



# **BRIGGS & STRATTON**

Auburn University Design Project  
Corporation 2

V-Twin Sump Sub-Assembly Production Line Improvements



# Corporation Members

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# The Production Problem

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The current assembly of the sump does not meet future production rate requirements.

- Time Study

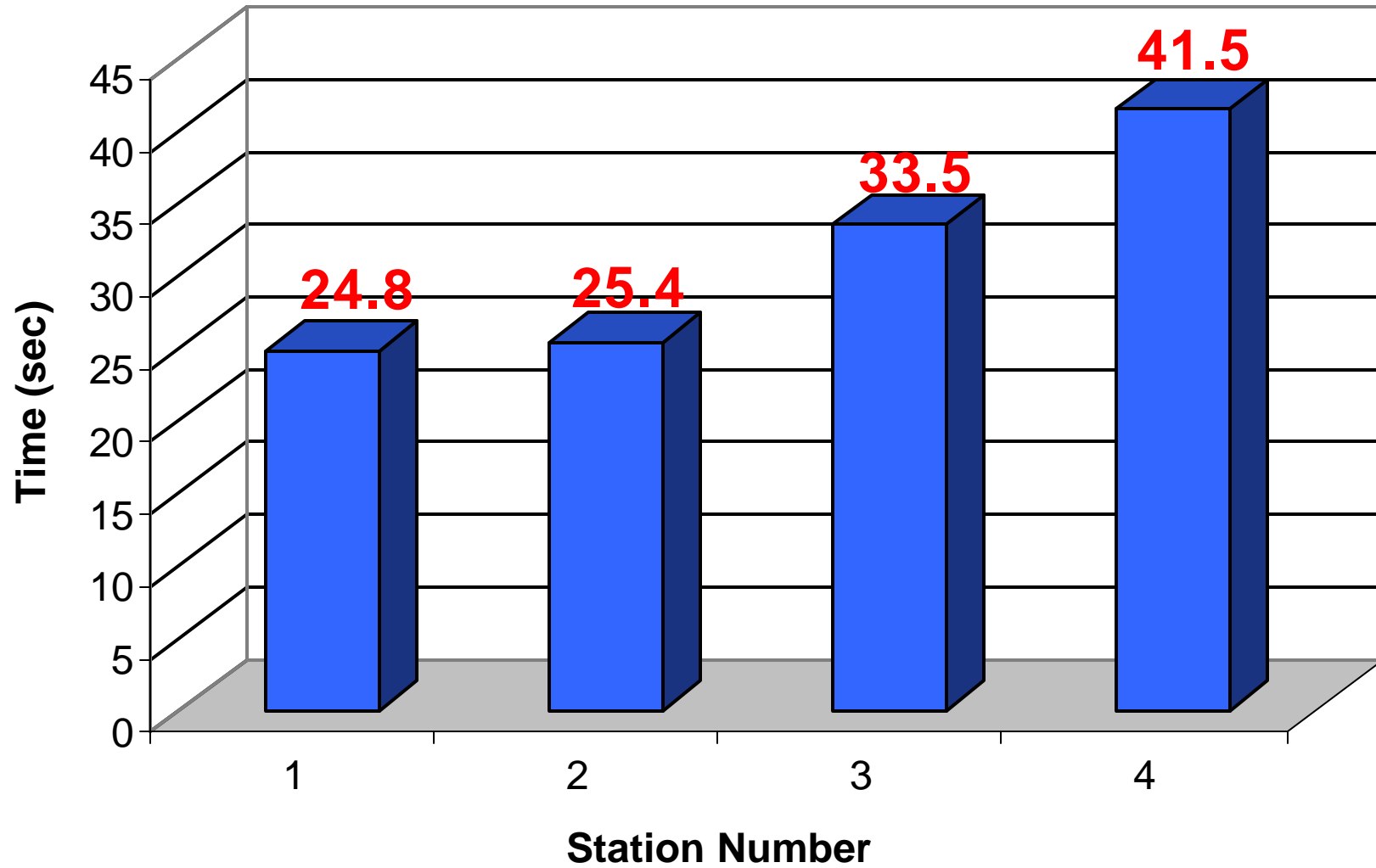


# Time Study

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#	Element Description	Time #1	Time #2	Time #3	Time #4	Time #5	Time #6	Time #7	Time #8	Average
	<b>Station 1</b>									<b>24.8</b>
1/10	Arrange sumps/insert oil tube	71.65	83.28	93.28						8.273667
	Retrieve sump	2.46	2.56	2.78	2.78	2.59	2.78	5.15	3.53	3.07875
	Ball, spring, plug installed, oil tube align	7.37	5.43	7.46	9.00	5.03	4.93	11.53	6.31	7.1325
	Cycle Machine	4.03	3.50	3.21	3.40	3.65	3.40	3.31	3.34	3.48
	Remove sump & set aside	3.12	3.09	2.71	2.56	3.02	2.46	2.87	3.18	2.87625
	<b>Station 2</b>									<b>25.4</b>
	Retrieve part, place in fixture	2.53	2.12	3.71	1.59	4.90	2.21	3.43	2.87	2.92
	Put screen in press	1.84	1.81	5.84	2.65	5.21	2.25	3.28	2.81	3.21125
	Screw in oil nipple	3.50	4.59	3.81	2.34	4.06	2.46	4.56	8.59	4.23875
	Cycle machine	10.12	10.93	10.28	13.43	10.46	14.46	16.00	16.00	12.71
	Remove and set aside	2.34	2.43	2.06	2.09	2.18	2.35	2.40	2.87	2.34
	<b>Station 3</b>									<b>33.5</b>
	Retrieve and place in fixture	5.40	4.09	4.96	2.50	2.96	4.71	5.00	4.53	4.26875
	Assemble plug & bushing to press	6.00	5.50	6.00	5.21	7.96	7.53	12.78	22.68	9.2075
	Cycle machine	2.96	3.59	2.37	3.56	3.62	5.90	6.75	2.84	3.94875
	Remove oil filter from carton, dip install	9.96	12.37	11.93	9.28	11.75	24.34	17.81	17.12	14.32
	Remove sump & set aside	1.00	1.50	2.84	1.76	1.75	1.84	1.63	2.00	1.79
	<b>Station 4</b>									<b>41.5</b>
	Retrieve sump & torque oil press C.V.	8.21	13.75	7.53	4.81	7.06	6.84	6.34	7.12	7.7075
	Position governor & install E-clips	15.96	14.93	20.81	14.03	22.06	15.34	13.21	22.93	17.40875
	Assemble governor seal to sump	10.28	6.21	6.46	8.62	6.03	6.87	9.40	7.75	7.7025
1/3	Assemble washer and bushings	22.78	27.28	21.28	32.78	24.87	30.71	24.65	24.84	8.71625

# Time Study





# The Production Problem

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The current assembly of the sump does not meet future production rate requirements.

