

Air Hoses, Fittings, Air Compressors - CFM / L/s, psi / bar Requirements

Please read all instructions before setting up to run the *Air Turbine Motors*® / *Air Turbine Spindles*® and optional adjustable TMA Autochanger - In addition refer to User Notes at www.airturbinetools.com.

- Do not connect air to your spindle / motor until installation is complete. Spindle will turn on as soon as air reaches turbine motor.
- Never turn on main spindle, or hit button on control panel FWD/REV, while ATT spindle is loaded!
- Install a new dedicated clean air line with a 1/2" (7.5mm) minimum Internal Diameter (ID) and a swaged-on fitting of the same diameter to the back of the machine where the 0.3 micron Filter/Regulator will be mounted to supply your ATT spindle. Use magnets for temporary mounting. *Air Turbine Spindles*® supply a Filter/Regulator and a hose to reach the Filter/Regulator as standard equipment in your spindle case. Avoid fittings with smaller ID's than stated on page 7, in the interior because these will restrict air flow to your spindle / motor.
- Install either Quick Change or standard plumbing **coupling / connector** fittings (brass or PVC) with minimum dimensions on page 6 + 7.
- If using 525X units please select couplings / connectors with a minimum 5/16" Internal Diameter. For 650X, 450X and 310RX units, please select couplings / connectors with a minimum 10mm Internal Diameter.

Note: Some fittings with nominal dimensions may have an internal diameter passage that is smaller than stated and will restrict air flow and power on ATT products.

- Buy a **manual shut off valve** (or two) and install on your hose line either before or after the ATT Filter/Regulator (see photos on page 2).
- If using TMA autoloading option and you are not using supplied TMA mounting block, remove the threaded air tip (Nozzle) from collar and hook up the air line directly to the NPT hole with supplied Quick Connect (Push On) hose fitting.
- Ensure plug is in place if air inlet is not in use.
- For full power supply the *Air Turbine Spindles*® with sufficient **compressed air pressure** at 90 to 100 psi (6.2 - 7.0 bar) and sufficient **CFM (L/s) rated in the catalog/online**.

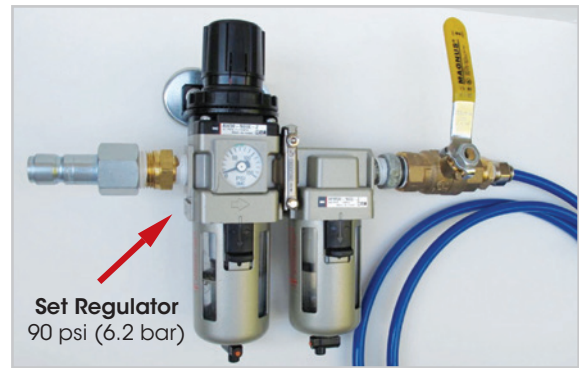
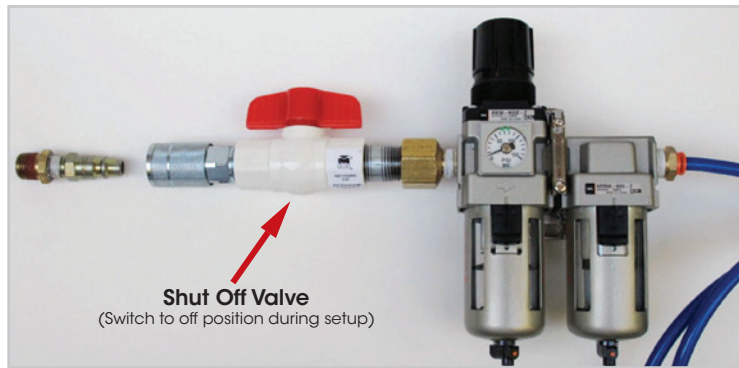
If while running the ATT spindle / motor you observe a drop in the pressure [i.e. below 90 psi (6.2 bar)], then you may not have enough CFM (L/s) output from your compressor [see more notes under CFM (L/s) & Fittings]. Falling under 90 psi (6.2 bar) will cause severe drop in power and rpm of your spindle / motor. Contamination of air supply can damage the bearings in your spindle / motor. The solutions are addressed below.

