Proposed
Laser Safety Facts label

Patrick Murphy
Editor, LaserPointerSafety.com

Problems with consumer misuse of visible lasers

- Almost 4,000 reports of lasers aimed at aircraft in the U.S. in 2013
- Increasing reports of consumer injuries from lasers
  - 14 persons in Saudi Arabia (2 of them children)
  - 9-year-old injured in both eyes by his uncle
  - Five children injured in U.K.

Solution must be multi-faceted

About 10 times a night, U.S. pilots report seeing or being illuminated by laser beams. The primary hazard is temporary interference with vision – distraction, glare, flashblindness – during critical phases of flight such as takeoff and landing.

Some ways to help reduce the number and severity of laser pointer/aircraft incidents

Pilot training & glasses

Pilots are the last line of defense

- **Provide information** on safely reacting to laser illuminations
- **Mandatory simulator training** with safe bright light
- Cockpit-certified **laser blocking glasses** for 1st responder pilots

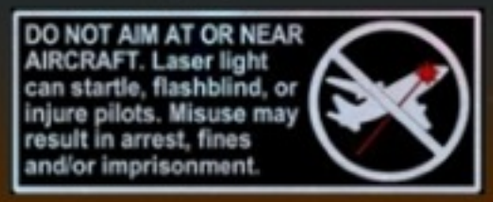
(Note: Anti-laser glasses are NOT recommended for routine use)

Arrests & prosecution

- **Fines and jail** for anyone intentionally aiming at aircraft
- **News reports** of arrests & prosecutions let users know the hazard is serious

Laser labeling

- Manufacturers voluntarily add **aircraft safety labels**
- Government can write new laws **mandating labels**



User education

- Educating users via **laser sellers' websites, manuals**
- **Media coverage** of hazards, prohibitions

If the above does not work, **new laws & restrictions** may be necessary

Limited restrictions

- **Import restrictions** to try to keep out illegal lasers
- **At locations** where misuse is high (beach resorts)
- **By age** (no public possession by youth, teens)

General restrictions or ban

- Nationwide - consider **restricting sale and/or possession** of consumer handheld lasers above a specified power level
- **Exemptions/licenses** for legitimate use

Note: Restrictions may not be effective. Australia banned pointers over 1 milliwatt in 2008, yet aircraft incidents rose 27% from 2008 to 2011. A 2013 scientific study concluded that the ban "may have detrimentally affected laser pointer safety within Australia without overtly impacting availability."

Source: LaserPointerSafety.com

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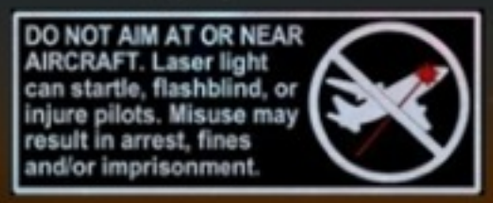

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Problems with current labels

- Designed for experts, back when lasers were expensive and bulky
- What does this IEC label mean to consumers?

- What is “Laser 2”? What are the hazards?

Problems with current labels (2)

- What do these labels mean to consumers?

- What is “Laser 4” or “Class IV”?
- What is “direct or scattered radiation”? Do you mean “Don’t look into the light beam, or at the bright dot”?

Problems with current labels (3)

- No warning against aiming at aircraft
  - No indication this is hazardous to pilots
  - No indication this is illegal —the user may be arrested or jailed

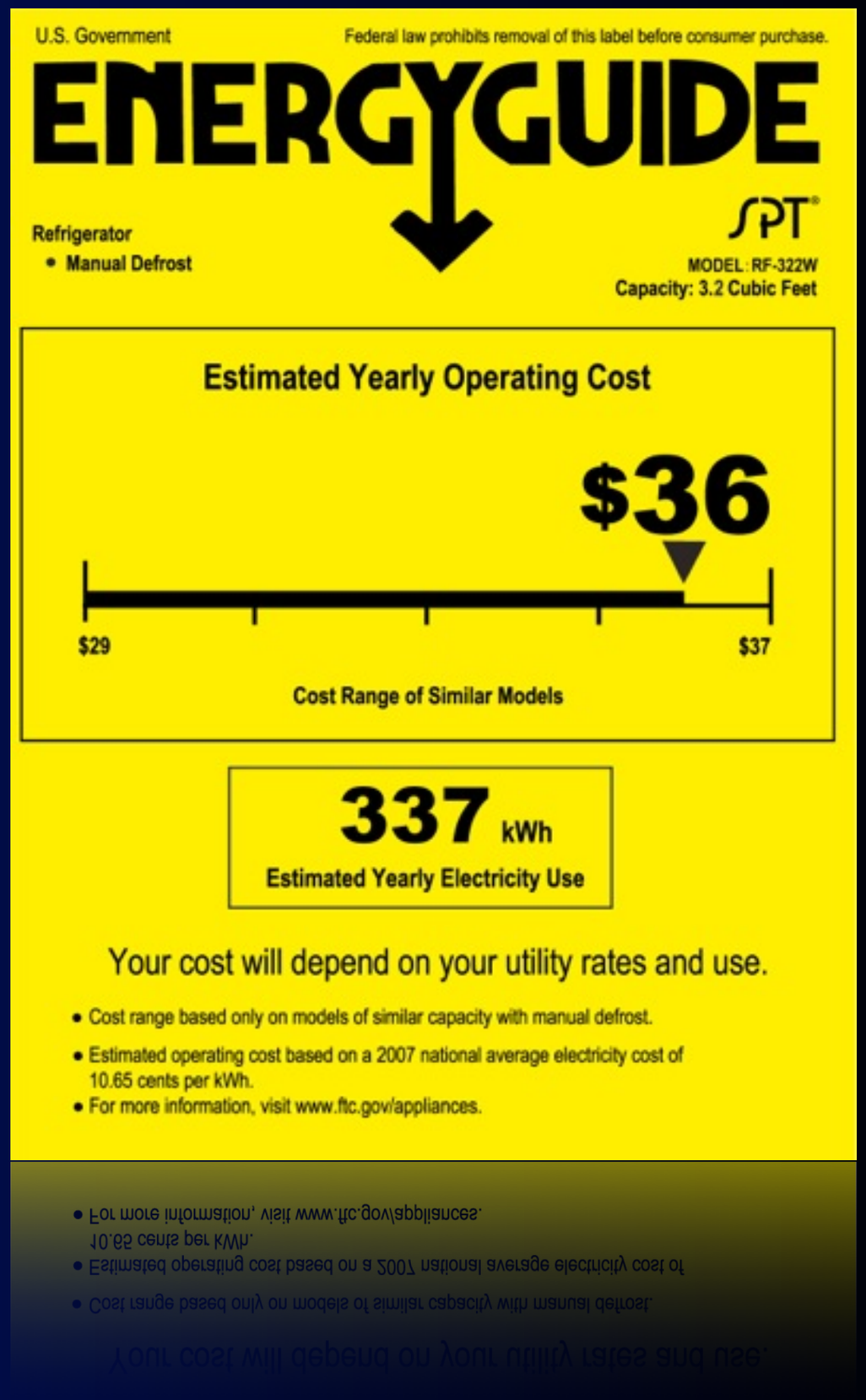
Advantages to improved labeling

- Give more information to consumers
  - More hazards, and more specifics on hazards
- Help reduce the number of laser/aircraft incidents
- Make laser/aircraft convictions easier
  - If the user has been specifically warned not to aim at aircraft

Look to current labels for guidance

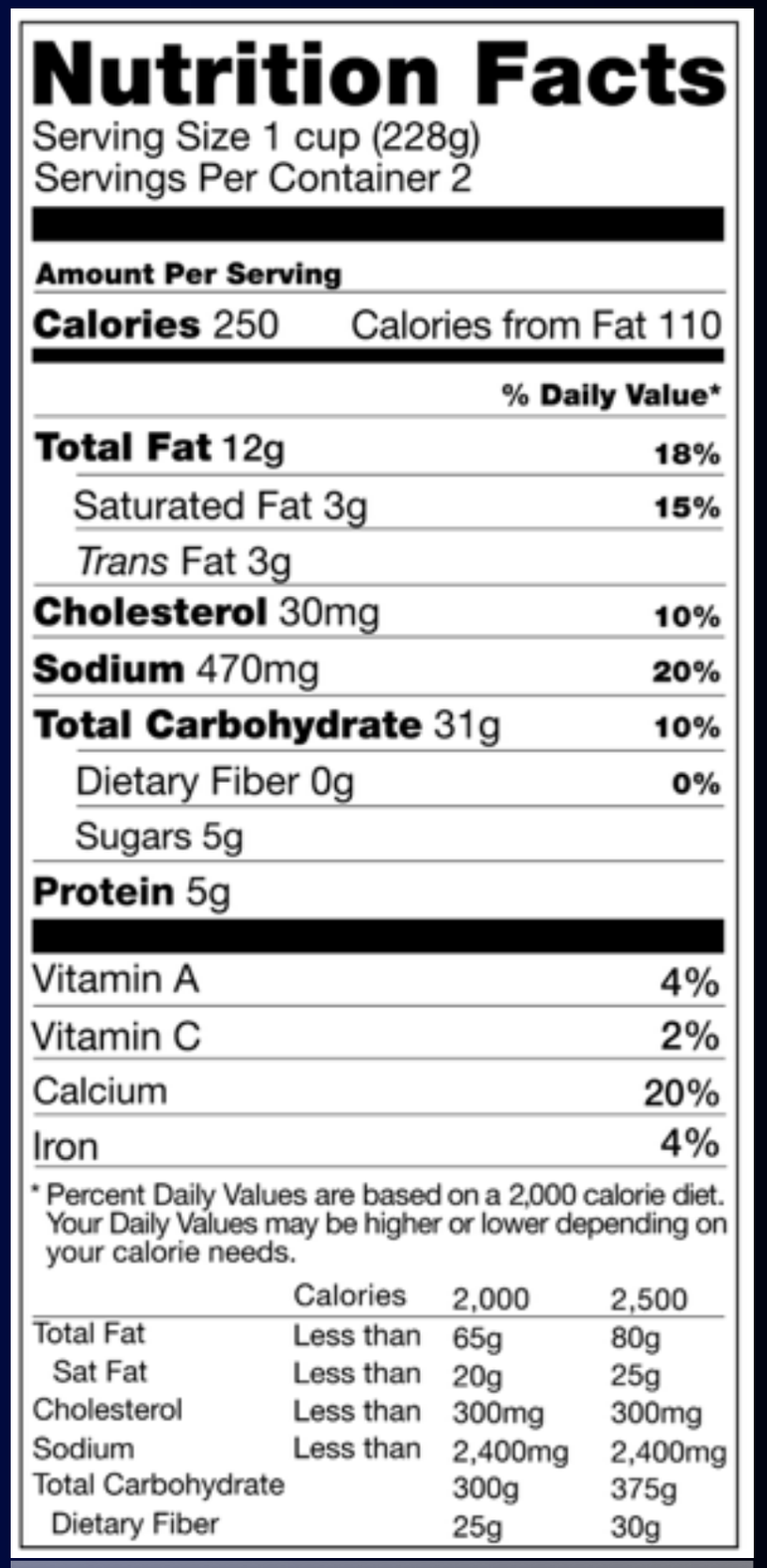
Current federally-mandated labels

EnergyGuide (FTC/EPA)



Current federally-mandated labels

Nutrition Facts
(FDA)



Nutrition Facts

Serving Size 1 cup (228g)
Servings Per Container 2

Amount Per Serving

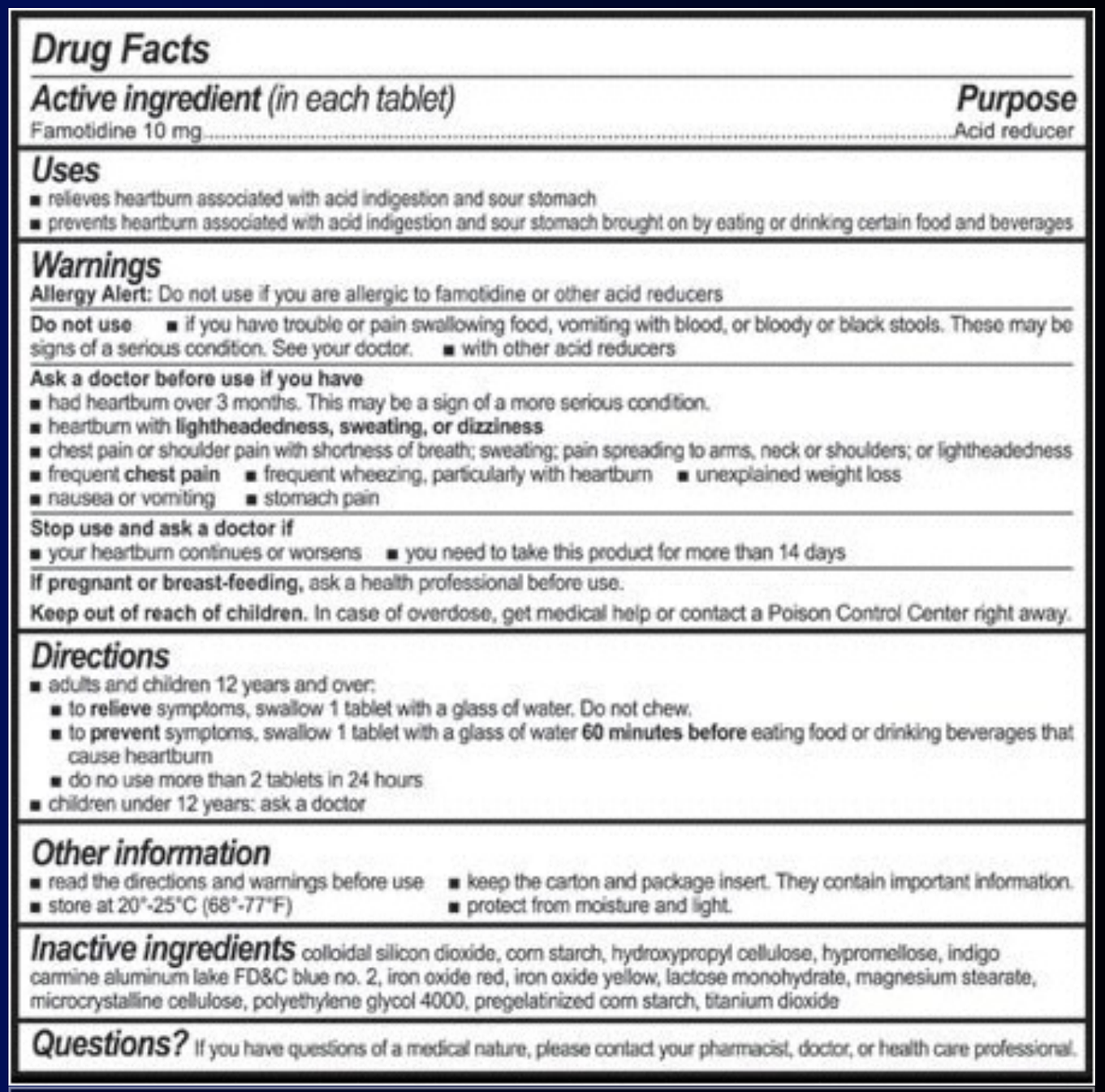
Calories 250	Calories from Fat 110
	% Daily Value*
Total Fat 12g	**18%**
Saturated Fat 3g	**15%**
Trans Fat 3g	
Cholesterol 30mg	**10%**
Sodium 470mg	**20%**
Total Carbohydrate 31g	**10%**
Dietary Fiber 0g	**0%**
Sugars 5g	
Protein 5g	
Vitamin A	4%
Vitamin C	2%
Calcium	20%
Iron	4%

* Percent Daily Values are based on a 2,000 calorie diet. Your Daily Values may be higher or lower depending on your calorie needs.

