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Selecting, Using, and Maintaining Pneumatic Tools for Installing Fasteners into Wood

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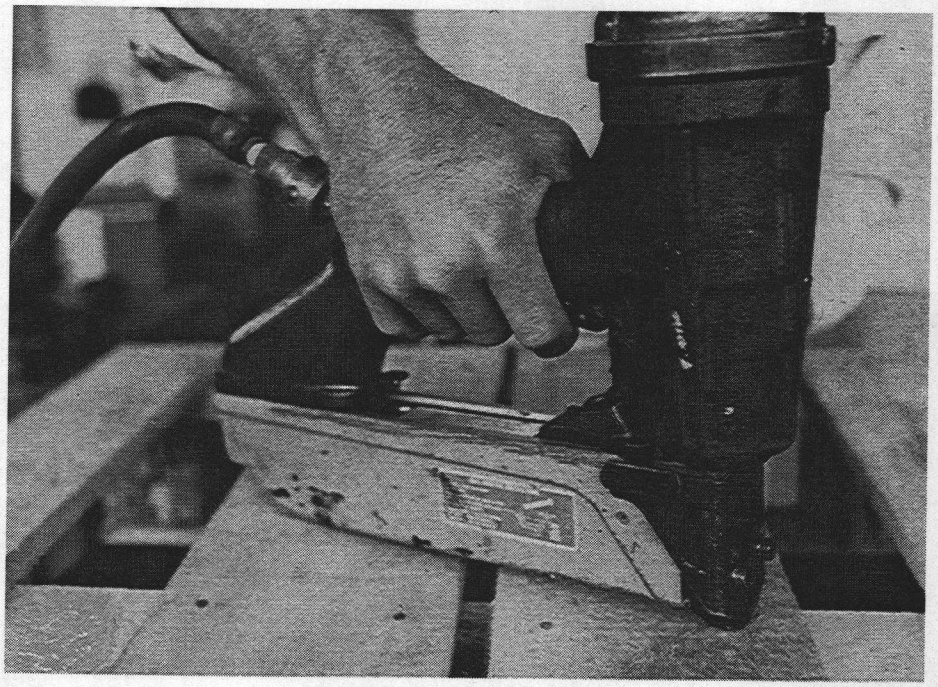
The use of pneumatic tools to drive fasteners into wood and wood products has dramatically increased during the last 10 years. These tools have become mainstays in the pallet industry and in manufactured housing. Based on the continuing desire to decrease labor costs in wood-to-wood assembly operations, such as furniture and cabinet manufacturing, and in building construction, there will be increased use of pneumatic nailers.

While the hammer and hand-driven nail will probably never be relegated to the antique shop, pneumatic tool use for site-built housing and remodeling will likewise become the norm. This is because the tools can be used in many situations, they're easy to operate, and they're moderately priced. Homeowners also are using pneumatic nailers for home projects because in many areas rental firms can supply a variety of tool types, on an as-needed basis.

For these reasons, it's our purpose in this publication to discuss the types of tools available, their uses, their safe operation, and the maintenance requirements of pneumatic nailers and staplers. We'll also discuss the air systems necessary for powering the tools, and we'll suggest guidelines for choosing the correct fastener.

(For the sake of simplicity, we'll use the term *pneumatic nailer* when either a nailer or stapler could apply, depending on the tool or fastener you select.)



The greatest advantage of pneumatic nailers is their speed. Whenever great numbers of fasteners need to be applied in a repetitive manner (as in fastening siding, shingles, or subfloors), these tools are real laborsavers. For example, some high-load nailers are capable of driving 16-penny nails into 3½ inches of wood at a rate of 160 nails per minute.

By selecting the proper air pressures (adjust the pressure regulator), the fastener will be driven to an exact depth. This eliminates the need to set nails below the surface, and it prevents damage to the surface from overdriving or hammer marks.

