# Tool Safeguarding and Controls

(Guidance originally developed by Yale University/Issued with permission)

<table>
<thead>
<tr>
<th>Tool Type</th>
<th>Size/Style</th>
<th>Power</th>
<th>Potential Hazards</th>
<th>Emergency Stopping and Power Controls</th>
<th>Shields and Guards</th>
<th>Other Protective Measures</th>
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</thead>
<tbody>
<tr>
<td>Arbor Press</td>
<td>Bench or Standing</td>
<td>Manual</td>
<td>• Caught between — crushing, limited by manual operation</td>
<td></td>
<td></td>
<td>• Warning label</td>
</tr>
<tr>
<td>Band Saw / Small</td>
<td>Bench</td>
<td>Electric</td>
<td>• Cutting blade — lacerations</td>
<td>• E-stop, accessible single action hand switch, or foot switch</td>
<td>• Blade</td>
<td>• Push sticks</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Rotating blade pulleys — pinch points, entanglement</td>
<td></td>
<td>• Covered pulleys</td>
<td>• Fence</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Flying objects — eye, face, skin injuries</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Band Saw / Large</td>
<td>Standing</td>
<td>Electric</td>
<td>• Cutting blade — lacerations, amputation</td>
<td>• E-stop, accessible single action hand switch, or foot switch</td>
<td>• Blade plus extension if needed</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Rotating blade pulleys — pinch points, entanglement</td>
<td></td>
<td>• Fully encased band saw wheels</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Flying objects — eye, face, skin injuries</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>• Smallest opening in work surface possible</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bead / Shot Blaster (w/ Glove box)</td>
<td>Bench</td>
<td>Electric</td>
<td>• Abrasive shot — skin irritation, abrasion</td>
<td>• E-stop, accessible single action hand switch, or foot switch</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Rotating / moving parts — blade in fan motor</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Flying objects — eye, face, skin injuries</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Door interlocks for large units</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brake, Metal Bending</td>
<td>Bench or Standing</td>
<td>Manual</td>
<td>• Caught between — finger crushing</td>
<td></td>
<td>• Rotating shaft and nut guards as feasible</td>
<td>• Clamps for small parts</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Rotating parts — entanglement</td>
<td></td>
<td></td>
<td>• Faceshield if excessive flying objects expected</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Flying objects — eye, face, skin injuries</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Parts pulled / thrown from hand — flying objects</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Faceshield if excessive flying objects expected</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cutting Block</td>
<td>Bench</td>
<td>Manual</td>
<td>• Cutting blades — lacerations, amputation</td>
<td>• E-stop, accessible single action hand switch, or foot switch</td>
<td>• Chip shield as feasible</td>
<td>• Bit vise / clamp</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Vertical oscillating shaft — minor punctures</td>
<td></td>
<td></td>
<td>• Faceshield if excessive flying objects expected</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Possible flying objects — eye, face, skin injuries</td>
<td></td>
<td></td>
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<tr>
<td>Die Filer</td>
<td>Bench or Standing</td>
<td>Electric</td>
<td>• Vertical oscillating shaft — minor punctures</td>
<td>• E-stop, accessible single action hand switch, or foot switch</td>
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<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Possible flying objects — eye, face, skin injuries</td>
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1 For all tools: Bench models affixed with bolts / clamps; standing / pedestal models bolted / secured to floor (except high mass units such as mills and lathes)
After-market E-stop placement at critical operator locations, installed in consultation with shop manager
Tool lights protected by covers or safety coated bulbs; low voltage (< 24 V) preferred
Safety glasses / goggles worn for all tools inside shop proper; no loose clothing, jewelry, or hair
All tool use limited to approved / qualified personnel only

2 Anti-restart: Required by OSHA for woodworking tools (Yale best practices - for all tools where accidental re-start would likely be unnoticed and pose risk of injury; also all new tools as available)
## Tool Safeguarding and Controls

