SANDIA REPORT
SAND2008-6028
Unlimited Release
Printed September 2008

Agile Machining and Inspection Thrust Area Team – On-Machine Probing / Compatibility Assessment of Parametric Technology Corporation (PTC) Pro/CMM with Zeiss DMISEngine

Edwin A. Bryce, Kurt Tomlinson, and Rokwel Wade

Prepared by
Sandia National Laboratories
Albuquerque, New Mexico 87185 and Livermore, California 94550

Sandia is a multiprogram laboratory operated by Sandia Corporation,
a Lockheed Martin Company, for the United States Department of Energy's
National Nuclear Security Administration under Contract DE-AC04-94AL85000.

Approved for public release; further dissemination unlimited.

Issued by Sandia National Laboratories, operated for the United States Department of Energy by Sandia Corporation.

NOTICE: This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government, nor any agency thereof, nor any of their employees, nor any of their contractors, subcontractors, or their employees, make any warranty, express or implied, or assume any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represent that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government, any agency thereof, or any of their contractors or subcontractors. The views and opinions expressed herein do not necessarily state or reflect those of the United States Government, any agency thereof, or any of their contractors.

Printed in the United States of America. This report has been reproduced directly from the best available copy.

Available to DOE and DOE contractors from
U.S. Department of Energy
Office of Scientific and Technical Information
P.O. Box 62
Oak Ridge, TN 37831

Telephone: (865) 576-8410
Facsimile: (865) 576-5728
E-mail reports@adonis.osti.gov
Online ordering http://www.osti.gov/bridge

Available to the public from
U.S. Department of Commerce
National Technical Information Service
5285 Port Royal Rd.
Springfield, VA 22161

Telephone: (800) 553-6847
Facsimile: (703) 605-6900
E-mail: orders@ntis.fedworld.gov
Online order: http://www.ntis.gov/help/ordermethods.asp?loc=7-4-0#online

SAND2008-6028
Unlimited Release
Printed September 2008

Agile Machining and Inspection Thrust Area Team – On-Machine Probing / Compatibility Assessment of Parametric Technology Corporation (PTC) Pro/CMM DMIS with Zeiss DMISEngine

Edwin A. Bryce, Kurt Tomlinson, and Rokwel Wade
Manufacturing Processes & Services Department
Sandia National Laboratories
P.O. Box 5800
Albuquerque, New Mexico 87185-0958

Abstract

The charter goal of the Agile Machining and Inspection Thrust Area Team is to identify technical requirements, within the nuclear weapons complex (NWC), for Agile Machining and Inspection capabilities. During FY 2008, the team identified Parametric Technology Corporation (PTC) Pro/CMM as a software tool for use in off-line programming of probing routines—used for measurement—for machining and turning centers. The probing routine would be used for in-process verification of part geometry. The same Pro/CMM program used on the machine tool could also be employed for program validation / part verification using a coordinate measuring machine (CMM). Funding was provided to determine the compatibility of the Pro/CMM probing program with CMM software (Zeiss DMISEngine).

ACKNOWLEDGEMENTS

Bryant Morgan of Sandia National Laboratories, Livermore, CA, for his assistance with the Pro/CMM software application.

Lutz Karras of Carl Zeiss IMT, Germany, for his assistance with the DMISEngine software application.

CONTENTS

INTRODUCTION 7
Procedure 8
Results 12
Summary 12
Recommendations 14
APPENDIX A – Zeiss DMISEngine / Characterization File 17
APPENDIX B – Pro/CMM / Characterization File 65
APPENDIX C – DMISEngine Interface Display 79
APPENDIX D – Zeiss DMISEngine / CMM-OS 81
APPENDIX E – Pro/CMM / DMIS Input File 83

FIGURES

Figure 1. Test Part – "Circle – Diamond – Square" 7
Figure 2. Aluminum Test Part 8
Figure 3. Zeiss DMISEngine Interface 9
Figure 4. Display Statement 10
Figure 5. Clear Surface Statement 10
Figure 6. Feedrate/Acceleration Statements 11
Figure 7. Angularity Definition 11
Figure 8. Datum Definition Statement 11
Figure 9. DMIS Display Command 12
Figure 10. DMISEngine Interface Display 12
Figure 11. Pro/CMM – DMISEngine Flow Chart 13
Figure 12. Pro/CMM AVI Training 14

INTRODUCTION

This compatibility assessment was based on an ongoing machine tool alignment test project being conducted at Sandia National Laboratories (SNL). The test project involved the use of what is commonly referred to as "circle - diamond - square" test part, which is used for evaluation of machining center performance. A Pro/Engineer (Wildfire) model was created of the test part using guidelines from chapter 8 of "Machining Test Parts" of the American Society of Mechanical Engineers (ASME) B5.54-2005 "Methods for Performance Evaluation of Computer Numerically Controlled Machining Centers" (see Figure 1). The test part was fabricated using 6061-T6 aluminum (see Figure 2).

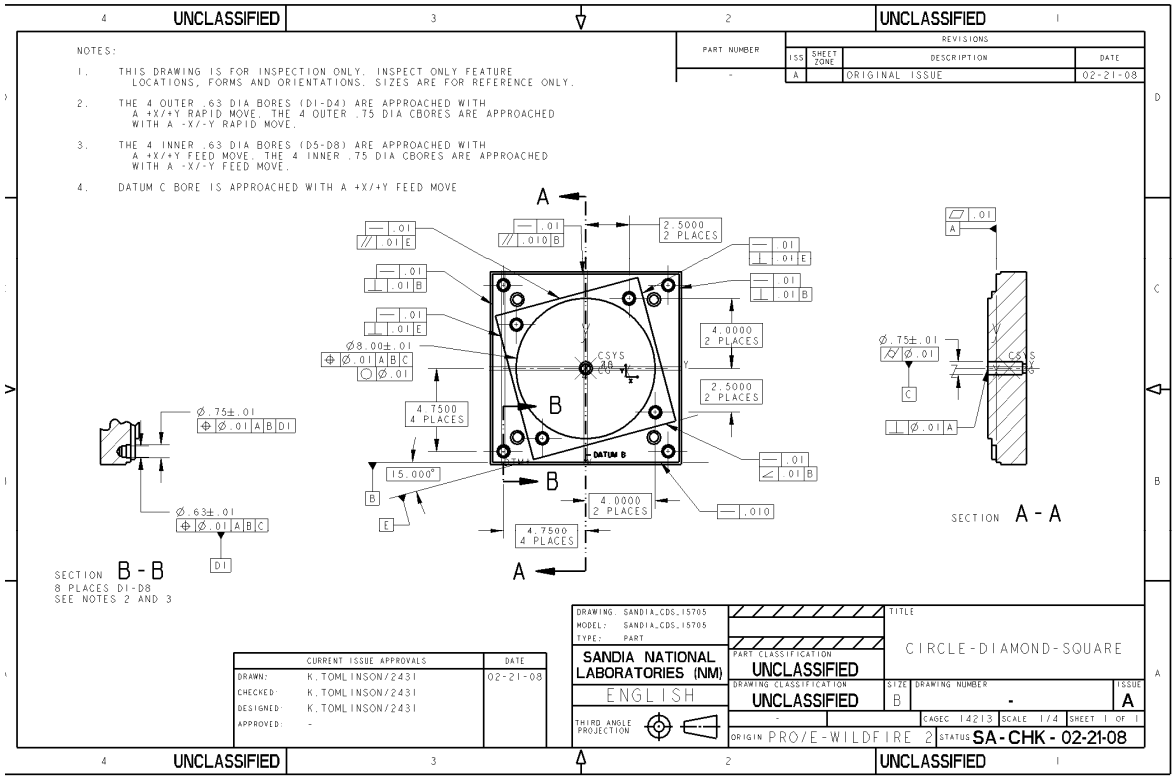

Figure 1. Test Part – "Circle – Diamond – Square"

The model was used to create a probing routine using the Pro/CMM programming module. Pro/CMM is normally used to program a probing routine for a CMM and uses the Dimensional Measurement Interface Standard (DMIS) language format. DMIS is a "man-readable" and "man-writable" language which allows viewing and editing using common text editing tools. The DMIS standard uses a major / minor word format and currently is at version 5.1. Use of Pro/CMM for the programming had the additional benefit of associativity provided in using only Pro/Engineer tools throughout the design, manufacture, and inspection process. For this assessment, the model and the machine control code for both the machining center and CMM were created by an experienced machinist.

After the test piece was fabricated and the probing routine (DMIS Input) written, the test part and the probing routine were taken to the SNL Mechanical Measurements Department (2431-4) for evaluation. The DMIS Input (DMI) code was evaluated for compatibility and performance when used with the Zeiss DMISEngine software module. The DMISEngine module is a relatively new software module in the United States, and it allows a DMIS Input program to be executed on the CMM without translation to another software language. Currently the DMISEngine is DMIS 5.0 compliant, where as Pro/CMM is DMIS 3.0 compliant. The purpose of this report is to document the results of the assessment. A complete listing of the Pro/CMM DMIS Input file is listed in Appendix E of this report.

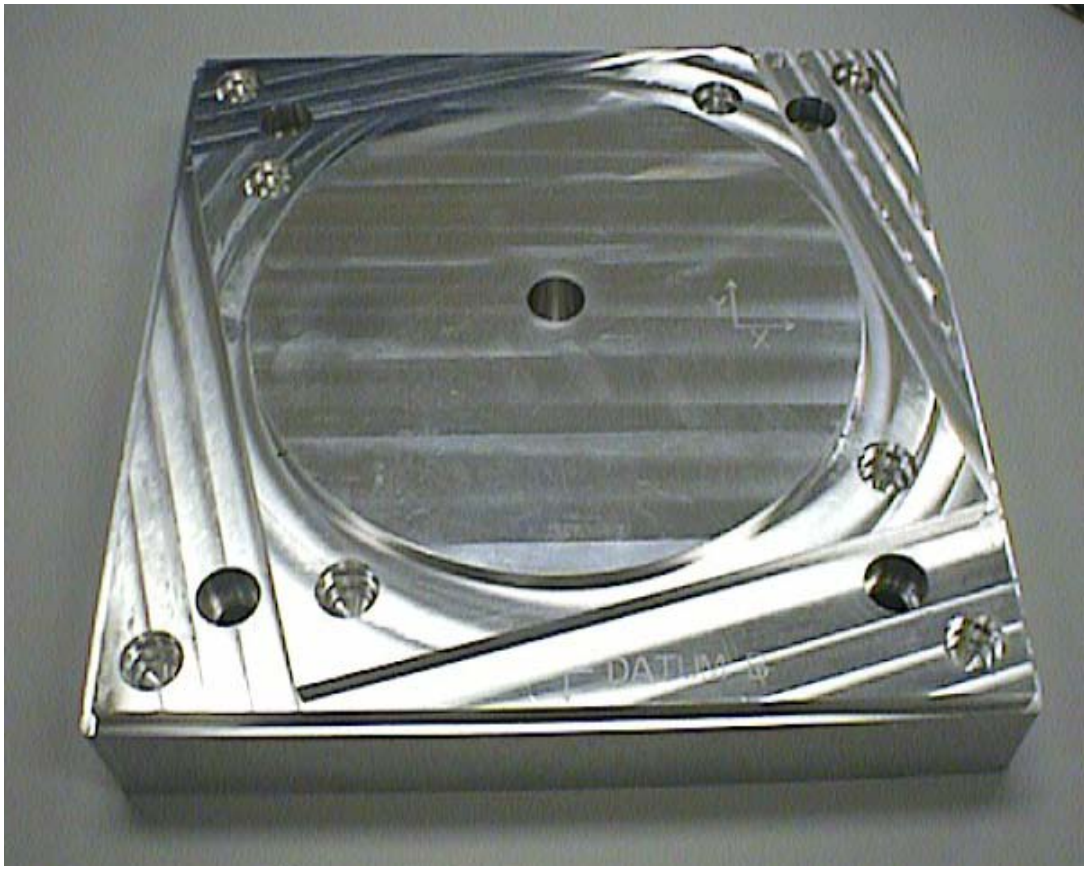

Figure 2. Aluminum Test Part

Procedure

The DMIS program was written using simple 2D probing strategies that evaluated the form, location, and orientation (parallelism, perpendicularity, and angularity) of various features on the test part. 2D probing strategies, without scanning routines, were used in order to keep the generated DMIS code compatible with a machining center probing system, which currently does not support scanning.

The Mechanical Measurements Department did not provide input into the design or programming of the test part, and although the program was written by an experienced machinist, there may be issues or concerns with the measurement plan because of this fact. For in-process measurements, programming by a machinist and not an individual from a quality department (e.g., inspector) may or may not be an acceptable practice. The determination as to the correct person to program the probing routine was outside the scope of this project. Consideration to this subject should be addressed in future discussions.

The Zeiss DMISEngine, version 1.2.9, provides a listing (characterization file) of supported DMIS commands. The DMISEngine supported commands are included in appendix A of this document. Figure 3 shows the DMISEngine interface display.

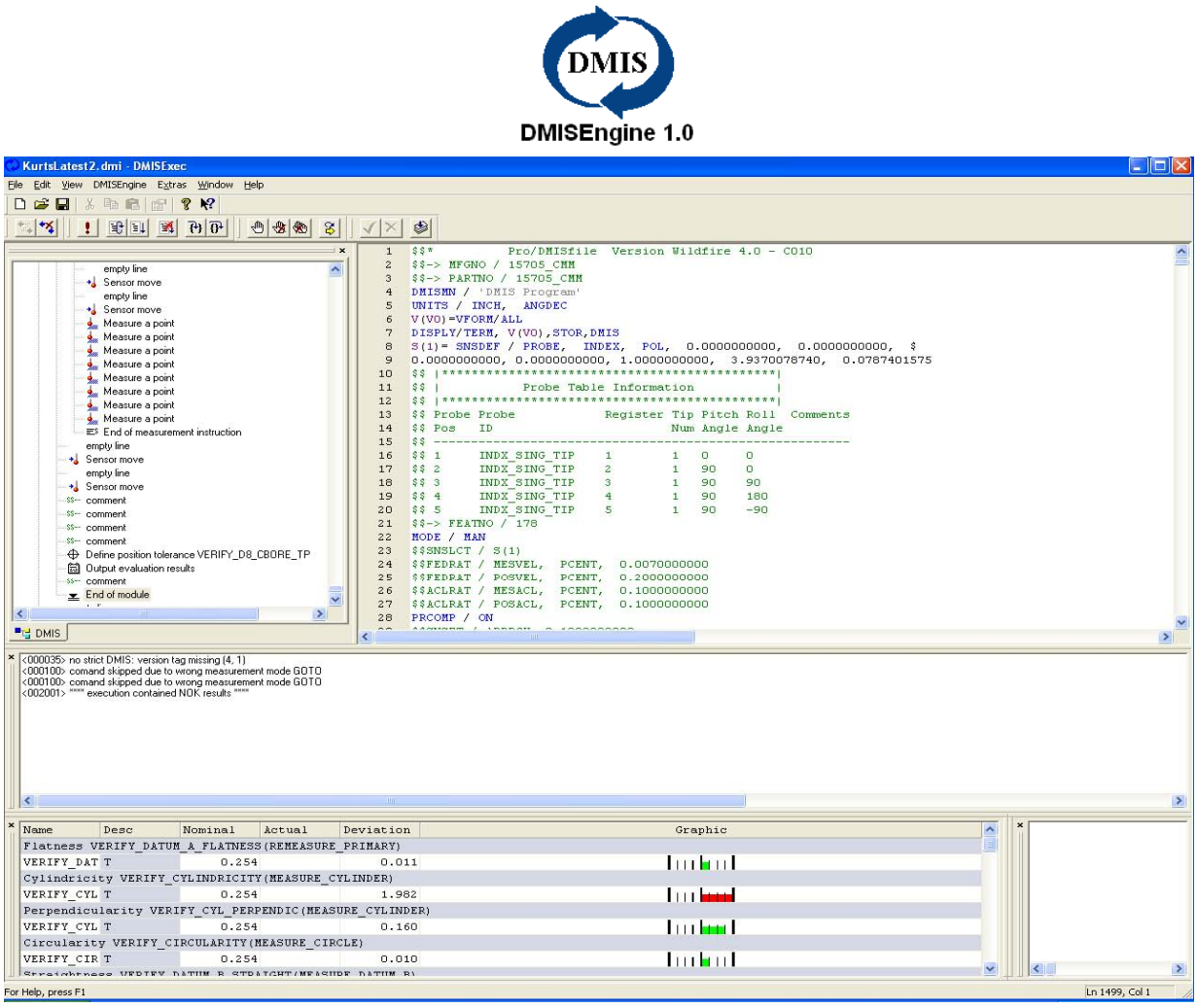

Figure 3. Zeiss DMISEngine Interface

Several issues were encountered when the DMIS Input was imported into the Zeiss DMISEngine. The majority of these issues were related to Pro/CMM DMIS commands which are not supported by the Zeiss DMISEngine. This issue could be reduced or eliminated if the configuration of Pro/CMM allowed generation of only DMISEngine supported commands. Another option could be some sort of filtering within DMISEngine to "comment out - $$" any commands not supported or the use of a text utility program.

