

**Woodworking
Tools**

Radial Arm Saws



Teacher's Guide

SHOPWARE

Introduction

This Teacher's Guide provides information to help you get the most out of *Radial Arm Saws*, part of the *Woodworking Tools* series. The contents in this guide will allow you to prepare your students before they use the program, assist them as they navigate through the contents, and present follow-up activities to reinforce the material's key learning points.

Woodworking Tools is a 16-part series of programs that address the safe operation of the most popular and useful types of woodworking tools. Each program delves into a different tool, including its purpose and associated parts. It teaches students how to choose the proper blade or bit for the task and perform the various woodworking operations that can be accomplished with a particular tool. The 16 videos in this series enable and encourage students to safely and creatively use power tools to their maximum proficiency.

Radial Arm Saws is an 18-minute video targeted to teenagers and young adults. Its content is appropriate to such curriculum areas as Technology Education, Trade, and Industrial Education. In addition, the information presented in this series could also be presented in vocational/technical schools or adult education courses that focus on shop, carpentry, woodworking, or construction education and research.

Learning Objectives

After watching each video program in the series, students will be able to:

- Identify which tools are best for which job in the wood shop.
- Understand how to safely operate a variety of woodworking tools.
- Demonstrate how to safely clean, maintain, and sharpen a variety of woodworking tools.
- Explain how to change and adjust bits, blades, and other elements of a variety of woodworking tools.

Educational Standards

The *Radial Arm Saws* video program correlates with the following standards:

- The competency standards for Core Curriculum and Carpentry from the National Center for Construction Education & Research;
 - The State Standards of Essential Knowledge and Skills for Trade and Industrial Education (Construction-Maintenance Systems, High School) for the State of Texas;
 - The Technology Education Standards (Tools, Resources, and Technological Processes) for the State of New York.
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- 2.0 Career Cluster: Architecture and Construction Careers in designing, planning, managing, building and maintaining the built environment. (*Competency Standards for Core Curriculum and Carpentry from the National Center for Construction Education & Research.*)
 - The student knows the function and application of the tools, equipment, technologies, and materials used in construction carpentry. The student is expected to safely use hand and

power tools and equipment commonly employed in carpentry. The student demonstrates knowledge of new and emerging technologies that may affect construction carpentry. (*Texas State Standards on Building Carpentry: Essential Knowledge and Skills for Trade and Industrial Education—Construction-Maintenance Systems, High School*)

- The student knows the function and application of the tools, equipment, technologies, and materials used in mill and cabinetmaking. The student is expected to safely use hand and power tools and equipment commonly employed in mill and cabinetmaking; properly handle and dispose of humanly and/or environmentally hazardous materials used in mill and cabinetmaking; utilize the proper procedures in sawing, planing, shaping, turning, boring, mortising, and sanding various types of woods; demonstrate knowledge of numerically-controlled and computer-controlled production devices; and demonstrate knowledge of new and emerging technologies that may affect mill and cabinetmaking. (*Texas State Standards on Mill and Cabinetmaking: Essential Knowledge and Skills for Trade and Industrial Education—Construction-Maintenance Systems, High School*)
- The student applies technological knowledge and skills to design, construct, use, and evaluate products and systems to satisfy human and environmental needs. The student uses a variety of materials and energy sources to construct things; understands the importance of safety and ease of use in selecting tools and resources for a specific purpose; and develops basic skills in the use of hand tools. (*New York State Standards on Technology Education—Tools, Resources, and Technological Processes*)

Program Summary

Regardless of whether a student wants to gain an overall understanding of the myriad of wood-working tools available in today's wood shops, or just focus on one specific tool's features and capabilities, the *Woodworking Tools* series will be an invaluable visual learning aid. By emphasizing safety issues, the series allows students to understand not only which tools are best for each kind of job in the wood shop, but also how to operate, clean, maintain, and sharpen the wood-working tools for maximum efficiency and safety.

The *Woodworking Tools* video program series consists of sixteen titles:

- Table Saws
- Cutoff Saws
- Radial Arm Saws
- Band Saws and Scroll Saws
- Routers
- Jointers
- Planers
- Lathes
- Power Nailers
- Drill Presses
- Drills and Drivers
- Stationary Sanders

- Circular Saws
- Jigsaws and Reciprocating Saws
- Rotary Tools, Bench Grinders, and Sharpeners
- Building a Workcenter

Radial Arm Saws presents a comprehensive review of the design and operation, safety features and safe operating techniques, and adjustments to alignment settings for radial arm saws.