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<tr>
<th>Tool Type</th>
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<th>Emergency Stopping and Power Controls ²</th>
<th>Shields and Guards</th>
<th>Other Protective Measures</th>
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</table>
| Drill Grinder/Sharpener | Bench or Standing | Electric | • Rotating shaft and wheel – pinch points, abrasions  
• Flying objects – eye, face, skin injuries  
• Heat / sparks – burns, fire | • E-stop, accessible single action hand switch, or foot switch | • Wheel  
• Chip shield as feasible | • Bit vise / clamp  
• Faceshield if excessive flying objects expected |
| Drill Press / Small | Bench | Electric | • Sharp cutting bit – minor lacerations, punctures  
• Rotating chuck and bit –entanglement  
• Flying objects – from parts working or centrifugal throw (chuck key, part) – eye, face, skin injuries  
• Torque exerted on work piece – impact injuries | • E-stop, accessible single action hand switch, or foot switch  
• Anti-restart for wood | • Covered pulley head  
• Portable chuck / chip  
• Rear shielding as needed | • Vise – secured  
• Spring-loaded chuck key  
• Work / tool rest |
| Drill Press / Large | Standing | Electric | • Sharp cutting bit – minor lacerations, punctures  
• Rotating chuck and bit –entanglement  
• Flying objects – from parts working or centrifugal throw (chuck key, part) – eye, face, skin injuries  
• Higher torque on work piece – impact injuries | • E-stop, accessible single action hand switch, or foot switch  
• Anti-restart for wood | • Covered pulley head  
• Affixed multi-plane chuck/chip  
• Rear shielding as needed | • Vise – secured  
• Spring-loaded chuck key  
• Hearing protection for high pitch metal cutting |
| Foam Cutter | Bench or Standing | Electric | • Hot wire – burns, fire  
• Smoke – inhalation exposure | • E-stop  
• Anti-restart  
• Key or code access | • Interlocked cover / access | • Local exhaust |
| Grinder (hard wheels) | Bench or Standing | Electric | • Rotating shaft and wheel – pinch points, abrasions  
• Flying objects – parts or wheel shatter - eye, face, skin injuries  
• Heat / sparks - burns, fire | • E-stop, accessible single action hand switch, or foot switch | • Wheel enclosure  
• Upper tongue  
• Chip shield  
• Rear shielding as needed | • Work / tool rest  
• Warning / label with gap tolerances  
• Depth / feeler gauge  
• Faceshield as needed |

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<td>Jig and Scroll Saws</td>
<td>Bench or Standing</td>
<td>Electric</td>
<td>• Sharp cutting blade - lacerations&lt;br&gt;• Flying objects – eye, face, skin injuries</td>
<td>• E-stop, accessible single action hand switch, or foot switch&lt;br&gt;• Anti-restart for wood</td>
<td>• Blade</td>
<td>• Faceshield if excessive flying objects expected</td>
</tr>
<tr>
<td>Jointer</td>
<td>Bench or Standing</td>
<td>Electric</td>
<td>• Sharp cutting heads – serious lacerations, amputation&lt;br&gt;• Rotating (horiz.) parts – entanglement&lt;br&gt;• Flying objects – eye, face, skin injuries</td>
<td>• E-stop, accessible single action hand switch, or foot switch&lt;br&gt;• Anti-restart for wood</td>
<td>• Cutter shield</td>
<td>• Push sticks and blocks</td>
</tr>
<tr>
<td>Laser Cutter</td>
<td>Bench or Standing</td>
<td>Electric</td>
<td>• Laser – ocular injury, burns&lt;br&gt;• Heat - burns, fire&lt;br&gt;• Moving laser head – physical injuries</td>
<td>• E-stop&lt;br&gt;• Anti-restart&lt;br&gt;• Key or cord access</td>
<td>• Interlocked cover / access</td>
<td>• Local exhaust</td>
</tr>
<tr>
<td>Lathe - Wood</td>
<td>Bench or Standing</td>
<td>Electric</td>
<td>• Rotating parts – serious entanglement&lt;br&gt;• Flying objects – from parts working or centrifugal throw (chuck key, part) – eye, face, skin injuries&lt;br&gt;• Sharp cutting tools - lacerations&lt;br&gt;• Pinch points – crushing, bruising</td>
<td>• E-stop, accessible single action hand switch, or foot switch&lt;br&gt;• Anti-restart</td>
<td>• Chuck&lt;br&gt;• Workpiece / point of operation</td>
<td>• Tool rest&lt;br&gt;• Facereshield if point of operation not possible</td>
</tr>
<tr>
<td>Lathe – Metal</td>
<td>Mini Bench</td>
<td>Electric</td>
<td>• Rotating parts – entanglement&lt;br&gt;• Flying objects – eye, face, skin injuries&lt;br&gt;• Sharp cutting tools - lacerations&lt;br&gt;• Pinch points – minor crushing, bruising</td>
<td>• E-stop, accessible single action hand switch, or foot switch</td>
<td>• Portable shield</td>
<td></td>
</tr>
<tr>
<td>Lathe – Metal</td>
<td>Bench or Standing</td>
<td>Electric</td>
<td>• Rotating parts – serious entanglement&lt;br&gt;• Flying objects – from parts working or centrifugal throw (chuck key, part) – eye, face, skin injuries&lt;br&gt;• Sharp cutting tools - lacerations&lt;br&gt;• Pinch points – crushing, bruising</td>
<td>• E-stop, accessible single action hand switch, or foot switch&lt;br&gt;• Emergency foot brake / power stop (geared by factory new equipment&lt;br&gt;• Fixed or portable chuck shield&lt;br&gt;• Cross-slide shield&lt;br&gt;• Lead screw if exposed</td>
<td>• Spring-loaded chuck wrenches&lt;br&gt;• Protect collet release handle if exposed</td>
<td></td>
</tr>
</tbody>
</table>