	Calories	2,000	2,500
Total Fat	Less than	65g	80g
Sat Fat	Less than	20g	25g
Cholesterol	Less than	300mg	300mg
Sodium	Less than	2,400mg	2,400mg
Total Carbohydrate		300g	375g
Dietary Fiber		25g	30g

Current federally-mandated labels

Over-the-Counter Drug Facts
(FDA)



Drug Facts

Active ingredient *(in each tablet)* — **Purpose**

Famotidine 10 mg ..... Acid reducer

Uses

- relieves heartburn associated with acid indigestion and sour stomach
- prevents heartburn associated with acid indigestion and sour stomach brought on by eating or drinking certain food and beverages

Warnings

Allergy Alert: Do not use if you are allergic to famotidine or other acid reducers

Do not use ■ if you have trouble or pain swallowing food, vomiting with blood, or bloody or black stools. These may be signs of a serious condition. See your doctor. ■ with other acid reducers

Ask a doctor before use if you have

- had heartburn over 3 months. This may be a sign of a more serious condition.
- heartburn with **lightheadedness, sweating, or dizziness**
- chest pain or shoulder pain with shortness of breath; sweating; pain spreading to arms, neck or shoulders; or lightheadedness
- frequent **chest pain** ■ frequent wheezing, particularly with heartburn ■ unexplained weight loss
- nausea or vomiting ■ stomach pain

Stop use and ask a doctor if

- your heartburn continues or worsens ■ you need to take this product for more than 14 days

If pregnant or breast-feeding, ask a health professional before use.

Keep out of reach of children. In case of overdose, get medical help or contact a Poison Control Center right away.

Directions

- adults and children 12 years and over:
  - to **relieve** symptoms, swallow 1 tablet with a glass of water. Do not chew.
  - to **prevent** symptoms, swallow 1 tablet with a glass of water **60 minutes before** eating food or drinking beverages that cause heartburn
  - do no use more than 2 tablets in 24 hours
- children under 12 years: ask a doctor

Other information

- read the directions and warnings before use
- keep the carton and package insert. They contain important information.
- store at 20°-25°C (68°-77°F)
- protect from moisture and light.

Inactive ingredients colloidal silicon dioxide, corn starch, hydroxypropyl cellulose, hypromellose, indigo carmine aluminum lake FD&C blue no. 2, iron oxide red, iron oxide yellow, lactose monohydrate, magnesium stearate, microcrystalline cellulose, polyethylene glycol 4000, pregelatinized corn starch, titanium dioxide

Questions? If you have questions of a medical nature, please contact your pharmacist, doctor, or health care professional.

Current federally-mandated labels

Lighting Facts
(FTC and DOE)

Lighting Facts™

LED Product

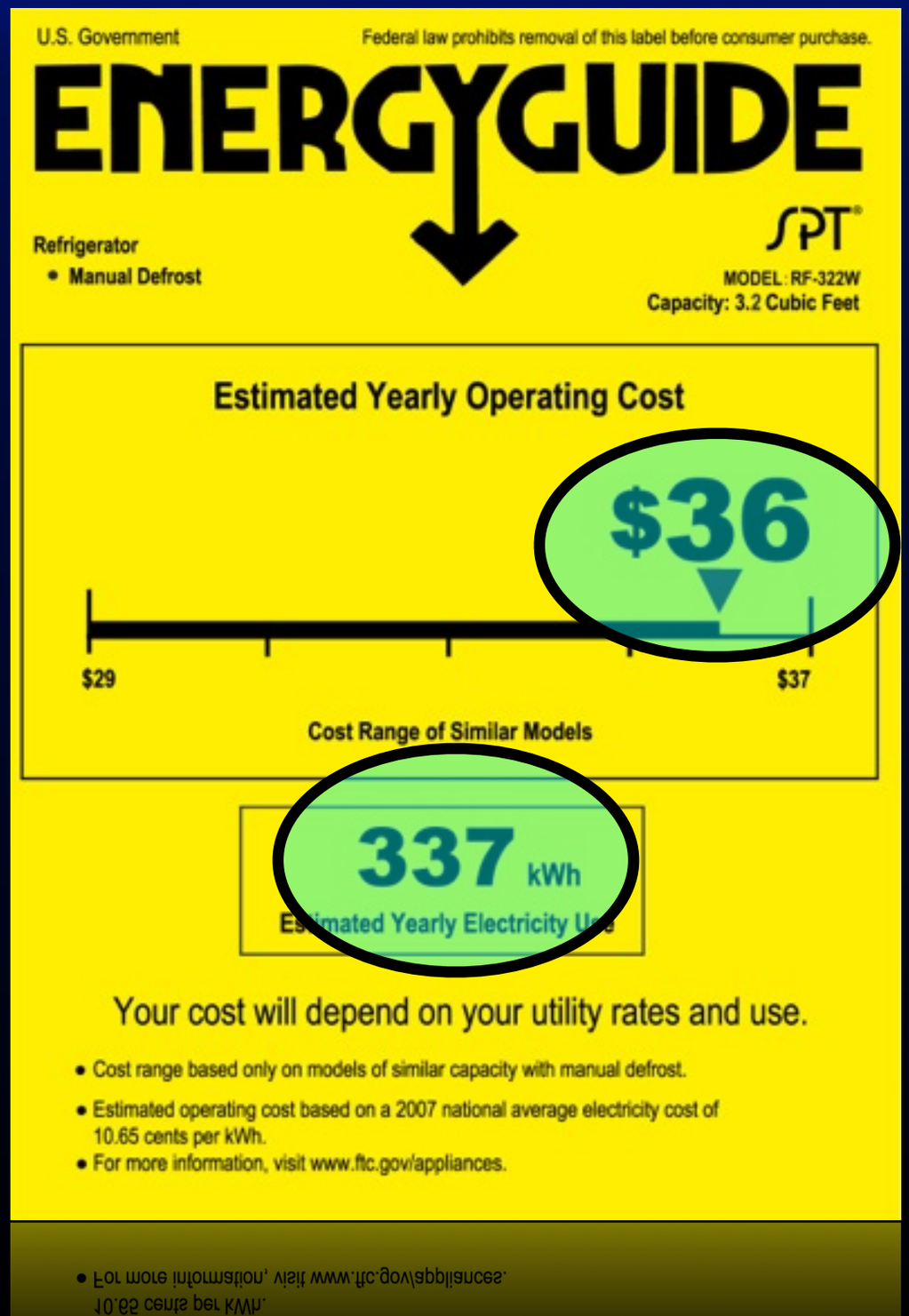
Light Output (Lumens)	345
Watts	8
Lumens per Watt (Efficacy)	46
Color Accuracy Color Rendering Index (CRI)	64

Light Color
Correlated Color Temperature (CCT) — 3054 (Warm White)

Visit www.lighting-facts.com for the *Label Reference Guide*.

All results are according to IESNA LM-79-2008: *Approved Method for the Electrical and Photometric Testing of Solid-State Lighting.*

Note: They all use specific numbers



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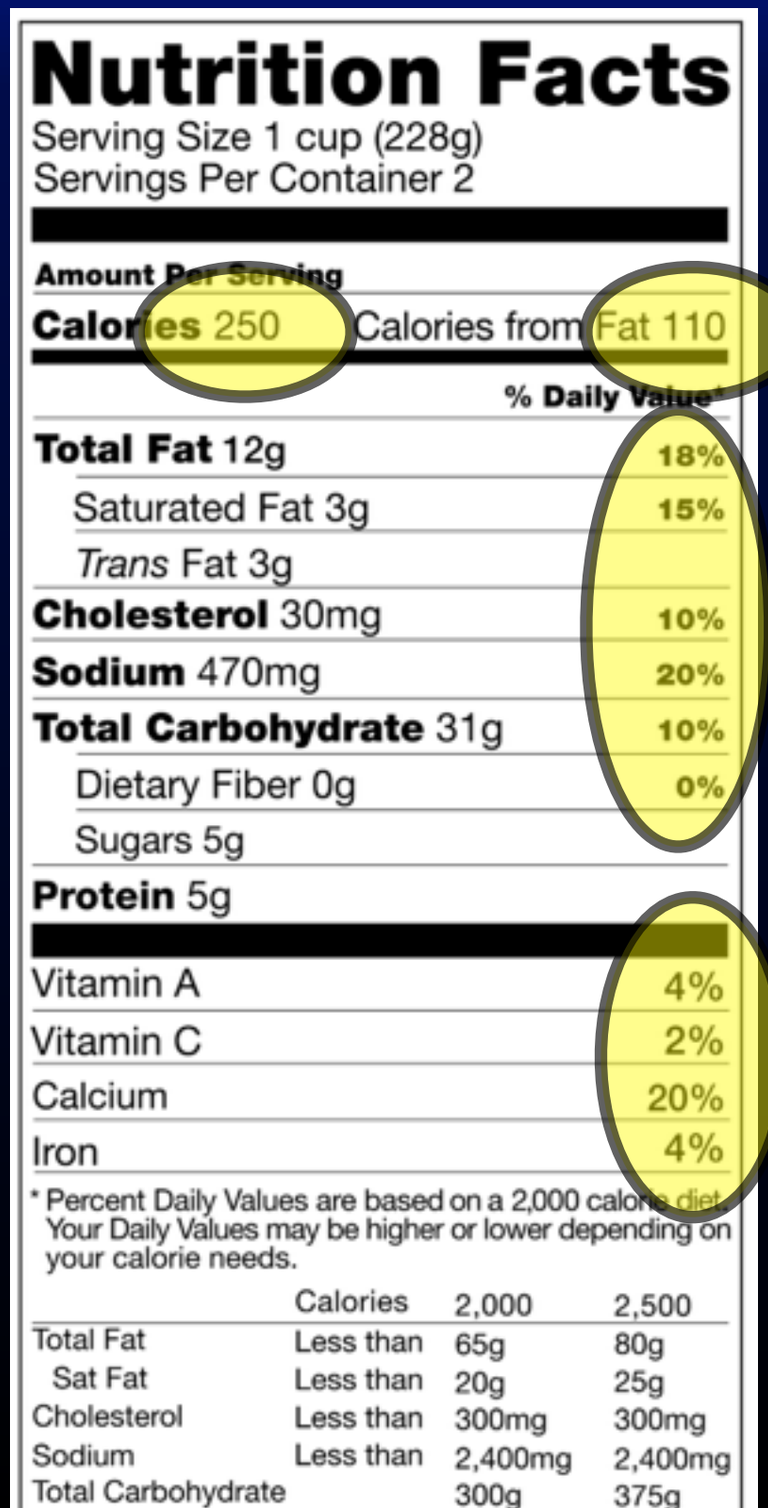

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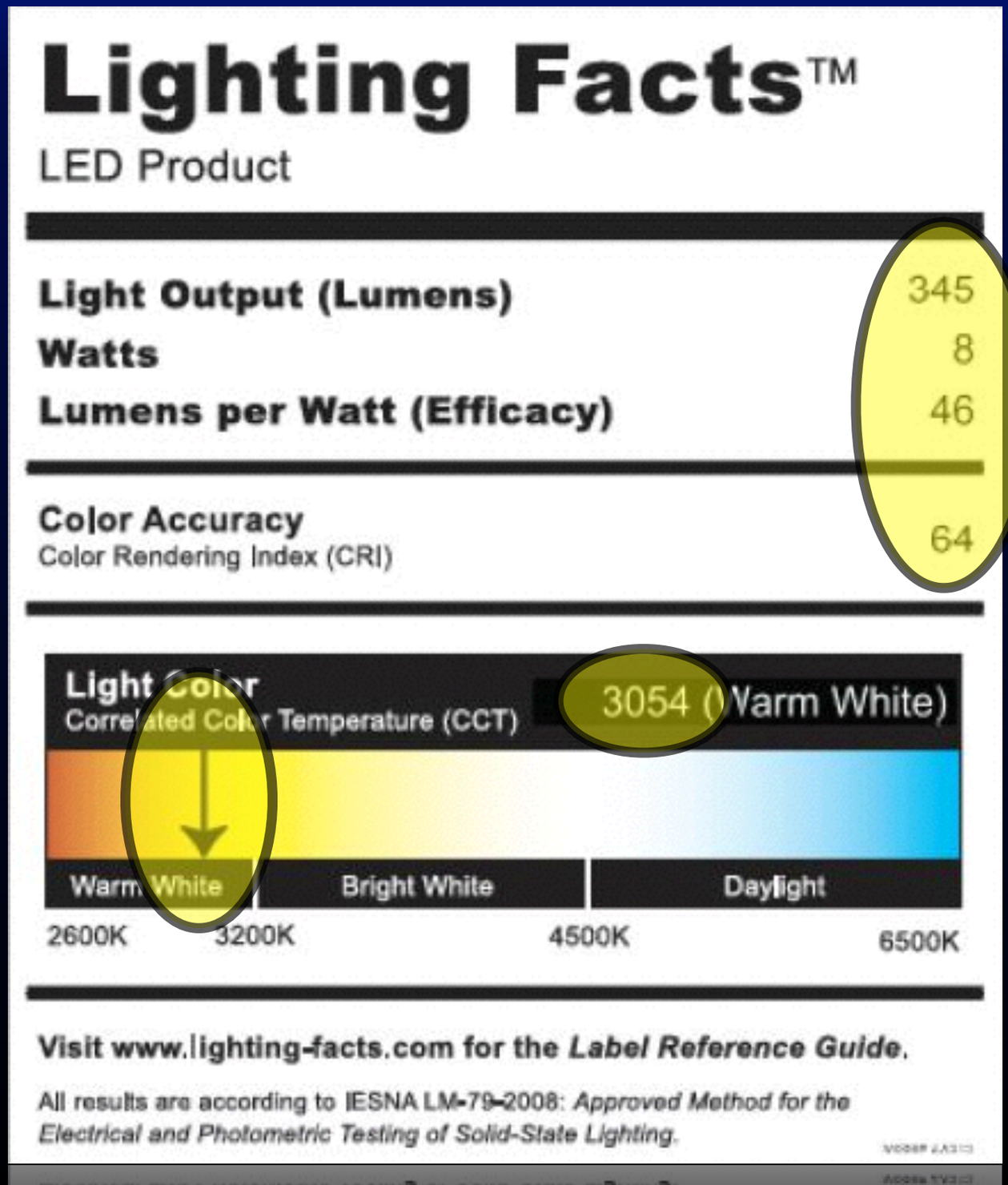

