

## Lean production and material flow in medical manufacturing

How to increase productivity in assembly and packaging



# Medical innovation demands lean production

Product change is a constant challenge for the medical product industry. You barely get one product manufactured, when you're asked to roll out the next one. Is your infrastructure flexible enough to handle the pace of change? Can lean production make you fast and flexible at the same time? With years of experience in both manual and automated assembly and packaging technologies, Rexroth can help you put lean to work.



## Unique conditions require a lean approach

To stay competitive, medical product manufacturers face some of the most demanding conditions anywhere:

- Short product runs and shrinking product lifecycles
- Complex products that require multi-step, precision assembly
- Small, sensitive components demanding careful handling
- Strict cleanliness and environmental controls

Tackling these challenges calls for a dynamic approach to lean production, with technologies engineered

to adapt to the constantly changing requirements of 21st century global markets. Why not work with a partner who has experience in factory

productivity across the spectrum of manufacturing technologies? Together, we can engineer the right platform for your operation.



Rexroth conveyors make it easy to integrate manual and automated production, as in this hearing aid assembly operation.



Hospital Supplies



Lab and Hospital Equipment



Personal and Home Health



Implanted Medical Devices

**Work with the worldwide experts in manufacturing flexibility**

With more installed conveyors and workstations in assembly systems worldwide than any other brand, Bosch Rexroth is the global leader in helping companies get the most out of their production systems.

From automotive and electronics, to appliances and power tools, we've

helped many of the world's leading manufacturers improve productivity, keep a lid on costs and build their competitive edge.

Working with you, we can equip your operation with the right mix of automated and manual technologies to make you more flexible. The result? Faster production changeovers, higher profits, less waste and better quality.



Efficient production of dialysis filters driven by Rexroth TSplus precision assembly conveyor system.



Optical Manufacturing



Dental



Pharmaceutical

## How to get the most out of this brochure

Lean production means the elimination of waste throughout your assembly process. To help you make the right choices, we've gathered up as much useful information as we could and designed this brochure around it. Here's how to get the most out of every section:

### Lean Production Decision Matrix



When does automation make sense? When is manual assembly a better choice? Open the foldout flap on

the last page and use the Rexroth Lean Production Decision Matrix for guidance. Keep the flap open as you go through the brochure to help you evaluate the effectiveness of each technology in your situation.



### Rexroth Rx for Success

The Rexroth Rx symbol connects individual Rexroth technologies to the Lean Production Matrix. Simply look for the corresponding number on the matrix to see where each product fits.

### Planning Guides and Support Resources

Need more comprehensive support? We've positioned additional guidebooks, weblinks and complete resource kits in sidebars throughout the brochure. It's all just a click away at [www.boschrexroth-us.com/lean](http://www.boschrexroth-us.com/lean).



# Flexible modular conveyor systems

Good technology can move product; lean thinking can move productivity. Rexroth transport systems give you more control, with the most options anywhere for routing, positioning, orientation, conveying and stopping. Plus, complete compatibility with our aluminum framing system lets you easily add tools, positioning fixtures, inspection systems, work instructions and other efficiency-critical devices. Eliminate wasted time, wasted motion, and wasted production with flexible, modular transport.