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1 For all tools: Bench models affixed with bolts / clamps; standing / pedestal models bolted / secured to floor (except high mass units such as mills and lathes) After-market E-stop placement at critical operator locations, installed in consultation with shop manager Tool lights protected by covers or safety coated bulbs; low voltage (< 24 V) preferred Safety glasses / goggles worn for all tools inside shop proper; no loose clothing, jewelry, or hair All tool use limited to approved / qualified personnel only

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<tbody>
<tr>
<td>Lathe – Metal (cont’d)</td>
<td></td>
<td></td>
<td>• Heat – burns</td>
<td>– required for student shops)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Anti-restart</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metal Cutting Saw – Horizontal</td>
<td>Standing</td>
<td>Electric</td>
<td>• Sharp cutting blade – lacerations, amputation, Rotating blade pulley – entanglement, pinch point, Flying objects – eye, face, skin injuries, Heat / sparks – burns, fire</td>
<td>• E-stop, accessible single action hand switch, or foot switch</td>
<td>• Blade guard, upper and lower</td>
<td>• Work piece vise / clamp</td>
</tr>
<tr>
<td>Milling Machine</td>
<td>Standing</td>
<td>Electric</td>
<td>• Sharp cutting bit – minor lacerations, punctures, Rotating chuck and bit – entanglement, Flying objects – from parts working or centrifugal throw (chuck key, part) – eye, face, skin injuries, Higher torque exerted on work piece – impact injuries</td>
<td>• E-stop, accessible single action hand switch, or foot switch</td>
<td>• Affixed multi-plane chuck/chip, Drive belt covers, Rear / side shielding as needed</td>
<td>• Spring-loaded chuck wrenches (if used), Vise – secured, Retractable handles on powered tables</td>
</tr>
<tr>
<td>Planer</td>
<td>Bench or Standing</td>
<td>Electric</td>
<td>• Sharp cutting heads – serious lacerations, amputations, Rotating (horiz.) parts – entanglement, Flying objects – eye, face, skin injuries</td>
<td>• E-stop, Anti-restart for wood</td>
<td>• Adjustable entry / feed, Cutting head</td>
<td>• Push sticks, Outfeed support, Hearing protection for high noise planing</td>
</tr>
<tr>
<td>Press</td>
<td>Bench or Standing</td>
<td>Manual</td>
<td>• Caught between – crushing, Flying objects – eye, face, skin injuries</td>
<td>• Portable shield or cage for potential shattering object</td>
<td>• Warning label</td>
<td></td>
</tr>
</tbody>
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# Yale Practices for Tool Safeguarding and Controls

