

### CONFERENCE TIME TABLE

(All rooms in Mellon Institute except as noted.)

#### SUNDAY, MAY 4, 1975

Registration and Refreshments — 7:00 - 9:00 p.m. — Social Room, 3rd Floor, Mellon Institute (Use Bellefield Street Entrance)

#### MONDAY, MAY 5, 1975

Registration 8:00 a.m. Social Room  
 Session 1 8:30 a.m. Auditorium  
 Morning Break 10:30 a.m. Social Room  
 Sessions 2, 3 11:00 a.m. Auditorium, Conference Room  
 Lunch 12:30 p.m. Webster Hall Hotel  
 Sessions 4, 5 2:00 p.m. Auditorium, Conference Room  
 Afternoon Break 3:30 p.m. Social Room  
 Sessions 6, 7 4:00 p.m. Auditorium, Conference Room  
 Reception 6:30 — 7:30 p.m. Webster Hall Hotel  
 Dinner 7:30 — 9:30 p.m. Webster Hall Hotel

#### TUESDAY, MAY 6, 1975

Registration 8:00 a.m. Social Room  
 Sessions 8, 9 8:30 a.m. Auditorium, Conference Room  
 Morning Break 10:00 a.m. Social Room  
 Sessions 10, 11 10:30 a.m. Auditorium, Conference Room  
 Lunch 12:00 noon Webster Hall Hotel  
 Sessions 12, 13 1:30 p.m. Auditorium, Conference Room  
 Afternoon Break 3:00 p.m. Social Room  
 Sessions 14, 15 3:30 p.m. Auditorium, Conference Room  
 Evening Free

#### WEDNESDAY, MAY 7, 1975

Registration 8:00 a.m. Social Room  
 Session 16 8:30 a.m. Auditorium  
 Sessions 17, 18 9:15 a.m. Auditorium, Conference Room  
 Morning Break 10:45 a.m. Social Room  
 Sessions 19, 20 11:15 a.m. Auditorium, Conference Room  
 Program Concludes 12:30 p.m.

### PROCEEDINGS

A 975 page hard cover bound copy of the PROCEEDINGS will be given to each full paid registrant attending the Conference. Additional copies may be purchased at the time of registration for \$35.00. After May 7, 1975, the PROCEEDINGS will be available from SME's Publication Sales Department, 20501 Ford Road, Dearborn, MI 48128 at a cost of \$40.00.



Carnegie-Mellon University

SITE OF THE ...

# THIRD NORTH AMERICAN METALWORKING RESEARCH CONFERENCE NAMRC-III

MAY 5-7, 1975, PITTSBURGH, PA.

With the participation of the following:



Scientific Engineering and Research Personnel in the Field of Metalworking  
 Please take note: An International Conference on Metalworking

SH 400 Carnegie-Mellon University Processing Research Institute  
 Schenley Park  
 Pittsburgh, Pa 15213

NAMRC-III

## REGISTRATION TIME AND PLACE

Mellon Institute - Social Room  
4400 Fifth Avenue  
Pittsburgh, PA 15213  
7-9 p.m. Sunday, May 4, 1975  
8:00 a.m. May 5, 6, 7, 1975

## ADVANCED REGISTRATION

Registration by mail before April 21 is recommended to avoid congestion at the time of the Conference and to assure the possibility of attendance and accommodations.

Please give a complete mailing address on the registration card. The registration fee is \$140.00. A check in this amount payable to NAMRC-III/CMU should accompany the registration card.

## REGISTRATION ON ARRIVAL

The registration desk will be open during the sessions. The desk will be located at the Social Room of Mellon Institute (3rd floor). Registration with refreshments will also take place in the Mellon Institute, 7-9 p.m., on Sunday, May 4, in the Social Room. If you do not register in advance by mail, you are urged to bring the completed registration card when you register on arrival.

## CONFERENCE LOCATION

All sessions will be held in Mellon Institute, 4400 Fifth Avenue, Pittsburgh, PA 15213. Parking is available in the Webster Hall parking lot.