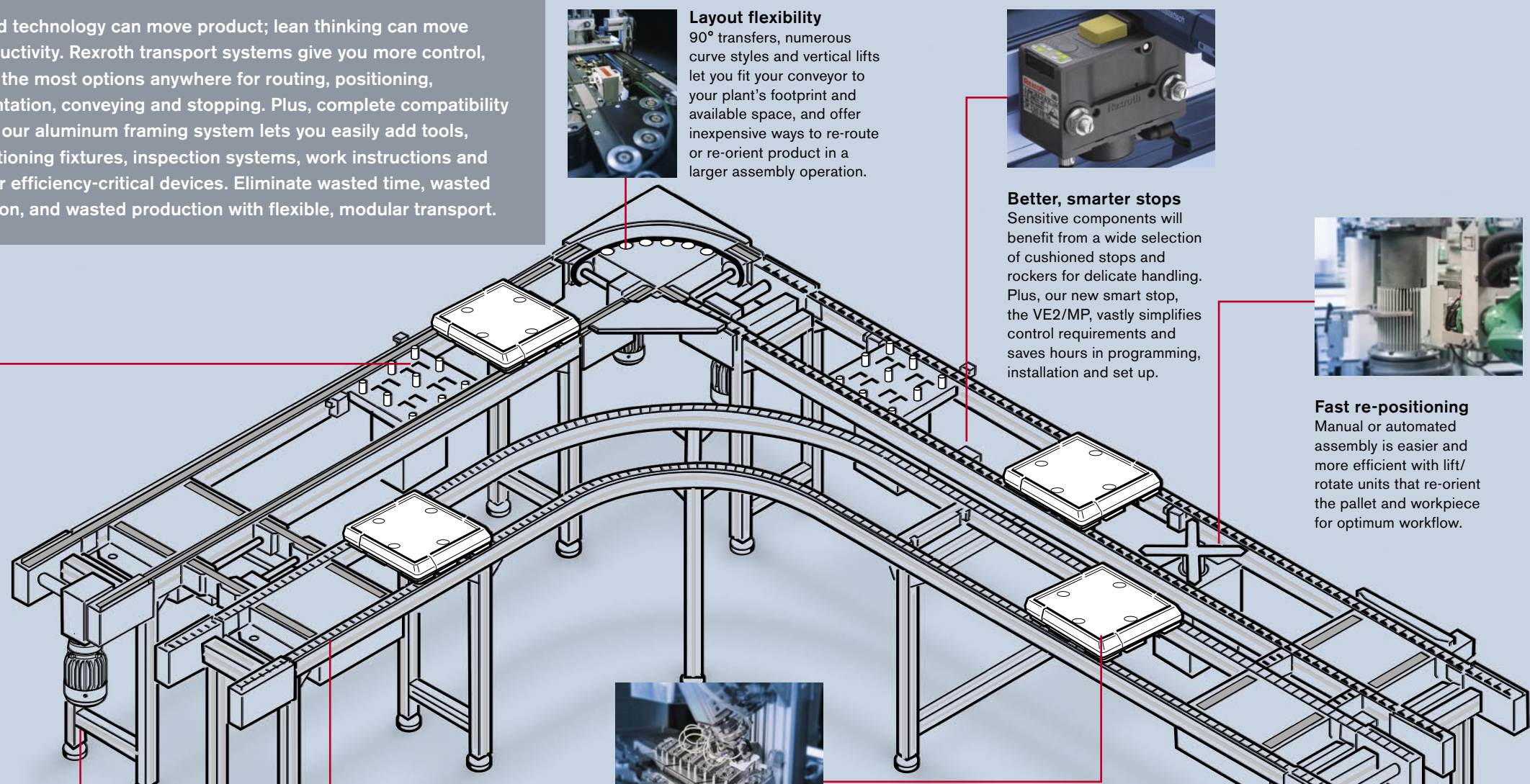
### Precision positioning

For medical manufacturing, where robotic or automated applications such as gluing, soldering, welding or pick and place may require extreme precision, our modular positioning units provide up to 0.015 mm positioning accuracy in manual or automated production.



### Bolt-together simplicity

Bolt-together modular framing is the key to manufacturing flexibility—when new products call for line changes, you can quickly reconfigure, add to, or re-purpose your investment with ease.



### Layout flexibility

90° transfers, numerous curve styles and vertical lifts let you fit your conveyor to your plant's footprint and available space, and offer inexpensive ways to re-route or re-orient product in a larger assembly operation.



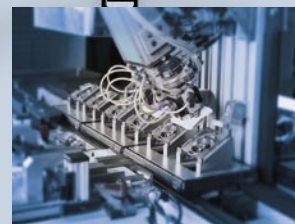
### Better, smarter stops

Sensitive components will benefit from a wide selection of cushioned stops and rockers for delicate handling. Plus, our new smart stop, the VE2/MP, vastly simplifies control requirements and saves hours in programming, installation and set up.



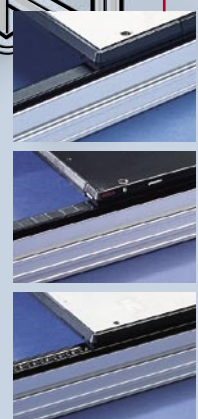
### Fast re-positioning

Manual or automated assembly is easier and more efficient with lift/rotate units that re-orient the pallet and workpiece for optimum workflow.



