Overview

The GE Healthcare PETtrace® 800 series is a compact, automated, dual-particle cyclotron system designed for fast, easy and efficient production of PET tracers. It offers the efficiency required to facilitate your clinical schedules, flexibility for research protocols and the performance necessary to meet regional distribution demands.

The PETtrace 800 series is built around a compact negative ion cyclotron with a vertical mid-plane of proven design, featuring both protons and deuterons allowing maximum flexibility and low-cost isotope production. You can configure the system with various targets and process systems to produce commonly used PET radioisotopes.

The PET isotopes that can be produced by PETtrace 800 include oxygen-15, nitrogen-13, carbon-11, fluorine-18 as well as a number of solid target isotopes. These are automatically transferred to the chemistry processing systems for efficient conversion into finished PET tracers and precursors.

For more details, refer to PETtrace 800 series Technical Specification (DOC0779602).

Primary benefits

Reliability and production capacity
The most significant characteristics of the PETtrace 800 series is the high demonstrated reliability. This, together with high production capacity, has made it one of the most preferred cyclotrons in the world.

Fully automated
The entire sequence of producing the PET isotopes and tracer is fully automated. The operator will only select the isotopes and the amount of activity needed. The control system automatically prepares the cyclotron and the targets, tunes the beam and manages the target irradiation.

Lower dose to personnel
The innovative vertical cyclotron mid-plane design and quick-release components have made it possible to reduce the radiation dose to the maintenance personnel.

Flexibility
The PETtrace 800 can be configured in a number of different ways to meet your needs. You can select different options including protons, deuterons, radiation shield, Beam Line, numerous target systems, including solid target, and chemistry modules.

Full upgradeability
At GE Healthcare we are committed to forming long lasting relationships with our customers. The PETtrace series cyclotrons each have an upgrade path built in to ensure a continuum of up to date advancements in your GE cyclotron. The first PETtrace installed was upgrade to current PETtrace technology 15 years after installation. For more details, see “Product upgrades”.

* PETtrace is a trademark of General Electric Company.
**Configuration**

The different PETtrace 800 versions are based on customer demand for beam current.

Three options are available:
- **S9120NA**, PETtrace 840, 60 µA
  6500 mCi / 240 GBq $^{18}$F-fluoride after 2 h of irradiation in single mode
- **S9120NB**, PETtrace 860, 100 µA
  10 800 mCi / 400 GBq $^{18}$F-fluoride after 2 h of irradiation in dual mode.
- **S9120NC**, PETtrace 880, 130 µA
  14 000 mCi / 518 GBq $^{18}$F-fluoride after 2 h of irradiation in dual mode.

A number of different options can be added to each system. For more details, see "Product options".

**System components**

**Magnet**

The design of the PETtrace 800 cyclotron magnet offers simple and robust operation. The coils are made of hollow-core copper conductors that are fiberglass insulated and cast in epoxy.

The magnet is water-cooled. Each conductor layer is equipped with a thermo-switch for overheat protection. Hardware interlocks continuously monitor the cooling water flow.

**Radio frequency (RF) system**

The RF system consists of two resonators and a RF Power Generator (RFPG) applying RF power to the two resonators within the vacuum chamber, that accelerate the particles. Operation is automatically regulated by the cyclotron control system.

**Ion source**

The ion source for the PETtrace 800 cyclotron is mounted internally in a fixed position. The design is of the Penning Ion Gauge (PIG) discharge type with cathodes heated by the discharge. The ion source is capable of generating both proton and deuteron beams.

**Beam extraction**

The PETtrace 800 has a beam extraction efficiency above 99.9%. Two carousels, equipped with six carbon foils each, are used to extract the beam. The extraction system can operate in single or dual mode. Dual mode allows simultaneous irradiation of two targets.

**Beam diagnostics**

The beam current is continuously monitored and regulated by the beam diagnostic system. One part of the diagnostic system provides a remotely actuated internal beam probe to aid in adjusting and tuning the beam. Another part continuously monitor the extraction foil carousel, collimators and targets to allow fully automated start-up, tuning and operation.

**Vacuum system**

The PETtrace 800 vacuum system consists of one high vacuum oil diffusion pump and one mechanical roughing pump. A dedicated vacuum system controller performs pressure monitoring, vacuum pump sequencing and system operation. The aluminum vacuum chamber is O-ring sealed against the magnet poles.

**Control system**

The PETtrace 800 control system is equipped with an accelerator control unit, a chemistry control unit and PC workstation. The control units carry out all the automated closed-loop and logical control tasks, while the workstation is used for operator inputs and database handling. A complete software package for fully automated cyclotron and process system operation is provided.

Control system functions include:
- System start-up, including warm-up periods (<5 min from a cold start) and component monitoring.
- Initiation of production parameters, including selection of irradiation, duration of irradiation and beam current.
- Beam tuning capability to optimize system operation and efficiency.
- Continuous monitoring of system operating parameters, with appropriate protection interlocks and warnings.
- Batch data logging with hard copy print out possibility.
- Data logging of operational parameters for trend analysis.
- Remote connectivity for monitoring and support by GE On-line Center.

**Target mounting and support**

Six fixed target ports are located along the front side of the cyclotron vacuum chamber.

Target media, cooling water and helium foil cooling are supplied to the target through a single supply manifold which is attached to the rear of each target with a quick-connector. The design of the PETtrace mounting flange and targets permits rapid and convenient mounting and dismounting of targets to minimize dose exposure.

