Cyclone® 30

Because expertise shouldn’t be an option

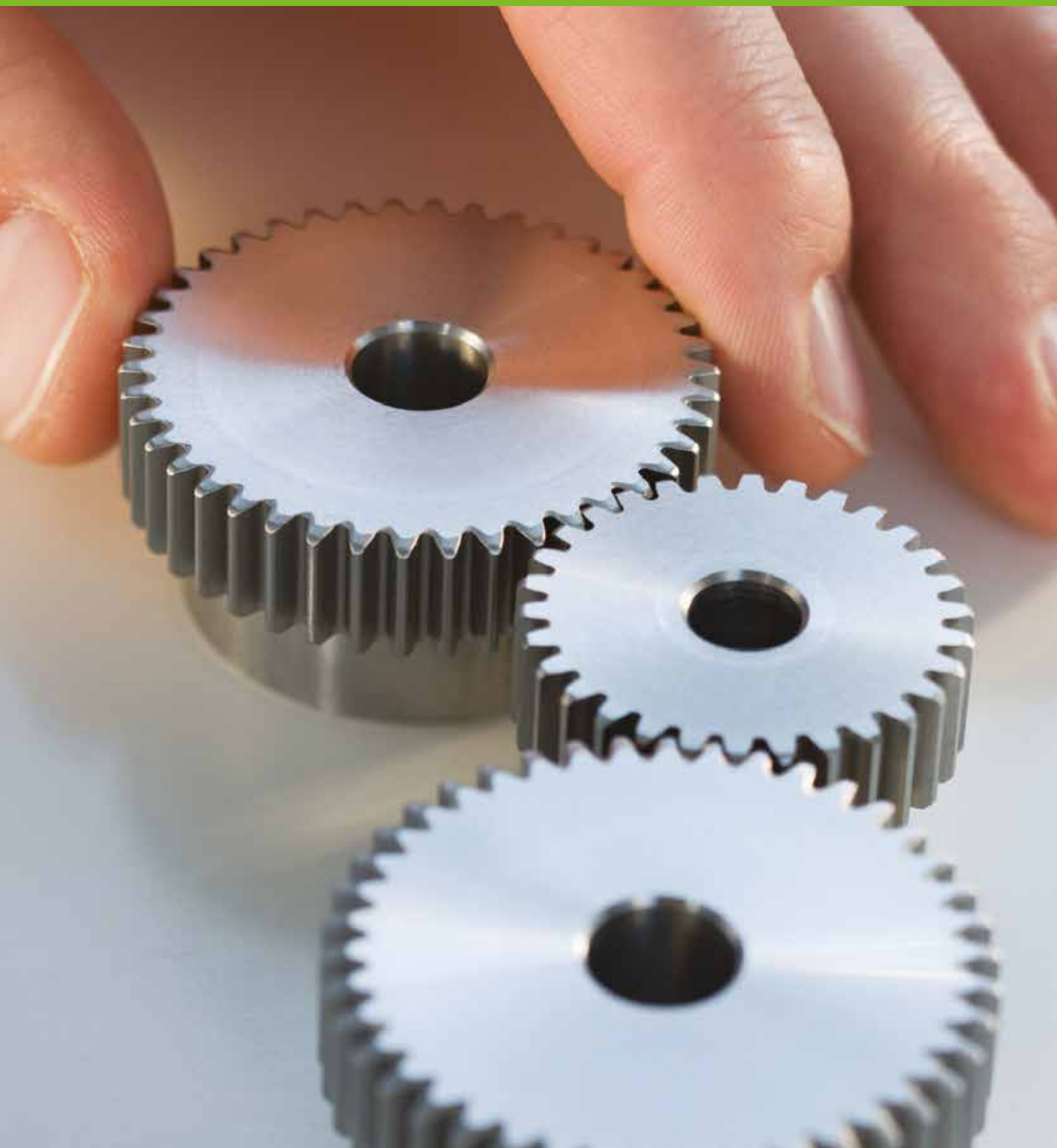


Table of contents

The more you compare, the fewer the options 3

Cyclone® 30 Up to date for every application 4

Cyclone® 30 XP Connect to the future 6

IntegraLab® From project to reality 8

IntegraLab® The key to success 10

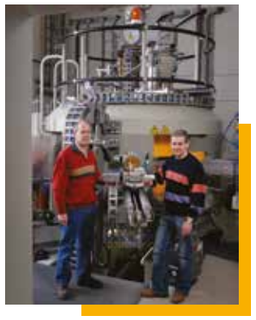
Wide range of PET & SPECT chemistry 12

Technical specifications 15

The more you compare, the fewer the options

"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, ^{123}I, ^{201}Tl ...