### Product where and when you want it

Put product where you want it, when you need it: pallet-based transport lets you control and position products precisely, making it much easier to make multiple products or models on a single line. Pallets provide workpiece access from all sides, along with optional data tags for product identification and tracking.



### More choices in media

Build your system to meet product-specific and environmental requirements—speed, weight, etc.—with three types of conveyor media: belt, flat-top chain, or roller chain.



## Your Rexroth Prescription for Success

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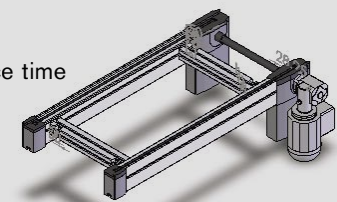
This technology is best for:

- Medium to high volume production
- Predictable product mix
- Manual, automated, or mixed production line
- ESD-safe transport of sensitive components
- Safe transport of heavy components

## Engineer's Corner: Tools for every need

### 3D Solid Models

Speed design and reduce time to market with our online 3D Solid Model Library. Download them today for nearly any 3D or 2D design software. Just go to [www.boschrexroth-us.com/brlcad](http://www.boschrexroth-us.com/brlcad)



### Network of System Integrators



We work with system integrators around the world to help define the best system design to improve your manufacturing flexibility, backed by our technology and support resources. To find an integrator, visit [www.boschrexroth-us.com/integrators](http://www.boschrexroth-us.com/integrators)

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### How To Optimize Assembly Operations

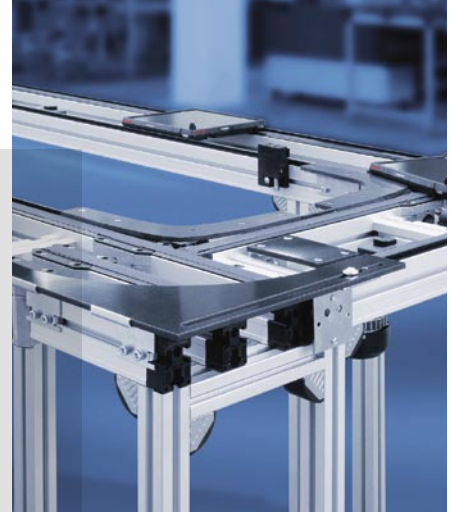
It's not just about having good products—you need good production. Our *How To Optimize Assembly Operations Guide* explores different conveyor options such as synchronous and non-synchronous, and provides recommendations on when to use each. The Guide also provides useful tips on getting the most productivity out of any line.



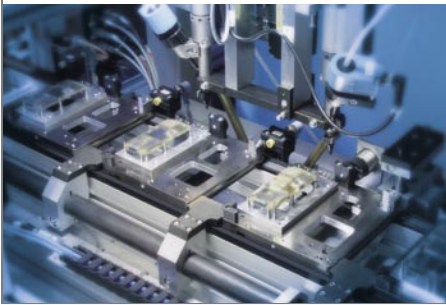
Download it at [www.boschrexroth-us.com/conveyors](http://www.boschrexroth-us.com/conveyors)

# Powered Transport Systems

The Rexroth TS family of modular conveyors is perfect for today's constantly changing medical assembly environment. Pre-engineered, modular, and flexible, TS conveyors let you tailor a system to meet your needs now, then expand or modify it as your needs change. Certified for Class 10,000 cleanrooms, Rexroth TS conveyors make it easy to integrate manual and automated operations and still meet your cleanliness requirements.



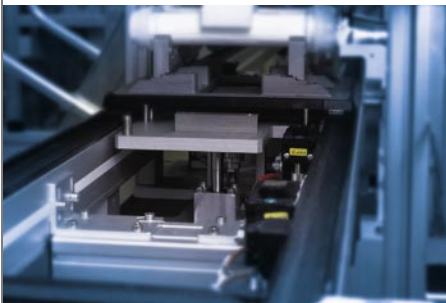
## TS1—for small products or small spaces



**TS1 is ideal for lightweight, multi-component products such as hearing aids, implantable devices, and contact lens kits.**

Workpiece pallet size range	80 x 80 mm 120 x 120 mm 160 x 160 mm
Pallet load capacity	Up to 3.0 kg (6.6 lbs.)
Transport media	Flat belt
Transport rate	9, 12, 15 or 18 m/min.
Positioning Accuracy	±0.015 mm

