

**The optimised
pre-machining robot**



**IRB 6660
– for high performance
applications**



Content

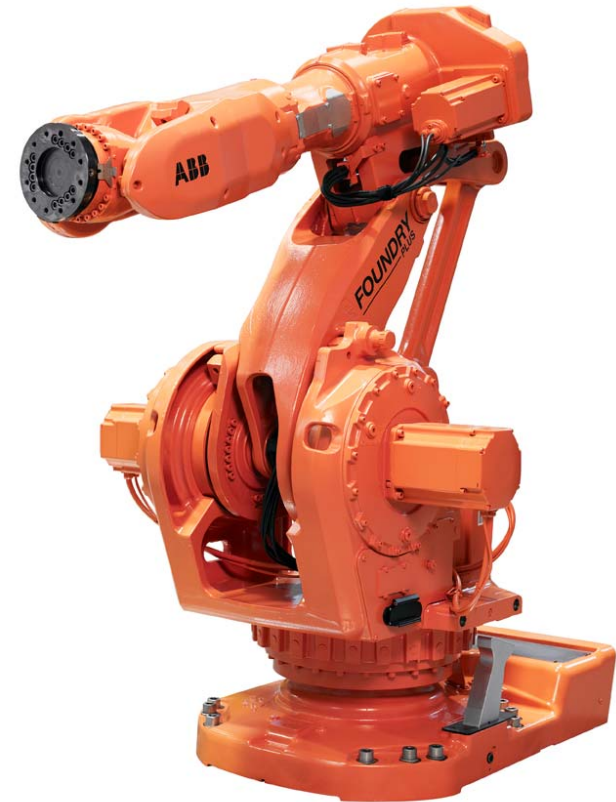
- **Introduction**
- **Background, expectations and result**
- Features, benefits and technical solutions
- Did we meet our objectives?
- Product offer
- Availability

One strategic move to victory.



Introduction IRB 6660

- IRB 6660
 - for high performance finishing applications
- Designed for finishing applications where robot stability is a key factor for success
 - Milling, grinding, cutting, sawing, etc
- High productivity
 - Improve material removal rate
 - Shorter cycle time
- High accuracy
 - Stiff, compact and robust design
 - Heavy weight reduce vibrations
- High uptime
- Commonality with the IRB 6600-family



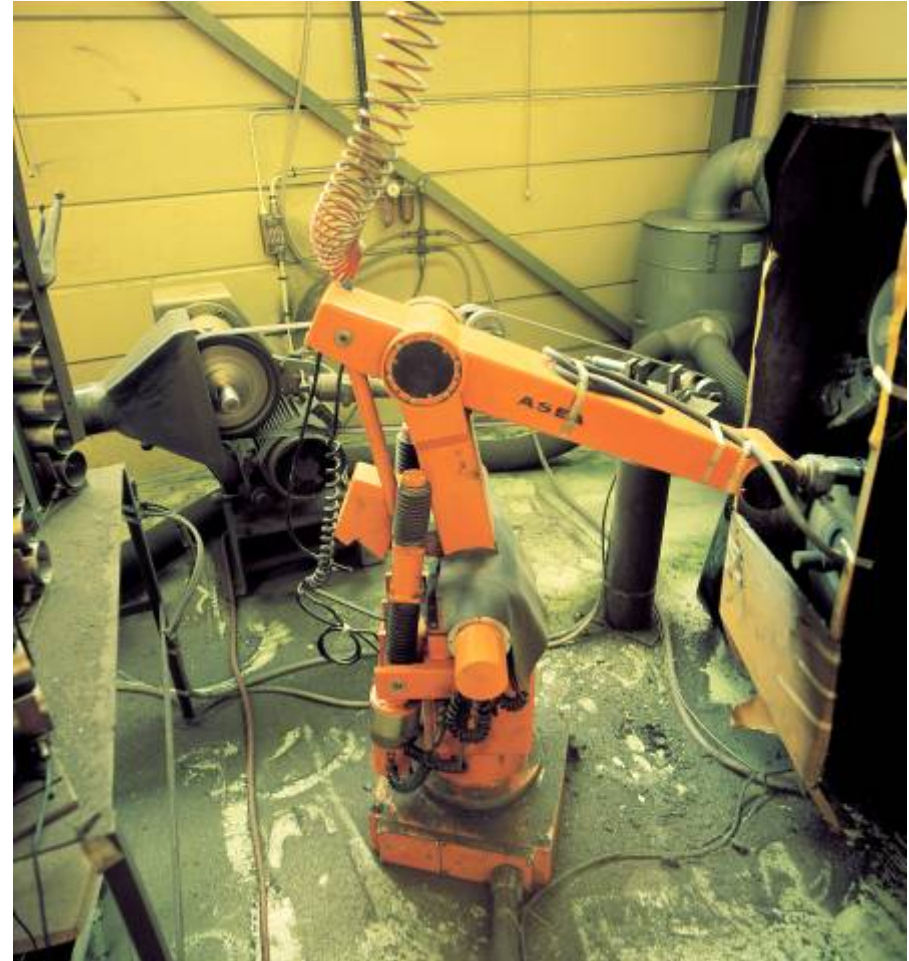
33 years of robotized finishing

“The world’s first electrical robot sold in 1974 was for grinding and polishing of stainless steel tubes.”