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.

Cyclone® 30 HC
Highest performing 30 MeV cyclotron.

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.

Simplicity in equipment use allows even junior cyclotron operators to reliably operate the systems.

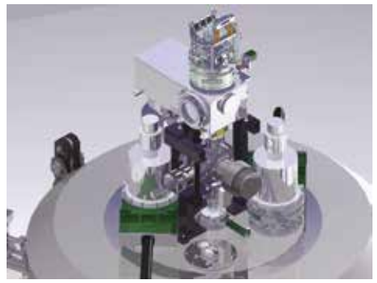
From cyclotron start-up to targetry and chemistry production, routine operation of the cyclotron is entirely automated.

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.



The Cyclone® 30 High Current with an extracted beam current of 1.5mA on target allows the market highest production rate on the new Nirta® Solid target.

Cyclone® 30 XP
Connect to the future

New radioisotopes generation production

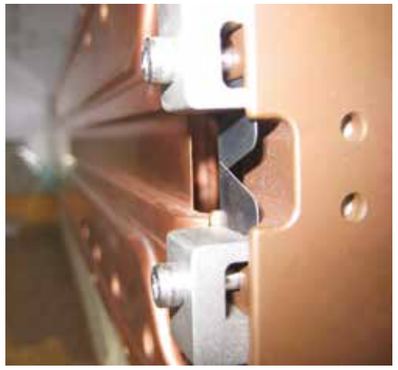
The Cyclone® 30 XP is the perfect tool that combines routine isotope production with the new generation of medical radioisotopes used in the field of diagnosis and therapy as well as research works.

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.



High performance Cyclone® 30 XP deflector for alpha particle extraction.

"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.

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 pharmacopeia.

"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 Ngoc Duy
Director of Tran Hung Dao Hospital
Vietnam

Wide range of PET & SPECT chemistry

Pinctada® ^{201}Tl Thallium

Fully industrial system for electroplating of high power ^{203}Tl solid targets.
PC-controlled separation and purification of ^{201}Pb produced by ^{203}Tl(p,3n)^{201}Pb. Separation and purification of ^{201}Tl obtained after 90% decay of ^{201}Pb→^{201}Tl.
Electro-recovery system for enriched ^{203}Tl target material.

Product: ^{201}Tl-TlCl in isotonic 0.9% NaCl.

Pinctada® ^{111}I Indium

Fully industrial system for electroplating of high power ^{112}Cd solid targets.
PC-controlled separation and purification of ^{111}In produced by ^{112}Cd(p,2n)^{111}In.
Electro-recovery system for enriched ^{112}Cd target material.

Product: ^{111}In-$InCl_3$ in 0.05N HCl.