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Warm White | Bright White | Daylight

2600K 3200K 4500K 6500K

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The proposed Laser Safety Facts label

Laser Safety Facts label

Currently intended for consumer pointers, handhelds, and projectors that emit visible laser beams

Legally required safety label

Legally required safety label

Can use any legally valid graphic format

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Legally required safety label

Laser parameters
(includes minimum divergence)

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Title, and QR code for website

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Safe use guidance

Legally required safety label

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Laser hazards

Safe use guidance

Where to find additional info

Legally required safety label

Laser parameters
(includes minimum divergence)

Title, and QR code for website

Laser hazards

Safe use guidance

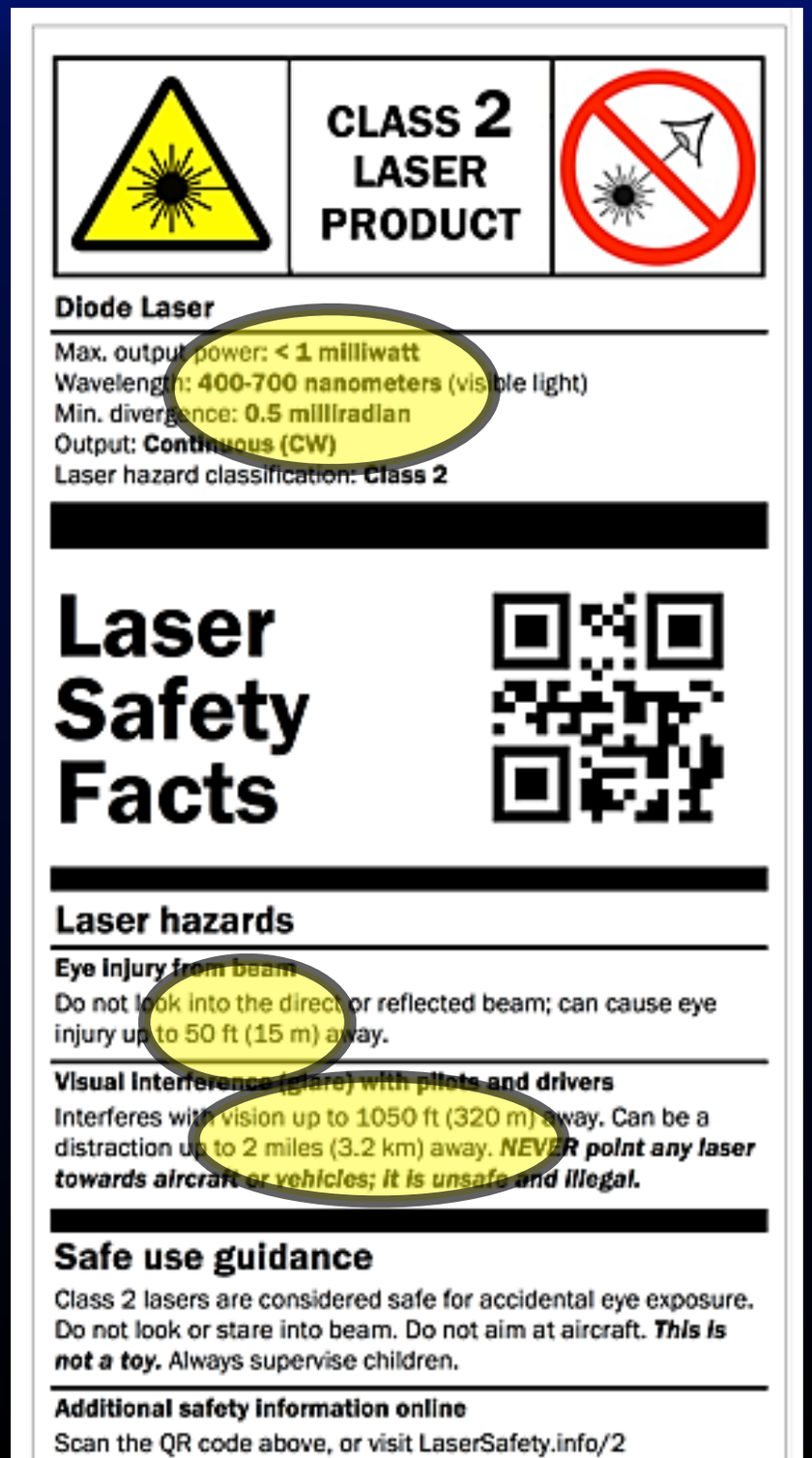
Where to find additional info

Manufacturer info

Intended for use on:

- Large lasers such as laser show projectors
- Outer packaging or hang tag
- User manual
- Marketing brochures, websites, etc.

Note: Uses specific numbers



CLASS 2
LASER
PRODUCT

Diode Laser

Max. output power: **< 1 milliwatt**
Wavelength: **400-700 nanometers** (visible light)
Min. divergence: **0.5 milliradian**
Output: **Continuous (CW)**
Laser hazard classification: **Class 2**

Laser Safety Facts

Laser hazards

Eye injury from beam

Do not look into the direct or reflected beam; can cause eye injury up to 50 ft (15 m) away.

Visual interference (glare) with pilots and drivers

Interferes with vision up to 1050 ft (320 m) away. Can be a distraction up to 2 miles (3.2 km) away. ***NEVER point any laser towards aircraft or vehicles; it is unsafe and illegal.***

Safe use guidance

Class 2 lasers are considered safe for accidental eye exposure. Do not look or stare into beam. Do not aim at aircraft. ***This is not a toy.*** Always supervise children.

Additional safety information online

Scan the QR code above, or visit LaserSafety.info/2

Labels for smaller lasers

For smaller lasers

- Can use existing labels, plus…
  - Add the URL web address (LaserSafety.info)
  - If there is room, add a QR or Data Matrix barcode
  - For outdoor lasers, add a warning against aiming at aircraft

Examples

- For laser pointers and portable handheld lasers

- Contains aircraft warnings

Examples

- For non-outdoor, non-portable lasers

- Does NOT contain aircraft warnings

The QR code

QR code = website address

= LSF.ME/2

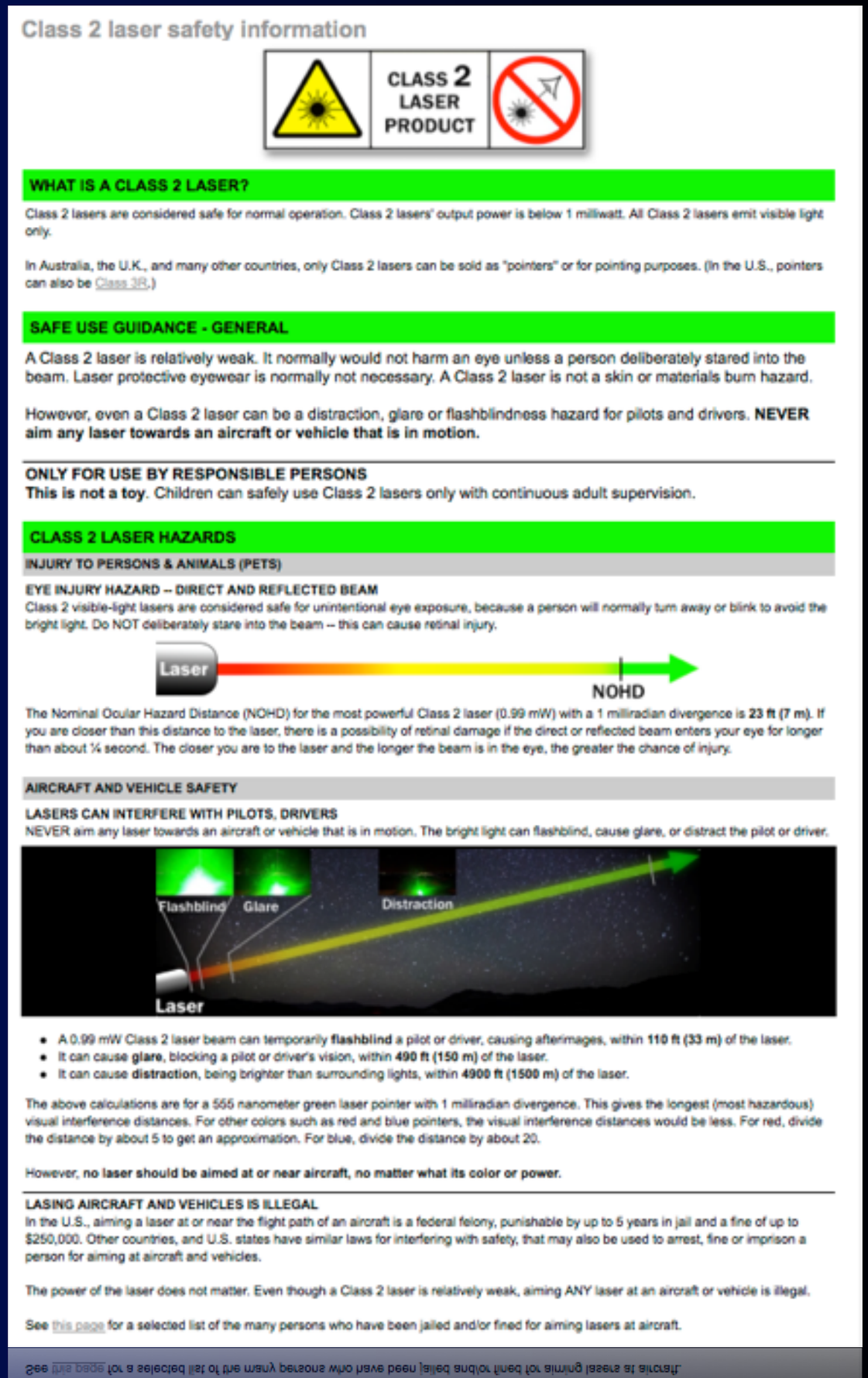
This automatically redirects to LaserSafetyFacts.com/2, a web page about Class 2 laser hazards

Use a smartphone or tablet to scan…

…and automatically be taken to a web page

The QR code

- Takes the user to a website page with more detailed safety information
- Can also get there by typing a human-readable URL such as LaserSafety.info/2



Class 2 laser safety information

CLASS 2 LASER PRODUCT

WHAT IS A CLASS 2 LASER?

Class 2 lasers are considered safe for normal operation. Class 2 lasers' output power is below 1 milliwatt. All Class 2 lasers emit visible light only.

In Australia, the U.K., and many other countries, only Class 2 lasers can be sold as "pointers" or for pointing purposes. (In the U.S., pointers can also be Class 3R.)

SAFE USE GUIDANCE - GENERAL

A Class 2 laser is relatively weak. It normally would not harm an eye unless a person deliberately stared into the beam. Laser protective eyewear is normally not necessary. A Class 2 laser is not a skin or materials burn hazard.

However, even a Class 2 laser can be a distraction, glare or flashblindness hazard for pilots and drivers. **NEVER aim any laser towards an aircraft or vehicle that is in motion.**

ONLY FOR USE BY RESPONSIBLE PERSONS

This is not a toy. Children can safely use Class 2 lasers only with continuous adult supervision.

CLASS 2 LASER HAZARDS

INJURY TO PERSONS & ANIMALS (PETS)

EYE INJURY HAZARD -- DIRECT AND REFLECTED BEAM

Class 2 visible-light lasers are considered safe for unintentional eye exposure, because a person will normally turn away or blink to avoid the bright light. Do NOT deliberately stare into the beam -- this can cause retinal injury.

The Nominal Ocular Hazard Distance (NOHD) for the most powerful Class 2 laser (0.99 mW) with a 1 milliradian divergence is **23 ft (7 m)**. If you are closer than this distance to the laser, there is a possibility of retinal damage if the direct or reflected beam enters your eye for longer than about ¼ second. The closer you are to the laser and the longer the beam is in the eye, the greater the chance of injury.

AIRCRAFT AND VEHICLE SAFETY

LASERS CAN INTERFERE WITH PILOTS, DRIVERS

NEVER aim any laser towards an aircraft or vehicle that is in motion. The bright light can flashblind, cause glare, or distract the pilot or driver.

- A 0.99 mW Class 2 laser beam can temporarily **flashblind** a pilot or driver, causing afterimages, within **110 ft (33 m)** of the laser.
- It can cause **glare**, blocking a pilot or driver's vision, within **490 ft (150 m)** of the laser.
- It can cause **distraction**, being brighter than surrounding lights, within **4900 ft (1500 m)** of the laser.

The above calculations are for a 555 nanometer green laser pointer with 1 milliradian divergence. This gives the longest (most hazardous) visual interference distances. For other colors such as red and blue pointers, the visual interference distances would be less. For red, divide the distance by about 5 to get an approximation. For blue, divide the distance by about 20.

However, **no laser should be aimed at or near aircraft, no matter what its color or power.**

LASING AIRCRAFT AND VEHICLES IS ILLEGAL

In the U.S., aiming a laser at or near the flight path of an aircraft is a federal felony, punishable by up to 5 years in jail and a fine of up to $250,000. Other countries, and U.S. states have similar laws for interfering with safety, that may also be used to arrest, fine or imprison a person for aiming at aircraft and vehicles.

The power of the laser does not matter. Even though a Class 2 laser is relatively weak, aiming ANY laser at an aircraft or vehicle is illegal.

See this page for a selected list of the many persons who have been jailed and/or fined for aiming lasers at aircraft.

Why a website page?

