



# Producing Medical Parts Efficiently with EDM

AI-based software, CMM help contractor produce parts from limited data

— by Robert S. Seeley, Nik Vitullo Advertising

Molded parts are machined by wire EDM

New Jersey Precision Technologies Inc, Mountainside, NJ, gives design engineers an assist from software that automatically interprets a customer's CAD data and runs the shop's CNC EDM machines and machining centers. The 25-person shop performs two-thirds of its work for the medical industry in addition to similar work for plastic extrusion and molding, OEM and aerospace industries, and general tool and die work. Besides mass-producing medical items such as bone screws and orthopedic surgical cutting blocks, the company manufactures custom medical parts such as patella-, total knee-, or hip-implants; end effects of catheters; and tools to fabricate angioplasty catheter stents. The contract manufacturer does work for major medical device companies and their trauma and custom groups.

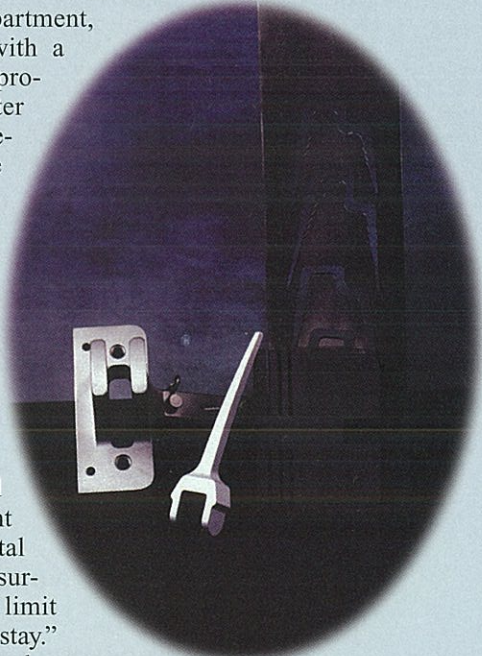
Between mass production by robot loading and CNC EDM machines, artificial intelligence-based software and CMM, NJPT shortens turnaround times to as soon as the next day or over the weekend compared to as long as several weeks for conventional machining. The turnaround helps shorten patient hospital stays. A digital coordinate measuring machine (CMM), further, can quickly "reverse engineer" a part sent to the shop without a blueprint or CAD file, and transmit the data into the machine tool's cutting program for production.

## Home-made software

The proprietary AI-based software system, developed by NJPT President and founder Bob Tarantino, automatically interprets the geometry and textual notations in a customer's e-mailed solid model CAD data or blueprint. Created specifically for the industries NJPT serves, the software almost entirely controls NJPT's 12 high-speed Mitsubishi CNC EDM machines and six vertical and horizontal CNC machining centers. It eliminates the need for engineers or operators to program the machine tools and continually re-check data. The program automatically checks errors and generates red circles that identify any incorrect or missing information. It also analyzes and identifies any conflicts in the data that would affect machining of the part. As output, the software creates the manufacturing program including tool path, feeds and speeds to make the part.

As an example of a custom part produced via the AI software, a medical device company needed a bone staple for a scheduled surgery within a few days. The design engineer had an idea of how the barbs of the titanium staple would adhere to a corner of the bone, but wasn't sure if it could actually be manufactured. Says Tarantino, "We took his CAD file, red-lined it in our engineering department, and came up with a better way of producing it. After two or three e-mails in the morning, we were wire cutting in the afternoon, and shipped the component that evening for receipt the following morning. This response helped get the patient out of the hospital to meet the insurance company's limit for the patient's stay."

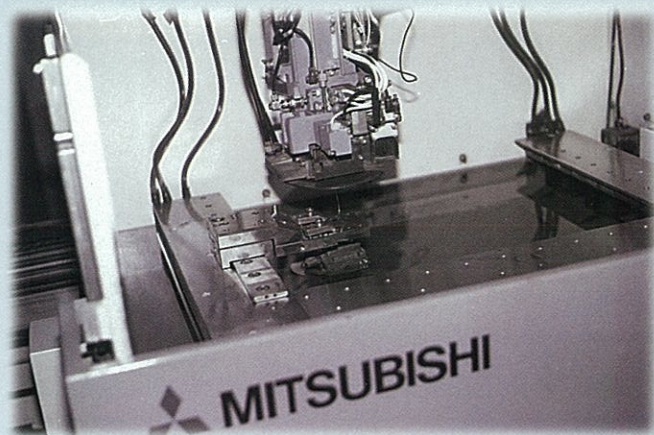
Most design and manufacturing iterations between NJPT and custom-



Samples of orthopedic parts and hip component.

ers rely on interchange of electronic data, i.e., CAD data, via e-mail. The company uses five commercially available CAD programs, providing compatibility with all customers' CAD files.