ABB was an innovator
and has become #1
in robotized finishing

We intend to stay
as the leader

IRB 6 sold by ABB in 1974 to
Magnusson in Genarp, Sweden



Changing values and demands

■ End of an era - **Manual Finishing**

- Inconsistent part quality, high scrap and reclaim rates
- Hazardous, dirty work environment
- High injury rate and long-term health problems
- Low availability
- Difficult to recruit personnel
- Low status
- Labor intensive and expensive operation



■ Beginning of an era - **Robot Finishing**

- Consistent high product quality
- Reduced tooling costs
- High availability
- Safe environment with less risk of injuries
- Safe environment
- More attractive & rewarding workplace
- Positive, high-tech image
- Improved recruitment possibilities
- Long-term profitability



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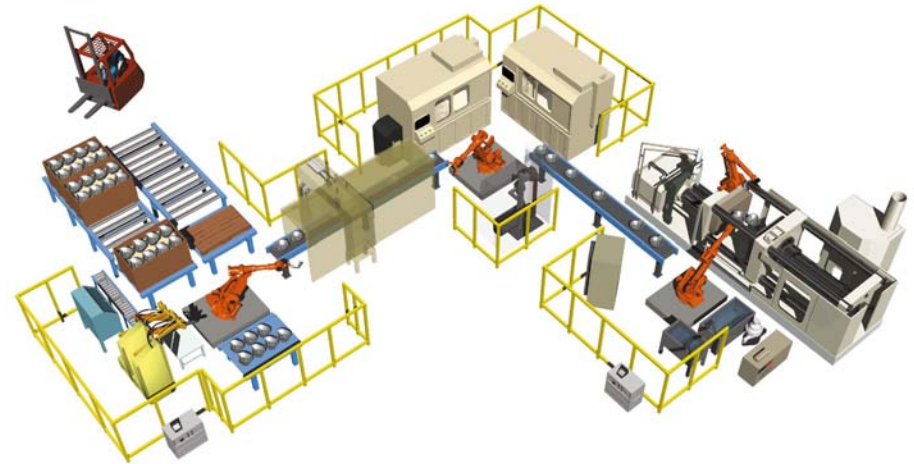
Application and process examples

■ Processes

- Deflashing
- Degating
- Grinding
- Sawing
- Cutting
- Pre-machining
- Machining
-

■ Focus parts

- Any part that needs post-processing after a casting operation
- Aluminum parts, but also other materials such as iron and magnesium alloys



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Expectations in robotized finishing

“Robots needs to be stiffer”



“Robots needs to be more accurate”



“Process needs to be more accurate and consistent”



”Cycle times need to be shortened”



“Tools have to last longer”



“Engineering and optimization has to be reduced”



“Programming time needs to be drastically reduced”



Robot trends in the machining industry

Flexibility

Accuracy

Manual finishing

20-40% of the cost

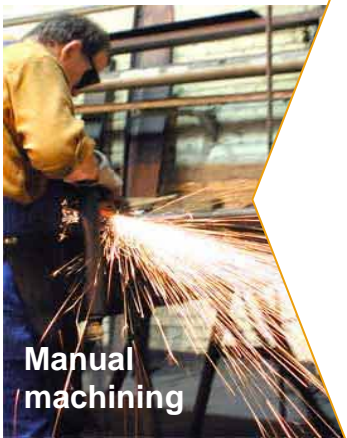
Work environment is hazardous and dirty

Injuries are prevalent

Tedious and repetitive tasks

Low status job – hard to recruit personnel

Traditional Robot machining



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Robot trends in the machining industry

