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Benefits and Cost Savings Associated with Automated Finishing Systems



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So you want to automate a paint line

- Why do you want to automate?
- What is important to know in order to automate?
- What variables should you consider controlling?
- Examples of value generated from automating
- Do I still need people once I automate?
- Purpose of today is not to provide all the answers, but to get your started in your journey
- We have people to help, but it's good to develop a game plan



Why Customers Automate

- **Safety – People First**
 - Exposure to hazardous pollutants
 - RSI – Repetitive Strain Injury
 - Approvals & Regulations
- **Quality – 1st Time Yield (% of parts without requiring rework)**
 - Is the part being reworked due to paint related issues?
 - Is the customer putting too much or not enough on the part?
 - How do the parts look vs. THEIR competitors?
- **Production - % completion vs. % available**
 - How do your products currently move through the finishing department?
 - Ask about how long many hours the conveyor is moving
 - Start up at beginning of day
 - Stop at end of shift
 - Unscheduled stops during production
 - Understand the tipping point between adding and eliminating shifts
- **Savings – Focus on Paint Costs**
 - You pay somebody to buy it
 - You pay somebody to apply it
 - You pay somebody to clean it up
 - You pay somebody to dispose of it



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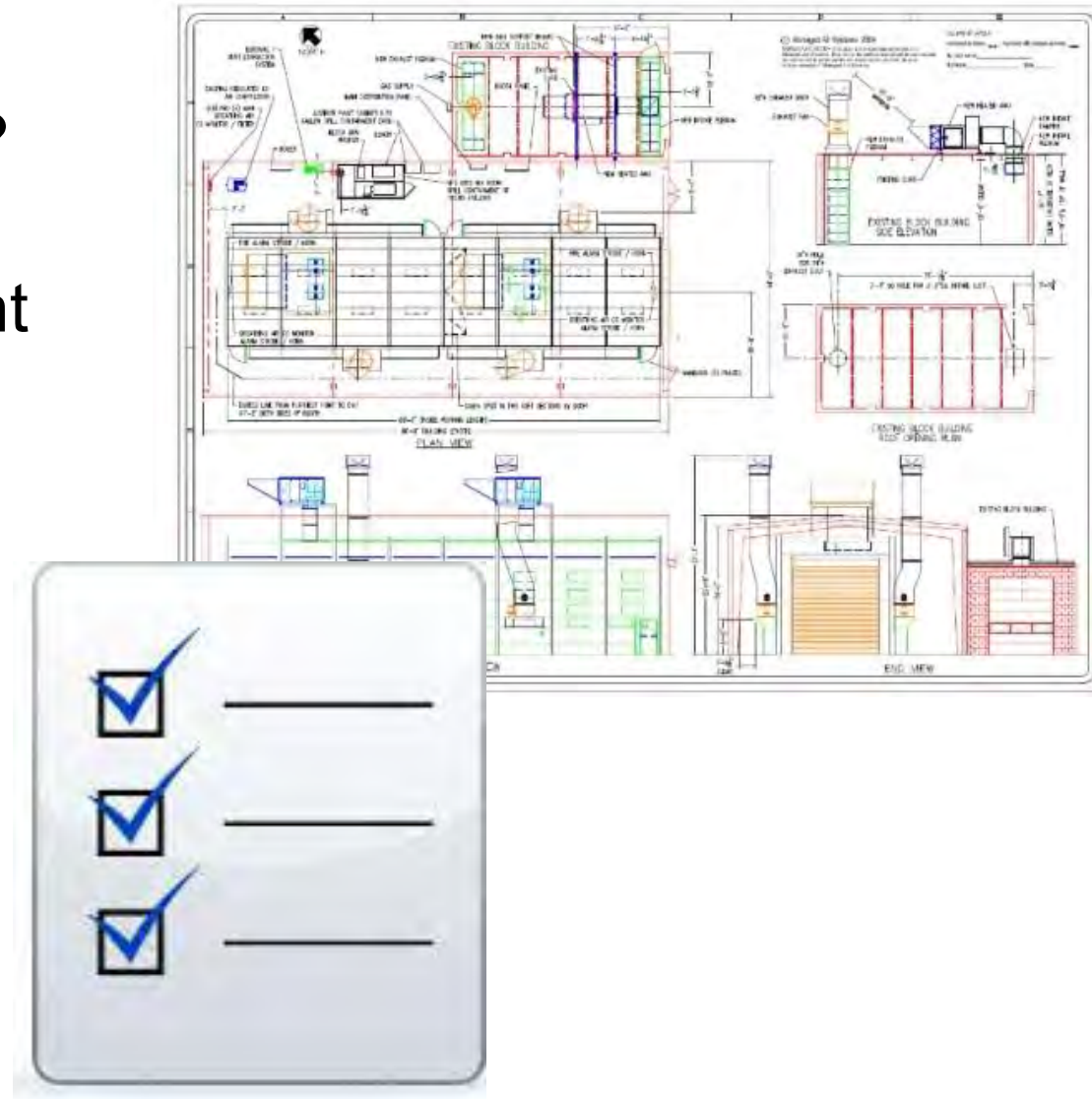
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Selecting Automation

- Greenfield project
 - How are you going to rack your parts?
 - What kind of conveyor to use?
 - How are you going to mount your paint gun/atomizer?
- New program in existing finishing system
 - What variables are you currently controlling?
 - How is your current consistency?



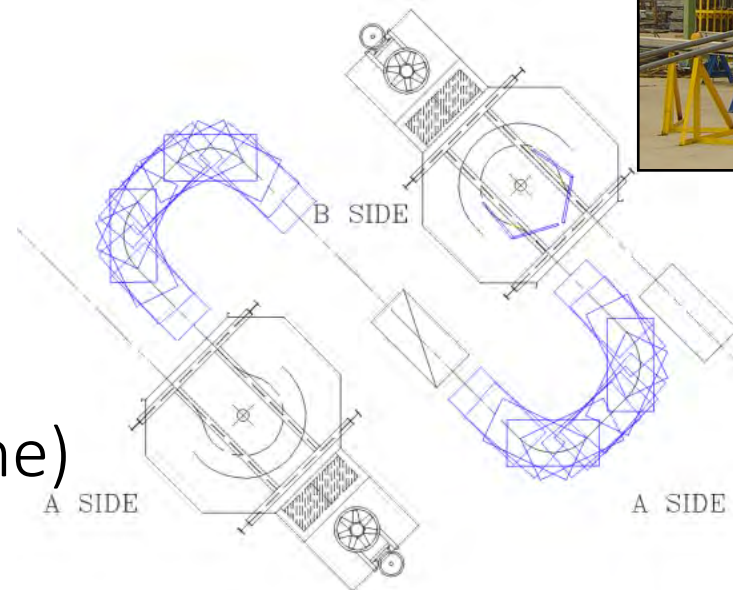
Product Presentation

Product presentation is most often dictated by

- Manufacturing process
- Size or weight of the product coated
- Desire to coat new product in existing system

