

# Advanced CNC Waterjet Cutting Is Transforming Metal Foundries

## Introduction

Advanced CNC waterjet cutting is a cold cutting technology that uses high-pressure water, often mixed with abrasive particles, to precisely cut metal without generating heat.

In modern metal foundries, where precision, material integrity, and production efficiency directly affect profitability, this technology is reshaping how cast components are finished and refined.

Foundries worldwide are under pressure to reduce scrap, shorten lead times, and meet tighter dimensional tolerances while processing an expanding range of alloys.

Industry manufacturing reports indicate that secondary machining and finishing can account for up to 30 percent of total casting costs, making process optimization a priority rather than an option.

This article explains how advanced CNC waterjet cutting works, why foundries are adopting it, what materials and applications benefit most, and how it compares to traditional cutting methods.

You will also see how this technology integrates into modern foundry workflows and where its limitations still exist.



## **What Is Advanced CNC Waterjet Cutting?**

Advanced CNC waterjet cutting is a manufacturing technology that removes material using a focused stream of ultra-high-pressure water, often combined with abrasive media, controlled by computer numerical control systems.

Within metal foundries, this technology enables precise post-casting trimming, contour cutting, and complex shaping without altering the material's microstructure.

CNC control allows digital CAD models to be translated directly into cutting paths.

This improves repeatability while reducing manual intervention and operator variability.

Unlike thermal cutting processes, waterjet cutting does not create a heat-affected zone.

That characteristic is critical for cast metals that are sensitive to thermal stress, warping, or microcracking.

Because cutting force is applied through a fluid stream rather than mechanical contact, brittle or heterogeneous cast materials can be processed with minimal stress.

This versatility makes CNC waterjet cutting highly compatible with modern foundry operations.

## **Why Are Metal Foundries Adopting CNC Waterjet Cutting?**

Metal foundries are adopting CNC waterjet cutting because it delivers precise, flexible, non-thermal material removal, reducing downstream processing challenges.

As casting designs become more complex and tolerances tighter, conventional cutting methods struggle to maintain consistency.

Waterjet cutting supports both productivity and quality.

It enables accurate removal of gates, risers, and excess material without introducing metallurgical changes.

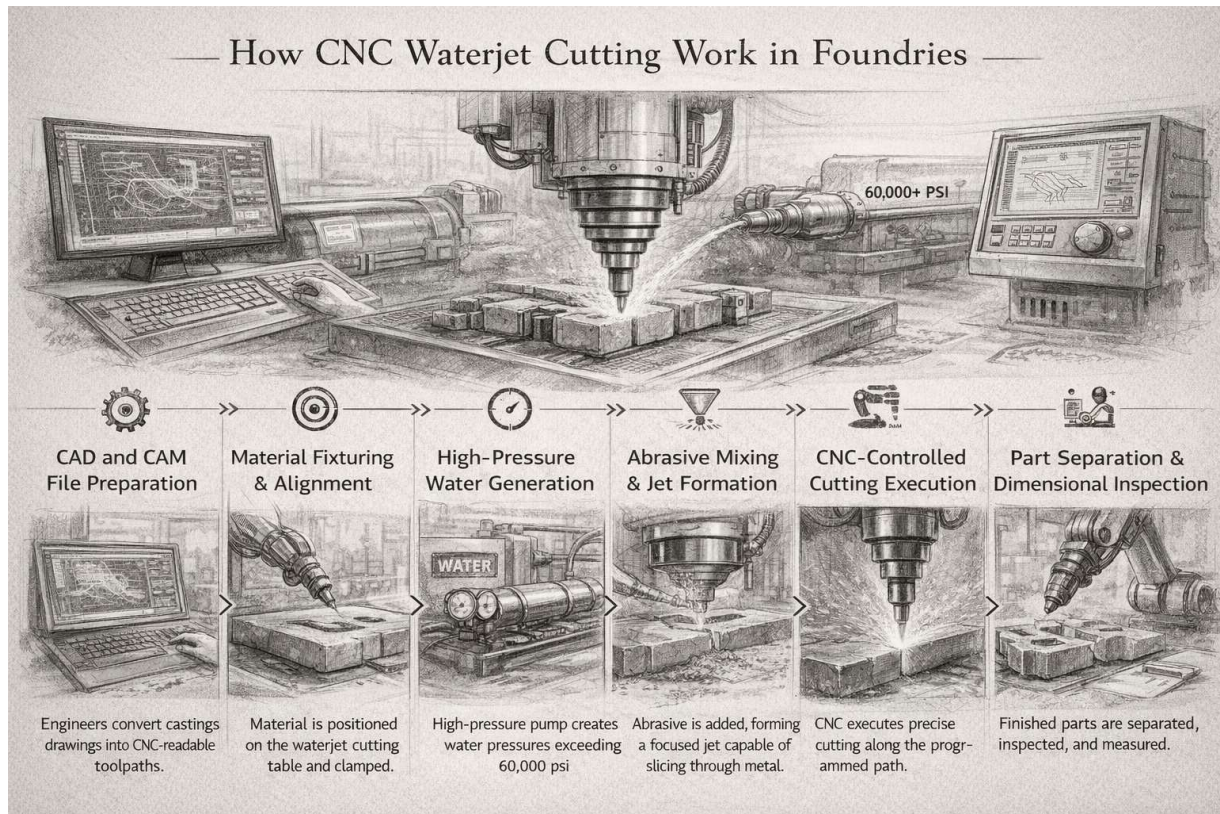
Material versatility is another key driver.

