



**Customer:** Volvo

**Program:** 2023 P6700

**Commodity:** Underbody Asm (17 JPH)

**Plant:** NRV

**Job #** 10214-Q16225-08

**Date:** 02-09-2022

**Cycle Time:** 212

Operator obtain small parts	How many	2	3.6
Operator load small parts	How many	4	7.2
Operator place small part (no precision)	How many		0.0
Operator obtain medium parts	How many	2	4.8
Operator load medium parts	How many	1	3.0
Operator place medium part (no precision)	How many		0.0
Operator obtain large parts	How many		0.0
Operator load large parts	How many	1	4.2
Operator place large part (no precision)	How many		0.0
Operator total walk	Total in feet	3	0.9
Operator hit P.B.		1	1.0
Operator Load Assist- load/unload part to fixt or rack(includes lwr, open/close clp and raise)	# of loads /unloads	1	12.5
Operator walk with load assist	Total in feet	6	3.0
Fixture - Clamp/Gripper close	# of close		0.0
Fixture - Clamp /Gripper open	# of open		0.0
Fixture - Suction Cup vacuum on	# of vacuum on		0.0
Fixture - Suction Cup vacuum off	# of vacuum off		0.0
Fixture - Manual Clamp close	# of close		0.0
Fixture - Manual Clamp open	# of open		0.0
Fixture - Shot pin extend	# of extends		0.0
Fixture - Shot pin retract	# of retracts		0.0
Fixture - Slide extend	# of extends		0.0
Fixture - Slide retract	# of retracts		0.0
Fixture - Pivot close	# of close		0.0
Fixture - Pivot open	# of open		0.0
Fixture - Trunnion rotates 180	# of rotates	1	4.0
Fixture - Turn Table rotates 180	# of rotates		0.0
Robot pick part	# of picks	1	6.00
Robot rotate 45	# of rotates		0.0
Robot rotate 90	# of rotates		0.0
Robot rotate 180	# of rotates		0.0
Robot rotate 270	# of rotates		0.0
Robot place part	# of places		0.0
Robot moves on 7th axis	Distance (# foot)	1	0.3
Robot rotate to home	# of rotates		0.0
Robot delay	# of delays		0.0
Robot date scribe	# of date scribe		0.0
Robot check tree (nuts & studs)	# of check positions		0.0
Robot changes EOAT (drop 1 and pick 1)	# of changes		0.0
Weld robot in			0.0
Weld robot welds (GEO)	# of welds -GEO-	1	4.0
Weld robot welds (Respot)	# of welds -Respot-	1	3.5
Weld robot out			0.0
Mig robot in			0.0
Mig robot weld	# of welds		0.0
Mig robot weld	Weld Length (mm)		0.0
Mig robot out			0.0
Laser brazing robot in		1	1.5
Seam detection at start of process	Weld Length (mm)		0.0
Laser brazing robot welds	Weld Length (mm)	328	6.0
Laser brazing robot out		1	1.5
Adh/Seal robot in			0.0
Adh/Seal robot	# of Beads	119	148.8
Adh/Seal robot	Adh/Seal Length (mm)	25552	85.2
Adh/Seal robot out			0.0
Proj/clinch nut/stud Weld robot in		1	1.5



Geo welds =	4.00	secs. Per weld
Respot welds =	3.50	secs. Per weld

MIG welds =	25	inches per min.
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Laser brazing =	130	inches per min.
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**Note:** Range of **95 inches/min** to max speed of **173 inches/min**. To achieve higher speeds 6 KW power unit needs to be used. **130 inches/min is an average.**

Adhesive/Seal =	300	mm per sec.
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6.0  
9.0

233.9

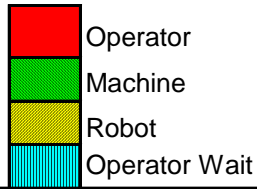
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# Man and Machine Motions

