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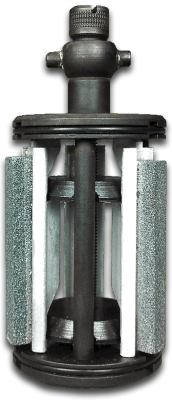
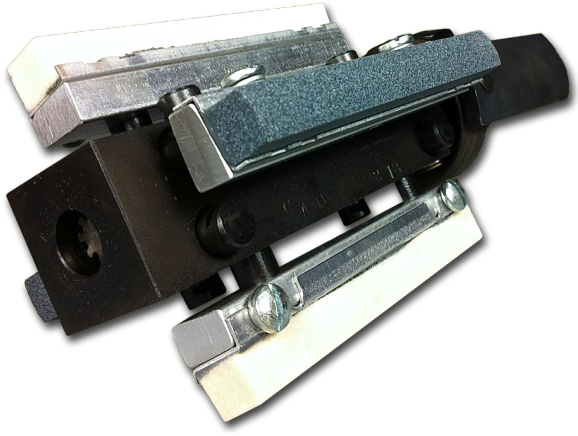
HONING OPERATIONAL INFORMATION & TROUBLE SHOOTING DATA





SELECTION OF ABRASIVE SPECIFICATIONS

Selection of the best abrasive stone for any application depends on the following factors:

1. Type of material to be honed
2. Material specification and heat treatment
3. Amount of stock to be removed
4. Microinch finish required
5. Geometric tolerances involved
6. Bore condition prior to honing
7. Type tooling, type feed, number, type and size of stones
8. Existing abrasive problems, if any
9. Type of bore -open end, blind end, keyways, ports, etc.

Note: Once these factors are known, then an intelligent selection of abrasive grades can be made. Since methods, abrasives, tooling, and coolants are constantly in a state of flux, a chart of recommended grades for specific materials is not practical.

MICRO INCH FINISHES

Metal		Micro Inch Finish and Correlating Abrasive Spec.				
Material	Hardness	Ra 100 to 80	Ra 80 to 60	Ra 60 to 40	Ra 40 to 20	Ra 20 to 5
Iron	Mild	C80 - C100	C100 - C150	C150 - C180	C180 - C220	C220 - C500
Iron	Hard	-	C80 - C100	C100 - C150	C150 - C180	C180 - C500
Steel	Mild	A60 - A80	A80 - 120	A120 - A150	A150 - A220	A220 - C500
Steel	Hard	-	-	A80 - A100	A100 - A150	A150 - C400
Stainless	-	-	A60 - A80	A80 - 120	A120 - A180	A180 - C500
Brass	-	C80 - C100	C100 - C150	C150 - C180	C180 - C220	C220 - C500
Bronze	-					
Aluminum	-					
		"A" indicates Aluminum Oxide. "C" indicates Silicon Carbide				

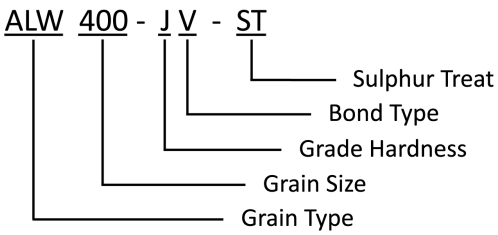
The chart above gives approximate micro inch readings to be expected on a variety of materials with specific grain sizes and grain type. Adjust accordingly for desired results. This is a starting point only.

Abrasive Operational Information

NOMENCLATURE AND TERMS

GRADING

A typical honing abrasive grade is read as follows:



GLAZING

A condition of the abrasive cutting surfaces noted when the grain become dull and fail to cut. The surfaces may appear clean or they may be smeared with metallic sludge. In either case, the condition is realized when excessive heat is generated, stock is removed at a greatly reduced rate or not at all, and the abrasives fail to break down. Seethe trouble shooting chart for remedies.

LOADING

When small or large particles of the material being honed become embedded in the surface of the abrasives, the stones are said to be loading.