- Time Study
- Current Sump Production Capability
  - 650 sumps per each 7 ½ hour shift



# Design Goal

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Our goal is to partially automate the sump sub-assembly and to increase production by 200 sumps per shift.



# Methods of Improvement

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- Reduce existing assembly line from 4 stations to 3 stations
- Integrate feeders into the new arrangement
- Improve governor and e-clip installation
- Add conveyors to transport sumps
- Keep assembly line compatible for future improvements





# Existing Stations & Machine Layout

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- Station 1
  - Ball, Spring, and Cap
  - Oil Tube
- Station 2
  - Screen
  - Oil Nipple
- Station 3
  - Bushing
  - Drain Plug
- Station 4
  - Check Valve
  - Governor and E-clips
  - Governor Seal

Drain Plug Gun

Screen Press

Oil Nipple Press

STATION 2

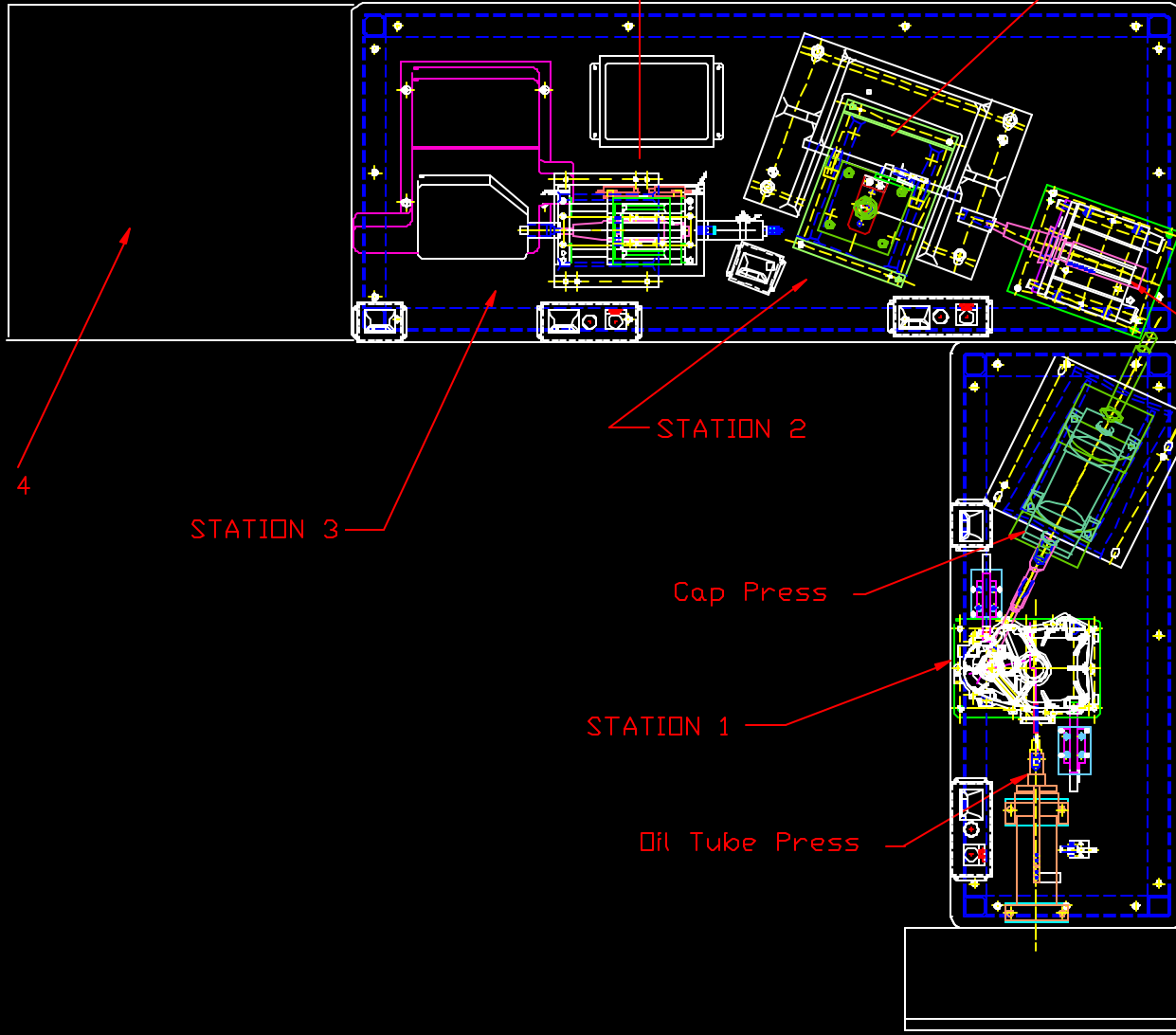
Cap Press

STATION 1

Oil Tube Press

STATION 4

STATION 3





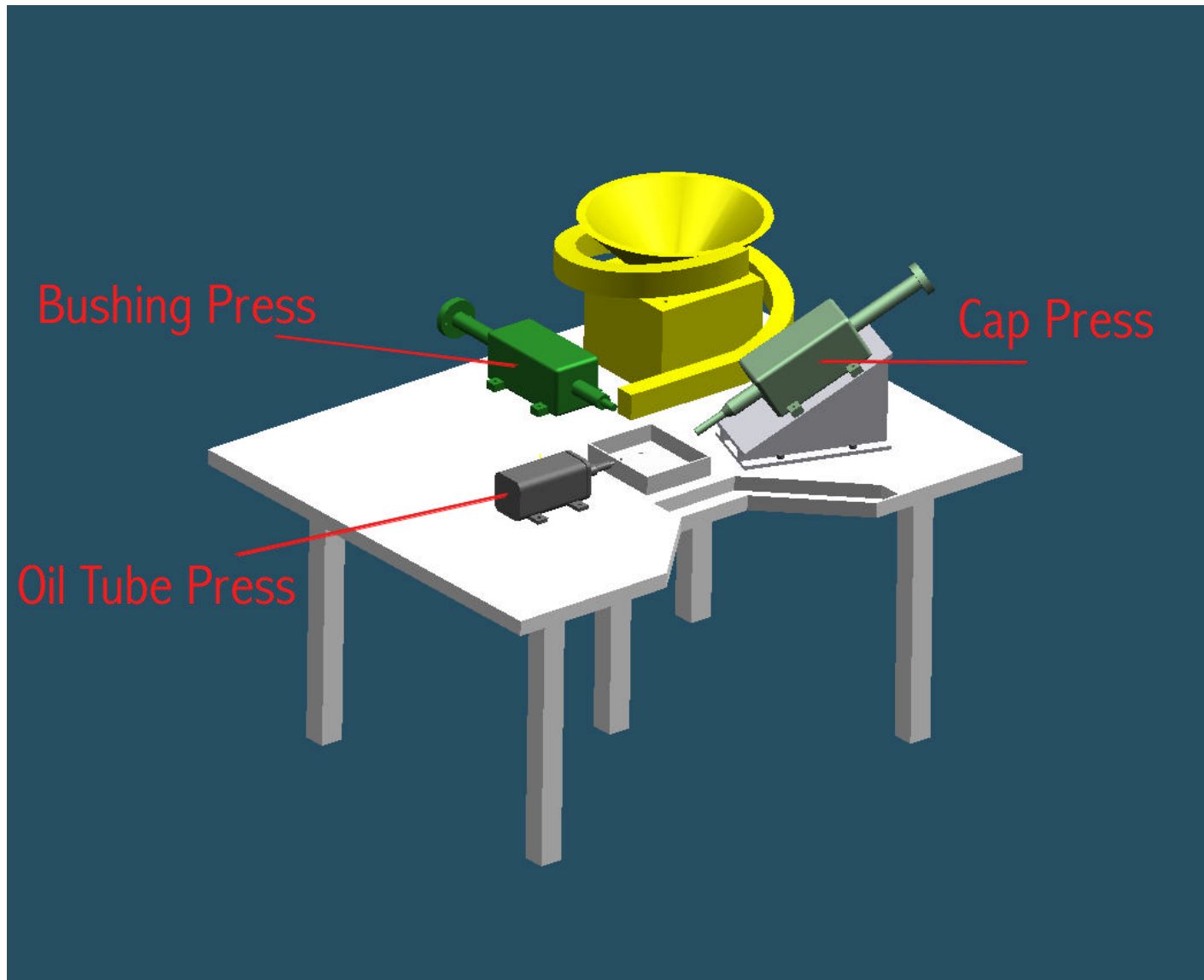
# Proposed Assembly Process

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## STATION 1

- Ball, Spring, & Cap
  - Manually loaded into sump and press
  - Existing machinery utilized
- Oil Tube
  - Manually loaded into press
  - Existing machinery utilized
- Bushing
  - Automatically loaded into press via feeder
  - Existing machinery utilized

# Layout of Station 1





# Proposed Assembly Process

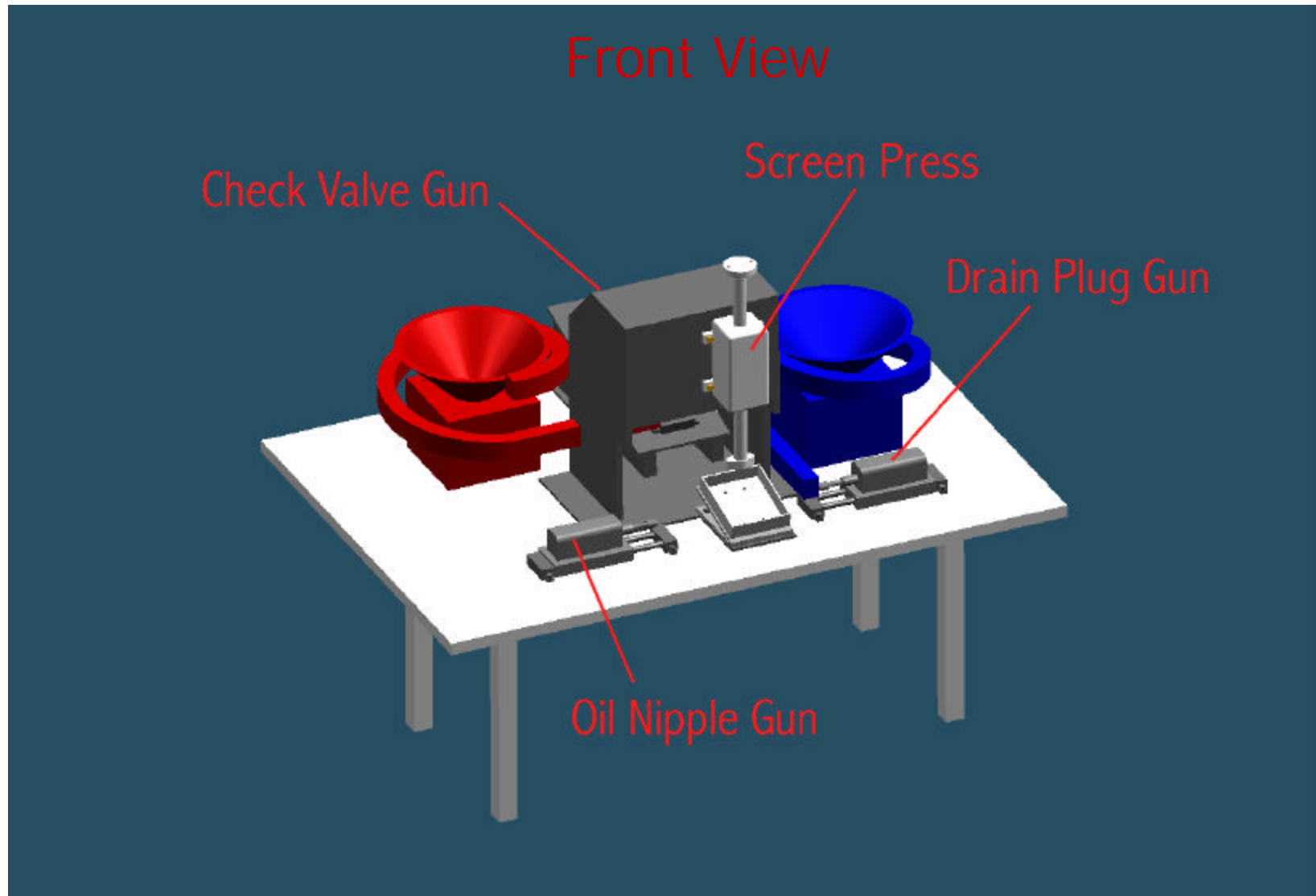
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## STATION 2

