

NAMRC — IX

**Ninth
NORTH AMERICAN
MANUFACTURING
RESEARCH CONFERENCE**

May 19-22, 1981

**The Pennsylvania State University
University Park, Pennsylvania**

**a continuing education service of
The Pennsylvania State University
College of Engineering**

**NAMRC-IX — Ninth North American
Manufacturing Research Conference
May 19-22, 1981**

TECHNICAL SESSIONS AND PROGRAM

Tuesday, May 19

6:00-
8:00 p.m. REGISTRATION — Main Lobby, Sheraton Inn,
State College
Cocktail Hour — Sheraton Inn

Wednesday, May 20

8:00-
9:00 a.m. REGISTRATION — Main Lobby, Kern Building

9:00-
10:00 OPENING SESSION — Auditorium, Kern Building
Cochairmen:

J. Tlustý, Chairman, Scientific Committee of
NAMRC, Mechanical Engineering Department,
McMaster University, Hamilton, Ontario, Canada
W. E. Biles, Cochairman of NAMRC-IX Organizing
Committee, and Head, Department of Industrial
and Management Systems Engineering, The
Pennsylvania State University.

Speakers:

Welcoming Address: **Dr. John W. Oswald**, Presi-
dent, The Pennsylvania State University

Opening Address: **J. Tlustý**, Chairman, Scientific
Committee of NAMRC

Announcements: **Inyong Ham**, Cochairman of
NAMRC-IX Organizing Committee, Department
of Industrial and Management Systems Engineer-
ing, The Pennsylvania State University

10:00-
10:30 Coffee Break — Multi-purpose Room, Keller Build-
ing

10:30-
12:00 noon SESSION 1 — Room 303, Keller Building
Cochairmen:

A. L. Hoffmann, Battelle's Columbus
Laboratories, Columbus, Ohio
L. Kops, McGill University, Montreal, Quebec,
Canada

Authors:

"A Programmable Die for the Powder Metallurgy
Process," P. K. Wright and A. J. Holzer,
Carnegie-Mellon University, Pittsburgh, Pennsyl-
vania

"P/M Forging of Wear-Resistant Materials," G. W.
Halldin and J. S. Hirschorn, University of
Wisconsin-Madison, Madison, Wisconsin

"Warm Extrusion of Sintered Metal Powder Pre-
forms," W. Schaub, Universitat Stuttgart,
Stuttgart, Federal Republic of Germany

10:30-
12:00 noon SESSION 2 — Room 312, Keller Building
Cochairmen:

B. F. von Turkovlch, University of Vermont, Bur-
lington, Vermont
J. T. Black, Ohio State University, Columbus, Ohio

Authors:

"A Study of Built-up Edge Formation Using Trans-
parent Cutting Tools," J. G. Horne, P. K. Wright,
and A. Bagchi, Carnegie-Mellon University,
Pittsburgh, Pennsylvania

"Chip Compression Relationships in Metal Cutting,"
L. DeChiffre and T. Wanheim, Technical Univer-
sity of Denmark, Lyngby, Denmark

"A Metallurgical Investigation of Chip Morphology in
Machining an AISI 1045 Steel at Various Speeds
up to 10,100 SFPM," R. Komanduri and J. Hazra,
General Electric Company, Schenectady, New
York

10:30-
12:00 noon

SESSION 3 — Room 305, Keller Building

Cochairmen:

G. Kane, Lehigh University, Bethlehem, Pennsyl-
vania

F. G. Varga, F. L. Smithe Machine Co., Dun-
cansville, Pennsylvania.

Authors:

"Geometrical Factors Affecting the Performance of
Centre Board Hopper Feeders," W. B. Hegin-
botham and K. K. Mishra, M.M.M. Engineering
College, Gorakhpur, India

"Basis for Comparing the Designs of Parts for Ease
of Automatic Feeding and Orienting," G. Booth-
royd, University of Massachusetts, Amherst,
Massachusetts

"Increasing Flexibility By Handling Systems," K. J.
Siemens, University of Hanover, Hanover, Fed-
eral Republic of Germany

12:00-
1:30 p.m.