The first discrepancy found in the Pro/CMM generated DMIS code was the lack of a display statement. This display statement is needed to define the output format of the measured results. Without the display statement, the DMIS program would simply run without generating any sort of measurement data report. Although it is not difficult to manually insert a customized display statement in to the DMIS program, having Pro/CMM generate a generic display statement automatically would certainly be a time-saving feature. It is not known if Pro/CMM supports the display commands or if Pro/CMM programmer inexperience was the cause. Figure 4 shows the generic display statement that was inserted into the DMIS program.

```
V(V0)=VFORM/ALL
DISPLY/TERM, V(V0),STOR,DMIS
```

Figure 4. Display Statement

The second issue found during the assessment was a group of statements that were not supported by the Zeiss DMISEngine. The clear surface statements generated an error when compiled within the Zeiss DMISEngine. These statements were commented out ($$) to prevent them from stopping the program run unnecessarily (see Figure 5 below).

```
$$SNSET / CLRSRF, 0.1000000000 *
```

Figure 5. Clear Surface Statement

Another issue encountered during the testing was the incompatibility of percentage feed and acceleration rates in the DMIS code with the DMISEngine software. The use of the commands such as ACLRAT / …, PCENT, and FEDRAT / ... PCENT makes programs no longer portable. A percentage federate such as 20% on one CMM may be quite different than 20% on another. Similarly, problems were encountered with the approach and retract commands. In communications with Zeiss, we were informed that the approach and retract commands are supported in the current DMISEngine version and that perhaps the problem may have been caused by our use of an earlier version of the software application. In further examination of the issue, the approach and retract command functions are compatible although they were commented out. These functions are typically applied by the Zeiss DMISEngine at the CMM control interface level. The feed rate, acceleration rate, approach distance, and retract distance commands were commented out for this test (see Figure 6).

```
$$FEDRAT / MESVEL, PCENT, 0.0070000000
$$FEDRAT / POSVEL, PCENT, 0.2000000000
$$ACLRAT / MESACL, PCENT, 0.1000000000
$$ACLRAT / POSACL, PCENT, 0.1000000000
      $$SNSET / APPRCH, 0.1000000000
      $$SNSET / RETRCT, 0.1000000000
```

Figure 6. Feedrate/Acceleration Statements

In one instance, the Pro/CMM module failed to completely define nominal geometries in the DMIS Input. This is shown in the DMIS code below (Figure 7) that evaluates angularity of a surface on the test piece.

```
T(VERIFY_DATUM_E_ANGLE)= TOL / ANGLR, 15, 0.0100000000, $
FA(MEASURE_DATUM_B)
OUTPUT / FA(MEASURE_DATUM_E), TA(VERIFY_DATUM_E_ANGLE)
```

Figure 7. Angularity Definition

The nominal value (15 degrees) for the angularity callout (highlighted in red) needed to be manually inserted into the code to fully define the characteristic. Without this correction, the Zeiss DMISEngine would break out of the program run at the line containing the incomplete command. This issue was the most significant problem found in the code generated by Pro/CMM. This problem occurred on all of the lines of code that defined angularity nominals and tolerances. Further investigation into the cause is needed.

The last potential compatibility issue found in this test was in the naming convention of features in the Pro/CMM generated DMIS code. Although the Pro/CMM module used the actual datum names from the model, common datum names such as “A” were flagged by the Zeiss DMISEngine with a warning as “A” is a minor word. The use of labels that use reserved words (major or minor) will receive a warning however it should not prevent program execution. When attempting to run a datum definition statement (see Figure 8), the Zeiss DMISEngine would display a “reserved word” error. This is only a warning and the any issues were due to our lack of experience in using DMIS and the DMISEngine.

```
DATDEF / FA(PROBE_PRIMARY), DAT(A)
D(REF_CSYS01)= DATSET / DAT(A), ZDIR
```

Figure 8. Datum Definition Statement

Results

CMM measurement results can be obtained from the DMISEngine in several formats. The DMIS Display command "DISPLAY/TERM" (see Figure 9) used in this test specifies output to the video terminal along with the command "STOR,DMIS" which specifies storage of results to electronic media in a DMIS output format (DMO). The DMISEngine interface window also provided a display of the CMM results which can be output (see Figure 10). A complete listing of the CMM results using the DMISEngine display is listed in Appendix C of this report.

```
V(V0)=VFORM/ALL
DISPLY/TERM, V(V0),STOR,DMIS
```

Figure 9. DMIS Display Command

Name	Desc	Nominal	Actual	Deviation	Graphic
Flatness VERIFY_DATUM_A_FLATNESS(REMEASURE_PRIMARY)					
VERIFY_DAT	T	0.254		0.011	
Cylindricity VERIFY_CYLINDRICITY(MEASURE_CYLINDER)					
VERIFY_CYL	T	0.254		1.982	
Perpendicularity VERIFY_CYL_PERPENDIC(MEASURE_CYLINDER)					
VERIFY_CYL	T	0.254		0.160	
Circularity VERIFY_CIRCULARITY(MEASURE_CIRCLE)					
VERIFY_CIR	T	0.254		0.010	
Straightness VERIFY_DATUM_B_STRAIGHT(MEASURE_DATUM_B)					
VERIFY_DAT	T	0.254		0.004	

Figure 10. DMISEngine Interface Display

Summary

As has been identified in this report, the majority of the issues that arose in this project related to the DMIS commands generated by Pro/CMM that are not supported by the Zeiss DMISEngine. This issue may cause some to reach the conclusion that the DMISEngine is lacking in capabilities when that is not the case. There is some historical information related to DMIS that must be understood to realize the root cause of this issue.

The original development of the DMIS standard took place in 1985 with the objective to provide bi-directional communication of inspection data between computer and inspection systems. DMIS uses a neutral format protocol for passing inspection programs to dimensional measuring equipment (DME), typically a CMM, and for passing inspection results from the DME to a post-processing application. The standard has had several revisions, currently at version 5.1, and has been accepted by the American National Standard (ANSI). The standard is maintained by the Dimensional Metrology Standards Consortium (DMSC). The web site for DMSC is: http://www.dmisstandards.org.

In many instances DMIS was not used as the CMM application software, but rather as a way to transfer part programs from one software application to another via translation. However, some CMM software applications use the DMIS file as the native language to operate the CMM.

Allowing the DMIS Input file to control some aspects of the CMM, such as probe tip definition and CMM feed rates, were viewed as a possible source of conflict between the CMM and the software application. Assuring that the CMM is providing the application software with correct and accurate data is essential, and it was determined by Zeiss that there are particular parameters needing to be addressed at the CMM control level and not at the application software level. Basically the CMM vendor, Zeiss in this case, would be responsible for the CMM accuracy and all function parameters. Zeiss developed CMM-OS which serves as the interface that allows interoperability of different softwares with a Zeiss CMM control. A software application, DMISEngine in this project, would communicate with the CMM through CMM-OS to provide the CMM information on what was to be measured (nominal geometry and tolerances/datums and datum reference frames) and also what data (result) was needed from the CMM.

The Pro/CMM DMIS Input file had commands specified, as documented in this report, that are controlled using CMM-OS at the CMM control level. The DMISEngine / CMM-OS interface rejected these commands and they should not be included in the DMIS Input file.

The Pro/CMM to final results (reporting) path is shown in Figure 11.

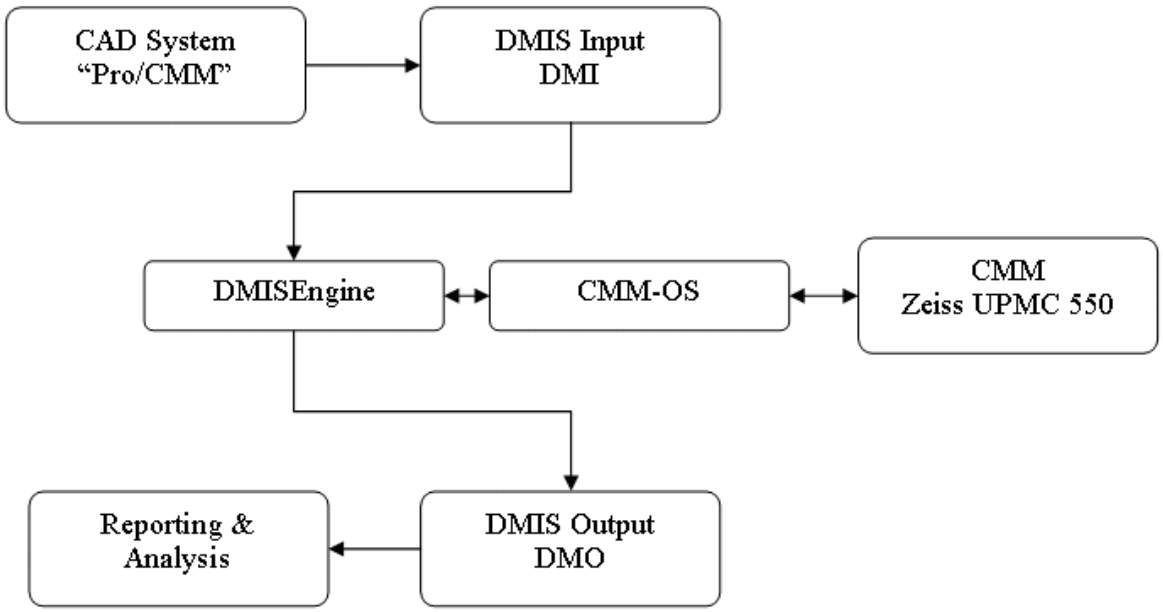

Figure 11. Pro/CMM – DMISEngine Flow Chart

Recommendations

The use of Pro/CMM to generate probing routines for machining and turning centers has potential benefits to the Nuclear Weapon Complex (NWC) for in-process measurements. Consideration of in-process part specifications should be addressed in future related activities of the Agile Machining and Inspection Thrust Area Team. To fully realize the benefits of using in-process measurements, there must be a significant effort made to provide training in a wide range of related activities. The following training areas include but are not limited to:

- Pro/CMM – Currently Parametric Technology Corporation (PTC) has limited training resources for the module. This is an issue that should be addressed with PTC.

  Training developed "in-house" is possible but as with any training of this kind, there are advantages as well as limitations. An example "in-house" training is one developed by Bryant Morgan of Sandia National Laboratories (Livermore, CA). Bryant Morgan is regarded as a Pro/CMM expert within the NWC and he has produced training modules for Pro/CMM, in the form of AVI files (see Figure 12).

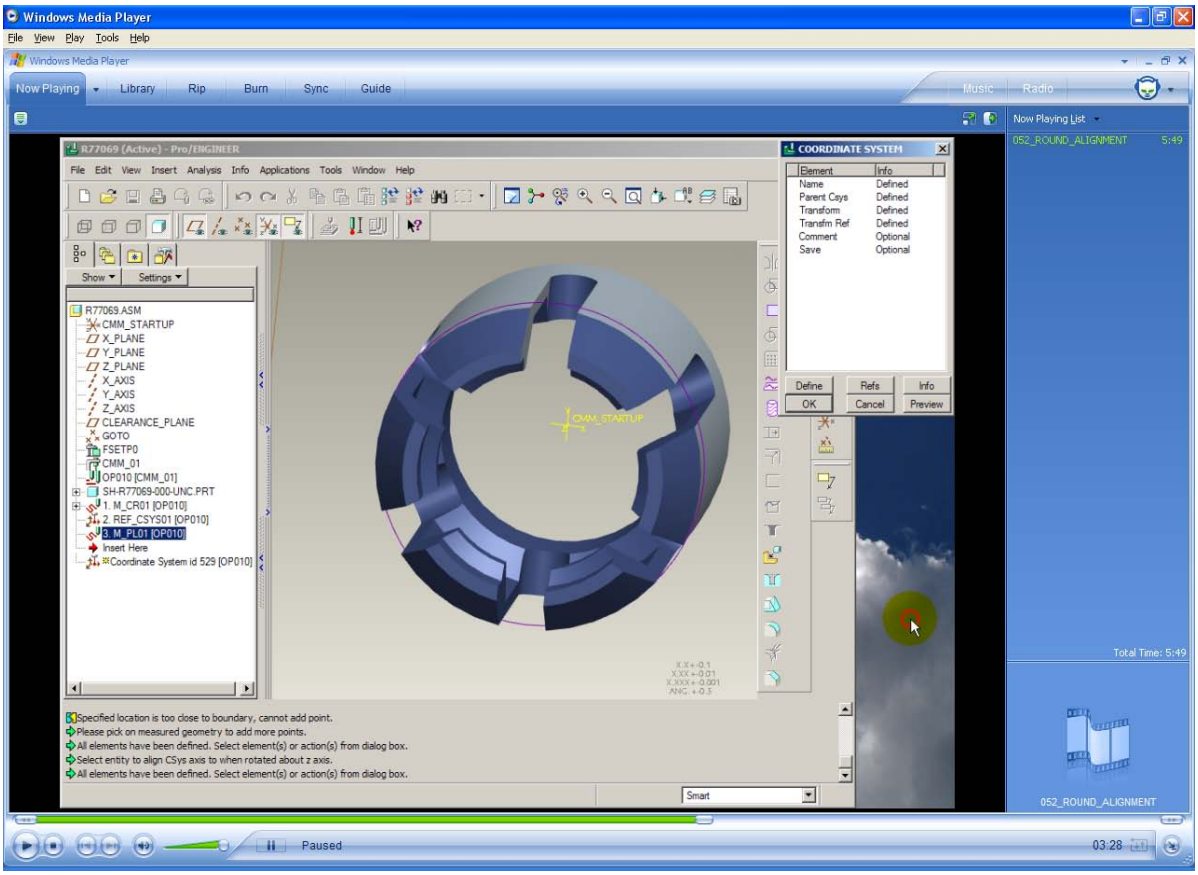

Figure 12. Pro/CMM AVI Training

- Dimensioning and Tolerancing (GD&T) - Understanding and application of ASME Y14.5M "Dimensioning and Tolerancing" callouts used in ProE is essential to proper probing routine generation. A major issue of concern is the construction of the datum reference frame (DRF). In some cases in-process measurement of a part may require establishment of a partial or temporary DRF due to the fact that the permanent datum features have not yet been machined. Consideration of in-process part specifications should be addressed in future.

- Inspection Planning – Includes the sequence used for probing, probing strategies (2D or vector probing) and sampling requirements. As stated previously, the programmer of the probing routine should have a background in the fundamentals of dimensional inspection at a minimum. The issue of whether a machinist or inspector is required for in-process programming should be addressed.

- DMIS – The use of Pro/CMM to generate a DMIS Input file although automatic may, in some instances, require manual editing of the DMIS file. Proficiency in, or at least a general working knowledge of, the DMIS language would be beneficial. Training in DMIS is offered by several commercial vendors and a resource for locating more information would be the Dimensional Metrology Standards Consortium (DMSC).

