Cyclone® 30
Because expertise shouldn’t be an option
The Cyclotron is in full operation since 2003, without a single failure. The contacts with both the commercial and technical staff of IBA was and remains enjoyable. The collaboration up to today has been fruitful and mutually greatly stimulating. The service is excellent and we always enjoy useful advice for our technicians.

Prof. Dr. M.J.A. de Voigt
Cyclotron Manager
Eindhoven University of Technology
Netherlands

Since its market introduction back in 1986, the Cyclone® 30 family from IBA has been manufactured and is in routine operation around the world for radioisotopes production and research.

World leader
With nearly 30 operating units worldwide, IBA is the leader in high energy cyclotrons. This demonstrates the very high reliability and the validity of the simple and reliable design.

Integrated solution
IBA has gained unique know-how and expertise not only on high energy cyclotrons but further related to beam transport lines, targetry, automated chemistry and the full integration of PET & SPECT isotopes production facilities.

High flexibility
The Cyclone® 30 family offers a large flexibility both for current and future production needs thanks to multiparticle production (deuterons, alpha beam) and the ability to upgrade to higher intensity versions if needed.

With the highest number of installed cyclotrons, IBA is the world leader in high energy cyclotrons.
Cyclone® 30
Up to date for every application

Large scale production of SPECT and PET compounds
Energy range from 15 to 30 MeV gives the flexibility to produce all the radioisotopes needed in nuclear medicine, including $^{11}$C, $^{13}$N, $^{15}$O, $^{18}$F, $^{64}$Cu, $^{67}$Ga, $^{111}$In, $^{192}$Ir, $^{201}$Rb ...

Dual beam extraction
Maximum efficiency is achieved through the simultaneous bombardment of two targets allowing the concurrent production of two different isotopes or the dual production of the most frequently used radioisotopes.

Adapted to your production needs
The Cyclone® 30 offers guaranteed intensities of 400μA, 750μA and 1500μA. Any upgraded version to intensities of 750μA and 1500μA are available throughout product life time.

Minimal Exposure
Exposure to personnel and activation of equipment is negligible thanks to the use of negative ion acceleration technology. The radiation exposure of the personnel is drastically reduced, even during maintenance.

Minimal running costs
The unique magnet design, derived from the patented IBA deep valley technology, minimizes power requirements and allows considerable savings in operation costs. The proprietary RF system assures highest stability and system availability.

Automation
The automation of Cyclone® 30 has been carefully designed to be user-friendly, flexible and reliable. Unique full automation of the cyclotron, targets and chemistry modules.

From cyclotron start-up to targetry and chemistry production, routine operation of the cyclotron is entirely automated.

High reliability
Many preventive measures are taken to make the Cyclone® 30 system safe to use, to maintain and to trouble-shoot.

A logbook of the cyclotron operation recording system operation data is automatically generated. It is used as a record file for preventive maintenance duties and for the customers batch record for radiopharmaceutical production according GMP requirements.

Modifications or new/additional configurations can be easily integrated into the system.
Cyclone® 30 XP
Connect to the future

New radioisotopes generation production
The Cyclone® 30 XP is the perfect tool that combines routine isotope production with the new generation of medical radioisotopes used in the field of diagnosis and therapy as well as research works.

Cyclone® 30 XP multi particles
The Cyclone® 30 XP produces proton, deuteron and alpha beams, with energy levels of up to 30 MeV. The 30 MeV alpha beam is well suited to produce isotopes as $^{211}$At, a promising alpha emitter for radiotherapeutic use.
While proton and deuteron are accelerated in the negative ion mode and extracted with stripping system, the positive alpha beam (He$^{++}$) is accelerated and extracted in positive ion mode using an electrostatic deflector.

A comprehensive range for your PET & SPECT production
IBA is the only supplier that offers you a complete solution in terms of beam transport lines, targetry, chemistry and laboratory equipment. IBA developed an exclusive solid target plating technology allowing enriched material recovery and savings with the highest production rate. IBA’s unique SPECT chemistry is the only completely automated system from the target preparation to the final injectable dose compliant with EU pharmacopoeia.

