

## CASE STUDY - Drilling

### TASK TITLE: Drilling

<b>Task Description:</b>	The task is performed for varying amounts of time depending on the complexity of the task. The task can be performed on wood, metal, plastic, rock or other material. The size of the drill bit will vary with the size of hole or bolt required. The effort associated with the task is often a function of; bit type and condition, speed and power of the drill, material type and technique.
<b>Job Performance Measures Most Often Impacted by Drilling:</b>	<p>There are many different types of drilling processes such as electric drill and drill press.</p> <p>Typical jobs in which drilling is performed include:</p> <ul style="list-style-type: none"><li>• metal fabrication</li><li>• carpentry</li><li>• assembly and repair</li></ul> <p>Drilling may be performed on flat or upright surface directly on aircraft, equipment, bench tops, and on a variety of surface shapes.</p>
<b>Job Performance Measures Most Often impacted by Drilling</b>	<ul style="list-style-type: none"><li>• Quality of drilling (e.g., straightness of hole)</li><li>• Speed of completion of drilling task</li></ul>
<b>Typical Employee Comments about Drilling:</b>	<p>Due to the wide variety of work situations, employees may report fatigue or discomfort in any of the following body regions: shoulder/neck, hands/wrists/arms, back/torso, legs/feet or head/eyes.</p> <p>Primary: varies depending on task Secondary: varies depending on task</p>
<b>Suggested Level II Analysis:</b>	Grip Force Measurement, Postural Analysis, Elemental Task Analysis

**Shoulder/Neck**

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
1. Reaching	<ul style="list-style-type: none"> <li>• Work location is too high</li> <li>• Drill must be manually supported, held or steadied (see Figure 1.1)</li> </ul>  <p><b>Figure 1.1</b></p> <ul style="list-style-type: none"> <li>• Work location is too far away</li> </ul>	123. Raise the person <ul style="list-style-type: none"> <li>• use a step stool, platform or ladder</li> <li>• provide an adjustable platform or scaffolding</li> </ul>	✓	✓	med	med	med
		32. Lower the work piece/work surface	✓	✓	high	med	high
		117. Provide support for the upper body <ul style="list-style-type: none"> <li>• rest arms on near-by surfaces</li> <li>• provide flexible armrests</li> </ul>	✓	✓	med	med	med
		38. Move closer to the work location	✓		low	med	med
		132. Remove obstructions	✓	✓	med	med	med
		41. Move work piece closer to body	✓		low	med	med

**Shoulder/Neck (cont'd)**

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
		103. Provide extensions for tools		✓	med	med	med
		8. Distribute intensive activities throughout the process <ul style="list-style-type: none"> <li>perform some activities as bench work rather than on the aircraft/structure</li> </ul>	✓	✓	med	med	med
		82. Provide adequate workspace <ul style="list-style-type: none"> <li>add access panels to increase access</li> <li>increase the size of access ports to increase access</li> </ul>		✓	high	med	high
				✓	high	med	med
	<ul style="list-style-type: none"> <li>Work location is blocked or is in an inappropriate orientation</li> </ul>	136. Rotate work piece (bench work) <ul style="list-style-type: none"> <li>rotate the work piece manually</li> <li>provide a fixture to allow the work piece to be rotated</li> </ul>	✓		low	med	med
				✓	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	
		103. Provide extensions for tools		✓	med	med	med	
		8. Distribute intensive activities throughout the process <ul style="list-style-type: none"> <li>perform some activities as bench work rather than on the aircraft/structure</li> </ul>	✓	✓	med	med	med	
	<ul style="list-style-type: none"> <li>Drilling is performed on flat work surface</li> </ul>	136. Rotate work piece (bench work) <ul style="list-style-type: none"> <li>turn the work piece to an upright position</li> <li>provide a fixture to allow the work piece to be rotated</li> </ul>	✓		low	med	med	
					✓	med	med	med
			77. Provide a tool with an appropriate handle angle <ul style="list-style-type: none"> <li>provide a drill tool with an in line grip or 90° off-set grip</li> </ul>		✓	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
2. Arm forces: Repeated contraction of the muscles of the arm or holding/carrying materials	<ul style="list-style-type: none"> <li>• Improper bit/material combination</li> <li>• Inadequate drill or speed</li> <li>• Poor technique</li> </ul>	76. Provide a tool that requires minimal force to use <ul style="list-style-type: none"> <li>• provide an alternative drill bit design</li> </ul>		✓	med	med	high
		13. Encourage ergonomic work techniques <ul style="list-style-type: none"> <li>• let the tool do the work</li> </ul>	✓		low	med	med
3. High speed, sudden shoulder movements	<ul style="list-style-type: none"> <li>• Rarely occurs</li> </ul>	N/A					
4. Head/neck bent or twisted	<ul style="list-style-type: none"> <li>• Work location is too low</li> </ul>	124. Raise the work piece/work surface (bench work) <ul style="list-style-type: none"> <li>• provide a fixed table to support work piece</li> </ul>	✓	✓	med	med	med
		<ul style="list-style-type: none"> <li>• provide an adjustable table</li> <li>• raise platform of drill press</li> </ul>	✓	✓	med med	med med	med med
		31. Lower the person <ul style="list-style-type: none"> <li>• provide a chair/stool to sit on for all or parts of the task</li> </ul>	✓	✓	med	med	med
		13. Encourage ergonomic work techniques <ul style="list-style-type: none"> <li>• educate worker to look up frequently</li> </ul>	✓		low	med	med