26 June 2015

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</table>
| Printer, 3-D       | Bench or Standing| Electric   | • Moving head — physical injuries  
                   • Ink aerosol — inhalation exposure                                          | • E-stop  
                   • Anti-restart  
                   • Key or code access                                                      | • Interlocked cover / access                                                      |                  |
| Printing Press     | Bench or Standing| Electric   | • Rotating parts, pulleys, wheels - entanglement  
                   • Caught between - crushing  
                   • Possible flying objects – eye, face, skin injuries  
                   • Pinch points – crushing, bruising  
                   • Ink and cleaning solvents - chemicals                                       | • E-stop, accessible single action hand switch, or foot switch  
                   • Anti-restart                                                             | • Pulley(s)  
                   • Feeds  
                   • Rollers                                                                 | • Gloves (nitrile exam) for incidental chemical handling and cleaning  
                   • Chemical substitution                                                      |                  |
| Punch              | Bench or Standing| Manual     | • Caught between – crushing, bruising  
                   • Possible flying objects – eye, face, skin injuries                          |                                      |                    |                                                              |
| Radial Arm Saw     | Bench            | Electric   | • Sharp cutting blade – serious lacerations and amputations  
                   • Flying objects – eye, face, skin injuries  
                   • Rotating shaft / blade –entanglement                                            | • Finger /constant pressure switch, E-stop, accessible single action hand switch, or foot switch  
                   • Anti-restart                                                              | • Top enclosed blade cover  
                   • Blade (self-adjusting)                                                     | • Auto-retraction  
                   • Fence (kerfed to avoid restricting blade guard)  
                   • Clamps  
                   • Faceshield if excessive flying objects expected                            |                  |
| Robotics Devices   | Bench or Standing| Electric   | • Various moving parts – physical injuries  
                   • Possible flying objects – eye, face, skin injuries                          | • E-stop  
                   • Anti-restart  
                   • Key or code access                                                      | • Enclosure as feasible  
                   • Interlocked cover / access as feasible                                      | • Marked exclusion zone                                                        |
| (tabletop, instructional) |            |            |                                                                      |                                      |                    |                                                              |
| Roller, Sheetmetal | Bench or Standing| Manual     | • Caught between / pinch points – crushing, limited by manual operation           |                                      |                    | • Warning label                                               |

---

1 For all tools:  
- Bench models affixed with bolts / clamps; standing / pedestal models bolted / secured to floor (except high mass units such as mills and lathes)  
- After-market E-stop placement at critical operator locations, installed in consultation with shop manager  
- Tool lights protected by covers or safety coated bulbs; low voltage (< 24 V) preferred  
- Safety glasses / goggles worn for all tools inside shop proper; no loose clothing, jewelry, or hair  
- All tool use limited to approved / qualified personnel only