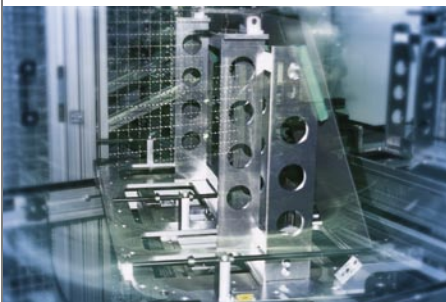
## TSplus—the high performance standard worldwide



**Flexibility makes the TSplus the world standard in high-performance conveyors. Compact and cost-effective, its wide range of pallet types and positioning and transfer modules makes it ideal for production of surgical and IV kits, drug delivery systems, pharmaceuticals, dental care products and home health care appliances.**

Workpiece pallet size range	26 sizes, from 160 x 160 mm to 1040 x 1040 mm
Pallet load capacity	Up to 70 kg (154 lbs.)
Transport media	Roller chain, flat top chain or flat belt
Transport rate	9, 12 or 18 m/min.
Positioning Accuracy	±0.05 mm

## TS4plus—produce heavy medical assemblies with precision



**When you have large, heavy or cumbersome workpiece products, the TS4plus can handle the load. Durable yet flexible, its robust design and low-friction roller chain make it the right platform for lab & hospital equipment, X-ray machines, hospital beds and exam tables, and other heavy duty or large format items.**

Workpiece pallet size range	From 443 x 443 mm to 1243 x 1243 mm
Pallet load capacity	Up to 250 kg (550 lbs.)
Transport media	Roller chain
Transport rate	9, 12, 15 or 18 m/min.
Positioning Accuracy	±0.125 mm

# VarioFlow

High functionality and low cost make the VarioFlow modular conveyor system a logical choice for many pharmaceutical and medical packaging applications. VarioFlow's Adaptive Modularity™ and wide selection of chain styles and widths make it ideal for today's flexible automation requirements. Used with or without pallets, VarioFlow is well-suited to linking manual workstations and light duty assembly and production operations into a complete line.



## VarioFlow: A new option for assembly and packaging

System widths	65, 80, 90, 100, 160, 240 and 320 mm
Transport media	Side-flexing plastic chain with industry-leading tensile strength. Non-pallet VarioFlow S also available in stainless steel.
Transport rate	Fixed: between 6 and 60 m/min. Variable: 3 to 108 m/min.
Industries	Optical lens Pharmaceuticals Medical Devices



VarioFlow's modular plastic chain conveyors, like their TS-series cousins, are pre-engineered to ensure quick system design, easy integration and fast changes when required.

VarioFlow, shown here in stainless steel, brings flexible modularity to pharmaceutical bottling and packaging environments.



## Your Rexroth Prescription for Success

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*VarioFlow conveyors are best suited for:*

- Combined manual and automated work processes
- Pre-machine buffering
- Light duty, non-precision or manual assembly
- Pharmaceutical and medical packaging operations
- High-value component handling, e.g., lenses

# Fully automated production

When you have long product lifecycles and high production runs, a fully automated production system can make operational sense by allowing you to take full advantage of your investment in sophisticated equipment. Full automation for certain processes also allows you to make better use of high-value human resources.



Combining modular conveyors, Cartesian robots, and automated tools for assembly, testing and packaging functions, you can dramatically reduce cost per unit produced, improve quality, and use your human capital to drive more efficient production and lean initiatives throughout your operation.

Automation can help your operation become “leaner” by:

- Eliminating correction and re-work in high-speed assembly
- Optimizing use of inventory and other resources
- Reducing waiting time, since needed parts are always at hand
- Minimizing waste in delicate operations
- Deployment of human capital for true value-added work