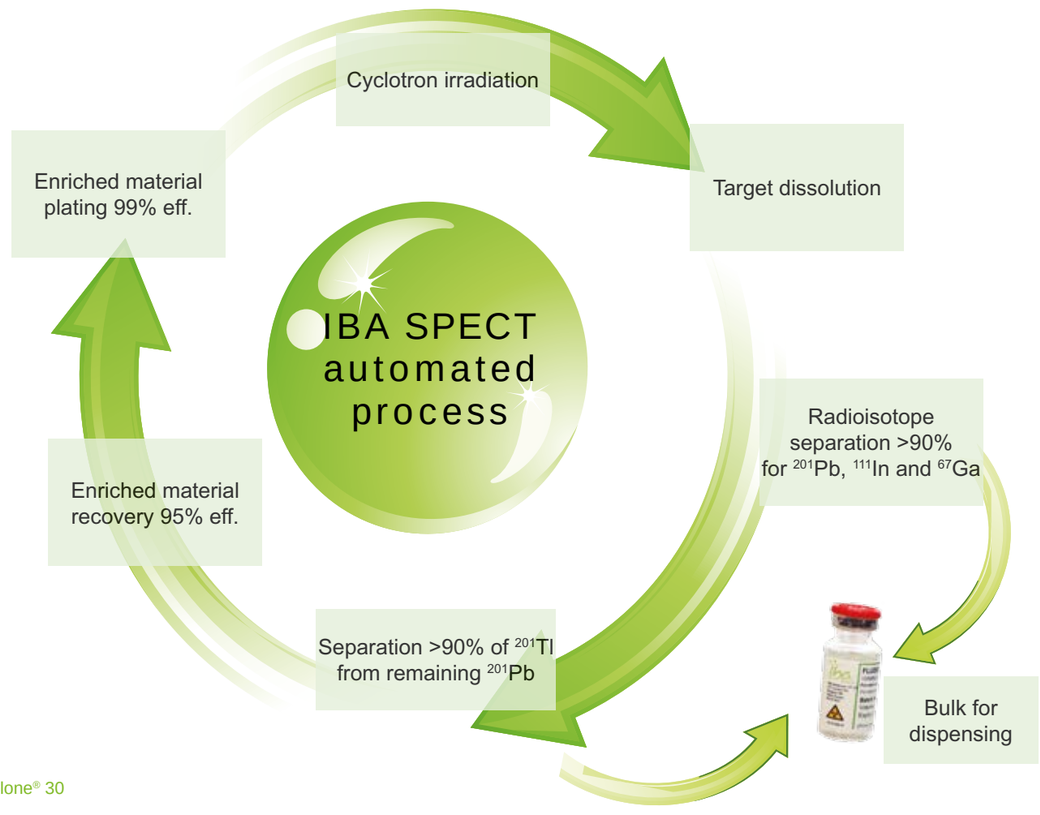
Pinctada® ^{67}Ga Gallium

Fully industrial system for electroplating of high power ^{68}Zn solid targets.
PC-controlled separation and purification of ^{67}Ga produced by ^{68}Zn(p,2n)^{67}Ga.
Electro-recovery system of enriched ^{68}Zn target material.

Products: ^{67}Ga-$GaCl_3$ in 0.05N HCl or isotonic ^{67}Ga-citrate.

IBA only

- Time-controlled multi-target preparation per plating batch in 1 shift
- High-efficiency PC-controlled radiochemistry systems (>90%)
- Efficient electro-recovery of enriched target material (>95%)
- Low running costs.



Pinctada® ^{123}I Iodine

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

- Reliable industrial production
- Minimum staff exposure
- Highest mCi/run.

Other PET radiopharmaceuticals

Tracers	Chemistry module	Molecules
^{18}F	Synthera®	FDG, FLT, F-Choline, NaF, F-Miso, F-Faza, ...
$^{18}F_2$	Electrophilic module	^{18}F F-DOPA, ^{18}F Fluoro-L-m-tyrosine, ^{18}F Fluoro-L-tyrosine, ^{18}F Fluorouracil
^{11}C	Methylation & labeling module	Raclopride,Flumazenil, Methionine, Acetate,Choline Thymidine, Palmitate,...
^{124}I	Terimo	NaI
^{64}Cu	Synthera® Metal	$CuCl_2$

"Our systems for ^{201}Tl and ^{67}Ga production work properly for more than 8 years with several runs per week. The operation and maintenance of the system offer a good reliability."