2 Anti-restart:  
- Required by OSHA for woodworking tools (Yale best practices - for all tools where accidental re-start would likely be unnoticed and pose risk of injury; also all new tools as available)
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<tr>
<td>Roller, Sheetmetal</td>
<td>Bench or Standing</td>
<td>Electric</td>
<td>• Caught between / pinch points – serious crushing, amputation</td>
<td>• E-stop (manual, foot, bump, wire, light curtain)</td>
<td>• Sliding adjustable roller shield</td>
<td>• Warning label</td>
</tr>
<tr>
<td>Sander, Belt (vertical or horizontal)</td>
<td>Bench or Standing</td>
<td>Electric</td>
<td>• Flying objects – eye, face, skin injuries • Rotating pulleys, belts - entanglement • Pinch points – crushing, bruising</td>
<td>• E-stop, accessible single action hand switch, or foot switch</td>
<td>• Pulleys • Rollers (both sides) • Area below tool rest</td>
<td>• Tool rest</td>
</tr>
<tr>
<td>Sander, Disc</td>
<td>Bench or Standing</td>
<td>Electric</td>
<td>• Flying objects – eye, face, skin injuries • Rotating pulleys, belts - entanglement • Pinch points – crushing, bruising</td>
<td>• E-stop, accessible single action hand switch, or foot switch</td>
<td>• Pulleys • Side</td>
<td>• Tool rest</td>
</tr>
<tr>
<td>Saw, Cut-Off (abrasive disc and metal cutting)</td>
<td>Bench</td>
<td>Electric</td>
<td>• Sharp cutting blade – lacerations, amputations • Rotating blade –entanglement • Flying objects – eye, face, skin injuries • Heat / sparks – burns, fire</td>
<td>• Finger / constant pressure switch</td>
<td>• Blade (self-adjusting)</td>
<td>• Auto-return to upright • Fence • Vise – bolted / clamped • Clamps</td>
</tr>
<tr>
<td>Saw, Miter / Compound Miter Chop-Style Saw</td>
<td>Bench</td>
<td>Electric</td>
<td>• Sharp cutting blade – lacerations, amputations • Rotating blade –entanglement • Flying objects – eye, face, skin injuries • Heat / sparks – burns, fire</td>
<td>• Finger / constant pressure switch</td>
<td>• Blade (self-adjusting)</td>
<td>• Auto-return to upright • Fence • Clamps • Laser sighted cut</td>
</tr>
<tr>
<td>Saw, Upright Panel Style</td>
<td>Standing</td>
<td>Electric</td>
<td>• Sharp cutting blade – lacerations, amputations • Rotating blade –entanglement • Flying objects – eye, face, skin injuries • Heat / sparks – burns, fire</td>
<td>• Finger / constant pressure switch</td>
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<td>• Auto-return • Fence • Clamps</td>
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| Saw, Wet Abrasive          | Bench or Standing   | Electric| • Sharp cutting blade – lacerations, amputations  
• Rotating blade – entanglement  
• Flying objects – eye, face, skin injuries  
• Heat / sparks – burns, fire  
• Water / electrical – shock | • E-stop, accessible single action hand switch, or foot switch | • Blade                         | • GFIC outlet / plug adapter  
• Fence  
• Clamps  
• Faceshield as needed |
| Shaper / Inverted Router   | Bench or Standing   | Electric| • Sharp cutting tool – lacerations, amputation  
• Rotating tool – entanglement  
• Flying objects – eye, face, skin injuries  
• Fence  
• Flying objects – parts or wheel shatter - eye, face, skin injuries  
• Heat / sparks - burns, fire | • E-stop, accessible single action hand switch, or foot switch  
| Shear / Cutter             | Bench or Standing   | Manual  | • Sharp cutting blade – serious lacerations, amputations  
• Caught between - crushing | | • Blade                       | • Warning label |
| Shear / Cutter             | Bench or Standing   | Electric| • Sharp cutting blade – serious lacerations, amputations  
• Caught between - crushing | • E-stop or foot switch  
| Surface Grinder            | Bench or Standing   | Electric| • Rotating shaft and wheel – pinch points, abrasions, entanglement  
• Flying objects – parts or wheel shatter - eye, face, skin injuries  
• Heat / sparks - burns, fire | • E-stop, accessible single action hand switch, or foot switch  
| Table Saw                  | Standing            | Electric| • Sharp cutting blade – serious lacerations or amputation  
• Rotating blade – entanglement  
• Flying objects – eye, face, skin injuries | • E-stop, accessible single action hand switch, or foot switch  
|                           |                     |         | • Blade (self-adjusting) | • Blade and hold down guard  
• Rear access prevention  
• Anti-restart down guard interim  
|                           |                     |         | • Faceshield if excessive flying objects expected | | |

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<th>Potential Hazards</th>
<th>Emergency Stopping and Power Controls²</th>
<th>Shields and Guards</th>
<th>Other Protective Measures</th>
</tr>
</thead>
</table>
| Water Jet Cutter  | Bench or Standing | Electric | • High pressure water – lacerations  
• Moving spray head(s) – physical injuries | • E-stop  
• Anti-restart  
• Key or code access | • Interlocked cover / access | • GFCI outlet / plug adapter |
|                   | Standing     |       | *Standing*  
• Moving spray head(s) – physical injuries | *Anti-restart cover / access* | *E-stop, accessible single action hand switch, or foot switch* | *Wheel enclosure as feasible* |
| Wire Wheel        | Bench or Standing | Electric | • Rotating shafts and wheels – abrasions, lacerations, entanglement  
• Flying objects – eye, face, skin injuries  
• Pinch points – crushing, bruising  
• Heat / sparks - burns, fire | *E-stop, accessible single action hand switch, or foot switch* | *Wheel enclosure as feasible* | *Tool rest if needed*  
*Clamps for holding small parts*  
*Faceshield if excessive flying objects expected* |

1 For all tools:  
Bench models affixed with bolts / clamps; standing / pedestal models bolted / secured to floor (except high mass units such as mills and lathes)  
After-market E-stop placement at critical operator locations, installed in consultation with shop manager  
Tool lights protected by covers or safety coated bulbs; low voltage (< 24 V) preferred  
Safety glasses / goggles worn for all tools inside shop proper; no loose clothing, jewelry, or hair  
All tool use limited to approved / qualified personnel only

2 Anti-restart: Required by OSHA for woodworking tools (Yale best practices - for all tools where accidental re-start would likely be unnoticed and pose risk of injury; also all new tools as available)