Flexibility

Accuracy



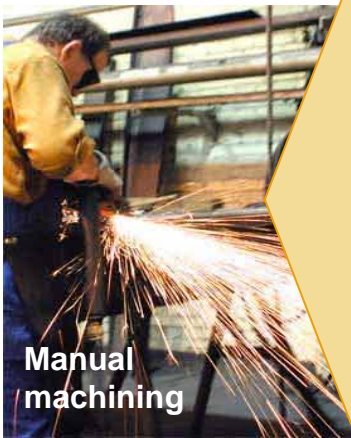
IRB 6660 & RW Machining FC

Efficient re-programming for short batches and complex parts

Handles variable castings in size, location of burrs, flashes, etc

Improves quality

Traditional Robot machining



Manual machining



Machine Tools



Robot trends in the machining industry

Flexibility

Accuracy



IRB 6660 & RW Machining FC

Efficient re-programming for short batches and complex parts

Handles variable castings in size, location of burrs, flashes, etc

Improves process quality

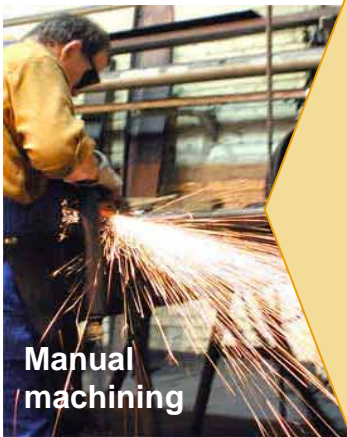
Machine Tools

Large investment costs

Needs loading-/unloading by robots or manual labor



Machine Tools



Manual machining



Robot trends in the machining industry

Flexibility

Accuracy



IRB 6660 & RW Machining FC

Efficient programming for short batches and complex parts

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IRB 6660

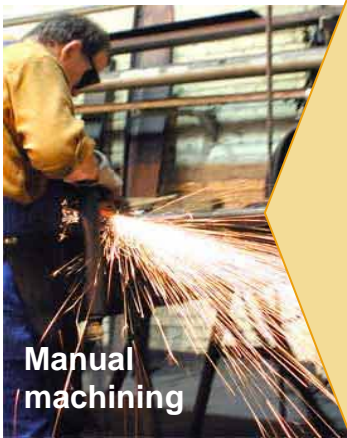
Higher process quality

Improved cycle time

Improved productivity

Aluminum

Efficient programming for short batches and complex parts



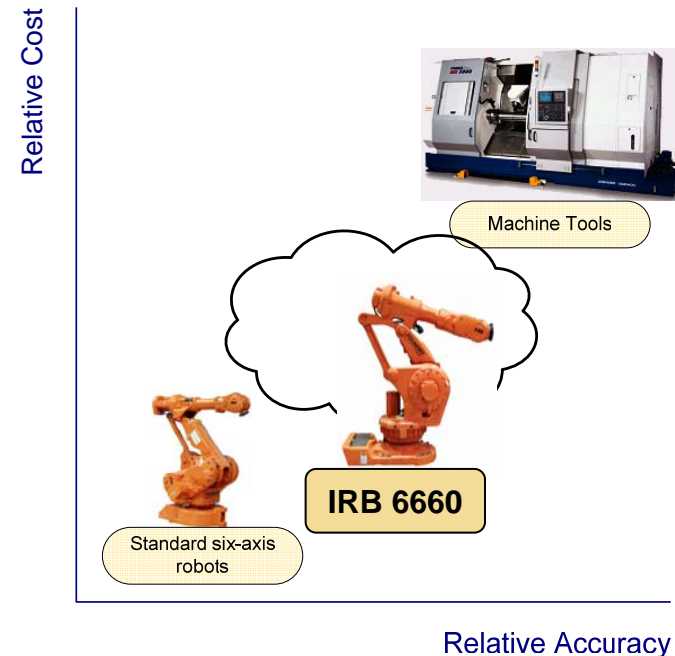
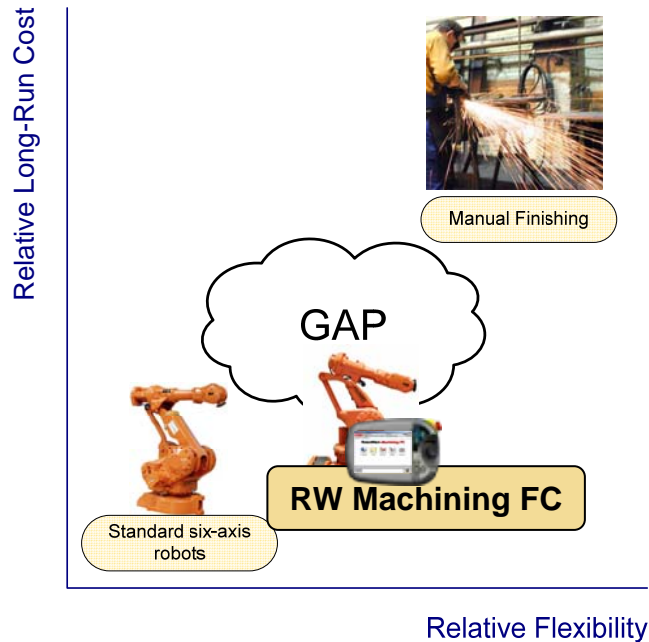
Manual machining



Tools



Filling the GAP with robotized cleaning



■ Force controlled robots

- Creates precision without the expense of being precise
- Shorter programming time with use of intelligent automatic path generation

■ Machine Tools

- In general very accurate and have a high material removal rate
- Expensive and inflexible
 - Small batches -> high unit cost

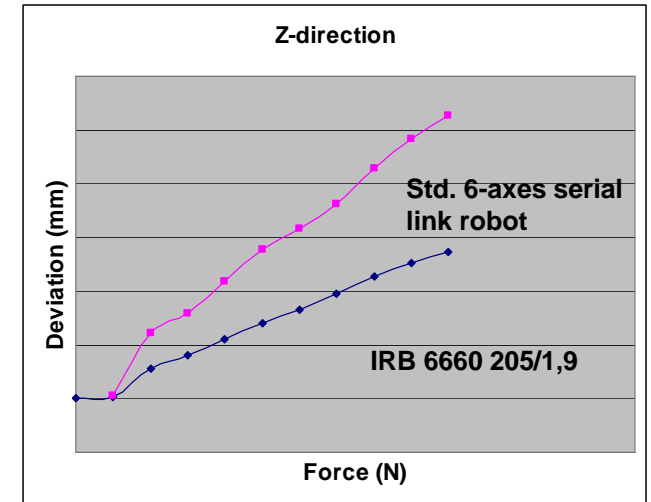
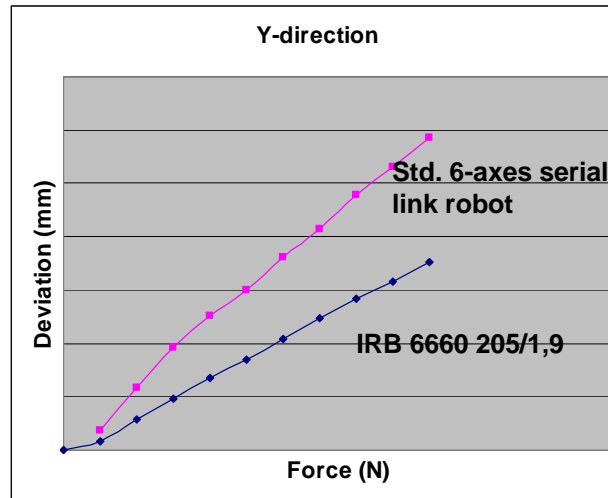
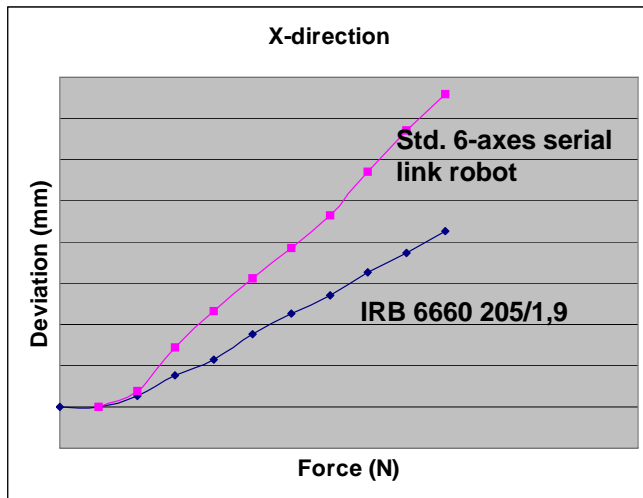
■ Standard six-axis robot

- Mechanical structure put limitations on accuracy
- Inexpensive and flexible



Mechanical Stiffness – Static Test

- 75% stiffer than a standard 6-axis serial link robot
 - Static test - apply a force and measure deviation in all directions*
 - In a typical machining position
- Designed for stiffness
 - Parallel rod design
 - Dual support bearings
 - Compact and sturdy



NOTE! Test done with defined requisites.
Process results depend on several variables.