- Contains additional hazard information, diagrams
- Uniform consistency for all lasers
- Easy to update as needed
- Solves the problem of lost user manuals
- Can contain links to sites such as FDA

Problem:

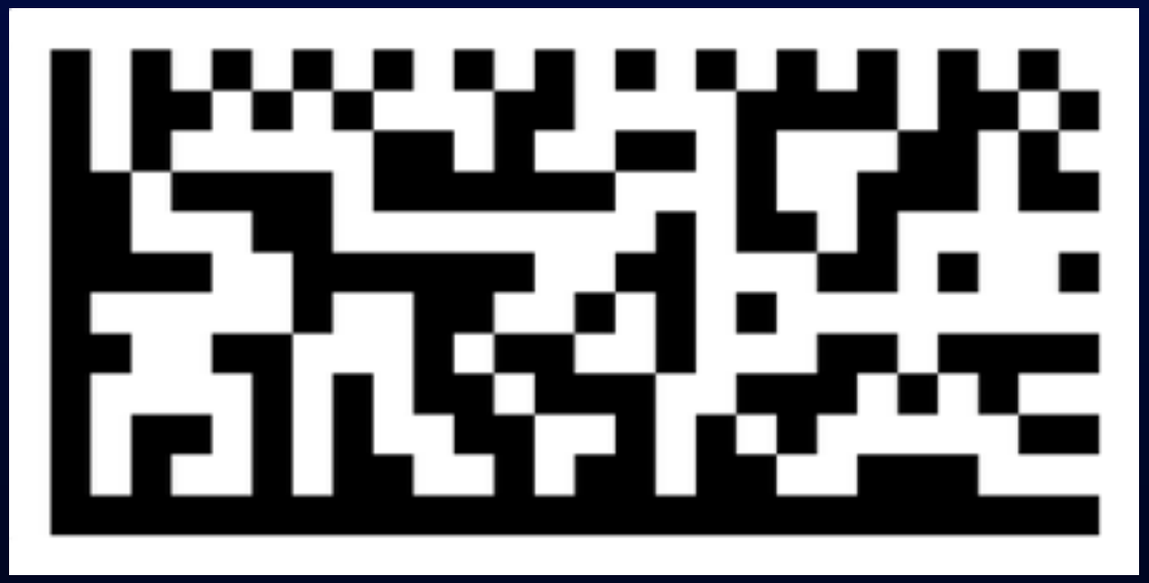
No space on small lasers

QR codes cannot be read if too curved

- This cannot be scanned if more than 1/3 the cylinder diameter

To help with small lasers…

- Uses a different encoding called Data Matrix or DM
  - Rectangular format
- Helps solve problem of distorted QM codes on cylinders



Data Matrix code for LSF.ME/3R

QR and DM codes, and where they redirect

SCAN CODE OR VISIT
LASERSAFETY.INFO/2

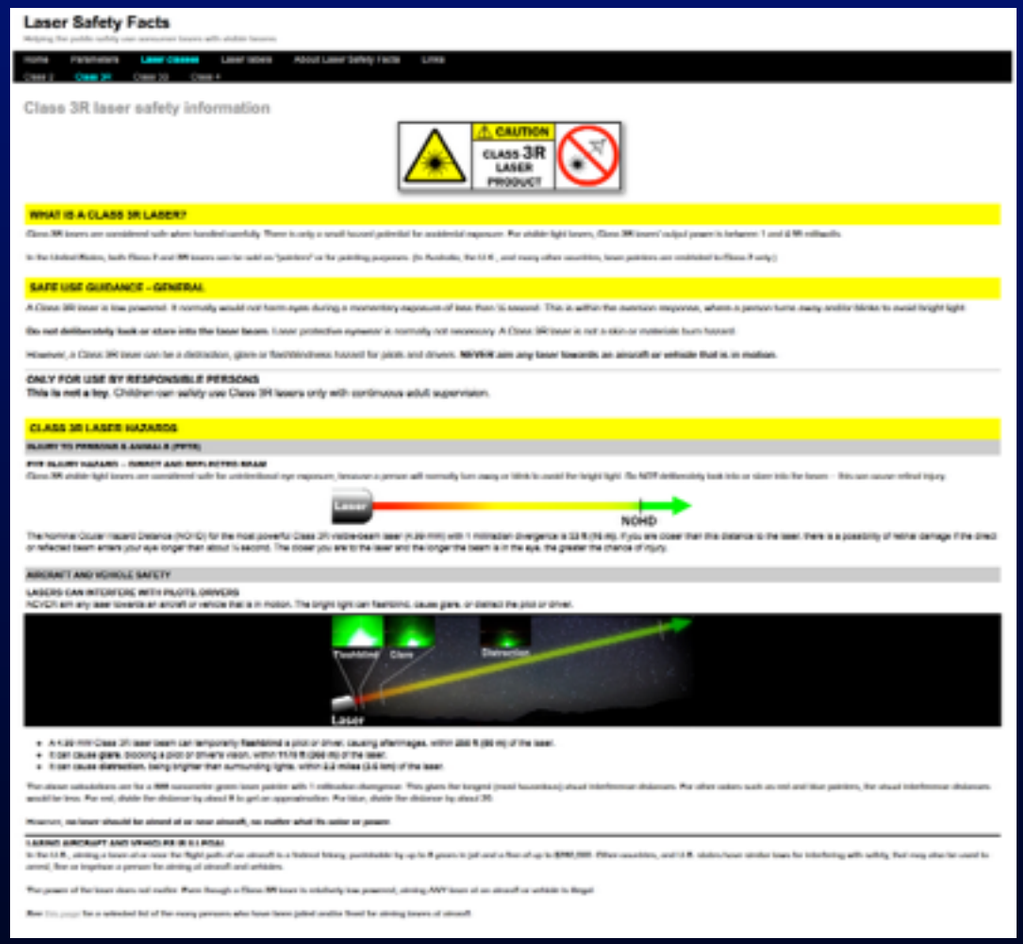
LSF.ME/2

These automatically redirect to LaserSafetyFacts.com/2, a web page about Class 2 laser hazards

SCAN CODE OR VISIT
LASERSAFETY.INFO/3R

LSF.ME/3R

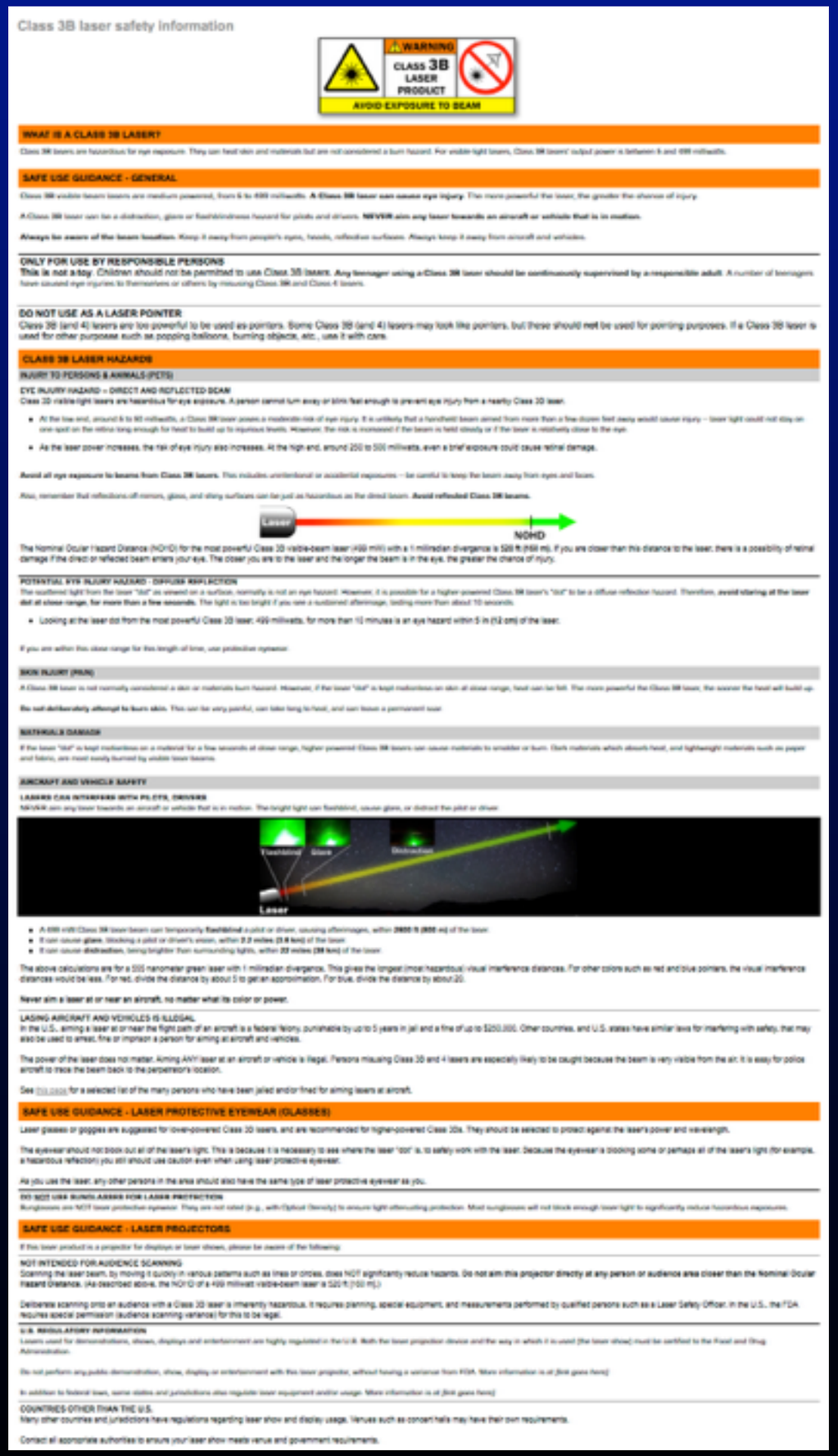
These automatically redirect to LaserSafetyFacts.com/3R, a web page about Class 3R laser hazards



SCAN CODE OR VISIT
LASERSAFETY.INFO/3B

LSF.ME/3B

These automatically redirect to LaserSafetyFacts.com/3B, a web page about Class 3B laser hazards



Class 3B laser safety information

WARNING
CLASS 3B LASER PRODUCT
AVOID EXPOSURE TO BEAM

WHAT IS A CLASS 3B LASER?

Class 3R lasers are hazardous for eye exposure. They can heat skin and materials but are not considered a burn hazard. For visible-light lasers, Class 3R lasers' output power is between 5 and 499 milliwatts.

SAFE USE GUIDANCE - GENERAL

Class 3B visible-beam lasers are medium-powered, from 5 to 499 milliwatts. **A Class 3B laser can cause eye injury.** The more powerful the laser, the greater the chance of injury.

A Class 3B laser can be a distraction, glare or flashblindness hazard for pilots and drivers. **NEVER aim any laser towards an aircraft or vehicle that is in motion.**

Always be aware of the beam location. Keep it away from people's eyes, hands, reflective surfaces. Always keep it away from aircraft and vehicles.

ONLY FOR USE BY RESPONSIBLE PERSONS
This is not a toy. Children should not be permitted to use Class 3B lasers. **Any teenager using a Class 3B laser should be continuously supervised by a responsible adult.** A number of teenagers have caused eye injuries to themselves or others by misusing Class 3R and Class 4 lasers.

DO NOT USE AS A LASER POINTER
Class 3B (and 4) lasers are too powerful to be used as pointers. Some Class 3B (and 4) lasers may look like pointers, but these should not be used for pointing purposes. If a Class 3B laser is used for other purposes such as popping balloons, burning objects, etc., use it with care.

CLASS 3B LASER HAZARDS

INJURY TO PERSONS & ANIMALS (PETS)

EYE INJURY HAZARD – DIRECT AND REFLECTED BEAM
Class 3B visible-light lasers are hazardous for eye exposure. A person cannot turn away or blink fast enough to prevent eye injury from a nearby Class 3B laser.

- At the low end, around 5 to 50 milliwatts, a Class 3B laser poses a moderate risk of eye injury. It is unlikely that a handheld beam aimed from more than a few dozen feet away would cause injury – laser light could not stay on one spot on the retina long enough for heat to build up to injurious levels. However, the risk is increased if the beam is held steady or if the laser is relatively close to the eye.
- As the laser power increases, the risk of eye injury also increases. At the high end, around 250 to 500 milliwatts, even a brief exposure could cause retinal damage.

Avoid all eye exposure to beams from Class 3B lasers. This includes unintentional or accidental exposures – be careful to keep the beam away from eyes and faces.

Also, remember that reflections off mirrors, glass, and shiny surfaces can be just as hazardous as the direct beam. **Avoid reflected Class 3B beams.**

The Nominal Ocular Hazard Distance (NOHD) for the most powerful Class 3B visible-beam laser (499 mW) with a 1 milliradian divergence is 526 ft (160 m). If you are closer than this distance to the laser, there is a possibility of retinal damage if the direct or reflected beam enters your eye. The closer you are to the laser and the longer the beam is in the eye, the greater the chance of injury.

POTENTIAL EYE INJURY HAZARD - DIFFUSE REFLECTION
The scattered light from the laser "dot" as viewed on a surface, normally is not an eye hazard. However, it is possible for a higher-powered Class 3B laser's "dot" to be a diffuse reflection hazard. Therefore, **avoid staring at the laser dot at close range, for more than a few seconds.** The light is too bright if you see a sunburned afterimage, lasting more than about 10 seconds.

- Looking at the laser dot from the most powerful Class 3B laser, 499 milliwatts, for more than 10 minutes is an eye hazard within 5 in (12 cm) of the laser.

If you are within this close range for this length of time, use protective eyewear.

SKIN INJURY (RISK)

A Class 3B laser is not normally considered a skin or materials burn hazard. However, if the laser "dot" is kept motionless on skin at close range, heat can be felt. The more powerful the Class 3B laser, the sooner the heat will build up.

Do not deliberately attempt to burn skin. This can be very painful, can take long to heal, and can leave a permanent scar.

MATERIALS DAMAGE

If the laser "dot" is kept motionless on a material for a few seconds at close range, higher-powered Class 3B lasers can cause materials to smolder or burn. Dark materials which absorb heat, and lightweight materials such as paper and fabric, are most easily burned by visible laser beams.

AIRCRAFT AND VEHICLE SAFETY

LASERS CAN INTERFERE WITH PILOTS, DRIVERS
NEVER aim any laser towards an aircraft or vehicle that is in motion. The bright light can flashblind, cause glare, or distract the pilot or driver.

- A 500 mW Class 3B laser beam can temporarily **flashblind** a pilot or driver, causing afterimages, within **2600 ft (800 m)** of the laser.
- It can cause **glare**, blocking a pilot or driver's vision, within **2.2 miles (3.6 km)** of the laser.
- It can cause **distraction**, being brighter than surrounding lights, within **22 miles (35 km)** of the laser.

The above calculations are for a 555 nanometer green laser with 1 milliradian divergence. This gives the longest (most hazardous) visual interference distances. For other colors such as red and blue pointers, the visual interference distances would be less. For red, divide the distance by about 3 to get an approximation. For blue, divide the distance by about 20.

Never aim a laser at or near an aircraft, no matter what its color or power.

LASING AIRCRAFT AND VEHICLES IS ILLEGAL
In the U.S., aiming a laser at or near the flight path of an aircraft is a federal felony, punishable by up to 5 years in jail and a fine of up to $250,000. Other countries, and U.S. states have similar laws for interfering with safety, that may also be used to arrest, fine or imprison a person for aiming at aircraft and vehicles.

The power of the laser does not matter. Aiming ANY laser at an aircraft or vehicle is illegal. Persons misusing Class 3B and 4 lasers are especially likely to be caught because the beam is very visible from the air. It is easy for police aircraft to trace the beam back to the perpetrator's location.

See this page for a selected list of the many persons who have been jailed and/or fined for aiming lasers at aircraft.

SAFE USE GUIDANCE - LASER PROTECTIVE EYEWEAR (GLASSES)

Laser glasses or goggles are suggested for lower-powered Class 3B lasers, and are recommended for higher-powered Class 3Bs. They should be selected to protect against the laser's power and wavelength.

The eyewear should not block out all of the laser's light. This is because it is necessary to see where the laser "dot" is, to safely work with the laser. Because the eyewear is blocking some or perhaps all of the laser's light (for example, a hazardous reflection) you still should use caution even when using laser protective eyewear.

As you use the laser, any other persons in the area should also have the same type of laser protective eyewear as you.