The use of Pro/CMM for programming of probing routines for machining or turning center in-process measurements, with the benefit of associativity to the ProE model, should be studied further to develop a comprehensive strategy for NWC wide implementation. How implementation can progress depends on the ability of the various application packages to interface with the various DME systems. There is significant effort being applied to the issue of interoperability at the National Institute of Standards and Technology (NIST). Additional information on this work can be located at:

http://www.isd.mel.nist.gov/projects/metrology_interoperability/

The use of a machining or turning center for in-process measurements should also address the issue of machine tool accuracy. Although outside the scope of this paper, future activities should also address how on-machine measurements are validated for conformance to a known reference standard.

APPENDIX A – ZEISS DMISENGINE / CHARACTERIZATION FILE

The following table displays which DMIS statements are supported by DMISEngine.
A „x“ in the last column indicates that the statement is supported.

COMMAND	PARAMETERS		
ACLRAT	**ACLRAT/var_1**		**x**
	var_1	MESACL,var_2	**x**
		POSACL,var_2	**x**
		ROTACL,var_3	**x**
	var_2	MPMM,n	**x**
		MMPSS,n	**x**
		IPMM,n	**x**
		IPSS,n	**x**
		var_4	**x**
	var_3	RPMM,n	**x**
		var_4	**x**
	var_4	PCENT,n	**x**
		HIGH	**x**
		LOW	**x**
		DEFAULT	**x**
ALGDEF	**VA(label)=ALGDEF/var_1**		
	var_1	CODE,n	
		'name' var_2	
	var_2	„parameter var_2	
ASSIGN	**varname=ASSIGN/expr**		**x**
BADTST	**BADTST/var_1**		
	var_1	ON	
		OFF	
BOUND	**BOUND/var_1 var_2 var_3**		**x**
	var_1	F(label1)	**x**
		T(label1)	**x**
	var_2	F(label3)	**x**
		FA(label4)	**x**
	var_3	var_2 var_3	**x**
		does not exist	**x**

CALIB	**CALIB/var_1**		**x**
	var_1	SENS,S(label1), var_2	**x**
		RTAB,RT(label2), var_3	**x**
	var_2	FA(label3), var_4	
		F(label4), var_4	**x**
	var_3	F(label5)	
		FA(label6), FA(label7)	**x**
	var_4	n	**x**
		'text'	
		'text',n	
CALL	**CALL/var_1**		**x**
	var_1	M(label1) var_2	**x**
		EXTERN, var_3	**x**
	var_2	,parameter var_2	**x**
		does not exist	**x**
	var_3	DME, 'routinename' var_4 var_2	
		SYS,'pathname' var_4 var_2	**x**
		DMIS, var_5	**x**
	var_4	,WAIT	**x**
		,CONT	**x**
		,SPAWN	**x**
		,ATTACH	**x**
		does not exist	**x**
	var_5	M(label1) var_2	**x**
		'module id'	**x**
CASE	**CASE/arg_1**		**x**
CLMPID	**CI(label)=CLMPID/'text'**		**x**
CLMPSN	**CS(label)=CLMPSN/'text'**		**x**
CLOSE	**CLOSE/DID(label1) var_1**		**x**
	var_1	,KEEP	**x**
		,DELETE	**x**
		,END	**x**
		does not exist	**x**

CMPNTGRP	**SG(label)=CMPNTGRP/BUILD var_1**		
	var_1	SG(label1) var_2	
		SW(label2) var_2	
		SX(label3) var_2	
		RM(label4) var_2	
	var_2	var_1	
		does not exist	
CONST (1)	**CONST/var_1,F(label1),BF,FA(label2),var_2 var_3**		**x**
	var_1	ARC	**x**
		CIRCLE	**x**
		CONE	**x**
		CYLINDR	**x**
		CPARLN	**x**
		ELLIPS	**x**
		LINE	**x**
		PATERN	**x**
		PLANE	**x**
		RCTNGL	**x**
		SPHERE	**x**
		TORUS	**x**
	var_2	FA(label3)	**x**
		F(label4)	**x**
	var_3	, var_2 var_3	**x**
		does not exist	**x**
CONST (2)	**CONST/LINE,F(label1),var_1**		**x**
	var_1	MIDLI, FA(label2), var_2	**x**
		PROJLI, FA(label2), var_3	**x**
	var_2	FA(label3)	**x**
		F(label4), var_4	**x**
	var_3	FA(label3)	**x**
		F(label4), var_4	**x**
		does not exist	**x**
CONST(3)	**CONST/PLANE,F(label1),MIDPL,FA(label2),var_1**		**x**
	var_1	FA(label3)	**x**
		F(label4)	**x**

CONST(4)	**CONST/POINT,F(label1),var_1**		**x**
	var_1	MIDPT, FA(label2), var_2	**x**
		PIERCE, FA (label2), var_2	**x**
		VERTEX, FA (label2)	**x**
		PROJPT, FA (label2) var_3	**x**
		MOVEPT, FA(label2), var_4	**x**
		CURVE, FA(label2), var_2	**x**
		EXTREM, var_5, FA(label2), var_6	**x**
		COG, FA(label3) var_7	**x**
	var_2	FA(label4)	**x**
		F(label5)	**x**
	var_3	,FA(label4)	**x**
		,F(label5)	**x**
		does not exist	**x**
	var_4	dx, dy, dz	**x**
		F(label5), dist	**x**
		FA(label4), dist	**x**
	var_5	MIN	**x**
		MAX	**x**
	var_6	XDIR	**x**
		YDIR	**x**
		ZDIR	**x**
		VEC, i, j, k	**x**
		F(label5)	**x**
		FA(label4)	**x**
		RADIAL	**x**
	var_7	,FA(label3) var_8	**x**
		,F(label6) var_8	**x**
	var_8	var_7	**x**
		does not exist	**x**
CONST(5)	**CONST/var_1,F(label1),PROJCT,FA(label2) var_2**		**x**
	var_1	ARC	**x**
		CIRCLE	**x**
		CPARLN	**x**
		ELLIPS	**x**
	var_2	,FA(label3)	**x**
		,F(label4)	**x**
		does not exist	**x**

CONST(6)	**CONST/var_1,FA(label1),var_3**		**x**
	var_1	CIRCLE,F(label2), var_2	**x**
		LINE, F(label2), var_2	**x**
		POINT, F(label2), INTOF	**x**
	var_2	TANTO	**x**
		INTOF	**x**
	var_3	FA(label3)	**x**
		F(label4)	**x**
CONST(7)	**CONST/var_1,var_2**		**x**
	var_1	CIRCLE, F(label1),TANTO	**x**
		LINE, F(label1), var_3	**x**
		PLANE, F(label1), var_3	**x**
	var_2	FA(label2), THRU, var_4	**x**
		F(label3), THRU, FA(label4)	**x**
	var_3	PERPTO	**x**
		TANTO	**x**
		PARTO	**x**
	var_4	FA(label4)	**x**
		FA(label5)	**x**
CONST(8)	**CONST/var_1,F(label1),OFFSET,FA(label2) var_2**		**x**
	var_1	LINE	**x**
		PLANE	**x**
	var_2	,FA(label2) var_2	**x**
		,F(label3) var_2	**x**
		does not exist	**x**
CONST(9)	**CONST/SGAGE,SE(label1) var_1**		
	var_1	,F(label2) var_2	
	var_2	var_1	
		does not exist	
CONST(10)	**CONST/SPART,ST(label1) var_1**		
	var_1	,FA(label2) var_2	
	var_2	var_1	
		does not exist	
CONST (11)	**CONST/var_1,F(label1),TR,FA(label2) var_2**		**x**
	var_1	ARC	**x**
		CIRCLE	**x**
		CONE	**x**
		CYLINDR	**x**

		CPARLN	**x**
		ELLIPS	**x**
		LINE	**x**
		PATERN	
		PLANE	**x**
		POINT	**x**
		RCTNGL	**x**
		SPHERE	**x**
		TORUS	**x**
	var_2	,DA(label3)	**x**
		,D(label4)	**x**
	var_3	does not exist	**x**
CONST (12)	**CONST/CIRCLE,F(label1),CONE,var_1,FA(label2)**		**x**
	var_1	DIAM, diameter	**x**
		DIST, distance	**x**
CONST (13)	**CONST/GEOM,F(label1),NEARPT,FA(label2)**		
CRGDEF	**CR(label)=CRGDEF/sx,sy,sz,dx,dy,dz,xi,xj,xk,yi,yj,yk,zi,zj,zk,a**		**x**
CRMODE	**CRMODE/var_1**		**x**
	var_1	SEQNTL	**x**
		SIMUL	**x**
		SYNC	
CROSCL	**CROSCL/var_1**		
	var_1	ON	
		OFF	
CRSLCT	**CRSLCT/var_1**		**x**
	var_1	CR(label1)	**x**
		ALL	**x**
CUTCOM	**CC(label)=CUTCOM/MD(label1),var_1**		
	var_1	ADJUST,TL(label2),var_2, var_3, amt	
		PARAM, x, y, z, a, b, c	
		MATRIX, dx, dy, dz, ix, iy, iz, jx, jy, jz, kx, ky, kz	
		USERDEF, ‘text’	
	var_2	LEFT	
		RIGHT	
	var_3	XYPLAN	
		YZPLAN	
		ZXPLAN	
CZONE	**CZ(label)=CZONE**		**x**

CZSLCT	**CZSLCT/CZ(label1),var_1**		**x**
DATDEF	**DATDEF/var_1**		**x**
	var_1	FA(label1), DAT(x)	**x**
		FA(label2), DAT(x-x)	**x**
		F(label3), DAT(x)	**x**
DATSET	**D(label)=DATSET/var_1**		**x**
	var_1	MCS	**x**
		var_2	**x**
		TRMATX,a1,a2,a3,b1,b2,b3,c1,c2,c3,d1,d2,d3	**x**
	var_2	DAT(x), var_3 var_4 var_5 var_6	**x**
		DAT(x), var_3 var_4 var_6 var_5	**x**
		DAT(x) var_7 var_5, DAT(x), var_3 var_4	**x**
		DAT(x) var_7, DAT(x), var_3 var_4 var_5	**x**
	var_3	XDIR	**x**
		-XDIR	**x**
		YDIR	**x**
		-YDIR	**x**
		ZDIR	**x**
		-ZDIR	**x**
	var_4	,XORIG var_4	**x**
		,YORIG var_4	**x**
		,ZORIG var_4	**x**
		does not exist	**x**
	var_5	,DAT(x), var_3 var_4	**x**
		,DAT(x) var_7	**x**
		does not exist	**x**
	var_6	,DAT(x), var_7	**x**
		does not exist	**x**
	var_7	,XORIG var_4	**x**
		,YORIG var_4	**x**
		,ZORIG var_4	**x**
DECL	**DECL/var_1 var_2 var_3**		**x**
	var_1	COMMON,	**x**
		GLOBAL,	**x**
		LOCAL,	**x**
		does not exist	**x**
	var_2	BOOL	**x**
		INTGR	**x**

		LONG	**x**
		REAL	**x**
		DOUBLE	**x**
		CHAR,n	**x**
		VECTOR	**x**
	var_3	,varname var_4	**x**
		,varname[index1 var_5] var_4	**x**
	var_4	var_3	**x**
		does not exist	**x**
	var_5	,indexn var_5	**x**
		does not exist	**x**
DECPL	**DECPL/var_1**		**x**
	var_1	ALL, var_2	**x**
		var_3,var_2 var_4	**x**
	var_2	DEFALT	**x**
		n	**x**
	var_3	ANGLE	**x**
		DIST	**x**
		HUMID	
		DEV	**x**
		TEMP	**x**
		VEC	**x**
	var_4	,var_3,var_2 var_4	**x**
		does not exist	**x**
DELETE	**DELETE/var_1 var_2**		**x**
	var_1	D(label)	**x**
		DA(label2)	**x**
		S(label3)	**x**
		SA(label4)	**x**
		FA(label5)	**x**
		RT(label6)	
		ALLSA var_3	
	var_2	, DID(label7)	**x**
		does not exist	**x**
	var_3	,EXCEPT, SA(label4) var_4	
		does not exist	
	var_4	SA(label4) var_4	
		does not exist	

DEVICE	**DID(label)=DEVICE/var_1**		**x**
	var_1	PRINT,'devicename'	
		TERM,'devicename'	
		COMM,'devicename'	
		STOR,'filename'	**x**
		INCR,'filemask'	**x**
DFTCAS	**DFTCAS**		**x**
DISPLY	**DISPLY/var_1**		**x**
	var_1	var_2	**x**
		OFF	**x**
	var_2	PRINT, var_3 var_4	**x**
		TERM, var_3 var_4	**x**
		STOR, var_3 var_4	**x**
		COMM, var_3 var_4	
	var_3	DMIS	**x**
		V(label1)	**x**
		DMIS,V(label1)	**x**
	var_4	,var_2	**x**
		does not exist	**x**
DMEHW	**DMEHW/var_1**		
	var_1	CONTIN	
		PAUSE	
		SINGLE	
		AUTO	
DMEID	**DI(label)=DMEID/'text'**		**x**
DMESW	**DMESW/var_1**		**x**
	var_1	COMAND,'command'	**x**
		CONTIN	
		DELAY,n	
		PAUSE	
DMESWI	**DS(label)=DMESWI/'text'**		**x**
DMESWV	**DV(label)=DMESWV/'text'**		**x**
DMIS	**DMIS/var_1**		
	var_1	OFF	
		ON	**x**
DMISMD	**DMISMD/'module_id',version**		**x**
DMISMN	**DMISMN/'text',version**		**x**

DO	**DO/index,initial,limit var_1**		**x**
	var_1	increment	**x**
ELSE			**x**
ENDCAS			**x**
ENDDO			**x**
ENDFIL			**x**
ENDGO			**x**
ENDIF			**x**
ENDMAC			**x**
ENDMES			**x**
ENDSEL			**x**
ENDXTN			**x**
EQUATE	**EQUATE/DA(label1),DA(label2)**		
	EQUATE/DA(label1),CADCS,DID(label3),var_1		
	var_1	a1,a2,a3,b1,b2,b3,c1,c2,c3,d1,d2,d3	
		'text'	
ERROR	**ERROR/var_1**		
	var_1	(jumptarget),var_2	
		OFF	
		AUTO,var_2	
	var_2	ALL	
		ILLEGALTOUCH	
		NOTOUCH	
		ercode	
EVAL	**EVAL/var_1**		**x**
	var_1	FA(label1),T(label2) var_2	**x**
		FA(label3),var_3,T(label4)	**x**
		var_4,FA(label5),T(label4)	**x**
	var_2	,T(label2) var_2	**x**
		does not exist	**x**
	var_3	F(label6)	**x**
		FA(label5)	**x**
		DAT(label7)	**x**
	var_4	F(label8)	**x**
		DAT(label7)	**x**
EXTENS	**SX(label)=EXTENS/var_1**		**x**
	var_1	dx,dy,dz	**x**
		VEC,i,j,k,length	**x**