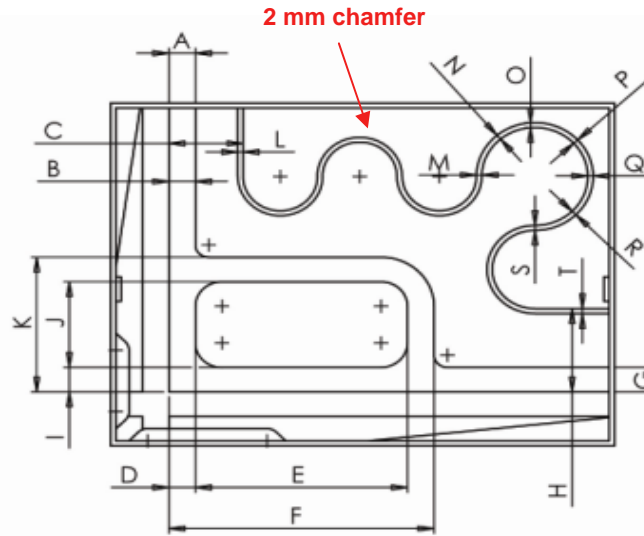
$$* \sum_{Stiffness} = \frac{1}{\sqrt{\left(\frac{1}{X^2} + \frac{1}{Y^2} + \frac{1}{Z^2}\right)}} \times \sqrt{3}$$



Mechanical Stiffness – Dynamic Test (1)

- Application test
 - Cut depth: 5 mm
 - Feed rate: 30 mm/s
 - Spindle revolution: ~4 500 rpm
 - Program and mill a 2 mm chamfer and measure deviation between programmed path vs. actual path

- Result*
 - Average deviation: -0,07 mm
 - Max deviation: -0,21 mm



Pre-requisites

Eurospindle:

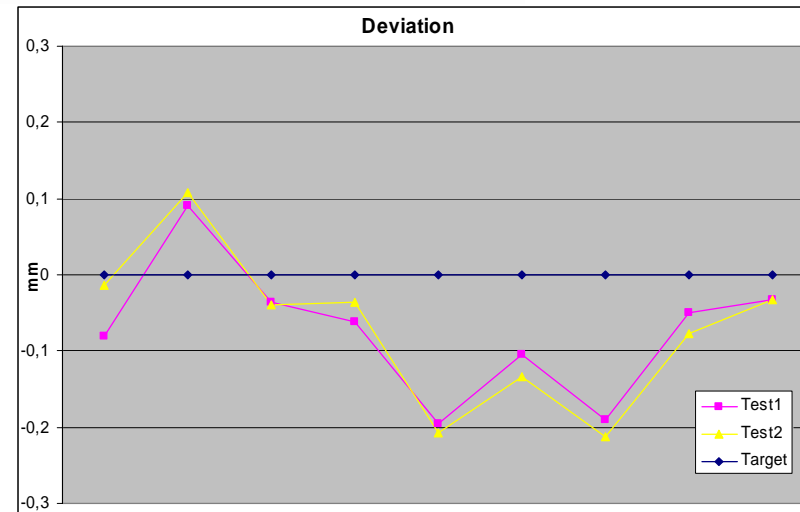
Pmax=6.8kW
 Nmax=20.000rpm
 Fmax=333Hz
 Cooling: Fan

Pin Miller:

D=10mm

Test piece material:

7075 - T7351
 or equal



* = Average deviation and max deviation from two test runs

NOTE! Test done with defined requisites. Process results depend on several variables.



Result – high performance effort

- Combination of proven technology, parts and design reduce time-to-market
- Modification of parallel arm design to improve mechanical stiffness
- Extensive testing to verify stiffness and stability
 - Static and dynamic test
- Robust and compact design with working range and payload covering most finishing applications
- Reduced vibrations gives better surface quality and longer tool lifetime



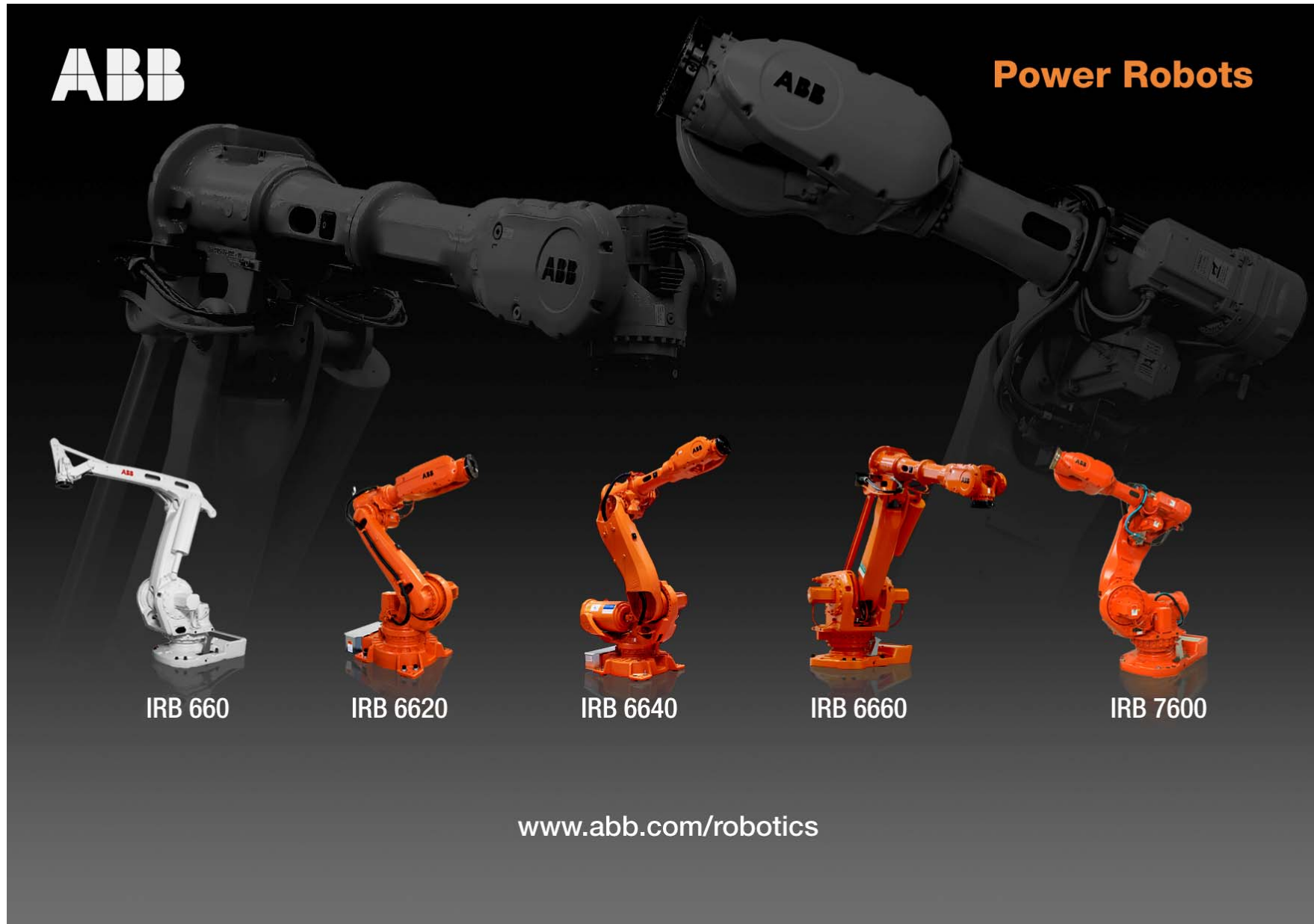
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Power robots – a powerful and robust family for all needs