DO NOT USE SUNGLASSES FOR LASER PROTECTION
Sunglasses are NOT laser protective eyewear. They are not rated (e.g., with Optical Density) to ensure light-attenuating protection. Most sunglasses will not block enough laser light to significantly reduce hazardous exposures.

SAFE USE GUIDANCE - LASER PROJECTORS

If this laser product is a projector for displays or laser shows, please be aware of the following:

NOT INTENDED FOR AUDIENCE SCANNING
Scanning the laser beam, by moving it quickly in various patterns such as lines or circles, does NOT significantly reduce hazards. Do not aim this projector directly at any person or audience area closer than the Nominal Ocular Hazard Distance. (As described above, the NOHD of a 499 milliwatt visible-beam laser is 526 ft (160 m).)

Deliberate scanning onto an audience with a Class 3B laser is inherently hazardous. It requires planning, special equipment, and measurements performed by qualified persons such as a Laser Safety Officer. In the U.S., the FDA requires special permission (audience scanning variance) for this to be legal.

U.S. REGULATORY INFORMATION
Lasers used for demonstrations, shows, displays and entertainment are highly regulated in the U.S. Both the laser projection device and the way in which it is used (the laser show) must be certified by the Food and Drug Administration.

Do not perform any public demonstration, show, display or entertainment with this laser projector, without having a variance from FDA. More information is at (link goes here)

In addition to federal laws, some states and jurisdictions also regulate laser equipment and/or usage. More information is at (link goes here)

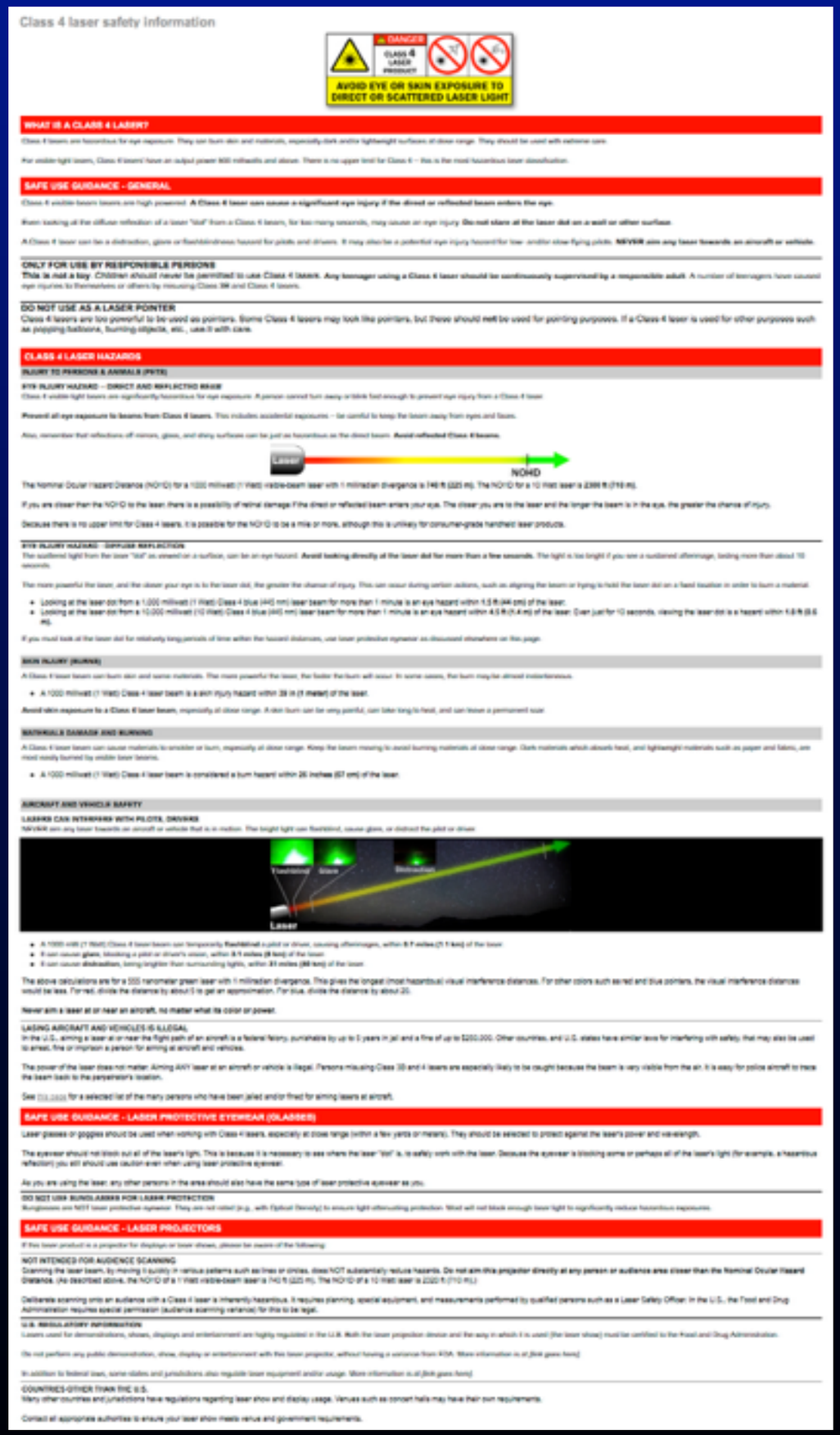
COUNTRIES OTHER THAN THE U.S.
Many other countries and jurisdictions have regulations regarding laser show and display usage. Venues such as concert halls may have their own requirements.

Contact all appropriate authorities to ensure your laser show meets venue and government requirements.

SCAN CODE OR VISIT
LASERSAFETY.INFO/4

LSF.ME/4

These automatically redirect to LaserSafetyFacts.com/4, a web page about Class 4 laser hazards



Class 4 laser safety information

DANGER
CLASS 4 LASER PRODUCT
AVOID EYE OR SKIN EXPOSURE TO DIRECT OR SCATTERED LASER LIGHT

WHAT IS A CLASS 4 LASER?

Class 4 lasers are hazardous for eye exposure. They can burn skin and materials, especially dark and/or lightweight surfaces at close range. They should be used with extreme care.

For visible-light lasers, Class 4 lasers have an output power 500 milliwatts and above. There is no upper limit for Class 4 — this is the most hazardous laser classification.

SAFE USE GUIDANCE - GENERAL

Class 4 visible-beam lasers are high-powered. **A Class 4 laser can cause a significant eye injury if the direct or reflected beam enters the eye.**

Even looking at the diffuse reflection of a laser "dot" from a Class 4 lasers, for too many seconds, may cause an eye injury. **Do not stare at the laser dot on a wall or other surface.**

A Class 4 laser can be a distraction, glare or flash/dazzle hazard for pilots and drivers. It may also be a potential eye injury hazard for low- and/or slow-flying pilots. **NEVER aim any laser towards an aircraft or vehicle.**

ONLY FOR USE BY RESPONSIBLE PERSONS

This is not a toy. Children should never be permitted to use Class 4 lasers. **Any teenager using a Class 4 laser should be continuously supervised by a responsible adult.** A number of teenagers have caused eye injuries to themselves or others by misusing Class 3R and Class 4 lasers.

DO NOT USE AS A LASER POINTER

Class 4 lasers are too powerful to be used as pointers. Some Class 4 lasers may look like pointers, but these should not be used for pointing purposes. If a Class 4 laser is used for other purposes such as popping balloons, burning objects, etc., use it with care.

CLASS 4 LASER HAZARDS

INJURY TO PERSONS & ANIMALS (PPTE)

EYE INJURY HAZARD – DIRECT AND REFLECTED BEAM

Class 4 visible-light lasers are significantly hazardous for eye exposure. A person cannot turn away or blink fast enough to prevent eye injury from a Class 4 laser.

Prevent all eye exposure to beams from Class 4 lasers. This includes accidental exposures – be careful to keep the beam away from eyes and faces.

Also, remember that reflections off mirrors, glass, and shiny surfaces can be just as hazardous as the direct beam. **Avoid reflected Class 4 beams.**

The Nominal Ocular Hazard Distance (NOHD) for a 1000 milliwatt (1 Watt) visible-beam laser with 1 milliradian divergence is 140 ft (225 m). The NOHD for a 10 Watt laser is 2300 ft (710 m).

If you are closer than the NOHD to the laser, there is a possibility of retinal damage if the direct or reflected beam enters your eye. The closer you are to the laser and the longer the beam is in the eye, the greater the chance of injury.

Because there is no upper limit for Class 4 lasers, it is possible for the NOHD to be a mile or more, although this is unlikely for consumer-grade handheld laser products.

EYE INJURY HAZARD – DIFFUSE REFLECTION

The scattered light from the laser "dot" on, viewed on a surface, can be an eye hazard. **Avoid looking directly at the laser dot for more than a few seconds.** The light is too bright if you see a sustained afterimage, lasting more than about 10 seconds.

The more powerful the laser, and the closer your eye is to the laser dot, the greater the chance of injury. This can occur during certain actions, such as aligning the beam or trying to hold the laser dot on a fixed location in order to burn a material.

- Looking at the laser dot from a 1,000 milliwatt (1 Watt) Class 4 blue (440 nm) laser beam for more than 1 minute is an eye hazard within 1.5 ft (44 cm) of the laser.
- Looking at the laser dot from a 10,000 milliwatt (10 Watt) Class 4 blue (440 nm) laser beam for more than 1 minute is an eye hazard within 4.5 ft (1.4 m) of the laser. Even just for 10 seconds, viewing the laser dot is a hazard within 1.5 ft (0.5 m).

If you must look at the laser dot for relatively long periods of time within the hazard distances, use laser protective eyewear as discussed elsewhere on this page.

SKIN INJURY (BURNS)

A Class 4 laser beam can burn skin and some materials. The more powerful the laser, the faster the burn will occur. In some cases, the burn may be almost instantaneous.

- A 1000 milliwatt (1 Watt) Class 4 laser beam is a skin injury hazard within 39 in (1 meter) of the laser.

Avoid skin exposure to a Class 4 laser beam, especially at close range. A skin burn can be very painful, can take long to heal, and can leave a permanent scar.

MATERIALS DAMAGE AND BURNING

A Class 4 laser beam can cause materials to smolder or burn, especially at close range. Keep the beam moving to avoid burning materials at close range. Dark materials which absorb heat, and lightweight materials such as paper and fabric, are most easily burned by visible laser beams.

- A 1000 milliwatt (1 Watt) Class 4 laser beam is considered a burn hazard within 26 inches (67 cm) of the laser.

AIRCRAFT AND VEHICLE SAFETY

LASERS CAN INTERFERE WITH PILOTS, DRIVERS

NEVER aim any laser towards an aircraft or vehicle that is in motion. The bright light can flash-blind, cause glare, or distract the pilot or driver.

- A 1000 mW (1 Watt) Class 4 laser beam can temporarily **flashblind** a pilot or driver, causing afterimages, within **0.7 miles (1.1 km)** of the laser.
- It can cause **glare**, blocking a pilot or driver's vision, within **8.1 miles (8 km)** of the laser.
- It can cause **distraction**, being brighter than surrounding lights, within **31 miles (50 km)** of the laser.

The above calculations are for a 555 nanometer green laser with 1 milliradian divergence. This gives the longest (most hazardous) visual interference distances. For other colors such as red and blue lasers, the visual interference distances would be less. For red, divide the distance by about 5 to get an approximation. For blue, divide the distance by about 20.

Never aim a laser at or near an aircraft, no matter what its color or power.

LASING AIRCRAFT AND VEHICLES IS ILLEGAL

In the U.S., aiming a laser at or near the flight path of an aircraft is a federal felony, punishable by up to 5 years in jail and a fine of up to $250,000. Other countries, and U.S. states have similar laws for interfering with safety, that may also be used to arrest, fine or imprison a person for aiming at aircraft and vehicles.

The power of the laser does not matter. Aiming ANY laser at an aircraft or vehicle is illegal. Persons misusing Class 3B and 4 lasers are especially likely to be caught because the beam is very visible from the air. It is easy for police aircraft to trace the beam back to the perpetrator's location.

See this page for a selected list of the many persons who have been jailed and/or fined for aiming lasers at aircraft.

SAFE USE GUIDANCE - LASER PROTECTIVE EYEWEAR (GLASSES)

Laser glasses or goggles should be used when working with Class 4 lasers, especially at close range (within a few yards or meters). They should be selected to protect against the laser's power and wavelength.

The eyewear should not block out all of the laser's light. This is because it is necessary to see where the laser "dot" is, to safely work with the laser. Because the eyewear is blocking some or perhaps all of the laser's light (for example, a hazardous reflection) you still should use caution even when using laser protective eyewear.

As you are using the laser, any other persons in the area should also have the same type of laser protective eyewear as you.

DO NOT USE SUNGLASSES FOR LASER PROTECTION

Sunglasses are NOT laser protective eyewear. They are not rated (e.g., with Optical Density) to ensure light-attenuating protection. Most will not block enough laser light to significantly reduce hazardous exposures.

SAFE USE GUIDANCE - LASER PROJECTORS

If this laser product is a projector for displays or laser shows, please be aware of the following:

NOT INTENDED FOR AUDIENCE SCANNING

Scanning the laser beam, by moving it quickly in various patterns such as lines or circles, does NOT substantially reduce hazards. **Do not aim this projector directly at any person or audience area closer than the Nominal Ocular Hazard Distance.** (As described above, the NOHD of a 1 Watt visible-beam laser is 140 ft (225 m). The NOHD of a 10 Watt laser is 2320 ft (710 m).)

Deliberate scanning onto an audience with a Class 4 laser is inherently hazardous. It requires planning, special equipment, and measurements performed by qualified persons such as a Laser Safety Officer. In the U.S., the Food and Drug Administration requires special permission (audience scanning variance) for this to be legal.

U.S. REGULATORY INFORMATION

Lasers used for demonstrations, shows, displays and entertainment are highly regulated in the U.S. Both the laser projection device and the way in which it is used (the laser show) must be certified by the Food and Drug Administration.

Do not perform any public demonstration, show, display or entertainment with this laser projector, without having a variance from FDA. More information is at [link goes here]

In addition to federal laws, some states and jurisdictions also regulate laser equipment and/or usage. More information is at [link goes here]

COUNTRIES OTHER THAN THE U.S.

Many other countries and jurisdictions have regulations regarding laser show and display usage. Venues such as concert halls may have their own requirements.

Contact all appropriate authorities to ensure your laser show meets venue and government requirements.

The webpage:
“An LSO course for this laser”

SCAN CODE OR VISIT
LASERSAFETY.INFO/4

LSF.ME/4
LaserSafetyFacts.com/4

Class 4 laser safety information

WHAT IS A CLASS 4 LASER?

Class 4 lasers are hazardous for eye exposure. They can burn skin and materials, especially dark and/or lightweight surfaces at close range. They should be used with extreme care.

For visible-light lasers, Class 4 lasers' have an output power 500 milliwatts and above. There is no upper limit for Class 4 -- this is the most hazardous laser classification.