GALLING

When stones load up, they commonly cause scratches in the bore. When this happens, the stones are said to be galling. This condition generally can be noted by observation of deep criss-cross tears in the abrasive surfaces.

SPALLING

If feed pressures are high and/or bores are rough, the trailing edges of the abrasive sticks tend to break out or spall. This has no adverse affect upon honing. Minimizing this condition, however, benefits economy.

RUN-OUT TIME

That time,at the conclusion of a roughing cycle, which is given the hone to operate in the bore at zero or greatly reduced feed pressure to improve geometric accuracies and surface finish. Synonymous with spark-out time in grinding.

GRAIN TYPES

The general honing grain type rules are:

Aluminum Oxide	For most steel applications
Silicon Carbide	Cast Iron, Aluminum, Copper, Bronze, Tungsten Carbide, Chrome

HONING SPEEDS AND FEEDS

ROTATION (RPM)

Spindle speeds are determined by:

1. The material being honed
2. The bore diameter
3. The size, number, and kind of abrasives being used
4. The surface finish desired

Spindle speeds affect cutting action thusly:

1. Increase RPM - Abrasives act harder, finish is finer
2 Decrease RPM - Abrasives act softer, finish is rougher

RECIPROCATION

The rate of reciprocation utilized is usually determined by the same factors applicable to rotation previously enumerated. The most common expression of reciprocation speed is in terms of the number of feet the honing head travels in one minute, including both directions of travel, expressed as surface feet per minute.

Reciprocation speeds affect cutting action thusly:

1. Increased Reciprocation - Abrasives act softer, finish is rougher
2. Decreased Reciprocation - Abrasives act harder, finish is smoother

Surface Feet Honing Guide

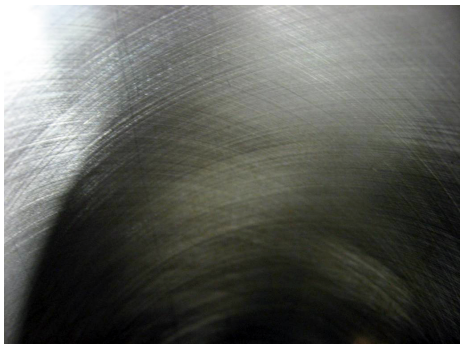
Metal Material	Hardness	Surface Feet Per Minute
Iron	Mild	150 - 200
Iron	Hard	80 - 120
Steel	Mild	100 - 150
Steel	Hard	60 - 100
Brass	-	150 - 200
Bronze	-	
Aluminum	-	

This is meant to be a guidline only. An optimum speed must be determined for each application through trial.

RPM to SFM Formula: Surface Feet Desired = RPM X .262 X Diameter in inches

CROSSHATCH ANGLE

This angle, as pictured on the right, is the resultant of the interaction of rotation and reciprocation. Crosshatch angles of 30 - 45 degrees are usually sought.



FEED RATES

Since machines, tools, abrasives, and materials vary widely, honing feed rates follow a wide range.

Increased Feed Rates affect cutting act thusly:

1. Give rougher finishes
2. Remove material faster
3. Use up abrasives faster
4. Generate more heat
5. Make fine tolerances more difficult to obtain
6. Tend to keep stones from glazing
7. Accellerate tool wear

The optimum feed rate at any set rotation and reciprocation speed is usually that rate which produces a part for the least cost figured by adding abrasive cost per part and the cost of time per part. Selection of a feed rate is therefore strictly a matter of trial and error until an optimum is found.