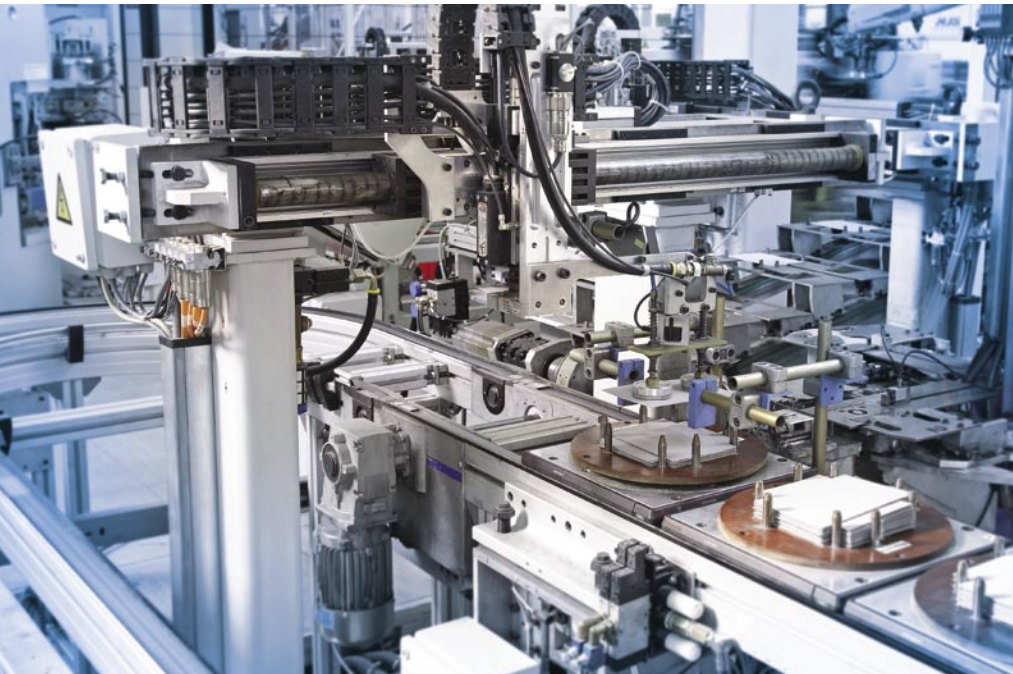


## Your Rexroth Prescription for Success

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*A fully integrated automated production system is the best choice for medical manufacturing which features:*

- High-volume, predictable mix
- High-speed assembly that doesn't require manual efforts
- Transport of sensitive components
- Safe transport of heavy components
- Complex, linked assembly sequences



## Your Rexroth Prescription for Success

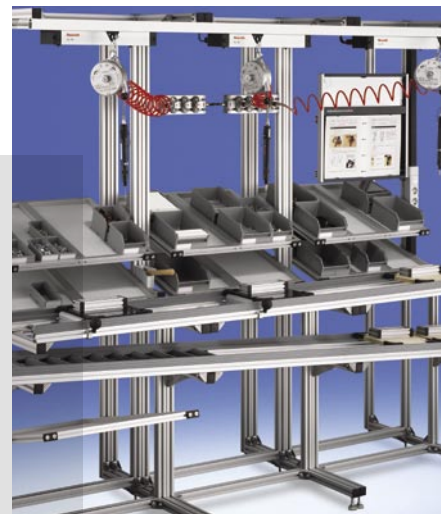
#1

*An unlinked automated production cell is usually most effective with:*

- High volumes
- Highly stable, predictable product mix
- High-speed or precise assembly
- Heavy or repetitive operations
- Non-value added load/unload

# Too soon for automated parts transfer? Introducing MPS Manual Production Systems

**Material flow, information flow and people flow:** the keys to cutting waste through lean manufacturing. Designed to make it easy to implement lean and single-piece flow, Rexroth Manual Production Systems can help you optimize all three types of flow. MPS can help you dramatically improve the flexibility of your medical products assembly, cut waste and improve product quality. It's the ideal assembly system for low-volume, high-mix production environments.



Based on our easy-to-reconfigure extruded aluminum framing system, MPS lets you build an extremely flexible lean manufacturing system for your needs, not someone else's idea of them. And it's robust enough to stand up to hundreds of changes—so when you need to, you can handle the short product runs and shrinking product lifecycles that drive this industry, while preserving your original investment.

## MPS—Designed from the ground up for Lean Manufacturing Systems



### Material Transfer

EcoFlow manual roller conveyors make single piece *material flow* easier than ever. This modular, workpiece-pallet-based product gives you complete flexibility in moving, stopping and positioning your products.



