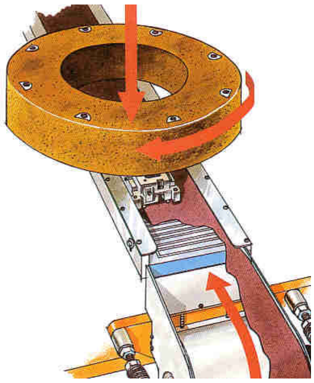
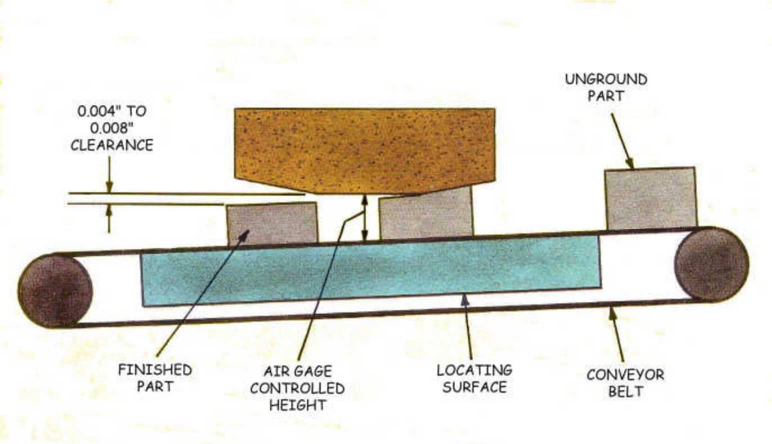
I. Overview

Thru-feed grinders offer an economical means to surface grind small parts in an efficient manner. There are several different models of these grinders available, though the Speedfam Thru-Feed grinder is probably the most common.



These grinders all have a vertical grinding spindle and the parts are passed beneath the wheel on a moving belt. The belt passes over a magnetic chuck beneath the grinding zone. The parts are held against a guide rail by the tangential force of the wheel and to the belt by the vertical force of the wheel. This set up has proven to be very effective at producing parts that are able to hold tight tolerances while being handled in an efficient, easily automated manner.

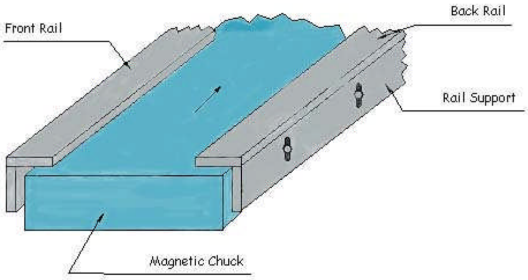


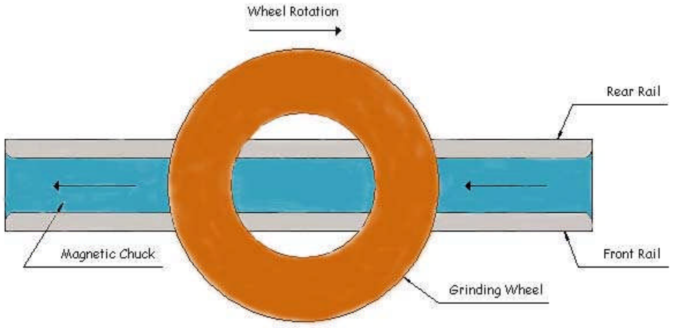
The basic set up calls for the grinding wheel to set stationary and the table is tilted front to rear normally at a rate of 0.0015” per inch. The grind is progressive, on the leading face of the wheel. The tilt is such that the part does not touch the wheel once it passes center, with typically 0.004” to 0.008” clearance between the part and the back side of the grinding wheel. The machines are usually equipped with an air gage that monitors the distance between the grinding wheel and the table, so wheel compensation is automatically adjusted.

II. General Considerations

Through-feed grinders are quite versatile. Typical parts ground are usually from ½” to 6” in diameter and from .040” to 6” thick. Smaller parts may be run, but they would require fixturing. Very small parts are often placed in fixtures that can hold multiple pieces. The machine is capable of running both magnetic and non-magnetic parts. Stock removals of as much as 0.100” are possible, depending upon the part size and material being ground. The speed of the part conveyor belt is infinitely variable from 0 to 36 fpm.

Proper set up of the machine is important to hold the parts accurately in place. This is done through the set-up of the guide rails. The machine is designed to hold the part firmly against one of the side rails as it being ground. It is important that the rail is the proper thickness and that it is set to the proper height.