"IBA was selected for its capacity to design, build and install such equipment based on its unique expertise in the field of radioisotope production and its contribution to cyclotron’s technological breakthroughs over the past few years."
Prof. Dr. H.H. Coenen
Institute of Neurosciences and Medicine director
Forschungszentrum Jülich, Germany

"Our hospital has selected IBA technology and know-how based on its worldwide leadership and its ability to understand and tailor a custom-made, comprehensive solution to meet our country’s needs, including personnel training."
Doctor Dinh Nguyen Duy
Director of Tran Hung Dao Hospital
Vietnam
Wide range of PET & SPECT chemistry

**Pinctada® 201Tl Thallium**
Fully industrial system for electroplating of high power 203Tl solid targets. PC-controlled separation and purification of 203Pb produced by 203Tl(p,3n)201Pb. Separation and purification of 203Tl obtained after 90% decay of 203Pb→201Tl. Electro-recovery system for enriched 201Tl target material. Product: 201Tl-TlCl in isotonic 0.9% NaCl.

**Pinctada® 111In Indium**
Fully industrial system for electroplating of high power 112Cd solid targets. PC-controlled separation and purification of 111In produced by 112Cd(p,2n)111In. Electro-recovery system for enriched 111In target material. Product: 111In-InCl3 in 0.05N HCl.

**Pinctada® 67Ga Gallium**
Fully industrial system for electroplating of high power 68Zn solid targets. PC-controlled separation and purification of 67Ga produced by 68Zn(p,2n)67Ga. Electro-recovery system of enriched 68Zn target material. Products: 67Ga-GaCl3 in 0.05N HCl or isotonic 67Ga-citrate.

**Pinctada® 123I Iodine**
Robust target exploiting the 123I indirect production from proton irradiation of 124Xe gas provided with a cryo-cooling loop for recovery. Automated chemistry system for purification and concentration providing 123I in NaI form.

**Other PET radiopharmaceuticals**

<table>
<thead>
<tr>
<th>Tracers</th>
<th>Chemistry module</th>
<th>Molecules</th>
</tr>
</thead>
<tbody>
<tr>
<td>18F</td>
<td>Synthera®</td>
<td>FDG, FLT, F-Choline, NaF, F-Miso, F-Faza, ...</td>
</tr>
<tr>
<td>18F2</td>
<td>Electrophilic module</td>
<td>18F-DOPA, 18F Fluoro-L-m-tyrosine, 18F Fluoro-L-tyrosine, 18F Fluorouracil</td>
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<tr>
<td>11C</td>
<td>Terimo</td>
<td>Raclopride, Flumazenil, Methionine, Acetate, Choline Thymidine, Palmitate, ...</td>
</tr>
<tr>
<td>64Cu</td>
<td>Synthera® Metal</td>
<td>CuCl2</td>
</tr>
</tbody>
</table>

Dr. Al Raies Abdul Hamid
Head of cyclotron and Medical radioisotopes Division, AECS, Syria

“"Our systems for 201Tl and 67Ga production work properly for more than 8 years with several runs per week. The operation and maintenance of the system offer a good reliability.”"
IntegraLab®
From project to reality

Acquiring a cyclotron is only the first step in a complex project. Multiple processes and highly sophisticated equipment must be integrated into a cost effective and performing solution. For many years, IBA’s large team of experts in equipment and radiopharmacy is providing the best support to realize your fully compliant GMP facility.