Benefits - IRB 6660 205/1,9

- Optimised for finishing and pre-machining applications
 - Based on requirements from machining operations.
- High productivity
 - Improve material removal rate
- High accuracy
 - Stiff, compact and robust design to withstand high process forces.
 - Parallel arm structure gives stiffness



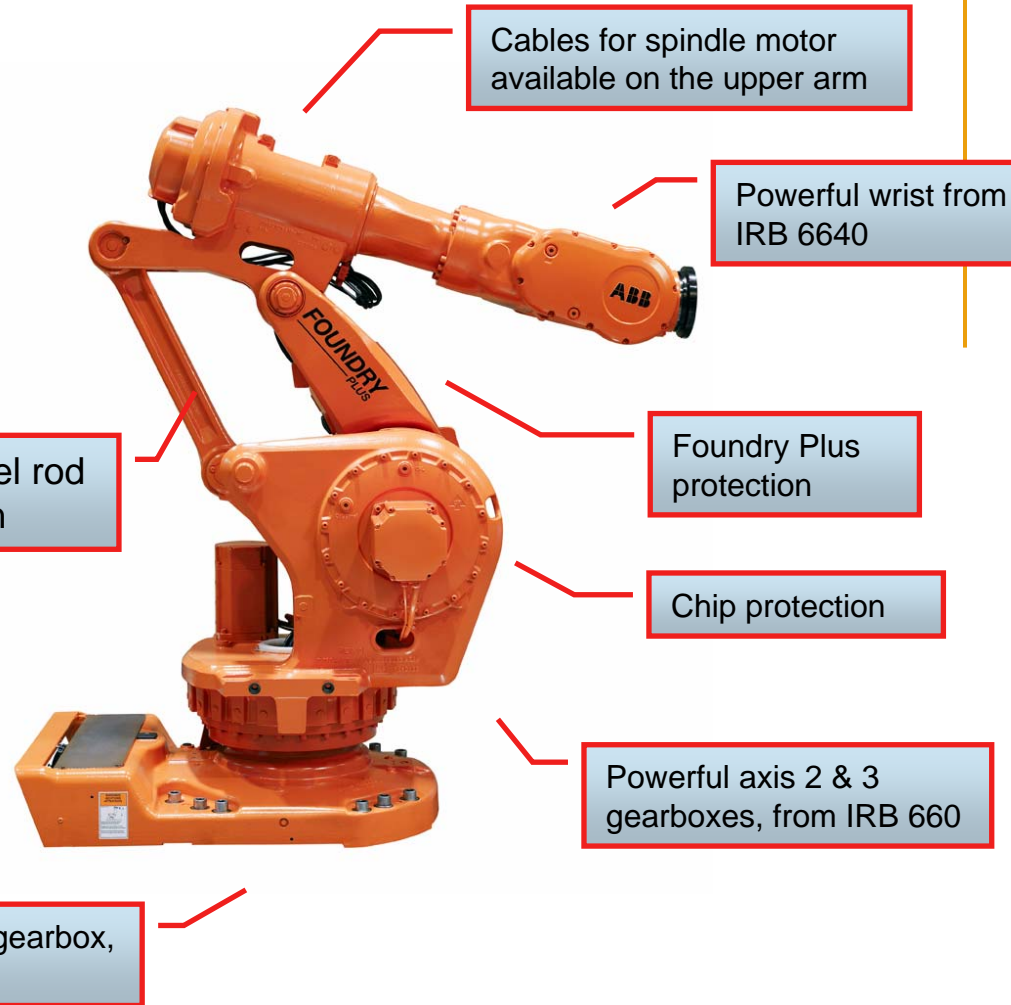
Movie

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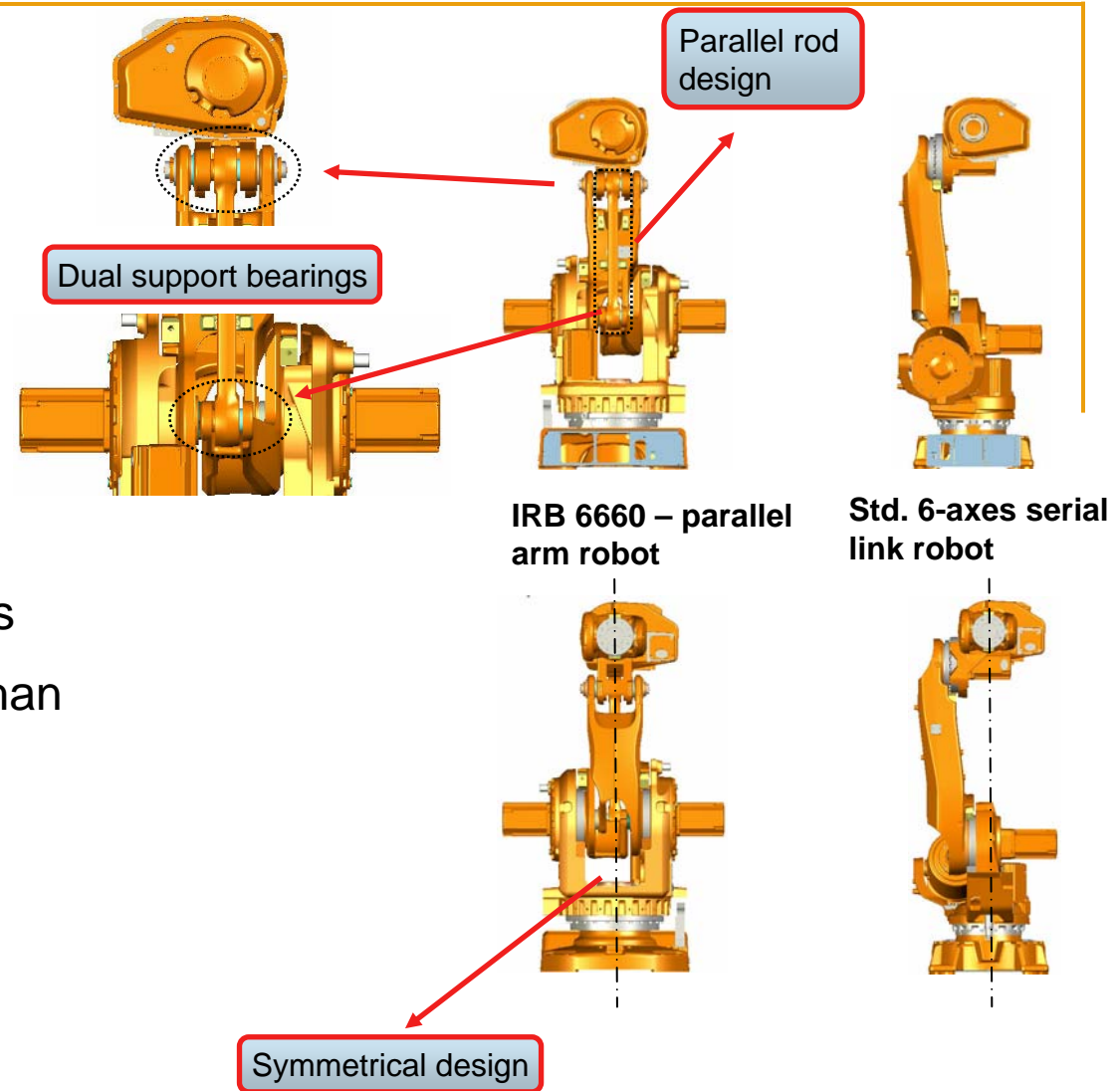
Technical solutions – Designed for high performance

- Combination of the best and most powerful components from ABB's well proven power robot family
 - Wrist with high torque capability
 - The markets best protection – Foundry Plus
 - Further improved with Chip protection
 - Speed and stability of the powerful axis 1 gearbox from IRB 7600



Technical solutions – Parallell structure

- Mechanical parallelogram construction in favor for contact applications
 - Supported by dual support bearings
 - Symmetrical distribution of contact forces
 - Reduce mechanical oscillations
 - In general stiffer and sturdier than serial link structure



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IRB 6660 – Heavy weight in favor for machining

- Vibrations in machining process is complicated as it depends on robot, work piece, tooling and forced vibration from spindle and cutter.
- Vibration can be both self-excited chatter or forced vibration
- Effect of vibration
 - Tool damage
 - Spindle damage
 - Low surface quality
- Conclusion of machining study
 - **Large** mass robot with a **light** mass spindle gives the best performance
 - Heavy structure for minimize both high and low frequency vibrations

	Heavy Spindle	Light Spindle
Heavy Robot	OK	BEST
Light Robot	Not good	Not good

IRB 6660 205/1,9



WEIGHTS MUCH MORE THAN ANY OF ITS MAIN COMPETITORS!



