RING SIGHTS PO Box 2108, Salisbury, SP2 2BX, UK

TRASER

(GASEOUS TRITIUM LIGHT SOURCES)

Doing business with products containing radioactive material requires special knowledge with respect to safety and regulatory restrictions. This report gives answers to the following six representative questions asked by people wanting to benefit from the unique properties of TRASERS.

- What is tritium?
- Why use tritium in a Traser?
- What are the risks of using tritium?
- What is important in handling Trasers?
- What about special equipment?
- Is tritium subject to regulations?

1. What is Tritium?

Tritium is a heavy form (=isotope) of hydrogen and for this reason behaves chemically exactly like it. Pure tritium, therefore, forms a gas, T2 (like hydrogen forms H2). However, tritium is not stable but decays to the inert gas helium with a half life of 12,3 years. This means that after this time half of any amount of tritium will have become helium. The transformation process of tritium is called a pure beta-decay. In this process no gamma radiation occurs and only a low energy electron is emitted.

2. Why use tritium in a Traser?

TRASERS are sealed hollow glass bodies internally coated with phosphor and filled with tritium gas. When the decay electrons of tritium reach the phosphor their energy is converted into light with remarkable efficiency. The same mechanism is used to produce a television picture. Thus, tritium provides:

- A self-contained, light-weight power source with longer lifetime than any chemical battery.
- A radioisotope with no gamma emission and such a low electron energy (0 - 18KeV) that these electrons cannot escape any solid container.
- No possibility of long-term impact on the environment as only helium will remain. Helium is a large part of the breathing air mixture for deep-sea divers.
- Tritium is, and will remain, commercially available as it is a by-product of nuclear power reactors.

3. What are the risks of using tritium?

The low energy electrons of tritium cannot escape the glass body of a Traser. mb-microtec produces Swiss quality Trasers[1] and tests all Trasers for leak-tightness. An intact Traser can therefore be considered safe. Rupture of a Traser will free the tritium. A small fraction (1%) of pure tritium inhaled will be incorporated in the bodywater and subsequently expelled from the body with a biological half life of 10 days.
During its stay in the body it will cause an internal radiation exposure.
Experiments have shown that under adverse conditions (remaining for an infinite time in a small poorly ventilated room) the rupture of a source containing 1 Curie = 1000 miliCurie tritium may cause a dose commitment of about 50 - 100 mrem. This is less than half the yearly dose of any person from natural background radiation. The yearly exposure limit for radiation-exposed personnel in industrialised countries subject to regulation is more than fifty times larger (5000 mrem).

4. What is important in handling Trasers?

The stability of final products typically protects any Traser from breakage so that no special precautions are necessary. However, when handling large quantities of bare Trasers, all efforts must be made to reduce the risk of rupture. This is readily achieved by observance of the following rules:

- Instruct and supervise your personnel in the careful handling of Trasers and enforce good housekeeping.

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[1] Traser quality complies with all requirements as specified in the following documents:
- American national Standard N-540
- Great Britain Ministry of Defence, Defence Standard 62-4/ issue 3, September 1976
- OECD Radiation Protection standards for gaseous tritium light devices, NEA 1973

Further Trasers are registered with US nuclear Regulatory Commission (NRC) under registration No: NR-446-S-102-S since September 1984 under models 400/1 to 400/6.

- Provide for safe transport and storage containers.
- Minimise the number of unprotected Trasers kept at any one place.
- Working and storage rooms should be well ventilated.
- If accidental breakage occurs, the room should immediately be left for a few minutes so that diffusion and ventilation can minimise tritium intake.
- Use gloves or tweezers to remove fractured parts and put them in a container. Then dispose of them according to the applicable regulations.

5. What about special equipment?

When planning a continuous operation with Trasers you will want to be able to measure tritium concentrations in order to avoid unnecessary exposures.

- Tritium in air can be measured with ionisation counters commercially available.
- Intake of tritium by personnel and their individual exposure can be controlled by measuring the tritium concentration in urine samples with a liquid scintillation counter.

6. Is tritium subject to regulations?

In general, handling, use, import and export of radioactive material is subject to licensing by a special government agency. The requirements to obtain such licences vary in different countries, e.g. in the USA two types of licences are typically required.

A. Facility Licence

It can be obtained if requirements are met that ensure the safety of personnel, operations and premises. Typical requirements may include:

- Personnel surveillance
- Competence in radiation protection
- Ventilation
- And so on.

B. Product Licences

They may be needed for the use of a product outside the licensed premises. Typically three levels of licensing are found:

- Special licences are obtained by one or a few users for a special application (e.g. military products).
- General licences allow a number of users to use a certain device. The supplier must submit relevant data and test results and describe the condition of use. With this licence a device can be distributed to non-licenced users if a licence conform use is guaranteed. A typical example is the generally licenced Exit Sign containing up to 25 Curies tritium in the USA and Canada.

- licence exempt status can free a product from any requirements for the end user. Many countries will exempt all products containing less than a maximum activity of tritium (e.g. Great Britain, 2 Curies), while others require extensive data on design features, tests and anticipated user statistics before granting the exemption. The licence exempt status is important, when large groups are intended to use this device. Typical examples are watches, compasses and weapon sights.

General conclusions

- Intact Trasers are safe.
- Destruction of a typical Traser may cause a radiation exposure that is much lower that the yearly natural background.
- Following a few guidelines, can establish a safe operation involving large quantities of bare Trasers.