Precision Machining Technology

State Submission

Mark Wilson, President

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PRECISION MACHINING TECHNOLOGY PROGRAM

EXECUTIVE SUMMARY

Western Dakota Technical Institute is seeking approval to create a Diploma program in Precision Machining Technology.

Labor market information for the state indicates that the demand for workers in the Machining field is strong now and in the future. Through 2020, the number of machinists is expected to grow by 13.8 percent, according to the South Dakota Labor Market Information Center (LMIC).

Graduates of this program will be able to seek employment in machine shops, factories, and other businesses that produce and repair machinery, parts, and related items.

Western Dakota Technical Institute will market this program as Precision Machining Technology. The diploma is a nine-month or two-semester curriculum.

IDENTIFICATION AND DESCRIPTION OF THE PROGRAM

The Precision Machining Technology graduate will be able to set up and operate a variety of machine tools to produce precision metal parts, instruments, and tools. Machinists use machine tools that are either conventionally controlled or computer numerically controlled, such as lathes, milling machines, and grinders, to produce precision metal parts. Although they may produce large quantities of one part, precision machinists often produce small batches or one-of-a-kind items. The parts that machinists make range from simple bolts of steel or brass to titanium bone screws for orthopedic implants. Hydraulic parts, anti-lock brakes and automobile pistons are other widely known products that machinists make.

OBJECTIVES AND PURPOSE OF THE PROGRAM

The primary objective of the Precision Machining Technology program is to prepare students with the necessary skills to be successful in the machining field. Students will take coursework in mill and lathe operation, blueprint reading, computer-aided design, CNC turning, and training that covers metallurgy, heat treating, and precision grinding. This program also will provide education and training in soft skills such as communication and math.

The aim of this program is to provide students a solid foundation in machining technology. According to the Occupational Outlook Handbook, machinists typically do the following:

- Work from blueprints, sketches, or computer-aided design (CAD) or computer-aided manufacturing (CAM) files
- Set up, operate, and tear down manual, automatic, or computer numeric controlled (CNC) machine tools
- Calculate dimensions using measuring instruments
- Install, align, secure, and adjust cutting tools and workpieces
- Monitor the feed and speed of machines
- Turn, mill, drill, shape, and grind machine parts to specifications
- Measure, examine, and test completed products for defects
- Deburr all surfaces of parts or products to ensure that they conform to specifications

Machinists may further be classified by specialty:

- **Production machinists** produce large quantities of one part, especially parts requiring the use of complex operations and great precision. Many modern machine tools are computer numerically controlled (CNC). CNC machines control the cutting tool speed and do all necessary cuts to create a part. The machinist determines the cutting path, the speed of the cut, and the feed rate by programming instructions into the CNC machine. Many machinists must be able to use both manual and computer-controlled machinery in their job.
- **Maintenance machinists** repair or make new parts for existing machinery. After an industrial machinery mechanic discovers the broken part of a machine, the machinist gets

the broken part. For more information, see the profile on industrial machinery mechanics and maintenance workers. To replace or remanufacture broken parts, maintenance machinists refer to blueprints and do the same machining operations that were needed to create the original part.

Although production machinists are concentrated in a few industries, maintenance machinists work in many manufacturing industries.

Because the technology of machining is changing rapidly, machinists must learn to operate a wide range of machines. Some newer manufacturing processes use lasers, water jets, electrical discharge machines (EDM), or electrified wires to cut the workpiece. Although some of the computer controls are similar to those of other machine tools, machinists must understand the unique capabilities of these different machines. As engineers create new types of machine tools, machinists must constantly learn new machining properties and techniques.

The program will articulate appropriate high school credits whenever possible, and there could be dual enrollment possibilities for high school students.

PROGRAM OUTCOMES

The Machining Technology graduate will be able to:

- Demonstrate knowledge and hands-on competencies in manufacturing/mechanical production, computers, machining instrumentation systems, and mechanical CAD
- Apply critical thinking to technical problems
- Understand ethical/social responsibility and a commitment to quality, timeliness, and continuous improvement
- Apply basic concepts of math, blueprint reading inspection, and knowledge of machining and manufacturing while producing quality products that meet customer specifications
- Work in a safe and efficient manner

METHODS OF OBTAINING THE OBJECTIVES OF THE PROGRAM

The program will include classroom and laboratory instruction, guest speakers, and internship opportunities.

The Precision Machining Technology program will work closely with an industry advisory board composed of representatives who are from manufacturing businesses and others in the field. The Advisory Board will approve the curriculum, discuss and recommend equipment purchases, and assist in forming partnerships to help WDT with innovative curriculum, internships, and presentations.

POPULATION SERVED BY THE PROGRAM

The Precision Machining Technology program will be available to all interested individuals who successfully meet the WDT admissions criteria established for the program. The program will be open to full-time and part-time students. All applicants must be high school graduates and take an admissions test to establish reading, writing, and math abilities. No restriction will be made regarding race, creed, gender or age. The program will draw students primarily from South Dakota. The opportunities for employment in the field will be primarily in South Dakota.

