

## CASE STUDY - Grinding

### TASK TITLE: Grinding

<b>Task Description:</b>	<p>Grinding involves the use of a manual (file) or powered (pneumatic or hydraulic hand grinders) tools to remove or shape material. The work piece is often metal or wood. Additionally, the work piece can be fixed (in a vise) or supported (mounted on a structure).</p> <p>Typical jobs in which grinding is performed include:</p> <ul style="list-style-type: none"><li>• aircraft maintenance</li><li>• sheet metal repair</li><li>• facility maintenance</li><li>• model shop</li></ul> <p>Grinding may be performed on flat or upright surfaces directly on aircraft, equipment, bench tops, or on a variety of surface shapes.</p>
<b>Job Performance Measures Most Often Impacted by Grinding:</b>	<ul style="list-style-type: none"><li>• Quality of finished surface (consistency, free of defects, no overgrind)</li><li>• Speed of completion of grinding task.</li></ul>
<b>Typical Employee Comments about Grinding:</b>	<p>Employees typically report discomfort and/or stiffness in the shoulders/neck and hands/wrists/arms.</p> <p>Primary: The primary body parts affected are the shoulder/neck and hand/wrists/arms</p> <p>Secondary: In some cases the back/torso and legs/feet are affected as well (although don't typically comment).</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	• Work location is too high	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 high	med med	med high
		32. Lower the work piece/work surface		✓	med	med	med
		112. Provide support for the arms <ul style="list-style-type: none"> <li>• rest arms on nearby surfaces</li> </ul>	✓		low	med	med
		38. Move closer to the work location <ul style="list-style-type: none"> <li>• remove obstructions</li> </ul>	✓	✓	med	med	med
		41. Move work piece closer to body	✓		low	med	med
	• Work location is too far away	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 work piece to be rotated</li> </ul>	✓	✓	low med	med 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

## Shoulder/Neck (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
		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 high	med med	high med
2. Arm forces: Repeated contraction of the muscles of the arm or holding/carrying materials	<ul style="list-style-type: none"><li>• Tool requires high forces to remove material</li><li>• Large quantity of material must be removed</li><li>• Tool is too heavy</li></ul>	92. Provide appropriate abrasive material <ul style="list-style-type: none"><li>• substitute higher grit media removal of large amounts of material</li><li>• Grind in stages with different grit to achieve appropriate finish</li></ul> 34. Maintain hand tools/power tools  66. Provide a power tool <ul style="list-style-type: none"><li>• obtain a heavier duty tool which reduces forces and time required to remove material</li></ul> 59. Provide a lighter weight tool <ul style="list-style-type: none"><li>• provide power tools of minimal weight (particularly for lighter grinding tasks)</li></ul>	✓ ✓ ✓		low low low med	med med med med	med med med med
3. High speed, sudden shoulder movements	<ul style="list-style-type: none"><li>• Manual grinding or filing requires high speed arm movements</li></ul>	66. Provide a power tool, whenever possible		✓	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
4. Head/neck bent or twisted	<ul style="list-style-type: none"> <li>Work location is too low (see Figure 1.1)</li> </ul>  <p><b>Figure 1.1</b></p>	<p>124. Raise the work piece/work surface</p> <ul style="list-style-type: none"> <li>provide a fixed table to raise the work piece</li> <li>tilt the work piece toward the worker</li> </ul> <p>79. Provide a work surface which is adjustable in height</p> <p>31. Lower the person</p> <ul style="list-style-type: none"> <li>provide a stool to sit on</li> </ul> <p>8. Distribute intensive activities throughout the process</p> <ul style="list-style-type: none"> <li>perform some activities as bench work rather than on the aircraft/structure</li> </ul> <p>82. Provide adequate workspace</p> <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>	✓        ✓        ✓        ✓        ✓        ✓        ✓        ✓        	✓        ✓        ✓        ✓        ✓        ✓        ✓        ✓        	med low high med med med med med med med high high	med med med med med med med med med med med high med	med med med med med med med med med med med high

## 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 high	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 high	med med	med med
	• Light levels are too low	32. Lower the work piece/work surface	✓	✓	med	med	med
		22. Increase light levels <ul style="list-style-type: none"><li>• (provide light levels at the task of 50-100 foot-candles (500-1000 lux)) for grinding tasks (precision grinding tasks require more light: 100 fc (1000 lux) or more)</li><li>• provide a task light which is easy to adjust</li><li>• increase room lighting</li></ul>		✓ ✓ ✓	med med high	med med high	med med high