For the most part, you can operate pneumatic nailers with one hand, leaving

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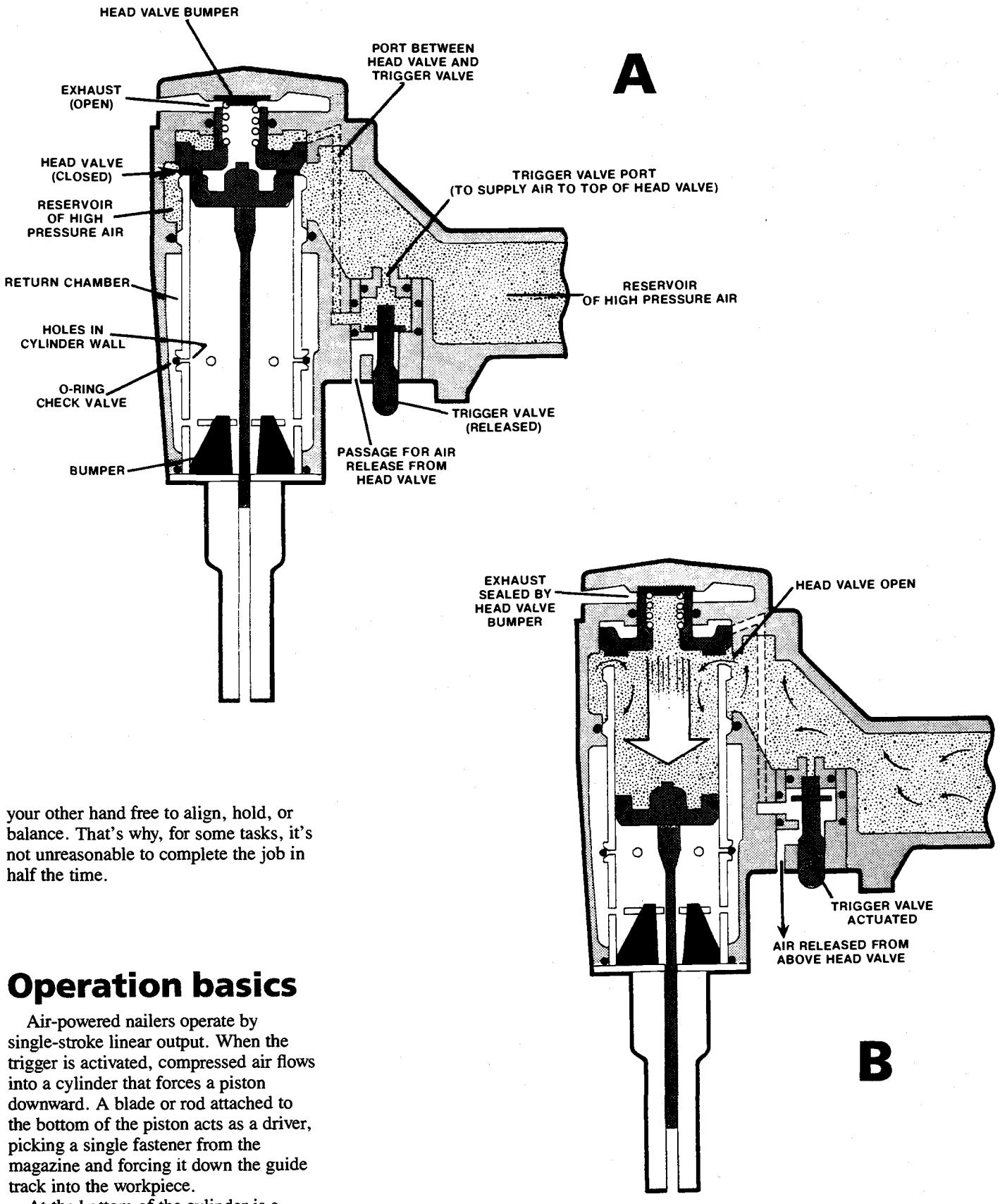