LUNCHEON — Colonial Room, Nittany Lion Inn

Chairman:

W. E. Biles, Co-Chairman of NAMRC-IX Organizing
Committee

Luncheon Speaker:

Professor William Rice, President of the Canadian
Society of Mechanical Engineers, and Queens
University, Canada

1:30-
3:00

SESSION 4 — Room 303, Keller Building

Co-Chairmen:

E. G. Thomson, University of California, Berkeley,
California

R. P. McDermott, Michigan Screw Products, Center
Line, Michigan

Authors:

"ALPID-A General Purpose FEM Program for Metal
Forming," S. I. Oh, G. D. Lahoti, and T. Altan,
Battelle Columbus Laboratories, Columbus, Ohio

"Machining With a Round-Nosed Form Tool,"
C. Beiswenger, Campbell Fittings, Inc., Boyer-
town, Pennsylvania

"Identification and Evaluation of Sliding Joint
Dynamics by Simplified Slide-Way Models,"
M. Yoshimura, Kyoto University, Kyoto, Japan

1:30-
3:00 SESSION 5 — Room 312, Keller Building
Cochairmen:
J. E. Mayer, Ford Motor Company, Dearborn, Michigan
M. J. Schmenk, Cincinnati Milacron Company, Cincinnati, Ohio
Authors:
"Grinding Mechanisms for Metallic and Nonmetallic Materials," S. Malkin, Cornell University, Ithaca, New York
"Creep-Feed-Grinding, Profile-Grinding," E. Salje and H. Y. Damlos, Fergigungstechnik der Technischen Universität Braunschweig, Braunschweig, Federal Republic of Germany

1:30-
3:00 SESSION 6 — Room 305, Keller Building
Cochairmen:
J. Datsko, University of Michigan, Ann Arbor, Michigan
V. A. Tipnis, Tipnis Associates, Cincinnati, Ohio
Authors:
"On the Simulation of Hot-Forming of Metals," J. Oudin, Y. Ravalard, and S. Rommens, ICAM, Lille Cedex, France
"A Numerical Simulation of the Extrusion Process," A. A. Tseng, Martin Marietta Lab, Baltimore, Maryland
"On Division of Stress on the Yield Locus and Correspondence Between the Regions on the Yield Locus and Size Variation of Workpiece During Metal Forming," Wang Zhong Ren, Harbin Institute of Technology, Harbin, People's Republic of China

3:00-
3:30 Coffee Break — Multi-purpose Room, Keller Building

3:30-
5:00 SESSION 7 — Room 303, Keller Building
Cochairmen:
T. Altan, Battelle Columbus Laboratories, Columbus, Ohio
In-Sun Hong, 3M Company, St. Paul, Minnesota
Authors:
"A New Non-Destructive Technique for Polymeric Materials," N. P. Suh, Ming Kai Tse, Massachusetts Institute of Technology, Cambridge, Massachusetts
"Limit Analysis of Behaviours of International Porosity of Slab and Plate Under Rolling Process," M. Kiuchi, University of Tokyo, Tokyo, Japan
"Improvements of Mechanical Properties of 2Cr13 Steel Weld Joints," Zhou Guangqi, Xian Jiaotong University, Xian, Shanghai, People's Republic of China

3:30-
5:00 SESSION 8 — Room 312, Keller Building
Cochairmen:
J. Tlusty, McMaster University, Hamilton, Ontario, Canada
N. H. Cook, Massachusetts Institute of Technology, Cambridge, Massachusetts