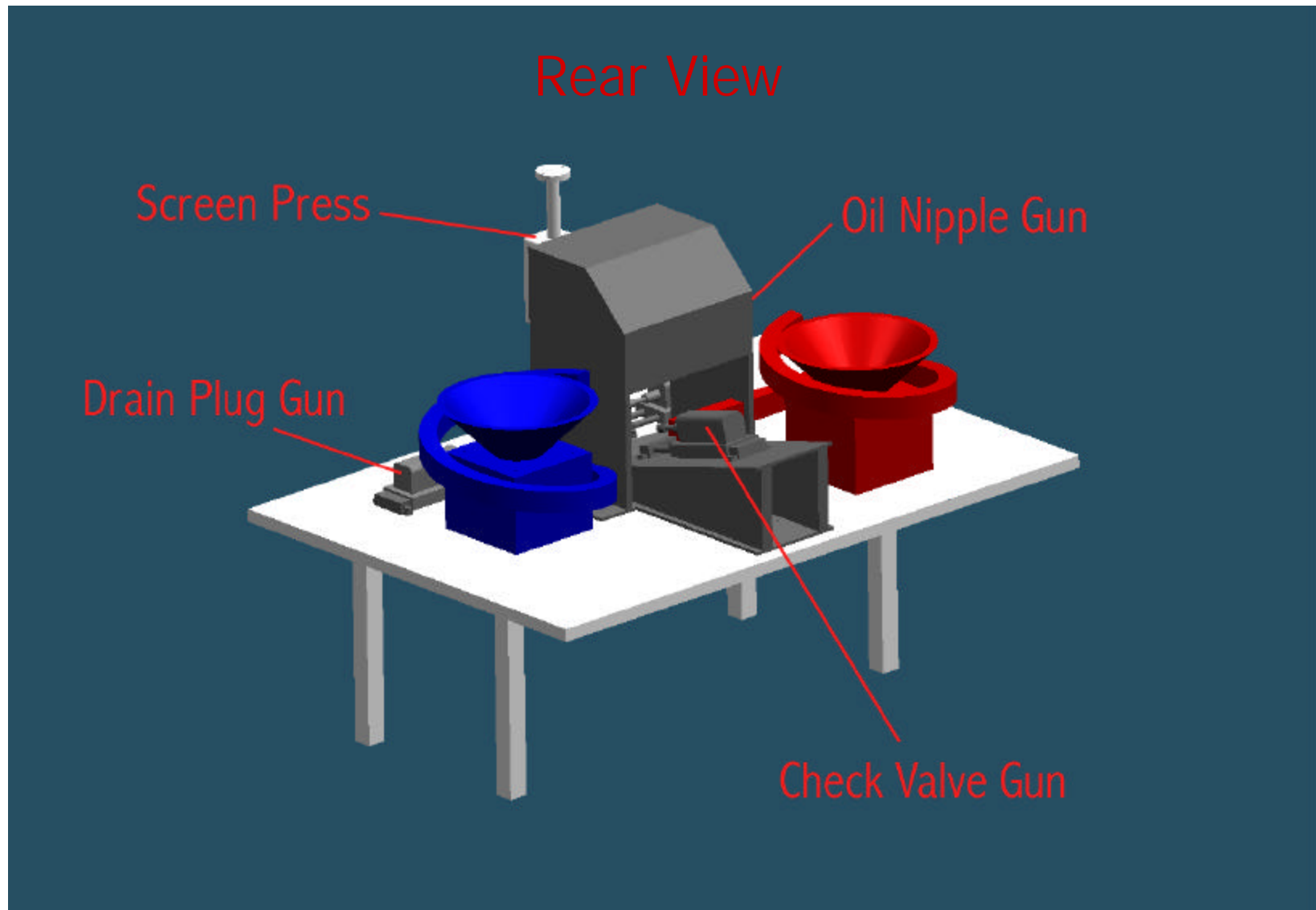
- Oil Nipple
  - Manually loaded into pneumatic gun
  - Existing machinery utilized
- Screen
  - Manually loaded into press
  - Existing machinery utilized
- Drain Plug
  - Automatically loaded into pneumatic gun via feeder
  - Existing machinery utilized
- Check Valve
  - Automatically loaded into pneumatic gun via feeder
  - Addition of pneumatic gun