## TRANSPORTATION

Pittsburgh is served by many of the nation's major airlines. Buses and train service are also available although less convenient. The Greater Pittsburgh Airport is located 18 miles (1 1/2 hour) South of the Mellon Institute building and the Webster Hall Hotel in Oakland. A limousine leaves the Airport directly for the Webster Hall Hotel every hour on the hour until 9 p.m. At other times a limousine leaves the Airport for the downtown hotels at 20 minute intervals. When going via downtown, it is convenient to go to the Hilton Hotel and take a cab from there to the Webster Hall Hotel. The cab fare from the airport to the Webster Hall Hotel is approximately \$11.00.

## REGISTRATION FEES

	Participant	Ladies Program
Full Conference	\$140	\$40
Monday or Tuesday Only	\$100	\$20
Wednesday Only	\$ 60	—

The fees include participation at sessions, breaks, lunches, conference dinner and one copy of the NAMRC-III PROCEEDINGS. Additional copies of the NAMRC-III PROCEEDINGS will be available at the Conference at \$35.00 per copy. The fees do not include accommodations, breakfasts, lunch on Wednesday or dinner on Tuesday.

**RESERVATIONS** will be accepted on a "first come, first served" basis. Your registration should be received no later than April 21. Registrations after this deadline should be made by telephone or wire. Your registration should be confirmed prior to attending the program. To insure attendance, early registration is advised. Space may be reserved by individuals required to obtain employer authorization. Companies may place reservations and send names at a later date.

**TAX DEDUCTION OF EXPENSES:** An income tax deduction is allowed for expenses of education (including registration fees, travel, meals, lodging) undertaken to maintain and improve professional skills (see Treas. Reg. 1.162-5).

## LADIES PROGRAM

An interesting program is being planned for those not participating in the technical sessions. This will provide an opportunity of visiting some of the resources of general interest on the Carnegie Tech campus, in the Oakland area, and in downtown Pittsburgh. The program is being organized for Monday and Tuesday only. The ladies will be free on Wednesday morning to do as they wish. Since bus and other facilities must be booked in advance of the meeting, we will greatly appreciate early registration so that we may properly plan these events. If you will be accompanied by someone interested in this program, please check the appropriate box on the registration form.

## CONFERENCE SPONSOR

Processing Research Institute  
of  
Carnegie-Mellon University  
in conjunction with  
The American Society of Mechanical Engineers  
The Canadian Society of Mechanical Engineers  
The National Science Foundation of the USA  
The Society of Manufacturing Engineers

## CONFERENCE PROSPECTUS

The Third North American Metalworking Conference (NAMRC-III) has as its purpose and scope the presentation and discussion of the results of basic and applied metalworking research. The format of the Conference is similar to NAMRC-I held at McMaster University in 1973 and NAMRC-II at the University of Wisconsin in 1974.

In addition to original papers in the fields of forming, cutting and grinding, machine tool design, control and stability, friction, wear and finish, and electrical removal methods, there will be three invited keynote papers. These will be presented by experts from Great Britain, Germany, and Japan. All papers presented at the Conference are contained in the Conference PROCEEDINGS which will be available at the time of the meeting.

## CONFERENCE ORGANIZATION

The North American Metalworking Conferences have been created by a group in North America dedicated to furthering knowledge, its dissemination and application in the field of materials processing.

The quality of papers presented is the responsibility of the Scientific Committee of the North American Metalworking Research Group. All of the technical arrangements for this Conference were carried out by the NAMRC-III Organizing Committee.

### SCIENTIFIC COMMITTEE

- |   |                          |
|---|--------------------------|
| J. Boltlinger<br>University of Wisconsin            | M. DeVries for ASME      |
| L. Colwell<br>University of Michigan                | J. Watson for CSME       |
| N. Cook<br>Massachusetts Institute<br>of Technology | B. Chern for NSF         |
| D. French<br>University of Waterloo                 | M. Field for SME         |
| S. Kobayashi<br>University of California            | G. Dieter, CMU           |
| I. Le May<br>University of Saskatchewan             | C. Hilpert, CMU          |
| W. Rice, CHAIRMAN<br>Queen's University             | F. Paul, CMU             |
| J. Szehey<br>University of Waterloo                 | W. Sauer, CMU            |
| M. Shaw<br>Carnegie-Mellon University               | M. Shaw, CMU (CHAIRMAN)  |
| J. Tlusty<br>McMaster University                    | A. Weinstein, CMU        |
| B. von Turkovich<br>University of Vermont           | J. Brecker, Westinghouse |
| S. Wu   |                          |