**Shoulder/Neck (cont'd)**

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
			✓	✓			
	<ul style="list-style-type: none"> <li>Work location is too high</li> </ul>	8. Distribute intensive activities throughout the process <ul style="list-style-type: none"> <li>perform some activities as bench work rather than on the aircraft/structure</li> </ul>	✓	✓	med	med	med
		123. Raise the person <ul style="list-style-type: none"> <li>use a step stool or ladder</li> <li>provide an adjustable platform or scaffolding</li> </ul>	✓	✓ ✓	med med	med med	med med
		32. Lower the work piece/work surface	✓	✓	low to 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
	<ul style="list-style-type: none"> <li>Work location is blocked or is in an inappropriate orientation</li> </ul>	136. Rotate work piece (bench work) <ul style="list-style-type: none"> <li>turn the work piece</li> <li>provide a fixture to allow the work piece to be rotated</li> </ul>	✓	✓	low med	low med	low med
		8. Distribute intensive activities throughout the process <ul style="list-style-type: none"> <li>perform some activities as bench work rather than on the aircraft/structure</li> </ul>	✓	✓	med	med	med
		82. Provide adequate workspace <ul style="list-style-type: none"> <li>increase the size of access ports to increase access</li> </ul>		✓	high	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	<ul style="list-style-type: none"> <li>Using pistol grip drill on horizontal surface</li> <li>Work location is blocked or is in an inappropriate orientation</li> </ul>	136. Rotate work piece (bench work) <ul style="list-style-type: none"> <li>rotate the work piece manually</li> <li>provide a fixture to allow the work piece to be rotated</li> </ul>	✓	✓	low med	med med	med med
		103. Provide extensions for tools  8. Distribute intensive activities throughout the process <ul style="list-style-type: none"> <li>perform some activities as bench work rather than on the aircraft/structure</li> </ul>	✓	✓	med  med	med  med	med  med
	<ul style="list-style-type: none"> <li>Work location is too high</li> </ul>	82. Provide adequate workspace <ul style="list-style-type: none"> <li>increase the size of access ports to increase access</li> </ul>		✓	high	med	med
		123. Raise the person <ul style="list-style-type: none"> <li>use a step stool or ladder</li> <li>provide an adjustable platform or scaffolding</li> </ul>	✓	✓ ✓	med med	med med	med med
		32. Lower the work piece/work surface	✓	✓	low to 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	<ul style="list-style-type: none"> <li>Rarely occurs</li> </ul>	N/A					
7. Hyperextension of finger/thumb or repeated single finger activation	<ul style="list-style-type: none"> <li>Use of drill with single finger trigger concentrates stress</li> </ul>	62. Provide a multi-finger trigger <ul style="list-style-type: none"> <li>extend current trigger</li> <li>provide a multi-finger trigger tool (e.g., enough surface for two fingers)</li> </ul>	✓	✓ ✓	med high	low med	med med
8. Hand/grip forces	<ul style="list-style-type: none"> <li>Drill tool or work piece must be manually supported, held or steadied</li> <li>Tool is too heavy</li> </ul>	118. Provide support for the work piece  54. Provide a high friction gripping surface <ul style="list-style-type: none"> <li>wrap the tool handle with a compressible grip surface</li> </ul> 116. Provide support for the tool <ul style="list-style-type: none"> <li>provide a tool balancer for bench work</li> </ul> 59. Provide a lighter weight tool <ul style="list-style-type: none"> <li>provide a drill of minimal weight</li> </ul>	✓	✓  ✓  ✓	high  low  med  med	med  med  med  med	med  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
	<ul style="list-style-type: none"> <li>Handle diameter is too large</li> </ul>	88. Provide an appropriate handle diameter <ul style="list-style-type: none"> <li>provide a tool with handle diameter between 1"-1.5" (2.5-3.5 cm)</li> </ul>		✓	med	med	med
9. High speed hand/wrist/arm movements or vibration, impact, or torque to the hand	<ul style="list-style-type: none"> <li>Design or poor condition of tool may expose employee to high levels of vibration</li> </ul>	34. Maintain hand tools/power tools <ul style="list-style-type: none"> <li>inspect and repair tool on a regular basis to eliminate unnecessary vibration.</li> </ul>	✓		low	med	med
		74. Provide a tool that minimizes exposure to vibration/impact/torque <ul style="list-style-type: none"> <li>provide a tool that emits less vibration</li> </ul>		✓	med	med	med
10. Exposure to hard edges	<ul style="list-style-type: none"> <li>Tool handle has hard edges</li> </ul>	9. Eliminate exposure to hard edges <ul style="list-style-type: none"> <li>provide a tool with a round, smooth handle with no ridges or edges</li> </ul>		✓	med	med	med
		<ul style="list-style-type: none"> <li>provide a handle of at least 5" (12.7 cm) in length</li> </ul>		✓	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
	<ul style="list-style-type: none"> <li>• Work station or work piece has hard or sharp edges</li> </ul>	9. Eliminate exposure to hard edges <ul style="list-style-type: none"> <li>• provide padding for edges</li> <li>• round off exposed edges</li> <li>• lay a blanket or cushion over hard edges</li> <li>• redesign work piece or component to eliminate hard edges</li> </ul>	✓ ✓ ✓	✓	low low low high	med med med med	med med med med