EXTFIL	**EXTFIL/var_1,'filename'**		**x**
	var_1	DMIS	**x**
		DME	
		SYS	
FEAT/ARC(1)	**F(label)=FEAT/ARC,var_1,var_2,I,j,k,rad,ang1,ang2 var_3**		**x**
	FA(label)=FEAT/ARC,var_1,var_2,I,j,k,rad,ang1,ang2 var_3		**x**
	var_1	INNER	**x**
		OUTER	**x**
	var_2	CART,x,y,z	**x**
		POL,r,a,h	**x**
	var_3	,is,js,ks	**x**
		does not exist	**x**
FEAT/ARC(2)	**F(label)=FEAT/ARC,4POINT,var_1,e1x,e1y,e1z,mx,my,mz,e2x,e2y,e2z,$ cx,cy,cz**		**x**
	FA(label)=FEAT/ARC,4POINT,var_1,e1x,e1y,e1z,mx,my,mz,e2x,e2y,e2z,$ cx,cy,cz		**x**
	var_1	INNER	**x**
		OUTER	**x**
FEAT/CIRCLE	**F(label)=FEAT/CIRCLE,var_1,var_2,I,j,k,diam**		**x**
	FA(label)=FEAT/CIRCLE,var_1,var_2,i,j,k,diam		**x**
	var_1	INNER	**x**
		OUTER	**x**
	var_2	CART,x,y,z	**x**
		POL,r,a,h	**x**
FEAT/CONE	**F(label)=FEAT/CONE,var_1,var_2,I,j,k,ang**		**x**
	FA(label)=FEAT/CONE,var_1,var_2,i,j,k,ang		**x**
	var_1	INNER	**x**
		OUTER	**x**
	var_2	CART,x,y,z	**x**
		POL,r,a,h	**x**
FEAT/CPARLN	**F(label)=FEAT/CPARLN,var_1,var_2,var_3,I,j,k,i1,j1,k1,len,wi**		**x**
	FA(label)=FEAT/CPARLN,var_1,var_2,var_3,I,j,k,i1,,j1,k1,len,		**x**
	var_1	INNER	**x**
		OUTER	**x**
	var_2	ROUND	**x**
		FLAT	**x**
	var_3	CART,x,y,z	**x**
		POL,r,a,h	**x**

FEAT/CYLINDR	**F(label)=FEAT/CYLNDR,var_1,var_2,I,j,k,diam var_3**		**x**
	FA(label)=FEAT/CYLNDR,var_1,var_2,I,j,k,diam var_3		**x**
	var_1	INNER	**x**
		OUTER	**x**
	var_2	CART,x,y,z	**x**
		POL,r,a,h	**x**
	var_3	,len	**x**
		does not exist	**x**
FEAT/EDGEPT	**F(label)=FEAT/EDGEPT,var_1,I,j,k,i1,j1,k1**		**x**
	FA(label)=FEAT/EDGEPT,var_1,I,j,k,i1,j1,k1		**x**
	var_1	CART,x,y,z	**x**
		POL,r,a,h	**x**
FEAT/ELLIPS	**F(label)=FEAT/ELLIPS,var_1,var_2,var_3,I,j,k,diam**		**x**
	FA(label)=FEAT/ELLIPS,var_1,var_2,var_3,I,j,k,diam		**x**
	var_1	INNER	**x**
		OUTER	**x**
	var_2	CART,f1x,f1y,f1z,f2x,f2y,f2z	**x**
		POL,f1r,f1a,f1h,f2r,f2a,f2h	**x**
	var_3	MAJOR	**x**
		MINOR	**x**
FEAT/GCURVE	**F(label)=FEAT/GCURVE,var_1,I,j,k**		**x**
	var_1	CART,x,y,z	**x**
		POL,r,a,h	**x**
FEAT/GEOM	**F(label)=FEAT/GEOM,G(label1),var_1**		
	var_1	CART	
		POL	
FEAT/GSURF	**F(label)=FEAT/GSURF**		**x**
FEAT/LINE	**F(label)=FEAT/LINE,var_1,ni,nj,nk**		**x**
	FA(label)=FEAT/LINE,var_1,ni,nj,nk		**x**
	var_1	UNBND,var_2	**x**
		BND,var_3	**x**
	var_2	CART,x,y,z,I,j,k	**x**
		POL,r,a,h,I,j,k	**x**
	var_3	CART,e1x,e1y,e1z,e2x,e2y,e2z	**x**
		POL,e1r,e1a,e1h,e2r,e2a,e2h	**x**

FEAT/OBJECT	**F(label)=FEAT/OBJECT,x,y,z,I,j,k,'text'**		
	FA(label)=FEAT/OBJECT,x,y,z,I,j,k,'text'		
	F(label)=FEAT/OBJECT,parm var_1		
	FA(label)=FEAT/OBJECT,parm var_1		
	var_1	,parm var_1	
		does not exist	
FEAT/PARPLN	**F(label)=FEAT/PARPLN,var_1,var_2,width**		**x**
	FA(label)=FEAT/PARPLN,var_1,var_2,width		**x**
	var_1	INNER	**x**
		OUTER	**x**
	var_2	CART,x,y,z,p1x,p1y,p1z,i1,j1,k1,p2x,p2y,p2z,i2,j2,k2	**x**
		POL,r,a,h,p1r,p1a,p1h,i1,j1,k1,p2r,p2a,p2h,i2,j2,k2	**x**
FEAT/PATERN	**F(label)=FEAT/PATERN,F(label1) var_1 var_2**		**x**
	var_1	,F(labeln)	**x**
	var_2	var_1 var_2	**x**
		does not exist	**x**
FEAT/PLANE	**F(label)=FEAT/PLANE,var_1,I,j,k**		**x**
	FA(label)=FEAT/PLANE,var_1,I,j,k		**x**
	var_1	CART,x,y,z	**x**
		POL,r,a,h	**x**
FEAT/POINT	**F(label)=FEAT/POINT,var_1,I,j,k**		**x**
	FA(label)=FEAT/POINT,var_1,I,j,k		**x**
	var_1	CART,x,y,z	**x**
		POL,r,a,h	**x**
FEAT/RECTNGL	**F(label)=FEAT/RCTNGL,var_1,var_2,i1,j1,k1,width1,i2,j2,k2,width2 $,i3,j3,k3,width3**		**x**
	FA(label)=FEAT/RCTNGL,var_1,var_2,i1,j1,k1,width1,i2,j2,k2,width2 $,i3,j3,k3,width3		**x**
	var_1	INNER	**x**
		OUTER	**x**
	var_2	CART,x,y,z	**x**
		POL,r,a,h	**x**
FEAT/SPHERE	**F(label)=FEAT/SPHERE,var_1,var_2,diam var_3**		**x**
	FA(label)=FEAT/SPHERE,var_1,var_2,diam		**x**
	var_1	INNER	**x**
		OUTER	**x**
	var_2	CART,x,y,z	**x**
		POL,r,a,h	**x**

	var_3	,I,j,k var_8	**x**
		does not exist	**x**
	var_8	,angle	**x**
		does not exist	**x**
FEAT/TORUS	**F(label)=FEAT/TORUS,var_1,var_2,i,j,k,diam1,diam2**		**x**
	FA(label)=FEAT/TORUS,var_1,var_2,i,j,k,diam1,diam2		**x**
	var_1	INNER	**x**
		OUTER	**x**
	var_2	CART,x,y,z	**x**
		POL,r,a,h	**x**
FEDRAT	**FEDRAT/var_1**		**x**
	var_1	MESVEL,var_2	**x**
		POSVEL,var_2	**x**
		ROTVEL,var_3	**x**
		SCNVEL,var_2	**x**
	var_2	MPM,n	**x**
		MMPS,n	**x**
		IPM,n	**x**
		IPS,n	**x**
		var_4	**x**
	var_3	RPM,n	**x**
		var_4	
	var_4	PCENT,n	**x**
		HIGH	**x**
		LOW	**x**
		DEFALT	**x**
FILDEF	**VF(label)=FILDEF/CODE,n**		
FILNAM	**FILNAM/'text',version**		**x**
FINPOS	**FINPOS/var_1**		**x**
	var_1	ON	**x**
		OFF	**x**
FIXTID	**FI(label)=FIXTID/'text'**		**x**
FIXTSN	**FS(label)=FIXTSN/'text'**		**x**
FLY	**FLY/var_1**		**x**
	var_1	radius	**x**
		OFF	**x**

FROM	**FROM/var_1**		**x**
	var_1	x,y,z	**x**
		POL,r,a,h	**x**
GECOMP	**GECOMP/var_1**		**x**
	var_1	ON	**x**
		OFF	
GEOALG	**GEOALG/var_1 var_a var_b**		**x**
	var_a	,ELIMINATE,var_c	**x**
		does not exist	**x**
	var_b	,FILTER,var_d	**x**
		does not exist	**x**
	var_c	STDDEV_LIMIT,dev_val	**x**
		OFF	**x**
	var_d	LAMBDAC,var_e	**x**
		CIRCULAR,var_e	**x**
		OFF	**x**
	var_e	LOWPASS,wave_val,var_f	**x**
		HIGHPASS,wave_val,var_f	**x**
		BANDPASS,wave_val,wave_val,var_f	**x**
	var_f	GAUSS	**x**
		2RC	**x**
		SPLINE	**x**
		RCTNGL	**x**
	var_1	ARC,var_2	**x**
		CIRCLE,var_3	**x**
		CONE,var_2	**x**
		CPARLN,var_4	**x**
		CYLNDR,var_3	**x**
		ELLIPS,var_2	**x**
		GCURVE,var_5	
		GSURF,var_6	
		LINE,var_2	**x**
		OBJECT,var_4	
		PARPLN,var_3	**x**
		PLANE,var_2	**x**
		RCTNGL,var_2	**x**
		SPHERE,var_3	**x**
		TORUS,var_3	**x**

	var_2	LSTSQR	**x**
		MINMAX	**x**
		DEFALT	**x**
		EXTERN,var_7	
	var_3	LSTSQR	**x**
		MAXINS	**x**
		MINCIR	**x**
		MINMAX	**x**
		DEFALT	**x**
		EXTERN,var_7	
	var_4	DEFALT	**x**
		EXTERN,var_7	
	var_5	LSTSQR	
		BSPLIN	
		MINMAX	
		DEFALT	
		EXTERN,var_7	
	var_6	LSTSQR	
		BEZIER	
		NURBS	
		MINMAX	
		DEFALT	
		EXTERN,var_7	
	var_7	DMIS,M(label1) var_8	
		DME,'routine' var_8	
		SYS,'pathname' var_8	
	var_8	,parameter var_8	
		does not exist	
GEOM	**G(label)=GEOM/var_1**		
	var_1	DID(label1)	
		G(label2) var_2	
		NONE	
	var_2	,ENTITY,'identity' var_3	
		,ENTITY,'identity',OFFSET,dist var_3	
		,OFFSET,dist	
		does not exist	
	var_3	,'identity' var_3	
		,'identity',OFFSET,dist var_3	

		does not exist	
GOHOME	**GOHOME**		**x**
GOTARG	**GOTARG/var_1**		**x**
	var_1	x,y,z	**x**
		POL,r,a,h	**x**
GOTO	**GOTO/var_1**		**x**
	var_1	x,y,z	**x**
		INCR,dist,I,j,k	**x**
		ARC,x1,y1,z1,x,y,z	**x**
		POL,r,a,h	**x**
GROUP	**GSA(label)=GROUP/SA(label1),SA(label2) var_1**		
	var_1	,SA(label3) var_1	
		does not exist	
IF	**IF/(var_1)**		**x**
	var_1	varname	**x**
		var_2 var_3 var_2	**x**
		.NOT. var_2	**x**
	var_2	var_1	**x**
		varname	**x**
		value	**x**
		expr	**x**
	var_3	.GT.	**x**
		.GE.	**x**
		.EQ.	**x**
		.LT.	**x**
		.LE.	**x**
		.NE.	**x**
		.AND.	**x**
		.OR.	**x**
I	**I/var_1,'pathname'**		**x**
	var_1	DMIS	**x**
		DME	
Intrinsic Functions			**x**
	var_1	ABS(x)	**x**
		ACOS(x)	**x**
		ASIN(x)	**x**
		ATAN(x)	**x**
		ATAN2(y,x)	**x**

		BADGT()	
		BADPT()	
		CHR(x)	x
		CONCAT(str,str var_3)	x
		COS(x)	x
		DBLE(x)	x
		DTOR(x)	x
		ELEMNT(x,char,str)	x
		EOF(DID(label1))	x
		EOLN(DID(label1))	x
		EXP(x)	x
		INDX(str,sstr)	x
		INT(x)	x
		LEN(str)	x
		LN(x)	x
		LOG(x)	x
		MN(x,x var_2)	x
		MOD(x,y)	x
		MX(x,x var_2)	x
		NINT(x)	x
		ORD(x)	x
		RL(x)	x
		RTOD(x)	x
		SCFEAT()	
		SCSNS()	
		SDATE()	x
		SENSNOTOUCH()	
		SERROR()	
		SIGN(x,y)	x
		SILTCH()	
		SIN(x)	x
		SMODE()	x
		SQRT(x)	x
		STIME()	x
		STR(x)	x
		SUBSTR(str,x,y)	x
		TAN(x)	x
		VAL(str)	x

		VCART(x,y,z)	x
		VCROSS(v1,v2)	x
		VDOT(v1,v2)	x
		VECX(v)	x
		VECY(v)	x
		VECZ(v)	x
		VMAG(v)	x
		VMCS(v)	x
		VPCS(v)	x
		VPOL(r,a,h)	x
		VUNIT(v)	x
	var_2	,x var_2	x
		does not exist	x
	var_3	,str var_3	x
		does not exist	x
ITERAT	**varname=ITERAT/(jumptarget1),(jumptarget2),convergence,var_1 $,limit var_2 var_3**		x
	var_1	ABSL	x
		INCR	x
	var_2	,XAXIS	x
		,YAXIS	x
		,ZAXIS	x
		,I,j,k	x
	var_3	,FA(label3) var_4	x
		,FA(label3) var_2 var_4	x
	var_4	var_3	x
		does not exist	x
JUMPTO	**JUMPTO/(jumptarget)**		x
LITDEF(1)	**VL(label)=LITDEF/var_1,I,j,k**		
	var_1	SURF	
		BACK	
		GRID	
		OBLQ	
LITDEF(2)	**VL(label)=LITDEF/STROBE,var_1,timeon,I,j,k**		
	var_1	CYCLE,value	
		TRIGER	

LOCATE	**D(label)=LOCATE/var_1 var_2 var_3**		**x**
	var_1	XDIR,	**x**
		YDIR,	**x**
		ZDIR,	**x**
		XYDIR,	**x**
		YZDIR,	**x**
		ZXDIR,	**x**
		XYZDIR,	**x**
		NOTRAN,	**x**
		does not exist	**x**
	var_2	XAXIS,	**x**
		YAXIS,	**x**
		ZAXIS,	**x**
		XYAXIS,	**x**
		YZAXIS,	**x**
		ZXAXIS,	**x**
		XYZAXI,	**x**
		NOROT,	**x**
		does not exist	**x**
	var_3	FA(label1) var_4	**x**
		MA(label2) var_4	
		DAT(label3) var_4	**x**
	var_4	,FA(label1) var_4	**x**
		,MA(label2) var_4	
		,DAT(label3) var_4	**x**
		does not exist	**x**
LOTID	**LI(label)=LOTID/'text'**		**x**
MACRO	**M(label)=MACRO var_1**		**x**
	var_1	/varname var_2	
		/'label1' var_2	
		does not exist	**x**
	var_2	,varname var_2	
		,'label1' var_2	
		does not exist	**x**
MATDEF	**MA(label)=MATDEF/var_1 var_2**		
	var_1	F(label1),FA(label2) var_3	
		G(label3),FA(label2) var_3	

	var_2	,PT2PT,var_4,var_5 var_6	
		,PT2LN,var_4,var_5 var_6	
		,PT2PL,var_4,var_5 var_6	
		,LN2LN,var_4,var_5 var_6	
		does not exist	
	var_3	,FA(label2) var_3	
		does not exist	
	var_4	BF	
		FZ	
	var_5	fitzon	
		loband,upband	
	var_6	,MMC,T(label4)	
		,LMC,T(label4)	
		does not exist	
MEAS	**MEAS/var_1,F(label1),n**		**x**
	var_1	ARC	**x**
		CIRCLE	**x**
		CONE	**x**
		CPARLN	**x**
		CYLNDR	**x**
		EDGEPT	**x**
		ELLIPS	**x**
		GCURVE	**x**
		GSURF	**x**
		LINE	**x**
		OBJECT	
		PARPLN	**x**
		PATERN	
		PLANE	**x**
		POINT	**x**
		RCTNGL	**x**
		SPHERE	**x**
		TORUS	**x**
MFGDEV	**MD(label)=MFGDEV/'text'**		
MODE	**MODE/var_1**		**x**
	var_1	AUTO,var_2	
		PROG,MAN	**x**

