CASE STUDY - Assembly/disassembly - internal components	
TASK TITLE: Assembly/disassembly - internal components	
Task Description:	Assembly/disassembly often involves the use of manual or power tools. The characteristic that makes this assembly/disassembly task unique is that the task is being performed on an internal component. The component is in a fixed location (e.g., inside the aircraft wing, wall, or other machine) and access to the part is typically severely limited. In some cases the employee must reach into or work through a small access opening to perform the work. In other cases, the employee must crawl into and work from inside a small compartment. Typical jobs in which assembly/disassembly is performed include (not necessarily limited to): • fuel line maintenance • hydraulics
Job Performance Measures Most Often Impacted by Assembly/disassembly:	• Speed of task completion (as measured against standard) • Integrity of seals • No foreign objects can be left inside aircraft
Typical Employee Comments about Assembly/disassembly:	Employees typically complain about discomfort in the hands/wrists and elbows. Depending on the work location and the type of access, employees may report a variety of complaints from knees (due to kneeling or squatting), shoulders (from constant reaching), and back and neck (from working in awkward postures for prolonged periods. Primary: varies depending on task Secondary: varies depending on task
Suggested Level II Analysis:	Postural Analysis, Dynamic Task Analysis, Grip Force Measurement

Shoulder/Neck

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
1. Reaching	• Work location is too high (see Figure 1.1)	123. Raise the person					
		• use a step stool or ladder	✓	✓	med	med	med
		• provide a fixed platform	✓		low	med	med
		• provide an adjustable platform or scaffolding		✓	high	med	med
		32. Lower the work piece/work surface	✓	✓	med	med	med
	Figure 1.1						
	• Work location is too far away	38. Move closer to the work location					
		• remove obstructions	✓	✓	med	med	med
		41. Move work piece closer to body	✓		low	med	med
	• Work location is blocked or is in an inappropriate orientation	136. Rotate the work piece					
		• remove adjacent access panel if possible		✓	med to high	med	med
	• Work space or access is limited	63. Provide a padded, compressible surface to lay on	✓		low	med	med
		117. Provide support for the upper body		✓	med	med	med

Shoulder/Neck (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
	• Manual procedure or tool requires excessive force	76. Provide a tool which requires minimal force to use • provide manual tool to replace "by hand" work		✓	med	med	med
2. Arm forces: Repeated contraction of the arm muscles or holding/carry-ing materials	• Component must be held in place	118. Provide support for the work piece • provide manual clamps/fixtures to hold components in place during assembly or removal	✓	✓	med	med	med
3. High speed, sudden shoulder movements	• Manual procedure or tool requires high speed movements	76. Provide a tool which requires minimal force to use • provide manual tool to replace "by hand" work		✓	med to high	med	med to high
4. Head/neck bent or twisted	• Work location too high or too low.	123. Raise the person • use a step stool or ladder • provide a fixed platform • provide an adjustable platform or scaffolding 32. Lower the work piece/work surface • change (e.g., invert) the orientation of the component, or machine.	✓ ✓

Shoulder/Neck (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
	• Work location is too far away	38. Move closer to the work location • remove obstructions	✓	✓	med	med	med
		41. Move work piece closer to body	✓		low	med	med
	• Light levels are too low for task	22. Increase light levels • provide a task light which is easy to adjust		✓	med	med	med
		• increase room lighting		✓	high	high	high
	• Lack of direct visual access to work location (see Figure 1.2) **Figure 1.2**	84. Provide an adjustable mirror • provide an articulating mirror to provide better visual contact to parts inside the access hole		✓	med	med	med
	• Lack of adequate support for head	114. Provide support for the head • provide neck roll or brace to support head if head must be tipped backward or forward when performing work		✓	med	med	med

