



Clean Lines:

Strategies for Reducing Your Environmental Footprint

Metal Fabrication Operations:



A Green Suppliers Network review can help you:

- **Optimize raw materials.** Choosing the right shape and size of metal stock used in your process can reduce the amount of scrap waste and the associated loss of revenue.
- **Reduce metalworking fluid use.** By switching to dry machining, you can increase revenue by reducing the cost of managing your machining fluids. Fluid purchase and management costs can total between 7.5 and 17 percent of your manufacturing costs.
- **Reduce regulatory burden.** Eliminating machining fluids would reduce your regulatory burden. Metalworking fluid regulations, such as 40 CFR 747, are not applicable to metal fabrication operations that do not employ fluids.
- **Increase competitiveness through efficiency and attract new customers.** By reducing your environmental footprint, you will help meet your customers' corporate environmental goals and potentially generate new business.

About the Green Suppliers Network

Working in collaboration with the U.S. Department of Commerce's Manufacturing Extension Partnership (MEP), the U.S. Environmental Protection Agency (EPA) established the Green Suppliers Network to help small and medium-sized manufacturers stay competitive and profitable while reducing impacts on the environment.

As a partner with the Green Suppliers Network, you receive a customized, onsite technical review of your materials and processes that couples lean manufacturing techniques with sound environmental strategies—the *Lean and Clean Advantage*. Your technical review will provide you with an opportunity to review your metal fabrication operations. All parts and products made from raw metal require some level of fabrication. Metal fabrication suppliers perform one major operation—shape metal into usable goods by deforming, adding, or removing the metal used to make the product.

Fabrication operations are sometimes better known as stamping, milling, grinding, machining, forming, and welding. Such operations can generate large amounts of wasted raw materials, hazardous wastes from lubricants and solvents, and wastewater. A Green Suppliers Network review can be customized to target the two major wastes generated by metal fabrication—scrap metal and machining fluids.

STEPS TO CLEAN METAL FABRICATION OPERATIONS

The following are just a few of the many strategies to consider while participating in a Green Suppliers Network technical review. The Green Suppliers Network provides experts in *Lean and Clean* manufacturing techniques who can help you visualize a future look for your operations, such as the enclosed process map—one that will save you money and reduce your environmental footprint.

Reduce Scrap

Metal parts are created from pieces of metal stock that come in limitless shapes and sizes. Parts are cut or formed out of the stock, and often metal scrap remains. Scrap is the largest type of waste generated by fabricating operations and will likely be thoroughly examined by a Green Suppliers Network review. Metal scrap can be sold back to metal suppliers or scrap dealers at a fraction of the original purchase price and can become contaminated by machining fluids. Suppliers sometimes need to make numerous cuts to the metal stock or "blanks" to make them the desired shape or size to form the part or product. To minimize waste, you should select blanks specific to product or part specification. Fabricating shops should also work



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with their metal suppliers so that blank cutting happens only when absolutely necessary.

Optimizing the cutting and milling pattern is another way to reduce scrap. A Green Suppliers Network review can focus on how best to optimize cutting patterns or pick the right metal stock for the process.

Reduce or Eliminate Machining Fluids

Machining fluids, or liquid lubricants, are used in metal fabrication to improve tool life, reduce workpiece thermal deformation, improve surface finish, and flush away metal shavings from the cutting area. Practically all machining fluids currently in use are either oil-based or synthetic.

The Green Suppliers Network review team will help you evaluate whether machining fluids are necessary and will explore other options. Dry machining, for example, eliminates fluid management issues, including the need for fluid purchase and management costs, the need for continuous treatment of fluid and maintenance of fluid composition, and the use of biocides. The following process changes make dry machining possible:

- Keeping tools clean, sharp, and within tolerances.
- Changing tool bits to alternative materials, such as low friction coatings and high-temperature wear resistant materials.
- Employing compressed air to remove chips from the work area.