IBA guides you through all the setting-up processes of your radiopharmaceutical center:

- Define
- Comply
- Design
- Build
- Run

- Define
- Comply
- Design
- Build
- Run

IBA guides you through all the setting-up processes of your radiopharmaceutical center:

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18F Capacity and New Radiotracers
Regulations and Safety
Select and Integrate
On Time and On Budget
Training and Support

IntegraLab® Solution
From definition to the operation, IBA will conduct you with full guidance through your radiopharmaceutical production center set-up.
IntegraLab®
the key to Success

IntegraLab® includes among others:
- Building design according to GMP guidelines
- Integrating of highly sophisticated SPECT production processes
- Clean room design
- Layout of waste management
- Radioprotection
- Selection, integration, supply and installation
- Complete training program

Your project will benefit from IBA’s know-how by operating its own SPECT production center and numerous successfully realized customer projects.

Ankara, Turkey
Cyclone® 30 HC, 2006
- Building design
- 4 Vectio® beam transport lines
- Solid target stations
- SPECT chemistry system for $^{201}$TI, $^{67}$Ga and $^{111}$In
- $^{123}$I gas target and chemistry
- PET chemistry system
- Hotcells & QC equipment

Almaty Kazakhstan
Cyclone® 30 LC, 2007
- Building design
- SPECT chemistry system for $^{201}$TI
- PET chemistry
- 3 solid target stations
- 4 Vectio® beam transport lines
- Hotcells & QC equipment

Eindhoven, Netherlands
Cyclone® 30 LC, 2002
- 4 Vectio® beam transport lines
- Customer target for $^{123}$I production
- Upgrade in progress.

Riyadh, Saudi Arabia
Cyclone® 30 LC, 2008
- Building design
- $^{123}$I gas target, solid target station for $^{201}$TI and $^{67}$Ga
- SPECT chemistry system for $^{201}$TI and $^{67}$Ga
- 3 Vectio® beam transport lines
- PET chemistry system

Hanoi, Vietnam
Cyclone® 30 ST, 2006
- Building design
- Building management system
- 3 Vectio® beam transport lines
- Solid target station
- Research and PET chemistry
- SPECT chemistry system for $^{201}$TI and $^{67}$Ga
- Hotcells & QC equipment
Technical Specifications

Cyclone® 30 LC  Cyclone® 30 ST  Cyclone® 30 HC  Cyclone® 30 XP

High capacity

Energy Proton 15-30 MeV 400 µA 15-30 MeV 800 µA 15-30 MeV 1200 µA 15-30 MeV 400 µA
Maximum proton intensity Deuteron - - - - - 8-15 MeV 50 µA
Maximum deuteron intensity Alpha He²⁺ - - - - - 30 MeV 50 µA
Maximum alpha intensity Target flexibility Simultaneous extracted beams 2 2 2 2 External Beam line 2m to 6m 2m to 6m 2m to 6m 2m to 6m
Exclusive chemistry system Solid target system electroplating technology with enriched material recovery Gas target system production with ¹³³Xe
Deep Valley Magnet Magnetic Structure Exclusive international patent(*) Hill field 1.7 Tesla 1.7 Tesla 1.7 Tesla 1.7 Tesla Valley field 0.12 Tesla 0.12 Tesla 0.12 Tesla 0.12 Tesla Coils D.C. power 8 kW 8 kW 8 kW 10 kW
Directly coupled RF System Frequency (fixed) 66 MHz 65 MHz 65 MHz 33-66 MHz(**) Power 25 kW 40 kW 100 kW 40 kW
State of the art injection system Type of source (external) Multicusp Multicusp Multicusp Multicusp Vacuum system Turbo’s Turbo’s Turbo’s Turbo’s Injected H– current 5 mA 10 mA 15 mA 5 mA
Compact design Total weight 50 tons 50 tons 50 tons 50 tons Cyclotron vault dimension 8 x 7.5 x 4m 8 x 7.5 x 4m 8 x 7.5 x 4m 8 x 7.5 x 4m
Minimal running cost 30 MeV no beam line 70 kW 90 kW 140 kW 90 kW 30 MeV using 2 beam lines simultaneously 110 kW 130 kW 180 kW 120 kW
HVAC load (typ) Cyclotron room 6 kW 6 kW 8 kW 6 kW Power supply room 10 kW 15 kW 20 kW 10 kW Target room 2 kW 2 kW 2 kW 2 kW
Low Cooling requirements Temperature 6°-20° 6°-20° 6°-20° 6°-20° Heat load (2 beamlines, full beam) 100 kW 120 kW 150 kW 120 kW
Clean vacuum Cyclotron Cryo-pumps 2 4 4 3