## PRELIMINARY TIMING ESTIMATES



**Volvo**  
**2023 P6700**  
**Underbody Asm (17 JPH)**  
**NRV**

TOOL DESCRIPTION:		Hours /Shift	REQUIRED JPH	TOTAL TIME AVAILABLE	TOTAL TIME UTILIZED	TOTAL MILES WALKED APPROX. 8 HR SHIFT	ROBOT TIME	OPERATOR TIME			MACHINE TIME													
								WORK	WAIT	% UTIL.														
<b>STA 070 OPER LOAD (L230)</b>		8	16.98	212.00	158.00	1.00	N/A	95.70	116.30	45.14	10.00													
step #	STATION DESCRIPTION	Cyl. Num.	WALK DIST.	RUN SEC	CYCLE TIME (seconds)																			
	Jobs Per Hour			22.78	14.0	28.0	42.0	56.0	70.0	84.0	98.0	112	126	140	154	168	182	196	210	224	238	252	266	280





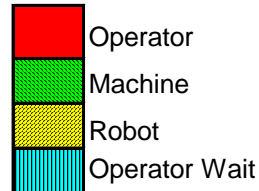


# Man and Machine Motions

## PRELIMINARY TIMING ESTIMATES



6.98



**Volvo**  
**2023 P6700**  
**Underbody Asm (17 JPH)**  
**NRV**

TOOL DESCRIPTION:	Hours /Shift	REQUIRED JPH	TOTAL TIME AVAILABLE	TOTAL TIME UTILIZED	TOTAL MILES WALKED APPROX. 8 HR SHIFT	ROBOT TIME	OPERATOR TIME			MACHINE TIME
							WORK	WAIT	% UTIL.	
							8	16.98	212.00	

**STA 070 FLR GEO (L230)**

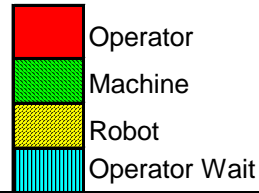
step #	STATION DESCRIPTION	Cyl. Num.	WALK DIST.	RUN SEC	CYCLE TIME (seconds)																			
					11.0	22.0	33.0	44.0	55.0	66.0	77.0	88.0	99.0	110	121	132	143	154	165	176	187	198	209	220
61	Robot V01AR12 moves to pick V01WR1UQ51 (070-GEO-T1)			3.63	126.25																			
62	V01AR12UQ42 Clamp Close S1	UQ5.1		1.50	127.75																			
63	Robot V01AR12 clears from STF BRKT pick			5.13	132.88																			
64	Robot V01AR12 moves to pick V01WR1UQ51 (070-GEO-T1)			2.78	135.66																			
65	V01AR12UQ42 Clamp Close S2	UQ1.2,		1.50	137.16																			
66	V01WR1UQ51 (070-GEO-T1) Clamps Open S5			1.00	138.16																			
67	Robot V01AR12 clears from MAIN FLR PNL pick			2.33	140.49																			
68	Robot V01AR12 moves to home			1.53	142.02																			
69	Turntable V01WR1 (070-GEO) Rotates 180° to load pos			6.00	148.02																			
70	Robot V01AR12 moves to drop to V01UQ52 (Flip Table)			8.78	150.80																			
71	V01AR12UQ42 Clamp Open S3	UQ1.2,		1.00	151.80																			
72	V01AR12UQ42 Pins Extend S4	UQ4.1		1.00	152.80																			
73	Robot V01AR12 repositions to pick			6.44	159.24																			
74	Robot V01AR12 moves to pounce			0.77	160.01																			
75	Robot V01AR12 moves to pick from V01UQ52			3.41	163.42																			
76	V01AR12UQ42 Clamp Close S5	UQ1.2,		1.50	164.92																			
77	Robot V01AR12 clears with flipped asm			4.03	168.95																			
78	Robot V01AR12 moves to home			2.49	171.44																			
79	<b>ROBOT LOAD FLR EXT REAR</b>																							
80	Robot V01AR11 moves from home w/ asm			9.00	21.98																			
81	Robot V01AR11 moves to drop asm			4.11	26.09																			
82	V01WR1UQ52 (070-GEO-T3) Clamps Close S2	UQ7.2,		1.00	27.09																			
###	V01AR11UQ41 Vacuum Off	UQ1.2,		1.50	28.59																			
###	V01AR11UQ41 Clamps Open S4	UQ2.2,		1.50	28.59																			
###	Robot V01AR11 clears from drop			2.58	31.17																			
###	Robot V01AR11 moves to home			5.78	36.95																			
###	Robot V01AR11 moves to pick FLR EXT REAR			2.87	39.82																			
###	Robot V01AR11 moves in to pick			3.73	43.55																			
###	V01AR11UQ41 Vacuum On	UQ1.2,		1.00	44.55																			
###	V01AR11UQ41 Clamps Close S3	UQ2.2,		1.00	44.55																			
###	Robot V01AR11 clears from pick			5.78	49.33																			
###	Robot V01AR11 moves to home			2.88	52.21																			
	<b>*RCS Timing*</b>																							
	Total Cycle Time				205.02																			
	Estimated Walk Total		0																					