Conveyor Systems

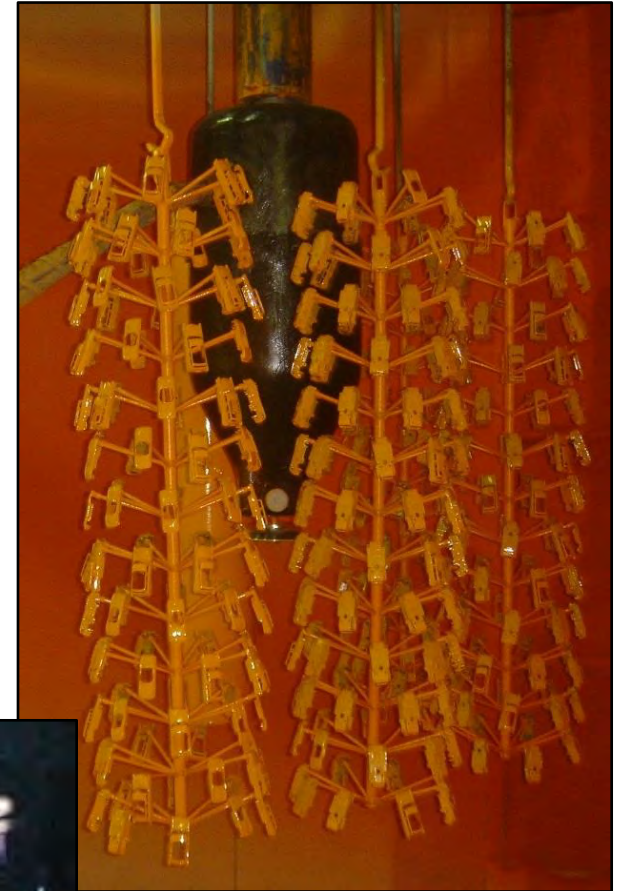
- Overhead
- Floor mounted
- Chain on edge
- Power and Free (indexing)
- Horizontal belt or web (flatline)



Product Presentation

Part Presentation

- Single or multiple parts per fixture
- Fixture may index on 90° or 180° increments
- Fixture may continuously rotate
- Rotation may be reversed in each spray zone



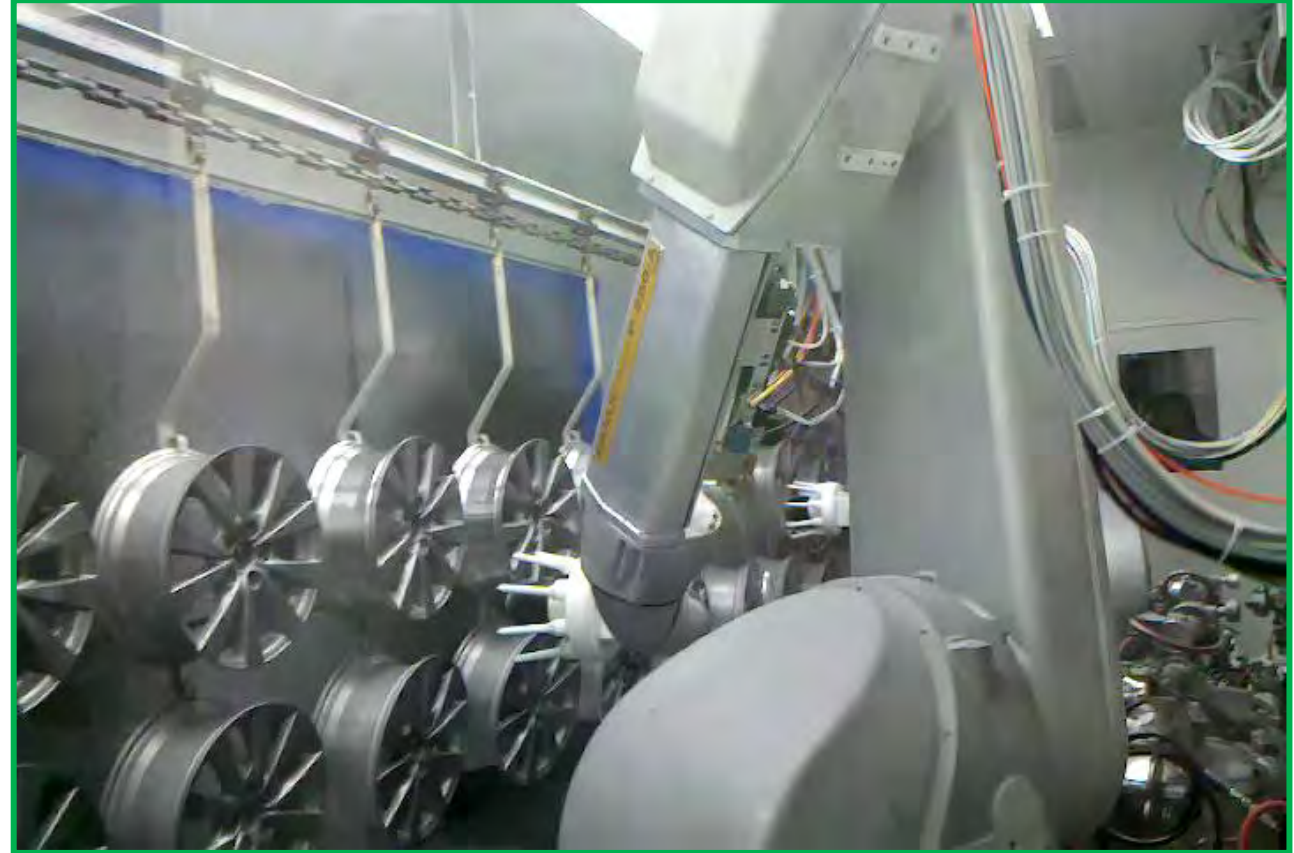
Product Presentation

Part Presentation

- Repeatability
- Grounding



Product Presentation



Electrostatics

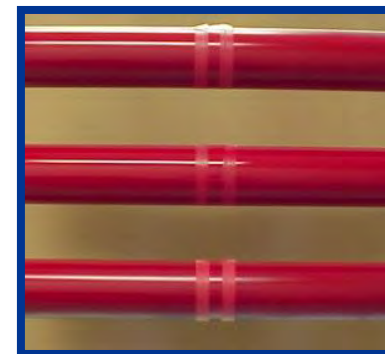
- More forgiving application
- Electrostatic “wrap”
- Better uniformity
- Increased transfer efficiency
 - ✓ Decreased coating cost
 - ✓ Decreased booth maintenance
 - ✓ Decreased emissions
 - ✓ Decreased waste disposal



