAVE OCCASION to be in a laser room shall be provided with Laser Safety training.

## Laser Safety Program

to Assess & Control Potential Laser Hazards

- **TRAINING** – all personnel that will be working in a laser room, or anyone that might have occasion to enter the room, is **REQUIRED** to have Laser Safety Training. This is essentially ALL perioperative personnel. It must be documented and on file with the LSO.
- **MAINTENANCE** – written service reports are **REQUIRED** to be kept by the LSO (or reference their location). Calibrations must be performed every six months.

**This is the end of the Expanded Laser Certification Review for Hair Removal.**

**If you purchased this review as part of a package for your NCLC Laser Certification Exam, then your exam and testing fee will already be covered.**

**If you want or need (to qualify for the credits) actual training courses, go to [www.LaserTraining.org](http://www.LaserTraining.org)**

**GOOD LUCK ON THE EXAM!**