# THIRD NORTH AMERICAN METALWORKING RESEARCH CONFERENCE Carnegie-Mellon University

## MONDAY, MAY 5, 1975

8:00 a.m. Registration — Social Room  
**SESSION 1** 8:30 a.m. Auditorium

### CHAIRMAN

William B. Rice, *Chairman*, Scientific Committee, NAMRC-III and Head, Mechanical Engineering Department, Queen's University, Kingston, Ontario;  
 Words of Welcome — Richard M. Cyert, President of Carnegie-Mellon University;  
 Introductory Remarks — William B. Rice;

Announcements — George E. Dieter, *Director*, Processing Research Institute, Carnegie-Mellon University.  
 9:00 Keynote Paper I

"Recent Developments in the Theory and Practice of Metal Forming", G. W. Rowe, University of Birmingham, England;  
 9:45 Keynote Paper II

"Fields of Research in Cutting and Grinding at the Laboratorium Fur Werkzeugmaschinen Und Betriebslehre of the Technical University Aachen", W. Koenig, Aachen Technische Hochschule, Germany.  
 Break — 10:30 - 11:00 a.m. — Social Room

**SESSION 2** 11:00 a.m. Auditorium

### CO-CHAIRMEN

B. Avitzur, Lehigh University, Bethlehem, Pennsylvania;  
 G. E. Dieter, Carnegie-Mellon University, Pittsburgh, Pennsylvania;  
 AUTHORS

"Analysis of the Three-Dimensional Metal Flow in Extrusion of Shapes with the Use of Dual Stream Functions", V. Nagpal, T. Altan, Battelle Columbus Laboratories, Columbus, Ohio;  
 "Effects of Ram Speed and Size on the Required Extrusion Pressure", R. G. Fenton, University of Toronto, Toronto, Ontario;  
 "Unsteady Hydrostatic Extrusion", W. R. D. Wilson, S. M. Mahdavian, University of Massachusetts, Amherst, Massachusetts.

**SESSION 3** 11:00 a.m. Conference Room

### CO-CHAIRMEN

M. F. DeVries, University of Wisconsin, Madison, Wisconsin;  
 R. Komanduri, Carnegie-Mellon University, Pittsburgh, Pennsylvania;  
 AUTHORS

"An Instrumented Milling Machine for Developing Machining Data Required for Adaptive Control", N. Zlatin, R. C. Garrison, V. A. Tpinis, Metcut Research Associates, Inc., Cincinnati, Ohio;  
 "A Compilation of Data on the Effect of Machining and Metallurgical Variables on the Chip-Tool Interface Temperature", B. S. Levy, R. W. Thompson, Inland Steel Research Laboratories, East Chicago, Indiana;  
 "Investigation of the Optimum Tool Life Under Varied Cutting Conditions", C. H. Kahng, G. A. Patterson, Michigan Technological University, Houghton, Michigan;  
 "Cutting Rate-Tool Life (R-TL) Characteristic Functions for Three Machining Variables — Theory and Applications", V. A. Tpinis, Metcut Research Associates, Inc., Cincinnati, Ohio;

**SESSION 4** 2:00 p.m. Auditorium

### CO-CHAIRMEN

M. Y. Friedman, Technion-Israel Institute of Technology, Haifa, Israel;  
 LUNCHEON — 12:30 - 2:00 — Webster Hall Hotel

**SESSION 5** 2:00 p.m. Conference Room

### CO-CHAIRMEN

J. B. Watson, WABCO, Ltd., Hamilton, Ontario;

A. S. Weinstein, Carnegie-Mellon University, Pittsburgh, Pennsylvania;

### AUTHORS

"Effects of Conditions at the Billet-Die Interface in Hot Forging", W. C. Keung, T. A. Daan, L. F. Jensch, University of Birmingham, Birmingham, England;  
 "A Study of Deformation in Simple Forging with Variable Friction", G. W. Rowe, T. F. Li, University of Birmingham, Birmingham, England, L. E. Farmer, University of New South Wales, Australia;  
 "High Strain Rate Forging of High Strength Zn-Al Alloys", R. W. Balliett, P. H. Abramowitz, St. Joe Minerals Corporation, Monaca, Pennsylvania.