# Man and Machine Motions

## PRELIMINARY TIMING ESTIMATES



6.98



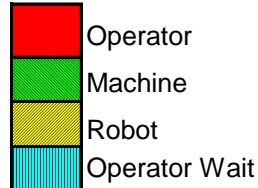
**Volvo**  
**2023 P6700**  
**Underbody Asm (17 JPH)**  
**NRV**

TOOL DESCRIPTION:				Hours /Shift	REQUIRED JPH	TOTAL TIME AVAILABLE	TOTAL TIME UTILIZED	TOTAL MILES WALKED APPROX. 8 HR SHIFT	ROBOT TIME	OPERATOR TIME			MACHINE TIME												
STA 070 FLR GEO (L230)				8	16.98	212.00	205.02	N/A	346.17	WORK	WAIT	% UTIL.	59.00												
step #	STATION DESCRIPTION	Cyl. Num.	WALK DIST.	RUN SEC	SEC	CYCLE TIME (seconds)																			
	Jobs Per Hour				17.56	11.0	22.0	33.0	44.0	55.0	66.0	77.0	88.0	99.0	110	121	132	143	154	165	176	187	198	209	220



# Man and Machine Motions

## PRELIMINARY TIMING ESTIMATES



**Volvo**  
**2023 P6700**  
**Underbody Asm (17 JPH)**

**NRV**

14.05

TOOL DESCRIPTION:				Hours	REQUIRED	TOTAL TIME	TOTAL TIME	TOTAL MILES WALKED	ROBOT	OPERATOR TIME			MACHINE												
STA 080 FLR RESPOT (L230)				/Shift	JPH	AVAILABLE	UTILIZED	APPROX. 8 HR SHIFT	TIME	WORK	WAIT	% UTIL.	TIME												
				8	16.98	212.00	197.95	N/A	569.94	N/A	N/A	N/A	31.16												
step #	STATION DESCRIPTION	Cyl. Num.	WALK DIST.	RUN		CYCLE TIME (seconds)																			
				SEC	SEC	10.6	21.2	31.8	42.4	53.0	63.6	74.2	84.8	95.4	106	117	127	138	148	159	170	180	191	201	212
9	Robot V01AR13 moves to pick			13.50	181.22																				
10	V01UQ51 (080-RS) Clamps Open	UQ6.2,		1.00	182.22																				
11	V01AR13UQ41 Clamps Close	UQ2.2,		1.50	183.72																				
12	V01AR13UQ41 Vacuum On	UQ1.2,		1.50	183.72																				
13	Robot V01AR13 clears from pick			11.39	195.11																				
14	V01UQ51 (080-RS) Shot Pins Extend	UQ3.1		1.00	196.11																				
15	Robot V01AR13 return to home			1.84	197.95																				
1	*RCS Timing*																								
	Total Cycle Time				197.95																				
	Estimated Walk Total		0																						
	Jobs Per Hour				18.19																				







