Overview

The GE Healthcare PETtrace 800 cyclotron 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 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. The isotopes are automatically transferred to the chemistry processing systems for efficient conversion into finished PET tracers and precursors.

Primary benefits

Reliability and production capacity

The most significant characteristic 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.

User-friendly

The entire sequence of producing the PET isotope and tracer is fully automated. The operator will only select the isotope 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.

Upgradeability and performance enhancement

At GE Healthcare we are committed to forming long lasting relationships with our customers. A continuous upgrade path is available to keep your PETtrace 800 cyclotron up-to-date. With this solution, you will always be able to adapt to your changing facility needs, increase your production capacity, and update your cyclotron with the latest technology – making the PETtrace 800 an investment for the future.

Contact your local GE representative to learn more about our product upgrades and TYLER, GE’s 10-year-life extension-and-refurbishment program for cyclotrons.
Configuration

The different PETtrace 800 versions are based on the customer's demand for proton beam current.

Four proton beam options are available:
- S9120NA, PETtrace 840, 60 µA
- S9120NB, PETtrace 860, 100 µA
- S9120NC, PETtrace 880, 130 µA
- S9120NG, PETtrace 890, 160 µA

For the PETtrace 840, 860 and 880 systems, a 60 µA deuteron option is available. For the PETtrace 890 system a 40 µA deuteron option is available.

A number of different target and other 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 an 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 monitors 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 a 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 printout possibilities.
- Data logging of operational parameters for trend analysis.
- Remote connectivity for monitoring and support by GE Online Center.

Target mounting and support

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

Target media, cooling water and helium cooling are supplied to the target through a single manifold attached to the rear of each target with a quick-connector. The design of the PETtrace 800 mounting flange and targets permits rapid and convenient installation and removal of the targets to minimize dose exposure.

PETtrace 800 user interface

Product options

PS260JG, PETtrace 800 basic cyclotron

The PETtrace 800 series cyclotron consists of
- a core system with magnet, ion source, beam extraction, beam diagnostics, vacuum and radiofrequency systems
- a control system that includes control units and a workstation. Additional workstations are optional. The system ensures robust...
system control and data recording during routine operation.

- electronics, power supply systems and support equipment required for cyclotron operation

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 a target in position 1 to 3 in combination with a target 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.

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.

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

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 performance
PETtrace 800 cyclotron series performance

<table>
<thead>
<tr>
<th>PETtrace 800</th>
<th>Proton beam current*</th>
<th>¹⁸F(F⁻) capacity / 2hr run Gbq / Ci (# of FDG doses)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PETtrace 840</td>
<td>60 µA</td>
<td>240 / 6.5 (45–80)</td>
</tr>
<tr>
<td>PETtrace 860</td>
<td>100 µA</td>
<td>403 / 10.9 (75–160)</td>
</tr>
<tr>
<td>PETtrace 880</td>
<td>130 µA**</td>
<td>524 / 14.2 (100–200)</td>
</tr>
<tr>
<td>PETtrace 890</td>
<td>160 µA**</td>
<td>648 / 17.5 (120–240)</td>
</tr>
</tbody>
</table>

*Total beam current on any target or target combination.
**Intended for dual beam. Maximum 100 µA on one beam port.

PETtrace 800 ion source

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PETtrace 800 cyclotron series performance

<table>
<thead>
<tr>
<th>Cyclotron</th>
<th>Magnet Power Supply, PSMC</th>
<th>Radio Frequency Power Generator, RFPG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length</td>
<td>1330 mm (52 in)</td>
<td>1180 mm (47 in)</td>
</tr>
<tr>
<td>Width</td>
<td>1200 mm (48 in)</td>
<td>800 mm (32 in)</td>
</tr>
<tr>
<td>Height</td>
<td>1910 mm (75 in)</td>
<td>1800 mm (71 in)</td>
</tr>
<tr>
<td>Weight</td>
<td>20,000 kg (44,000 lbs)*</td>
<td>700 kg (1540 lbs)</td>
</tr>
</tbody>
</table>

*Equally distributed over 1000 mm × 1200 mm (41 in × 47 in)
Control electronics CAB 3

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Width</td>
<td>600 mm (24 in)</td>
</tr>
<tr>
<td>Depth</td>
<td>800 mm (32 in)</td>
</tr>
<tr>
<td>Height</td>
<td>1800 mm (71 in)</td>
</tr>
<tr>
<td>Weight</td>
<td>250 kg (550 lbs)</td>
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</tbody>
</table>

Cooling water system

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

System requirements

**Cyclotron cooling system**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
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</thead>
<tbody>
<tr>
<td>Flow</td>
<td>120-160 l/min (32-42 US Gallon/min)</td>
</tr>
<tr>
<td>Inlet temperature to secondary cooling system</td>
<td>10-15 °C (50-59 °F)</td>
</tr>
<tr>
<td>Max system pressure</td>
<td>~ 0.13 Mpa</td>
</tr>
<tr>
<td>Connection</td>
<td>DN32</td>
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<tr>
<td>Capacity</td>
<td>Minimum 80 kW</td>
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</tbody>
</table>

**Total power consumption**

<table>
<thead>
<tr>
<th>Mode</th>
<th>Power Consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operation mode (max)</td>
<td>75 kW</td>
</tr>
<tr>
<td>Standby mode</td>
<td>4 kW</td>
</tr>
</tbody>
</table>

Imagination at work