SHEFFIELD™ STAINLESS MACHINING DATA

MACHINING "SHEFFIELD TG&P STAINLESS"

NOTE: Our standard grade of TG&P stainless shafting is a high grade AUSTENITIC STAINLESS STEEL, that will meet specifications for type 316L.

This grade performs well in temperatures to 1600°F.

The following machining data is furnished as a guide. It is not intended to replace existing specifications for machining Type 316L stainless. Persons performing machining operations on this product are urged to wear appropriate safety gear, and be familiar with the machining characteristics of Austenitic Stainless Steel Grades.

As a general characteristic, all austenitic stainless steel can be more difficult to machine because austenitic steels have a tendency to work harden.

Austenitic Stainless Steels have been characterized as gummy during cutting or machining, with a tendency to produce long stringy chips. These chips may form a build-up on the edge of the tool. This increases the degree of machining difficulty and degrades the surface finish of the bar.

Cut surfaces may work harden and become more difficult to machine if the feed rate is too low.

Where higher strength and greater machinability are desired, refer to Nass 45 PSQ on pages 30 and 31, of this TECHNICAL DATA BOOK.

In general, more power is required when machining stainless steels, then is necessary with carbon or alloy grades. Cutting speeds must be lower, and a positive feed must be maintained. Tooling must be rigid and in good condition. Chip- breakers, and/ or, curlers may be needed on the tools. Maintaining good lubrication is required.

It is generally understood that as hardness increases in the material, the degree of machining difficulty also increases. However, with austenitic stainless grades, machinability is more directly influenced by microstructure than by hardness. Some degree of cold work actually helps in the machining process. That cold work will reduce ductility and produce a cleaner chip, with less tendency for a build up on the edge. This produces a superior machined surface. **Sheffield TG&P Stainless** Shafting is cold worked prior to arriving at your site. This insures you get an Austenitic Stainless grade that is easier to machine than most similar grades. Note that duplex stainless alloy's and high temperature grades of stainless are generally more difficult to machine than Sheffield Stainless.

Sulfur is often added to stainless to increase machinability. **Sheffield Stainless Steel** does not have added sulfur, as this material is engineered specifically for maintenance. Sulfur additives tend to reduce service life, and decrease abrasion resistance.

To avoid glazing, (a hardening of the surface of the work-piece), a positive feed must be maintained. Increase the feed and reduce the speed. A succession of thin cuts should be avoided. High speed tools and carbide tools are both adequate. Both must be kept sharp, with a fine finish, to minimize friction with the chip.

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CUTTING FLUID:
In general, the use of a high grade cutting fluid is more desirable with stainless than carbon or alloy grades. This is due to the lower heat conductivity of stainless steels.

Water soluble oils, usually in proportions of one part oil to 12 to 20 parts water, and sulfochlorinated cutting oils are the cutting fluids most widely used in machining stainless steel.

Water soluble oils are used for most single point tool operations, such as turning and boring. Stainless steels are drilled with twist drills using soluble oil, although, as the hole depth increases, the need for sulfochlorinated, or other additive oils, increases.

Soluble oil is typically used when reaming stainless steel. Deep-hole drilling, or gun drilling, generally requires sulfochlorinated or other additive type oil. When additive oils are used, insure that the viscosity is not higher than 300 SUS at 100°F, in order to permit the necessary flow. Additive type cutting oils are also used for broaching stainless steel. These permit faster penetration rates and are often preferred for drilling very hard abrasive materials.

When machining stainless steels, two types of sulfurized oil may be used:

A sulfochlorinated petroleum oil, containing active sulfur with 8% to 10% fatty oil. Viscosity of approximately 200 SUS at 100°F.

A sulfochlorinated petroleum oil, with active sulfur, but without fatty based oil. Viscosity approximately 130 SUS at 100°F. **Note:** The 8% to 10% fatty oil is generally used with non-free-machining stainless steels, such as **Sheffield Stainless**.

They can be used straight, or blended with paraffin, oil. Normally 1: 1 mixture of oil to paraffin oil is used.

If chips weld to the tool, or if the tool burns, cut back on the paraffin blending oil in the mixture. In general, when machining **Sheffield Stainless**, a mixture of 1: 1 of the 8% to 10% fatty oil, mixed with paraffin oil, should give excellent results. Use caution to insure that the viscosity of the cutting fluid is sufficiently low to allow it to reach the point of cutting. Usually, 120 SUS at 70°F is satisfactory.

A good rule of thumb is; the more difficult the item is to machine, the more sulfurized oil is needed. When greater cooling capacities are required, water soluble cutting fluids should be considered. Water-based fluids are unsuitable however, where the cutting fluid could mix with the machining lubrication. Many of the water soluble oils will not withstand more severe cutting operations. The cutting fluid should contain polar and extreme pressure (E-P) additives.

TURNING:
Single point turning tools. It is impossible to make specific recommendations that would apply to all conditions when turning operations on automatic machines are involved.

TURNING: (Continued)
Tools with a 5 to 10° positive top rake angle will generate less heat and cut more freely, developing a cleaner surface. The front clearance angle should be kept to a minimum, approximately 7 to 10°. Use tools ground with top rake angles on the high side of the 5 to 10° range to control the chips. They may require an increased side clearance angle to prevent rubbing and localized work hardening.

Utilize chip curlers or chip breakers. In addition to controlling long chips, they reduce friction on the cutting edge of the tool. When carbide tools are used, in single point turning operations, they allow higher speeds than high-speed steel. However, greater attention must be paid to the rigidity of the tooling. Interrupted cuts should be avoided.

CUT-OFF TOOLS:
Circular cut off tools are more rigid than the blade type tools and can withstand more shock. Because of their size, they dissipate heat better.

DRILLING:
Work must be clean and chips removed frequently. Retained chips will act as an abrasive, to dull the drill.

Drills must be ground correctly. Drills must be aligned properly and the work must be supported firmly.

A stream of cutting fluid must be properly directed to the work-piece.

Drills must be chucked for the shortest drill length, to avoid flex.

Heavier feed, and lower speeds, will tend to reduce work hardening.

Use a sharp three cornered punch rather than a prick-punch, to avoid work hardening at the mark. It is helpful to use drilling templates to locate the mark.

Drills must occasionally be backed out, and re-inserted at full speed, to relieve chip congestion. The general rule is to drill to a depth of three to four times the diameter of the drill for the first bite. The second bite-depth would be one to two diameters. For each subsequent bite, you would use approximately 1 diameter depth. Often a groove, ground parallel to the cutting edge in the flute for chip clearance, will allow a deeper hole to be drilled per bite. Do not allow the drill to dwell (sit-and-spin) during cutting. This causes glazing at the bottom of the hole, which will make restarting difficult.

TAPPING AND CUTTING FLUID.
Sulfurized oils are most successful. It is often advisable to use two streams of cutting fluid, one on each side of the tap. Start the flow before it begins to cut and do not shut off the flow until the cut is finished.

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