		MAN	**x**
	var_2	PROG,MAN	**x**
		MAN	**x**
OBTAIN	**varname=OBTAIN/var_1,n**		**x**
	var_1	CC(label1)	
		CI(label1)	
		CR(label1)	
		CS(label1)	
		D(label1)	**x**
		DA(label1)	**x**
		DI(label1)	
		DID(label1)	
		DS(label1)	
		DV(label1)	
		F(label1)	**x**
		FA(label1)	**x**
		F(label1)[p]	
		FA(label1)[p]	
		FI(label1)	
		FS(label1)	
		G(label1)	
		GSA(label1)	
		LI(label1)	
		MA(label1)	
		MD(label1)	
		OP(label1)	
		PC(label1)	
		PL(label1)	
		PN(label1)	
		PR(label1)	
		PS(label1)	
		PV(label1)	
		Q(label1)	
		R(label1)	
		RM(label1)	
		RT(label1)	
		S(label1)	**x**
		SA(label1)	**x**

		SG(label1)	
		SGS(label1)	
		SS(label1)	
		SW(label1)	
		SX(label1)	
		T(label1)	**x**
		TA(label1)	**x**
		TH(label1)	
		TL(label1)	
		V(label1)	
		VA(label1)	
		VF(label1)	
		VL(label1)	
		VW(label1)	
OPEN	**OPEN/DID(label1),var_1**		**x**
	var_1	DIRECT,var_3	**x**
		FDATA,var_2,OUTPUT var_6	**x**
		CAD var_4	
		var_5	**x**
	var_2	V(label1)	**x**
		DMIS	**x**
	var_3	INPUT	**x**
		OUTPUT var_6	**x**
	var_4	,STEP	
		,IGES	
		,VENDOR,'text'	
		does not exist	
	var_5	SNS,var_5	**x**
		PCS,var_5	**x**
		FEATUR,var_5	**x**
		RTAB,var_5	**x**
		does not exist	**x**
	var_6	,APPEND	**x**
		,OVERWR	**x**
		does not exist	**x**
OPERID	**OP(label)=OPERID/'text'**		**x**

OUTPUT	**OUTPUT/var_1**		**x**
	var_1	FA(label1) var_2 var_3	**x**
		FA(label2),var_4,TA(label3) var_3	**x**
		var_5,FA(label4),TA(label3) var_3	**x**
		F(label5) var_6 var_3	**x**
		F(label6),F(label7),T(label8) var_3	**x**
		R(label9)	**x**
		S(label10)	
		SA(label11) var_7	
		SE(label12)	
		ST(label13)	
		T(label14)	**x**
		TA(label15)	**x**
	var_2	,TA(label15) var_2	**x**
		does not exist	**x**
	var_3	,R(label9)	**x**
		does not exist	**x**
	var_4	,F(label7)	**x**
		,FA(label4)	**x**
		,DAT(x)	**x**
	var_5	F(label6)	**x**
		DAT(x)	**x**
	var_6	,T(label16) var_6	**x**
		does not exist	**x**
	var_7	var_8 var_9	
		,CURENT	
		does not exist	
	var_8	,'desc'	
		,tipnum	
		does not exist	
	var_9	,SW(label17),'anglename',ang var_10 var_9	
		does not exist	
	var_10	,'anglename',ang var_10	
		does not exist	
PAMEAS	**PAMEAS/var_1 var_2 var_3**		**x**
	var_1	P(label)	**x**
	var_2	,i,j,k	**x**
		does not exist	**x**

	var_3	,SENSOR,SA(label1),var_4	
		,ROTARY,RT(label2),var_5	
		does not exist	**x**
	var_4	,SW(label3),'anglename' var_6	
	var_5	,var_7,rot_ang	
		does not exist	
	var_6	,'anglename'	
		var_4	
		does not exist	
	var_7	ABSL,var_8	
		INCR,var_9	
	var_8	CW	
		CCW	
		SHORT	
	var_9	CW	
		CCW	
PARTID	**PN(label)=PARTID/'text'**		**x**
PARTRV	**PR(label)=PARTRV/'text'**		**x**
PARTSN	**PS(label)=PARTSN/'text'**		**x**
PATH	**P(label)=PATH/var_1**		**x**
	var_1	POINT,var_2,ip,jp,kp	
		ARC,var_2,ia,ja,ka,rad,ang1,ang2 var_3	**x**
		UNKNOWN,xs,ys,zs,xd,yd,zd,xe,ye,ze	**x**
		LINE,BND,var_4,il,jl,kl	**x**
		CURVE,var_5	**x**
		HELICAL,var_2,iax,jax,kax,hel_rad,hel_ang1,hel_ang2 var_	**x**
		USERDF,'algname' var_7	
		GRID,xg,yg,zg,iu,ju,ku,im,jm,km,lp,var_12	
	var_2	CART,x,y,z	**x**
		POL,r,a,h	**x**
	var_3	,is,js,ks	**x**
		does not exist	**x**
	var_4	CART,e1x,e1y,e1z,e2x,e2y,e2z	**x**
		POL,e1r,e1a,e1h,e2r,e2a,e2h	**x**
	var_5	G(label)	
		F(label3)	
		x1,y1,z1,i,j,k,x2,y2,z2,i,j,k var_8	**x**

	var_6	,ih,jh,kh	**x**
		does not exist	**x**
	var_7	,DATA var_9	
		,FILNAM,'filename'	
	var_8	,xn,yn,zn,i,j,k var_10	**x**
		does not exist	**x**
	var_9	,data var_11	
	var_10	var_8	**x**
		does not exist	**x**
	var_11	var_9	
		does not exist	
	var_12	b1x,b1y,b1z,b2x,b2y,b2z,b3x,b3y,b3z var_13	
		var_15	
	var_13	,bnx,bny,bnz var_14	
		does not exist	
	var_14	var_13	
		does not exist	
	var_15	F(label1) var_16	
		FA(label2) var_16	
	var_16	,var_15	
		does not exist	
PLANID	**PL(label)=PLANID/'text'**		**x**
POP	**POP/var_1 var_2**		
	var_1	ALGOR	
		DME	
		DATSET	
		REPORT	
	var_2	,var_1 var_2	
PRCOMP	**PRCOMP/var_1**		**x**
	var_1	ON	**x**
		OFF	**x**
PREVOP	**PV(label)=PREVOP/'text'**		**x**
PROCID	**PC(label)=PROCID/'text'**		**x**
PROMPT	**varname=PROMPT/var_1**		**x**
	var_1	'text' var_2	**x**
		var_3 var_4	**x**
	var_2	,maxval var_5	**x**

		does not exist	**x**
	var_3	BUTTON,'text',ret_val	**x**
		CHECK,'text',chk_var	**x**
		EDIT,edit_var var_2	**x**
		GROUP,'text',group_var,'item','item' var_6	**x**
		LIST,list_var,'item','item' var_6	**x**
		PICTURE,'filename' var_7	**x**
		PIXBTN,'filnam1' var_8,ret_val	**x**
		SOUND,'filename'	**x**
		TEXT,'text'	**x**
		TITLE,'text'	**x**
	var_4	,var_3	**x**
		does not exist	**x**
	var_5	,minval	**x**
		does not exist	**x**
	var_6	,'item' var_6	**x**
		does not exist	**x**
	var_7	,index	**x**
		does not exist	**x**
	var_8	,'filnam2'	
		does not exist	**x**
PSTHRU	**PSTHRU/var_1**		
	var_1	COMAND,'command'	
		CONTIN	
		PAUSE	
		START	
		STOP	
		TRMATX,a1,a2,a3,b1,b2,b3,c1,c2,c3,d1,d2,d3	
PTBUFF	**PTBUFF/var_1**		**x**
	var_1	ON	**x**
		OFF	**x**
	NOTE:	It is OK if the DME ignores PTBUF/OFF	
PTMEAS	**PTMEAS/var_1 var_2**		**x**
	var_1	CART,x,y,z	**x**
		POL,r,a,h	**x**
	var_2	,i,j,k	**x**
		does not exist	**x**

PUSH	**PUSH/var_1 var_2**		
	var_1	ALGOR	
		DME	
		DATSET	
		REPORT	
	var_2	,var_1 var_2	
		does not exist	
QISDEF	**Q(label)=QISDEF/'type' var_1**		**x**
RAPID	**RAPID/speed**		
READ	**READ/DID(label1),var_1**		**x**
	var_1	variable:x:y var_2	**x**
		variable:x var_2	**x**
		variable var_2	**x**
	var_2	,var_1	**x**
		does not exist	**x**
RECALL	**RECALL/var_1 var_2**		**x**
	var_1	D(label2)	**x**
		DA(label1)	**x**
		S(label3)	**x**
		SA(label4)	**x**
		FA(label5)	**x**
		RT(label6)	**x**
	var_2	,DID(label7)	**x**
		does not exist	**x**
REFMNT	**RM(label)=REFMNT/XVEC,xi,xj,xk,ZVEC,zi,zj,zk,MNTLEN,dx,dy,**		
REPORT	**R(label)=REPORT/var_1 var_2 var_3**		**x**
	var_1	ALGOR	**x**
		CC(label1)	**x**
		CI(label2)	**x**
		CS(label3)	**x**
		DATE	**x**
		DI(label4)	**x**
		DS(label5)	**x**
		DV(label6)	**x**
		FI(label7)	**x**
		FS(label8)	**x**
		HUMID	
		LI(label9)	**x**

		MD(label10)	**x**
		MODE	**x**
		OP(label11)	**x**
		PC(label12)	**x**
		PL(label13)	**x**
		PN(label14)	**x**
		PR(label15)	**x**
		PS(label16)	**x**
		PV(label17)	**x**
		Q(label18)	**x**
		TEMPC	
		TEMPF	
		TEMPWC	
		TEMPWF	
		TIME	**x**
		TL(label19)	**x**
	var_2	,var_1 var_2	**x**
		does not exist	**x**
	var_3	,'text'	**x**
		does not exist	**x**
RESUME	**RESUME/var_1**		
	var_1	(jumptarget)	
		CURENT	
		END	
		NEXT	
		START	
		STOP	
RMEAS(1)	**RMEAS/var_1,F(label1),n,var_2**		
	var_1	ARC	
		CIRCLE	
		ELLIPS	
		OBJECT	
	var_2	FA(label2)	
		VECBLD,r,n1	
RMEAS(2)	**RMEAS/var_1,F(label1),n,FA(label2)**		
	var_1	CONE	
		CYLNDR	
		PARPLN	

		PATERN	
		RCTNGL	
RMEAS(3)	**RMEAS/CPARLN,F(label1),n,var_1 var_2**		
	var_1	FA(label2)	
		VECBLD,r,n1	
	var_2	,ORIENT	
		does not exist	
RMEAS(4)	**RMEAS/var_1,F(label1),n,var_2**		
	var_1	GCURVE	
		LINE	
	var_2	F(label1) var_3	
		FA(label2) var_3	
		VECBLD,r,n1	
		XAXIS	
		YAXIS	
		ZAXIS	
	var_3	,XAXIS	
		,YAXIS	
		,ZAXIS	
		does not exist	
RMEAS(5)	**RMEAS/var_1,F(label1),n,var_2**		
	var_1	PLANE	
		GSURF	
		SPHERE	
		TORUS	
	var_2	FA(label2) var_3	
		XAXIS	
		YAXIS	
		ZAXIS	
	var_3	,XAXIS	
		,YAXIS	
		,ZAXIS	
		does not exist	
RMEAS(6)	**RMEAS/POINT,F(label1),n,var_1**		**x**
	var_1	FA(label2) var_2	**x**
		VECBLD,r,n1	**x**
		XAXIS	**x**
		YAXIS	**x**

		ZAXIS	x
	var_2	,XAXIS	x
		,YAXIS	x
		,ZAXIS	x
		does not exist	x
RMEAS(7)	**RMEAS/EDGEPT,F(label1),n,var_1**		
	var_1	FA(label2) var_3	
		VECBLD,r,n1,edge_offset var_4 var_3	
		var_2	
	var_2	XAXIS	
		YAXIS	
		ZAXIS	
	var_3	,var_2	
		does not exist	
	var_4	,XDIR	
		,YDIR	
		,ZDIR	
		does not exist	
ROTAB	**ROTAB/RT(label1),var_1,var_2,ang**		x
	var_1	ABSL,var_3	x
		INCR,var_4	x
	var_2	ROTTOT	x
		ROTORG	
		ROTNUL	
	var_3	CW	x
		CCW	x
		SHORT	x
	var_4	CW	x
		CCW	x
ROTATE	**D(label)=ROTATE/var_1,var_2**		x
	var_1	XAXIS	x
		YAXIS	x
		ZAXIS	x
	var_2	ang	x
		F(label1),var_3	x
		FA(label2),var_3	x
		DAT(x),var_3	x
	var_3	XDIR	x

		-XDIR	**x**
		YDIR	**x**
		-YDIR	**x**
		ZDIR	**x**
		-ZDIR	**x**
ROTDEF	**RT(label)=ROTDEF/x,y,z,i,j,k var_1**		**x**
	var_1	,RT(label1)	
		does not exist	**x**
ROTSET	**ROTSET/RT(label1),val**		**x**
SAVE	**SAVE/var_1 var_2**		**x**
	var_1	D(label1)	**x**
		DA(label2)	**x**
		S(label3)	**x**
		SA(label4)	**x**
		FA(label5)	**x**
		RT(label6)	**x**
SCNMOD	**SCNMOD/var_1**		**x**
	var_1	ON	**x**
		OFF	**x**
SCNSET	**SCNSET/var_1**		**x**
	var_1	PECK,var_2	**x**
		DRAG,var_2 var_3	**x**
		NONCON,var_2	**x**
		STOP,var_4	**x**
		VENDOR,var_5	
	var_2	DIST,dist var_6	**x**
		CHORD,chord var_7	
		TIME,time	
		ANGLE,ang	
		DEFALT	
	var_3	,FORCE,force	
		does not exist	**x**
	var_4	PLANE,i,j,k var_8	
		SPHERE,sphere_rad	**x**
	var_5	FORM	
		POS	
		SIZE	
	var_6	,XAXIS	

		,YAXIS	
		,ZAXIS	
		does not exist	
	var_7	,maxdist	
		does not exist	
	var_8	,RADIUS,plane_rad var_9	
		var_9	
	var_9	,COUNT,stop_count	
		does not exist	**x**
SELECT	**SELECT/arg**		**x**
SENSOR	**SS(label)=SENSOR/var_1**		**x**
	var_1	PROBE,dx,dy,dz,sni,snj,snk,diam var_2 var_3	
		MLTPRB,n var_4 var_3	**x**
		VIDEO,dx,dy,dz,sni,snj,snk,sci,scj,sck,focal,mag,apert var_	
		LASER,dx,dy,dz,sni,snj,snk,sci,scj,sck,power,shuter var_3	
		INFRED,dx,dy,dz,sni,snj,snk,sci,scj,sck,fovx,fovy,freq,dwell	
		NONCON,dx,dy,dz,sni,snj,snk,sci,scj,sck,proben var_3	
		XRAY,dx,dy,dz,sni,snj,snk,sci,scj,sck,volts,amps,spotz var_	
		POINT,dx,dy,dz,sni,snj,snk,sci,scj,sck,fovn var_3	
		LINE,dx,dy,dz,sni,snj,snk,sci,scj,sck,fovn,fovc var_3	**x**
		AREA,dx,dy,dz,sni,snj,snk,sci,scj,sck,fovc,fovo,fovn var_3	
	var_2	,SPHERE	
		,CYLNDR,len1	
		,DISK,thkn	
		does not exist	**x**
	var_3	,'data_stor','data_list',var_5	
		does not exist	**x**
	var_4	,var_6,dx,dy,dz,sni,snj,snk,diam var_7	**x**
	var_5	'data_item'	
		index	
	var_6	'desc'	**x**
		tipnum	**x**
	var_7	var_4	**x**
		does not exist	**x**