The front rail is necessary for all parts, both magnetic and non-magnetic. It is important to have a space between the guide supports and the magnetic chuck to allow coolant flow and swarf removal. The rear guide rails are important for non-magnetic parts to keep the parts stable in the coolant flow. The rear guide rails also prevent swarf from getting under the abrasive belt. The rails need to be sturdy enough to give stability to the parts.

The guide rails should be positioned to be about 80% of the height of the finished part. For non-magnetic parts, the rear rail should be positioned close to the part. The rails need to be set parallel to a point on the belt as it moves through the grinder.

The principal variables in the process, besides the part, are:

- Grinding wheel selection,
- Depth of cut, and
- Feed rate.

It is the balance of these variables that is the prime consideration in arriving at the most efficient operation.

Before a discussion on grinding wheel selection, it is good to also have an understanding of some general axioms regarding some of the process variables.

1. The optimal feed rate is inversely proportional to the surface area of the part and its hardness. That is, larger and harder parts are normally run more slowly than smaller parts to remove equal amounts of stock.

2. The stock removal per pass is indirectly related to the material hardness, surface area and the feed rate. The stock removal per pass is directly related to the grit size in the grinding wheel.

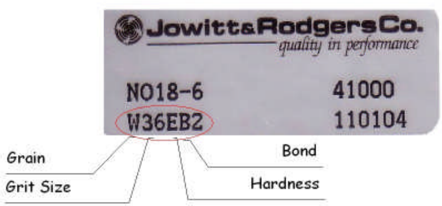
III. Abrasives

Efficient grinding requires that the proper abrasive is used that best matches the job. Abrasive wheels for these types of grinders are typically nutted resin or epoxy bonded disc wheels.

Abrasives are made of abrasive grain, which are the materials that do the actual cutting, and bonding materials that hold the wheel together. The abrasive materials are usually forms of either Aluminum Oxide or Silicon Carbide and the bonding materials are usually either resin or epoxy.

The choice abrasive grain is normally determined by the material being ground. The grains, through their chemistry, have varying properties of hardness, friability and sharpness. These are matched to the physical properties of the material being ground to give the most appropriate cutting action. The grain is also available in a wide range of particle sizes, referred to as grit size. This is matched as well to both the part material and tolerance of the operation to provide the optimum results, where coarser grits are used for soft materials and high stock removal.

The bond is the glue that holds the abrasive grain in the wheel. 'Harder' grades hold the grain more firmly than 'softer' grades. Resin bonds are usually phenol/formaldehyde resins that are baked at relatively low temperatures. At Jowitt & Rodgers Co. we make resin and epoxy bonded products.



Shown here is a typical product label with our grade marking circled. Our markings are always in the format of Grain, Grit Size, Hardness, Bond. Grain types are identified in the chart below. Grit size is the size of the abrasive grain; smaller numbers for larger grain and larger numbers for smaller grain. Our bonds all start with 'B', signifying resin bonds.

Jowitt & Rodgers Co. Abrasive Grain Guide:

Type	Code	Description
Aluminum Oxides	G	This is a form of brown aluminum oxide that is blocky and not exceptionally friable. Due to its shape and lack of friability, it is a hard acting grain, good for general purpose grinding of soft steels. It also is often used in combination with more friable grains to add additional life to the wheel. It is a relatively inexpensive grain.
	A	This is a more friable version of G grain. It is still an inexpensive brown aluminum oxide, but is a little sharper and more friable. It is used on slightly harder materials than G and in combination with other grains on hard steels.
	W	A white aluminum oxide, this is a very aggressive grain. It is sharper, harder and more brittle than the brown grains. This is an expensive grain that works well on hard steels such as tool steels and stainless steel. It often is used in combination with either G or A to offset the cost.
	F	An even more friable form of white aluminum oxide. It is the sharpest, most aggressive of the aluminum oxides that we have available. F is used where W is not aggressive enough, and is often used in combination with other grains to offset the cost.
Silicon Carbide	X	This is our standard silicon carbide grain. Silicon carbide is a hard, brittle grain, more so than aluminum oxide. It is most commonly used on non-steel materials, such as cast iron and aluminum. It does not work well on steel because it is chemically reactive with the carbon in steel.
	C	A more pure form of silicon carbide, it is slightly more friable than X. This grain is not used a great deal. It is some times referred to as green silicon carbide.
Ceramic grains	R	A ceramic coated brown aluminum oxide, this grain forms stronger bonds with our resin. It is used to make very hard wheels.
	Q, L, U	These grains are polycrystalline ceramic aluminum oxides that are extremely hard and sharp, and very friable. They are either sintered grains or sol-gel grains. They retain their sharpness for an extensive period, giving good wheel life and improved grinding speed. Very aggressive grains, they are used for hard steels in combination with conventional aluminum oxide grain.