- Use air flow meter to check CFM (L/s) air flow going to your *Air Turbine Spindles*®.
- Check for restrictions in your airline.
- Use air holding tank.
- Smaller size cutting tools optimize performance at high speed with a light pass at a high rate of advance. Consult cutting tool supplier for an appropriate selection of speed rated cutting tools. Avoid long stick out from collet.

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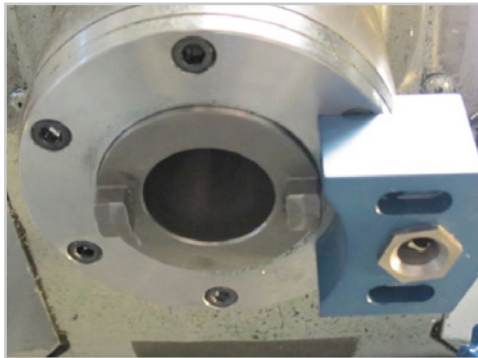
Set Up and Operation of Air Turbine Spindles® with TMA Autochanger Option

- Install compressed Air Filter / Extractor/ Regulator (AFTER) with at least 0.3 micron extraction A Filter / Extractor is provided with Spindle. Please set regulator at correct 90 psi (6.2 bar).
- Install in-bound shop air to AFTER with shut off valve (see example photos below).



Photos of customer supplied "shut-off" valves. Ensure internal diameter meets specifications (see page 6 + 7).

- Shut off all air flow or remove hose from regulator at this time so that no compressed air reaches your Spindle. **WARNING: ATT spindle will turn on as it loads into spindle with air turned on!**
- Never assume the TMA Nozzle will clear all portions for CNC Tool changer guarding or machine columns. Consult CNC machine manufacturer drawings and / or verify all clearances via mock up tool.
- Dimensions of *Air Turbine Spindles®* and TMA are found in our catalog and at www.airturbinetools.com.



Install ATT supplied Spindle Mount Block (many pre-drilled CNC machine models available in addition to Universal Block).

Install action requires SHCS 10-32 x 0.75" on Haas CNC machines.

Note in example photo left the CNC spindle drive dogs (40T) are inline directly with ATT Nozzle inlet on block (typical Carousel ATC). See Spindle Orientation section next. Side mount type ATC's normally have dogs at some angle vs. inline.

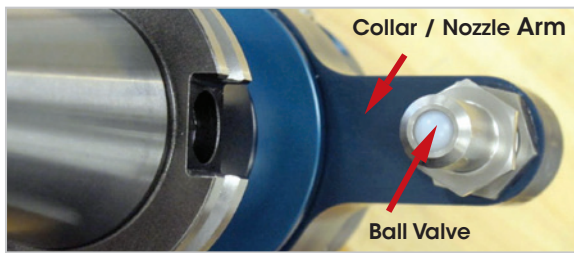
Prepare CNC spindle by performing M19 or Spindle Orientation (as the control would normally do on its own orientation just before a Toolchange).

In most CNC's there are drive dogs (if 40/50 taper), and similar clocking drive notches if HSK toolchangers.

Always ensure main spindle is programmed not to rotate CNC door is shut before inducing air to *Air Turbine Spindles®*.



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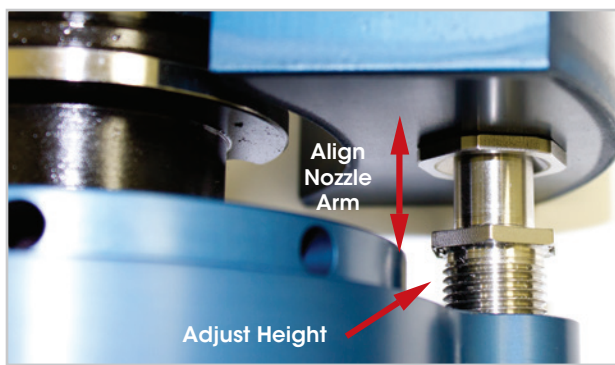


Alignment of drive dogs with TMA Mounting Block

Observe the position of drive dogs in machine's main spindle (while at spindle orient) and rotate *Air Turbine Spindles*[®] collar / nozzle arm to align with Spindle Mount Block. In the example, left, drive dogs are aligned directly with Nozzle inlet on block, so this makes it easy to set (see photo left).