Main Topics

Topic 1: Introduction

The program's host, Pete Bilotta, introduces the versatile, multi-tasking, woodworking machine—the radial arm saw.

Topic 2: Design and Operation

The student learns about the overall design of a radial arm saw, including its various components, functions, and positions.

Topic 3: Safety Features

Pete reviews the safety features associated with radial arm saws, including the power switch with lockout, the blade guard, the riving knife and anti-kickback pawls, and the unique safety feature of the control cut system.

Topic 4: Safe Operating Techniques

When making crosscuts, miter cuts, or rip cuts of various widths, using the radial arm saw safely and feeding the material into it correctly are essential. In this section, the host details the proper techniques for the radial arm saw's safe operation.

Topic 5: Adjustments

The host familiarizes the student with how to adjust four alignment settings, namely, arm-to-table, blade-to-fence, blade angle (zero-degree), and blade-to-table (a.k.a. parallelism).

Topic 6: Key Points

The program concludes with a high-level overview of the key points that have been discussed.

Fast Facts

- Occupational Safety and Health Administration (OSHA) standards exist to ensure worker safety in this area. To comply with these standards, radial arm saws must have a hood that completely covers the upper portion of the blade; the lower portion must be guarded to the full diameter of the blade by a device that automatically adjusts to stock thickness; radial arm saws used for ripping must have a non-kickback device; adjustable stops must be provided to prevent the saw from traveling beyond the distance needed to perform the cut; and radial arm saws must have the front slightly higher than the back, so the cutting head will return gently to the starting position when released.

- Beside all types of crosscuts, a radial arm saw can also be used for ripping, as well as sanding, routing, and drilling, when fitted with the appropriate attachments.
- A radial arm saw is essentially a circular saw suspended from an overhead trolley.
- Unlike a compound miter saw, where the blade travels through an open cutting path formed by the split fence and kerf plate, the blade on a radial arm saw actually cuts through the fence and into the table. Consequently, the fence and table are sacrificial components, typically made of particleboard or high-density fiberboard.
- In order to preserve the life of the worktable, attach a sheet of quarter-inch hardboard to the surface. Instead of using fasteners, spot-glue the piece in position to eliminate the possibility of a nail or screw getting in the way of the blade.
- Crosscutting on a radial arm saw is relatively safe. This is because the rotation of the blade helps keep the work down on the table and up against the fence as the saw is pulled towards you. When it comes to rip cutting however, a radial arm saw can be extremely hazardous unless the appropriate safety guidelines are followed.
- When making wide rip cuts, rotate the saw in the opposite direction so that the blade faces away from the column. This is called the outtrip position. For maximum stability, always choose the position that allows the widest part of the workpiece to be between the blade and fence.
- To minimize the risk of injury should kickback occur, one should never stand directly in line with the cut.
- Before performing any maintenance or adjustment procedures, be sure the saw is unplugged.
- Use a 60-tooth blade to produce a finer finish on crosscuts, and a 24-tooth blade to rip cut heavy stock more efficiently.

Vocabulary Terms

bevel: Two surfaces meeting at an angle other than 90°.

blade guard: A spring-loaded guard that completely covers the blade when it is in the up position but rotates out of the way when the handle is lowered.

carriage: The radial arm saw is mounted on a fixture called a yoke which is attached to a rotating carriage assembly. The carriage is fitted with rollers that slide along two rails mounted on the arm. This arrangement enables the saw to move back and forth, as well as rotate 360° at any point.

climbing: A condition in which a workpiece loses contact with the table.

combination square: A tool used for measuring angles, determining flatness, approximating level surfaces, and measuring the center of a circular bar or dowel. It is composed of a rule and a head.

control cut system: One of the unique safety features offered on the radial arm saw, the mechanism is designed to increase operator control by providing a counterforce as the carriage is pulled forward.

crossover blade: A blade that can be used for multiple kinds of cuts.

fence: A piece of lath or scrap fixed to the bench surface to prevent movement of the work.