## Robot / Operator Utilization Matrix

**Customer:** Volvo

**Program:** 2023 P6700

**Commodity:** Underbody Asm (17 JPH)

Over Cycle

Station #	Robot / Operator #	System Cycle Time	Proposed Cycle Time	Utilization
10	OP1	212.00	115.80	54.62%
30	OP2/3	212.00	130.20	61.42%
40	OP4	212.00	108.60	51.23%
80	OP5	212.00	92.10	43.44%
10	10R1	212.00	186.50	87.97%
	10R2	212.00	78.00	36.79%
30	30R1	212.00	187.25	88.33%
	30R2	212.00	120.25	56.72%
	30R3	212.00	90.00	42.45%
40	40R1	212.00	49.00	23.11%
	40R2	212.00	28.40	13.40%
	40R3	212.00	26.00	12.26%
60	60R1	212.00	176.00	83.02%
	60R2	212.00	176.00	83.02%
	60R3	212.00	176.00	83.02%
	60R4	212.00	176.00	83.02%
80	80R1	212.00	105.50	49.76%
	80R2	212.00	105.50	49.76%
	80R3	212.00	26.00	12.26%
	80R4	212.00	144.43	68.13%
	80R5	212.00	91.53	43.17%
100	100R1	212.00	58.60	27.64%
90	90R1	212.00	192.00	90.57%
	90R2	212.00	192.00	90.57%
	90R3	212.00	192.00	90.57%
	90R4	212.00	192.00	90.57%
120	120R1	212.00	85.00	40.09%
130	130R1	212.00	28.00	13.21%
	130R2	212.00	28.00	13.21%
140	140R1	212.00	180.25	85.02%
	140R2	212.00	180.25	85.02%
	140R3	212.00	180.25	85.02%
	140R4	212.00	180.25	85.02%
	140R5	212.00	28.00	13.21%
	140R6	212.00	14.00	6.60%
145	145R1	212.00	193.00	91.04%
	145R2	212.00	193.00	91.04%
	145R3	212.00	193.00	91.04%
	145R4	212.00	193.00	91.04%
	145R7	212.00	14.00	6.60%
146	146R1	212.00	193.00	91.04%
	146R2	212.00	193.00	91.04%
	146R3	212.00	193.00	91.04%
	146R4	212.00	193.00	91.04%



	146R7	212.00	14.00	6.60%
160	160R1	212.00	143.00	67.45%
	160R2	212.00	143.00	67.45%
	160R3	212.00	111.50	52.59%
	160R4	212.00	111.50	52.59%
170	170R1	212.00	40.00	18.87%
180	20R1	212.00	80.00	37.74%
	20R2	212.00	80.00	37.74%

