

# Modern Applications News

JUNE  
2000

THE METALWORKING IDEA MAGAZINE

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**Modular Fixturing  
System Halves Robot  
Welding Cycle Time**

## COVER STORY

# Modular Fixturing System Slashes Robot Welding Cycle Time By Half

Expanding manufacturing requirements and shrinking budgets have persuaded many manufacturers to partner with their suppliers to shoulder a larger share of the production burden.

Progressive, farsighted companies have accepted this challenge by striving to offer a greater range of services and capabilities to their customers. From custom and specialty product assistance to complete fabrication, these shops offer service support well beyond the norm.

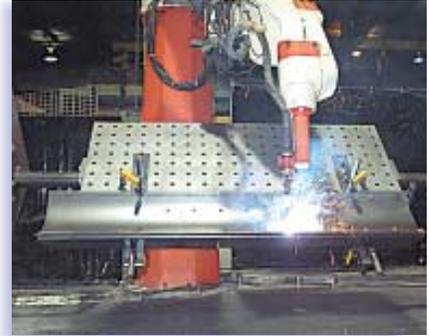
nomical means of producing many of these parts. As a result, in their commitment to cutting-edge technologies and to provide their customers with better service, Super Steel has attempted to automate many of the jobs.

Super Steel Products utilizes robotic welders. However, robots are not always ideal when used with the customer-specified fixtures. Frequently, problems would occur between these fixtures and the robots. Since robots are automated tools that will only go where they are programmed to go, for example, if the robot welder arrives at a spot where a seam is supposed to be and the seam is not there, it will run a bead of weld anyway.

Typically, these jobs require highly accurate fixtures to maintain the required precision and repeatability needed from one production run to the next. As a job shop, it would be impractical for Super Steel to justify the cost of upgrading the customer's fixtures for robotic welding because the future of each contract is always uncertain. Since their customers did not want to modify their existing tooling or spend the additional money for new fixtures, Super Steel had to find another way to meet its existing and projected requirements.

## Flexible Worktable Delivers Robot Precision

The solution they adopted was the Demmeler modular fixturing system from Bluco Corporation (Naperville, IL) that is designed specifically for creating welding fixtures. The main element of the system is a welded three-dimensional worktable that provides a sturdy platform for mounting the workpieces and various fixturing accessories. The table



**The modular fixture provides an accurate, repeatable means of locating the assembly for finish welding.**

is made from high tensile strength steel and is heavily ribbed for maximum stability and flatness (within 0.0004" per foot). Worktables are available in several sizes to suit many applications, and they may be used individually or joined together for larger fabricated assemblies.

Each worktable has a grid pattern of mounting holes for attaching different fixturing elements. The 28 mm (1.1") diameter holes are spaced 100 mm (3.9") apart across the face of the table. The individual mounting holes and the complete grid pattern are accurate to within 0.0015" per foot at any point on the face of the table. This grid pattern of holes also is included in the structural elements furnished with the system. To enable precise positioning of the elements between holes, some structural elements also are made with 28 mm wide slots. Combined with the mounting holes, these slots permit placement of the fixturing elements anywhere on the table that they are required.

The fixturing elements and workpiece positioners are attached to the worktables or joined together with unique positioning and clamping bolts. These hardened bolts are designed to position the individual fixturing elements precisely and to clamp them securely in place. Each bolt provides up to 3 tons of clamping force while withstanding up to 25 tons of shear force.

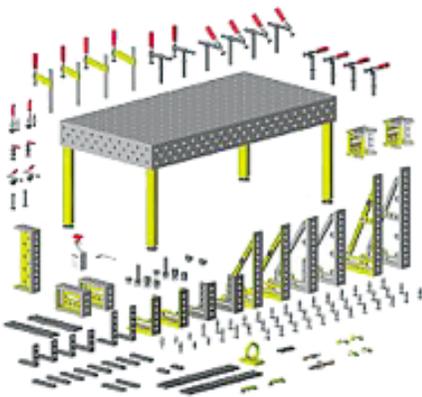


**Loose workpieces are assembled outside the robot welding area, using a customer-supplied dedicated fixture to tack-weld parts in an initial stage.**

Such is the case with Super Steel Products Corporation, a full-service fabricator headquartered in Milwaukee, WI, with additional facilities in Schenectady, NY. As a contract manufacturer servicing a number of key industrial businesses, this progressive company faces expanding customer requirements that keep it on the cutting edge of technology.