**SESSION 5** 2:00 p.m. Conference Room

### CO-CHAIRMEN

J. N. Brecker, Westinghouse Electric Corporation, Pittsburgh, Pennsylvania;  
 N. H. Cook, Massachusetts Institute of Technology, Cambridge, Massachusetts;  
 AUTHORS

"The Role of Lead and Its Effect on MnS Inclusions in Leaded Free Cutting Steels", S. Ramalingam, K. Basu, State University of New York, Buffalo, New York, J. Hazra, General Electric Company, Detroit, Michigan;  
 "Wear and Failure of High-Speed Steel Cut-Off Tools", R. W. Thompson, R. B. Dixon, B. S. Levy, Inland Steel Company, East Chicago, Indiana;  
 "A General Equation for Estimating Tool Wear in Machining Using Remote Thermocouples", M. P. Groover, Lehigh University, Bethlehem, Pennsylvania, A. Berman, Willis and Paul, Inc., E. K. Levy, Lehigh University, Bethlehem, Pennsylvania.

**BREAK** — 3:30 - 4:00 p.m. — Social Room

**SESSION 6** 4:00 p.m. Auditorium

### CO-CHAIRMEN

H. A. Kuhn, University of Pittsburgh, Pittsburgh, Pennsylvania;  
 J. A. Schey, University of Waterloo, Waterloo, Ontario;  
 AUTHORS

"Some Aspects of Non-Linear Finite Element Computer Programs", J. L. Gordon, Westinghouse Electric Corporation, West Mifflin, Pennsylvania;  
 "Finite Difference Method for the Complete Analysis of Plane Strain Extrusion", A. H. Shabak, University of California, Los Angeles, California;  
 "Optimum Die Profile for Drawing of Shells and Cups", G. D. Lahoti, Battelle Columbus Laboratories, Columbus, Ohio, P. F. Gordon, Pittman Dunn Laboratories, Philadelphia, Pennsylvania, T. Altan, Battelle Columbus Laboratories, Columbus, Ohio.

**SESSION 7** 4:00 p.m. Conference Room

### CO-CHAIRMEN

R. O. Lane, Frank Bancroft Company, Inc., Dearborn, Michigan;  
 E. D. Whitney, University of Florida, Gainesville, Florida;  
 AUTHORS

"Using Grinding Principles to Increase Productivity and Output Quality", R. P. Lindsay, Cincinnati Milacron-Heald Corporation, Worcester, Massachusetts;  
 "An Investigation of Grinding Wheel Behavior During Lubricated Grinding of Hardened and Annealed Steels", J. A. Kirk, J. F. Cardenas-Garcia, University of Maryland, College Park, Maryland;  
 "A Semipermanent Chip Grinding Process"

### AUTHORS

"The Application of Slip-Line Theory to Predict Forming Loads for Sandwich Metal Strips", W. H. Harden, Swanson Engineer Associates Corporation, McMurray, Pennsylvania, A. S. Weinstein, Carnegie-Mellon University, Pittsburgh, Pennsylvania;  
 "Residual Stress Development in Rolling of Homogeneous and Clad Sheet", S. L. Semiatin, H. R. Plisher, Carnegie-Mellon University, Pittsburgh, Pennsylvania;  
 "Springback in Bending Round Wires", K. S. Turke, Chicago Rawhide Mfg. Company, Elgin, Illinois, S. Kalpakjian, Illinois Institute of Technology, Chicago, Illinois.

**SESSION 13** 1:30 p.m. Conference Room

### CO-CHAIRMEN

M. Hoch, University of Cincinnati, Cincinnati, Ohio;  
 G. E. Kane, Lehigh University, Bethlehem, Pennsylvania;  
 AUTHORS

"A Study of Chip Curl Formation During Twist Drilling", C. H. Kahng, W. C. Koegler, Michigan Technological University, Houghton, Michigan;  
 "Theory and Experiments in Tapping", W. E. Henderer, Vermont Tap and Die Company, Lyndonville, Vermont, B. F. von Turkovich, University of Vermont, Burlington, Vermont;

"Crack Nucleation and Its Propagation in Discontinuous Chip Formation Performed Within a Scanning Electron Microscope", K. Iwata, K. Ueda, Kobe University, Kobe, Japan;  
 "A TEM Study of Dislocation Processes During Chip Formation in 70/30 Brass", S. Ramalingam, B. Thomann, State University of New York, Buffalo, New York.