<u>Robot Material Handling</u>		<u>Secs</u>	<u>Welding Robots Only</u>		<u>Secs</u>	<u>Handling parts</u>		<u>Obtain</u>	<u>Select</u>	<u>Load</u>	<u>Place</u>			
1	Logic delay	1.0	1	Rotates approx. 45 degrees to	3.0	Very Small Part (No Walk)	0.7	0.2	0.7	0.2	1.1	0.5		
2	Rotates approx. 45 degrees to	3.0	2	Rotates approx. 90 degrees to	4.0	Small Part	3.5	0.9	3.5	0.9	1.1	0.5		
3	Rotates approx. 90 degrees to	4.0	3	Rotates pounce to first weld	2.0	Medium Part	4.4		5.3		1.1	1.0		
4	Rotates approx. 180 degrees to	6.0	4	Articulate weld gun through welds on part in fixtur	3.0	Large Part	5.4		6.3		2.7	1.8		
5	Clamps on end effector extend, securir	1.0	5	Repositions to weld in additional plane	3.0	Large Special	6.7		7.6		2.7	1.8		
6	Clamps on end effector retract, releasir	1.0	6	Moves clear of fixture clamps	1.5	Very Large Part * V0	17.5	V0	18.4	V0	1.7	V0	0.5	V0
7	Articulates part through welds at PED \	3.0	7	Rotates clear of fixture	2.5	Very Large Part * F0	12.0	F0	12.9	F0	1.7	F0	0.5	F0
8	Rotates clear of fixture	3.0	8	Rotate home to pounce	2.0	Very Large Part * N0	15.5	N0	16.4	N0	2.0	N0	0.5	N0
9	Rotate to home	3.0	9	Logic delay	1.0	Very Large Part * H0	11.6	H0	12.5	H0	2.0	H0	0.5	H0
10	Rotates to Pounce	2.0				Very Large Part * V1	18.8	V1	19.7	V1	1.7	V1	0.5	V1
11	Articulate and pick second part	5.0				Very Large Part * F1	13.3	F1	14.2	F1	1.7	F1	0.5	F1
12	Articulate and set second part	5.0				Very Large Part * N1	14.7	N1	15.6	N1	2.0	N1	0.5	N1
						Very Large Part * H1	10.9	H1	11.8	H1	2.0	H1	0.5	H1

<u>Other Robot Operations</u>		<u>Secs</u>	<u>Palm Buttons</u>		<u>Secs</u>	<u>Unload/Transfer/Position</u>		<u>Unload</u>	<u>Transfer</u>	<u>Position</u>
1	Rotates pounce to start position	2.0		Step to pedestal, press and release 2 palm buttor	2.9	Very Small Part		1.7	3.7	0.8
2	Apply mastic daubs at PED stand	3.0		Press palm button located on fixture requiring one	0.6	Small Part		1.7	4.0	0.8
3	Apply mastic bead at PED stand	275.0		Press and hold palm button (hold dependent on n	0.6	Medium Part		1.7	5.2	1.1
4	Apply adhesive at PED stand	275.0		Depress foot pedal	0.4	Large Part		2.6	8.3	2.3
5	Apply sealer at PED stand	275.0		Turn selector knob	1.2	Very Large Part *	V	1.7	10.4	1.4
6	Reposions to another area on part	2.0		Press toggle switch	0.6	Very Large Part *	F	1.7	7.2	1.4
7	Apply mastic bead at fixture	275.0		Press keypad button (when extra force not requir	0.5	Very Large Part *	N	1.7	9.2	1.4
8	Apply adhesive at fixture	275.0		Firmly press keypad button (when button requires	1.2	Very Large Part *	H	1.7	9.2	1.4
9	Apply sealer at fixture	275.0								
10	Apply CLINCH nuts	4.5								
11	Apply WELD nuts	5.5								
12	Applies date stamp	2.0								

Part Handling

Note that lines between jobs contain "blanks" (not

	<u>Walk</u>	<u>Sec/ft</u>	<u>Hoists</u>	<u>Type</u>	<u>0 Hooks</u>	<u>1 Hook</u>	<u>2 Hooks</u>
Walk / Carry Parts	Standard walk with any other than large part	0.3	Obtain and engage part	V	9.7	11	12.8
	Any walk with very large object or 2 operators wal	0.4	Obtain and engage part	F	7.4	8.6	10.4
Obtain / Select/ Load / Place Parts	Unrestricted walk over a long distance such in a v	0.2	Obtain and engage part	N	9.5	9.3	11.1
	Standard walk without part	0.3	Obtain and engage part	H	7.7	9.1	10.9
Unload / Transfer / Position Part			Disengage from part and put aside	V	4.6	5.8	7.5
			Disengage from part and put aside	F	5.2	6.3	8.0
Palm Buttons			Disengage from part and put aside	N	2.2	3.4	5.0
			Disengage from part and put aside	H	6.1	7.2	8.9

Handling with Hoists

Typical Part Sizes

Tip Dress Times