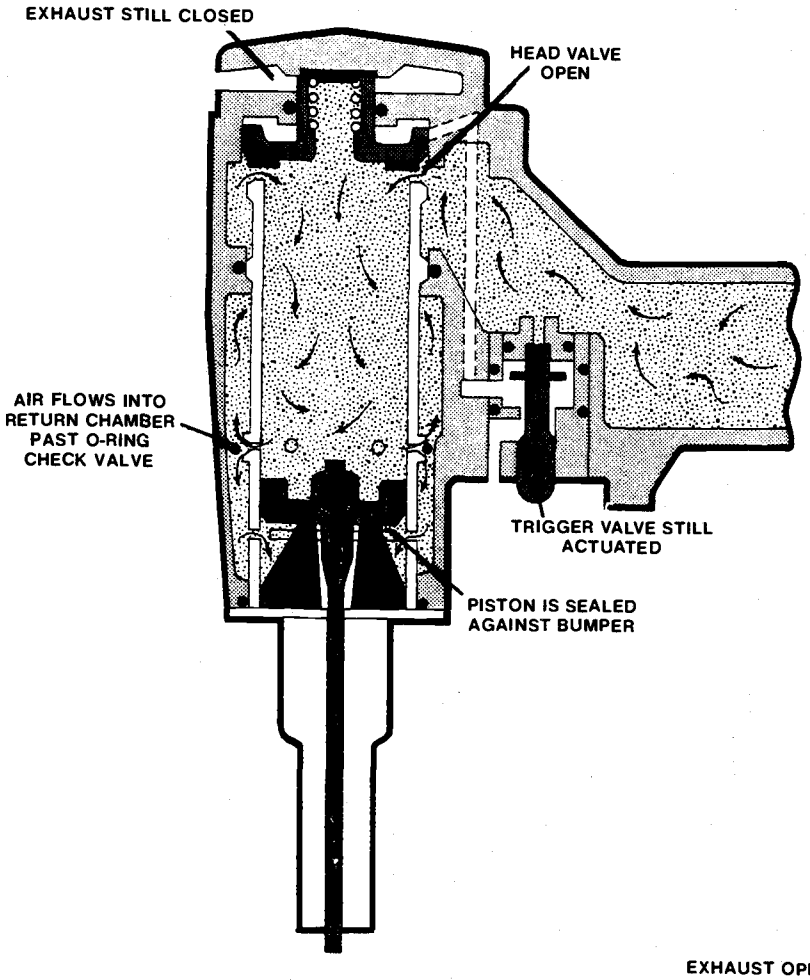
your other hand free to align, hold, or balance. That's why, for some tasks, it's not unreasonable to complete the job in half the time.

Operation basics

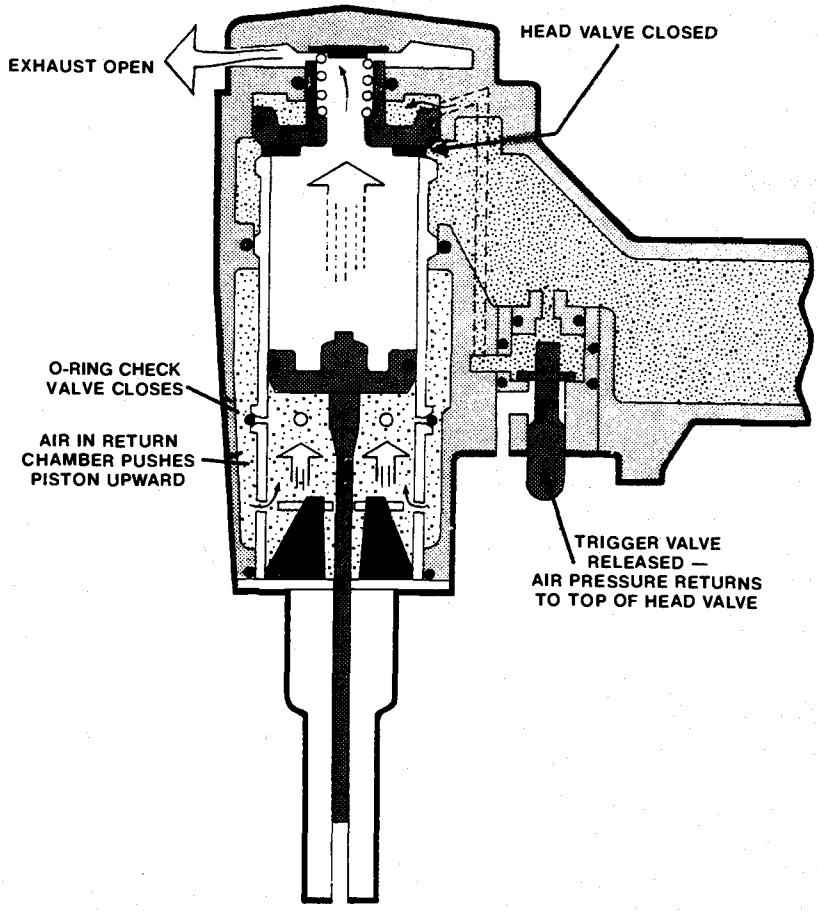
Air-powered nailers operate by single-stroke linear output. When the trigger is activated, compressed air flows into a cylinder that forces a piston downward. A blade or rod attached to the bottom of the piston acts as a driver, picking a single fastener from the magazine and forcing it down the guide track into the workpiece.

At the bottom of the cylinder is a bumper that allows the piston to rebound. Valves within the cylinder allow compressed air to return the piston to its starting position, ready for another cycle (See figure 1). The O-rings or seals that interface between the cylinder wall

Figure 1.—Basic single-piston stapler-nailer: **A.** At rest. **B.** Driving stroke. **C.** End of drive stoke—trigger still pulled. **D.** Returning. Reproduced, with permission, from Manual TR40, *Maintenance Procedures, Trouble Shooting and Sequence of Operation for Bostitch Pneumatic Nailers and Staplers*, August 1988, Stanley-Bostitch, Inc., a Subsidiary of The Stanley Works.


