Tattoo Removal Devices

Tattoo lasers are one of the most misunderstood and misrepresented devices on the aesthetic market. There are a few companies that sell what they call a "tattoo removal" laser, but some are nothing more than a modified hair removal device and don't work well enough on all tattoo ink colors to satisfy the entire patient base looking for comprehensive tattoo removal services. Most tattoo lasers do not have the energy to completely remove all ink colors in a reasonable number of treatments, and because the patient has to wait between treatments for the skin to heal, this could take a very long time if the system is less effective. With a weak tattoo laser, the possible outcomes would be leaving behind a faded tattoo, requiring patients to spend a lot of money and time to get an acceptable outcome, or pushing the limits of the laser that results in a burn, leaving behind a scar in the shape of the tattoo. Any one of those scenarios will result in a very dissatisfied customer base with a negative public image that makes it difficult or impossible to establish and grow a tattoo removal or aesthetic business.

A tattoo laser is a Q-Switched device. Q-Switched (aka quick switched) basically means it delivers light energy in a very short pulse that is much shorter than a standard laser. Standard aesthetic lasers measure their pulse width in milliseconds (ms) but a Q-Switched laser measures the pulse width in nanoseconds (ns). A millisecond is one-one thousandth of a second. A nanosecond is one-one billionth of a second. The light emitted from a Q-Switched laser acts more like an acoustic wave than traditional light; it still is attracted to a specific pigment or color much like a standard laser is attracted to various chromophores based on the wavelength, but the light blasts the pigment/ink into microscopic particles so it can be absorbed by the body.

The mechanics of the process is that the light is attracted to the ink based on the color of the ink and the wavelength of the laser light. Since the ink resides deep in the skin, the difficulty of the procedure is that you have to deliver the right level of energy to affect the ink without damaging the skin between the surface and the ink. This is done by delivering a very high amount of energy in a very short period of time, hitting the ink with that acoustic blast and generating heat in the tissue only where the ink resides, without creating too much heat in the skin above the ink. To reach deeper in the skin without generating too much heat on the surface, the spot size must be large in relation to the energy applied, since the laser energy creates a profile that resembles a cone; the deeper it reaches into the skin, the more narrow the peak power area becomes until it comes to a point. The area the laser beam can affect shrinks as you go deeper into the skin, reducing the amount of ink the beam will remove. If you reduce the spot size to increase the energy (the power density rule: take the same amount of energy output from a laser at one spot size, reduce the spot size and you increase the light energy of the beam), you reduce the overall area of ink that is treated deep in the skin and this dramatically increases the chance of causing a burn on the surface of the skin. Having a device that can generate a high energy with a large spot size is critical for success with the minimization or elimination of complications.

Here's why the maximum energy of a tattoo laser is critical and the biggest problem with most of the devices currently sold on the market. The lower the maximum energy per pulse the system can produce, the less ink the device will affect per treatment, so a lower powered laser will require more treatments in a series to completely remove a tattoo of any ink color. The base wavelength of a tattoo removal device is traditionally 1064nm (YAG laser) and the laser manufacturer will advertise, or list in the device specifications, the maximum energy at the 1064nm wavelength. Most of the current tattoo lasers are a 1 Joule per pulse system (in the 1064nm wavelength). The 1064nm wavelength will treat black and dark blue inks. A maximum energy of 1 Joule per pulse is sufficient for effective tattoo removal, so a 1 Joule/1064nm device will work well for tattoos with dark ink colors. As you can see, since a large percentage of tattoos are dark in color, even a basic tattoo removal laser can treat a good percentage of tattoo clients. But that is like opening a coffee shop and only selling plain black coffee; you will have many clients, but you will turn a lot of potential customers away or, worse yet, create unhappy clients by trying to serve them something they don’t want. When considering the purchase of a tattoo laser that will be useful for all tattoo types and patients, you have to look beyond the specifications of the base wavelength.

To affect red inks or colors close to that hue, the system is switched to 532nm (when changing a system from 1064nm to 532nm, it is referred to as "doubling" the wavelength), but when you switch to 532nm, you reduce the laser's energy by 55%. So, if you start with a 1 Joule system (1,000mj), when changing to 532nm, you end up with roughly 450mj as the workable energy. 450mj is still a sufficient level of energy, but remember that as you lower the total energy delivered, this means it will take a higher number of treatments in a series to completely remove a tattoo. When setting the system to treat sky blue inks, you install a handset called a dye pack while the system is operated in the 532nm mode. The dye pack contains a dye that alters the light wavelength exiting the handset from 532nm to 585nm. There is also another dye pack to change the wavelength from 532nm to 650nm, to affect the greens. When the 650nm or 585nm dye packs are installed, it further reduces the light energy output by 45% to 65%. This means that, when you start with 1 Joule per pulse in the 1064nm mode, you will end up working with around 200mj or less in the 650nm or 585nm modes. At that low level of output, the spot size must be reduced dramatically to generate enough energy to have any effect on the tattoo, resulting in less ink being removed per session. Treating a tattoo with exotic colors such as turquoise or greens will require many treatments and may never completely remove all the ink, leaving behind a faded image. If the operator has to reduce the spot size to generate enough energy, then there is a possibility it could cause a burn. Either a burn or a faded tattoo is not an acceptable result.