**BREAK** — 3:00 - 3:30 p.m. — Social Room

**SESSION 14** 3:30 p.m. Auditorium

### CO-CHAIRMEN

M. L. Devpenpeck, United States Steel Corporation, Monroeville, Pennsylvania;  
 L. Kops, McGill University, Montreal, Quebec;  
 AUTHORS

"Metal Flow Studies for Workability Analysis of Forging Processes", H. A. Kuhn, University of Pittsburgh, Pittsburgh, Pennsylvania, S. K. Suh, Drexel University, Philadelphia, Pennsylvania;  
 "The Effects of Strain Paths on the Stretching Limit Strains of Sheet Metal with Planar Anisotropy", S. H. Lee, S. Kobayashi, University of California, Berkeley, California;  
 "Torsional Hopkinson-Bar Tests to Measure Stress-Strain Properties Relevant to Machining and High Speed Forming", M. G. Stevenson, University of New South Wales, Australia.

**SESSION 15** 3:30 p.m. Conference Room

### CO-CHAIRMEN

L. V. Colwell, University of Michigan, Ann Arbor, Michigan;  
 T. Hoshi, Kyoto University, Kyoto, Japan;  
 AUTHORS

"Observation of Deformation Occurring in the Cutting Process Related to a Three Zone Model of Machining", J. Williams, University of Connecticut, Storrs, Connecticut;  
 "Evaluation of Strain and Strain-Rate in Orthogonal Cutting", J. V. McCabe, Brown and Sharpe Manufacturing Company, North Kingstown, Rhode Island;  
 "Mechanics of Machining: Strain-Rate in the Primary Deformation Zone", R. G. Fenton, W. L. Cleghorn, University of Toronto, Toronto, Ontario.

**EVENING — FREE**

**WEDNESDAY, MAY 7, 1975**

### SESSION 16

8:30 a.m. Auditorium  
 CHAIRMAN  
 W. B. Rice, Queen's University, Kingston, Ontario.  
 Keynote Paper III  
 "Automation Developments in Japan", H. Takeyama, Mechanical Engineering Laboratory, Tokyo, Japan.

**SESSION 17** 9:15 a.m. Auditorium

### CO-CHAIRMEN

J. Tiusty, McMaster University, Hamilton, Ontario;

Massachusetts, S. Buckley, Massachusetts Institute of Technology, Cambridge, Massachusetts; "Phase Part Coding and the Optimization of Process Planning", J. ElGomayel, Purdue University, Lafayette, Indiana, M. R. Abou-Zeid, University of Alabama, Huntsville, Alabama; "Computer-Controlled Manufacturing Systems - Planning and Organization", W. Eversheim, E. Westkamper, Aachen Technische Hochschule, Germany; "What Aids Are Available for Design and Development of Computer Controlled Manufacturing Systems", M. Weck, A. Schuring, Aachen Technische Hochschule, Germany.

**SESSION 18 9:15 a.m. Conference Room**  
**CO-CHAIRMEN**  
 J. F. Kahles, Machinability Data Center, Cincinnati, Ohio;  
 S. Ramalingam, State University of New York, Buffalo, New York.

**AUTHORS**  
 "The Friction Characteristics of High Speed Steel-Manganese Sulphide Coated Steel Surfaces Undergoing Plastic Flow", J. Williams, D. McCarthy, University of Connecticut, Storrs, Connecticut;  
 "The Effect of Second Phase Particles on the Sliding Wear of Metals", S. Jahanmir, E. P. Abrahamson, II, N. P. Suh, Massachusetts Institute of Technology, Cambridge, Massachusetts;  
 "The Surface Integrity Approach to the Pitting of Machine Tool Gears", R. Krishnamurthy, V. C. Venkatesh, Indian Institute of Technology, Madras, India;  
 "Two-Dimensional Characterization of Machined Surfaces", M.O.M. Osman, T. S. Sankar, Concordia University, Montreal, Quebec;  
 "Dynamic Shear Stress Constancy with Respect to Deformation Textures in 6061-T6 Aluminum and Alpha Brass", J. T. Black, D. Breneiser, H. B. Mitchell, University of Rhode Island, Kingston, Rhode Island.