## 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>• Tool handle orientation causes awkward postures</li> <li>• Work location is blocked or is in an inappropriate orientation</li> </ul>	<p>77. Provide a tool with an appropriate handle angle</p> <ul style="list-style-type: none"> <li>• provide multiple tool designs for complex parts</li> </ul> <p>136. Rotate work piece (bench work)</p> <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> <p>8. Distribute intensive activities throughout the process</p> <ul style="list-style-type: none"> <li>• perform some activities as bench work rather than on the aircraft/structure</li> </ul> <p>82. Provide adequate workspace</p> <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>		✓ ✓ ✓ ✓ ✓	med low med med med high	med med med med med	med low med med med high

## 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	• Rarely occurs	N/A					
7. Hyper-extension of finger/thumb or repeated single finger activation	• Use of power tool with single finger trigger concentrates stress on finger	62. Provide a multi-finger trigger • provide a tool with a multi-finger trigger		✓	med	med	med
8. Hand/grip forces	• Hand grinding may cause excessive fingertip forces	118. Provide support for the work piece • provide and mount small parts (that must be held against a grinding wheel) to a grinding block with an attached handle so that pressure is applied with a full hand grip rather than a finger press		✓	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>• Tool or work piece must be manually supported, held or steadied</li> <li>• Tool is too heavy</li> <li>• Handle diameter is too large</li> </ul>	<p>118. Provide support for the work piece</p> <ul style="list-style-type: none"> <li>• provide a clamp</li> </ul> <p>54. Provide a high friction gripping surface</p> <ul style="list-style-type: none"> <li>• wrap the tool handle</li> </ul> <p>59. Provide a lighter weight tool</p> <ul style="list-style-type: none"> <li>• provide a tool of minimal weight when appropriate</li> </ul> <p>88. Provide an appropriate handle diameter</p> <ul style="list-style-type: none"> <li>• provide tool with an appropriate handle diameter between 1"-1.5" (2.5-3.8 cm)</li> </ul>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	low	med	med
				<input checked="" type="checkbox"/>	low	med	med
				<input checked="" type="checkbox"/>	med	med	med
				<input checked="" type="checkbox"/>	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>• Vibration often causes person to apply more force to control the tool</li> </ul>	<p>74. Provide a tool that minimizes exposure to vibration/impact/torque</p> <ul style="list-style-type: none"> <li>• 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))</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>• Power tools produce hand/arm vibrations</li> </ul>	<p>74. Provide a tool that minimizes exposure to vibration/impact/torque</p> <ul style="list-style-type: none"> <li>• provide a power tool with internal vibration damping</li> <li>• 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))</li> </ul>		✓ ✓	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
10. Exposure to hard edges	<ul style="list-style-type: none"> <li>• Tool handle has hard edges</li> <li>• Work station has hard or sharp edges</li> </ul>	<p>9. Eliminate exposure to hard edges</p> <ul style="list-style-type: none"> <li>• provide a tool with a round, smooth handle with no ridges or edges</li> <li>• provide a handle of at least 5" in length</li> </ul> <p>9. Eliminate exposure to hard edges</p> <ul style="list-style-type: none"> <li>• provide padding for edges</li> <li>• round off exposed edges</li> </ul>		<span style="font-size: 2em;">✓</span> <span style="font-size: 2em;">✓</span>	med med	med med	med med
11. Hands and fingers exposed to cold temperatures	<ul style="list-style-type: none"> <li>• Cold exhaust from air powered tool blows on hand</li> </ul>	<p>7. Direct cold air away from the hands</p> <ul style="list-style-type: none"> <li>• provide tool which does not blow cold air on the hands</li> </ul> <p>93. Provide appropriate gloves</p> <ul style="list-style-type: none"> <li>• caution: gloves of an inappropriate material or size can cause person to increase hand forces to perform task</li> </ul>	<span style="font-size: 2em;">✓</span>	<span style="font-size: 2em;">✓</span>	med med low	med low	med low

### Hands/Wrists/Arms (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
	• Work area is too cold	23. Increase room temperature  105. Provide portable heaters  110. Provide shields or barriers from the wind	✓	✓ ✓	low med med	low low low	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 (see Figure 1.2)</li> </ul>  <p><b>Figure 1.2</b></p>	124. Raise the work piece/work surface <ul style="list-style-type: none"> <li>provide a fixed table to support work piece</li> </ul> 79. Provide a work surface which is adjustable in height 31. Lower the person <ul style="list-style-type: none"> <li>provide a stool for working on low areas</li> </ul>	✓	✓	med	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>	136. Rotate work piece (bench work) <ul style="list-style-type: none"> <li>turn the work piece manually</li> <li>provide a fixture to allow work piece to be rotated</li> </ul> 63. Provide a padded, compressible surface to lay on 117. Provide support for the upper body	✓	✓	low med	med med	med med
14. High speed, sudden movements	<ul style="list-style-type: none"> <li>Rarely occurs</li> </ul>	N/A					