A standard treatment involves utilizing the 1064nm wavelength to get the darker colors first (if the majority of the tattoo is made up of dark inks). The patient then must allow the "injury" to heal for 8 weeks or longer between each treatment. If the system has a high enough maximum energy output to safely deliver a large spot, it may be able to remove most if not all of the dark colors in one or two treatments. In the majority of cases, the patient needs to come back for multiple treatments with every wavelength. Next, the system is changed to another wavelength (532nm, 585nm or 650nm) based on the color composition of the tattoo. Most low powered systems do not have enough of an effect on the non-standard colors to remove them in two treatments so again, it will take a number of sessions. Depending on how the treatment/service was sold to the patient, there could be a variety of issues: if sold as a package of a certain number of treatments, the patient will not be happy if they have to pay for additional treatments to remove the remnants of a faded tattoo, and if sold by the practitioner as a complete removal (removal of the tattoo, regardless of the number of treatments) the clinic may lose money.

When shopping for a tattoo laser, the buyer must be aware that there are some companies who intentionally exaggerate the specifications of their technology. All manufacturers know that energy is the key and a low powered device will have a limited useful application in tattoo removal. Some manufacturers will list their system's maximum pulse energy much higher than what the system can actually deliver in tattoo removal mode. Here is how they do it:

1. A Q-Switched laser generator (the tube inside the machine that generates the laser beam) is designed to produce 1 Joule per pulse. However, the generator can be pushed to produce more than 1 Joule, but that energy level is inconsistent and the beam is not considered to be "clean". This can result in an isolated reading of up to 1300mj (1.3 Joules) or more. It may be somewhat consistent at 1.1 Joules, but the reliable output of any Q-Switched generator will be 1 Joule based on current laser technology. If a laser manufacturer lists their energy output higher than 1 Joule per pulse, they are claiming an energy level that the laser cannot consistently produce; unless their system incorporates multiple laser generators.
2. A Q-Switched laser is also useful for pigmentation removal and, to effectively treat pigmentation, a Q-Switched laser can be set in a "double-pulse" mode. This means that the system can be set to deliver two pulses in quick succession and this stacking of the pulses will generate heat. This effect is very similar to what an IPL does and is useful for pigmentation since most hyperpigmented lesions reside near the skin surface and light-induced absorbed heat will treat most pigmented lesion issues. Allowing the heat to build up in the pigmented lesion is intentional and effective. However, you cannot use this double-pulsing technology on a tattoo because the heat build-up will cause a burn. Some manufacturers will list their double-pulsing specification as the top energy for their systems, but that is misleading since that is not a per single pulse measurement. The manufacturer does not specifically indicate that the

listed maximum energy is for pigmented lesions only and a buyer incorrectly assumes they are comparing apples to apples when evaluating other tattoo removal systems and looking solely at the top energy specifications of each system.

3. Another tactic is to list the energy output of their system measured from the end of the articulated arm. What this means is that they list the specification for the energy output of their device at the end of the arm, but without the handset installed. All handsets incorporate lens that will absorb some of the laser energy, so by listing the energy measurement taken BEFORE the handset is installed, it will be higher than the actual laser beam energy striking the skin during a procedure. The other major issue this addresses is the fact that a dye pack (the handset that is used in the 532nm mode to change the wavelength to 585nm or 650nm) absorbs a lot of the light energy, so the only useful measurement of the light output is where the light hits the skin, at the end of the handset. And a dye pack will wear out over time, gradually reducing in energy output as it is being used, and further eroding the efficacy of an already lower-energy treatment.

How does a buyer know what level of technology they are purchasing?

1. First determine if the system has a double pulse mode (some manufacturers have a trademarked name for this technology, so ask if you are not certain) and see if the maximum energy specification listed is for the double pulse mode or for tattoo removal mode.
2. If a manufacturer lists their top energy as more than 1 Joule per pulse, look at the specification tables for all wavelengths. If it is based on a 1064nm technology, look at the specs for the 532nm wavelength, take that number and double it, then add 10%. That is the true maximum energy of that device in the tattoo removal mode. As an example: if the specifications for the 532nm wavelength indicates 450mj, double that (which is 900mj) then add 10% (90mj) and you end up with 990mj, or roughly 1 Joule per pulse.
3. When looking at the specification tables for the wavelengths intended to treat the exotic colors, examine the spot sizes. A very small spot size will be difficult to work with and less effective.
4. Also look at the energy levels for those other wavelengths and you will see that most systems deliver such a low level of energy the system will be relatively ineffective for some situations.
5. The last important factor to consider is that the dye packs will wear out over time (mentioned above). As they wear out, they lose their power. The system must have an energy port (which allows the operator to test the energy output of each handset before starting the treatment), giving the operator an actual reading of how much energy is being delivered during the treatment.

FYI:

- The NaturaLase 2-Joule is the most powerful tattoo removal laser in the world, with almost 2 times the energy of any other system available. The measurement of 2 Joules per pulse is in the tattoo removal mode, at the end of the handset.
- This system is the only device on the market that utilizes two laser generators, that's why it can deliver more than 1 Joule of energy per pulse. (This system can be pushed to deliver almost 2.6 Joules per pulse, but that is not listed in the specifications or promised by the manufacturer.)
- It can treat all tattoo ink colors effectively in fewer treatments than any other device. It will remove even the exotic colors such as yellows and turquoise, which no other device can remove without a high number of treatments in a series (other devices will leave a faded tattoo even after multiple treatments).
- The NaturaLase 2-Joule has an energy port so the operator can measure the exact energy delivered during a treatment. No other system has this feature.
- The price of the NaturaLase 2-Joule is approximately the same as the top-end 1 Joule systems on the market. With two laser generators, compared to all other systems with one laser generator, you get double the technology in the NaturaLase 2-Joule for the same price as the competition.