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14. ABSTRACT <b>Hamill Manufacturing Company, Trafford, Pa., was contracted to drill several hundred close-tolerance through-holes in an Inconel tube sheet component approximately four inches thick. Hamill Manufacturing had experience drilling Inconel as thick as two inches, but the added depth, large number of holes and close tolerances involved presented a new challenge. Hamill Manufacturing considered drilling and reaming the holes using the same parameters employed when drilling thinner Inconel workpieces. In that case, experience indicated that each component would require over 200 hours to produce. Additionally, if even a single hole was drilled out of specification, the part would have to be scrapped and the process started over again. Prior to commencing production, Hamill asked the National Center for Defense Manufacturing &amp; Machining (NCDMM) to suggest ways to reduce drilling time, meet required tolerances, and ensure consistent quality.</b>					
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## PROBLEM / OBJECTIVE

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## ACCOMPLISHMENTS / PAYOFF

### Process Improvement

Through existing process evaluation, the NCDMM determined that increased productivity and top quality could be achieved by applying advanced gun drilling methods. Gun drills are specialized holemaking tools designed to produce deep, straight, and accurate holes.

### Implementation and Technology Transfer

The NCDMM conducted a series of drilling tests on four-inch-thick Inconel samples to identify methods and products that would maximize savings in machining time while maintaining the required tolerances.

Analysis of test results determined the best gun drill (Star Cutter) and drill diameter for the application. The best results occurred when the gun drill entered the pilot hole rotating counterclockwise then changed to clockwise rotation when the actual drilling began. Retracting the drill from the hole with the machine spindle off was also beneficial.

The tests additionally determined the best coolant concentration and pressure level for the gun drill's

internal through-coolant system. NCDMM staff verified part quality with gage pins and an internal bore gage, then delivered all test results to Hamill for further evaluation and implementation.



NCDMM performed "proof-of-concept" machining tests on a four-inch-thick sample of Inconel. All tests were performed on a HAAS vertical CNC machining center at NCDMM.

### Expected Benefits

NCDMM estimates that:

- Gun drilling will reduce component machining time by 50% or more - an estimated cost savings of \$33,360 for 4 components
- Recommended procedures will significantly reduce scrap, rework, downtime and material costs
- The new methods will enable Hamill to meet and maintain close part tolerances.

## TIME LINE / MILESTONE

Start Date ..... June 05  
End Date ..... July 05

## PROJECT FUNDING

Project fully funded by Hamill Manufacturing Company

## PARTICIPANTS

NCDMM  
Hamill Manufacturing Company  
HAAS Machine Tool

*For additional information concerning this project, contact the NCDMM at [www.ncdmm.org](http://www.ncdmm.org)*