Technical Specifications

Typical Production Yields

SPECT Isotopes

<table>
<thead>
<tr>
<th>Isotope</th>
<th>Chemical Form</th>
<th>Target Reaction</th>
<th>Enriched Material</th>
<th>Irradiation Time (h) typ.</th>
<th>Yield EOC(*) (Ci/100µA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>¹¹¹In</td>
<td>InCl₃</td>
<td>¹¹⁹Cd(p,2n)¹¹¹In</td>
<td>¹¹⁹Cd</td>
<td>9.5</td>
<td>4.5</td>
</tr>
<tr>
<td>²⁰¹Tl</td>
<td>TlCl₂</td>
<td>²⁰⁵Tl､3n(¹⁰⁵Pb)²⁰¹Tl</td>
<td>²⁰⁵Tl</td>
<td>9.5</td>
<td>1.2</td>
</tr>
<tr>
<td>¹³¹Ba</td>
<td>BaCl₂</td>
<td>²⁰⁵Zn(p,2n)²⁰⁵Ba</td>
<td>²⁰⁵Zn</td>
<td>9.5</td>
<td>4</td>
</tr>
</tbody>
</table>

PET Isotopes

<table>
<thead>
<tr>
<th>Isotope</th>
<th>Chemical Form</th>
<th>Target Reaction</th>
<th>Target Material</th>
<th>Target size</th>
<th>Irradiation Time (min)</th>
<th>Recovered Activity (mCi) EOB</th>
</tr>
</thead>
<tbody>
<tr>
<td>¹³¹In</td>
<td>InCl₃</td>
<td>¹¹⁹Cd(p,2n)¹¹¹In</td>
<td>¹¹⁹Cd</td>
<td>30</td>
<td>3000</td>
<td></td>
</tr>
<tr>
<td>¹⁷⁷Lu</td>
<td>LuCl₃</td>
<td>¹⁷⁷Lu;p,n¹⁷⁷Lu</td>
<td>¹⁷⁷Lu</td>
<td>25</td>
<td>1000</td>
<td></td>
</tr>
</tbody>
</table>

(*) Purity according to EU pharmacopoeia
EOC : End of chemistry
EOB : End of beam.
IBA: opening new ways in healthcare with a focus on fighting cancer

IBA develops and markets leading-edge technologies, pharmaceuticals and tailor-made solutions for healthcare, with a focus on cancer diagnosis and therapy... Leveraging on its scientific expertise, IBA is also active in the field of industrial sterilization and ionization. IBA Group is present worldwide with over 2,000 persons in 40 locations.

Diagnosis: making molecular medicine a reality
IBA has unique expertise in the design of cyclotrons and in the production and distribution of radiopharmaceutical tracers which are used every day in thousands of hospitals worldwide, to quickly and accurately detect cancer, neurological and cardiac diseases. IBA also offers solutions for drug discovery and in vitro diagnostics.

Particle Therapy: the next frontier in cancer therapy
IBA is the undisputed leader in particle therapy, acknowledged to be the most precise and effective clinical radiotherapy method in the selective destruction of cancer cells. To date, more than 11 world renowned medical institutions have built a Particle Therapy Centre with IBA.

The fastest and most accurate Dosimetry solutions
IBA develops innovative, precise and high quality equipment for use in hospitals and by industry partners worldwide. IBA offers a full range of measuring instruments and software that enable radiologists to perform the necessary checking and calibration procedures.

Environmentally friendly Sterilization & Ionization
IBA is designing electron accelerators and high power X-ray solutions used in many industries to sterilize medical devices, to cold pasteurize food products and to improve the properties of polymers. Over 220 IBA Industrial accelerators are used in the world, many of which have been in use for several decades.

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