framing square: The framing square has a body (the wider blade) and a tongue (the narrower one), set conveniently at 90° to one another. It can be used to accurately lay out any angle from 0° to 90°.

induction motor: Designed for heavy-duty use, induction motors are relatively quiet due to their brushless design.

inrip position: A position in which the saw is rotated so that the blade faces the column.

kerf: A groove or notch made by a cutting tool.

kickback: Kickback occurs when the wood contacts the back half of the blade. Under this condition, the material can be thrown backwards towards the operator with considerable force. For example, when cutting moisture-laden material, the saw kerf may actually close up after being cut, pinching the back of the blade in the process. As a result, the spinning blade will propel the material back at the operator, resulting in a potentially serious injury.

miter joint: A joint made by beveling each of two surfaces to be joined, usually at a 45° angle, to form a corner, usually a 90° angle.

miter scale: A fractional scale on top of the radial saw arm that indicates the miter settings.

outfeed support stand: A stand, such as a hinged extension leaf resting on a fold-down leg support that reaches the floor, which supports the waste of the workpiece while making the cut.

outrip position: A position in which the saw is rotated in the opposite direction so that the blade faces away from the column.

push stick: An essential safety tool that allows the operator to keep fingers away from a table-saw or router's blades, especially when ripping narrow stock.

rail: A metal bar that makes a track along which the woodworking tool can roll.

radial arm saw (RAS): A machine intended for cutting materials to length. Table saws are ideal for ripping stock, but it is awkward to push a long piece of stock widthwise through a table saw blade. When a radial arm saw is used, the stock remains stationary on the saw's table and the blade is pulled through the stock.

rip cut: To split or saw (wood) along the grain.

ripping knife: The ripping knife is a very important safety feature that substantially reduces the chance of kickback. It functions similar to a spreader on a blade guard assembly but does not extend above the top of the blade. Therefore, the ripping knife can be used when making non-through cuts and other cuts where the blade guard cannot be used.

safety glasses: Safety glasses are usually made with shatter-resistant plastic lenses to protect the eye from flying debris. Although safety lenses may be constructed from a variety of materials that vary in impact resistance, standards suggest that they maintain a minimum 1 mm thickness at the thinnest point, regardless of material.

speed square: An abbreviated or simplified steel square that is a 12- or 7-inch isosceles triangle in shape, made of steel aluminum or plastic. At the intersection of the two sides of the triangle there is a squared pivot point, which is placed on the edge of the board.

universal motor: A motor that can run on either AC or DC voltage, which saves space and reduces bulk for portability.

woodworking: The forming or shaping of wood to create, restore, or repair useful or decorative objects. Carpentry, joinery, and cabinetmaking are specialized woodworking crafts, providing a range of products from wooden structures and furniture to wooden toys.

yoke: A clamp or vise that holds a machine part in place or controls its movement or that holds two such parts together. A radial arm saw is mounted on the yoke, which is attached to a rotating carriage assembly.

Pre-Program Discussion Questions

1. Do you know for what tasks a radial arm saw can be used?
2. Can you identify the three main pieces of the radial arm saw work surface?
3. Have you heard of a control cut system? What is it and why is it important?

Post-Program Discussion Questions

1. Identify each of the major components of the radial arm saw; explain the purpose of each.
2. What kind of motor powers the saw blade, and what is the usual horsepower rating?
3. How can the chance of kickback be reduced when using a radial arm saw?
4. When inripping, how should the material be fed? How should it be fed when outripping?
5. Name four alignment settings common to all radial arm saws.

Individual Student Projects

- Have each student take a turn getting the feel of the radial arm saws by practicing various crosscuts, rip cuts, and miter cuts.

Group Activities

- Ask your students to explain what kickback is, how it can occur, and how it should be prevented. Then, demonstrate the proper techniques to employ when using a wet piece of wood as your cutting material on a radial arm saw.
- Break your class into small groups and assign them one of the following maintenance or replacement activities:
 - Check the arm-to-table alignment
 - Check the blade-to-fence alignment
 - Check the blade angle (0°)
 - Check the blade-to-table alignment (parallelism)

Have each group create a poster of the step-by-step procedure, practice the steps and safety considerations, then present the procedure, start-to-finish, to the rest of the class.