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

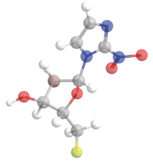



IntegraLab®
From project to reality

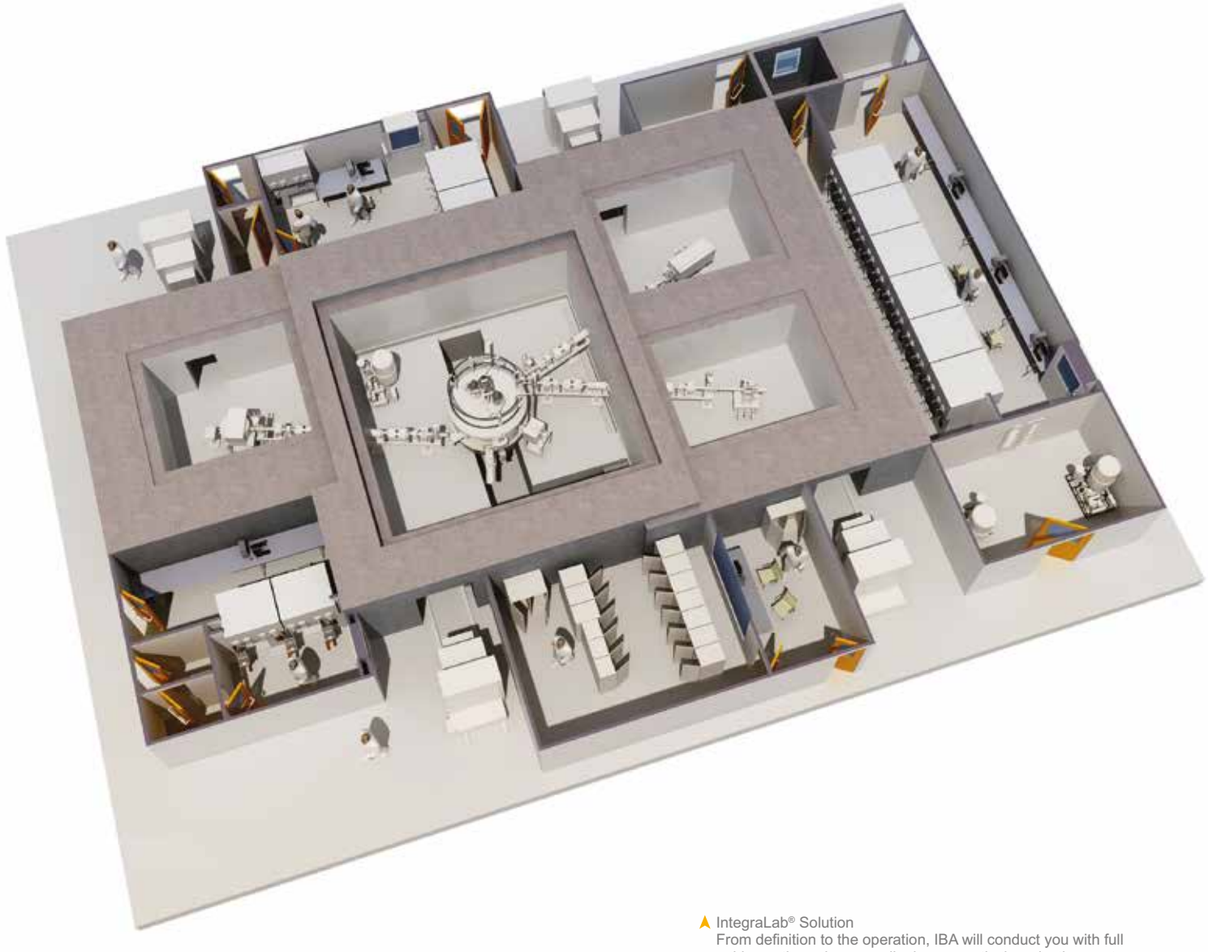
Acquiring a cyclotron is only the first step in a complex project. Multiple processes and highly sophisticated equipment must be integrated into a cost effective and performing solution.
For many years, IBA's large team of experts in equipment and radiopharmacy is providing the best support to realize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

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

^{18}F Capacity and New Radiotracers	*Regulations and Safety*	*Select and Integrate*	*On Time and On Budget*	*Training and Support*
Define	Comply	Design	Build	Run





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:

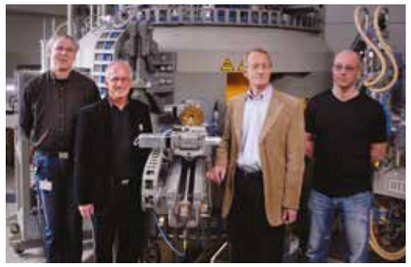
- Building design according to GMP guidelines
- Integrating of highly sophisticated SPECT production processes
- Clean room design
- Layout of waste management
- Radioprotection
- Selection, integration, supply and installation
- Complete training program