Screw TMA Nozzle into threaded collar tapped hole. Adjust the correct length to connect with the mounting block on your CNC machine (you may need to loosen lock nut). An extension block may be required if the distance is greater than the nozzle length.

Note: Once the *Air Turbine Spindle*[®] is loaded into main spindle, you may need to raise this Nozzle more to engage the ball valve seal, which starts air flow. The air flow will turn on *Air Turbine Spindle*[®] in a few seconds after coupling.



Load *Air Turbine Spindle*[®] carefully into CNC spindle with left hand while holding Tool Release button on CNC machine. Some trial and error may be needed, but do not let main spindle drawbar (tool release button) start unless Connector Nozzle goes up into block Inlet hole (approximately 1/4" (6mm) up into inlet hole).

If Nozzle Arm is misaligned from inlet, remove from CNC spindle taper area and adjust clocking of TMA Nozzle to properly align with inlet hole and re-try loading procedure.

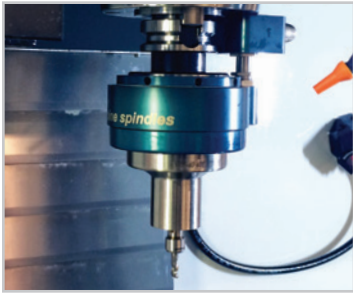
Once successfully loaded into CNC machine main spindle, turn on air hose shut-off valve or install air hose to filter / regulator. If spindle turns on and sounds good, then Connector Nozzle can be presumed to be set at correct height.

If ATT spindle does not turn on, then begin procedure to raise height of nozzle using proper open end wrenches. Turn hex on nozzle counter-clockwise to raise up the Nozzle. **Use caution with Hands and any clothing that may be next to cutting tool in ATT collet nose because the spindle will turn on and begin rotating at rated rpm when air is supplied.** Once *Air Turbine Spindle*[®] spindle turns on, raise the Nozzle another small amount and then lock the hex lock-nut to secure the Nozzle in place.

If the Nozzle is too high, you will see the blue spindle collar tilt or cock. This may loosen the bottom lock in the spindle collar or allow excessive air to become released from the collar O-rings which seal the TMA collar to the main flange portion of the TMA collar system. If too high, reverse procedure to lower the Nozzle re-tighten the lock-nut so the connector is an accurate fit.

If spindle collar does not rotate, loosen the collar by adjusting hex nuts in spindle collar so that the rotation is free at a light pressure but not loose.

Air Turbine Technology, Inc's TMA collar and nozzle are patent pending products.



Example Model 650 Spindle loaded into CNC machine spindle. Please perform a tool change (i.e. with over-ride set to lowest speed) several times to observe the loading and unloading of the ATT spindle and ensure it engages and operates correctly.

Note: On some Gantry machines, the Nozzle/O.D. of collar will not clear the column corner (i.e. All GR type machines require special tool rack on machine table or hand loading). Always ask the CNC machine builder or review machine design drawings to make sure your CNC model has a clear path to operate.

Instructions & Warnings for safe running of ATT spindles by all personnel

Also refer to user notes, safety instructions, CNC manufacturer/program manual, and local regulations.

G-Codes/Spindle Orient - Each CNC control has slightly different codes to ensure the CNC main spindle never turns on while the ATT spindle is loaded. It is an important safety precaution to ensure Set Up Personnel, Machine Operators, Programmers, etc. are all properly notified that the main spindle must remain stationary, except while CNC machine is doing a Tool Change. During a tool change after loading the ATT spindle the CNC spindle normally does a spindle orientation or rotation to ensure the drive dogs are aligned prior to loading into Tool changer drum or sidemount mechanism.

The *Air Turbine Spindles*® "TMA" option allows a spindle orientation due to its patent pending collar system.