Backside of part
Conventional Air Spray



Backside of part
E-Stat Air Atomizer



Backside of part
E-Stat Rotary Atomizer

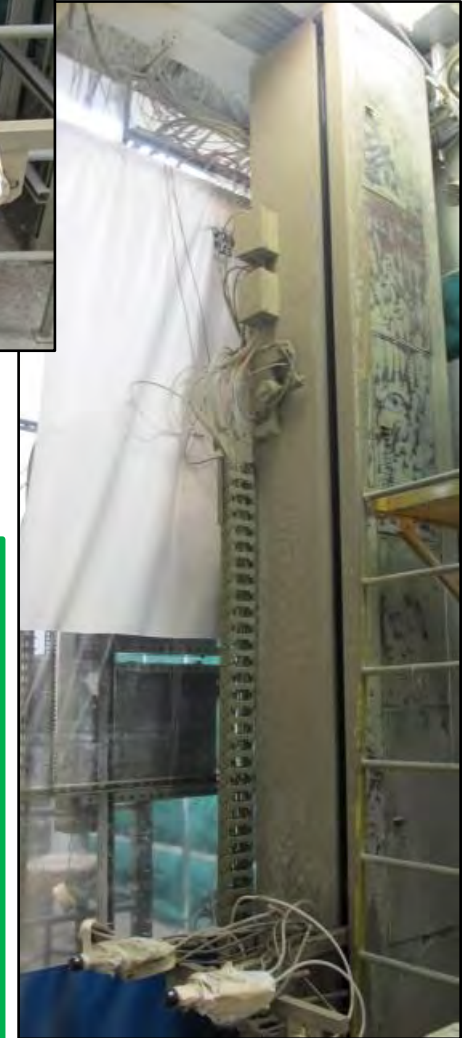
Automation: Reciprocators and Robots

- Short Stroke Reciprocators
 - ✓ A reciprocator increase the effective coating area of the applicator.
 - ✓ Typical stroke range 7 – 14"
 - ✓ Blends round spray patterns together providing very good coating uniformity.
 - ✓ Improves coverage by changing presentation of the applicator to the part.
 - ✓ Rotary atomizer, 30 cycles per minute
 - ✓ Air atomizers, 60 cycles per minute



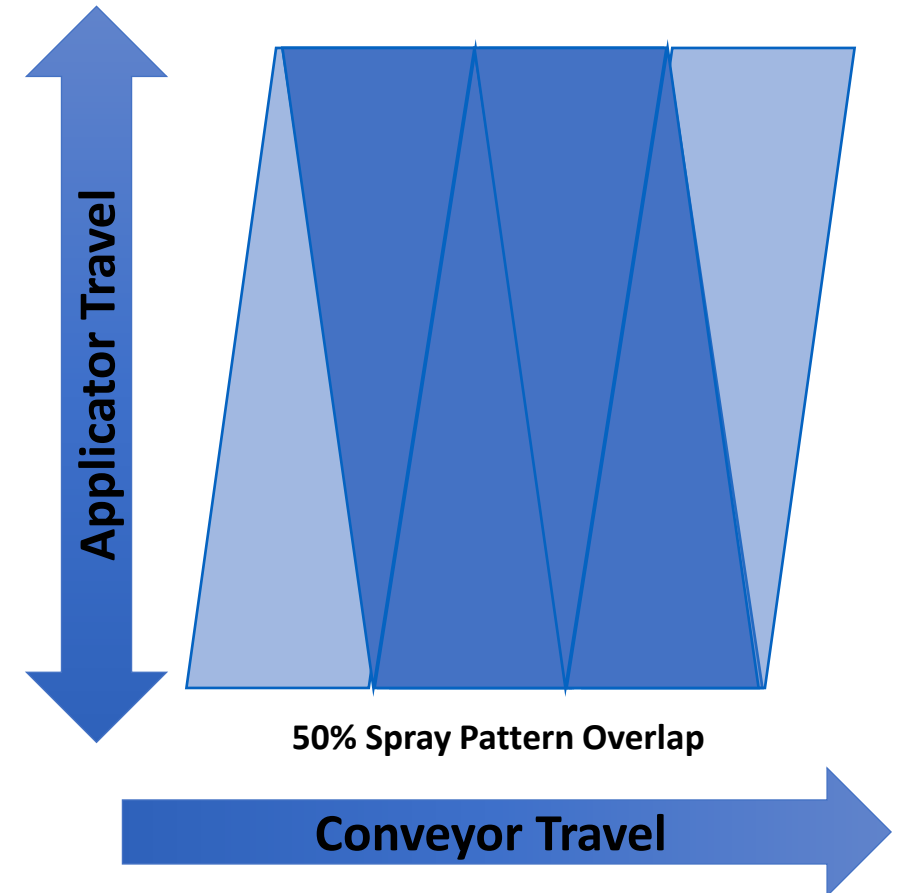
Automation: Reciprocators and Robots

- Long Stroke Reciprocators
 - ✓ A reciprocator increase the effective coating area of the applicator.
 - ✓ Typical stroke length 3' – 14'
 - ✓ May be equipped with “toeing” feature that angles applicators in direction of travel.
 - ✓ Rotary atomizer, 180 ft/min maximum
 - ✓ Air atomizers, 280 ft/min maximum