The T-slotted extruded aluminum frame lets you position anything you need exactly where you need it.

### Material Supply

Customize our Flow Rack to fit any lean cell you need. Design details, such as colored rollers, provide at-a-glance material management to improve *information flow*. Material shuttles, grab bins and a wide range of conveying media let you replenish line-side inventory or supermarkets with ease.



### Custom Workstations

Eliminate wasted space and improve *people flow* with custom ergonomic workstations. Easily interlinked, these workstations give you maximum resource flexibility and let workers move freely from station to station.





A complete line of accessories for manual production and single-piece flow, engineered for easy integration with other Rexroth manual and automated systems.

#### Advantages of MPS:

- Three core elements—roller conveyors for *material flow*, inventory flow racks for *information flow*, and custom workstations for *people flow*
- Pallet-based design optimizes both worker productivity and system flexibility
- Sturdy, T-slotted modular aluminum framing makes it easy to attach tool holders, information boards, and other accessories exactly where you need them
- MPScalc software lets you design, price and order custom workstations with unprecedented ease.



## Your Rexroth Prescription for Success

#3

*Manual Production Systems work best for:*

- Products driven almost entirely by “pull”, or customer demand
- Low-volume, limited run products or models
- Frequently changing product mix, as in contract manufacturing, or with highly differentiated product models
- Low to moderate precision

## Benefit from our lean experience



Bosch Rexroth has built a worldwide reputation as a thought leader in worker productivity and work flow, production time and process optimization.

We've applied that expertise to enhance our own performance: The Bosch Production System was developed to help our manufacturing operations around the globe become leaner, more productive, and more responsive to market conditions.

#### Three free guidebooks

We've distilled that experience and insight into a set of three practical guides created to help you make the principles of lean manufacturing a reality in your operation. They include:

- **Lean Manufacturing Guidebook**
- **Efficient Material Transport in Lean Production**
- **Ergonomics Guidebook**

To get started with lean, simply download these free guidebooks at [www.boschrexroth-us.com/lean](http://www.boschrexroth-us.com/lean).

# Clean technology from Bosch Rexroth

Driven by customer requirements in semiconductor, medical and “clean” automotive applications, Rexroth ensures cleanroom compatibility of relevant products through independent testing at Germany’s prestigious Fraunhofer Institute, one of the world’s leading technical testing and certification laboratories. With access to global Bosch development resources, we have a history of pioneering new materials and design features that minimize particle traps and outgassing. Even our assembly conveyors have been certified for Class 10,000 cleanroom use, and other products for use in cleanrooms to Class 10.

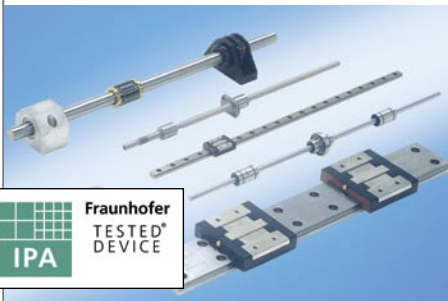


## Aluminum Structural Framing



To bring the flexibility of aluminum structural framing to cleanroom applications, Rexroth has developed new smooth-sided curved extrusions, aluminum cover strips, zinc-plated fasteners, casters, door latches and other special cleanroom components. Equip your cleanrooms with racks, shelving, carts, changing stations and other components and be confident that your structures are high-quality, stable and “clean.”

## Miniature Ball Rail Guides



For stable, smooth, precision motion in small machines, labs and other sensitive medical production environments, Rexroth miniature ball rail guides are certified for Class 100 use. Our high-performance linear bearing systems give medical production machine designers new linear guide options for cleanroom production demanding precise, steady movement.

## Modules and Cartesian Motion Systems



Rexroth modules and Cartesian systems also meet stringent cleanroom requirements. For smaller, lighter payload applications, PSK modules are certified for Class 10 use; for heavier payloads and longer travel lengths, CKK modules are Class 100 certified. For many pick-and-place applications, Rexroth pre-engineered Cartesian Motion Systems (CMS) use our Class 100-certified CKK modules to save time and money in the design, specification and implementation of Cartesian motion in your clean production system.