SNSDEF(1)	**S(label)=SNSDEF/PROBE,var_1,var_2 var_3**		**x**
	var_1	FIXED	**x**
		INDEX	**x**
	var_2	CART,dx,dy,dz,ti,tj,tk,diam	**x**
		POL,tilt,rot,ti,tj,tk,len,diam	**x**
		VEC,i,j,k,ti,tj,tk,len,diam	**x**
		var_4,CART,rx,ry,rz,diam	**x**
		var_4,VEC,ri,rj,rk,rlen,diam	**x**
	var_3	,SPHERE	**x**
		,CYLNDR,len1	
		,DISK,thkn	**x**
		does not exist	**x**
	var_4	S(label1)	**x**
		SA(label2)	**x**
SNSDEF(2)	**S(label)=SNSDEF/VIDEO,var_1,var_2,focal,mag,apert**		
	var_1	FIXED	
		INDEX	
	var_2	CART,dx,dy,dz,ti,tj,tk	
		POL,tilt,rot,ti,tj,tk	
		VEC,i,j,k,ti,tj,tk	
SNSDEF(3)	**S(label)=SNSDEF/LASER,var_1,var_2,power,shuter**		
	var_1	FIXED	
		INDEX	
	var_2	CART,dx,dy,dz,ti,tj,tk	
		POL,tilt,rot,ti,tj,tk	
		VEC,i,j,k,ti,tj,tk	
SNSDEF(4)	**S(label)=SNSDEF/INFRED,var_1,var_2,fovx,fovy,freq,dwell**		
	var_1	FIXED	
		INDEX	
	var_2	CART,dx,dy,dz,ti,tj,tk	
		POL,tilt,rot,ti,tj,tk	
		VEC,i,j,k,ti,tj,tk	
SNSDEF(5)	**S(label)=SNSDEF/NONCON,var_1,var_2,proben**		
	var_1	FIXED	
		INDEX	
	var_2	CART,dx,dy,dz,ti,tj,tk	
		POL,tilt,rot,ti,tj,tk	
		VEC,i,j,k,ti,tj,tk	

SNSDEF(6)	**S(label)=SNSDEF/XRAY,var_1,var_2,volts,amps,spotsz**		
	var_1	FIXED	
		INDEX	
	var_2	CART,dx,dy,dz,ti,tj,tk	
		POL,tilt,rot,ti,tj,tk	
		VEC,i,j,k,ti,tj,tk	
SNSDEF(7)	**S(label)=SNSDEF/BUILD var_1,var_2**		**x**
	var_1	,SG(label1) var_3	
		,SW(label2) var_4	**x**
		,SX(label3) var_3	**x**
		,RM(label4) var_3	
	var_2	SS(label5)	
		SGS(label6)	
	var_3	var_1	**x**
		does not exist	**x**
	var_4	,'anglename',angle var_5	
		var_1	**x**
	var_5	var_4	
		does not exist	**x**
SNSET	**SNSET/var_1 var_2**		**x**
	var_1	APPRCH,dist1	**x**
		RETRCT,dist1	**x**
		SEARCH,dist1	**x**
		CLRSRF,var_3	
		DEPTH,var_3	**x**
		VA(label1)	
		VF(label2)	
		VL(label3),intnsty	
		VW(label4)	
		FOCUSY	
		FOCUSN	
		SCALEX,n	
		SCALEY,n	
		MINCON,level	
	var_2	,var_1 var_2	**x**
		does not exist	**x**
	var_3	F(label5) var_4	
		FA(label6) var_4	

		DAT(x) var_4	
		dist2	x
		OFF	x
	var_4	,dist3	
		does not exist	
SNSGRP	**SGS(label)=SNSGRP/BUILD var_1**		
	var_1	var_2,SS(label1)	
		var_2,SGS(label2)	
	var_2	,SG(label3) var_3	
		,SW(label4) var_3	
		,SX(label5) var_3	
		,RM(label6) var_3	
SNSLCT	**SNSLCT/var_1**		x
	var_1	GSA(label1) var_3	
		var_4 var_5	x
	var_3	,F(label2) var_7	
		,FA(label3) var_7	
		,VEC,i,j,k var_7	
	var_4	S(label4) var_8	
		SA(label5) var_8	x
		S(label6) var_9	
		SA(label7) var_9	x
	var_5	,SW(label8) var_10 var_5	x
		,F(label2) var_7	
		,FA(label3) var_7	
		,VEC,i,j,k var_7	
		does not exist	x
	var_7	,FZ,dev	
		does not exist	
	var_8	,S(label9) var_12	
		,SA(label10) var_12	
		does not exist	x
	var_9	,'desc'	x
		,tipnum	x
	var_10	,'anglename',ang var_13	x

		,'anglename',F(label2) var_7 var_13	
		,'anglename',FA(label3) var_7 var_13	
		,'anglename',VEC,i,j,k var_7 var_13	
	var_12	var_8	
		does not exist	**x**
	var_13	var_10	**x**
		does not exist	**x**
SNSMNT	**SNSMNT/XVEC,xi,xj,xk,ZVEC,zi,zj,zk,MNTLEN,dx,dy,dz**		
TECOMP	**TECOMP**		**x**
	var_1	ON var_2	**x**
		OFF	**x**
	var_2	,tmpexp	**x**
		does not exist	**x**
TEXT	**TEXT/va**		**x**
	var_1	OPER	**x**
		OUTFIL	**x**
		MAN	**x**
		QUERY,(label1),length,var_2,var_3	**x**
	var_2	A	**x**
		N	**x**
		AN	**x**
	var_3	L	**x**
		R	**x**
THLDEF	**TH(label**		**x**
	var_1	S(label1),n	**x**
		SS(label2),n	**x**
		SGS(label3),n	**x**
		SG(label4),n	
		SW(label5),n	**x**
		SX(label6),n	
		RM(label7),n	**x**
	var_2	,var_1	**x**
		does not exist	**x**
TOL/ANGL	**T(label)**		**x**
TOL/ANGB	**T(label)**		**x**

TOL/ANGLR	**T(label)**		**x**
	var_1	,MMC	**x**
		,LMC	**x**
		,RFS	**x**
		does not exist	**x**
	var_2	,DAT(x) var_1	**x**
		,F(label1)	**x**
		,FA(label2) var_1	**x**
	var_3	,DAT(x) var_1	
		,F(label1)	
		,FA(label2) var_1	
		does not exist	**x**
	var_4	,TANGPL	
		,PARPLN	
		does not exist	**x**
TOL/CIRLTY	**T(label)**		**x**
TOL/COMPOS	**T(label)=TOL/COMPOS,PATERN,tolzon var_1 var_2 var_3 var_3,FEATUR, $ tolzon2 var_1 var_3 var_3 var_3**		**x**
	var_1	,MMC	**x**
		,LMC	**x**
		,RFS	**x**
		does not exist	**x**
	var_2	,DAT(x) var_1	**x**
		,F(label1)	**x**
		,FA(label2) var_1	**x**
	var_3	,DAT(x) var_1	**x**
		,F(label1)	**x**
		,FA(label2) var_1	**x**
		does not exist	**x**
TOL/CONCEN	**T(label)**		**x**
	var_1	DAT(x)	**x**
		F(label1)	**x**
		FA(label2)	**x**

TOL/CORTOL	**T(label)**		**x**
	var_1	XAXIS	**x**
		YAXIS	**x**
		ZAXIS	**x**
		RADIAL	**x**
		RADIUS	**x**
		ANGLE	**x**
TOL/CPROFS	**T(label)=TOL/CPROFS,lotol1,uptol1 var_1 var_1 var_1 var_2, $ lotol2,uptol2 var_1 var_1 var_1 var_2**		**x**
	var_1	,DAT(x) var_6	**x**
		,F(label1)	**x**
		,FA(label2) var_6	**x**
		does not exist	**x**
	var_2	,AVGDEV	
		does not exist	**x**
TOL/CRNOUT	**T(label)**		**x**
	var_1	,DAT(x)	**x**
		,F(label1)	**x**
		,FA(label2)	**x**
		does not exist	**x**
TOL/CYLCTY	**T(label)**		**x**
TOL/DIAM	**T(label)**		**x**
	var_1	,MAJOR	**x**
		,MINOR	**x**
		does not exist	**x**
	var_2	,AVG	
		,MINMAX	
		does not exist	**x**
TOL/DISTB	**T(label)**		**x**
	var_1	NOMINL,dist,lotol,uptol	**x**
		LIMIT,lolimt,uplimt	**x**
	var_2	XAXIS	**x**
		YAXIS	**x**
		ZAXIS	**x**
		PT2PT	**x**
	var_3	,AVG	**x**
		,MAX	**x**
		,MIN	**x**

		does not exist	**x**
TOL/FLAT	**T(label)**		**x**
	var_1	tolzon	**x**
		tolzon,tolzon1,unit1,unit2	**x**
		tolzon1,unit1,unit2	**x**
TOL/GTOL	**T(label)**		
	var_1	,XDIR	
		,YDIR	
		,ZDIR	
		,XYDIR	
		,YZDIR	
		,ZXDIR	
		,XYZDIR	
		,NOTRAN	
	var_2	,XAXIS	
		,YAXIS	
		,ZAXIS	
		,XYAXIS	
		,YZAXIS	
		,ZXAXIS	
		,XYZAXI	
		,NOROT	
	var_3	,PERCNT	
		,INTFPT	
		does not exist	
TOL/PARLEL	**T(label)**		**x**
	var_1	,MMC var_6	**x**
		,LMC	**x**
		,RFS	**x**
		does not exist	**x**
	var_2	,DAT(x) var_1	**x**
		,F(label1)	**x**
		,FA(label2) var_1	**x**
	var_3	,DAT(x) var_1	
		,F(label1)	
		,FA(label2) var_1	
		does not exist	
	var_4	,TANGPL	

		,PARPLN	
		does not exist	**x**
	var_6	,MAX,maxtol	
		does not exist	**x**
TOL/PERP	**T(label)**		**x**
	var_1	,MMC var_6	**x**
		,LMC	**x**
		,RFS	**x**
		does not exist	**x**
	var_2	,DAT(x) var_1	**x**
		,F(label1)	**x**
		,FA(label2) var_1	**x**
	var_3	,DAT(x) var_1	
		,F(label1)	
		,FA(label2) var_1	
		does not exist	**x**
	var_4	,TANGPL	
		,PARPLN	
		does not exist	**x**
	var_6	,MAX,maxtol	
		does not exist	**x**
TOL/POS	**T(label)**		**x**
	var_1	2D	**x**
		3D	**x**
	var_2	,MMC	**x**
		,LMC	**x**
		,RFS	**x**
		does not exist	**x**
	var_3	,DAT(x) var_2	**x**
		,F(label1)	**x**
		,FA(label2) var_2	**x**
		does not exist	**x**
	var_4	,XAXIS	**x**
		,YAXIS	**x**
		,ZAXIS	**x**
		,RADIUS	
		,RADIAL	**x**
		,ANGLE	**x**

		does not exist	**x**
TOL/PROFL	**T(label)**		**x**
	var_1	,DAT(x) var_3	**x**
		,F(label1)	**x**
		,FA(label2) var_3	**x**
		does not exist	**x**
	var_3	,MMC	**x**
		,LMC	**x**
		,RFS	**x**
		does not exist	**x**
TOL/PROFP	**T(label)**		**x**
	var_1	,DAT(x) var_3	
		,F(label1)	
		,FA(label2) var_3	
		does not exist	**x**
	var_3	,MMC	
		,LMC	
		,RFS	
		does not exist	**x**
TOL/PROFS	**T(label)**		**x**
	var_1	,DAT(x) var_5	**x**
		,F(label1)	**x**
		,FA(label2) var_5	**x**
		does not exist	**x**
	var_2	,AVGDEV	**x**
		does not exist	**x**
	var_5	,MMC	**x**
		,LMC	**x**
		,RFS	**x**
		does not exist	**x**
TOL/RAD	**T(label)**		**x**
	var_1	,AVG	
		,CRAD	
		does not exist	**x**
	var_2	,MINMAX	
		does not exist	**x**
TOL/STRGHT	**T(label)**		**x**
	var_1	tolzon var_2	**x**

		tolzon,unit	**x**
	var_2	,MMC	**x**
		,LMC	**x**
		,RFS	**x**
		,tolzon1,unit	**x**
		does not exist	**x**
TOL/SYM	**T(label)**		**x**
	var_1	DAT(x) var_3	**x**
		F(label1)	**x**
		FA(label2) var_3	**x**
	var_3	,MMC	**x**
		,LMC	**x**
		,RFS	**x**
		does not exist	**x**
TOL/TRNOUT	**T(label)**		**x**
	var_1	,DAT(x)	**x**
		,F(label1)	**x**
		,FA(label2)	**x**
		does not exist	**x**
TOL/USETOL	**T(label)=TOL/USETOL,'text'** **T(label)=TOL/USETOL,parm var_1**		
	var_1	,parm var_1	
		does not exist	
TOL/WIDTH	**T(label)**		**x**
	var_1	,i,j,k	**x**
		,SHORT	**x**
		,LONG	**x**
		does not exist	**x**
	var_2	,MINMAX	
		does not exist	**x**
TOOLDF	**TL(label**		
TRANS	**D(label)**		**x**
	var_1	XORIG	**x**
		YORIG	**x**
		ZORIG	**x**
	var_2	var_6	**x**
		var_7	**x**
	var_3	,var_1,var_2	**x**

		does not exist	**x**
	var_6	value	**x**
		F(label1)	**x**
		FA(label2)	**x**
		DAT(x)	**x**
	var_7	PRBRAD	**x**
		-PRBRAD	**x**
UNITS	**UNITS/v**		**x**
	var_1	MM	**x**
		CM	**x**
		M	**x**
		INCH	**x**
		FEET	**x**
	var_2	ANGDEC	**x**
		ANGDMS	**x**
		ANGRAD	**x**
	var_3	,TEMPF	
		,TEMPC	
		does not exist	**x**
VALUE	**varnam**		**x**
	var_1	ACLRAT var_2	
		BADTST	
		BOUND,var_4	
		CRMODE	
		CROSCL	
		CRSLCT	
		CZSLCT,label1	
		DATSET	
		DMISMD,var_5	
		DMISMN,var_5	
		ERROR,var_6	
		FEDRAT var_7	
		FILNAM,var_5	
		FINPOS	
		GECOMP	
		GEOALG,var_9	
		GOTO,var_10	
		MODE	

		PRCOMP	
		PTBUFF	
		PTMEAS,var_10	
		SCNMOD	
		SNSET,var_11	
		SNSLCT	
		SNSMNT,var_12	
		TECOMP	
		UNITS,var_13	
		WKPLAN	
		FA(label2),var_14	**x**
		RT(label3),var_16	
		SA(label4) var_17	
		SW(label5),var_18	
		TA(label6),var_19	**x**
	var_2	,var_3,ACEL	
		does not exist	
	var_3	MESACL	
		POSACL	
		ROTACL	
	var_4	F(label7),COUNT	
		FA(label8),COUNT	
		T(label9),COUNT	
		TA(label10),COUNT	
		F(label7),bndnum	
		FA(label8),bndnum	
		T(label9),bndnum	
		TA(label10),bndnum	
	var_5	NAME	
		VERSION	
	var_6	ERR	
		ERRMODE	
	var_7	,var_8,FEED	
		does not exist	
	var_8	MESVEL	
		POSVEL	
		ROTVEL	
		SCNVEL	

	var_9	ARC	
		CIRCLE	
		CONE	
		CPARLN	
		CYLNDR	
		ELLIPS	
		EDGEPT	
		GCURVE	
		GSURF	
		LINE	
		OBJECT	
		PARPLN	
		PLANE	
		RCTNGL	
		SPHERE	
		TORUS	
	var_10	XAXIS	
		YAXIS	
		ZAXIS	
		POS	
	var_11	APPRCH	
		RETRCT	
		SEARCH	
		CLRSRF	
		CLRSRF,DIST	
		DEPTH	
		DEPTH,DIST	
	var_12	XVEC	
		ZVEC	
		MNTLEN	
	var_13	DIST	
		ANGL	
		TEMP	
	var_14	PTDATA	
		SIZE var_15	**x**
	var_15	,sizenum	
		does not exist	**x**
	var_16	ANGL,CW	

		ANGL,CCW	
	var_17	,'desc'	
		,tipnum	
		does not exist	
	var_18	ANGLE,'anglename'	
	var_19	var_20 var_21	**x**
	var_20	ACT	**x**
		DEV	**x**
		AMT	**x**
		INTOL	**x**
		OUTOL	**x**
	var_21	,tolnum	
		does not exist	**x**
VFORM	**V(label)**		**x**
	var_1	NOM var_3	**x**
		ACT var_3	**x**
		DEV var_3	**x**
		AMT var_3	**x**
		HIST var_3	**x**
		PLOT var_3	
		STAT var_3	
		ALL	**x**
		DME var_3	
	var_2	,var_1 var_2	**x**
		does not exist	**x**
	var_3	,'text'	
		does not exist	**x**
WINDEF(1)	**VW(labe**		
WINDEF(2)	**VW(labe**		
WKPLAN	**WKPLAN**		**x**
	var_1	XYPLAN	**x**
		YZPLAN	**x**
		ZXPLAN	**x**
WRIST	**SW(labe**		**x**
	var_1	ROTCEN,tx,ty,tz,ai,aj,ak,di,dj,dk	**x**
	var_2	ANGLE,'anglename',var_5,var_6	**x**
	var_3	,var_1,var_2 var_3	**x**
		does not exist	**x**

	var_4	,'data_store','data_list',var_7	**x**
		does not exist	**x**
	var_5	begin,end	**x**
		THRU	**x**
	var_6	step	**x**
		CONTIN	**x**
	var_7	'data_item'	
		index	
WRITE	**WRITE/**		**x**
	var_1	variable:x:y var_2	**x**
		variable:x var_2	**x**
		variable var_2	**x**
		'text' var_2	**x**
	var_2	,var_1	**x**
		does not exist	**x**
XTERN	**XTERN**		**x**
XTRACT	**XTRACT**		

APPENDIX B – PRO/CMM / CHARACTERIZATION FILE

A subset of DMIS commands is automatically output by Pro/CMM to a probe path file. These commands are shown below with their associated parameters and definitions.

$$

Any line or portion of a line preceded by "$$" is a comment or command for the use of Pro/CMM.