TMA Collar Rotation - A factory set level of resistance (i.e. collar with plunger section to spindle body section) keeps the Plunger in place during a tool change, while still allowing the free rotation (i.e. spindle orient). Over time this friction may change due to coolant, lubrications, dust, etc., so ensure there is not too much friction or too little, as this may cause misloading of spindle. Tightness of collar may be adjusted using hex keys, if necessary, so it remains free to rotate but remains in securely place.

Canned Cycles - Beware that on some CNC controls the G81, G82, G83 (peck drilling) commands may turn on the machine spindle, even with M05 (spindle stop) and not spindle command in the code (i.e. S0 M03).

Spindle Commands - Use M05 on Fanuc type controls to ensure main spindle is turned off.

Dry Run, Graphic Run - Always run the CNC machine program in Graphics and/or in a slow dry run to verify the CNC spindle does not turn on.

Parameters to disable CNC Main Spindle RPM - Some CNC machine controls have specific parameters to allow "0" rpm, which can ensure no rpm is possible via control or program.

Setting Tool Length - With *Air Turbine Spindles*® loaded in CNC machine spindle: use a small pin or known tool shank to roll under tool in collet of ATT spindle as you jog down (once close use 0.001 or 0.0001" increments). Alternatively, tool setting via probes is possible with Drill type macro cycles (i.e. this will not turn on main CNC spindle).

Main Spindle Lubrication - Many CNC machines will continue to pump oil into the main spindle when the machine axes are moving, even though the main CNC spindle is not turning while the ATT spindle is loaded.

After running the ATT spindle for more than several hours continuously, it is highly recommended to run a "warm up" program on the CNC main spindle to purge excess oil that may have built up. Each machine is different so please check with manufacturer.

Keys to Success when using Air Turbine Spindles / Motors / Hand Tools

1. Pressure at 90 to 100 psi (6.2 bar to 7.0 bar) - Air Pressure and flow must remain constant with minimal drop over time or when cutting. If a drop in psi (bar) occurs [below 90 psi (6.2 bar)], this could mean your compressor does not have enough CFM / L/s to power the spindle / motor or there is some restriction in the air line. Undersized Internal Diameter inside fittings or on the air line, etc., will restrict air flow and cause under power performance - see below and page 7 for required specifications. Avoid pressure above 100 psi (7 bar) which will damage the turbine motor.

2. CFM (L/s) Air Supply - please ensure the rated air flow volume CFM (L/s) to maintain "working air consumption" (and depending on application, one must consider peak or stall capacity consumption). Review *Air Turbine Tools*® catalogs online at www.airturbinetools.com for specifications.

- Consider duty cycle rating on compressor for long term or continuous operation.
- *Air Turbine Tools*® consume more air as load (material removal) on tool or spindle increases. See idle CFM / L/s rating vs. Working Air Consumption rating for each spindle. This is normal operation of the patented governor and makes *Air Turbine Tools*® both powerful and efficient in air consumption.
- Always monitor Air Pressure Gage during typical CNC operation of *Air Turbine Tools*® (i.e. load on ATT spindle and all other equipment in operation using shop air).

If the CFM (L/s) is insufficient, one can typically see the psi (bar) on Air Filter/Regulator/Water Trap gage (which should be mounted close to ATT spindle) drop below 90 psi (6.2 bar). In this case, check for restrictions on air flow and to review compressor operation and turn up minimum psi (bar). This may be necessary because default compressor settings may allow psi / bar to drop down to ~80 or 85 psi (5.5 or 5.9 bar) before turning on to build up pressure.

An alternative is to secure a larger Air Holding Tank, which can prevent drop in the air flow and allow longer run time at sufficient CFM (L/s) pressure before compressor has to start up.

- The Air Turbine unit will normally drop in rpm while engaging a cut or during its plunge to initial working load. This is normal for an instant, then the rpm of your spindle / motor should remain within 20% of rated speed constant up to 80% of max power.
- If air hoses are in a humid environment we recommend installation of a second air filter < 5 micron near the compressor to ensure clean, dry air quality.
- At high speed a small concentric speed rated cutting tool should be used with a fast advance using shallow cut (0.2mm - 0.5mm). This strategy results in fast, precise, clean cutting action which optimizes tool performance and life.