STICKS & STONES ABRASIVES

Honing Variables and Effects/Behaviors

RPM - RECIPROCATION - FEED RATE - FLUID LUBRICITY

INCREASING RPM
- Will make stones act harder
- Will give finer surface finish
- Will slow cutting ability
- Will decrease crosshatch angle
- Will decrease geometric accuracy if increased too much

DECREASING RPM
- Will make stones act softer
- Will give rougher surface finish
- Will increase cutting ability
- Will increase crosshatch angle
- Will improve geometric accuracy

INCREASE RECIPROCATION SPEED
- Will make stones act softer
- Will give rougher surface finish
- Will increase stones ability to stay sharp
- Will increase crosshatch angle
- Will remove stock slower if excessive

DECREASING RECIPROCATION SPEED
- Will make stones act harder
- Will give finer surface finish
- Will decrease stones ability to stay sharp
- Will decrease crosshatch angle
- Will remove less stock if too slow

INCREASE FEED PRESSURE
- Will cause stones to act softer
- Will increase stones ability to stay sharp
- Will remove stock faster
- Will give geometric inaccuracy if excessive
- Will generate more heat in part
- Will waste abrasive it excessive

DECREASE FEED PRESSURE
- Will cause stones to act harder
- Will decrease stones ability to stay sharp
- Will remove stock slower
- Will improve geometric accuracy
- Will generate less heat in part
- Will increase honing time if too light

INCREASE LUBRICITY OF HONING FLUID
- Will cause stones to act harder
- Will improve surface finish
- Will retard cutting if fluid is too rich

DECREASE LUBRICITY OF HONING FLUID
- Will cause stones to act softer
- Will decrease surface finish
- Will speed cut if lean and stones wear faster

NOTE: Tramp oil leakage, both hydraulic and machine lubricating oils are the major cause of honing machine malfunction. Clean and contaminant free honing fluid is a critical part of a successful honing application. Fluid must be free of "Tramp" oils as well as honing swarf. Proper fluid filtration is imperative and refrigerated coolant is highly beneficial if possible.

STICKS & STONES
ABRASIVES

Trouble Shooting Chart

Conditions and Recommended Corrections

Witnessed Condition	Corrections From Below in Usual Order of Importance
Abrasive glazing	2 - 3 - 5 - 15 - 13 - 18 - 11
Abrasive loading	2 - 3 - 15 - 7 - 17 - 19 - 11
Abrasive galling	2 - 3 - 7 - 15 - 9 - 17 - 19 - 24 - 11
Abrasive spalling	31 - 6 - 22 - 23
Finish too rough	1 - 4 - 6 - 17 - 16 - 7 - 12
Finish too smooth	2 - 3 - 5 - 18 - 15 - 8 - 13
Excessive Abrasive usage	1 - 4 - 6 - 16 - 7
Tapered stone wear	14 - 22 - 21 - 16
Eccentric stone wear	14 - 22 - 21 - 16
Slow stock removal	5 - 3 - 2 - 8 - 11 - 15 - 18
Excessive heat generation	10 - 6 - 8 - 11 - 24 - 15 - 20
Part out-of-round	6 - 2 - 3 - 12 - 14 - 15 - 25
Part bell-mouthed/ tapered	26 - 12 - 14 - 25
Part not axially straight	32 - 14 - 25 - 33
Part being honed eccentric to OD	14 - 29 - 30
Swipe marks in bore	27
Bore not square to face	29 - 14 - 33
Washout around keyways, ports	6 - 17 - 28

Corrections

1. Increase spindle RPM
2. Decrease spindle RPM
3. Increase reciprocation
4. Decrease reciprocation
5. Increase feed rate
6. Decrease feed rate
7. Increase coolant's base content
8. Decrease coolant's base content
9. Check filtration of coolant
10. Check refrigeration of coolant
11. Check coolant for hydraulic oil contamination
12. Increase run-out time
13. Decrease run-out time
14. Check spindle to part alignment
15. Use softer abrasives
16. Use harder abrasives
17. Use finer grit stones
18. Use coarser grit stones
19. Use less porous stone
20. Use more porous stone
21. Check that abrasives are on grade
22. Check tool slots, pins, cone, for wear
23. Trial other abrasives
24. Use more coolant
25. Check to see that fixture is not distorting part
26. Adjust over- run of stroke
27. Use guides
28. Use fibre clad abrasives
29. Tram part face to determine that it is square to spindle
30. Rotate part occasionally while honing
31. Use light feed pressure at start of hone cycle
32. Use longer abrasives
33. Check part accuracy prior to honing