ACLRAT / MESACL, *units*, *feed*

Sets the measure acceleration feedrate, where:

- *units*—The ACCEL_UNITS value.
- *feed*—The MEASURE_ACCEL value.

ACLRAT / POSACL, *units*, *feed*

Sets the safe acceleration feedrate, where:

- *units*—The ACCEL_UNITS value.
- *feed*—The SAFE_ACCEL value.

ACLRAT / SCNACL, *units*, *feed*

Sets the scanning acceleration, where:

- *units*—The ACCEL_UNITS value.
- *feed*—The MEASURE_ACCEL value.

BOUND / F(*ent_name*), F(BND_#)[, F(BND_#)]

Bounds a Measured or Constructed entity, where:

- *ent_name*—The Measured or Constructed entity name, for example, M_PL01 or C_LN01.
- BND_#—The name of the internal bounding plane, for example, BND_12. The number of bounding planes depends on the type of the Measured or Constructed entity being bounded.

CONST / CIRCLE, F(*con_name*), *type*, FA(*ref*)[, FA(*ref*)]

Constructs a circle, where:

- *con_name*—The Construct step name, for example, C_LN01.
- *type*—The Constructed Circle type. Can be one of:
- BF—Best Fit
- PROJCT—Projection
- INTOF—Intersect
- *ref*—The name of a Measured or Constructed reference entity, for example, M_PT01 or C_PL01. The number of reference entities varies depending on *type*.

CONST / CYLNDR, F(*con_name*), BF, FA(*ref*), FA(*ref*), FA(*ref*)[, FA(*ref*)]

Constructs a cylinder, where:

- *con_name*—The Construct step name, for example, C_CY01.
- *ref*—The name of a reference entity, for example, C_LN01. There can be three or more reference entities.

CONST / LINE, F(*con_name*), *type*, FA(*ref*)[, FA(*ref*)]

Constructs a line, where:

- *con_name*—The Construct step name, for example, C_LN01.
- *type*—The Constructed Line type. Can be one of:
- BF—Best Fit
- MIDLI—Midline
- PROJLI—Projection
- INTOF—Intersect
- *ref*—The name of a Measured or Constructed reference entity, for example, M_PT01 or C_LN01. The number of reference entities varies depending on *type*.

CONST / PLANE, F(*con_name*), *type*, FA(*ref*)[, FA(*ref*)]

Constructs a plane, where:

- *con_name*—The Construct step name, for example, C_PL01.
- *type*—The Constructed Plane type. Can be one of:

- BF—Best Fit
- MIDPL—Midplane
- NORM—Normal
- PARLEL—Parallel
- *ref*—The name of a Measured or Constructed reference entity, for example, M_PT01 or C_PL01. The number of reference entities varies depending on *type*.

CONST / POINT, F(*con_name*), *type*, FA(*ref*)[, FA(*ref*)]

Constructs a point, where:

- *con_name*—The Construct step name, for example, C_PT01.
- *type*—The Constructed Point type. Can be one of:
- MIDPT—Midpoint
- PROJPT—Projection
- INTOF—Intersect
- *ref*—The name of a Measured or Constructed reference entity, for example, M_PL01 or C_LN01. The number of reference entities varies depending on *type*.

CONST / SPHERE, F(*con_name*), BF, FA(*ref*)[, FA(*ref*)]

Constructs a sphere, where:

- *con_name*—The Construct step name, for example, C_SP01.
- *ref*—The name of a reference entity, for example, C_PT01. There can be four or more reference entities.

D(*csys*)= DATSET / DAT(*dat_name*), *dir*

Creates a new Ref Csys using Primary Axis transformation, where:

- *csys*—The Ref Csys name, for example, REF_CSYS01.
- *dat_name*—The datum label corresponding to the selected reference entity, derived from the preceding DATDEF statement.
- *dir*—The primary axis and direction vector. Can be one of: XDIR, -XDIR, YDIR, -YDIR, ZDIR, -ZDIR.

D(*csys*)= DATSET / DAT(*dat_name*)[, XDIR, YDIR, ZDIR, XORIG, YORIG, ZORIG]

Creates a new Ref Csys using Custom transformation, where:

- *csys*—The Ref Csys name, for example, REF_CSYS01.
- *dat_name*—The datum label corresponding to the selected reference entity, derived from the preceding DATDEF statement.

The system will output only those direction and origin components that you checked off when specifying the degrees of freedom.

D(*csys*)= TRANS / XORIG, *x_value*, YORIG, *y_value*, ZORIG, *z_value*

Creates a new Ref Csys using Translate by value, where:

- *csys*—The Ref Csys name, for example, REF_CSYS01.
- *x_value*, *y_value*, *z_value*—The offset values along the axes.

The system will output only those axes that are actually used for transformation.

D(*csys*)= TRANS / XORIG, FA(*ref*), YORIG, FA(*ref*), ZORIG, FA(*ref*)

Creates a new Ref Csys using Translate by aligning to reference, where:

- *csys*—The Ref Csys name, for example, REF_CSYS01.
- *ref*—The names of the Measured or Constructed reference entities used for alignment, for example, M_PL01 or C_LN01.

The system will output only those axes that are actually used for transformation.

D(*csys*)= ROTATE / *axis*, *value*

Creates a new Ref Csys using Rotate by value, where:

- *csys*—The Ref Csys name, for example, REF_CSYS01.
- *axis*—The axis of rotation. Can be one of: XAXIS, YAXIS, ZAXIS.
- *value*—The angle of rotation.

D(*csys*)= ROTATE / *axis*, FA(*ref*), *dir*

Creates a new Ref Csys using Rotate by aligning to axis, where:

- *csys*—The Ref Csys name, for example, REF_CSYS01.
- *axis*—The axis of rotation. Can be one of: XAXIS, YAXIS, ZAXIS.

- *ref*—The name of the Measured or Constructed reference entity used for alignment, for example, M_PL01 or C_LN01.
- *dir*—The axis being aligned to reference. Can be one of: XDIR, YDIR, ZDIR.

DATDEF / FA(*ref*), DAT(*dat_name*)

Assigns a datum label to a Measured or Constructed entity prior to issuing a DATSET statement, where:

- *ref*—The name of the Measured or Constructed reference entity, for example, M_PL01 or C_LN01.
- *dat_name*—The datum label generated by the system (A, B, and so on).

DMESW / COMAND, '*command*[, *args*]'

Outputs a non-DMIS command to create a new Ref Csys using Custom transformation, where:

- *command*—The name of the command (**Func Name**).
- *args*—Arguments separated by commas, if specified (**Func Args**).

DMIS / *var_1*

Enables or disables the processing of DMIS statements (*var_1* = ON or OFF)

DMISMN / 'DMIS Program'

Output at the beginning of a DMIS file.

ENDFIL

Output at the end of a DMIS file.

ENDMES

Output at the end of a sequence of PTMEAS commands.

F(BND_#)= FEAT / PLANE, CART, *x*, *y*, *z*, *i*, *j*, *k*

Creates an internal bounding plane, where:

- BND_#—The name of the bounding plane, for example, BND_12.
- *x*, *y*, *z*—Coordinates of a point on the plane.

- *i, j, k*—The direction vector of the plane.

`F(ent_name)= FEAT / CIRCLE, side, CART, x, y, z, i, j, k, diam`

Defines a circle, where:

- *ent_name*—The Measured or Constructed circle name, for example, `M_CR01`.
- *side*—`INNER` or `OUTER`.
- *x, y, z*—Coordinates of the center of the circle.
- *i, j, k*—The direction vector of the plane that the circle lies in.
- *diam*—The diameter of the circle.

`F(ent_name)= FEAT / CONE, side, CART, x, y, z, i, j, k, ang`

Defines a cone, where:

- *ent_name*—The Measured or Constructed cone name, for example, `M_CN01`.
- *side*—`INNER` or `OUTER`.
- *x, y, z*—Coordinates of the vertex of the cone.
- *i, j, k*—The direction vector associated with the cone, which points along the cone's axis from the vertex to the base of the cone.
- *ang*—The angle of the cone.

`F(ent_name)= FEAT / CYLNDR, side, CART, x, y, z, i, j, k, diam`

Defines a cylinder, where:

- *ent_name*—The Measured or Constructed cylinder name, for example, `M_CY01`.
- *side*—`INNER` or `OUTER`.
- *x, y, z*—Coordinates of a point on the cylinder's axis; this point is the centerpoint for bounded cylinders.
- *i, j, k*—The direction vector associated with the cylinder, which points along the cylinder's axis from the first end measured to the other end.
- *diam*—The diameter of the cylinder.

`F(ent_name)= FEAT / GSURF`

Defines a surface, where:

- *ent_name*—The Measured surface name, for example, M_SF01.

F(*ent_name*)= FEAT / LINE, BND, CART, *x1, y1, z1, x2, y2, z2, ni, nj, nk*

Defines a bounded line, where:

- *ent_name*—The Measured line name, for example, M_LN01.
- BND—Specifies that the line is bounded.
- *x1, y1, z1* and *x2, y2, z2*—Coordinates of the two endpoints of the best fit line.
- *ni, nj, nk*—The normal vector of the plane where the line lies.

F(*ent_name*)= FEAT / LINE, UNBND, CART, *x, y, z, i, j, k, ni, nj, nk*

Defines an unbounded line, where:

- *ent_name*—The Measured or Constructed line name, for example, M_LN01 or C_LN01.
- UNBND—Specifies that the line is unbounded.
- *x, y, z*—Coordinates of a point on the line (for a Measured line, coordinates of the start point of the line).
- *i, j, k*—The direction vector which points along the line (for a Measured line, the direction is defined by the flip arrow).
- *ni, nj, nk*—The normal vector of the plane in which the line lies, that can be used for probe compensation.

F(*ent_name*)= FEAT / PLANE, CART, *x, y, z, i, j, k*

Defines a plane, where:

- *ent_name*—The Measured or Constructed plane name, for example, M_PL01.
- *x, y, z*—Coordinates of a point on the plane.
- *i, j, k*—The direction vector of the plane which points away from the part.

F(*ent_name*)= FEAT / POINT, CART, *x, y, z, i, j, k*

Defines a point, where:

- *ent_name*—The Measured or Constructed point name, for example, M_PT01.

- *x, y, z*—Coordinates of the point.
- *i, j, k*—A vector, normal to and pointing away from the surface in which the point lies, that can be used for probe compensation.

`F(ent_name)= FEAT / SPHERE, side, CART, x, y, z, diam`

Defines a sphere, where:

- *ent_name*—The Measured or Constructed sphere name, for example, `M_SP01`.
- *side*—`INNER` or `OUTER`.
- *x, y, z*—Coordinates of the center of the sphere.
- *diam*—The diameter of the sphere.

`FEDRAT / MESVEL, units, feed`

Sets the measure feedrate, where:

- *units*—The FEED_UNITS value.
- *feed*—The MEASURE_FEED value.

`FEDRAT / POSVEL, units, feed`

Sets the safe feedrate, where:

- *units*—The FEED_UNITS value.
- *feed*—The SAFE_FEED value.

FEDRAT / SCNVEL, *units*, *velocity*

Sets the scanning velocity where:

- *units*—The FEED_UNITS value.
- *velocity*—The MEASURE_FEED value.

`FROM / x, y, z`

The Start point for a Measure step, where:

- *x, y, z*—Coordinates of the probe tip center or of the contact point (depending on the value of the workcell parameter PTMEAS_OUTPUT_POINT).

GOTO / *x*, *y*, *z*

Go to point, where:

- *x*, *y*, *z*—Coordinates of the probe tip center or of the contact point (depending on the value of the workcell parameter PTMEAS_OUTPUT_POINT).

MEAS / *type*, F(*meas_name*), *n*

Performs a Measure step, where:

- *type*—The type of Measure step. Can be one of: CIRCLE, CONE, CYLNDR, GSURF, PLANE, POINT, SPHERE.
- *meas_name*—The Measure step name, for example, M_PL01.
- *n*—The number of Measured points.

MODE / AUTO, MAN

Measure points and probe path will be controlled by the built-in algorithm of the CMM.

MODE / PROG, MAN

Measure points and probe path will be controlled by Pro/CMM.

MODE / MAN

Measure points and probe path will be controlled by the CMM operator.

OUTPUT / FA(*ref_name*)[, FA(*dat_name*)], TA(*ver_name*)

Output for Verify steps, where:

- *ref_name*—The name of a Measured or Constructed reference feature, for example, M_CY01.
- *dat_name*—The name of a Measured or Constructed reference datum, for example, M_PL01. Output if required by the tolerance type.
- *ver_name*—The Verify step name, for example, VER01.

PATH / USERDF *alg_name*, FILNAM *file_name*

Defines the path for the scanning probe using a user defined algorithm, where:

- *alg_name*—Name of the user defined algorithm

- *file_name*—Name of the file that contains the data to be used with the algorithm

PAMEAS / *x*, *y*, *z*, *i*, *j*, *k*

Performs path directed scanning measurement, where:

- *x*, *y*, *z*—Coordinates of the point.
- *i*, *j*, *k*—A direction vector, normal to and pointing away from the surface of the feature being measured

`PARTNO name`

Part name.

`PRCOMP / OFF`

Sets probe compensation OFF.

`PRCOMP / ON`

Sets probe compensation ON.

`PTMEAS / CART, x, y, z, i, j, k`

Performs an automatic point measurement, where:

- `x, y, z`—Coordinates of the point.
- `i, j, k`—A direction vector, normal to and pointing away from the surface of the feature being measured, that can be used for probe compensation.

`RAPID / pcent`

The next motion statement will be a rapid traverse feed, where:

- `pcent`—The workcell parameter RAPID_FEED_RATE (specified as a percent of maximum value).

`RECALL / D(csys)`

Makes a Ref Csys current (`csys` is the Ref Csys name).