SCAN CODE OR VISIT
LASERSAFETY.INFO/4

LSF.ME/4
LaserSafetyFacts.com/4

SAFE USE GUIDANCE - GENERAL

Class 4 visible-beam lasers are high powered. **A Class 4 laser can cause a significant eye injury if the direct or reflected beam enters the eye.**

Even looking at the diffuse reflection of a laser "dot" from a Class 4 beam, for too many seconds, may cause an eye injury. **Do not stare at the laser dot on a wall or other surface**.

A Class 4 laser can be a distraction, glare or flashblindness hazard for pilots and drivers. It may also be a potential eye injury hazard for low- and/or slow-flying pilots. **NEVER aim any laser towards an aircraft or vehicle.**

ONLY FOR USE BY RESPONSIBLE PERSONS

This is not a toy. Children should never be permitted to use Class 4 lasers. **Any teenager using a Class 4 laser should be continuously supervised by a responsible adult**. A number of teenagers have caused eye injuries to themselves or others by misusing Class 3B and Class 4 lasers.

DO NOT USE AS A LASER POINTER

Class 4 lasers are too powerful to be used as pointers. Some Class 4 lasers may look like pointers, but these should **not** be used for pointing purposes. If a Class 4 laser is used for other purposes such as popping balloons, burning objects, etc., use it with care.

SCAN CODE OR VISIT
LASERSAFETY.INFO/4

LSF.ME/4
LaserSafetyFacts.com/4

CLASS 4 LASER HAZARDS

INJURY TO PERSONS & ANIMALS (PETS)

EYE INJURY HAZARD -- DIRECT AND REFLECTED BEAM
Class 4 visible-light lasers are significantly hazardous for eye exposure. A person cannot turn away or blink fast enough to prevent eye injury from a Class 4 laser.

Prevent all eye exposure to beams from Class 4 lasers. This includes accidental exposures -- be careful to keep the beam away from eyes and faces.

Also, remember that reflections off mirrors, glass, and shiny surfaces can be just as hazardous as the direct beam. **Avoid reflected Class 4 beams.**

The Nominal Ocular Hazard Distance (NOHD) for a 1000 milliwatt (1 Watt) visible-beam laser with 1 milliradian divergence is **740 ft (225 m)**. The NOHD for a 10 Watt laser is **2300 ft (710 m)**.

If you are closer than the NOHD to the laser, there is a possibility of retinal damage if the direct or reflected beam enters your eye. The closer you are to the laser and the longer the beam is in the eye, the greater the chance of injury.

Because there is no upper limit for Class 4 lasers, it is possible for the NOHD to be a mile or more, although this is unlikely for consumer-grade handheld laser products.

SCAN CODE OR VISIT
LASERSAFETY.INFO/4

LSF.ME/4
LaserSafetyFacts.com/4

EYE INJURY HAZARD - DIFFUSE REFLECTION

The scattered light from the laser "dot" as viewed on a surface, can be an eye hazard. **Avoid looking directly at the laser dot for more than a few seconds.** The light is too bright if you see a sustained afterimage, lasting more than about 10 seconds.

The more powerful the laser, and the closer your eye is to the laser dot, the greater the chance of injury. This can occur during certain actions, such as aligning the beam or trying to hold the laser dot on a fixed location in order to burn a material.

- Looking at the laser dot from a 1,000 milliwatt (1 Watt) Class 4 blue (445 nm) laser beam for more than 1 minute is an eye hazard within **1.5 ft (44 cm)** of the laser.
- Looking at the laser dot from a 10,000 milliwatt (10 Watt) Class 4 blue (445 nm) laser beam for more than 1 minute is an eye hazard within **4.5 ft (1.4 m)** of the laser. Even just for 10 seconds, viewing the laser dot is a hazard within **1.8 ft (0.6 m).**

If you must look at the laser dot for relatively long periods of time within the hazard distances, use laser protective eyewear as discussed elsewhere on this page.

SCAN CODE OR VISIT
LASERSAFETY.INFO/4

LSF.ME/4
LaserSafetyFacts.com/4

SKIN INJURY (BURNS)

A Class 4 laser beam can burn skin and some materials. The more powerful the laser, the faster the burn will occur. In some cases, the burn may be almost instantaneous.

- A 1000 milliwatt (1 Watt) Class 4 laser beam is a skin injury hazard within **39 in (1 meter)** of the laser.

Avoid skin exposure to a Class 4 laser beam, especially at close range. A skin burn can be very painful, can take long to heal, and can leave a permanent scar.

MATERIALS DAMAGE AND BURNING

A Class 4 laser beam can cause materials to smolder or burn, especially at close range. Keep the beam moving to avoid burning materials at close range. Dark materials which absorb heat, and lightweight materials such as paper and fabric, are most easily burned by visible laser beams.

- A 1000 milliwatt (1 Watt) Class 4 laser beam is considered a burn hazard within **26 inches (67 cm)** of the laser.

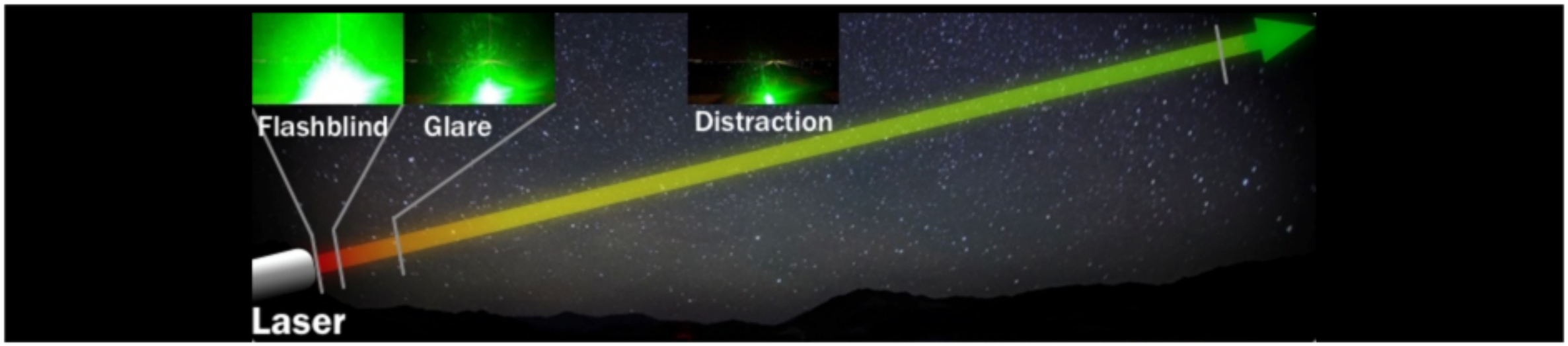
SCAN CODE OR VISIT
LASERSAFETY.INFO/4

LSF.ME/4
LaserSafetyFacts.com/4

AIRCRAFT AND VEHICLE SAFETY

LASERS CAN INTERFERE WITH PILOTS, DRIVERS

NEVER aim any laser towards an aircraft or vehicle that is in motion. The bright light can flashblind, cause glare, or distract the pilot or driver.



- A 1000 mW (1 Watt) Class 4 laser beam can temporarily **flashblind** a pilot or driver, causing afterimages, within **0.7 miles (1.1 km)** of the laser.
- It can cause **glare**, blocking a pilot or driver's vision, within **3.1 miles (5 km)** of the laser.
- It can cause **distraction**, being brighter than surrounding lights, within **31 miles (50 km)** of the laser.

The above calculations are for a 555 nanometer green laser with 1 milliradian divergence. This gives the longest (most hazardous) visual interference distances. For other colors such as red and blue pointers, the visual interference distances would be less. For red, divide the distance by about 5 to get an approximation. For blue, divide the distance by about 20.

Never aim a laser at or near an aircraft, no matter what its color or power.

SCAN CODE OR VISIT
LASERSAFETY.INFO/4

LSF.ME/4
LaserSafetyFacts.com/4

LASING AIRCRAFT AND VEHICLES IS ILLEGAL

In the U.S., aiming a laser at or near the flight path of an aircraft is a federal felony, punishable by up to 5 years in jail and a fine of up to $250,000. Other countries, and U.S. states have similar laws for interfering with safety, that may also be used to arrest, fine or imprison a person for aiming at aircraft and vehicles.

The power of the laser does not matter. Aiming ANY laser at an aircraft or vehicle is illegal. Persons misusing Class 3B and 4 lasers are especially likely to be caught because the beam is very visible from the air. It is easy for police aircraft to trace the beam back to the perpetrator's location.

See this page for a selected list of the many persons who have been jailed and/or fined for aiming lasers at aircraft.

SCAN CODE OR VISIT
LASERSAFETY.INFO/4

LSF.ME/4
LaserSafetyFacts.com/4

SAFE USE GUIDANCE - LASER PROTECTIVE EYEWEAR (GLASSES)

Laser glasses or goggles should be used when working with Class 4 lasers, especially at close range (within a few yards or meters). They should be selected to protect against the laser's power and wavelength.

The eyewear should not block out all of the laser's light. This is because it is necessary to see where the laser "dot" is, to safely work with the laser. Because the eyewear is blocking some or perhaps all of the laser's light (for example, a hazardous reflection) you still should use caution even when using laser protective eyewear.

As you are using the laser, any other persons in the area should also have the same type of laser protective eyewear as you.

DO NOT USE SUNGLASSES FOR LASER PROTECTION

Sunglasses are NOT laser protective eyewear. They are not rated (e.g., with Optical Density) to ensure light-attenuating protection. Most will not block enough laser light to significantly reduce hazardous exposures.

SCAN CODE OR VISIT
LASERSAFETY.INFO/4

LSF.ME/4
LaserSafetyFacts.com/4

SAFE USE GUIDANCE - LASER PROJECTORS

If this laser product is a projector for displays or laser shows, please be aware of the following:

NOT INTENDED FOR AUDIENCE SCANNING
Scanning the laser beam, by moving it quickly in various patterns such as lines or circles, does NOT significantly reduce hazards.

Do not aim this laser projector directly at any person or audience area. Deliberate scanning onto an audience with a Class 3B or 4 laser is inherently hazardous.

Because the labels on consumer lasers may give incorrect information -- the wrong Class or the wrong power -- do NOT rely on the label for any safety-critical calculations. Any laser aimed into an audience-accessible area must be measured with appropriate equipment by a qualified Laser Safety Officer. The LSO will determine the laser's Nominal Ocular Hazard Distance. The audience must be further than this distance. The LSO will also determine any other safety measures to be taken; for example, continuous supervision of the area, emergency stop buttons, etc.

In addition, in the U.S. and many countries and venues, special permission is required before ANY human access to Class 3B or 4 laser beams is allowed -- even if the audience is further than the NOHD. For example, the U.S. FDA requires submission and FDA approval of an audience scanning variance.

SCAN CODE OR VISIT
LASERSAFETY.INFO/4

LSF.ME/4
LaserSafetyFacts.com/4

U.S. REGULATORY INFORMATION

Lasers used for demonstrations, shows, displays and entertainment are highly regulated in the U.S. Both the laser projection device and the way in which it is used (the laser show) must be certified to the Food and Drug Administration. This is for ANY laser show even if the laser beam is kept away from audience areas. Generally, shows in a private home with friends and family are not covered but all other demonstrations, shows, displays, etc. done with a Class 3B or 4 laser would require the user to submit a variance, and get FDA approval before the show can proceed.

Do not perform any public demonstration, show, display or entertainment with this laser projector, without having a variance from FDA. More information is at *[link goes here]*.

In addition to federal laws, some states and jurisdictions also regulate laser equipment and/or usage. More information is at *[link goes here]*.

U.K. REGULATORY INFORMATION

At the national level, laser show safety advice is given by Public Health England, formerly the Health Protection Agency. On their website they give the following guidance (as of Feb. 1 2014):

The NRPB, now the Radiation Protection Division of the Health Protection Agency, has undertaken considerable research into the use of lasers in the entertainment industry. Some situations have given cause for concern, mainly because the potential or actual exposure of people, including the audience, has not been properly assessed. The use of lasers may be covered by conditions on the premises under the Licensing Act, which is enforced by the local council (district, unitary or other authority). HPA advice to such councils is that a risk assessment should be carried out to demonstrate that people are not exposed to unacceptable risks. Assessment of laser display effects used for intentionally scanning the audience is time-consuming and complex. HPA experience is that such assessments are rarely satisfactorily undertaken and the practice should not routinely take place.

COUNTRIES OTHER THAN THE U.S. AND U.K.

Many other countries and jurisdictions have regulations regarding laser show and display usage. Venues such as concert halls may have their own requirements.

Contact all appropriate authorities to ensure your laser show meets venue and government requirements.

Three types of QR codes

Class code

- Goes to pages for Class 2, 3R, 3B or 4 lasers

LSF.ME/2

- These are generic pages for any laser of this class

Freeform Parameter code

- Use to encode any laser. Example:

LSF.ME/PR_635-900-532-700-445-500_15_CW_4

- Decoded by the webpage; gives specific hazard distances for that particular laser

Shortener code

- 5-characters; goes to a specific Freeform Parameter page

Left: LSF.ME/34567
Right: www.LaserSafetyFacts.com/HH_445-2500_15_CW_4_WCK01

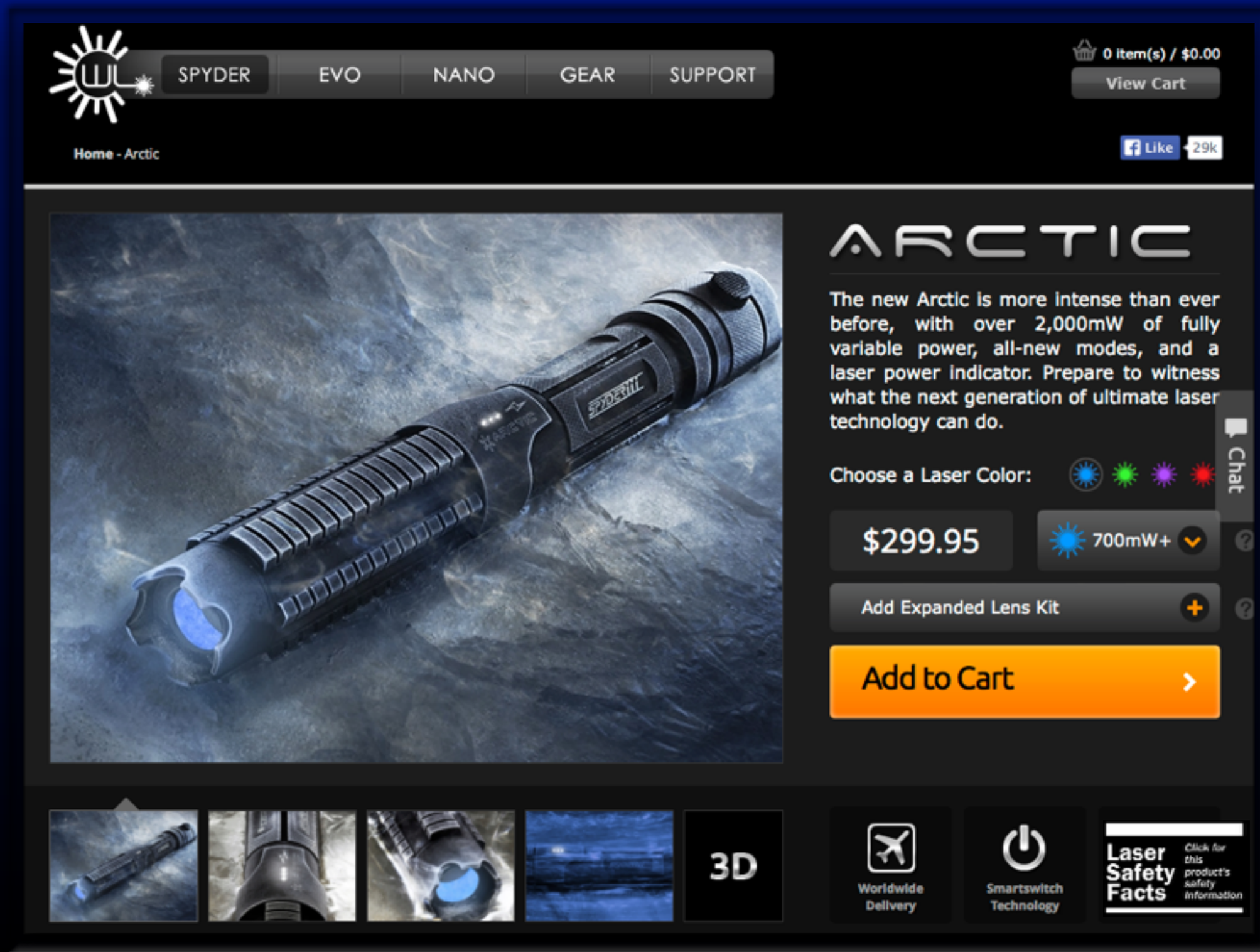
- Used so that the QR code “dots” can be larger and easier to scan