Authors:
"Analysis of Cutting Process Damping," P. Balakrishnan, K. F. Eman and S. M. Wu, University of Wisconsin-Madison, Madison, Wisconsin
"Orthogonal Machining of Single Crystals," P. H. Cohen, J. T. Black, and J. G. Horne, Ohio State University, Columbus, Ohio
"High Speed Machining Analysis of Difficult to Machine Alloys," T. A. Schroeder, J. Hazra, and R. Komanduri, General Electric, Detroit, Michigan

3:30-
5:00 SESSION 9 — Room 305, Keller Building
Cochairmen:
D. T. Koenig, General Electric Company, Schenectady, New York
N. G. Odrey, University of Rhode Island, Kingston, Rhode Island
Authors:
"Computer Aided Scheduling: A Heuristic Model," A. Conti, M. Corbo, G. Manfrinato, and S. Rossetto, Politecnico di Torino, Torino, Italy
"The Use of a Micro-Computer for Group Scheduling," J. F. Taylor and I. Ham, The Pennsylvania State University, University Park, Pennsylvania
"A Productivity-Oriented Model of Mass Production Systems," D. Miconi, P. Sterposi, and P. Toni, Istituto Di Ingegneria Meccanica, Via di S. Marta, Italy

6:30 p.m. Dinner Meeting — Ballroom, Sheraton Inn, State College
Chairman:
Inyong Ham, Co-Chairman of NAMRC-IX Organizing Committee
Speaker:
Dr. Eric Walker, President-Emeritus, The Pennsylvania State University

Thursday, May 21

8:00 a.m. Registration — Keller Building, Main Lobby

8:30-
10:00 SESSION 10 — Room 303, Keller Building
Cochairmen:
R. E. Fromson, Westinghouse Electric Corporation, Pittsburgh, Pennsylvania
J. K. Weinmann, Michigan Technological University, Houghton, Michigan
Authors:
"On the Determination of the Domain of Plasticity Associated With a Plastic Free Boundary and its Application to the Machining Problem," S. Ramalingam, P. V. Desai, and K. Kim, Georgia Institute of Technology, Atlanta, Georgia
"A Slip-Line Solution for Negative Rake Angle Cutting," M. Abebe and F. C. Appl, Kansas State University, Manhattan, Kansas
"The Thermal Behaviour of Machine Tool Guide-ways," Qu Lian Shen, Xian Jiaotong University, Xian, Shanghai, People's Republic of China, and Chao Zhefong and Shen Zeng, Shanghai Machine Tool Works, Shanghai, People's Republic of China

8:30-
10:00

SESSION 11 — Room 312, Keller Building

Cochairmen:

W. B. Rice, Queen's University, Kingston, Ontario, Canada

M. F. DeVries, University of Wisconsin, Madison, Wisconsin

Authors:

"Effect of Thermal Cycling on Tool Wear in Milling," J. Tlustý and E. Orady, McMaster University, Hamilton, Ontario, Canada

"A Study of Wear of Cemented Titanium Carbide Tool," B. J. Ranganath and V. C. Venkatesh, Indian Institute of Technology, Madras, India

"Probabilistic Model for Cutting Tool Fracture Control," R. Levi, Y. Koren, S. Malkin, and O. Masory, Cornell University, Ithaca, New York

8:30-
10:00

SESSION 12 — Room 305, Keller Building

Cochairmen:

A. F. Gould, Lehigh University, Bethlehem, Pennsylvania

B. W. Niebel, The Pennsylvania State University, University Park, Pennsylvania

Authors:

"Applications of Group Technology Concepts for Plant Layout and Management of a Miscellaneous Parts Shop," D. T. Koenig, General Electric, Schenectady, New York, and T. Gongaware and I. Ham, The Pennsylvania State University, University Park, Pennsylvania

"Cluster Analysis Applications for GT Manufacturing Systems Families," T. Gongaware and I. Ham, The Pennsylvania State University, University Park, Pennsylvania

"Automated Coding and Process Selection-ACAPS," C. Emerson, V. Bond, and I. Ham, The Pennsylvania State University, University Park, Pennsylvania