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Expectations in robotized finishing

“Robots needs to be stiffer”

IRB 6660 is 75% stiffer than a standard 6-axes robot

“Robots needs to be more accurate”

The mechanical design of IRB 6660 is a pre-requisite for accuracy

“Process needs to be more accurate and consistent”

IRB 6660 can manage and correct process errors

”Cycle times need to be shortened”

IRB 6660 is powerful allowing for high material removal rates

“Tools have to last longer”

Force controlled robots give a constant and predictable tool wear

“Engineering and optimization has to be reduced”

Offline programming together with quick robot programming reduce engineering

“Programming time needs to be drastically reduced”

With force control software, programming time can be up to 80% reduced



Mainly addressed with software features in RobotWare Machining FC and RobotStudio



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One strategic move to victory.



Product offer - IRB 6660 205/1.9

- 6-axes robot
- Payload: 205 kg
- Reach: 1.93 m
- Protection
 - Chip protection
 - Mechanical protection reduce chips entering axis 2
 - Complete Robot IP67
 - Foundry Plus option
- Floor mounted
- Based on selected high-performance components from ABB Power Robots



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Selected Options - IRB 6660 205/1.9

- Absolute Accuracy
 - Makes a real robot an ideal robot as it maintains the accuracy between the real world and the offline world of CAD software and ABB's RobotStudio.
- RobotWare Machining Force Control
 - Software for simplified programming and improved process results in demanding applications
- RobotStudio
 - Programming can also be done with RobotStudio's offline capabilities, including reusing data from CAD/CAM generated programs and special supporting features that makes it easy to create paths.