## 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	• Work location is too low	124. Raise the work piece/work surface			med	med	med
		• provide a fixed table to support work piece		✓	high	med	high
	• Work location is too far away	83. Provide an adjustable height lift table		✓	low	med	med
		38. Move closer to the work location	✓		med	med	med
		132. Remove obstructions	✓	✓	low	med	med
		41. Move work piece closer to body	✓		med	med	med
		136. Rotate work piece (bench work)	✓		med	med	med
		• rotate the work piece manually			med	med	med
		• provide a fixture to allow work piece to be rotated		✓	med	med	med
		8. Distribute intensive activities throughout the process	✓	✓	med	med	med
		• perform some activities as bench work rather than on the aircraft/structure			med	med	med
		82. Provide adequate workspace		✓	high	med	high
		• add access panels to increase access			high	med	med
		• increase the size of access ports to increase access		✓	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</li> </ul>	<p>117. Provide support for the upper body</p> <ul style="list-style-type: none"> <li>provide a device to support the head and upper body while the person is working</li> </ul> <p>115. Provide support for the lower back</p> <ul style="list-style-type: none"> <li>pull chair forward and lean back while working</li> <li>attach a small pillow to back rest to support lower back</li> <li>provide chair with lower back support</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
16. Lifting forces	• Rarely occurs (If it occurs, see Lifting case study)	N/A					
17. Pushing or pulling	• Rarely occurs	N/A					
18. Whole body vibration	• Rarely occurs	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	Standing surface is hard	86. Provide appropriate anti-fatigue mat 96. Provide appropriate shoe inserts	✓ ✓		med med	low low	low low
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 has hard edges</li> </ul>	9. Eliminate exposure to hard edges <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> 9. Eliminate exposure to hard edges <ul style="list-style-type: none"> <li>• provide padding for edges</li> <li>• round off exposed edges</li> </ul>	✓ ✓ ✓	✓ ✓ ✓	low med low	low low low	low low low
21. Awkward leg postures	<ul style="list-style-type: none"> <li>• Rarely occurs</li> </ul>	N/A					
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>• Glare directly from a light source: looking towards an overhead light</li><li>• Glare from an overhead light reflected off equipment or worksurface.</li></ul>	<p>109. Provide protection from glare from overhead lights/task lights</p> <ul style="list-style-type: none"><li>• position work between overhead lights.</li><li>• remove glossy or shiny surfaces from work area</li><li>• place the work station so that it faces a wall or partition.</li><li>• install parabolic louvers to direct light down on the surface.</li></ul>	✓		low	med	med
	<ul style="list-style-type: none"><li>• Glare directly from a light source: looking towards an uncovered window</li><li>• Glare from an uncovered window reflected off equipment or worksurface.</li></ul>	<p>108. Provide protection from glare from natural light</p> <ul style="list-style-type: none"><li>• orient work station so that the person faces perpendicular to the window.</li><li>• adjust window coverings</li><li>• provide window coverings</li></ul>	✓	✓	low	med	med
	<ul style="list-style-type: none"><li>• Glare directly from a light source: looking towards a task light</li><li>• Glare from a task light reflected off equipment or worksurface.</li></ul>	<p>109. Provide protection from glare from overhead lights/task lights</p> <ul style="list-style-type: none"><li>• adjust the task light to reduce glare.</li><li>• turn off the task light.</li><li>• shield task light to prevent it from shining into eyes.</li></ul>	✓	✓	low low to med	med med	med med

## Head/Eyes (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>• Light levels too high.</li> <li>• Light levels too low:</li> <li>• Uncorrected visual disorders cause the person to lean forward to see work</li> <li>• Text too small to read.</li> <li>• Text is difficult to read (poor quality)</li> </ul>	<p>27. Lower the light levels</p> <ul style="list-style-type: none"> <li>• remove pairs of fluorescent light bulbs from overhead fixtures. Note: this should be done with the appropriate technical assistance and the agreement of co-workers in the area.</li> </ul> <p>22. Increase light levels</p> <ul style="list-style-type: none"> <li>• provide task light</li> <li>• increase overall light levels to meet the needs of tasks</li> </ul> <p>14. Encourage person to have visual disorders corrected</p> <p>18. Improve visual access to work</p> <ul style="list-style-type: none"> <li>• increase size of text</li> <li>• increase the legibility of text</li> </ul>		✓	low to med	med	med
24. Intensive visual tasks, staring at work objects for long periods	<ul style="list-style-type: none"> <li>• Length of work task without a change of position for the eyes.</li> </ul>	<p>8. Distribute intensive activities throughout the process</p> <ul style="list-style-type: none"> <li>• perform intensive visual tasks for short periods throughout the day (as opposed to in one continuous session).</li> </ul>	✓	✓	low	med	med

### Head/Eyes (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes	Cost	Impact On	
			✓ Minor Modification	✓ Major Change	Quality	Productivity
		20. Incorporate rest pauses <ul style="list-style-type: none"> <li>• periodically look away from screen.</li> </ul>	✓		low	med

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