"Group Technology Applications for Machine Loading Under Multi Resource Constraints," K. Hitomi, Kyoto University, Kyoto, Japan, and I. Ham, The Pennsylvania State University, University Park, Pennsylvania

10:00-

10:30

Coffee Break — Multi-purpose Room, Keller Building

10:30-

12:00 noon

SESSION 13 — Room 303, Keller Building

Cochairmen:

B. Avitzur, Lehigh University, Bethlehem, Pennsylvania

R. A. Kohser, University of Missouri-Rolla, Rolla, Missouri

Authors:

"Production of Involute-toothed Gears by Cold Rolling," M. Weck, H. C. W. König, J. Goebbele, and G. Bartsch, Technische Hochschule Aachen, Aachen, Federal Republic of Germany

"Tapering of Aluminum Rings During Ring Compression Test," D. Bhattacharyya, University of Auckland, New Zealand

10:30-

12:00 noon

SESSION 14 — Room 312, Keller Building

Cochairmen:

M. C. Shaw, Arizona State University, Tempe, Arizona

R. A. Thompson, General Electric Company, Schenectady, New York

Authors:

"Cylindrical Creep Feed Grinding," Z. I. Zhou and M. C. Shaw, Arizona State University, Tempe, Arizona

"A New Approach to the Analysis of Wheel-Workpiece Interaction in Surface Grinding," S. M. Pandit and G. Sathyanarayanan, Michigan Technological University, Houghton, Michigan

"Application of the Regeneration Spectrum Method to Workpiece Regenerative Chatter in Grinding," K. Srinivasan, Ohio State University, Columbus, Ohio

10:30-

12:00 noon

SESSION 15 — Room 305, Keller Building

Cochairmen:

J. Hazra, General Electric Company, Warren, Michigan

R. E. DeVor, University of Illinois, Urbana, Illinois

Authors:

"Noise Control in Rotating Production Machine Installations," J. Bollinger and J. Yerges, University of Wisconsin, Madison, Wisconsin

"Computer Aided Optimum Design of Absolute Zero Positioning System for Machine Tools with Pseudo Random Binary Series" and "Computer Aided Optimum Design of Zero Grating's Line Pattern With Pseudo Random Binary Series," Chang Po-Peng, Quinghua University, Beijing, People's Republic of China

"Investigation of Adaptive Exponential Smoothing Algorithms in Monitoring Tool Wear," W. R. DeVries, J. Z. Raski, and J. C. Mazur, University of Michigan, Ann Arbor, Michigan

12:00-

1:30 p.m.

LUNCHEON — Colonial Room, Nittany Lion Inn (Sponsored by the Society of Manufacturing Engineers)

Chairman:

Mark Fugelso, Cochairman of NAMRC-IX Organizing Committee

Luncheon Speaker:

Dr. M. E. Merchant, Director of Research Planning, Cincinnati Milacron, Inc.

1:30-

3:00

SESSION 16 — Room 303, Keller Building

Cochairmen:

S. Kalpakjian, Illinois Institute of Technology, Chicago, Illinois

A. T. Male, Westinghouse Research and Development Center, Pittsburgh, Pennsylvania

Authors:

"Sheet Metal Forming With Discrete Die Surfaces," D. E. Hardt, B. A. Olsen, B. T. Allison, and K. Pasch, Massachusetts Institute of Technology, Cambridge, Massachusetts

"Process Optimization in Sheet Metal Forming of Aluminum Alloys," K. Lange and M. Blach, Institut Fur Umformtechnik, Stuttgart, Federal Republic of Germany

"A Simple Method for Flow-Stress Determination Under Metalworking Conditions," S. S. Saluja, P. C. Pandey, and S. Dalela, University of Roorkee, Roorkee, India

SESSION 17 — Room 312, Keller Building

Cochairmen:

S. Ramalingam, Georgia Institute of Technology, Atlanta, Georgia

G. F. Wilson, General Electric Co., Worthington, Ohio

Authors:

"Machinability of Pearlitic Gray Cast Iron," R. T. Wimber, Deere and Company, Moline, Illinois

"Machinability of Cast Aluminum Alloys with Carbide and Diamond Cutting Tools," J. C. Miller and R. E. DeVor, Reynolds Metals Company, Richmond, Virginia

"Machinability Testing Method Using Face-Milling of Cylindrical Workpiece," R. Kitagawa, C. H. Kahng, T. Akasawa, and K. Okusa, University of Colorado, Boulder, Colorado

SESSION 18 — Room 305, Keller Building

Cochairmen:

N. P. Suh, Massachusetts Institute of Technology, Cambridge, Massachusetts

W. Lutz, Sikorsky Aircraft, Stratford, Connecticut

Authors:

"Cutting Process Identification From Closed-Loop Operating Data," R. Gan, K. F. Eman, and S. M. Wu, University of Wisconsin-Madison, Madison, Wisconsin

"Probabilistic Computer Simulation of Machining Lines," S. R. Taraman, Ford Motor Company, Detroit, Michigan

"Investigation of the Degree of Biaxiality on the Limit Strains in Sheet Metal Stretching," H. A. Al-Qureshi, and J. D. Bressan, C.T.A., Sao Jose Campus, Sao Paulo, Brazil

Coffee Break — Multi-purpose Room, Keller Building

SESSION 19 — Room 303, Keller Building

Cochairmen:

K. K. Wang, Cornell University, Ithaca, New York

C. O. Stockdale, ALCOA, Alcoa Center, Pennsylvania

Authors:

"Classification for Systematic Component and Process Design for Forging Operations," M. Goekler, W. A. Knight and C. Poli, University of Oxford, Oxford, England

"An Experimental Study of Some Problems on the Rotary Forging Technology," Wang Zhong (Ren), Harbin Institute of Technology, Harbin, People's Republic of China

"Energy Considerations in the Forging Industry," B. Avitzur and L. Ache, Lehigh University, Bethlehem, Pennsylvania

SESSION 20 — Room 312, Keller Building

Cochairmen:

C. J. Oxford, Jr., Lear Siegler, Inc., Rochester, Michigan

J. C. Mazur, University of Michigan, Ann Arbor, Michigan

Authors:

"High Speed Machining," J. Chaplin, M. Miller, and R. King, Lockheed Missiles and Space Company, Inc., Sunnyvale, California

"An Ultra-High-Speed Machining Research Facility," J. P. Kottenstette and R. F. Recht, University of Denver, Denver, Colorado

"Metalurgical Aspects of Chip Formation Process at Very High Cutting Speed," M. Lee and D. G. Flom, General Electric Company, Schenectady, New York

SESSION 21 — Room 305, Keller Building

Cochairmen:

D. S. Ermer, University of Wisconsin, Madison, Wisconsin

R. I. King, Lockheed Missiles & Space Company, Los Angeles, California

Authors:

"Application of Hierarchical Control Theory to Estimate the Optimum Buffer Stocks of Automatic Transfer Lines," K. N. Chen, G. P. Yang, and H. H. Yang, Xian Jiaotong University, Xian, Shanghai, People's Republic of China

"Economic Feasibility of Laser-Assisted Machining," V. A. Tipnis, S. J. Mantel, Jr., and G. L. Ravnigani, Tipnis Associates, Inc., Cincinnati, Ohio

"Optimization Analysis of Automated Transfer-Type Multi-Item Manufacturing Systems," K. Hitomi and K. Yura, Kyoto University, Kyoto, Japan

Friday, May 22

8:30-10:00 a.m.