# Layout of Station 2

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# Layout of Station 2





# Proposed Assembly Process

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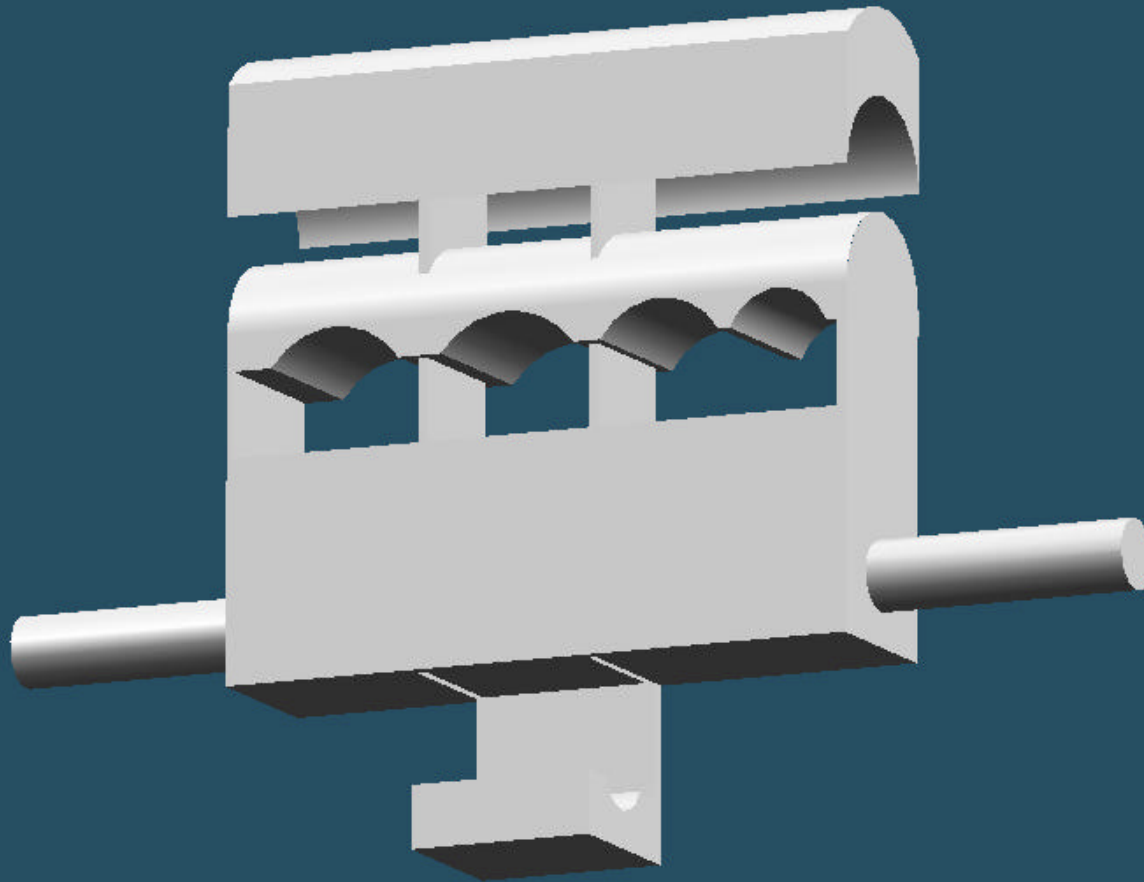
## STATION 3

- Governor
  - Manually loaded into sump
- E-clips
  - Automatically loaded with pneumatic press
  - Hand stapler used as backup if press fails



# E-clip Hand Stapler

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# Proposed Assembly Process

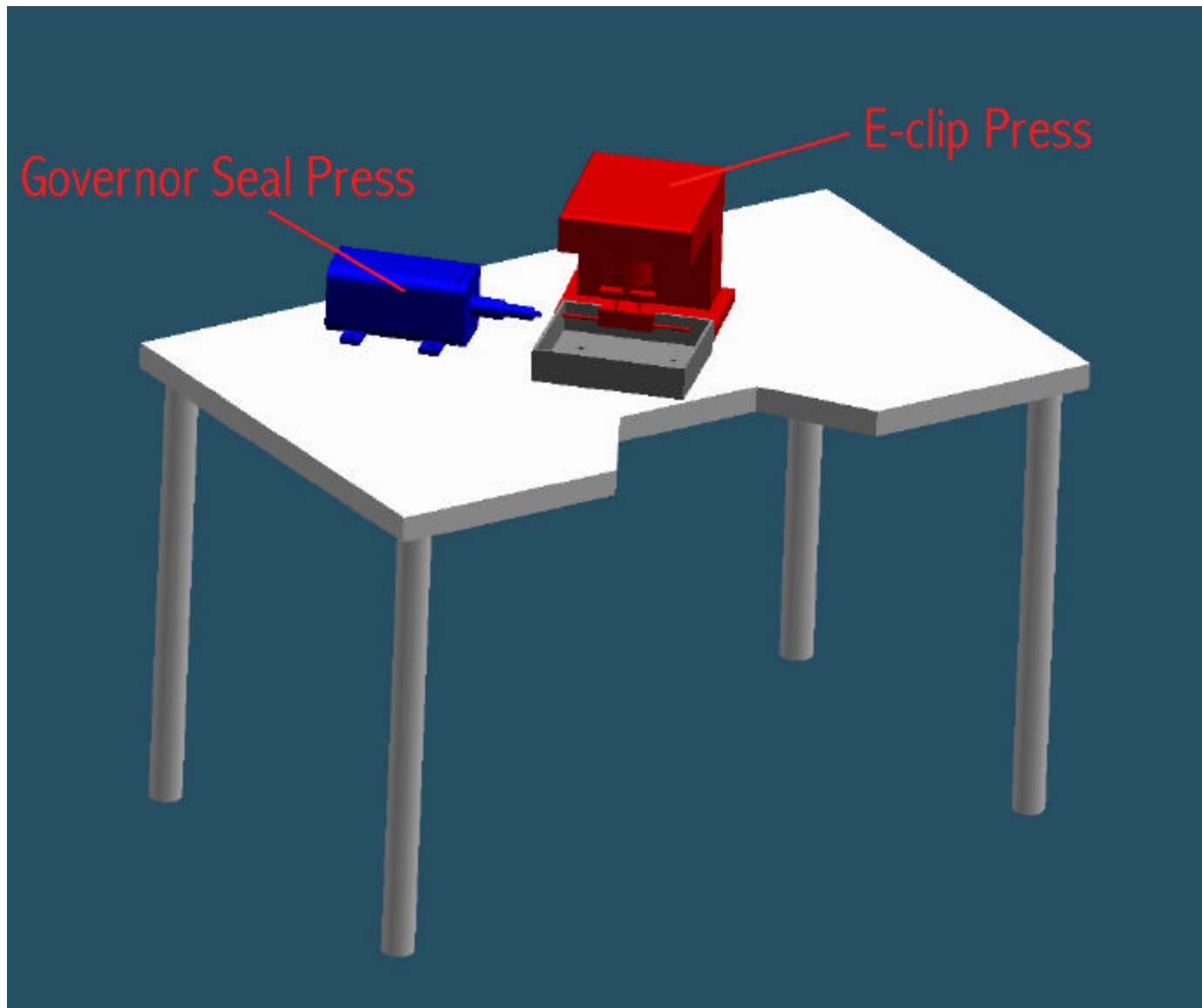
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## STATION 3

- Governor
  - Manually loaded into sump
- E-clips
  - Automatically loaded with pneumatic press
  - Hand stapler used as backup if press fails
- Governor Seal
  - Automatically loaded with pneumatic press