EXHAUST STILL CLOSED
HEAD VALVE OPEN
AIR FLOWS INTO RETURN CHAMBER PAST O-RING CHECK VALVE
TRIGGER VALVE STILL ACTUATED
PISTON IS SEALED AGAINST BUMPER

C


EXHAUST OPEN
HEAD VALVE CLOSED
O-RING CHECK VALVE CLOSES
AIR IN RETURN CHAMBER PUSHES PISTON UPWARD
TRIGGER VALVE RELEASED — AIR PRESSURE RETURNS TO TOP OF HEAD VALVE

D

and the piston control the air flow to prevent leakage and excess air consumption. These rings are critical to the proper operation of the tools; with the bumper, they're just about the only parts that need servicing to maintain efficient functioning of the tools.

Selecting a tool and fastener

Consider these basic points:

1. There are many different fasteners that hammers and pneumatic nailers will drive.
2. However, each model of a pneumatic nailer will drive
   - only *one* style of fastener (nail or staple) and
   - only a limited range of lengths.

This means that there's no pneumatic tool that will drive both small-finish nails and large sinkers because the driver, nose assembly, and magazine parts are controlled by design.

Therefore, you'll have to decide what type of pneumatic nailer or stapler you need before you acquire it. You can determine this by deciding three factors: the fastener head shape, the load capacities of the fastener, and the cost of the tool.

Table 1 describes the common types of pneumatic nailers and staplers, including fastener sizes and styles and typical uses.

Fastener head shape

Your first consideration when you select a pneumatic nailer is the type of work you plan to do and the finished look you desire. The style of nail head or the width of the staple crown will determine this.

As an example, it would be inappropriate to use wide-crown staples to fasten wood siding, casework, or trim because of the unsightly appearance of the crown—even though with proper design specifications, the fastener would adequately secure the material. For finish work, it would be better to use a fastener such as a brad or T-head nail; each is driven by a specific tool.

Load capacity

The second consideration when purchasing a pneumatic nailer is the fastener's load-carrying capacity. Fastener loading is evaluated in two ways:

1. *Lateral loading* measures the force that can be applied perpendicular to the longitudinal axis of the nail. This measures the joint strength for fasteners driven into side grain.
2. *Withdrawal resistance* measures the force required to pull a nail from the wood or to separate two boards that are nailed together.

Prescribed formulas are used to determine the allowable load for each application, and building-code requirements that control fastener selection have been established through engineering and experience.

For both withdrawal resistance and lateral loading, the amount of load a fastener is capable of withstanding depends on the diameter of the fastener, the depth of penetration for the piece receiving the point, and the species of wood that you're using.

For side or shear loading, the depth of penetration required for the member receiving the point may be as little as 10 times the diameter, in the more dense species. In soft, low-density woods, the penetration may need to be as high as 14 times the diameter to obtain maximum load bearing strength.

For withdrawal resistance, greater penetrations require greater forces to remove the nail for a particular wood species. Between wood species of varying densities, there are great changes in withdrawal resistance, such that low-density woods will require several times the penetration to bear the same load as a more dense wood.

This means that (a) the tool you select should install fasteners that will conform to the design requirements or established building codes and (b) you can't expect a tool designed for cabinet assembly to be suitable for house framing or that you can adequately use a shingling stapler to secure plywood subflooring.

Costs

The final consideration in tool selection is the costs associated with the purchase and operation of the nailer. The various manufacturers produce tools of different specifications. If you're a builder or contractor, a better designed tool—one that's more flexible to load and use, and withstands more use and abuse—will prove to be a better bargain in the long run, even though its initial cost is greater.

Coupled with the initial cost of the tool is the availability of fasteners, parts, and service. Trade and craft magazines (such as *Fine Homebuilding* and *Popular Mechanics*) or mail order catalogs often advertise pneumatic nailers at bargain prices; but if you *need* a different length of nail, it won't help to hear a voice on the phone tell you that delivery time for that item is 2 weeks.

This is especially important since the fasteners for one manufacturer's gun may not fit another's. It also means that you're not only purchasing the manufacturer's tool, you're also purchasing the manufacturer's fasteners. When you purchase a nailer, it's important to have a local, reputable dealer who can supply the necessary fasteners and parts.