SESSION 22 — Room 303, Keller Building

Cochairmen:

J. T. Berry, Georgia Institute of Technology, Atlanta, Georgia

S. G. Kapoor, University of Illinois, Urbana, Illinois

Authors:

"A Comparison of Hydrostatic Extrusion Versus Drawing As A Method of Producing Nb₃Sn Superconducting Wire," Y. T. Chou, B. Avitzur, Y. Thadani, and T. S. Luffman, Lehigh University, Bethlehem, Pennsylvania

"A Theoretical and Experimental Investigation in Radial Extrusion Forging," S. S. Saluja, P. C. Pandey, and S. Dalela, University of Roorkee, Roorkee, India

"The Relationship Between Formability and Microstructure for Al-Mn Alloy 3003-0," J. M. Story, W. H. Hunt, Jr., and D. J. Lege, Aluminum Company of America, Alcoa Center, Pennsylvania

1:30-3:00

1:30-3:00

3:00-3:30

3:30-5:00

3:30-5:00

3:30-5:00

"Study on the Reheat Cracking with the Implant Method," Zhang Xiang-quan, Chen Ze-xin, and Wu Xianhe, Xian Jiaotong University, Xian, Shanghai, People's Republic of China

8:30-
10:00

SESSION 23 — Room 312 Keller Building

Cochairmen:

M. Field, Metcut Research Associates, Inc., Cincinnati, Ohio

P. Komanduri, General Electric Co., Schenectady, New York

Authors:

"Preliminary Results with Ion Implanted Tools," R. Fromson and R. Kossowsky, Westinghouse Electric Corp., Pittsburgh, Pennsylvania

"Synthetic Polycrystalline Diamond (PDC) Tools for Milling of Al-Alloys with High Silicon Content," H. K. Toenshoff and G. Chrystsolouris, Cambridge, Massachusetts

"Process Parameter Considerations in the Cutting Performance of TiC Sputter Coated Carbide Cutting Tools," N. G. Odrey, University of Rhode Island, Kingston, Rhode Island, and I. Ham, The Pennsylvania State University, University Park, Pennsylvania

8:30-
10:00

SESSION 24 — Room 305, Keller Building

Cochairmen:

G. Boothroyd, University of Massachusetts, Amherst, Massachusetts

W. Pentland, Xomox Corporation, Cincinnati, Ohio

Authors:

"A TIPS-I Based CAD Program for Mold Design," T. Akiyama and K. K. Wang, Cornell University, Ithaca, New York

"Ductile Fracture of Copper Produced in Continuous-Casting Process," R. Godoy, F.D. Negróni & E.G. Thomsen, University of California, Berkeley, California

"Computer-Aided Analysis and Experimental Evaluation of a Roll-Pass Schedule for Rolling of Round Bars," P. C. Cohen, G. D. Lahoti, and T. Altan, Battelle Columbus Laboratories, Columbus, Ohio

10:00-
10:30 a.m.

Coffee Break — Multi-purpose Room, Keller Building

10:30-
12:00 noon

SESSION 25 — Room 303, Keller Building

Cochairmen:

F. W. Boulger, Battelle Columbus Laboratory, Columbus, Ohio

J. M. Hardy, John Deere & Company, Moline, Illinois

Authors:

"Viscoplasticity Analysis of Solid Phase Forging of Ultra-High Molecular Weight Polyethylene," G. W. Halldin, University of Wisconsin-Madison, Madison, Wisconsin

"Mirror Finish Piercing of Glass Fiber-Epoxy, Laminates Using a Vibrated Punching Technique," T. Nakagawa and H. Yokoi, University of Tokyo, Tokyo, Japan

"Energy Conservation Aspects of Near Net-Shape Manufacturing Processes," S. Rajagopal, I.I.T. Research Institute, Chicago, Illinois

10:30-
12:00 noon

SESSION 26 — Room 312, Keller Building

Cochairmen:

E. Clark, Standard Steel, Burnham, Pennsylvania

C. H. Kahng, University of Colorado, Boulder, Colorado

Authors:

"Surface Treatment of Cemented Titanium Carbide," P. D. Hartung and B. M. Kramer, Massachusetts Institute of Technology, Cambridge, Massachusetts

"Application of PID Controller to Design of a Machine Tool Chatter Control System," H. S. Cho, J. W. Lee, and C. S. Hong, Korea Advanced Institute of Science, Seoul, Korea

"Shear Angle Relationship in Cutting with Self-Propelled Rotary Tools," A. A. Radwan, Cairo University, Cairo, Egypt

10:30-
12:00 noon

SESSION 27 — Room 305, Keller Building

Cochairmen:

D. L. Shunk, International Harvester Company, Hinsdale, Illinois

S. Hart, U.S. Army Armament R & D Command, Dover, New Jersey

Authors:

"Optimizing Turning Operations with a Programmable Pocket Calculator," J. Datsko and R. Kirschbaum, University of Michigan, Ann Arbor, Michigan

"An Investigation on Optimum Control of Metal Cutting Processes Based on Modern Control Theory," K. N. Chen and H. H. Yang, Xian Jiaotong University, Xian, Shanghai, People's Republic of China

"Multiobjective Optimization of a Multi-Stage Production System," S. Takakuwa, The Pennsylvania State University, University Park, Pennsylvania, and K. Hitomi, Kyoto University, Kyoto, Japan

GENERAL AND REGISTRATION INFORMATION

LOCATION

Program sessions will be on the campus of The Pennsylvania State University in the town of State College, Pennsylvania, near the geographical center of the state on Routes 26 and 322 and near Interstate 80. USAir/Allegheny Commuter Airline provides numerous daily flights into State College Airport via Pittsburgh, Philadelphia, and Baltimore/Washington. The State College Airport is located five miles from campus with limousine and taxi service (on call) available for all flights. Please check with your travel agent for current schedules. Private or charter aircraft may fly into State College Airport (814) 355-5511. Aircraft can be accommodated overnight at the airport with fuel and maintenance services available. The reservationists airport computer symbol is SCE.

REGISTRATION

Advance registration is important to the organization of the conference, as adequate facilities and meeting space may be arranged only when the size of the group is known in advance. Please complete the attached advanced registration form and return by Monday, May 11, 1981. All registrations will be acknowledged and further information will be sent including campus maps, parking permits, travel information, etc.

Final registration will be conducted at the times and locations given below:

Tuesday, May 19, 6:00-8:00 p.m. — Lobby of the Sheraton Penn State Inn

Wednesday, May 20, 8:00-9:30 a.m. — Lobby of the Kern Graduate Building; 9:30-all day — Lobby of the Conference Center

Thursday, May 21, 8:00 a.m.-noon — Lobby of the Conference Center

FEE

The registration fee of \$200 per person includes two lunches, a banquet, coffee breaks, and hardbound copy of the NAMRC-IX Proceedings. There will be no one-day registration fees.

The registration fee may be paid by cash, check, money order, or by a billing to a company or organization. VISA or MasterCard plates are also accepted for payment of all registration fees. All payments by credit card are subject to authorization by the appropriate bank. Please indicate on the advance registration form the method of payment. A refund of the registration fee will be made if notification of cancellation is received one week prior to the start of the conference. Substitutions will be accepted anytime.

LODGING

A block of rooms for the conference has been reserved at the Sheraton Penn State Inn. Reservations should be made directly with the Sheraton by calling (814) 238-8454, or writing: Sheraton Penn State Inn, 240 South Pugh Street, State College, PA 16801. Be sure to state that you will be attending NAMRC-IX. Free shuttle bus service will be provided between the Sheraton and all conference sessions.

A list of other area hotels and motels, provided by the State College Chamber of Commerce, is available upon request (indicate on the advance registration form).

PARKING

For those who drive to campus, free parking is available in the visitors' lot adjacent to the Conference Center. A special parking permit will be mailed upon receipt of the advance registration form.