11. Hands and fingers exposed to cold temperatures	<ul style="list-style-type: none"> <li>• Work area is too cold</li> </ul>	105. Provide portable heaters  110. Provide shields or barriers from the wind  93. Provide appropriate gloves	✓	✓ ✓	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	<ul style="list-style-type: none"> <li>Work location is too low</li> </ul>	124. Raise the work piece/work surface					
		<ul style="list-style-type: none"> <li>provide a fixed table to support work piece</li> </ul>	✓	✓	med	med	med
		<ul style="list-style-type: none"> <li>provide an adjustable table for work piece</li> </ul>		✓	med	med	med
		<ul style="list-style-type: none"> <li>raise platform of drill press</li> </ul>	✓	✓	low	med	med
13. Twisting of the lower back	<ul style="list-style-type: none"> <li>Work location is blocked or is in an inappropriate orientation</li> <li>Work space or access is limited</li> </ul>	31. Lower the person					
		<ul style="list-style-type: none"> <li>provide a chair/stool to sit on</li> </ul>	✓	✓	med	med	med
		136. Rotate the work piece	✓		low	med	low
		<ul style="list-style-type: none"> <li>turn the work piece manually</li> <li>provide a fixture to allow the work piece to be rotated</li> </ul>		✓	med	med	low
14. High speed, sudden movements	<ul style="list-style-type: none"> <li>Rarely occurs</li> </ul>	117. Provide support for the upper body					
		<ul style="list-style-type: none"> <li>provide a pad/mat</li> <li>provide a device to support the upper body while welding (see illustration)</li> </ul>	✓	✓	low 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	<ul style="list-style-type: none"> <li>• Work location is too low</li> </ul>	124. Raise the work piece/work surface					
		<ul style="list-style-type: none"> <li>• provide a fixed table to support work piece</li> <li>• provide an adjustable table for work piece</li> </ul>	✓	✓	med	med	med
		8. Distribute intensive activities throughout the process	✓	✓	high	med	high
		<ul style="list-style-type: none"> <li>• perform some activities as bench work rather than on the aircraft/structure</li> </ul>			med	med	med
		82. Provide adequate workspace					
<ul style="list-style-type: none"> <li>• increase the size of access ports to increase access</li> </ul>				✓	high	med	med
117. Provide support for the upper body							
<ul style="list-style-type: none"> <li>• provide a device to support the head and upper body while the person is working</li> </ul>				✓	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
	<ul style="list-style-type: none"> <li>Work location is too far away</li> </ul>	38. Move closer to the work location  32. Remove obstructions  41. Move work piece closer to body  136. Rotate the work piece <ul style="list-style-type: none"> <li>rotate the work piece manually</li> <li>provide a fixture to allow the work piece to be rotated</li> </ul>	✓  ✓  ✓  ✓ ✓		low  low  low  low med	low  low  low  med med	low  low  low  low low
		8. Distribute intensive activities throughout the process <ul style="list-style-type: none"> <li>perform some activities as bench work rather than on the aircraft/structure</li> </ul>		✓	med	med	med
		82. Provide adequate workspace <ul style="list-style-type: none"> <li>add access panels to increase access</li> <li>increase the size of access ports to increase access</li> </ul>		✓	high	med	high
		117. Provide support for the upper body <ul style="list-style-type: none"> <li>provide a device to support the head and upper body while the person is working</li> </ul>		✓	high	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
	<ul style="list-style-type: none"> <li>Chair or stool provides inadequate back support (see Figure 1.2)</li> </ul>  <p style="text-align: center;"><b>Figure 1.2</b></p>	115. Provide support for the lower back <ul style="list-style-type: none"> <li>pull chair forward and lean back while working</li> <li>adjust back rest to support lower back</li> <li>attach a small pillow to back rest to support lower back</li> <li>provide chair with lower back support</li> </ul>	<ul style="list-style-type: none"> <li>✓</li> <li>✓</li> <li>✓</li> </ul>	<ul style="list-style-type: none"> <li>✓</li> </ul>	low low low med	low low med med	low low med med
16. Lifting forces	<ul style="list-style-type: none"> <li>Initial setup may require the placement of the part on the workbench.</li> </ul>	61. Provide a mechanical lift device <ul style="list-style-type: none"> <li>provide a hoist to place the unit on the workbench</li> </ul>		<ul style="list-style-type: none"> <li>✓</li> </ul>	high	med	med
17. Pushing or pulling	<ul style="list-style-type: none"> <li>Initial setup requires movement of heavy equipment</li> </ul>	48. Provide a cart <ul style="list-style-type: none"> <li>provide a powered cart to carry and move the equipment</li> </ul>		<ul style="list-style-type: none"> <li>✓</li> </ul>	med	med	med
18. Whole body vibration	<ul style="list-style-type: none"> <li>Rarely occurs</li> </ul>	N/A					