Another cost consideration that's important when you select an air-powered nailer is the cost of the fasteners. Nails and staples for most pneumatic nailers come collated or cohered—that is, they're joined together in coils, clips, or strips to fit directly into the magazine (see figure 2 for representative pneumatic fasteners). While this makes loading and handling very efficient, it significantly increases the cost.

It's not unreasonable to expect that fasteners for pneumatic tools will be two to three times the cost of bulk nails, and you'll often have to buy a considerably greater quantity (say, multiples of 1,000 or 10,000). This may not be a factor when you compare the savings in labor with the cost of nails when building a house, but it's a fact worth mentioning.

If you decide not to purchase a pneumatic nailer or stapler because the tasks at hand don't justify the cost of the tool and the related equipment, rental firms offer a wide variety of tool types. This service allows you to use pneumatic tools for various projects in a cost-effective manner.

Other points

There are several other points we must clarify regarding pneumatic tool fasteners.

In many instances, there isn't a one-to-one correspondence in the diameters of hand- and air-driven nails. In most cases, the diameter of the pneumatic tool nail is slightly thinner than its hammer-driven counterpart; therefore, it will carry a smaller load. Always verify that the fastener you use

Table 1.—General types of pneumatic nailers and staplers, indicating the types of tools available and some of the capacities and applications (because of the numerous tool manufacturers, each with a distinct product line, some unintentional disparities may exist)

Tool type	Fastener sizes and styles	Tool description	Typical uses
Strip nailers			
Heavy duty	4-5″ length; smooth and deformed shank; 0.150" diameter.	About 13 lb with tilted magazine; 50-nail capacity.	Construction framing; roof decking; heavy carton, pallet, and box assembly.
Framing and assembly	2-4″ length; smooth, screw, and ring shank types; 0.110-0.150″ diameter.	Less than 10 lb with tilted magazine.	Framing; truss assembly; sheathing (sidewall and roof) and subflooring; pallet construction and repair; crating and boxing; door and window installation; siding.
Coil nailers			
Heavy duty	3½-5″ length; smooth shanks, 0.150″ diameter.	About 15 lb; 150-nail capacity.	Construction and framing; heavy crating; pallet and box assembly.
Framing	2-4″ length; smooth, ring, and screw shank, 0.110-0.150" diameter.	Less than 10 lb; 250-nail capacity.	Framing; door and window installation; truss assembly; sheathing (sidewall and roof) and subflooring; pallet construction and repair; crating and boxing; prefabricated housing.
Assembly	3/4-3″ length; smooth, ring, and screw shank; 0.060-0.120″ diameter.	3-8 lb; 400-nail capacity.	Frame assembly; prefabricated housing; furniture and cabinet construction; pallet and boxing; sheathing and subflooring; siding.
Dry wall	1¼-2″ length; ring shank nails.	About 5 lb; 400-nail capacity.	Installing gypsum board and panel products (can "dimple" surface).
Roofing	3/4-1¾″ length; 0.120″ diameter.	About 5 lb; 125-nail capacity.	Shingles (asphalt and wood).
Finish nailers			
T-head	1-2½″ T-head or finishing head nail.	5½-7½ lb; tilted or straight magazine; 100-nail capacity.	Molding and trim application; T&G flooring; cabinet and furniture assembly; door and window installation; box spring assembly; finish carpentry.
Brad and finish	1/2-2½″ T-head or finish head or brad nail.	3½-6½ lb; tilted or straight magazine; 120-nail capacity.	Molding and trim application; cabinet and furniture assembly; paneling; picture frames and small boxes.
Staplers			
Heavy duty	1½-2½″ length; 15-gauge; maximum crown width ½″.	5½-7 lb; 125-staple capacity.	Sheathing; subflooring and decking; mobile home and prefabricated housing; pallet, boxes, and crates; furniture frames and cabinet assembly.
Intermediate	3/4-2″ length; 15-16 gauge; maximum crown width ½″.	5-6½ lb; 140-staple capacity.	Sheathing and subflooring; mobile home and prefabricated housing; furniture and cabinet assembly.
Wide crown roofing	1/2-1½″ length; 16-gauge; maximum crown width 1″.	5½-7 lb; 140-staple capacity.	Shingles; wall sheathing.
Light duty	1/4-1″ length; 17-20 gauge; crown width from 3/16 to ½″.	2-3 lb; 100-staple capacity.	Upholstery; carpet laying; toy making; silk screening; light wood assembly; cabinet and furniture assembly.