**BREAK - 10:45 - 11:15 a.m. - Social Room**  
**SESSION 19 11:15 a.m. Auditorium**  
**CO-CHAIRMEN**  
 F. W. Paul, Carnegie-Mellon University, Pittsburgh, Pennsylvania;  
 H. B. Voelcker, University of Rochester, Rochester, New York.

**AUTHORS**  
 "Machine Tool Chatter: Cutting Forces During Wave Generating and Regenerative Chatter", C. Poli, G. Boothroyd, C. Ho, University of Massachusetts, Amherst, Massachusetts;  
 "Mechanism, Diagnosis, and Control of Several Types of Machining Chatter", T. Hoshi, Kyoto University, Kyoto, Japan;  
 "Noise and Vibration Reduction Techniques for Designing Multitooth Circular Tools", F. A. Burney, S. M. Wu, University of Wisconsin, Madison, Wisconsin;  
 "Optimal Design of Machine Tool Hydraulic Copying Systems for a Specified Manufacturing Tolerance", M.O.M. Osman, Concordia University, Montreal, Quebec, S. Sankar, Naval Engineering Test Establishment, Montreal, Quebec;  
 "3-D Circular Interpolation and a Simplified Method of Programming", Y. Koren, J. G. Bollinger, University of Wisconsin, Madison, Wisconsin.

**SESSION 20 11:15 a.m. Conference Room**  
**CO-CHAIRMEN**  
 J. T. Black, University of Rhode Island, Kingston, Rhode Island;  
 I. Le May, University of Saskatchewan, Saskatoon, Saskatchewan.

**AUTHORS**  
 "Computerized Process Parameter Selection for EDM of Blanking and Piercing Dies", M. Tsang, F. VanDyck, O. D. Lascoe, Purdue University, West Lafayette, Indiana;  
 "Computational Method for Predicting the Thickness of the Recast Layer in EDM", F. VanDyck, M. R. Reda, Purdue University, West Lafayette, Indiana;  
 "An Optimizer for E.C.G.", G. N. Levy, AGIE, Losone, Switzerland, E. Lenz, Technion-Israel Institute of Technology, Haifa, Israel;  
 "The Role of Abrasive Grains in Ultrasonic-Electrochemical Combined Process", L. Kops, McGill University, Montreal, Quebec.

**CONFERENCE ADJOURNED 12:30 p.m.**

**CONFERENCE DINNER**  
 Cocktails (cash bar), 6:30 - 7:30 p.m. Webster Hall Hotel  
 Dinner and Program, 7:30 - 9:30 p.m. Webster Hall Hotel

**TUESDAY, MAY 6, 1975**

**SESSION 8 8:30 a.m. Auditorium**  
**CO-CHAIRMEN**  
 F. W. Boulger, Battelle Columbus Laboratories, Columbus, Ohio;  
 D. French, University of Waterloo, Waterloo, Ontario.

**AUTHORS**  
 "Calculation of Frictional Stress Distribution at the Die-Workpiece Interface in Simple Upsetting", S. I. Oh, S. Kobayashi, E. G. Thomson, University of California, Berkeley, California;  
 "An Experimental Study of the Formation of Liquid Lubricant Films in High Speed Upsetting", W. R. D. Wilson, C. J. Wong, University of Massachusetts, Amherst, Massachusetts.

**SESSION 9 8:30 a.m. Conference Room**  
**CO-CHAIRMEN**  
 R. S. Hahn, Cincinnati: Milacron-Heald Corporation, Worcester, Massachusetts;  
 H.F.G. Ueltz, General Abrasive Company, Niagara Falls, New York.

**AUTHORS**  
 "Analysis of Methods Used in the Optimisation of Grinding Conditions", G. Trmal, H. Kaiszer, University of Birmingham, Birmingham, England;  
 "On the Grindability of AISI T-15 Tool Steel Produced by the Consolidation of Atomized Metal Powder", R. Komanduri, M. C. Shaw, Carnegie-Mellon University, Pittsburgh, Pennsylvania;  
 "On the Generation of Surface Texture on Ground Surfaces", C. P. Bhateja, The Torrington Company, Torrington, Connecticut;  
 "High Rate Grinding with Coated Abrasive Belts to Produce Planar Surfaces on Various Types of Metals", S. E. Amundson, R. C. Lokken, 3M Company, St. Paul, Minnesota.