Foundries increasingly work with aluminum, stainless steel, high-nickel alloys, and specialty metals that are difficult to cut with heat-based methods.

Environmental and safety considerations also influence adoption.

Waterjet cutting produces no fumes, minimal dust, and lower noise levels compared to abrasive or thermal methods, helping facilities meet modern workplace standards.

# How Does CNC Waterjet Cutting Work in Foundry Applications?



CNC waterjet cutting is a process that uses pressurized water, accelerated through a small orifice, to erode metal along a programmed path.

In foundry applications, abrasive particles are added to increase cutting power for thick or hard cast metals.

The process begins with digital preparation.

Engineers convert casting drawings into CNC-readable toolpaths that define exact cutting geometry.

Once material is positioned, a high-pressure pump generates water pressures exceeding 60,000 psi.

Abrasive material is introduced, forming a focused jet capable of slicing through dense metal.

The main stages of CNC waterjet cutting in foundries include:

1. CAD and CAM file preparation
2. Material fixturing and alignment
3. High-pressure water generation

4. Abrasive mixing and jet formation
5. CNC-controlled cutting execution
6. Part separation and dimensional inspection

This sequence ensures consistent edge quality and dimensional accuracy across production runs.

## **What Types of CNC Waterjet Cutting Systems Are Used in Metal Foundries?**

CNC waterjet cutting systems are machine categories designed to deliver controlled high-pressure cutting for different production needs.

In foundries, system selection depends on material thickness, part complexity, and required throughput.

Some systems prioritize speed and simplicity.

Others emphasize multi-axis precision for complex geometries and tight tolerances.

Understanding these distinctions helps foundries select equipment that aligns with their operational goals.

### **Pure Waterjet Cutting Systems**

Pure waterjet cutting systems use pressurized water without an abrasive to cut softer materials.

In foundries, they are typically used for non-metallic molds, patterns, gaskets, and composite components.

These systems rely on water velocity rather than abrasive erosion.

They offer clean cuts and low maintenance, but are unsuitable for metal trimming.

Their value lies in simplicity and cost efficiency.

For metal components, abrasive systems are required.

### **Abrasive Waterjet Cutting Systems**

Abrasive waterjet cutting systems mix abrasive particles with high-pressure water to cut metal and hard materials.

This is the primary technology used in metal foundries.

These systems cut cast steel, aluminum, stainless steel, and exotic alloys with consistent accuracy.

They are widely used for trimming thick sections, removing risers, and cutting intricate profiles.



Many foundries rely on [advanced waterjet cutting systems](#) for industrial metal processing to achieve durability, precision, and production-scale reliability.

## **Multi-Axis CNC Waterjet Systems**

Multi-axis CNC waterjet systems add rotational and angular movement to the cutting head.

They are used for beveled edges, complex contours, and three-dimensional geometries standard in advanced cast components.

These systems reduce the need for secondary machining.

They are increasingly important in aerospace, automotive, and heavy equipment foundries.

## **What Are the Main Advantages of CNC Waterjet Cutting for Metal Foundries?**

CNC waterjet cutting offers several advantages that directly address common foundry challenges.

These advantages improve quality, efficiency, and operational flexibility.

There are six main advantages of using CNC waterjet cutting in metal foundries:

1. Preserve material properties by eliminating heat-affected zones
2. Improve dimensional accuracy through CNC-controlled cutting paths
3. Reduce secondary machining by producing clean, burr-free edges
4. Support complex geometries that are difficult to achieve mechanically
5. Increase material versatility across ferrous and non-ferrous alloys
6. Enhance sustainability by minimizing waste and emissions

Each benefit compounds over time, helping foundries streamline operations while maintaining consistent output quality.

## **What Are the Limitations of CNC Waterjet Cutting in Foundry Environments?**

CNC waterjet cutting also has limitations that must be considered.

Understanding these constraints ensures appropriate deployment.

There are five primary limitations associated with CNC waterjet cutting:

1. Increase operating costs due to abrasive consumption
2. Limit cutting speed on extremely thick metal sections
3. Require water management and recycling systems

4. Demand skilled programming for complex parts
5. Reduce efficiency for very high-volume simple cuts

Despite these factors, most foundries find the trade-offs acceptable when applied strategically.