Hands/Wrists/Arms

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
5. Bent wrists/repeated wrist movements or repeated forearm rotation	• Manual procedure or tool requires bent wrists	76. Provide a tool which requires minimal force to use					
		• provide power tool to replace forceful work with manual tool		✓	med	med	med
		• provide manual tool to replace hand work		✓	med	med	med
	• Using the wrong type of tool can cause bent wrists	77. Provide a tool with an appropriate handle angle					
		• provide in-line power tools for horizontal surfaces		✓	med	med	med
		• provide pistol grip power tools for vertical surfaces		✓	med	med	med
		• provide power tool with a handle which can be angled/bent for different nut driving tasks		✓	med	med	med
		• use tube gun for tube (e.g., fuel line, hydraulic line) fasteners.		✓	med	med	med
	• Work location is too far away	103. Provide extensions for tools					
		• provide extensions and angles on wrenches in order to access bolt with minimal reaching		✓	med	med	med
		38. Move closer to the work location					
		• remove obstructions	✓	✓	med	med	med

Hands/Wrists/Arms (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
6. Repeated manipulations with fingers	• Manual tightening/loosening on small bolts, nuts & screws	66. Provide a power tool.		✓	med	med	med
7. Hyperextension of finger/thumb or repeated single finger activation	• Wide spans on tools such as vise grips cause finger and thumb hyperextension	13. Encourage ergonomic work techniques • use two hands when possible	✓		low	med	med
		89. Provide an appropriate handle grip span on plier-type tools • provide a tool with a handle span less than 3"		✓	med	med	med
		• use crescent wrenches or appropriately sized sockets	✓		low	med	med
	• Tool requires single finger trigger activation	62. Provide a multi-finger trigger • extend current trigger	✓	✓	med	med	med
		• provide a tool with a multi-finger trigger		✓	med	med	med
8. Hand/grip forces	• Component must be held in place	118. Provide support for the work piece • provide manual clamps/fixtures to hold components in place during assembly or removal	✓	✓	med	med	med
		• replace pliers with vice grips for holding, squeezing or stabilizing parts during installation	✓	✓	med	med	med

Hands/Wrists/Arms (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
	• Tool is too heavy	59. Provide a lighter weight tool • provide light-weight tools		✓	med	med	med
		75. Provide a tool which can be used with both hands • add an auxiliary handle or extension to enable employee to hold/stabilize tool with two hands	✓	✓	med	med	med
	• Lack of friction between hand/fingers and tools or components	76. Provide a tool which requires minimal force to use • provide thin, anti-slip gloves • clean components (e.g., remove dirt, grease etc.) prior to handling	✓ ✓		low low	high high	high high
	• Manual procedure or tool requires forceful grips	76. Provide a tool which requires minimal force to use • provide manual tool to replace hand work		✓	med	med	med
		• provide power tool to replace forceful work with manual tool		✓	med	med	med

Hands/Wrists/Arms (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
	• Power tools produce hand/arm vibrations	34. Maintain hand tool/power tools • provide regular maintenance and lubrication for tools	✓		low to med	med	med
		74. Provide a tool that minimizes exposure to vibration/impact/torque • provide a power tool with internal vibration damping		✓	med	med	med
		• attach vibration damping material to tool handle (Caution: adding to the handle should not cause the tool diameter to be larger than 1.5" (3.8 cm))	✓		low	med	med
9. High speed hand/wrist/arm movements or vibration, impact, or torque to the hand	• Power tool causes impact and torque to the hand	34. Maintain hand tools/power tools • provide regular maintenance and lubrication for tools	✓		low	med	med
		76. Provide a tool which requires minimal force to use • provide tools with torque releases to minimize forces required to control the tool		✓	med	med	med

Hands/Wrists/Arms (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
10. Exposure to hard edges	• Tool handle has hard edges	9. Eliminate exposure to hard edges • provide a tool with a round, smooth handle with no ridges or edges		✓	med	med	med
		• provide a handle of at least 5" (12.7 cm) in length		✓	med	med	med
	• Work area has hard or sharp edges	9. Eliminate exposure to hard edges	✓		low	med	med
		• lay a blanket or cushion over hard edges • redesign work piece or component to eliminate hard edges		✓	med	med	med