PROJECTED THREE-YEAR BUDGET

This program will be staffed by a current full-time WDT instructor. Adjunct instructors with industry experience may be used to teach some courses. The projected budget is as follows:

Expenses	**Year One**	**Year Two**	**Year Three**
Instructors	$66,152.00	$68,136.00	$70,180.00
Equipment	$25,000.00	$25,000.00	$10,000.00
Supplies	$10,000.00	$10,000.00	$10,000.00

PROGRAM COMPETENCIES AND ENTRY AND EXIT POINTS

Entry point: Fall Semester

Exit point: Graduation with a diploma in Precision Machining Technology.

PROGRAM DUPLICATION

Western Dakota Tech is proposing this program to meet regional industry needs for precision machining technicians. While there are other machining-related programs in South Dakota, they are not meeting the needs of industries in western South Dakota.

CURRICULUM DESIGN

See Appendix A for Curriculum Sequence.

WAGE FACTOR

Wages of machinists and tool and die makers vary with their skill and with the industry and establishment in which they work.

The median hourly wage of machinists was $18.52 in May 2010. The median wage is the wage at which half the workers in an occupation earned more than that amount and half earned less. The lowest 10 percent earned less than $11.59, and the top 10 percent earned more than $27.91.

The pay of apprentices is tied to their skill level. As they gain more skills and reach specific levels of performance and experience, their pay increases.

South Dakota Wage Estimates for SD, Rapid City, and West					**Percentile**				
AREA	**SOC CODE**	**Occupation**	**Workers**	**Avg. Wage**	**10th**	**25th**	**50th**	**75th**	**90th**
Statewide	51-4041	Machinists	760	17.28	13.19	15.14	17.11	19.31	22.15
Rapid City MSA	51-4041	Machinists	70	17.55	14.10	15.60	17.17	18.75	22.23
West	51-4041	Machinists	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Data derived from SD Department of Labor http://dlr.sd.gov/lmic/menu_occupational_wages.aspx

EMPLOYMENT OUTLOOK

South Dakota Occupational Projections
2010-2020

SOC	SOC Title	2010	2020	Growth	% Growth	Average Annual Demand
51-4041	Machinists	760	865	105	13.8	20

Data derived from SD Department of Labor http://dlr.sd.gov/lmic/occupation_projections.aspx

On a national level (retrieved from the Occupational Outlook Handbook):

Overall employment of machinists and tool and die makers is expected to grow 7 percent from 2010 to 2020, slower than the average for all occupations. Employment growth will vary by specialty.

Employment of machinists is projected to grow 8 percent from 2010 to 2020, slower than the average for all occupations.

Despite improvements in technologies such as CNC machine tools, autoloaders, high-speed machining, and lights-out manufacturing, machinists will still be required to set up, monitor, and maintain these automated systems.

In addition, employers are expected to continue needing machinists who have a wide range of skills and are capable of performing modern production techniques and almost any task in a machine shop. Manufacturers will continue to rely heavily on skilled machinists as they invest in new equipment, modify production techniques, and implement product design changes more rapidly.

Machinist CIP Code: 48.0501

APPENDIX A – Precision Machining Technology PROGRAM CURRICULUM

Diploma Course Sequence

First Semester		Credits
MATH104	**Technical Math** This course includes real numbers and variable expressions, first-degree equations, polynomials, factoring, rational expressions, rational exponents and radicals, geometry, quadratic equations and trigonometry. This course is designed for students who are preparing for technical careers. It stresses a working knowledge of applied mathematical concepts. The practice problems are applications from various technical fields but do not require prior knowledge of the technical applications. Problems are selected to help develop an understanding of where and how mathematics is used in the various fields of employment. PREREQUISITES: High School Math and a COMPASS Score in Pre-Algebra Domain of 40 or higher.	3
MACHXXX	**Machine Shop Procedures** This course will cover the topics of machine shop safety, semi-precision and precision measurement, layout, inspection, bench work, band saw and drill press work, job planning, order of operations, tooling options, tool grinding, work holding devices and fixtures, and maintenance.	3
MACHXXX	**Turning Theory and Operation I** This course introduces the metal cutting lathe, its care, setup, and use as applied to current industry practices. Topics addressed will include lathe safety, machine setup, and carrying out the basic lathe operations of turning, drilling, boring, facing, and thread cutting.	3
MACHXXX	**Milling Theory and Operation I** The vertical milling machine and its set-up and operation are introduced in this course. Students will learn milling machine safety, tramming of the mill, and the use of edge finders and dial indicators to locate part features and align work. Use of the Cartesian coordinate system, drilling, surfacing, slotting, pocketing and contour milling procedures will be covered.	3
MACHXXX	**Mechanical Blueprint Reading** This course addresses the interpretation of blueprints commonly encountered in the machine shop. Drawing layout, sectional views, auxiliary views, assembly drawings, conventional, baseline, and GT&D dimensioning conventions, bill of materials, and symbols used in the metal working industry are among the topics covered.	3
CIS105	**Microcomputer Software Applications** This course is an introductory course in software applications, which includes basic technical concepts, as well as, hands-on experience. The utility of the computer is demonstrated by	3