## Legs/Feet

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
19. Fixed position, standing	<ul style="list-style-type: none"> <li>Standing surface is hard (see Figure 1.3)</li> </ul>  <p style="text-align: center;"><b>Figure 1.3</b></p>	86. Provide an appropriate anti-fatigue mat		✓	med	med	med
		96. Provide appropriate shoe inserts	✓		low	med	med
20. Exposure to hard edges on legs, knees, and feet	<ul style="list-style-type: none"> <li>Front edge of seat is hard or square</li> <li>Work station or work piece has hard edges</li> </ul>	9. Eliminate exposure to hard edges	✓		low	med	med
		<ul style="list-style-type: none"> <li>use a cushion eliminate exposure to pressure point</li> <li>provide chair with rounded front edge of seat</li> </ul>		✓	med	med	med
		9. Eliminate exposure to hard edges	✓		low	med	med
		<ul style="list-style-type: none"> <li>provide padding for edges</li> <li>round off exposed edges</li> </ul>	✓		low	med	med

**Legs/Feet (cont'd)**

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On		
			✓ Minor Modification	✓ Major Change		Quality	Productivity	
		<ul style="list-style-type: none"> <li>lay a blanket or cushion over hard edges</li> <li>redesign work piece or component to eliminate hard edges</li> </ul>	✓		low	med	med	
				✓	high	med	med	
21. Awkward leg postures	<ul style="list-style-type: none"> <li>Work location is too low</li> </ul>	124. Raise the work piece/work surface (bench work)						
		<ul style="list-style-type: none"> <li>provide a fixed table to support work piece</li> <li>provide an adjustable table for work piece</li> </ul>		✓	med	med	med	
				✓	med	med	med	
		31. Lower the person		✓	low	med	med	
		<ul style="list-style-type: none"> <li>provide a chair/stool to sit on</li> </ul>			✓	med	med	med
		8. Distribute intensive activities throughout the process				✓	med	med
		<ul style="list-style-type: none"> <li>perform some activities as bench work rather than on the aircraft/structure</li> </ul>						
		82. Provide adequate workspace						
		<ul style="list-style-type: none"> <li>add access panels to increase access</li> <li>increase the size of access ports to increase access</li> </ul>		✓	high	med	high	
				✓	high	med	med	
22. Standing foot pedal	<ul style="list-style-type: none"> <li>Rarely occurs</li> </ul>	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	<ul style="list-style-type: none"> <li>Light levels are too low for task</li> </ul>	22. Increase light levels <ul style="list-style-type: none"> <li>provide a task light which is easy to adjust</li> <li>increase room lighting</li> </ul>		✓ ✓	med high	med med	med med
24. Intensive visual tasks, staring at work objects for long periods	<ul style="list-style-type: none"> <li>Rarely occurs</li> </ul>	N/A					