Automation: Reciprocators and Robots

- Long Stroke Reciprocators
 - ✓ Machine must be synchronized with conveyor to get uniform finish
 - ✓ 50% or 75% spray pattern overlap most commonly used
 - ✓ 50% overlap: conveyor speed (in) / pattern width (in) = machine cycle rate
 - ✓ 75% overlap = above X 2
 - ✓ Assume:
 - 14 ft/min
 - 12 in spray pattern
- $$\frac{14 \cancel{\text{ft}}}{1 \text{ min}} \times \frac{12 \cancel{\text{in}}}{1 \cancel{\text{ft}}} \times \frac{1 \text{ cyc}}{12 \cancel{\text{in}}} = \frac{12 \text{ cyc}}{1 \text{ min}} @ 50\% \text{ Overlap}$$



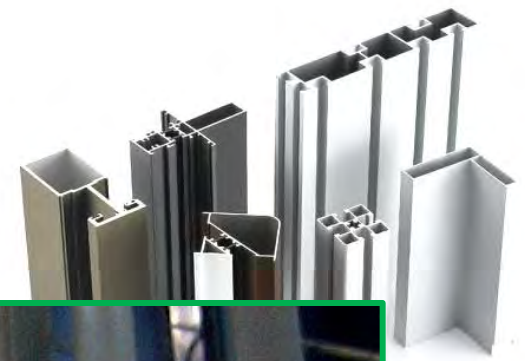
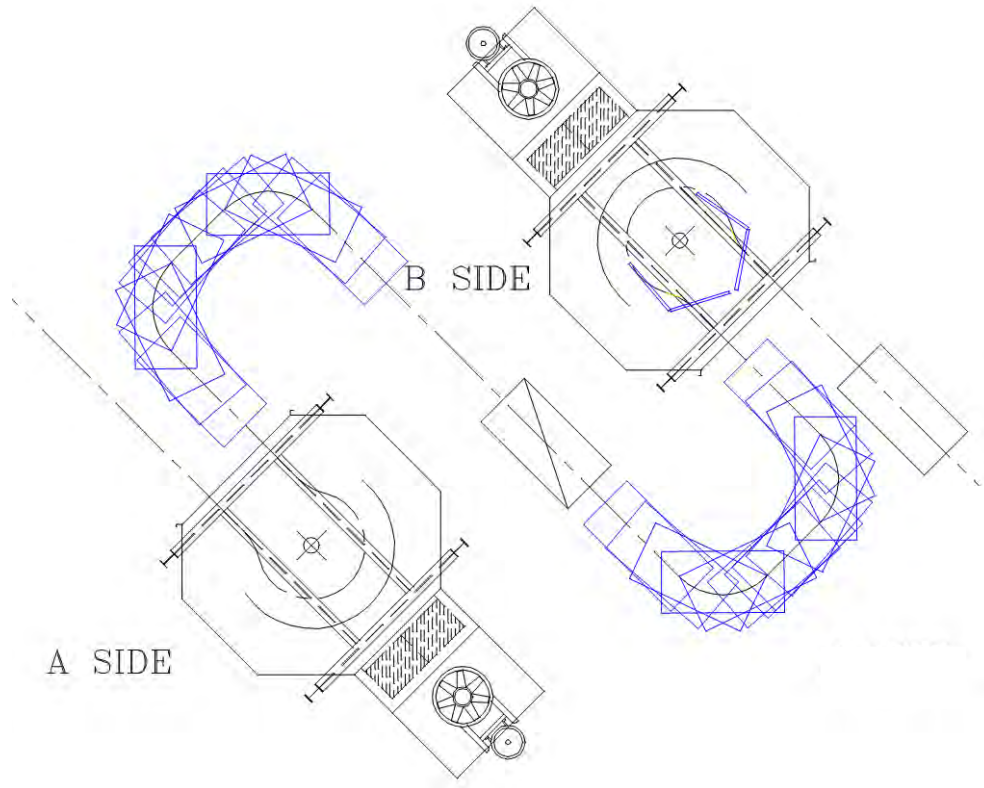
Automation: Reciprocators and Robots

- Long Stroke Reciprocators
 - ✓ Used with disk system
 - ✓ Typical stroke range 3' – 24'
 - ✓ Recommend a minimum of 4 strokes on part while in disk loop
 - ✓ Maximum speed 4ft/sec, slower speed is recommended.



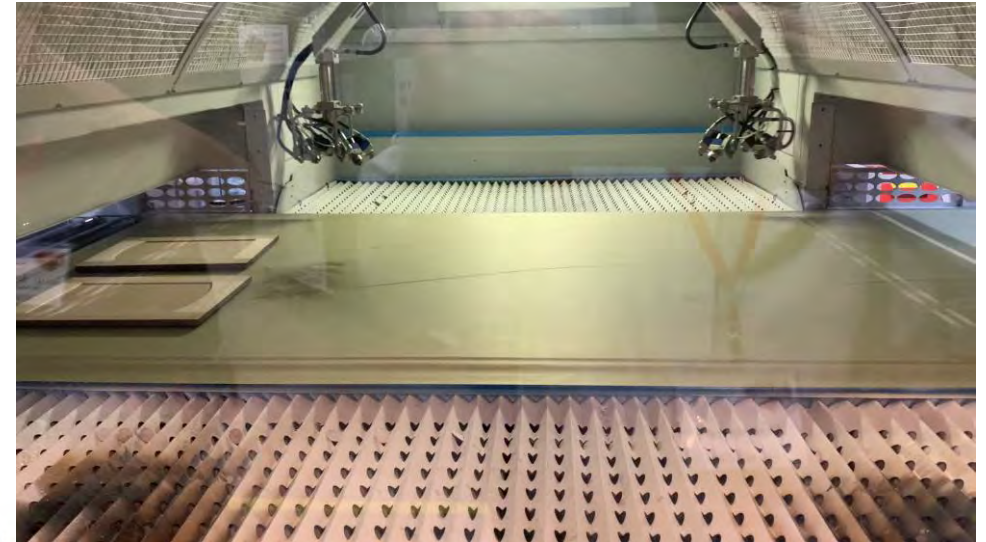
Automation: Reciprocators and Robots

- Long Stroke Reciprocators
 - ✓ “S” loop conveyor configuration
 - ✓ Allows access to both sides of part