Technical Data

IRB 6660- 205/1.9

Industrial Robot

TECHNICAL DATA, IRB 6660 INDUSTRIAL ROBOT

SPECIFICATION

Robot versions	Reach	Handling capacity	Center of gravity	Wrist torque
IRB 6660-205/1.9	1.93	205	375 mm	Axis 5 1177 Nm Axis 6 620 Nm

Extra loads can be mounted on the robot
15 kg on upper arm with 205 kg payload and 500 kg on the frame.

Number of axes:	6
Protection	Complete robot IP 67 Chip protection
Mounting:	Floor mounted

PERFORMANCE

Positions repeatability	0,07	
Axis movements	Working range	Axis max speed
Axis 1 Rotation	+180° to - 180 °	Axis 1 130 °/s
Axis 2 Arm	+ 85° to - 42 °	Axis 2 130 °/s
Axis 3 Arm	+120° to - 20 °	Axis 3 130 °/s
Axis 4 Wrist	+300° to - 300 °	Axis 4 150 °/s
Axis 5 Bend	+120° to - 120 °	Axis 5 120 °/s
Axis 6 Turn	+360° to - 360 °	Axis 6 190 °/s
Axis 2-3	+160° to + 20 °	

A supervision function prevents overheating in applications with intensive and frequent movements.

ELECTRICAL CONNECTIONS

Supply voltage	200-600 V,50/60 Hz
Power consumption	ISO-Cube 2.6kW
Normal robot movements	3.8kW

ELECTRICAL CONNECTIONS

Dimensions robot base	1206 x 798 mm
Weight	1730 kg

ENVIRONMENT

Ambient temperature for mechanical unit	
During operation	+ 5° C (41° F) --+50°C (122° F)
During transportation and storage for short periods (max 24h)	- 25° C (13° F) --+55°C (131° F) up to +70° C (158° F)

Relative humidity	Max 95%
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Noise level	Max 70 dB (A)
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Safety	Double circuits with supervision, emergency stops and safety functions, 3-positions enable device.
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Emission	EMC/EMI-shielded
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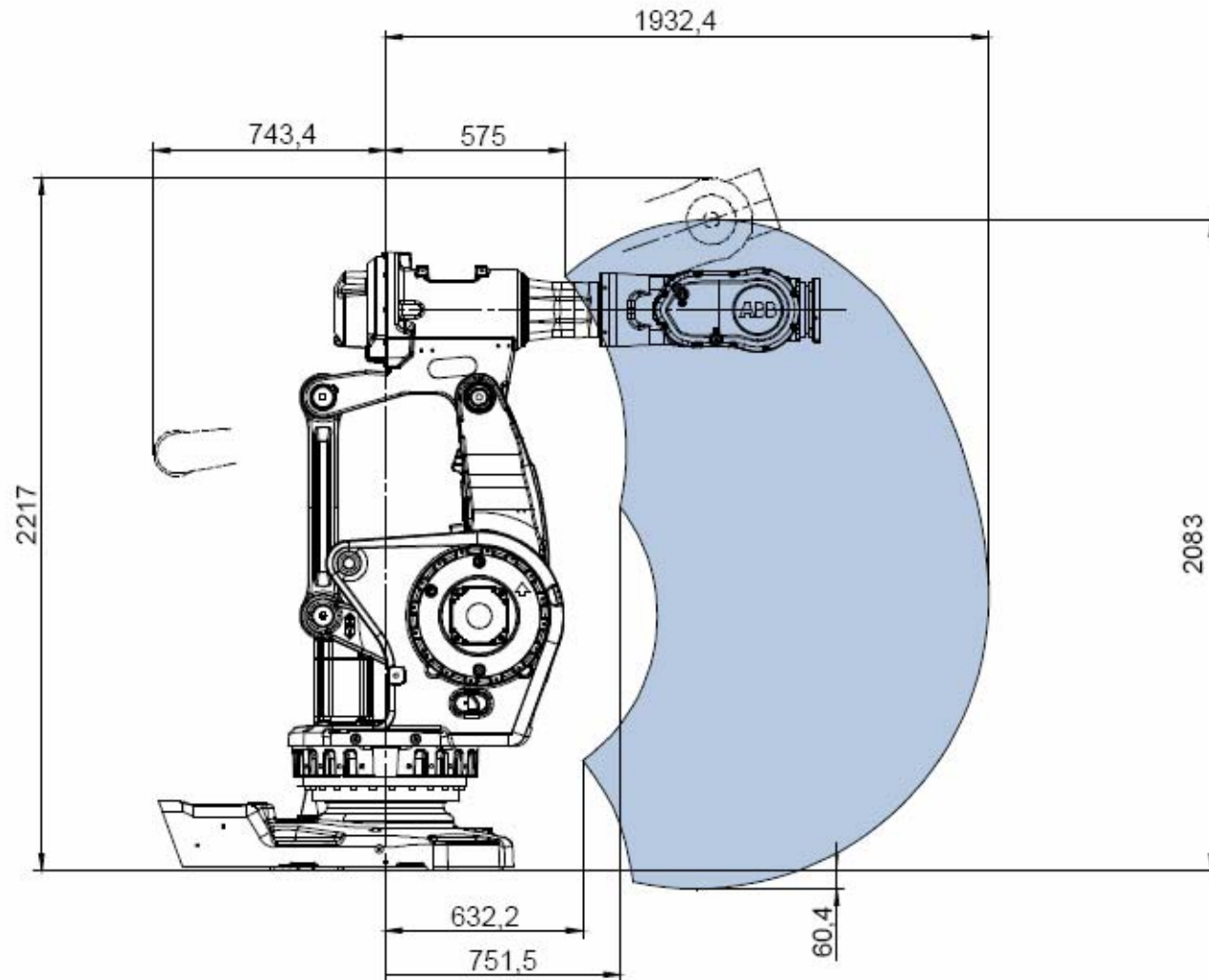
Selected Options	RobotWare Machining Force Control Foundry Plus Absolute Accuracy
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Data and dimensions may be changed without notice.