Many of Super Steel's jobs rely on specialized, dedicated fixtures. In some cases, the customer specifies that the product be produced on customer-supplied tooling. Many of these fixtures were designed and fabricated for manual operations. Unfortunately, manual welding is not always the most efficient nor eco-

In use, the positioning and clamping bolt is inserted through the fixturing element into the worktable. When everything is properly positioned, the bolts are securely tightened by turning the knurled end with a hex wrench. An integral O-ring in the shank prevents the bolt from rotating while being tightened. This tightening action extends a series of locking balls within the shank to engage the fixturing elements and the table in a chamfered recess in the bottom of each mounting hole. This action accurately centers the bolt shank in the mounting hole, enabling the bolt to apply the necessary clamping force.



**The Demmeler modular fixturing system**

An assortment of general and special purpose clamps also is available with the system to hold the pieces securely for welding. These fast-acting clamps are available as either toggle or threaded, with many of them having a relatively standard design. Some of the threaded clamps include a compensating mechanism to ensure that the clamping force is always applied perpendicular to the thread, regardless of the clamping height. This extends the clamping contact at an angle as the clamp is tightened and the clamping tube deflects slightly. This compensating mechanism neutralizes the effects of the deflection and keeps the clamp contact properly aligned to the workpiece.

Super Steel's pedestal-mounted IGM model RT welding robot has a working area that is divided into separate work cells. The program-

mer creates the program to position the robot for each part and weld operation using the robot's teach pendant. Once completed and checked, the programs are stored on a floppy disk for rapid access for repeat jobs. The setup is further documented on-site with a digital camera. The photos are used by the programmer to assist in creating the set-up sheets for each job.

**Worktable Makes Robot Cell More Productive**

In one robot cell, a Demmeler 3-D worktable (1000 mm ∞ 2000 mm) is mounted between a robot-controlled indexing table and a tailstock. A series of modular fixturing elements are installed on the table to construct the fixture for holding the parts to be welded. In this case, the pieces are assembled to produce an agricultural blade for a tractor. Outside the robot welding area, a dedicated fixture, furnished by the customer, is used to position and tack-weld the loose pieces.

Once tacked, the assembled unit is mounted in the modular fixture on the robot's table for finish welding. For this part, the new procedure has reduced the overall cycle times by about 30% over earlier methods. In addition to the increased speed, the finish welding is now more consistent and much better looking.



**Robot with a pallet changer allows robot to run while the welder sets up the next part.**



**For larger parts, a gantry robot has two Demmeler tables as floor plates.**

A second cell uses an adapter plate mounted to a robot-controlled tilting and rotating table. This part is an agricultural attachment frame; and, while the unit is smaller, the part requires the additional angular positioning provided by the tilting and rotating table. As before, the loose pieces are assembled outside the robot welding area in a customer-supplied dedicated fixture where the pieces are tack-welded in an initial step. While useful for this tacking operation, this fixture is not compatible with the robot's requirement of accuracy and access.

For the finish welding, it is important to maintain specific part positions and attitudes to eliminate weld quality problems. Occasionally, the tilting table actually passes below vertical to achieve the desired position. In this case, the modular fixture must hold the part away from the adapter plate while providing an accurate and repeatable means of locating and clamping the part. With this new modular fixture setup, the overall cycle time was reduced nearly 50% for this assembly.

The programming time required for the agricultural blade was about two hours, and assembling the more complicated agricultural attachment frame required about six hours. However, once these programs and modular fixturing were complete and recorded, repeating the setup and loading the program each time the job repeats, can be done in less than 20 minutes. ■

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