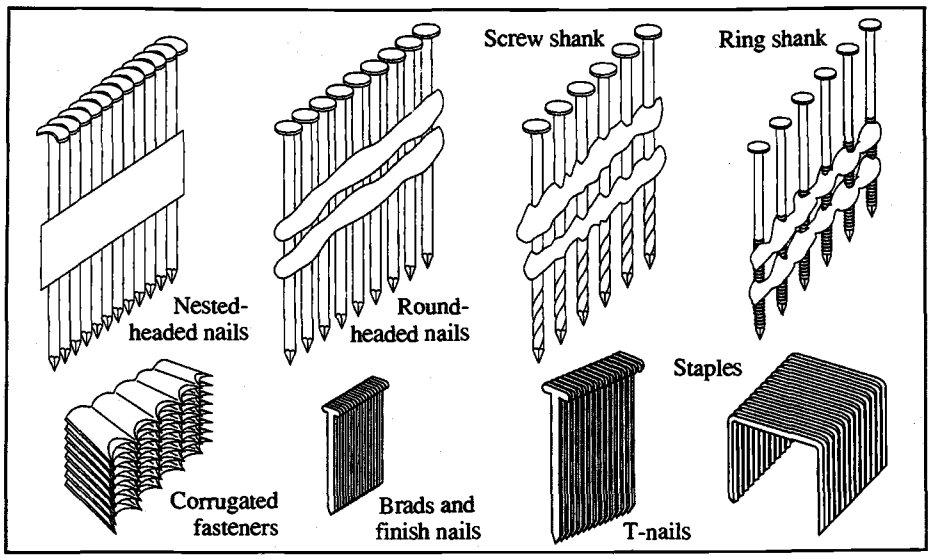


Figure 2.—Representative pneumatic fasteners.

will meet the design or building code requirements.

For the staples you'll use, designers and engineers determined the load capacities for one staple leg, then doubled them to reflect the performance of both legs of the fastener. In framing and sheathing applications, this means you can substitute staples of an appropriate diameter and length for nails if you meet the building code specifications. This may significantly increase the versatility of the tool you acquire.

If the shape of the fastener head isn't stipulated, it won't matter in most instances if you use a round head nail, a narrow crown staple, a wide crown staple, or a T-head nail. In most design situations, head shape is not considered. This means that with the proper selection of one or two pneumatic tools, you can complete a diverse variety of jobs, as in plant assembly operations or at a building site.

There are two instances where head shape *does* matter: the width of the crown when stapling shingles, and the effect of fastener pull-through in plywood when using T-head nails.

Finally, most pneumatic fasteners are galvanized with a thin layer of zinc to reduce corrosion. Corrosion can rapidly decrease the load-carrying capacity of the fastener and, thereby, weaken the assembly. Beside zinc-galvanized nails and staples, stainless steel or aluminum specialty products are often available.

Additionally, there are special fasteners available for pneumatic nailers that are superior to smooth-shanked nails and staples. Examples include ring-shank nails and threaded nails. While more expensive, these specialty fasteners have increased load-capacity ratings, and they increase the versatility of the tools.

Air system requirements

The proper operation of pneumatic tools requires both the correct amount of air pressure (as rated in psi, pounds per square inch) and the correct volume of air (as rated in CFM, cubic feet per minute). Pneumatic nailers and staplers generally require from 60 to 115 psi to operate and effectively drive fasteners. The safe-pressure range of each tool should either be stamped on the tool or included in the technical information supplied when you buy it.

For safe operation, and to prevent damage to the tool, *maintain the correct pressure range*. Incorrect pressures will damage rings, seals, or valves and contribute to excessive tool wear—and they may cause tools to misfire or jam.

Inadequate air volume may prevent the tool from cycling properly, or it will drive fasteners in a stairstep (where each successive nail head or crown will be slightly higher than the preceding one). This is caused by diminished air flow from small air lines, kinked or crimped hoses, and restrictive fittings. High-flow fittings are recommended; obtain them from your dealer when you buy the tool. These fittings are different from the quick-disconnect sets used for tire inflation or light spray tools. If you're having trouble with a pneumatic tool, check its operation at a reliable air-pressure source, preferably before sending a tool for service or rebuilding.

It's also important to note that there's an air-pressure loss in air hoses and lines, depending on the flow rate and the line size. This is similar to the resistance in electrical wiring, with the resulting decrease in voltage to the tool. If you use long lengths of small-diameter pipes and hoses, the pressure at the tool may be significantly different from that at the regulator. To minimize this effect, always use the shortest possible length of hose.

When you use air lines, be certain they're rated to withstand the pressures from the compressor. It's best to use lines rated at 150% of the operating pressure of the tool.