**PETtrace 800 user interface**
Product options

**P5260JG, PETtrace 800 basic cyclotron**
The PETtrace 800 is an automated, fixed energy, negative ion accelerator designed for fast, easy, efficient and reliable production of PET isotopes.

**P5220JD, PETtrace 800 proton option**
Proton acceleration capability. Providing a proton beam with an energy of 16.5 MeV on target.

**P5220JB, PETtrace 800 deuteron option**
Deuteron acceleration capability. Providing a deuteron beam with an energy of 8.4 MeV on target.

**P5220JC, PETtrace 800 dual extraction**
The dual extraction option enables simultaneous irradiation of two targets with the same particle. The dual extraction system option will allow irradiation of targets in position 1 to 6 in single mode. It also allows dual irradiation of targets in position 1 to 3 in combination with targets in position 4 to 6.

**P5220JS, PETtrace 800 installation stand**
The PETtrace 800 installation stand makes it possible to install an unshielded PETtrace 800 into a bunker without a floor pit for the vacuum system.

**P5260MK, PETtrace 800 client station**
Additional workstation that allows the user to operate and monitor the cyclotron system from other locations than the Master station. Requires PETtrace 800 PC Lynx control system.

**P5270JA, PETtrace 800 operator manual set**
Set of printed operator manuals in English.

**P5260MJ, PETtrace 800 external proton target interface**
Interface to connect a non-GE target to the cyclotron.

**PETtrace 800 radiation shield options**
Refer to separate data sheet for radiation shield options.

**PETtrace 800 target and process system options**
Refer to separate data sheets for the different target and process system options.

**PETtrace 800 Beam Line options**
Refer to separate data sheet for Beam Line options.

Product upgrades

**P5260PE, PETtrace 800 ion source upgrade**
Includes parts to upgrade the ion source to Gen II.

**P5260ML, PETtrace 800 RFPG control system upgrade**
An upgrade package for the RFPG control system. Upgrades the RFPG control system to Gen II.

**P5260PA, PETtrace 800 PC Lynx control system upgrade**
An upgrade package for the cyclotron control system. Upgrades the cyclotron control system to PC Lynx configuration.

**P5260KA, PETtrace 800 RFPG water cooled DPA upgrade**
An upgrade package for the RFPG DPA. Upgrades the RFPG DPA to the water cooled DPA version.

**P5260PD, PETtrace 800 PC Lynx Master upgrade**
An upgrade package for the Master station. Upgrades the Master station to PC Lynx.

System performance

**PETtrace 800 cyclotron performance**

<table>
<thead>
<tr>
<th>PETtrace 800</th>
<th>Proton beam current*</th>
<th>Deuteron (optional) beam current*</th>
</tr>
</thead>
<tbody>
<tr>
<td>PETtrace 840</td>
<td>60 µA</td>
<td>60 µA</td>
</tr>
<tr>
<td>PETtrace 860</td>
<td>100 µA</td>
<td>60 µA</td>
</tr>
<tr>
<td>PETtrace 880</td>
<td>130 µA**</td>
<td>60 µA</td>
</tr>
</tbody>
</table>

*Total beam current on any target or target combination.

**Tracer production yields and specifications**
See separate data sheets for:
- Radiation shield options
- Target and process system options
- Beam Line option

PETtrace 800 ion source
Site planning requirements
GE Healthcare will assist the customer in site planning and give suggestions how to design the facility.

For detailed site preparation requirements, refer to PETtrace 800 series Site Planning Guide (dir. 2102960-100).

System dimensions

<table>
<thead>
<tr>
<th>Cyclotron</th>
<th>Width 1330 mm (52 in)</th>
<th>Length 1200 mm (48 in)</th>
<th>Height 1910 mm (75 in)</th>
<th>Weight 20 000 kg (44 000 lbs)*</th>
</tr>
</thead>
</table>

* Equally distributed over 1000 mm x 1200 mm (41 in x 47 in)

<table>
<thead>
<tr>
<th>Magnet Power Supply, PSMC</th>
<th>Width 600 mm (24 in)</th>
<th>Depth 800 mm (32 in)</th>
<th>Height 1800 mm (71 in)</th>
<th>Weight 700 kg (1540 lbs)</th>
</tr>
</thead>
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<thead>
<tr>
<th>Radio Frequency Power Generator, RFPG</th>
<th>Width 1180 mm (47 in)</th>
<th>Depth 800 mm (32 in)</th>
<th>Height 1800 mm (71 in)</th>
<th>Weight 750 kg (1640 lbs)</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Control electronics CAB 3</th>
<th>Width 600 mm (24 in)</th>
<th>Depth 800 mm (32 in)</th>
<th>Height 1800 mm (71 in)</th>
<th>Weight 250 kg (550 lbs)</th>
</tr>
</thead>
</table>

Cooling water system

<table>
<thead>
<tr>
<th>Width 1300 mm (51 in)</th>
<th>Depth 600 mm (24 in)</th>
<th>Height 1500 mm (59 in)</th>
<th>Weight 415 kg (915 lbs)</th>
</tr>
</thead>
</table>

System power requirements

Cyclotron cooling circuit

<table>
<thead>
<tr>
<th>Cooling capacity 80 kW</th>
<th>Flow rate 80 l/min (22 gpm)</th>
<th>Outlet temperature 20 °C (68 °F)</th>
<th>Temp. stability ± 1.0 °C (1.8 °F)*</th>
</tr>
</thead>
</table>

* Temperature regulation included in cooling water system

Total power consumption

<table>
<thead>
<tr>
<th>Operation mode (max) 75 kW</th>
<th>Standby mode 4 kW</th>
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</thead>
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Example of facility layout

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