A customer without blueprints or CAD file can even send a part to NJPT, which "reverse engineers" it with a Brown & Sharpe digitizing CMM (coordinate measuring machine). The digitized 3-D geometry then goes directly into NJPT's custom CAD/CAM system.



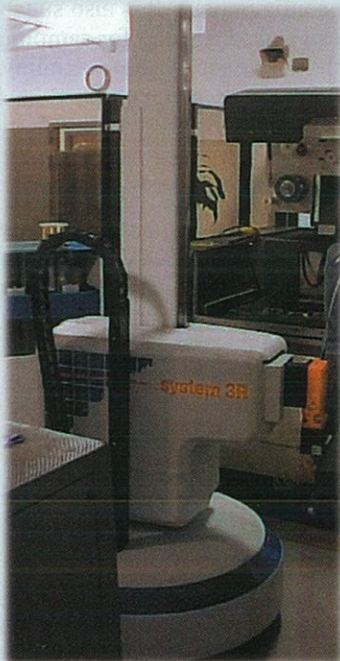
NJPT has 12 high-speed Mitsubishi CNC EDM machines.

### EDM faster than conventional machining

A conventional shop outfitted with CNC milling machines, says Tarantino, would take several weeks to produce complex parts such as implants. Conventional machining requires working with soft metals, then sending the part to a heat-treater to harden it, followed by finish grinding. However, heat-treating can sometimes distort the part.

EDM cutting action is suited to hard metals, and can also cut contours and shapes in heat-treated metal, so dimensional accuracy remains stable (see sidebar). As a limitation, EDM can only cut metal and cut contours and shapes in 2-1/2 dimensions.

Drawing from its stock of various grades of hardened stainless steel, titanium alloys, cobalt chrome and other metals, NJPT mass-produces items in a manufacturing cell that uses a System 3R pallet loader robot loading two Mitsubishi 5-axis high-speed EDM machines. Unattended machining takes place on a third shift. Tarantino points out that this mass production via robots and CNC attains economies of scale to reduce prices.



System 3R robot loads EDM machine in mass-producing orthopedic surgery and other parts.

### Bone screw production

NJPT produces about 10-15,000 bone screws per month for major orthopedic companies. A ram EDM cell is dedicated to creating hex, lined, torque and other shapes in the screws (a ram, or "sinker," EDM penetrates a part with a copper or graphite conductive electrode to produce the shape). According to Tarantino, broaching, the conventional way of machining bone screws, can leave a small burr in the bottom of the hex. "These little burrs over time

break loose and lodge in ligaments surrounding the bone, causing a lot of pain. EDM is the best process for bone screws, because it machines burr-free and more accurately," he says.

Helping multiply NJPT's bone screw output, the company retains thousands of CAD files on almost every type of bone screw. The company has developed fixtures, electrode holders and screw holders "for every size screw we've seen. We have thousands of possibilities of screw and electrode combinations," says Tarantino. This capability allows NJPT to invoice for bone screws and other parts without tooling and setup charges.

With this mass production and data storage capability, Tarantino says he can ship an order for 1000 screws within a day or two, where conventional machining would take more than a week. Toward the future, Tarantino says he plans to offer customers the ability to track jobs via his web site from the 400 jobs on the floor at any given time. Efficient medical part machining will continue to improve.

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## EDM means clean machining

In EDM (electrical discharge machining), an electrode removes metal using energy generated by sparks between the electrode and the work piece. The operation is performed in a dielectric fluid, usually deionized water, to prevent premature spark discharge. The fluid also cools the work piece and flushes away the small particles from the gap.

Wire EDM cuts conductive materials with a thin wire electrode that follows a programmed path, creating a contour in one continuous operation. As the wire feeds from reel to reel, sparks of electrical energy progressively erode the work piece along a path determined by the relative motion of the machine's axis. No physical contact takes place between the wire and the part, and no burrs are generated. Typical wire diameters range from 0.004- to 0.012-in. Hardness of the work piece material has no detrimental effect on the cutting speed. Pieces over 16-in. thick can be machined. Wire EDM can be accurate to +/-0.0001 in.

Since no cutting forces are present, wire EDM is ideal for delicate parts. Time to completion is short because no tooling is required. EDM needs fewer machining sequences than conventional machining and minimal post-machining operations. Parts are machined after heat treatment, so dimensional accuracy holds, unaffected by heat treat distortion. *D&A*