	introducing Windows, word processing, spreadsheet, database, and presentation software to the student. (A computer course is required of all students at WDTI; students may take CIS 105 or CIS 106).	
	TOTAL CREDITS	**18**
Second Semester		**Credits**
PSYC103	**Human Relations in the Workplace** Success in the world of work requires not only the ability to perform according to the requirements of the position, but also the ability to adjust and get along with others. The purpose of this course is to help students grasp the importance of human relations skills in both their personal and career lives. It will introduce students to the skills necessary to create and maintain positive relationships and interactions in the workplace.	3
ENGL201	**Technical Writing** This course presents the basic principles and forms of written communication in the workplace. Instruction leads students through the planning tasks, identifying audiences, and gathering information. More emphasis is on reports.	3
MACHXXX	**Materials Applications** Training in this course includes metals composition and characteristics, material selection, heat treatment, hardness testing, machinability, and use of the surface grinder and other precision grinding equipment.	3
MACHXXX	**Turning Theory and Operations II** Expands on basic lathe skills by implementing the use of four-jaw chucks, collets, steady rests, follower rests, and face plate work. Taper turning, knurling, parting and machining between centers will be explored. Work will progress to include multi-part assemblies where fit, finish, and attention to detail need to be employed. Basics on operation of the CNC TRAK lathe will also be introduced.	3
MACHXXX	**Milling Theory and Operations II** Expands on basic milling machine skills. Additional work holding methods such as rotary tables, strap clamps, angle plates, and a variety of fixtures will be implemented. The use of sine bars, gauge blocks, boring heads, indexing heads, and special purpose cutters will be explored. Work will progress to include multi-part assemblies where fit, finish, and attention to detail need to be employed. Basics on operation of the two axis ProtoTrak mill will also be introduced.	3
MACHXXX	**Applied CAD Fundamentals** This course provides training in the use of SolidWorks to generate part geometry, shop drawings, and bills of materials for mechanical parts and assemblies. Design intent and strategies for using software to streamline work planning, fixturing, and finding set-up solutions in the machine shop are some of the topics covered.	3
	TOTAL CREDITS	**18**

APPENDIX B – LETTERS OF SUPPORT

SHOENER MACHINE & TOOL SUPPLY, INC.
1131 PLANT STREET
PO BOX 609
RAPID CITY, SD 57709-0609

February 22, 2013

Mark Wilson, President
Western Dakota Tech
800 Mickelson Dr
Rapid City SD 57703

RE: Precision Machining Technology and Metalworking Technology

Dear Mr. Wilson:

I have been on the advisory board since its inception and I am definitely in favor of expanding the program for machinists and welders. My customer base is always looking for machinists and welders to hire. Graduates of the current program have been starting their own businesses as well as finding jobs at local businesses. This is one program that needs to be continued and the curriculum needs to be one with the flexibility to change and expand as changes are made in technology and design.

Sincerely,

Shoener Machine & Tool Supply, Inc.

Michael D. Shoener

Michael D. Shoener
President

MDS/rjh

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An ISC Company

February 20, 2013

Mark Wilson, President
Western Dakota Tech
800 Michelson Drive
Rapid City, SD 57702

Dear Mr. Wilson,

Adams-ISC has carefully reviewed your proposal to the State of South Dakota to issue a diploma in Precision Machining Technology.

We are pleased to offer this letter of full support for this valuable program.

Adams-ISC is a fast growing company servicing the regional and energy markets that surround Rapid City and as such we have several machinists on staff and over the past year have employed additional machinist to keep pace. Unfortunately, we have had to look as far away as Illinois to fill these positions.

To be able to work with WDT on this program and hire local South Dakota trained talent would be of great value to the company.

Regards,

Duff Kruse
President & General Manager

Machining & Fabrication *Group* | Bearings, Power Transmission & Hydraulics *Group* | Equipment Repair *Group* | Pipe & Vessel *Group*
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(605) 391-7299

Feb. 20, 2013

To all concerned:

I am writing to give my full support for an advanced machining program at Western Dakota Tech.

As the owner of a precision tool and die machine shop I am concerned at the lack of applicants I see coming in my door seeking employment.

As I travel around the country dealing with other machine shops and machine tool dealers we are all appalled as the skilled trades have been ignored by the education industry. Our country is facing a critical shortage of true "Toolmakers". Those are not the CNC operators that many schools are churning out but the true thinkers and builders of the machine tool trade who design and build the prototypes then the fixtures and processes that the CNC's don't figure out for themselves.

As I look around me in the industry I see men in their mid 60's with very few young men in the trade. The future for this profession, and indeed our country, is in serious jeopardy if we don't immediately bring young men into this industry.

As this program develops I am confident that other shop owners will take up the call and support your decision to grow the next generation of "Toolmakers".

If this program comes to fruition I pledge to create an internship to give star students a place to get their start in a rewarding career.

Robert Hanson
Tool & Die Maker
Owner of Manufacturing Solutions