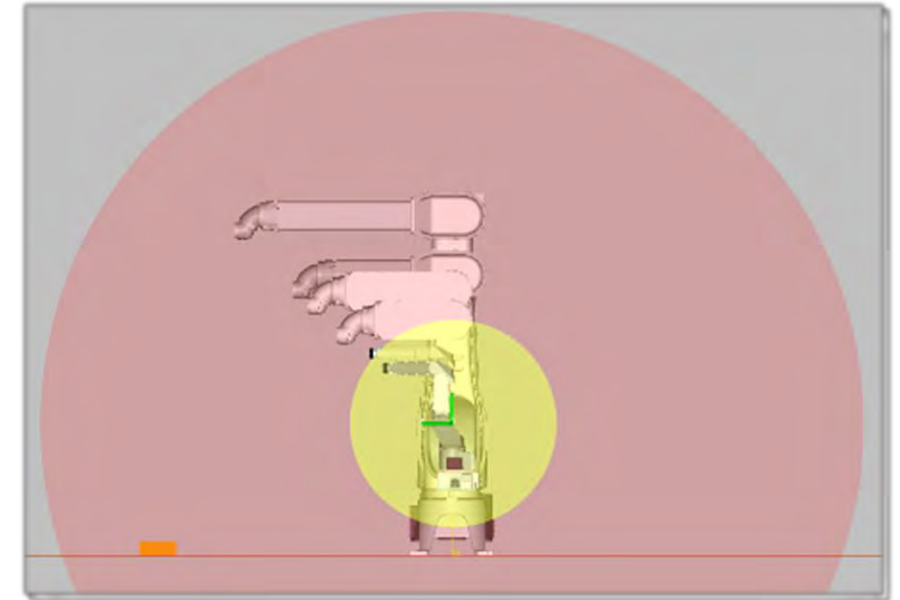
Automation: Reciprocators and Robots

- Smart Reciprocators
 - ✓ Similar to long stroke style reciprocator
 - ✓ Additional axis of movement incorporated
 - ✓ Variable stroke length
- Special Machines (Flat Line)
 - ✓ Multiple atomizer on carriage
 - ✓ Product coated conveyed on belt beneath atomizers
 - ✓ Integrated system to reclaim material



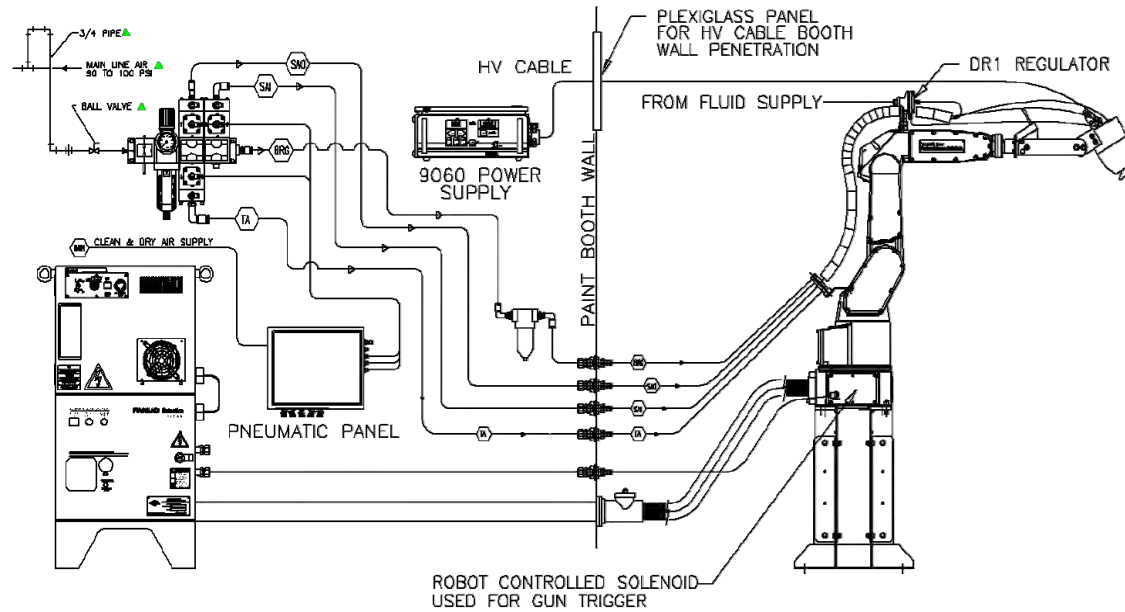
Automation: Reciprocators and Robots

- Robots
 - ✓ Flexible automation, programmed to accommodate product coated.
 - ✓ Ability to maintain optimal distance between applicator and substrate.
 - ✓ In most cases more cost effective than designing custom “hardware” solution
 - ✓ Robot selection made based on work envelope “reach” and payload capability



Automation: Reciprocators and Robots

- Robots



Automation: Reciprocators and Robots

- Robots



Automation: Reciprocators and Robots

- Robots



Mounting Automatic Applicators



Non-Manifold

- Lowest Cost
- Difficult to replace in same location



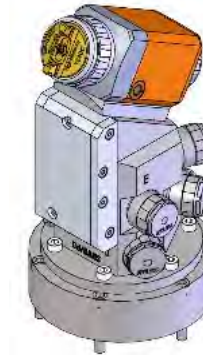
Manifold

- Only remove the gun
- Mount stays in same location



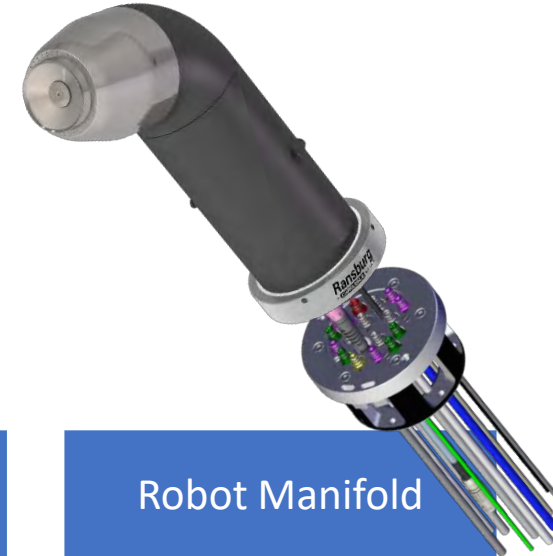
Manifold with Dump Valve

- Perform color changes without spraying through the front of the gun
- Keep your booth clean