- Break your class in half and assign each half to either crosscutting or ripping. Have each group present the safe operation of the radial arm saw for its task, pointing out safety measures. The crosscutting group should perform multiple crosscuts and wide crosscuts; the ripping group should perform normal, narrow, and wide rip cuts.

Internet Activities

- Have your students research possible projects on the Web sites listed later in this guide, locating steps in the project that call for the use of radial arm saws. This will provide practical applications for the procedures that are shown in the video.

Assessment Questions

- Q1: Besides performing all types of crosscuts, a radial arm saw can also be used for which of the following?
- a) Ripping
 - b) Sanding
 - c) Routing
 - d) Drilling
 - e) All of these, when fitted with the appropriate attachments
- Q2: Since a radial arm saw is used for crosscutting and rip cutting, most saws come with a ____-tooth combination blade, which is suitable for both operations. However, use a ____-tooth blade to rip cut heavy stock more efficiently and a ____-tooth blade to produce a finer finish on crosscuts. (Choose from 24, 40, or 60.)
- Q3: True or False: The blade travels through an open cutting path formed by the split fence and kerf plate in the radial arm saw.
- Q4: For maximum rip capacity, the fence should be inserted where in relation to the spacer table and rear table?
- a) behind the spacer table
 - b) behind the rear table
 - c) behind the front table
 - d) between the spacer table and rear table
- Q5: To make a kerf, turn the saw and lower the arm gradually until the blade cuts into the table about how much?
- a) $\frac{1}{16}$ "
 - b) $\frac{1}{8}$ "
 - c) $\frac{1}{4}$ "
 - d) 1"
- Q6: Place the following steps in the proper order for checking blade-to-fence alignment:
- a. Place the short leg of the framing square against the fence, and rotate the square upward until it is angled 45° relative to the table. Be sure the square is positioned between two teeth.
 - b. Rotate the yoke assembly until the gap is closed, and then secure the yoke lock handle.
 - c. If a gap is visible between the blade and square, remove the right-hand carriage cover to access the adjustment bolts.
 - d. Tighten the two adjustment bolts and replace the carriage cover.
 - e. With the arm locked in the 0° position, pull the saw all the way forward and secure the carriage lock knob.
 - f. Release the yoke lock handle and slightly loosen the adjustment bolts.
- Q7: The saw is mounted on a fixture called a _____, which is attached to a rotating carriage assembly. The _____ is fitted with rollers that slide along two rails mounted on the arm. To adjust cutting depth, the column can be raised or lowered by turning a _____ at the front of the machine. (Choose carriage, handwheel, or yoke.)
- Q8: True or False: For narrow rip cuts, the saw should be rotated so that the blade faces the column (the inrip position).
- Q9: Where should you stand when making making a cut?
- Q10: What is it called when a workpiece loses contact with the table?

Assessment Questions Answer Key

Q1: Besides performing all types of crosscuts, a radial arm saw can also be used for which of the following?

- a) Ripping
- b) Sanding
- c) Routing
- d) Drilling
- e) All of these, when fitted with the appropriate attachments

A1: The correct answer is (e). When fitted with the appropriate attachments, a radial arm saw is versatile enough to perform all of these tasks.

Q2: Since a radial arm saw is used for crosscutting and rip cutting, most saws come with a ____-tooth combination blade, which is suitable for both operations. However, use a ____-tooth blade to rip cut heavy stock more efficiently and a ____-tooth blade to produce a finer finish on crosscuts. (Choose from 24, 40, or 60.)

A2: Since a radial arm saw is used for crosscutting and rip cutting, most saws come with a **40**-tooth combination blade, which is suitable for both operations. However, use a **24**-tooth blade to rip cut heavy stock more efficiently and a **60**-tooth blade to produce a finer finish on crosscuts.

Q3: True or False: The blade travels through an open cutting path formed by the split fence and kerf plate in the radial arm saw.

A3: False. Unlike a compound miter saw, where the blade travels through an open cutting path formed by the split fence and kerf plate, the blade on a radial arm saw actually cuts through the fence and into the table. Consequently, the fence and table are sacrificial components, typically made of particleboard or high-density fiberboard.

Q4: For maximum rip capacity, the fence should be inserted where in relation to the spacer table and rear table?