The air supply should also be clean and dry. Water in air lines can cause corrosion of the internal parts or (more likely) dilute or wash away the oil and grease lubricants necessary to keep seals and O-rings functioning. Water may also cause swelling of the O-rings within the tool.

It's also advisable to install and maintain air filters on compressors and particle traps or screens in air lines to prevent dirt from entering the tools. The abrasive tendency of dirt can score cylinder side walls or cause seals to fail prematurely. In all circumstances, water and dirt contribute to decreased tool effectiveness or increased maintenance costs. For permanent in-house systems, driers and water traps are recommended.

For portable gasoline or electric compressors, drain the pressure tanks at regular intervals determined by air consumption. Do this draining at least once a day. It's advisable to obtain and install a water trap on the outfeed air line near the compressor.

When you use a pneumatic tool in cold weather, water in the air hoses and lines can turn to slush or freeze. Special antifreeze solutions and lubricants may be required; you can obtain them from your air tool supplier. This, however, is only a minor inconvenience, especially when compared to the difficulty of driving nails with a hammer in cold weather.

In cold weather, keep compressors, hoses, and tools warm when you're not using them. The best way to do this is to store the equipment in a warm area at nights and during breaks and lunches.

Compressed air from an air compressor is the only source that anyone should use with any pneumatic tool. *Under no circumstances use bottled gases*. Bottled gases may be at pressures greater than 2,000 psi—if the pressure regulator fails or is overridden, excess pressure will cause lines to rupture or tools to explode.

Using oxygen or propane from tanks could create explosion dangers of horrifying proportions. **Use only compressed air from an air compressor.**

Maintenance

The requirements for pneumatic tool maintenance are simple and straightforward—but important.

Keep the nailer clean

This is the first rule to follow. The buildup of dirt or other foreign materials (like tar and grit on roofing tools) can affect tool operation and decrease part life. Periodic cleaning is required to remove those substances, and there are recommended procedures.

Cleaning solvents will do the best job, but be careful—never immerse the complete tool or the components; many solvents will attack or soften O-rings, seals, and bumpers. It's also not advisable to use flammable solvents like gasoline, which could ignite or explode from sparks.

Unless you've used a tool in an extremely dirty location or it hasn't been cleaned regularly, all that's required is some minimal solvents on soft rags or towels and a little "elbow grease." Cleaning should include the exterior of the nailer and the driver-nose assembly.

Keep the tool lubricated

This is the second rule for proper maintenance. Frequent, but not excessive, lubrication will result in the better tool performance. Add oil regularly, either with an inline device or by manually adding several drops through the air line connection periodically during the day.

Only a small amount is required. Too much oil will lead to exhaust port and muffler clogging, and it may dilute the grease in seals or on O-rings, which will contribute to increased oil consumption.

Excess oil or silicon-containing products may also contaminate surfaces and lead to problems in later finishing or painting operations. Bumpers, seals, and O-rings are often attacked by detergents in certain oils or by oil additives. Make sure that you have the proper grade and type of oil before inserting it in the tool.

The other type of lubricant that is required is grease. When you clean or replace O-rings and seals, it's recommended that you apply a light coating of grease to seals and ring surfaces and into the seating grooves before reassembly. For use in cold weather, different grades of grease may be required, and you can get these from your tool dealer.

Finally, a regular light coating of oil or lubricant on the magazine track will prevent sticking of the fasteners in the track. Only a small amount is required—too much can contribute to dirt accumulation.

Regrinding and tightening

Periodically, depending on how much you use the tool, the driver will require regrinding to obtain a flat, square surface. Do this grinding slowly—*and cool the tip frequently*—to prevent drawing the temper from the metal and thereby softening the metal. Use discretion when you decide both when and how to regrind the driver tip.

It's necessary to keep all threaded parts tight. Follow the manufacturer's guidelines about torque specifications or the use of industrial thread adhesives.

Safety

Any tool that's capable of driving a 3½-inch fastener almost instantaneously into high-density woods deserves respect—and it requires special handling and operating guidelines. In fact, because of the speed with which pneumatic fasteners are fired and because of the force behind them, all pneumatic nailers and staplers require a high level of safety consciousness. Good judgment for the most part is all that's required, *but you must follow* these Dos and Don'ts at all times:

Dos

"Wear eye protection" is the rule—for everyone at the work site—when you use air-powered nailers. Safety glasses can provide protection from flying fasteners and debris that could cause serious or permanent injury.

Keep hands and body parts away from fastener discharge area when you operate, load, and connect air-powered tools.