Manifold with Color Change & 2K Mixing

- Minimize Waste
- Perform Fast Color Changes

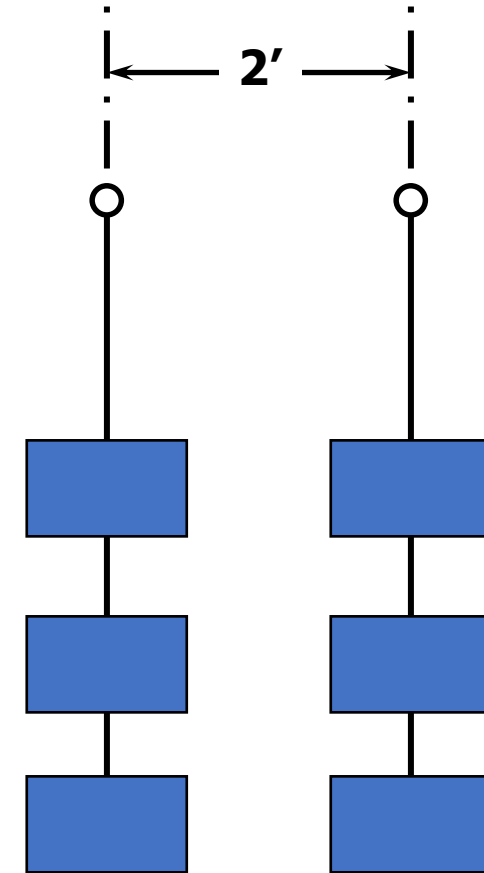


Robot Manifold

- Perform quick applicator removal
- Some versions allow spraying to occur while performing color change

Process Information

- Following information is needed to make equipment recommendations
 - ✓ Conveyor speed (ft/min)
 - ✓ Rack centers (ft)
 - ✓ Parts per rack
 - ✓ Hours per shift
 - ✓ Shifts per day
 - ✓ Days per week
 - ✓ Weeks per year of operation



Finishing Process Adjustments

“We become the scientists by turning the knobs” – Production Manager,
Cabinet Manufacturer

How can a finishing department stay consistent when there are so many things to adjust and people to adjust them?

Products	Setting Range	Unit	Products	Setting Range	Unit	Products	Setting Range	Unit
Gun Atomization Air	0-125	PSI	Agitation Speed	0-300	RPM	Turbo disk Stroke Speed	0-60	inches/second
Low Pressure Fluid Pump Air Pressure	0-125	PSI	Air Cap Selection	Hundreds of options		Rotary Atomizer Shaping Air	0-125	PSI
Pressure Tank Air Pressure	0-125	PSI	Material Viscosity	1-20,000	centipoise	Rotary Atomizer Bearing Air	0-125	PSI
Gun Low Pressure Fluid Pressure	0-300	PSI	Quick Disconnects	1-20	CFM restriction	Rotary Atomizer Speed	1-100,000	RPM
Low Pressure Fluid Regulator	0-300	PSI	Material Temperature	0-160	Degrees	Bell Cup Selection	Multiple sizes	
Low Pressure Fluid Pump Pressure	0-300	PSI	Substrate Temperature	0-1000	Degrees	Recip Rate	0-60	Cycles/Minute
Low Pressure Back Pressure Regulator	0-300	PSI	Ambient Temperature	0-110	Degrees	Convection Oven Temperature	60-500	Degrees
High Pressure Fluid Pump Pressure	300-8000	PSI	Atomization Air Temperature	0-180	Degrees	Gas IR Temperature	100-1000	Degrees
High Pressure Fluid Regulator	300-8000	PSI	Booth Air Flow	1-500	Feet/Sec	Electric IR Temperature	100-1000	Degrees
High Pressure Back Pressure Regulator	300-8000	PSI	Filter Size	20-200	mesh	Conveyor Speed	1-100	Feet/Minute
Gun High Pressure Fluid Pressure	300-8000	PSI	Air Cleanliness	5-.01	Microns	Recip Stroke Length	8-14	inches
Fluid Hose Length	1-300	Feet	Ball Valves	On / Off	N/A	COE Rotation Speed	1-300	RPM
Air Hose Length	1-300	Feet	Material Percent Solids	1-100	percent	Air Cap Orientation	0-90	Degrees
Fluid Hose Size	1/16-1.5	Inch	Humidity	0-100	Percent	Spray Gun Yaw and Pitch	0-90	Degrees
Air Hose Size	1/16-1	Inch	Substrate Preparation	mil spec, solvent wiped		Spray Gun Movement Speed	0-10	Feet/Sec
Fluid Nozzle Size	.4-3.0	mm	Product Grounded	Yes / No	???	Distance from Atomizer to Substrate	1-24	Inch
Gun Trigger Air	0-125	PSI	Turbo disk Stroke Length	5-32	Feet	Fan Pattern Size	1-20	Inch
			Voltage	0-100,000	Feet/Sec	Fan Pattern Shape	Round to Oval	

Calculating Transfer Efficiency

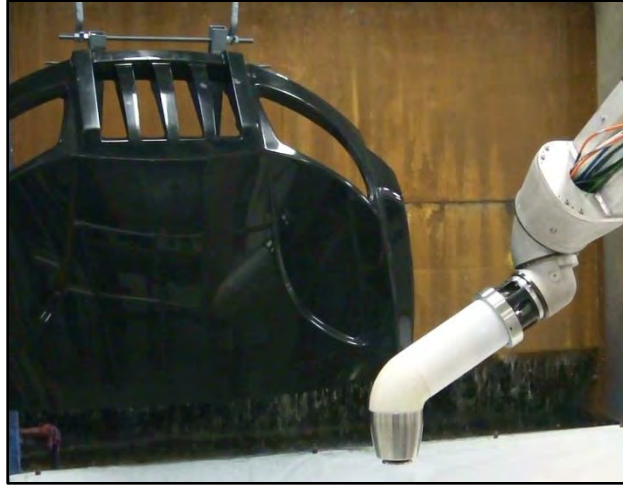
Process Variables	Air Atomized E-Stat Gun		Rotary Atomizer	
	Eng. Units	Metric	Eng. Units	Metric
Conveyor Speed (ft/min), (M/min) =	18.00	5.5	18.00	5.5
Rack Spacing (ft), (mm) =	0.75	228.6	0.75	228.6
Parts Per Rack =	1	1	1	1
Seconds / Rack - Part (sec) =	2.50	2.5	2.50	2.5
Racks - Part Per Minute =	24.00	24.00	24.00	24.00
Racks - Part Per Hour =	1440.00	1440.0	1440.00	1440.0
Parts Per Hour =	1440.00	1440.00	1440.00	1440.00