- a) behind the spacer table
- b) behind the rear table
- c) behind the front table
- d) between the spacer table and rear table

A4: The correct answer is (d).

Q5: To make a kerf, turn the saw and lower the arm gradually until the blade cuts into the table about how much?

- a) $\frac{1}{16}$ "
- b) $\frac{1}{8}$ "
- c) $\frac{1}{4}$ "
- d) 1"

A5: The correct answer is (b).

Q6: Place the following steps in the proper order for checking blade-to-fence alignment:

- a. Place the short leg of the framing square against the fence, and rotate the square upward until it is angled 45° relative to the table. Be sure the square is positioned between two teeth.
- b. Rotate the yoke assembly until the gap is closed, and then secure the yoke lock handle.
- c. If a gap is visible between the blade and square, remove the right-hand carriage cover to access the adjustment bolts.
- d. Tighten the two adjustment bolts and replace the carriage cover.
- e. With the arm locked in the 0° position, pull the saw all the way forward and secure the carriage lock knob.
- f. Release the yoke lock handle and slightly loosen the adjustment bolts.

A6: These are the correct procedural steps:

1. e. With the arm locked in the 0° position, pull the saw all the way forward and secure the carriage lock knob.
2. a. Place the short leg of the framing square against the fence, and rotate the square upward until it is angled 45° relative to the table. Be sure the square is positioned between two teeth.
3. c. If a gap is visible between the blade and square, remove the right-hand carriage cover to access the adjustment bolts.
4. f. Release the yoke lock handle and slightly loosen the adjustment bolts.
5. b. Rotate the yoke assembly until the gap is closed, and then secure the yoke lock handle.
6. d. Tighten the two adjustment bolts and replace the carriage cover.

Q7: The saw is mounted on a fixture called a _____, which is attached to a rotating carriage assembly. The _____ is fitted with rollers that slide along two rails mounted on the arm. To adjust cutting depth, the column can be raised or lowered by turning a _____ at the front of the machine. (Choose carriage, handwheel, or yoke.)

A7: The saw is mounted on a fixture called a **yoke**, which is attached to a rotating carriage assembly. The **carriage** is fitted with rollers that slide along two rails mounted on the arm. To adjust cutting depth, the column can be raised or lowered by turning a **handwheel** at the front of the machine.

Q8: True or False: For narrow rip cuts, the saw should be rotated so that the blade faces the column (the inrip position).

A8: True. The blade should only face AWAY from the column when making wide rip cuts (the outrip position).

Q9: Where should you stand when making making a cut?

A9: You should always stand to the side. You should never stand directly in line with the cut, to minimize the risk of injury should kickback occur.

Q10: What is it called when a workpiece loses contact with the table?

A10: The condition is called *climbing*.

Additional Resources

About.com: Woodworking

<http://woodworking.about.com>

Encarta Encyclopedia: Woodworking

http://encarta.msn.com/encyclopedia_761570306/Woodworking.html

WoodNet.net: The Woodworker's Online Resource

<http://www.woodnet.net/tips/index>

Woodworker's Information and Plans for Woodworkers: WOOD Magazine

<http://www.woodmagazine.com>

Woodworking Shop Safety Tips

http://www.wood-worker.com/articles/shop_safety.htm

Woodzone.com

<http://www.woodzone.com/tips.htm>

Available from Films Media Group • www.filmsmediagroup.com • 1-800-257-5126

Multimedia Woodshop Safety

- Windows/Macintosh CD-ROM #20466

Multimedia Woodshop Safety uses video and animation sequences, along with still photos, to provide an overview of shop practices including stationary woodworking equipment, portable power and hand tools, as well as material storage and handling. In addition to the usual shop safety practices, the user is also reminded of the hazards of horseplay, loose clothing, and lack of concentration on the job. As the viewer moves into the arenas of stationary woodworking equipment and power tools, he is guided through an inspection for evidence of loose fittings, bad wiring and/or grounding, and poor tool use of lathe, drill press, and band and bench saws. The program segment dealing with materials storage offers ideas which facilitate safety and accessibility. Issues of wood stacking, container labeling, chemical mixing, hazardous materials handling, and lighting are addressed. Part of the Series *Shop Safety*. A Shopware Production. ©1996.