Disconnect tools from the air supply to prevent accidental cycling when you service the tool, when the tool is not in use, before you make adjustments, when you clear jams, or when you move to a different work area.

Read all instructional materials before using a pneumatic nailer. The few minutes required will help you familiarize yourself with the specific requirements of each tool.

Don'ts

Never connect the tool to bottled gas or to an air source that exceeds 200 psi.

Never point a pneumatic tool at anyone. Horseplay and foolish behavior often leads to serious, unwanted consequences that serve no purpose and recklessly endanger people.

Avoid carrying the tool with your finger on the trigger. Trips or snags in the air hose may lead to accidental firings.

Never modify the tool by removing parts or adding special fixtures without the manufacturer's approval.

Avoid operating the nailer without fasteners in the magazine. Depressing the trigger without fasteners will reduce the life of the tool and increase maintenance requirements.

In addition to these rules, you should wear ear protection when you operate a tool that's excessively loud or when you work in a tight or enclosed area. Before starting work, it's good practice to check that the nailer is loaded and that the operating pressure is correctly set.

When you work where electrical wiring is present, it's also prudent to mark off areas where fasteners should not be driven. This is especially important when you apply panels or sheet stock to walls or when you do any remodeling work.

The extra effort required for safe operation of these tools is part of the price you pay when you acquire these tools. It would be foolish not to obtain the many benefits because you're

unwilling to assume a high level of safe operating standards.

Be aware that in certain applications, a pneumatic nailer or stapler may not be the best tool for the job. As an example, if you're reshingling your roof without removing the existing layers, it will be virtually impossible to determine if the nail or staple is driven correctly into solid supporting material unless you hand-nail the shingles. Without secure fasteners, the new roof surface will be more readily damaged in high, gusty winds.

This idea also applies anytime you're applying materials over existing work and can't be sure you're securing the material to supporting studs, joists, or rafters.

Conclusion

The hammer and hand-driven nail will never be replaced. There are always those unique instances where, because of volume or location, pneumatic tools won't be economically feasible. There's always the spot that requires the extra "coaxing" that only a hammer will provide, or the small project that doesn't justify moving compressors or air hoses. But the versatility of pneumatic tools and the diversity of models means these situations are becoming fewer and fewer.

The impact these tools are having in the wood-fastening industry is best compared to the introduction of electrical circular saws. Electric saws haven't displaced the hand saw, but you have to look hard to find a professional or serious do-it-yourselfer who operates without one. And besides, you'll still have to keep your hammer so you can pull nails out!

Operating checklist

Safety

1. Read all instructional materials.
2. **Never connect tools to bottled gases;** use only air compressors as a source of air supply.
3. Disconnect tools from the air supply when clearing jammed fasteners, servicing the tool, when moving to a different work area, or when not in use.
4. Keep fingers, hands, and other body parts away from fastener discharge areas and away from exhaust port openings.
5. Use fittings and air lines that are designed for pneumatic tools only. Use air lines that are specifically designed to operate at the pressures you're using. Don't use fittings that will allow the tool to remain charged with air after it's disconnected.
6. Wear hearing protection devices when you work with large, loud tools or when you work in enclosed areas.
7. Wear protective eyewear when you work with and around pneumatic nailers and staplers.
8. Use good judgment and maintain a high level of safety consciousness when you operate pneumatic nailers.

Daily maintenance

1. Keep tools clean; remove grit, tar, or dust accumulation from the nose assembly, exhaust ports, and magazine assembly.
2. Check the in-line oiler for proper functioning and fill as required. If tools are not equipped with automatic oilers, add *a few drops* of the specified tool oil at the air line connection fitting at the base of the tool.
3. Drain all water from compressors.
4. Check flexible air lines for kinks, tears, or cuts.

Trouble shooting

Tool fails to cycle properly:

- Air pressure too low or air lines are restricted or the distance from the compressor is too great.
- Dry or improperly lubricated parts.
- Damaged or dirty driver or nose assembly.
- Damaged bumpers, seals, or O-rings.
- Clogged or obstructed exhaust ports.

Tool jams or fasteners jam in the tool:

- Damaged or dirty driver or nose assembly.
- Incorrect fastener size—either the fastener is too short for the tool tip, or it's incorrectly sized for the tool and driver (as when you use a different manufacturer's nails).
- Incorrect air pressures (too low).

Improper feed of fasteners:

- Dirty or dry magazine assembly parts.
- Fasteners or fastener points deformed, crossed, or crushed.
- Incorrectly sized fasteners.
- Broken or damaged magazine springs.

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