# Layout of Station 3

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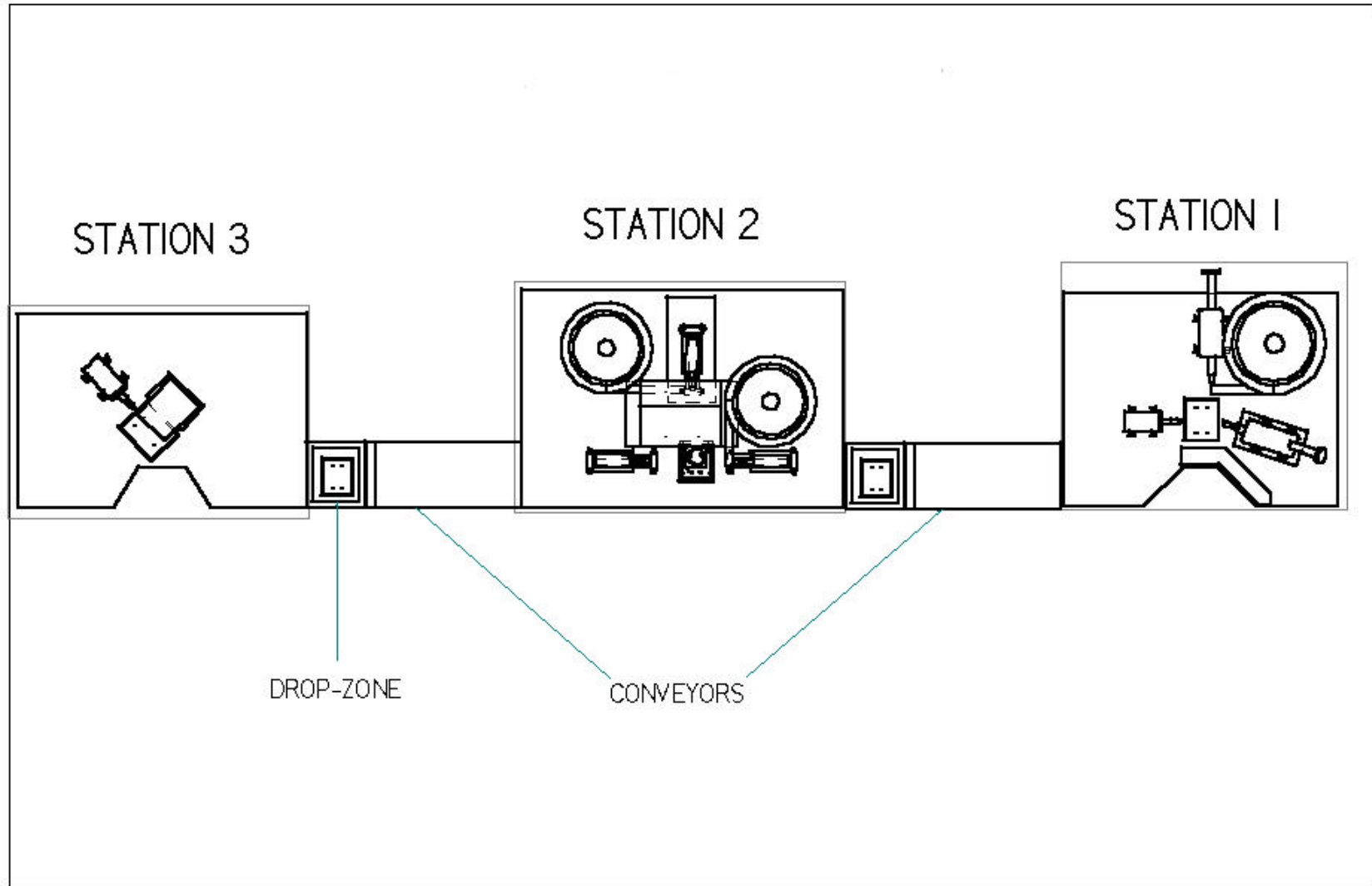


# Method of Sump Transport

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- Conveyor system will transport sumps from each station
- There will be a drop zone for the sumps to ensure maximum efficiency
- Sensors will be used to keep the belt moving at the necessary speed

# New Assembly Layout





# New Assembly Results

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- Save time by reducing number of stations
- Automatic feeders reduce loading times
- Operator responsibilities reduced to one station
- Conveyor systems increase assembly line efficiency
- Check valve loaded by pneumatic gun
- Faster e-clip installation with pneumatic press improves current limiting factor
- Governor seal loaded by pneumatic press