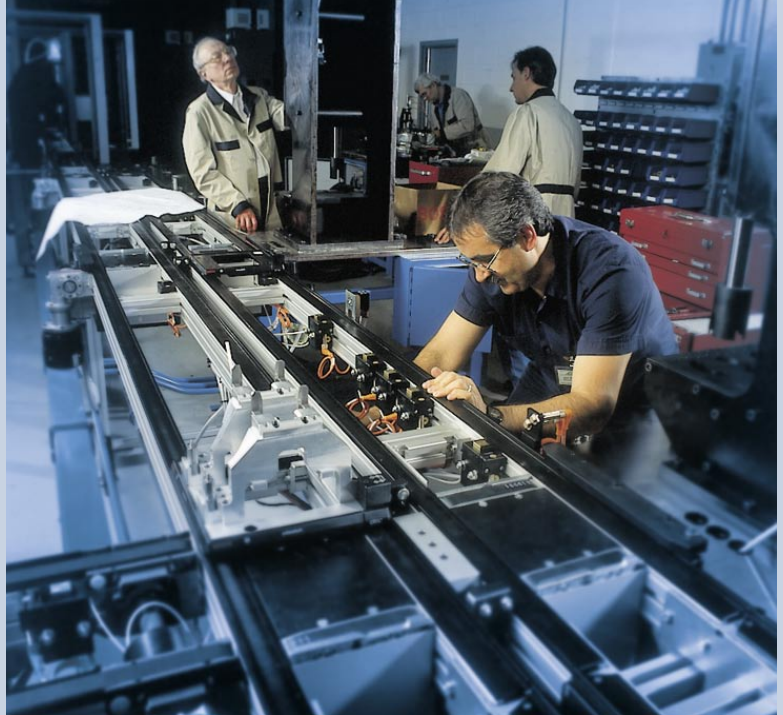
# Lean on Rexroth for complete support

Bosch Rexroth is committed to ensuring that you fully benefit from your flexible production system, whether it's manual, automated or somewhere in between. That's why we back our technology with world-class service and genuine Rexroth parts. We offer:

- **Complete conveyor tune-ups:** We'll perform a detailed function check of your Bosch Rexroth conveyor system, recommend spare parts and help you tune your line back to first-day performance
- **Easy-to-understand user documentation:** Each Rexroth module comes with fully illustrated and easy-to-follow operating, installation and maintenance instructions
- **Software and CAD support:** Engineering is our business, too, and we've created numerous tools to streamline the design process with configurators, solid models, and complete design software. To start using these tools now, visit [www.boschrexroth-us.com/tools](http://www.boschrexroth-us.com/tools).

## Lean Information and Support Tools, too

Whether you're just getting started with lean production or are a seasoned pro, Rexroth offers a range of lean resources. From online resources like those presented in this brochure to practical lean training and workstation design, you can count on Rexroth to help you cut waste, lower costs and improve quality. To request training, simply visit [www.boschrexroth-us.com/lean](http://www.boschrexroth-us.com/lean).



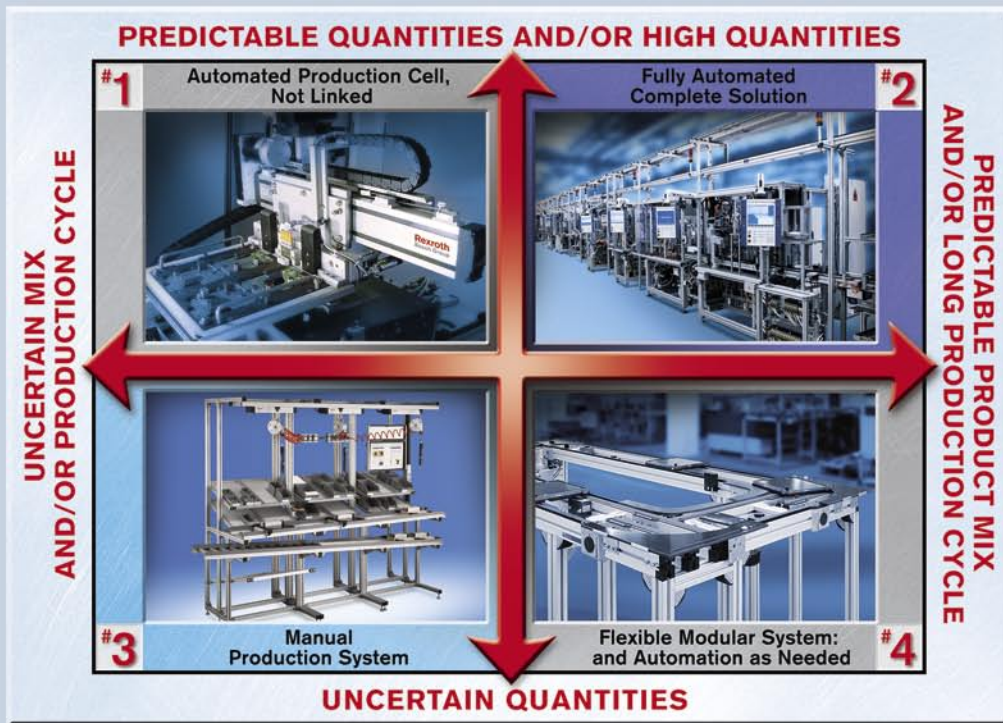
Maximize production and keep your operation running at full tilt by counting on our complete range of spare parts and expert technical support