Making it easy to provide laser safety information on product websites

Standard icon for webpages

- Put on a product's webpage, to lead to the complete safety information for that laser
- Goes to the appropriate LaserSafetyFacts.com page

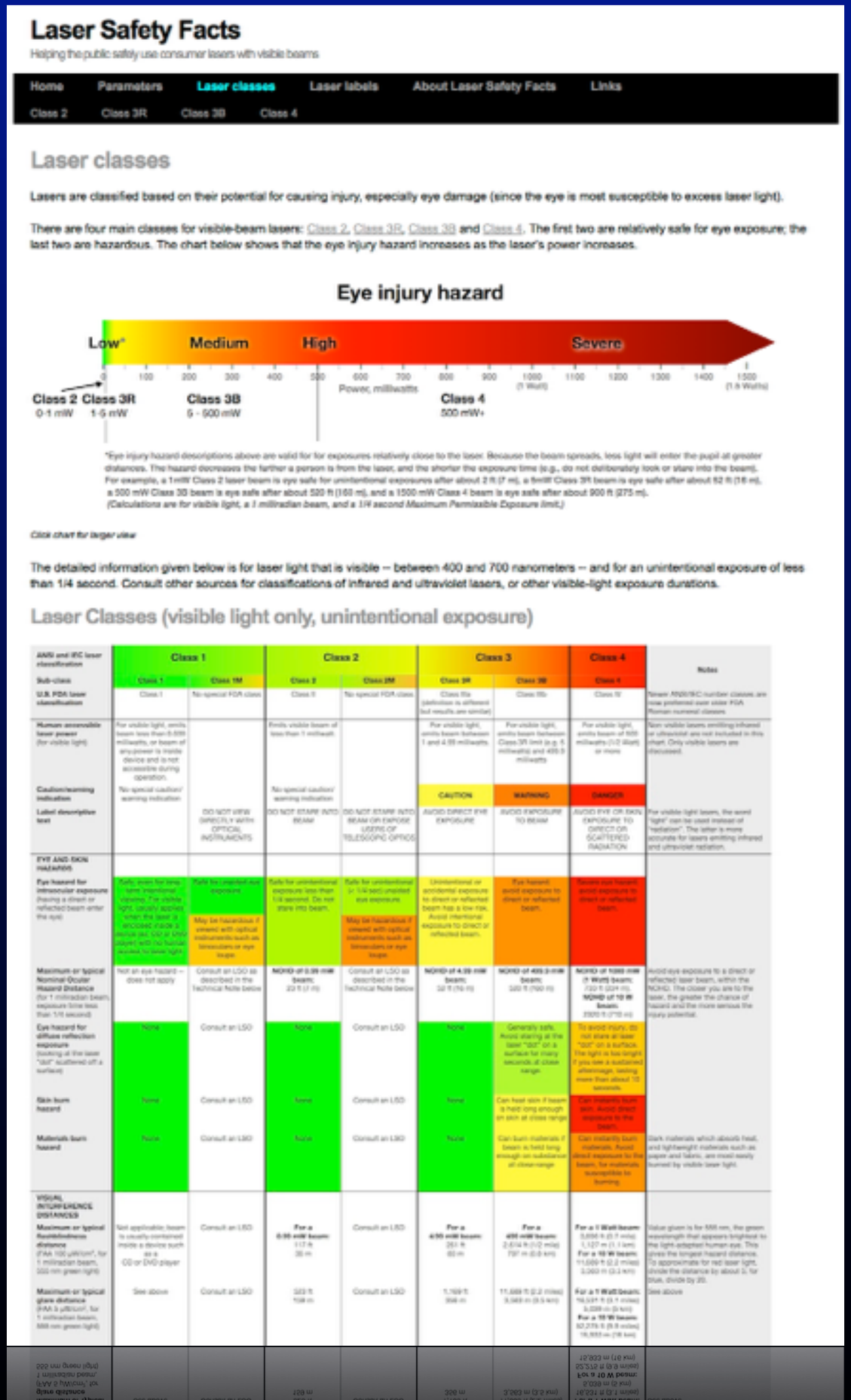
Sample website usage



Additional features at LaserSafetyFacts.com

Other features of the website

- General overview of laser classes and corresponding hazards



Laser Safety Facts

Helping the public safely use consumer lasers with visible beams

Home | Parameters | **Laser classes** | Laser labels | About Laser Safety Facts | Links

Class 2 | Class 3R | Class 3B | Class 4

Laser classes

Lasers are classified based on their potential for causing injury, especially eye damage (since the eye is most susceptible to excess laser light).

There are four main classes for visible-beam lasers: Class 2, Class 3R, Class 3B and Class 4. The first two are relatively safe for eye exposure; the last two are hazardous. The chart below shows that the eye injury hazard increases as the laser's power increases.

Eye injury hazard

Low* | Medium | High | Severe

0 100 200 300 400 500 600 700 800 900 1000 (1 Watt) 1100 1200 1300 1400 1500 (1.5 Watts)

Power, milliwatts

Class 2 0-1 mW | **Class 3R** 1-5 mW | **Class 3B** 5 - 500 mW | **Class 4** 500 mW+

*Eye injury hazard descriptions above are valid for for exposures relatively close to the laser. Because the beam spreads, less light will enter the pupil at greater distances. The hazard decreases the farther a person is from the laser, and the shorter the exposure time (e.g., do not deliberately look or stare into the beam). For example, a 1mW Class 2 laser beam is eye safe for unintentional exposures after about 2 ft (7 m), a 5mW Class 3R beam is eye safe after about 52 ft (16 m), a 500 mW Class 3B beam is eye safe after about 520 ft (160 m), and a 1500 mW Class 4 beam is eye safe after about 900 ft (275 m). *(Calculations are for visible light, a 1 milliradian beam, and a 1/4 second Maximum Permissible Exposure limit.)*

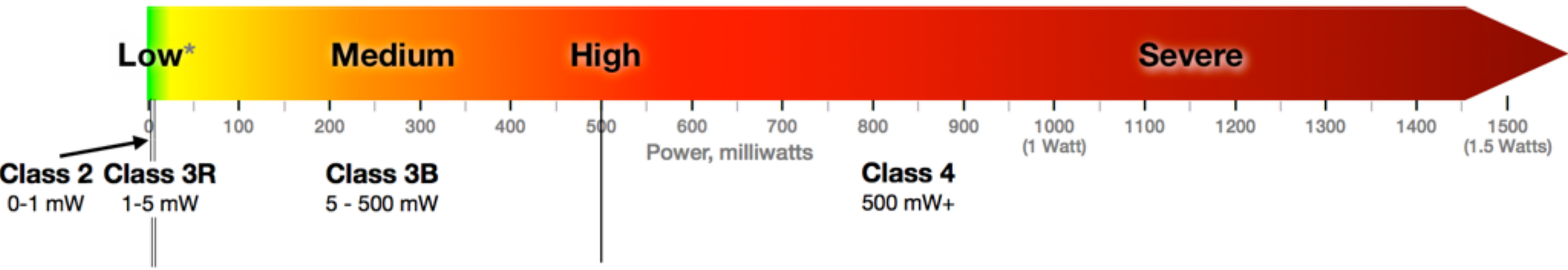
Click chart for larger view

The detailed information given below is for laser light that is visible -- between 400 and 700 nanometers -- and for an unintentional exposure of less than 1/4 second. Consult other sources for classifications of infrared and ultraviolet lasers, or other visible-light exposure durations.

Laser Classes (visible light only, unintentional exposure)

ANSI and IEC laser classification	Class 1		Class 2		Class 3		Class 4	Notes
Sub-class	Class 1	Class 1M	Class 2	Class 2M	Class 3R	Class 3B	Class 4	
U.S. FDA laser classification	Class I	No special FDA class	Class II	No special FDA class	Class IIIa (definition is different but results are similar)	Class IIIb	Class IV	Newer ANSI/IEC number classes are now preferred over older FDA Roman numeral classes.
Human accessible laser power (for visible light)	For visible light, emits beam less than 0.399 milliwatts, or beam of any power is inside device and is not accessible during operation.		Emits visible beam of less than 1 milliwatt.		For visible light, emits beam between 1 and 4.99 milliwatts.	For visible light, emits beam between Class 3R limit (e.g. 5 milliwatts) and 499.9 milliwatts	For visible light, emits beam of 500 milliwatts (0.5 Watt) or more.	Non-visible lasers emitting infrared or ultraviolet are not included in this chart. Only visible lasers are discussed.
Caution/warning indication	No special caution/ warning indication		No special caution/ warning indication		CAUTION	WARNING	DANGER	
Label descriptive text		DO NOT VIEW DIRECTLY WITH OPTICAL INSTRUMENTS	DO NOT STARE INTO BEAM	DO NOT STARE INTO BEAM OR EXPOSE USERS OF TELESCOPIC OPTICS	AVOID DIRECT EYE EXPOSURE	AVOID EXPOSURE TO BEAM	AVOID EYE OR SKIN EXPOSURE TO DIRECT OR SCATTERED RADIATION	For visible light lasers, the word "light" can be used instead of "radiation". The latter is more accurate for lasers emitting infrared and ultraviolet radiation.
EYE AND SKIN HAZARDS								
Eye hazard for intraocular exposure (having a direct or reflected beam enter the eye)	Safe, even for long-term intentional viewing. (For visible light, caution applies when the laser is enclosed inside a device (ex: CD or DVD player) with no human accessible laser light.)	Safe for unaided eye exposure. May be hazardous if viewed with optical instruments such as binoculars or eye loupe.	Safe for unintentional exposure less than 1/4 second. Do not stare into beam.	Safe for unintentional (< 1/4 sec) unaided eye exposure. May be hazardous if viewed with optical instruments such as binoculars or eye loupe.	Unintentional or accidental exposure to direct or reflected beam has a low risk. Avoid intentional exposure to direct or reflected beam.	Eye hazard; avoid exposure to direct or reflected beam.	Severe eye hazard; avoid exposure to direct or reflected beam.	
Maximum or typical Nominal Ocular Hazard Distance (for 1 milliradian beam, exposure time less than 1/4 second)	Not an eye hazard -- does not apply	Consult an LSO as described in the Technical Note below	NOHD of 0.39 mW beam: 23 ft (7 m)	Consult an LSO as described in the Technical Note below	NOHD of 4.99 mW beam: 52 ft (16 m)	NOHD of 499.9 mW beam: 160 ft (160 m)	NOHD of 1000 mW (1 Watt) beam: 720 ft (224 m). NOHD of 10 W beam: 3600 ft (1100 m)	Avoid eye exposure to a direct or reflected laser beam, within the NOHD. The closer you are to the laser, the greater the chance of hazard and the more serious the injury potential.
Eye hazard for diffuse reflection exposure (looking at the laser "dot" scattered off a surface)	None	Consult an LSO	None	Consult an LSO	None	Generally safe. Avoid staring at the laser "dot" on a surface for many seconds at close range.	To avoid injury, do not stare at laser "dot" on a surface. The light is too bright if you see a sustained afterimage, lasting more than about 10 seconds.	
Skin burn hazard	None	Consult an LSO	None	Consult an LSO	None	Can heat skin if beam is held long enough on skin at close range.	Can instantly burn skin. Avoid direct exposure to the beam.	
Materials burn hazard	None	Consult an LSO	None	Consult an LSO	None	Can burn materials if beam is held long enough on substance at close range.	Can instantly burn materials. Avoid direct exposure to the beam, for materials susceptible to burning.	Dark materials which absorb heat, and lightweight materials such as paper and fabric, are most easily burned by visible laser light.
VISUAL INTERFERENCE DISTANCES								
Maximum or typical Hazardindoors distance (FAA 100 µW/cm², for 1 milliradian beam, 532 nm green light)	Not applicable; beam is usually contained inside a device such as a CD or DVD player	Consult an LSO	For a 0.95 mW beam: 115 ft 35 m	Consult an LSO	For a 4.95 mW beam: 262 ft 80 m	For a 499 mW beam: 2,614 ft (0.5 miles) 797 m (0.8 km)	For a 1 Watt beam: 5,656 ft (0.7 miles) 1,127 m (1.1 km). For a 10 W beam: 11,669 ft (2.2 miles) 3,560 m (3.5 km)	Value given is for 555 nm, the green wavelength that appears brightest to the light-adapted human eye. This gives the longest hazard distance. To approximate for red laser light, divide the distance by about 3, for blue, divide by 20.
Maximum or typical glare distance (FAA 5 µW/cm², for 1 milliradian beam, 555 nm green light)	See above	Consult an LSO	223 ft 68 m	Consult an LSO	1,169 ft 356 m	11,669 ft (2.2 miles) 3,560 m (3.5 km)	For a 1 Watt beam: 25,321 ft (4.7 miles) 7,720 m (7.7 km). For a 10 W beam: 80,076 ft (15.2 miles) 24,413 m (24 km)	See above