## **CNC Waterjet Cutting vs Traditional Foundry Cutting Methods**

CNC waterjet cutting differs from traditional cutting methods by providing cold, precision-controlled material removal.

Plasma, oxy-fuel, and mechanical cutting rely on heat or force that can compromise casting integrity.

Waterjet cutting excels in accuracy and flexibility.

Thermal methods cut faster on thick steel but introduce distortion and oxidation.

Mechanical sawing offers simplicity but limited geometric freedom.

A comparison table should evaluate accuracy, thermal impact, material range, operating cost, and flexibility to guide equipment selection.

## **What Metals Can Be Processed with CNC Waterjet Cutting in Foundries?**



CNC waterjet cutting is a versatile process suitable for a wide range of cast metals.

Its cold-cutting nature makes it ideal for heat-sensitive materials.

Commonly processed metals include cast steel, cast aluminum, cast iron, and high-nickel alloys.

Each responds differently based on physical and metallurgical properties.

### **Cast Steel**

Cast steel is a ferrous alloy known for strength and toughness.

Waterjet cutting trims cast steel accurately without introducing thermal stress.

### **Cast Aluminum**

Cast aluminum is lightweight and thermally sensitive.

Waterjet cutting prevents melting, warping, and oxidation.

### **Cast Iron**

Cast iron is brittle and carbon-rich.

Waterjet cutting minimizes cracking by applying low mechanical stress.

## **Exotic and High-Nickel Alloys**

Exotic alloys are engineered for extreme conditions.

Abrasive waterjet cutting processes these alloys without tool wear or thermal degradation.

## **What Are the Key Applications of CNC Waterjet Cutting in Metal Foundries?**

CNC waterjet cutting supports a wide range of foundry applications.

These applications improve productivity and reduce rework.

There are six primary applications of CNC waterjet cutting in metal foundries:

1. Gating and riser removal
2. Post-casting trimming and finishing
3. Prototype and low-volume cutting
4. Tooling and fixture fabrication
5. Complex contour shaping
6. Repair and modification of cast components

Each application benefits from precision and flexibility.

## **How Accurate Is CNC Waterjet Cutting for Foundry Components?**

CNC waterjet cutting is highly accurate, typically achieving tolerances of  $\pm 0.1$  mm to  $\pm 0.3$  mm, depending on material thickness.

This precision supports most post-casting operations.

Repeatability is ensured through CNC motion control.

Consistent edge quality reduces the need for secondary machining.

## **How Much Does CNC Waterjet Cutting Cost for Foundries?**

CNC waterjet cutting costs vary based on equipment and usage.

Average operating costs typically range from \$75 to \$150 per hour.

Five key factors influence cost:



1. Machine size and pressure capability
2. Abrasive type and consumption rate
3. Material thickness and hardness
4. Programming complexity
5. Maintenance and labor

Cost awareness supports accurate budgeting and ROI analysis.

## How to Integrate CNC Waterjet Cutting into an Existing Foundry Workflow



Integrating CNC waterjet cutting involves assessment, equipment selection, and training.

There are three main steps to successful integration.

### Step 1: Assess Cutting and Finishing Bottlenecks

This step identifies inefficiencies in current processes.

Scrap rates, cycle times, and rework areas are analyzed.

### Step 2: Select the Right CNC Waterjet Configuration

This step focuses on machine size, pressure rating, and axis capability.

Integration with [CNC press brake machines](#) ensures workflow continuity across cutting and forming operations.

### **Step 3: Train Operators and Integrate CAD/CAM**

Training ensures accurate programming and safe operation.

CAD/CAM integration enables digital production efficiency.

## **What Safety Considerations Apply to CNC Waterjet Cutting in Foundries?**

CNC waterjet cutting safety centers on high-pressure systems and abrasive handling.

Proper procedures reduce operational risk.

Protective equipment, pressure monitoring, noise control, and water management are essential.

Clear protocols ensure safe and consistent operation.

## **What Does the Future Hold for CNC Waterjet Cutting in Metal Foundries?**

The future of CNC waterjet cutting is driven by automation and digital connectivity.

Sensors, robotics, and Industry 4.0 integration will expand capabilities.

Multi-axis systems will become more common.

Sustainability improvements will further reduce waste and resource consumption.

## **Conclusion**

Advanced CNC waterjet cutting is transforming metal foundries by delivering precision, flexibility, and material integrity.

Its cold cutting capability addresses many limitations of traditional methods.

As foundries modernize, waterjet cutting shifts from an optional tool to a strategic production asset.

Facilities that integrate it effectively gain long-term advantages in quality, efficiency, and competitiveness.