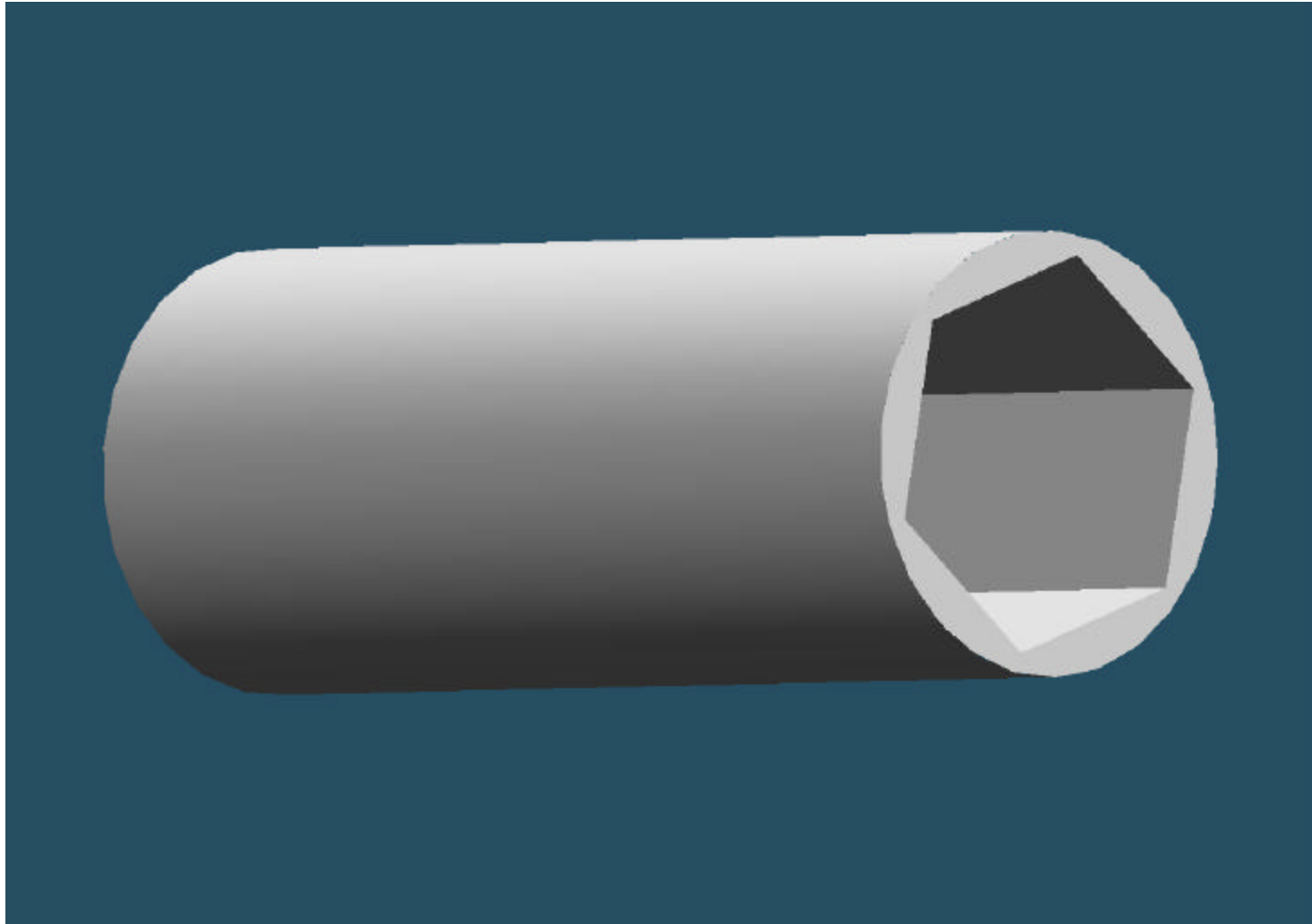
# Future Improvements

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- Add more feeders for automatic loading
  - Screen
  - Oil Nipple
- Redesign oil nipple for faster installation

# Future Oil Nipple

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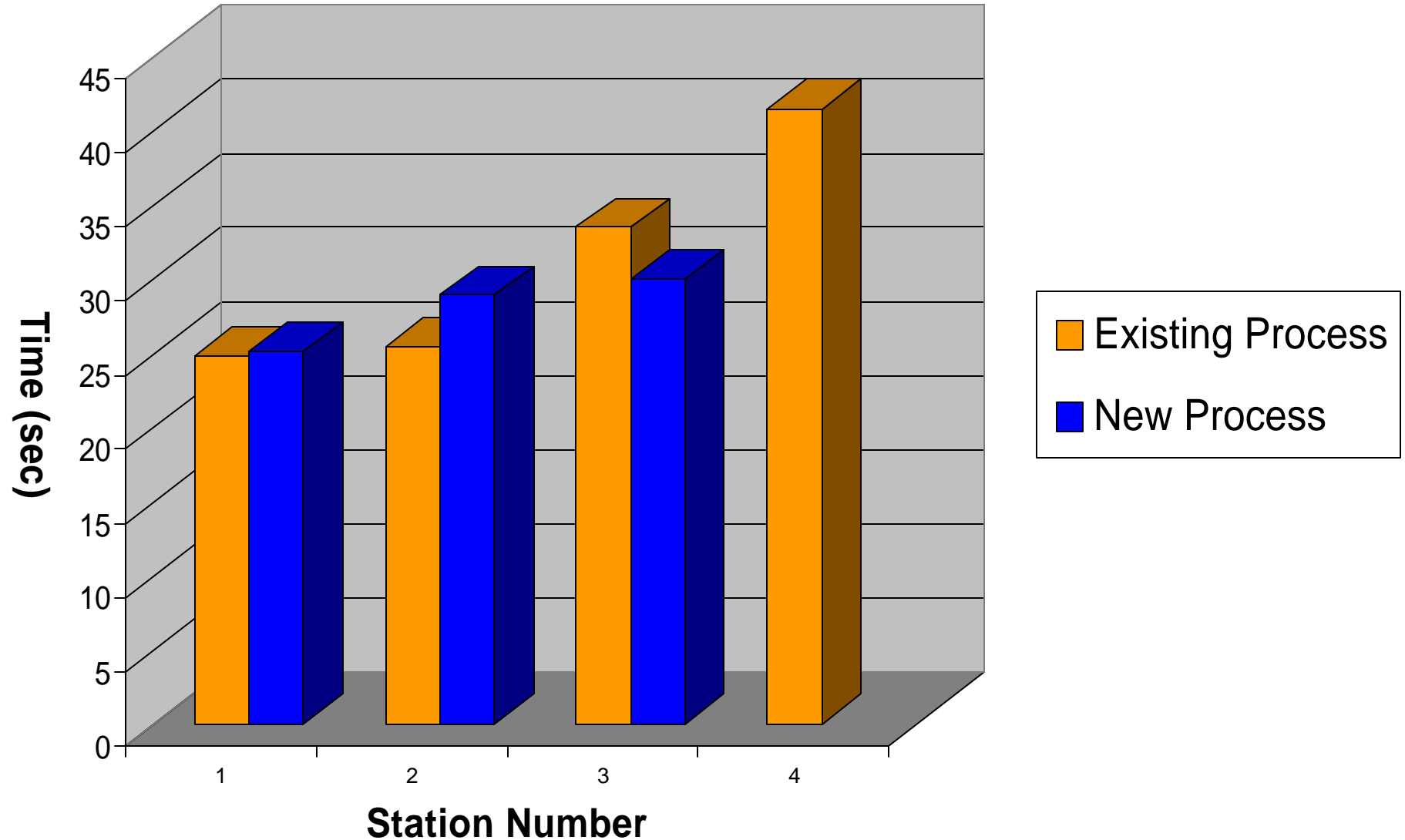