3. Hose/Couplings/Fittings/Pipe - All must have the minimum internal dimensions, as stated on page 6 + 7. Only one fitting with too small Internal Diameter can reduce air flow and reduce hp (kW) of *Air Turbine Tools*®.

4. Spindle Through Shank / Toolholder Air Supply - To supply Thru-Spindle-Air (TSA) to power to *Air Turbine Spindles*®, verify the maximum CFM (L/s) flow possible through the air channel and determine the maximum drawbar/pull stud/internal hose Internal Diameter in the system, including any solenoid used to actuate the air. Some pull plugs can be drilled to enlarge openings and permit higher flow.

For a 601X, 602, 602X or 625 the coolant channel used to supply air must be at least 6.5mm Internal Diameter for the entire length of the passage. The channel must be impeccably clean with no part smaller than 6.5mm so that air pressure is unrestricted. Purge line of contamination before use.

All HSK spindles may be used with center airfeed if the airline and all connectors meet the minimum internal dimension requirements stated on page 6 + 7.

5. Filtration - Many machine shops use an air dryer, but always install a 0.3 micron High Flow Air Filter / Extractor Regulator or equivalent. Beware that some Air Dryers / Extractors may not have enough flow capacity [verify CFM (L/s) rating], when in line from compressor to *Air Turbine Tools*®. We recommend a minimum of 0.3 micron filter/ extractor.

Filter elements need to be changed and the regulator and extractor drained in regular maintenance cycles. A filter will not remove oil from compressed air if present. An extractor should be used in combination, as supplied with standard equipment for spindles only. A second filter is used when the hose line is long or compressor output is wet.

Contamination will damage your tool and require a repair.

6. Air Compressor - Always review specifications for 100% Duty Cycle and compare to intended usage. Verify the rated CFM (L/s) @ 90 to 100 psi (6.2 to 7 bar).

Some ratings are less than optimal CFM (L/s) @ 80 psi (5.4 bar) for example.

Air Turbine Tools® Hose / Fitting / Connector Internal Diameter Specifications

Minimum 90 psi (6.2 bar) air pressure (Okay to adjust up to 100 psi (7 bar) at regulator in line to *Air Turbine Tools*®, as psi / bar air pressure will drop under idle/working load). Do not exceed 100 psi (7 bar).

Models	Minimum Internal Diameter
200, 201, 0145, 0190	3/16"
720, 722, 730, 732	5mm
202, 202, 206X, 525, 2545, 2590	1/4" / 6mm
601, 602, 602X, 625, 740MX	6.5mm
525X	5/16"
625X, 650, (602, 625, 625X and 650 TMA Spindles), 450, 740XP	8mm
210, 230, 310R	3/8" / 9.5mm
650X, (650X TMA Spindles), 450X, 310RX	10mm

See accessory filter extractors and hoses on page 26, and CFM / L/s required in catalog.

General Air Fitting Dimensions

Quick Disconnect type fittings (shop air type):

- 1/4" Male > ID = Usually 0.210" but some variations occur.
- 1/4" Male (High Flow, Harbor) ID = 0.277" with 1/4" NPT male thread
- 3/8" Male hole = 0.283" - 0.285" with thread of 3/8" - NPT (internal ID of female mating OD appears even smaller ID).
- 1/2" Male hole = 0.375" (0.655" OD)

Hose Notes: Actual Internal Diameter on brass fittings (i.e. swedged on ends) of standard Goodyear, etc. brands of 1/2" & 3/8" hose have various internal dimensions. (Example = Goodyear 1/2" Red hose with 3/8" / 9.5mm NPT fitting has Internal diameter hole of 0.282", which is sufficient for 601, 602, 602X, 625, 202, 720, 722, 730, 732, 740MX, 200, 201, 202, 206X, 525, 525X, 0145, 0190, 2545 and 2590 units but undersized for 625X, 650, 650X, 210, 450, 450X, 740XP, 230, 310R and 310RX units.

Goodyear black 3/8" / 9.5mm hose has Internal Diameter hole on swedged fittings of ~0.265" are suitable for 601, 602, 602X, 625, 202, 720, 722, 730, 732, 740MX, 200, 201, 202, 206X, 525, 0145, 0190, 2545 and 2590 units.

