# Report Documentation Page

*Form Approved*
*OMB No. 0704-0188*



| 1. REPORT DATE | 2. REPORT TYPE | 3. DATES COVERED |
|---|---|---|
| **24 SEP 2004** | **Technical, Success Stories** | **19-05-2004 to 23-09-2004** |

| 4. TITLE AND SUBTITLE | 5a. CONTRACT NUMBER |
|---|---|
| **CH-53 Gun Yoke** | 5b. GRANT NUMBER |
| | 5c. PROGRAM ELEMENT NUMBER |
| 6. AUTHOR(S) | 5d. PROJECT NUMBER **04-0036-04** |
| | 5e. TASK NUMBER |
| | 5f. WORK UNIT NUMBER |
| 7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **National Center for Defense Manufacturing & Machining,1600 Technology Way,Latrobe,PA,15650** | 8. PERFORMING ORGANIZATION REPORT NUMBER |
| 9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) | 10. SPONSOR/MONITOR'S ACRONYM(S) |
| | 11. SPONSOR/MONITOR'S REPORT NUMBER(S) |

12. DISTRIBUTION/AVAILABILITY STATEMENT
**Approved for public release; distribution unlimited**

13. SUPPLEMENTARY NOTES

14. ABSTRACT
**Augustine Die & Mold, Inc, of Somerset, Pa., is producing gun turret components for various military helicopters, including the Sikorsky CH-53. Machining a 12" wide, 18" long, 10" thick, horseshoe-shaped aluminum gun yoke was a challenge; roughing operations alone were taking over 3-4 hours for each yoke. Additionally, existing processes created stresses that distorted the part, requiring straightening operations that consumed about anhour. Augustine sought the help of NCDMM to reduce machining time and eliminate residual stress.**

15. SUBJECT TERMS
**NCDMM; Augustine Die & Mold, Inc; Sikorsky CH-53**

| 16. SECURITY CLASSIFICATION OF: | | | 17. LIMITATION OF ABSTRACT | 18. NUMBER OF PAGES | 19a. NAME OF RESPONSIBLE PERSON |
|---|---|---|---|---|---|
| a. REPORT | b. ABSTRACT | c. THIS PAGE | | | |
| **unclassified** | **unclassified** | **unclassified** | **1** | **1** | |

# CH-53 Gun Yoke

**NCDMM Project No. 04-0036-04**

Technical Report

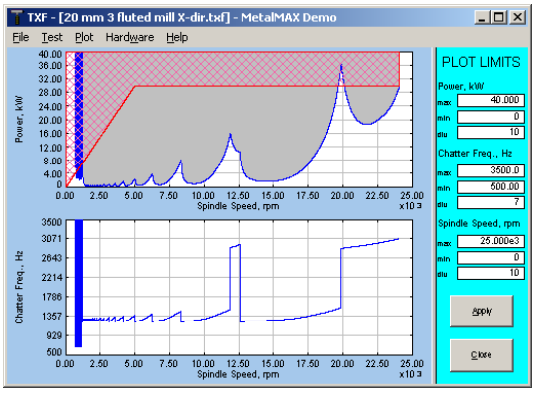
## PROBLEM / OBJECTIVE

Augustine Die & Mold, Inc, of Somerset, Pa., is producing gun turret components for various military helicopters, including the Sikorsky CH-53. Machining a 12" wide, 18" long, 10" thick, horseshoe-shaped aluminum gun yoke was a challenge; roughing operations alone were taking over 3-4 hours for each yoke. Additionally, existing processes created stresses that distorted the part, requiring straightening operations that consumed about an hour. Augustine sought the help of NCDMM to reduce machining time and eliminate residual stress.

## ACCOMPLISHMENTS / PAYOFF

***Process Improvement***

NCDMM analyzed the operation and applied modal analysis technologies from alliance partners Design & Manufacturing Solutions, Inc. (DMS) and Manufacturing Laboratories, Inc. (MLI). Modal analysis can determine the cutting characteristics of individual tools while they are mounted in the machine tool. The information is used to create stability lobe diagrams revealing the combinations of cutting speeds and feed rates that can best deliver high productivity without chatter.

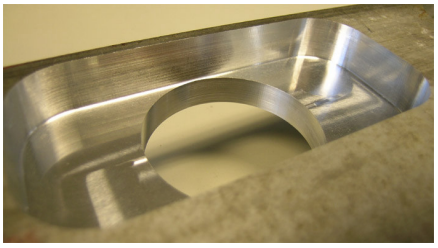



Stability Lobe Diagram

NCDMM also recommended the application of the new Mill 1 indexable insert endmills featuring insert coatings designed especially for milling of aluminum by alliance partner Kennametal Inc. The Mill 1 tool and advanced programming techniques aided in the reduction of both machining time and of the number of tools required to machine the part.

***Implementation and Technology Transfer***

The modal analysis indicated that chatter-free operation could be achieved at an 8,000 revolutions per minute (rpm) spindle speed and 300 inches per minute (ipm) feed rate, compared to the 4,500 rpm and 90 ipm used previously. NCDMM demonstrated a "proof-of-concept" part to confirm the analysis.



"Proof-of-Concept" Part

Roughing time dropped from over three hours to approximately 25 minutes. The new cutting parameters and tooling significantly reduced cutting forces. Stress and distortion were eliminated, as was the time required to straighten the workpiece.

***Expected Benefits***

In summary, implementation produced:

- An immediate 85 percent reduction in time required for roughing
- Elimination of time required for straightening operations
- Reductions in finishing operations

Further savings are expected following full implementation of NCDMM recommendations. Savings of $40,000 over the length of the initial order will be realized based on the average hourly rate for this area. ***NOTE:*** Savings based on an average $60/hour shop rate for the Southwest Pa. area.

## TIME LINE / MILESTONE

Start Date.....May 04
End Date.....September 04

## PROJECT FUNDING

NCDMM funding.....$10K

## PARTICIPANTS

Augustine Die & Mold, Inc.
Design & Manufacturing Solutions, Inc. (DMS)
Kennametal Inc.
Manufacturing Laboratories, Inc. (MLI)

*For additional information concerning this project, contact the NCDMM at www.ncdmm.org*