# Estimated Time Study For New Assembly

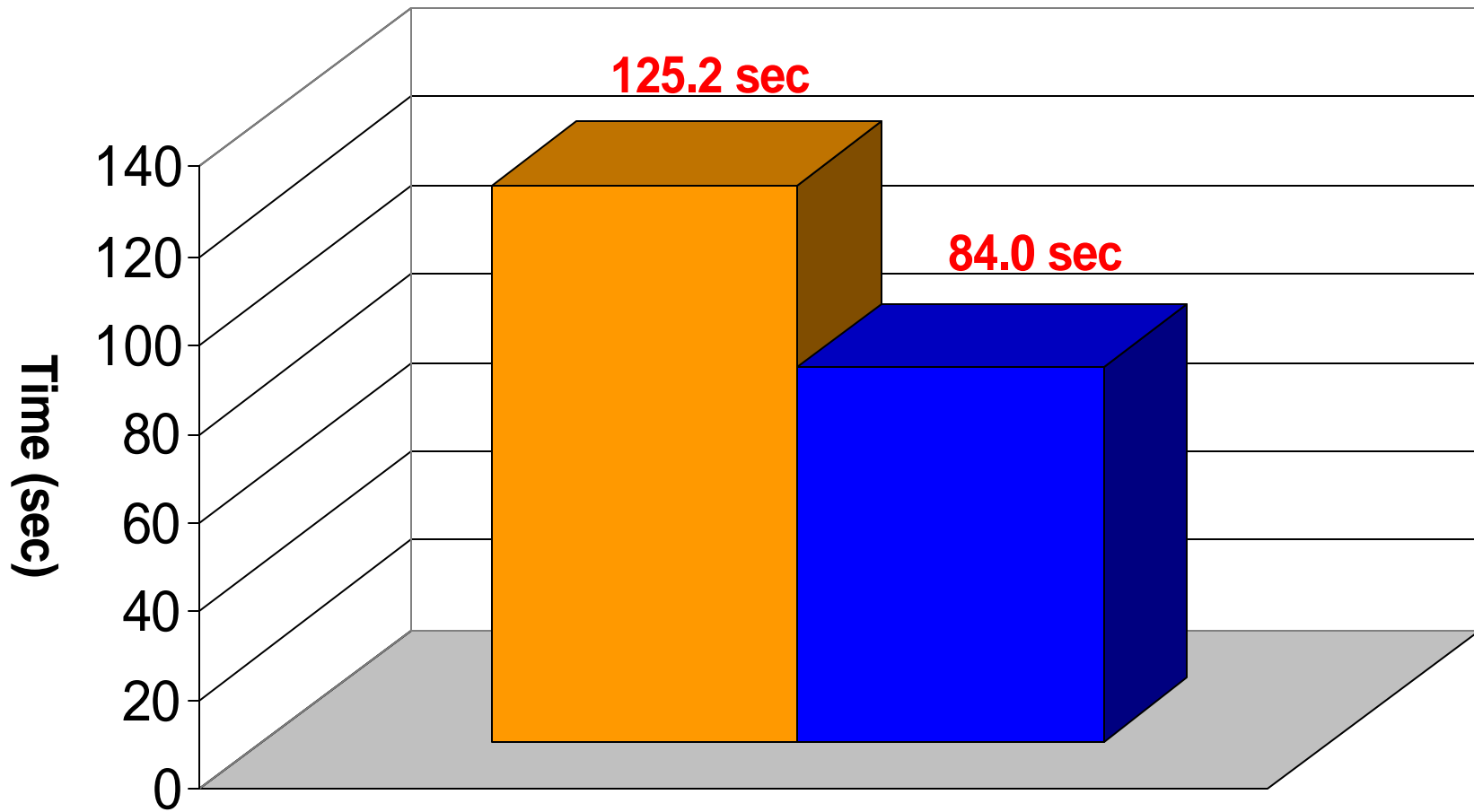
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Element Description	Estimated time
<b>Station 1</b>	<b>25.1 sec</b>
Retrieve sump, insert & align oil tube, place in fixture	8.0 sec
Ball, spring, cap installed, bushing fed to press	9.2 sec
Cycle machine	5.1 sec
Remove sump & set aside	2.8 sec
<b>Station 2</b>	<b>28.9 sec</b>
Retrieve sump, place in fixture	2.9 sec
Put screen in press, drain plug & CV fed to presses	8.2 sec
Screw in oil nipple	4.3 sec
Cycle machine	10.7 sec
Remove sump & set aside	2.8 sec
<b>Station 3</b>	<b>30.0 sec</b>
Retrieve sump, place in fixture	3.0 sec
Position governor	6.5 sec
Position seal	4.0 sec
Cycle machine for e-clips and governor seal	5.7 sec
Assemble bushings to governor (1/3)	8.0 sec
Remove sump & set aside	2.8 sec

# Time Comparison



# Total Time Comparison



**33 % Total Time Reduction**



# New Sump Production

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- Current Sump Production Capability
  - 650 sumps per each 7 ½ hour shift
- New Sump Production Capability
  - 900 sumps per each 7 ½ hour shift

250 Sump Increase Per Shift



# Major Estimated Costs

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- Three pneumatic presses
  - \$1,500/press = \$4,500
- Two conveyors with sensors
  - \$3,300
- Three automatic feeders
  - \$10,000/feeder = \$30,000
- Three new tables
  - \$3000
- **TOTAL = \$40,800**



# Estimated Profit

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## Labor Savings due to new assembly

- 650 sumps/8 hrs = 900 sumps/11 hours
- This yields 3 free hrs/person
  
- $3\text{hrs/person} * 3\text{ persons/shift} * 2\text{ shifts/day} * 5\text{ days/week} * 48\text{ weeks/year} * \$9.05/\text{hr} =$

**\$39,096 / year**



# Estimated Profit

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## Profit increase due to new production

- Cost of sump = \$26.11
- Sales mark up = 15%
- Profit per sump =  $0.15 * \$26.11 = \$3.9165$
  
- $\$3.9165/\text{sump} * 250 \text{ sumps/shift} * 2 \text{ shifts/day}$   
\*  $5 \text{ days/week} * 48 \text{ weeks/year} =$

**\$469,980 / year**



# Payback Period

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## Payback From New Production Profits

- $\$40,800 / 3.9165$  profit per sump = 10,418 sumps
- $10,418$  sumps /  $500$  extra sumps per day = 21 days

The profit from the new assembly production will pay for all expenses in **21** working days. (0% interest)



# Questions

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