Application Variables	Air Atomized E-Stat Gun		Rotary Atomizer	
	Eng. Units	Metric	Eng. Units	Metric
Coating Thickness (mils), (microns) =	1	25	1	25
% Solids by Volume =	58%	58%	58%	58%
Surface Area Coated (sq ft), (sq M) =	1.694	0.16	1.694	0.16
Transfer Efficiency Estimated =	45%	45%	70%	70%
Estimated Wet Paint Volume per Part (cc's) =	15.21	15	9.78	10
Estimated Wet Paint Volume per Rack (cc's) =	15.21	15	9.78	10

Calculated Flow Rate	Air Atomized E-Stat Gun		Rotary Atomizer	
	Eng. Units	Metric	Eng. Units	Metric
% Trigger on Part =	100%		100%	
Actual Total Flow Rate Required (cc/min) =	365		235	
Recommended Number of Applicators =	1		1	
Flow Rate per Applicator =	365		235	



Rotary Atomizer ROI



Existing Process

	Application Method	ml / part	Est. % TE
Primer	Manual Spray Gun	228	35%
Base Coat # 1	Manual Spray Gun	290	32%
Base Coat # 2	Manual Spray Gun	195	27%
Clear Coat # 1	Manual Spray Gun	290	31%
Clear Coat # 2	Manual Spray Gun	290	31%
Clear Coat # 3	Manual Spray Gun	290	31%



Proposed Process

	Application Method	ml / part	TE
	Robot / Rotary Atomizer, 0 kV	157	51%
	Robot / Rotary Atomizer, 85 kV	142	69%
	Robot / Rotary Atomizer, 65 kV	78	65%
	Robot / Rotary Atomizer, 85 kV	185	73%
	Robot / Rotary Atomizer, 85 kV	185	73%
	Not Required	N/A	N/A

Is There An Opportunity To Upgrade?

- Spraying Oil Filters
- Using two 95A guns
- Spraying 12 Gallons Per Day @ \$80 per Gallon
- How do you progress in the sales process?

	95A Guns	Ransflex Auto	Evolver SE	Aerobell 168
Cost of Product	\$3,000	\$7,500	\$11,500	\$25,500
Yearly Maintenance Expenses	\$1,500	\$3,750	\$5,750	\$12,750
Yearly Material Usage	3750	3187.5	2625	2062.5
Yearly Material Spend	\$318,750	\$270,938	\$223,125	\$175,313
Year 1 Cost	\$323,250	\$282,188	\$240,375	\$213,563
Material Reduction	Baseline	15%	30%	45%
Year 1 Savings	Baseline	\$41,063	\$82,875	\$109,688

"By spending \$26,000 on rotary atomizer technology we estimate a savings of \$110,000 in year 1. Does that present an opportunity for us to spend more time to propose the equipment that can provide that savings?"



\$3,000



\$7,500



\$11,500



\$25,500

Aerobell 168: Customer Success Story



Customers System:

- Metal shelving and racking systems
- 2 long stroke reciprocators with 4 AA guns each (8 total applicators)
- Flow rate 500 ml/min each (4000 ml/min)

Primary concerns:

- Coverage
- Material usage

Finishing Brands Solution:

- Use applications lab facility to develop new process
- 3 Aerobell 168 mounted on short stroke reciprocator (2 stations)

Primary concerns addressed:

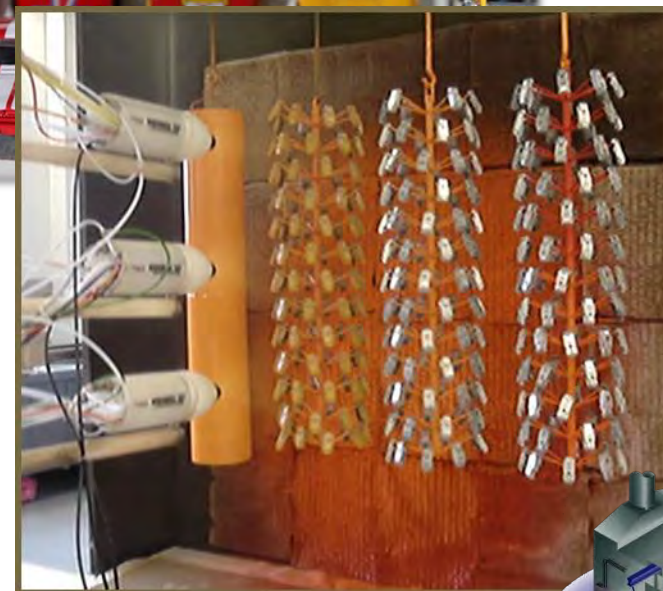
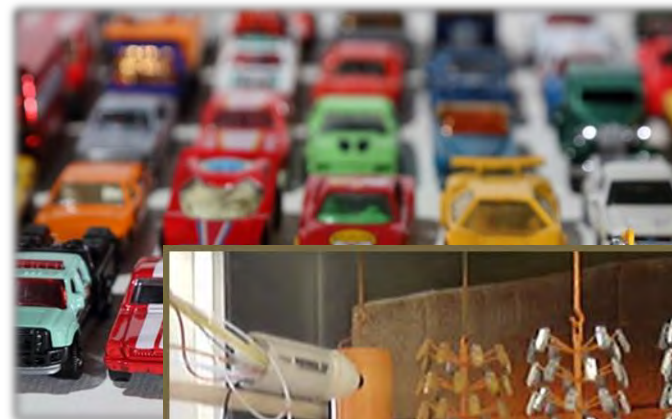
- Coverage – Aerobell 168 provide better coverage than current system
- Material usage – 375 ml/min (2250 ml/min total flow rate)
- Reduced material usage by 44% (2250/4000)



Why Else Do Customers Upgrade?