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

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}Tl and ^{67}Ga
- SPECT chemistry system for ^{201}Tl and ^{67}Ga
- 3 Vectio® beam transport lines
- PET chemistry system

Ankara, Turkey

Cyclone® 30 HC, 2006

- Building design
- 4 Vectio® beam transport lines
- Solid target stations
- SPECT chemistry system for ^{201}Tl, ^{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}Tl
- PET chemistry
- 3 solid target stations
- 4 Vectio® beam transport lines
- Hotcells & QC equipment

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}Tl 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	15-30 MeV	15-30 MeV	15-30 MeV
Maximum proton intensity		400 µA	800 µA	1200 µA	400 µA
	Deuteron	-	-	-	8-15 MeV
Maximum deuteron intensity					50 µA
	Alpha He^{++}	-	-	-	30 MeV
Maximum alpha intensity					50 µAe
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		^{123}I production with ^{124}Xe			
Deep Valley Magnet					
Magnetic Structure		Exclusive international patent(*)			
Number of sectors		4	4	4	4 + flaps (**)
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					
Number of dees connected at the center		2	2	2	2
Frequency (fixed)		65 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

(*) Patent numbers EP 0 222 786 and US 4,771,208
(**) Patent pending

Typical Production Yields

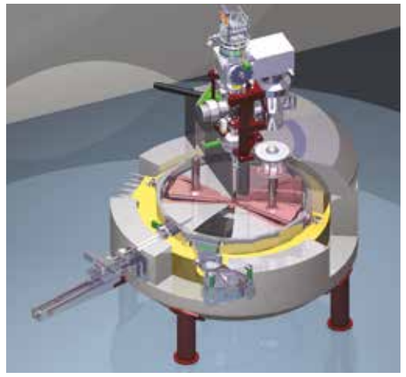
SPECT Isotopes

Isotope	Chemical Form	Target Reaction	Enriched Material	Irradiation Time (h) typ.	Yield EOC(*) (Ci/100µA)
^{111}In	$InCl_3$	$^{112}Cd(p,2n)^{111}In$	^{112}Cd	9.5	4.5
^{201}Tl	TlCl	$^{203}Tl(p,3n)^{201}Pb \rightarrow ^{201}Tl$	^{203}Tl	9.5	1.2
^{67}Ga	$GaCl_3$	$^{68}Zn(p,2n)^{67}Ga$	^{68}Zn	9.5	4
^{123}I	NaI	$^{124}Xe(p,x)^{123}Cs^{123}Xe \rightarrow ^{123}I$	^{124}Xe	6	4.5 (EOB+6h)

PET Isotopes

Isotope	Chemical Form	Target Reaction	Target Material	Target size	Irradiation Time (min)	Recovered Activity (mCi) EOB
^{11}C	CO_2	$^{14}N(p,\alpha)^{11}C$	N_2+ 1% O_2		30	3000
	CH_4		N_2+ 5 % H_2		25	1000
^{13}N	NH_3	$^{16}O(p,\alpha)^{13}N$	H_2O (natural)		20	400
^{15}O	O_2	$^{16}O(p,pn)^{15}O$	O_2 natural		on line	500 /min (cont.flow)
^{18}F	F-	$^{18}O(p,n)^{18}F$	$H_2{}^{18}O$	L	60	5000
				XL	120	7000
				2XL	120	9000
				3XL	120	13000
	F_2	$^{18}O_2$ (p,n) ^{18}F	$^{18}O_2$		60	1500
^{64}Cu	$CuCl_2$	$^{64}Ni(p,n)$ ^{64}Cu	^{64}Ni		60-240	5 mCi/µAh
^{124}I	NaI	$^{124}Te(p,n)$ ^{124}I	$^{124}TeO_2$		60-600	0.5 mCi/µAh

(*) Purity according to EU pharmacopoeia
EOC : End of chemistry
EOB : End of beam.



Cyclone® 30 ➤
What matters most is invisible: IBA expertise.

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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Protect, enhance and save lives

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