Eye injury hazard



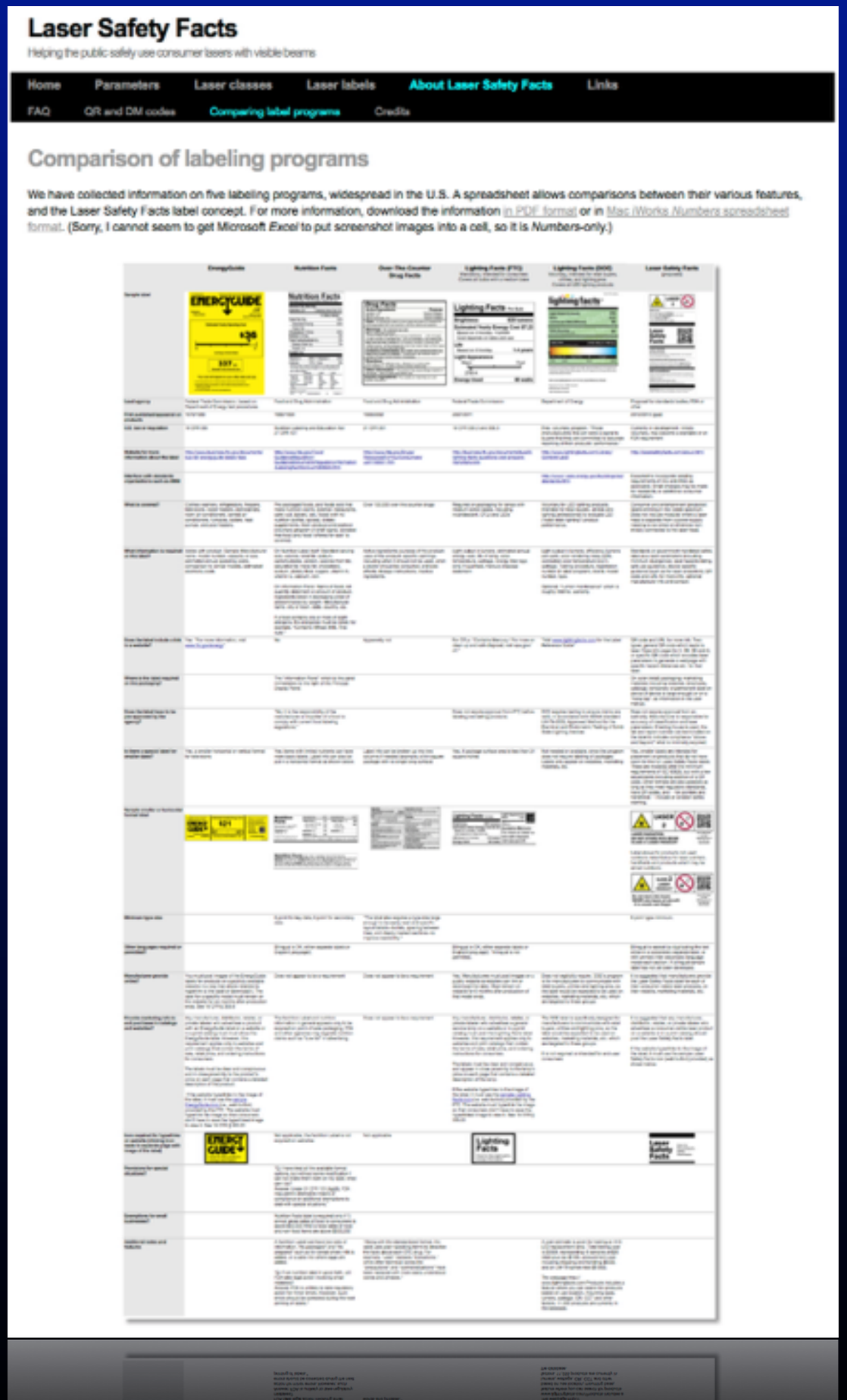
*Eye injury hazard descriptions above are valid for for exposures relatively close to the laser. Because the beam spreads, less light will enter the pupil at greater distances. The hazard decreases the farther a person is from the laser, and the shorter the exposure time (e.g., do not deliberately look or stare into the beam). For example, a 1mW Class 2 laser beam is eye safe for unintentional exposures after about 2 ft (7 m), a 5mW Class 3R beam is eye safe after about 52 ft (16 m), a 500 mW Class 3B beam is eye safe after about 520 ft (160 m), and a 1500 mW Class 4 beam is eye safe after about 900 ft (275 m).

(Calculations are for visible light, a 1 milliradian beam, and a 1/4 second Maximum Permissible Exposure limit.)

ANSI and IEC laser classification	Class 1		Class 2		Class 3		Class 4	Notes
Sub-class	**Class 1**	**Class 1M**	**Class 2**	**Class 2M**	**Class 3R**	**Class 3B**	**Class 4**	
U.S. FDA laser classification	Class I	No special FDA class	Class II	No special FDA class	Class IIIa (definition is different but results are similar)	Class IIIb	Class IV	Newer ANSI/IEC number classes are now preferred over older FDA Roman numeral classes
Human-accessible laser power (for visible light)	For visible light, emits beam less than 0.039 milliwatts, or beam of any power is inside device and is not accessible during operation.		Emits visible beam of less than 1 milliwatt.		For visible light, emits beam between 1 and 4.99 milliwatts.	For visible light, emits beam between Class 3R limit (e.g. 5 milliwatts) and 499.9 milliwatts	For visible light, emits beam of 500 milliwatts (1/2 Watt) or more	Non-visible lasers emitting infrared or ultraviolet are not included in this chart. Only visible lasers are discussed.
Caution/warning indication	No special caution/ warning indication		No special caution/ warning indication		**CAUTION**	**WARNING**	**DANGER**	
Label descriptive text		DO NOT VIEW DIRECTLY WITH OPTICAL INSTRUMENTS	DO NOT STARE INTO BEAM	DO NOT STARE INTO BEAM OR EXPOSE USERS OF TELESCOPIC OPTICS	AVOID DIRECT EYE EXPOSURE	AVOID EXPOSURE TO BEAM	AVOID EYE OR SKIN EXPOSURE TO DIRECT OR SCATTERED RADIATION	For visible-light lasers, the word "light" can be used instead of "radiation". The latter is more accurate for lasers emitting infrared and ultraviolet radiation.
EYE AND SKIN HAZARDS								
Eye hazard for intraocular exposure (having a direct or reflected beam enter the eye)	Safe, even for long-term intentional viewing. For visible light, usually applies when the laser is enclosed inside a device (ex: CD or DVD player) with no human access to laser light.	Safe for unaided eye exposure. May be hazardous if viewed with optical instruments such as binoculars or eye loupe.	Safe for unintentional exposure less than 1/4 second. Do not stare into beam.	Safe for unintentional (< 1/4 sec) unaided eye exposure. May be hazardous if viewed with optical instruments such as binoculars or eye loupe.	Unintentional or accidental exposure to direct or reflected beam has a low risk. Avoid intentional exposure to direct or reflected beam.	Eye hazard; avoid exposure to direct or reflected beam.	Severe eye hazard; avoid exposure to direct or reflected beam.	
Maximum or typical Nominal Ocular Hazard Distance (for 1 milliradian beam, exposure time less than 1/4 second)	Not an eye hazard -- does not apply	Consult an LSO as described in the Technical Note below	**NOHD of 0.99 mW beam:** 23 ft (7 m)	Consult an LSO as described in the Technical Note below	**NOHD of 4.99 mW beam:** 52 ft (16 m)	**NOHD of 499.9 mW beam:** 520 ft (160 m)	**NOHD of 1000 mW (1 Watt) beam:** 733 ft (224 m). **NOHD of 10 W beam:** 2320 ft (710 m)	Avoid eye exposure to a direct or reflected laser beam, within the NOHD. The closer you are to the laser, the greater the chance of hazard and the more serious the injury potential.
Eye hazard for diffuse reflection exposure (looking at the laser "dot" scattered off a surface)	None	Consult an LSO	None	Consult an LSO	None	Generally safe. Avoid staring at the laser "dot" on a surface for many seconds at close range.	To avoid injury, do not stare at laser "dot" on a surface. The light is too bright if you see a sustained afterimage, lasting more than about 10 seconds.	
Skin burn hazard	None	Consult an LSO	None	Consult an LSO	None	Can heat skin if beam is held long enough on skin at close range	Can instantly burn skin. Avoid direct exposure to the beam.	
Materials burn hazard	None	Consult an LSO	None	Consult an LSO	None	Can burn materials if beam is held long enough on substance at close range	Can instantly burn materials. Avoid direct exposure to the beam, for materials susceptible to burning.	Dark materials which absorb heat, and lightweight materials such as paper and fabric, are most easily burned by visible laser light.
VISUAL								

Other features of the website

- Comparison of 6 labeling programs:
  - EnergyGuide, Nutrition Facts, OTC Drug Facts, Lighting Facts (FTC), Lighting Facts (DOE), Laser Safety Facts



	EnergyGuide	Nutrition Facts	Over-The-Counter Drug Facts	Lighting Facts (FTC) Mandatory, intended for consumers Covers all bulbs with a medium base	Lighting Facts (DOE) Voluntary, intended for retail buyers, utilities, and lighting pros. Covers all LED lighting products	Laser Safety Facts (proposed)
Sample label						
Lead agency	Federal Trade Commission, based on Department of Energy test procedures	Food and Drug Administration	Food and Drug Administration	Federal Trade Commission	Department of Energy	Proposal for standards bodies, FDA or other
First published/appeared on products	1979/1980	1990/1994	1999/2002	2007/2011		2013/2014 (goal)
U.S. law or regulation	16 CFR 305	Nutrition Labeling and Education Act 21 CFR 101	21 CFR 201	16 CFR 305.2 and 305.3	Free, voluntary program. "Those [manufacturers] that join send a signal to buyers that they are committed to accurate reporting of their products' performance."	Currently in development. Initially voluntary, may become a standard or an FDA requirement
Website for more information about the label	http://www.business.ftc.gov/documents/bus-82-energyguide-labels-faqs	http://www.fda.gov/Food/GuidanceRegulation/GuidanceDocumentsRegulatoryInformation/LabelingNutrition/ucm064904.htm	http://www.fda.gov/Drugs/ResourcesForYou/Consumers/ucm143551.htm	http://business.ftc.gov/documents/bus26-lighting-facts-questions-and-answers-manufacturers	http://www.lightingfacts.com/Library/Content/Label	http://lasersafetyfacts.com/about.html
Interface with standards organizations such as ANSI					http://www1.eere.energy.gov/buildings/ssl/standards.html	Expected to incorporate labeling requirements of IEC and ANSI as applicable. Small changes may be made for readability or additional consumer information.
What is covered?	Clothes washers, refrigerators, freezers, televisions, water heaters, dishwashers, room air conditioners, central air conditioners, furnaces, boilers, heat pumps, and pool heaters.	Pre-packaged foods, and foods sold that make nutrition claims. Exempt: restaurants, carry-out, bakery, deli, foods with no nutrition (coffee, spices), dietary supplements, fresh produce and seafood (voluntary program of shelf signs), donated free food (only food "offered for sale" is covered).	Over 100,000 over-the-counter drugs	Required on packaging for lamps with medium screw bases, including incandescent, CFLs and LEDs	Voluntary for LED lighting products. Intended for retail buyers, utilities and lighting professionals to evaluate LED ("solid-state lighting") product performance.	Consumer and entertainment (projector) lasers emitting in the visible spectrum. Does not include modules where a laser head is separate from a power supply needing to be wired or otherwise non-trivially connected to the laser head.
What information is required on the label?	Varies with product. Sample: Manufacturer name, model number, capacity or size, estimated annual operating costs, comparison to similar models, estimated electricity costs	On Nutrition Label itself: Standard serving size, calories, total fat, sodium, carbohydrates, protein, calories from fat, saturated fat, trans fat, cholesterol, sodium, dietary fiber, sugars, vitamin A, vitamin C, calcium, iron. On Information Panel: Name of food, net quantity statement or amount of product. Ingredients listed in decreasing order of predominance by weight. Manufacturer name, city or town, state, country, zip. If a food contains one or more of eight allergens, the allergen(s) must be listed; for example, "Contains: Wheat, Milk, Tree nuts."	Active ingredients; purpose of the product; uses of the product; specific warnings including when it should not be used, when a doctor should be consulted, and side effects; dosage instructions, inactive ingredients.	Light output in lumens, estimated annual energy cost, life of lamp, color temperature, wattage, Energy Star logo (only if qualified), mercury disposal statement	Light output in lumens, efficiency (lumens per watt), color rendering index (CRI), correlated color temperature (CCT), wattage. Testing procedure, registration number (in label program), brand, model number, type. Optional: "Lumen maintenance" which is roughly lifetime, warranty	Standards or government mandated safety label plus laser parameters (including minimum divergence), laser hazards listing, safe use guidance, device-specific guidance (such as for laser projectors), QR code and URL for more info, optional manufacturer info and contact.
Does the label include a link to a website?	Yes: "For more information, visit www.ftc.gov/energy"	No	Apparently not	For CFLs: "Contains Mercury / For more on clean up and safe disposal, visit epa.gov/cfl."	"Visit www.lightingfacts.com for the Label Reference Guide"	QR code and URL for more info. Two types: general QR code which leads to laser Class info page (for 2, 3R, 3B and 4), or specific QR code which encodes laser parameters to generate a webpage with specific hazard distances etc. for that laser.
Where is the label required on the packaging?		The "Information Panel" which is the panel immediately to the right of the Principal Display Panel.				On outer (retail) packaging; marketing materials including websites, brochures, catalogs; temporary or permanent label on device (if device is large enough) or on a "hang tag"; as information in the user manual.

Laser Safety Facts label status

Laser safety information status

- Has been reviewed by selected individuals including Greg Makhov
- Looking to groups such as SAE G-10T, ANSI for any additional review, suggestions, etc.
- In July 2014, a major manufacturer of handheld lasers planned to add this to their product line

Adoption status

- Currently voluntary
  - Intended for manufacturers and marketing materials
- Could become a standard such as ANSI or IEC
  - If so, perhaps run by a non-profit group such as Laser Institute of America
- Could become a legal requirement
  - If so, Congress must enact legislation giving FDA authority and funding

Functional status

- LaserSafetyFacts.com ***works right now***
  - Can add QR or DM code to any visible consumer laser
  - Pages already exist for Class 2, 3R, 3B and 4 lasers
  - Freeform Parameter pages can be easily created, for specific lasers
  - Downloadable labels are at the website
  - Any manufacturer or marketer can add these

Functional status (2)

- Need to add coding to automatically interpret Freeform Parameter pages
  - These can be manually added now
  - Automatic coding is more efficient

Design status

- Design has been reviewed by Burkey Belser of Greenfield/Belser
  - Creator of the EnergyGuide, Nutrition Facts, and Drug Facts labels
  - He has agreed to help work on the Laser Safety Facts label
  - He is familiar with federal requirements for label programs

Summary

- Detailed label on packaging, marketing materials
- Can be affixed to larger lasers such as projectors

- Labels for smaller lasers
- Human-readable URL plus QR or DM code
- Includes aircraft hazard warning

- Both labels link to a webpage
- Contains detailed information about hazards, and safe use guidance

A key tool to inform users

- Help prevent eye injuries
- Help prevent laser/aircraft illuminations
- Provide detailed information for persons who need this (schools, non-LSOs, etc.)
- Can be used right now

Questions?