Working range

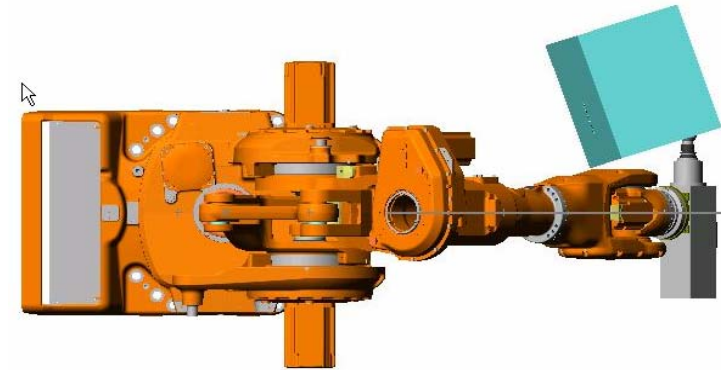
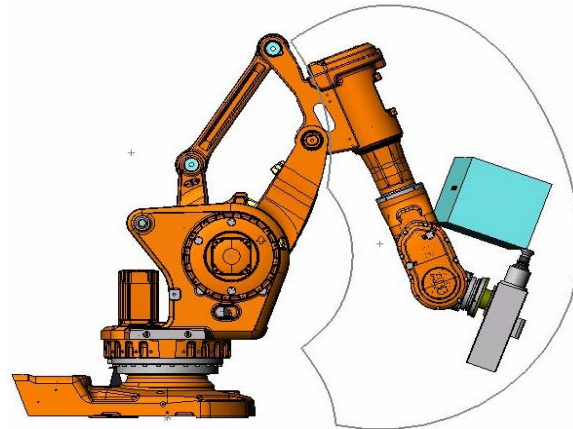
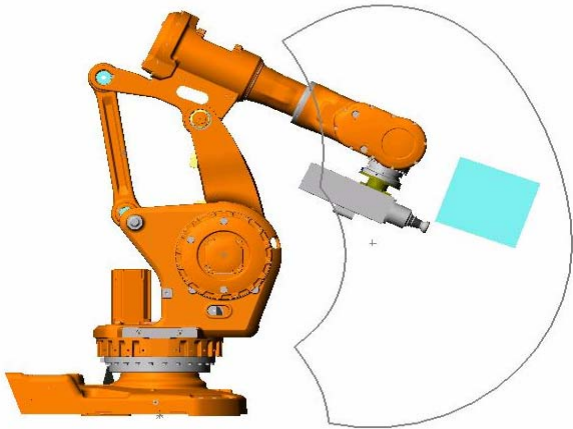
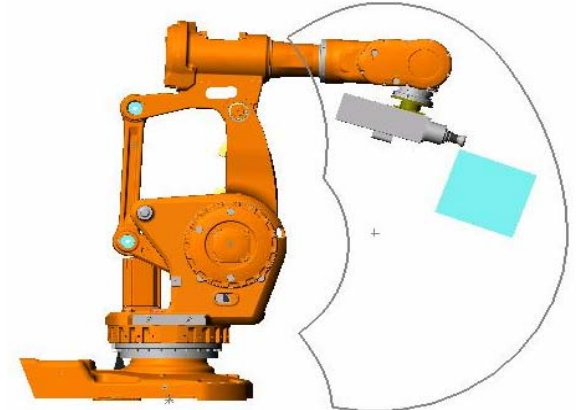
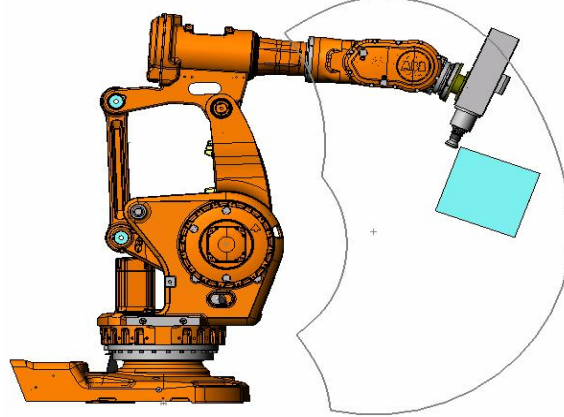
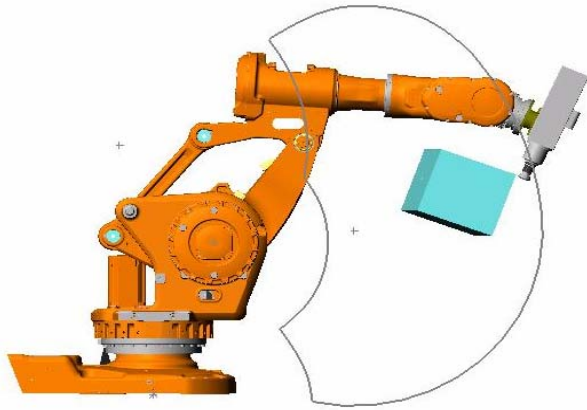
WORKING RANGE

IRB 6660 optimized for pre-machining
IRB 6660-205/1.9



Accessibility: engine block 500x350x400

Reach: 1933 mm, stroke: 1066 mm



IRB 6660 - 205/1.9 - Summary

Market leader

- Stiffest robot in its class
- Highest path performance
- Highest gear strength
- Highest inertia capability
- Exceptional robustness
- Most compact
- Best protection



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One strategic move to victory.



Availability

- First delivery
 - 2008, week 21



ABB

Power and productivity
for a better world™

The ABB logo, consisting of the letters 'A', 'B', and 'B' in a bold, red, sans-serif font. Each letter is divided into four quadrants by a white cross.