**BREAK - 10:00 - 10:30 a.m. - Social Room**  
**SESSION 10 10:30 a.m. Auditorium**  
**CO-CHAIRMEN**  
 S. Kalpakjian, Illinois Institute of Technology, Chicago, Illinois;  
 H. R. Pihler, Carnegie-Mellon University, Pittsburgh, Pennsylvania.

**AUTHORS**  
 "Formation of Folds During Upsetting of Hollow Bodies", K. Dieterle, University of Stuttgart, Germany;  
 "An Investigation of Defect Formation in the Cold Lateral Extrusion of 6061-0 Aluminum", G. P. Masura, K. J. Weinmann, F. W. Kauppia, Michigan Technological University, Houghton, Michigan;  
 "Side-indentation of Slabs of a Strain-Hardening Material", T. A. Restivo, Borg-Warner Corporation, Des Plaines, Illinois, J. A. Schev, University of Waterloo, Waterloo, Ontario.

**SESSION 11 10:30 a.m. Conference Room**  
**CO-CHAIRMEN**  
 G. D. Lascoe, Purdue University, West Lafayette, Indiana;  
 W. J. Sauer, Carnegie-Mellon University, Pittsburgh, Pennsylvania.

**AUTHORS**  
 "The Influence of Radical Negative Rake Angles Upon the Performance of Ceramic Cutting Tools", W. L. Roper, D.P.H. Hasselman, G. E. Kane, Lehigh University, Bethlehem, Pennsylvania;  
 "Mechanical Properties and Performance Evaluation of a Model Family of Ceramic Cutting Tools", H. E. Shuit, J. V. Biggers, J. M. Bind, The Pennsylvania State University, University Park, Pennsylvania;  
 "Second Generation Coated Carbides-Characteristics and Applications", C. R. Cline, Sandvik Steel, Inc., Fair Lawn, New Jersey.

**LUNCHEON - 12:00 - 1:30 p.m. - Webster Hall Hotel**  
**SESSION 12 1:30 p.m. Auditorium**  
**CO-CHAIRMEN**  
 A. T. Male, Westinghouse Electric Corporation, Pittsburgh, Pennsylvania;  
 C. F. Zorowski, North Carolina State University, Raleigh, North Carolina.

## HOUSING

A block of rooms has been reserved at the Webster Hall Hotel which is located directly across the street from the Mellon Institute, where the Conference will be held.

Hotel reservations should be made directly with the Hotel (ATTN: Miss Rittinger) being sure to mention NAMRC-III.

Reservations will not be guaranteed unless submitted Before April 25, 1975.

**MAIL TO: Webster Hall Hotel, Attn: Miss Rittinger**  
 4415 Fifth Avenue  
 Pittsburgh, PA 15213

I plan to attend the NAMRC-III Conference, May 5-7, 1975

NAME \_\_\_\_\_  
 ADDRESS \_\_\_\_\_  
 CITY AND STATE \_\_\_\_\_  
 ARRIVAL TIME (Date and Hour) \_\_\_\_\_  
 DEPARTURE TIME (Date and Hour) \_\_\_\_\_  
 I wish to share a twin room with \_\_\_\_\_

Single	Twin
\$20	\$24
\$23	\$26
\$25	\$31
\$27	

## REGISTRATION

Mail at least 10 days before conference - otherwise call 412/681-876

**MAIL TO: Miss Joanne Dubrawski**  
 Mechanical Engineering-SH 402  
 Carnegie-Mellon University  
 Pittsburgh, PA 15213

NAME \_\_\_\_\_ POSITION \_\_\_\_\_  
 (First) (Initial) (Last)

COMPANY OR INSTITUTION \_\_\_\_\_

ADDRESS \_\_\_\_\_

CITY AND STATE \_\_\_\_\_ ZIP CODE \_\_\_\_\_

PHONE ( ) \_\_\_\_\_ will join the ladies' program  
 Area Code (Number)

on \_\_\_\_\_ (dates)

Please enclose check, money order or company P.O. with registration. Make checks payable to NAMRC-III/CMU.

For further information: Miss Joanne Dubrawski, 412/681-8763.