## Get started now: Request our Lean Production Resource Kit CD for Medical Manufacturing

At Bosch Rexroth, we think everything should be lean. So we've bundled up all of the resources you've seen in this brochure on a single CD: Our *Lean Production Resource Kit for Medical Manufacturing*. The CD includes our comprehensive package of Lean Productivity planning guides, product catalogs, lean-related internet links, software tools, and other lean-related materials. Just order the *Bosch Rexroth Lean Production Resource Kit for Medical Manufacturing*. You can get it by going to [www.boschrexroth-us.com/lean](http://www.boschrexroth-us.com/lean).



# The Rexroth Lean Production System Decision Matrix



## When does automation make sense?

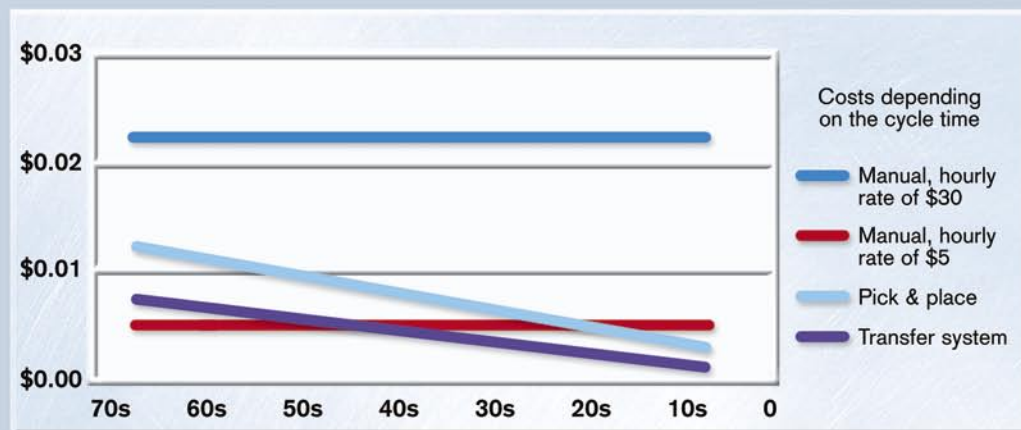
Lean production means cutting waste. As a result, automated production is the right choice when it helps you increase process reliability and cut costs in comparison to a manual solution.

But automation needs a certain volume and predictable product mix to recoup the original investment. Our lean production decision matrix may be a helpful tool in defining your assembly system needs.

As you implement lean production principles and practices, use this matrix to identify the technology, or mix of technologies, best suited to cutting waste and optimizing productivity in your operation. Variables to consider are product quantities, lifecycle and mix, and the predictability of these factors.

## Costs per transfer cycle

A good lean production system starts with customer takt time to determine the optimum production cycle time requirements. As cycle time goes down, in other words, as you need to make products faster, automated transfer makes greater economic sense—even in low wage countries. In a higher-wage environment, or when tight cycle times are required, automation becomes very cost-effective.



## Modular technology for lean production from Bosch Rexroth



Aluminum Framing

Manual Production Systems

VarioFlow Conveyor Systems

TS-Series Conveyor Systems

Cartesian Robots and Linear Modules

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Charlotte, NC 28273-6791  
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