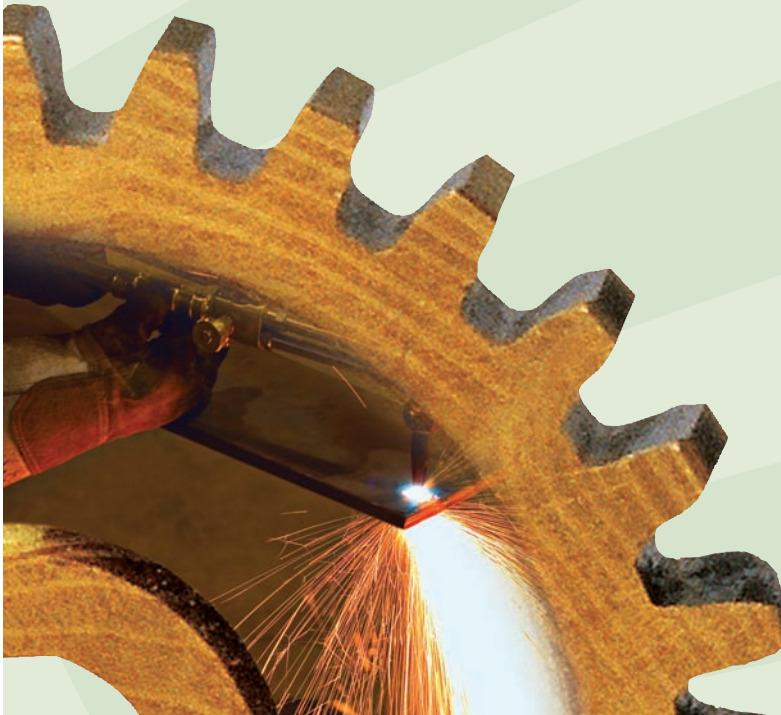
In addition, you can greatly reduce fluid use and associated waste issues by modernizing and optimizing application equipment. A Green Suppliers Network review can evaluate the volume of fluid applied and increase its efficiency by:

- Analyzing the lubrication and cooling requirements of the machining process.
- Using bulk fluid delivery systems only when absolutely necessary.
- Using micro-dispersion and other low-volume fluid applicators with metalworking fluids that have higher lubricating qualities.

Another way to eliminate liquids is by employing new cutting technologies, such as laser, plasma, water-jet cutting, and electrodischarge machining (EDM) systems. These systems can be investigated during a Green Suppliers Network review to see whether any are appropriate and beneficial to your operations.

Recycle and Recover Machining Fluids

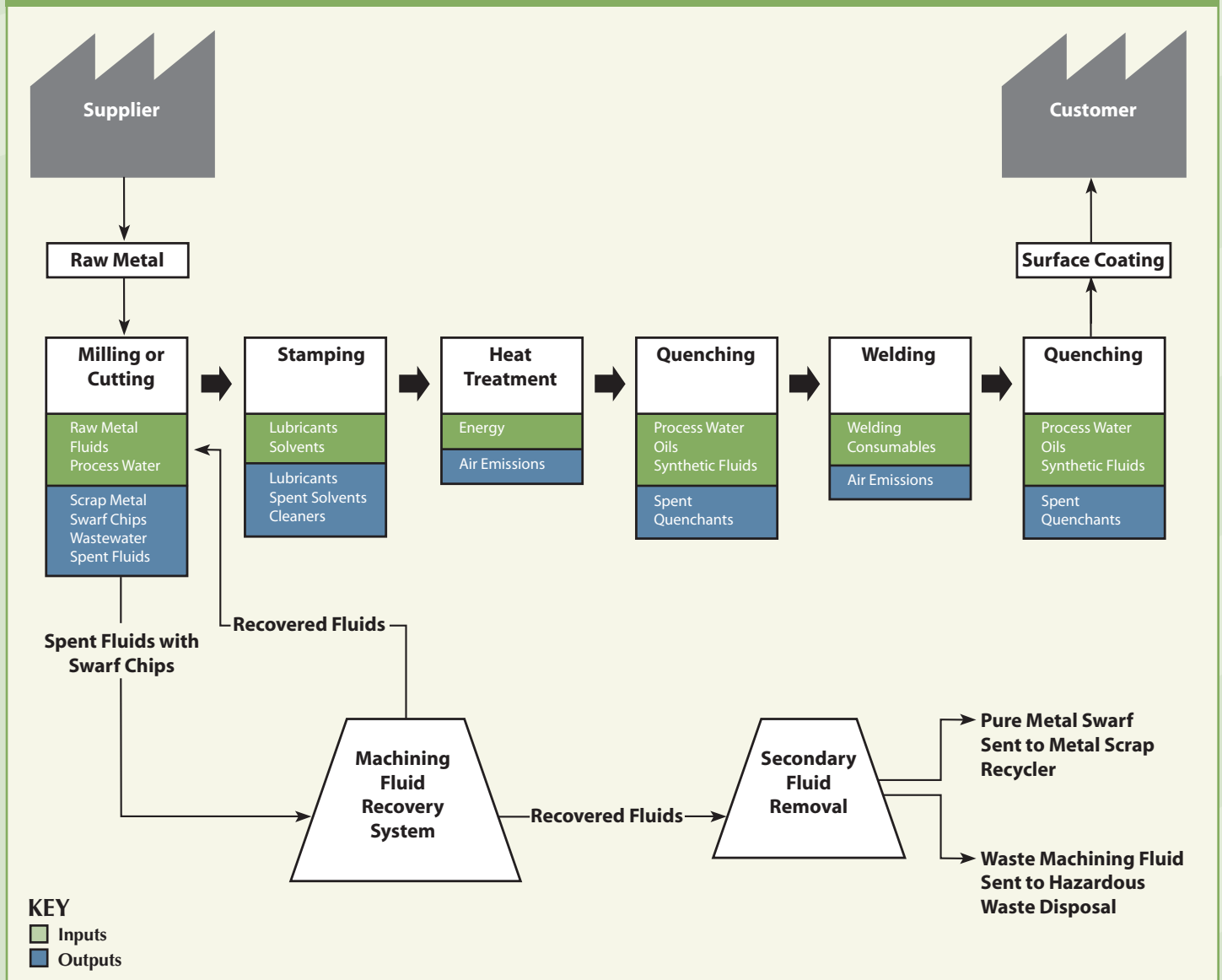
Fluids used for machining metal become contaminated with swarf, or fine metal chips removed from work pieces during machining, which reduce fluid life. Machining fluid life can be extended through recycling that removes the swarf. Fluids can be recycled through various means such as filtering, centrifuges, or hydroclones. The type of fluid recycling used to remove swarf depends largely on the size of the particles and the type of metalworking fluid that is present. Centrifuges can remove mineral oil-based metalworking fluids from swarf. Hydroclones are effective at separating very fine particles from water-based fluids. Once removed from the recycled machining fluid, the swarf can retain significant amounts of waste fluid, which makes scrap dealers reluctant to accept these types of metal scraps. Spent fluids pose potential environmental and health and safety risks and potential liabilities for scrap dealers and also cause problems with processing these types of metal scrap. Some form of secondary fluid removal is typically required. At a minimum, swarf should be initially stored in a container that allows for drainage of waste fluid. Other means of waste fluid removal include adding steam or solutions to break up the waste fluid to further remove excess from the swarf. The importance of secondary fluid removal is to eliminate as much waste fluid as possible and increase the value of swarf as recyclable metal.