Portable Power Woodworking Tools

- VHS/DVD-R #26093
- 9-part series

This series features the most popular and useful types of woodworking tools. Students learn the safe operation of each tool, the different models and their purpose, the parts, choosing the proper blade or bit for the task, and the various woodworking operations that can be accomplished with each tool. A Meridian Production. The series includes: Biscuit Joiner | Circular Saws | Drills | Jigsaws | Power Plane | Reciprocating Saw | Router Bit Magic | Routers | Sanders. (14-20 minutes each)

Safety First: Woodworking Safety

- VHS/DVD-R #14464
- Closed captioned

Covers the most common hand tools and their proper applications. The importance of a clean working environment, preventive maintenance on machinery, and using the correct tool for each job is covered in detail. Also covered are how to check power cords for defects, sharpening and replacing saw blades, and correct body position when using equipment. Part of the series *Safety First: Shop Safety*. A Cambridge Educational Production. (30 minutes) ©1995.

Woodworking

- VHS/DVD-R #26839

- 19-part series

This comprehensive library of low-cost woodworking videos provides all of the information your students need in the world of woodworking, from types of wood, to cutting techniques, to workshop safety. Each video covers a specific topic clearly and comprehensively, giving enormous flexibility in the classroom. Use videos to complement your lesson plans, to introduce new material, to review safety procedures, or as a handy reference for students who need additional help. A Meridian Production. The series includes: Cabinet Doors and Hinges | Cabinet Drawers | Chamfers and Bevels | Crosscutting | Cutting Curves and Circles | Dados and Rabbets | Gluing and Clamping | How to Safely Build with Pressure Treated Wood | Joinery | Measuring Hardwoods | Miter Joints | Outdoor Uses of Pressure Treated Wood | Preparing Hardwood to Use | Ripping | Safety in the Workshop | Smoothing Wood | Uses of Hardwood | Using Veneers | What Is Hardwood. (8-14 minutes each)

Woodworking Equipment Safety

- VHS/DVD-R #20422

- 15-part series

- Closed captioned

This series of fifteen live-action videotapes shows students the proper safety procedures for the set-up and use of stationary and portable woodworking equipment. Viewers are guided through the step-by-step procedures for using safety guards, clamping devices, protective equipment, and more. An excellent series for introducing new students to the joys of safe woodworking and also as a refresher course for experienced craftsmen. A Shopware Production. The series includes: Router Safety | Portable Drill Safety | Saber Saw Safety | Portable Circular Saw Safety | Portable Sander Safety | Drill Press Safety | Scroll Saw Safety | Shaper Safety | Wood Lathe Safety | Jointer Safety | Thickness Planer Safety | Band Saw Safety | Radial Arm Saw Safety | Table Saw Safety | Disk/Belt Sander Safety. (13-33 minutes each)

Woodworking Power Tools

- VHS/DVD-R #26837

- 5-part series

- Closed captioned

This series of live-action videotapes details both basic and advanced operational techniques for each of the five most important and useful woodworking power tools. Clear, sharp, color video graphically portrays the proper operation of each machine, and the correct use of its associated accessories. Close-ups detail how each machine performs cutting, forming, or shaping operations. Shaping procedures and considerations are stressed throughout, emphasizing the proper use of each machine's safety guards. Personal safety procedures and equipment are also thoroughly covered, along with proper housekeeping methods which can help assure that accidents do not occur. This series is recommended for all woodworking students as well as the home craftsman. A Meridian Production. The series includes: Band Saw: Operation & Safety | Jointer/Surfacer & Accessories: Operation & Safety | Radial Arm Saw: Operation & Safety | Table Saw & Accessories: Operation & Safety | Wood Lathe & Accessories: Operation & Safety. (14 minutes each)

Woodworking Tools

- VHS/DVD-R #26836

- 7-part series

This series explains the basic operation of each woodworking tool, how each is adjusted, how blades are changed, and how each is used for specialty operations. Safety is stressed throughout. A Meridian Production. The series includes: Band Saw | Drill Press | Jointer | Planer | Shaper | Table Saw: Safety and Basic Operation | Table Saw: Specialty Operations. (7-26 minutes each)



2572 Brunswick Pike, Lawrenceville, NJ 08648

www.shopware-usa.com

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