This chart gives some guidelines for which type of grain to use for various materials. These are general suggestions only. Ceramic grains may also be used as well for most of these materials, depending upon the actual requirements of the job.

Grain Selection

Material	Grain
Cast iron	X
Carbon/low alloy steel	G, A
Stainless Steel	W, GW
Tool Steel	W, GW, AW
Super alloys	W, F, AF
Aluminum	X

IV. Basic Operational Procedures

1. Grinding Wheel Installation

Care should be taken while installing the grinding wheel. Grinding wheels are fragile and can become unsafe if cracked or damaged. Wheels that are cracked or show signs of physical damage should not be mounted.

a. Raise the head to provide clearance for the backing plate and the chuck.

b. Insert wooden blocks, long enough to support the grinding wheel and high enough so bolts in the wheel can be hand tightened at front and rear. Blocks should be approximately 2" x 4" x 10".

c. Place the wheel on top of the blocks and center under the backing plate.

d. Clean the back of the wheel and the backplate.

e. Lower the head slowly to engage the bolts. Hand tighten and align the wheel with the backplate. Use a ratchet and tighten the bolts to 15 ft. lbs. of torque. No not over tighten.

f. Prior to running, it is necessary to dress the face of the grinding wheel. Use a cluster diamond dresser and pass it under the wheel just as the part would be ground. Set the guide rails to support the dressing block. Use a slow feed, approximately 6" per minute and 100% magnetic force to insure holding the dresser. Remove approximately .100" to assure clean up and to put the proper taper on the wheel. The table is inclined .050" from entry to exit and a new wheel must be dressed parallel to the table. Suggested removal rate is .020"/pass.

2. Guide Rail Installation

a. The front guide rail is necessary for all grinding operations on both magnetic and non-magnetic parts. It is important to have a space between the guide rail supports and the magnetic chuck to allow coolant flow and swarf removal.

b. The rear guide rail is important for non-magnetic parts to prevent tipping from the coolant flow.

c. Rear guide rails are needed to prevent swarf from getting under the abrasive belt. This is especially important when critical accuracy is needed.

d. For magnetic and non-magnetic parts, the guide rail should be only 80% of the finished height of the part. For non-magnetic parts, the rear rail should be placed close to the part.

e. The guide rail should be set so that it is parallel to an imaginary line formed by a point on the belt as the belt moves.

f. If large parts are being ground, the guide rails should be made as thick as possible to insure stability.

g. Material used for the guide rails varies. It is determined by the part being ground, the surface finish of the piece in contact with the rail, and the force exerted on the rail due to the amount of stock removal. Standard rails that are supplied with the machine are typically stainless steel for maximum wear. Other materials commonly used are brass, hardened steel and tungsten carbide.

h. When a guide rail is worn, it should be replaced.

3. **Set Up For A Specific Part**

a. Turn the hydraulics on.

b. Raise the guard.

c. Adjust the rail height to 80% of the part height.

d. Lift the wheel high enough to pass the part under it.

e. Place the part under the wheel as close to the I.D. as possible. Turn the magnet off if needed.

f. Lower the head down, push the downfeed button until the wheel comes close to the part. Then microfeed the wheel until it touches the part by rotating the wheel by hand in a clockwise rotation while microfeeding.

g. Zero the readout by pushing the reset button.

h. Crank the air gage nozzle up close to the wheel, approximately 1/8” away.

i. Lift the wheel head up.

j. Remove the part.

k. Lower the guard with the guard switch and adjust the entrance and exit doors to allow clearance for the part to enter and exit but to stop the coolant from splashing.

l. Start the machine in this sequence:

    i. Coolant first,
    ii. Wheel second,
    iii. Beltfeed last.

m. Lower the head using the down button to get close, then mirofeed to “0”.

n. Select the feed rate in inches per minute. All rates should be timed.

o. Turn the magnet on.

p. Pass the part under the wheel. When loading, place the part against the front rail.

q. Check the part for size. If the part is undersize, lift the head to the amount needed. If oversize, lower the head to desired size.

r. Rotate the hand wheel on the air gage nozzle toward the right, bringing the nozzle closer to the wheel. Set the nozzle as close to the yellow/green lights as possible with the green staying lit. This is the running condition. Lock the hand wheel in place.

s. Turn on the air gage switch.

t. You are now ready to run and feed parts against the feed rail.