Compressor Tip: Typical CFM (L/s) compressor > over 10 hp, each additional hp (kW) of motor capacity will generate about 4 CFM (1.9 L/s) of compressed air at 90 psi (6.2 bar).

Do Not Oil Or Lubricate - Dry, Clean, Oil Free 90 psi (6.2 bar) Air Supply Only

Important Note For All Users:

Do not restrict air flow by using smaller couplings, hoses, pipes or fittings smaller than minimum size.

For Spindles: Use couplings / hoses with a minimum ID of 3/16" for 200, 201, 0145 and 0190 units, minimum ID of 1/4" / 6mm for 202, 206X, 525, 2545 and 2590 units, minimum ID of 5/16" for 525X units, minimum ID of 3/8" / 9.5mm for 230 and 310R units and minimum ID of 10mm for 310RX units.

For Motors: Use couplings / hoses with a minimum ID of 5mm for 720, 722, 730 and 732 units, minimum ID of 1/4" / 6mm for 202 units, minimum ID of 6.5mm for 740MX units, minimum ID of 8mm for 450 and 740XP units, minimum ID of 3/8" / 9.5mm for 210 units and minimum ID of 10mm for 450X units.

For Hand Tools: Use couplings / hoses with a minimum ID of 3/16" for 200, 201, 0145 and 0190 units, minimum ID of 1/4" / 6mm for 202, 206X, 525, 2545 and 2590 units, minimum ID of 5/16" for 525X units, minimum ID of 3/8" / 9.5mm for 230 and 310R units and minimum ID of 10mm for 310RX units.

The required flow rate is in your catalog and on www.airturbinetools.com, and pressure must be **90 psi (6.2 bar)**. Air flow varies with load for maximum efficiency while maintaining high speed under load. Use a Reservoir Tank to avoid fall in air flow or pressure at peak load, if required. Restricted air flow will cause under power performance and damage bearings. "Speed does the cutting". It is counterproductive to slow down your motor to stall point. A fast frequent pass at high peripheral speed cutting action, improves finish quality and extends cutting tool life.

General Notes:

Air Turbine Tools® are governed turbine motors using variable air consumption to maintain high speed and torque under load. Therefore, your tool or spindle will run at less than stall flow unless at full load. Optimal cutting action occurs with a light pass with the motor operating at constant high speed. The governor keeps the speed in a range close to rated speed up to 80% of rated maximum rated power. It is essential the air supply not be constricted by hoses, pipes, fittings or couplings less than the **required internal diameter specified above, and on page 6**.

Use only a concentric speed rated cutting tool matching the capacity of your collet and do not allow the cutting to protrude excessively from the collet. Hand Tool Slide valves must be fully opened or closed. Red indicates 'Off' and green 'On' position.

Insert speed rated cutting tool in accordance with manufacturers instructions with control in 'Off' position. Tighten fully with wrenches provided. Optional collet sizes are available up to 1/4" / 6mm.

As a precaution, your Air Turbine Spindles® should be run for at least 30 minutes every month to maintain optimum performance.

Always operate in compliance with:

1. Safety code for portable air tools - ANSI 186.1, etc. Always use eye + face protection.
2. General Industry Safety & Health Regulations, Part 1910 and 2206 OSHA, etc.
3. Federal, State and local regulations and laws in your country.
4. Cutting tool manufacturers operating instructions. Do not use cutting tools unless they are RPM rated equal to or more than the air tool/ motor/ spindle rpm.
5. Air pressure exceeding 100 psi (7 bar) must not be used. Avoid airleaks and obstructions which reduce power.

Use flow meter to check air flow. Ensure hose lines are clean. Plug air inlet on spindles not in use.



In addition to the filter extractor supplied with spindles (pictured right), it is necessary to place a large filter on the air line at the compressor where heavy contamination is emitted by the compressor (pictured left).

WARNING: FAILURE TO COMPLY WITH ALL SAFETY REGULATIONS COULD RESULT IN SERIOUS INJURY. 