Toy manufacturer

- Switched to “bells” (rotary atomizers) mounted on short stroke reciprocator.
 - ✓ Faster color change time
 - ✓ More accommodating for “batch running”
 - ✓ Increased system efficiency



Toy Manufacturer Justification



System justification based on increased production

System Variables	
Conveyor Speed (ft/min) =	8.00
Rack Spacing (ft) =	1.33
Parts Per Rack =	104
Seconds / Rack (sec) =	9.98
Racks Per Minute =	6.02
Racks Per Hour =	361
Parts Per Hour =	37,534
Hours Per Day =	20
Parts \ Day @ 100% Yield (no loss to color change) =	750,677

Color Change Variables	TurboDisk System	AeroBell System
Color Changes Per Day =	100	100
Racks Skipped Per Color Change (Disk System) =	15	4
Color Change Time (sec) =	150	40
Number of Parts Per Day Lost to Color Change =	156,000	41,600
Actual Yield Per Day =	594,677	709,077
Increased Production Per Day =		114,400 19.2%

Rotary Vs. Air Atomization Technology

Q – Quality P – Production \$ - Savings

	Air Atomization	\$	Rotary Atomization	
	Transfer efficiency (35 – 65%) with electrostatics.	\$	Transfer efficiency (60 – 85%) with electrostatics, reduces material usage.	
	Transfer efficiency (15 – 40%) without electrostatics.	\$	Transfer efficiency (35 – 65%) without electrostatics, reduces material usage.	
	Elliptical spray pattern often presents problems with uniformity causing mottled appearance.	Q	Round spray pattern with excellent uniformity produces more uniform finish quality.	
	Wide range of atomized particle size distribution in spray pattern causing irregular surface / film.	Q	Very narrow atomized particle size distribution resulting in better finish and film build uniformity.	
	Elliptical spray pattern must be re-orientated normal to the surface being coated.	P	Round spray pattern is easily manipulated by robot resulting in programming efficiency of 10 - 15%.	
	Defects can be created if applicator is “triggered on” the surface (spitting).	Q	Atomizer is always rotating so applicator can be “triggered on” the surface.	

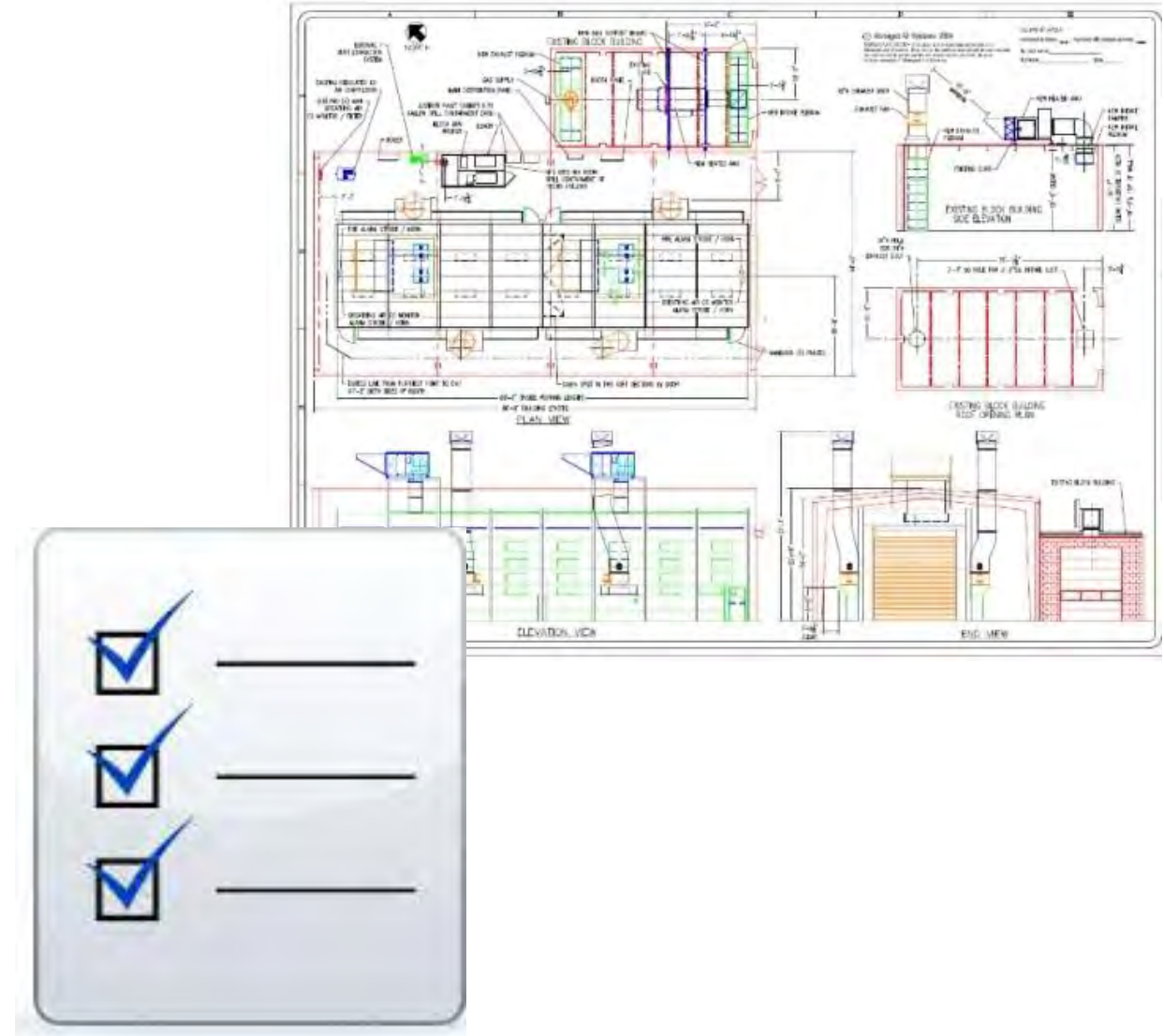
Employees Needed



- Programmer – Internal or External
- Someone to load/unload parts
- Operator/Supervisor
- Manufacturing Engineer
- Maintenance
- Paint Kitchen Operator

Why Customers Don't Receive Budget Approval

- Value has not been quantified
- Competing with other priorities outside of Paint Shop
- Value has not been proven – must show it!
- Safety, safety, safety
 - People using the equipment
 - People approving the equipment
 - People overseeing safety
- Can the rest of your conveyor handle the change?
 - Wash station
 - Oven



Tools For Success

- Understand your processes and be ready to share with others
- Quantify the opportunity to change
- You must be excited and ready to implement change
- Leverage experts for product conversations
- Lab testing, lab testing, lab testing



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