LADIES PROGRAM

A tour of Penn's Cave, the only publicly accessible water-filled cavern in America, and a special guided tour of The Pennsylvania State University's Art Museum and Gallery have been scheduled.

In addition to these activities, there are a variety of other interesting things to do at the University and in the State College area. University athletic facilities are available, and downtown State College offers many delightful shops and dining establishments.

TAX DEDUCTION OF EXPENSES

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

PROCEEDINGS

All participants in the conference paying the registration fee will receive one hardbound copy of the NAMRC-IX Proceedings. Those who wish additional copies, at \$35 each, may order them in advance or at the Conference. After May 22, 1981, copies will be available by mail order through: Society of Manufacturing Engineers, One SME Drive, P.O. Box 930, Dearborn, Michigan 48128, USA (at a somewhat higher rate to be set by SME).

FOR FURTHER INFORMATION

Regarding papers, proceedings, sessions, etc.:

Dr. Mark Fugelso (814) 863-2360 or

Dr. W. E. Biles (814) 865-7601

Department of Industrial and Management Systems Engineering
The Pennsylvania State University
207 Hammond Building
University Park, PA 16802

Regarding registration, housing, etc.:

Ron Avillion

The Pennsylvania State University
410 Keller Building
University Park, PA 16802

(814) 865-0313 — TWX 510-670-3532

CONFERENCE ORGANIZATION

The North American Manufacturing Research Conferences were created by a group of researchers dedicated to furthering knowledge, its dissemination and application in the field of materials processing.

The papers presented at this Conference have been selected by the Scientific Committee of NAMRC from a large number of submitted abstracts. Conference arrangements are the responsibility of NAMRC-IX Organizing Committee and the Conference Center at The Pennsylvania State University.

CONFERENCE PROSPECTUS

The Ninth North American Manufacturing Research Conference (NAMRC-IX) is designed to provide a forum for the presentation and informed critical discussion of results of basic and applied research in metalworking and related manufacturing. The format of the Conference is similar to that of NAMRC-I (McMaster University, 1973), NAMRC-II (University of Wisconsin, 1974), NAMRC-III (Carnegie-Mellon University, 1975), NAMRC-IV (Battelle Columbus Laboratories and Ohio State University, 1976), NAMRC-V (University of Massachusetts, 1977), NAMRC-VI (University of Florida, 1978), NAMRC-VII (University of Michigan, 1979), NAMRC-VIII (University of Missouri, 1980), and previous NAMRC conferences.

The papers presented at this conference will describe work in the fields of metal forming, metal cutting, machine tools, and manufacturing systems and controls. All papers presented at the conference are contained in the hardbound *Conference Proceedings* (which will form part of the SWE Manufacturing Engineering Transactions) and represent work conducted in many renowned metalworking research centers throughout the world.

SCIENTIFIC COMMITTEE

T. Altan

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University of Wisconsin

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 G. Boothroyd
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 L. Colwell
 University of Michigan
 N. Cook
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 University of California
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 The Pennsylvania State University
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 Illinois Institute of Technology
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 Georgia Institute of Technology
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 M. C. Shaw
 Arizona State University
 V. von Turkovich
 University of Vermont
 J. Tlusty, Chairman
 McMaster University
 S. Wu
 University of Wisconsin

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 American Society of Metals
 J. Grove
 Society of Manufacturing Engineers
 I. Ham, Co-Chairman
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 American Association of CIRP Industrial Sponsors
 A. L. Hoffmann
 American Institute of Mining,
 Metallurgical and Petroleum Engineers
 R. A. Kohser
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 American Society of Mechanical Engineers
 J. J. Nassr
 Canadian Society of Mechanical Engineering
 R. Roy
 The Pennsylvania State University

**ADVANCED REGISTRATION FORM
 NAMRC-IX, May 19-22, 1981**

Name Nickname for badge Soc. Sec. No.

Home Address (street) Phone

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