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Sample Metal Fabrication Process Map Customized for Green Suppliers Network Partner



Clean Quenching

Many metal fabrication operations require quenching metal following heating. Metal is heated to make it take on shapes more easily by friction from cutting or from welding. A heated part is typically submerged into a quenching bath to cure it before leaving the metal fabrication process line. Quenching might not be seen as much of an opportunity for waste reduction, but in reality, quenching can generate substantial amounts of waste.

Oil, which is the most commonly used quenchant, needs to be handled as a hazardous waste when it is spent because of contamination with salts and metals. Your Green Suppliers Network review team will assist you in examining your quenchant and evaluate cleaner alternatives. Whenever possible, oil should be replaced with either water or a polymer quenchant. Polymer quenchants are effective replacements since they do not pose the fire hazards associated with oil use and are much cleaner to work with. Purchase costs for polymer quenchants are competitive with oil.

Drag-out of quenchants should also be reduced to minimize waste. Drag-out is the amount of solution retained through surface tension on the part being quenched. Replacing a high viscosity quenchant, such as oil, with a lower viscosity quenchant will reduce drag-out and consumption rates.

If customer product **SPECIFICATIONS** and performance **REQUIREMENTS** are keeping your facility from implementing changes to your metal fabrication **OPERATIONS**, the Green Suppliers Network can help. By working with **Corporate Champions**—your customers—the Network can **EASE** barriers and **FACILITATE** process improvements specific to your situation.

METAL FABRICATION QUICK LINKS

EPA Sector Notebook

www.epa.gov/compliance/resources/publications/assistance/sectors/notebooks/fabric.htm

A document focusing on a comprehensive analysis of air, water, and land pollution for the metal fabrication industry, which includes metal parts washing.

P2Rx Topic Hub for Metal Fabrication

www.p2rx.org/topichubs/toc.cfm?hub=23&subsec=7&nav=7

A quick guide to essential P2 information on metal fabrication and machining, as well as a compilation of pertinent online resources.

P2 in Machining and Metal Fabrication: Manual for Technical Assistance Providers

www.newmoa.org/prevention/topichub/23/NEWMOAmanual.pdf

An overview of metal fabrication industry, regulatory requirements, and opportunities for increased efficiency and environmental improvement.



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(7409M)
November 2007
www.epa.gov