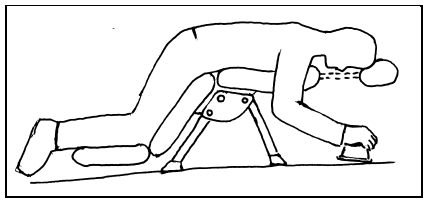
Hands/Wrists/Arms (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
11. Hands and fingers exposed to cold temperatures	• Cold exhaust from air powered tool blows on hand • Work area is too cold	7. Direct cold air away from the hands • direct exhaust air away from hands • provide tool which does not blow cold air on the hands 93. Provide appropriate gloves • provide gloves of the right size and type of material to match the task Caution: gloves of an inappropriate material or size can cause person to increase hand forces to perform task	 ✓ ✓ ✓	 ✓ ✓ 	 med med low	 med med med	 med med med

Back/Torso

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
12. Repeated forward or sideways bending movements	• Rarely occurs	N/A					
13. Twisting of the lower back	• Work space or access is limited	63. Provide a padded, compressible surface to lay on • provide a pad/mat • provide a device to support the upper body while working 132. Remove obstructions • remove hoses, carts, access covers	✓ ✓	✓	low med low	med med high	med med high
14. High speed, sudden movements	• Item is stuck in location • Item is difficult to install or remove	74. Provide a tool that minimizes exposure to vibration/ impact/torque • use lubricant where feasible • modify design of component or subsystem to reduce forces during installation or removal • use tool to “pry” instead of pull.	✓ ✓	✓	low med to high low	med med med	med med med

Back/Torso (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
15. Static, awkward back postures	• Inappropriate back support	117. Provide support for the upper body • provide padded, portable leaning rests for working in areas which prevent the use of a chair or stool. (see Illustration 1.1)  **Illustration 1.1**		✓	med	med	med
	• Work location is too low	124. Raise the work piece/work surface					
		• elevate with an available hoist	✓		low	med	med
		• provide a stationary platform or ramp		✓	med	med	med
		• provide a height-adjustable work platform		✓	high	med	high
	• Work location is too far away	38. Move closer to the work location • remove obstructions	✓	✓	med	med	med
	• Light levels too low	22. Increase light levels					
		• provide a task light which is easy to adjust		✓	med	med	med
		• increase room lighting		✓	high	high	high

Back/Torso (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
16. Lifting forces	• Component is too heavy	61. Provide a mechanical lift device					
		• use portable lift cart to raise/position component	✓	✓	med	low	med
		• get it close to install point		✓	med	low	med
		• place the part on temporary hangers to avoid lifting while part is being positioned	✓	✓	med	low	med
		142. Use two or more persons to perform the transfer	✓		low	low	low
17. Pushing or pulling	• High forces are required to install or remove the component	74. Provide a tool that minimizes exposure to vibration/impact/torque					
		• use lubricant where feasible	✓		low	med	med
		• modify design of component or subsystem to reduce forces during installation or removal		✓	med to high	med	med
		• "pry" component away instead of pulling	✓		low	med	med

Legs/Feet

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
18. Whole body vibration	• Rarely occurs	N/A					
19. Fixed position, standing	• Standing surface is hard	86. Provide appropriate anti-fatigue mat		✓	med	med	low
		96. Provide appropriate shoe inserts	✓		low	low	low
20. Exposure to hard edges on legs, knees, and feet	• Kneeling causes external pressure to the knee (see Figure 1.3) **Figure 1.3**	95. Provide appropriate knee protection					
		• provide knee pads		✓	med	med	med
		• provide a pad or cushion to kneel on	✓		low	low	low
	• Work area has hard edges	9. Eliminate exposure to hard edges					
		• lay a blanket or cushion over hard edges	✓		low	low	med
		• redesign work piece or component to eliminate hard edges		✓	med	med	med

Legs/Feet (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
21. Awkward leg postures	• Work location is too low	31. Lower the person • provide a chair/stool to sit on • provide knee pads • provide a pad or cushion to kneel on	 ✓	 ✓ ✓ 	 med med med	 med med med	 med med med
22. Standing foot pedal	• Rarely occurs	N/A					

Head/eyes

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
23. Difficult to see/light levels too low/too high	• Light levels are too low for task	22. Increase light levels • provide a task light which is easy to adjust • increase room lighting	✓	✓	med high	med high	med high
24. Intensive visual tasks, staring at work objects for long periods	• Task lacks variety	20. Incorporate rest pauses 25. Increase task variety	✓ ✓		low low	med med	med med