`S(r)= SNSDEF / PROBE, FIXED, CART, dx, dy, dz, ti, tj, tk, diam`

Defines a fixed probe, where:

- *r* = REGISTER in the Probe Table.
- *dx, dy, dz*—The distance along X, Y, and Z between the probe tip center (the TIP# coordinate system) and the probe origin (the TOOL coordinate system)
- *ti, tj, tk*—The unit vector of the sensor mount socket's axis.
- *diam*—The tip diameter.

`S(r)= SNSDEF / PROBE, INDEX, POL, pitch, roll, ti, tj, tk, len, diam`

Defines a rotating probe, where:

- *r* = REGISTER in the Probe Table.
- POL—Specifies that the probe tip's location is defined in polar coordinates.
- *pitch*—The pitch angle.
- *roll*—The roll angle.
- *ti, tj, tk*—The unit vector of the sensor mount socket's axis.
- *len*—The total length between the sensor mount and the probe tip center.
- *diam*—The tip diameter.

`SAVE / D(csys)`

Saves a Ref Csys in CMM's memory (*csys* is the Ref Csys name).

`SAVE / S(r)`

Saves sensor calibration data in CMM's memory (*r* is the probe name, which corresponds to the REGISTER value in the Probe Table).

SCNMOD / *var_1*

Enables or disables the scanning mode (*var_1* = ON or OFF)

SCNSET / DRAG

Sets the drag routine for scanning.

`SNSET / APPRCH, value`

Sets the measure approach distance (*value* = MEAS_APPR_DIST).

`SNSET / CLRSRF, value`

Sets the border clearance (*value* = BORDER_CLEARANCE).

`SNSET / RETRCT, value`

Sets the measure pullout distance (*value* = MEAS_PULLOUT_DIST).

`SNSLCT / S(r)`

Load probe (*r* = REGISTER in the Probe Table).

`T(ver_name)= TOL / ANGLB, angle, lower_tol, upper_tol`

Output for verifying an angular dimension tolerance, where:

- *ver_name*—The Verify step name, for example, `VER01`.
- *angle*—The nominal value of the angular dimension.
- *lower_tol*—The lower bound for the dimension.
- *upper_tol*—The upper bound for the dimension.

`T(ver_name)= TOL / CORTOL, axis, lower_tol, upper_tol`

Output for verifying dimension tolerance in the direction of a Ref Csys axis, where:

- *ver_name*—The Verify step name, for example, `VER01`.
- *axis*—The Ref Csys axis. Can be one of: `XAXIS`, `YAXIS`, `ZAXIS`.
- *lower_tol*—The lower bound for the dimension.
- *upper_tol*—The upper bound for the dimension.

`T(ver_name)= TOL / DIAM, lower_tol, upper_tol`

Output for verifying a diameter dimension tolerance, where:

- *ver_name*—The Verify step name, for example, VER01.
- *lower_tol*—The lower bound for the dimension.
- *upper_tol*—The upper bound for the dimension.

T(*ver_name*)= TOL / DISTB, NOMINL, *nom_value*, *lower_tol*, *upper_tol*, PT2PT

Output for verifying dimension tolerance between two features, where:

- *ver_name*—The Verify step name, for example, VER01.
- *nom_value*—The nominal value of the dimension.
- *lower_tol*—The lower bound for the dimension.
- *upper_tol*—The upper bound for the dimension.

T(*ver_name*)= TOL / RAD, *lower_tol*, *upper_tol*

Output for verifying a radius dimension tolerance, where:

- *ver_name*—The Verify step name, for example, VER01.
- *lower_tol*—The lower bound for the dimension.
- *upper_tol*—The upper bound for the dimension.

T(*ver_name*)= TOL / *type*[, *ang_dim*], *value*[, FA(*ref_name*)]

Output for verifying geometric tolerance, where:

- *ver_name*—The Verify step name, for example, VER01.
- *type*—The geometric tolerance type. Can be one of:
- PARLEL—Parallelism
- PERP—Perpendicularity
- ANGLR—Angularity
- POS, 2D—Position for circles
- POS, 3D—Position for cylinders and surfaces
- SYM—Symmetry

- CONCEN—Concentricity
- FLAT—Flatness
- STRGHT—Straightness
- CIRLTY—Circularity
- CILCTY—Cylindricity
- PROFS—Surface Profile
- *ang_dim*—The nominal value of angular dimension. Output for Angularity verification only.
- *value*—The geometric tolerance value.
- *ref_name*—The name of a Measured or Constructed reference feature, for example, M_PL01. Output if required by *type*.

UNITS / INCH, ANGDEC

Model units.

APPENDIX C – DMISENGINE INTERFACE DISPLAY

Name	Desc	Nominal	Actual	Deviation	Graphic
Flatness VERIFY_DATUM_A_FLATNESS(REMEASURE_PRIMARY)					
VERIFY_DAT	T	0.254		0.011	
Cylindricity VERIFY_CYLINDRICITY(MEASURE_CYLINDER)					
VERIFY_CYL	T	0.254		1.982	
Perpendicularity VERIFY_CYL_PERPENDIC(MEASURE_CYLINDER)					
VERIFY_CYL	T	0.254		0.160	
Circularity VERIFY_CIRCULARITY(MEASURE_CIRCLE)					
VERIFY_CIR	T	0.254		0.010	
Straightness VERIFY_DATUM_B_STRAIGHT(MEASURE_DATUM_B)					
VERIFY_DAT	T	0.254		0.004	
Straightness VERIFY_RT_SIDE_STRAIGHT(MEASURE_RIGHT_SIDE)					
VERIFY_RT_	T	0.254		0.005	
Perpendicularity VERIFY_RT_SIDE_SQUARE(MEASURE_RIGHT_SIDE)					
VERIFY_RT_	T	0.254		0.005	
Straightness VERIFY_LEFT_SIDE_STRAIGHT(MEASURE_LEFT_SIDE)					
VERIFY_LEF	T	0.254		0.008	
Perpendicularity VERIFY_LEFT_SIDE_SQUARE(MEASURE_LEFT_SIDE)					
VERIFY_LEF	T	0.254		0.008	
Straightness VERIFY_TOP_SIDE_STRAIGHT(MEASURE_TOP_SIDE)					
VERIFY_TOP	T	0.254		0.004	
Parallelism VERIFY_TOP_SIDE_PARALLEL(MEASURE_TOP_SIDE)					
VERIFY_TOP	T	0.254		0.004	
Straightness VERIFY_DATUM_E_STRAIGHT(MEASURE_DATUM_E)					
VERIFY_DAT	T	0.254		0.006	
Angularity VERIFY_DATUM_E_ANGLE(MEASURE_DATUM_E)					
VERIFY_DAT	T	0.254		0.006	
Straightness VERIFY_RT_DIAMOND_STRAIGHT(MEASURE_RT_DIAMOND_SIDE)					
VERIFY_RT_	T	0.254		0.006	
Perpendicularity VERIFY_RT_DIAMOND_SQUARE(MEASURE_RT_DIAMOND_SID					
VERIFY_RT_	T	0.254		0.006	
Straightness VERIFY_LEFT_DIAMOND_STRAIGHT(MEASURE_LEFT_DIAMOND_S					
VERIFY_LEF	T	0.254		0.011	
Perpendicularity VERIFY_LEFT_DIAMOND_SQUARE(MEASURE_LEFT_DIAMOND					
VERIFY_LEF	T	0.254		0.011	
Straightness VERIFY_TOP_DIAMOND_STRAIGHT(MEASURE_TOP_DIAMOND)					
VERIFY_TOP	T	0.254		0.009	
Parallelism VERITY_TOP_DIAMOND_PARALLEL(MEASURE_TOP_DIAMOND)					
VERITY_TOP	T	0.254		0.009	
2D position VERIFY_D1_TP(MEASURE_D1)					
VERIFY_D1_	T	0.254		0.066	
2D position VERIFY_D1_CBORE_TP(MEASURE_D1_CBORE)					
VERIFY_D1_	T	0.254		0.045	
2D position VERIFY_D2_TP(MEASURE_D2)					
VERIFY_D2_	T	0.254		0.048	
2D position VERIFY_D2_CBORE_TP(MEASURE_D2_CBORE)					
VERIFY_D2_	T	0.254		0.048	
2D position VERIFY_D3_TP(MEASURE_D3)					
VERIFY_D3_	T	0.254		0.051	

"Results"

Name	Desc	Nominal	Actual	Deviation	Graphic
2D position VERIFY_D3_CBORE_TP(MEASURE_D3_CBORE)					
VERIFY_D3_	T	0.254		0.037	
2D position VERIFY_D4_TP(MEASURE_D4)					
VERIFY_D4_	T	0.254		0.065	
2D position VERIFY_D4_CBORE_TP(MEASURE_D4_CBORE)					
VERIFY_D4_	T	0.254		0.045	
2D position VERIFY_D5_TP(MEASURE_D5)					
VERIFY_D5_	T	0.254		0.071	
2D position VERIFY_D5_CBORE_TP(MEASURE_D5_CBORE)					
VERIFY_D5_	T	0.254		0.051	
2D position VERIFY_D6_TP(MEASURE_D6)					
VERIFY_D6_	T	0.254		0.054	
2D position VERIFY_D6_CBORE_TP(MEASURE_D6_CBORE)					
VERIFY_D6_	T	0.254		0.032	
2D position VERIFY_D7_TP(MEASURE_D7)					
VERIFY_D7_	T	0.254		0.050	
2D position VERIFY_D7_CBORE_TP(MEASURE_D7_CBORE)					
VERIFY_D7_	T	0.254		0.035	
2D position VERIFY_D8_TP(MEASURE_D8)					
VERIFY_D8_	T	0.254		0.066	
2D position VERIFY_D8_CBORE_TP(MEASURE_D8_CBORE)					
VERIFY_D8_	T	0.254		0.047	
Elapsed time DMISMN-ENDFIL 2047 second(s)					

APPENDIX D – ZEISS DMISENGINE / CMM-OS

APPENDIX E – PRO/CMM / DMIS INPUT FILE

```
$$*          Pro/DMISfile  Version Wildfire 4.0 - C010
$$-> MFGNO / 15705_CMM
$$-> PARTNO / 15705_CMM
DMISMN / 'DMIS Program'
UNITS / INCH,  ANGDEC
S(1)= SNSDEF / PROBE,  INDEX,  POL,  0.0000000000,  0.0000000000,  $
0.0000000000, 0.0000000000, 1.0000000000,  3.9370078740,  0.0787401575
$$ |*********************************************|
$$ |           Probe Table Information           |
$$ |*********************************************|
$$ Probe Probe            Register Tip Pitch Roll  Comments
$$ Pos   ID                       Num Angle Angle
$$ ------------------------------------------------------
$$ 1     INDX_SING_TIP    1        1   0     0
$$ 2     INDX_SING_TIP    2        1   90    0
$$ 3     INDX_SING_TIP    3        1   90    90
$$ 4     INDX_SING_TIP    4        1   90    180
$$ 5     INDX_SING_TIP    5        1   90    -90
$$-> FEATNO / 178
MODE / MAN
$$SNSLCT / S(1)
$$FEDRAT / MESVEL,  PCENT,  0.0070000000
$$FEDRAT / POSVEL,  PCENT,  0.2000000000
$$ACLRAT / MESACL,  PCENT,  0.1000000000
$$ACLRAT / POSACL,  PCENT,  0.1000000000
PRCOMP / ON
$$SNSET / APPRCH, 0.1000000000
$$SNSET / RETRCT, 0.1000000000
$$SNSET / CLRSRF, 0.1000000000
F(PROBE_PRIMARY)= FEAT / PLANE,  CART,  -5.3750000, -5.3750000, 0.0000000,  $
0.0000000000, 0.0000000000, 1.0000000000
F(BND_56)= FEAT / PLANE,  CART,  5.3750000, -5.3750000, 0.0000000,  $
0.0000000000, -1.0000000000, 0.0000000000
F(BND_57)= FEAT / PLANE,  CART,  5.3750000, 5.3750000, 0.0000000,  $
1.0000000000, 0.0000000000, 0.0000000000
F(BND_58)= FEAT / PLANE,  CART,  -5.3750000, 5.3750000, 0.0000000,  $
0.0000000000, 1.0000000000, 0.0000000000
F(BND_59)= FEAT / PLANE,  CART,  -5.3750000, -5.3750000, 0.0000000,  $
-1.0000000000, 0.0000000000, 0.0000000000
BOUND / F(PROBE_PRIMARY),  F(BND_56),  F(BND_57),  F(BND_58),  F(BND_59)
MEAS / PLANE,  F(PROBE_PRIMARY),  3
GOTO / 4.9827832, -0.8224247, 2.0000000
GOTO / 4.9827832, -0.8224247, 0.2393701
PTMEAS / CART,  4.9827832, -0.8224247, 0.0000000,  $
0.0000000000, 0.0000000000, 1.0000000000
PTMEAS / CART,  0.1284451, 5.0039084, 0.0000000,  $
0.0000000000, 0.0000000000, 1.0000000000
PTMEAS / CART,  -4.8003414, -3.2905304, 0.0000000,  $
0.0000000000, 0.0000000000, 1.0000000000
GOTO / -4.8003414, -3.2905304, 0.2393701
GOTO / -4.8003414, -3.2905304, 2.0000000
ENDMES
$$-> END /
$$-> FEATNO / 279
```

```
DATDEF / FA(PROBE_PRIMARY),  DAT(A)
D(REF_CSYS01)= DATSET / DAT(A),  ZDIR
$$-> END /
$$-> FEATNO / 281
D(REF_CSYS02)= TRANS / ZORIG,  FA(PROBE_PRIMARY)
$$-> END /
$$-> FEATNO / 1476
MODE / MAN
$$FEDRAT / MESVEL,  PCENT,  0.0070000000
$$FEDRAT / POSVEL,  PCENT,  0.2000000000
$$ACLRAT / MESACL,  PCENT,  0.1000000000
$$ACLRAT / POSACL,  PCENT,  0.1000000000
PRCOMP / ON
$$SNSET / APPRCH, 0.1000000000
$$SNSET / RETRCT, 0.1000000000
$$SNSET / CLRSRF, 0.1000000000
F(PROBE_SECONDARY)= FEAT / LINE,  BND,  CART,  $
-4.6461260, -5.3750000, -0.1373463,  4.5287248, -5.3750000, -0.1191689,  $
0.0000000000, -1.0000000000, 0.0000000000
MEAS / LINE,  F(PROBE_SECONDARY),  2

GOTO / -4.6461260, -5.6143701, 2.0000000
GOTO / -4.6461260, -5.6143701, -0.1373463
PTMEAS / CART,  -4.6461260, -5.3750000, -0.1373463,  $
0.0000000000, -1.0000000000, 0.0000000000
PTMEAS / CART,  4.5287248, -5.3750000, -0.1191689,  $
0.0000000000, -1.0000000000, 0.0000000000
GOTO / 4.5287248, -5.6143701, -0.1191689
GOTO / 4.5287248, -5.6143701, 2.0000000
ENDMES
$$-> END /
$$-> FEATNO / 305
DATDEF / FA(PROBE_SECONDARY),  DAT(B)
D(REF_CSYS03)= DATSET / DAT(B),  XDIR
$$-> END /
$$-> FEATNO / 343
MODE / MAN
$$FEDRAT / MESVEL,  PCENT,  0.0070000000
$$FEDRAT / POSVEL,  PCENT,  0.2000000000
$$ACLRAT / MESACL,  PCENT,  0.1000000000
$$ACLRAT / POSACL,  PCENT,  0.1000000000
PRCOMP / ON
$$SNSET / APPRCH, 0.1000000000
$$SNSET / RETRCT, 0.1000000000
$$SNSET / CLRSRF, 0.1000000000
F(PROBE_TERTIARY)= FEAT / CIRCLE,  INNER,  CART,  $
0.0007430, 0.0000000, 0.3749993,  0.0019812141, 0.0000000000, 0.9999980374,
$
0.7500000000
MEAS / CIRCLE,  F(PROBE_TERTIARY),  3
GOTO / 0.1363726, 0.0000000, 1.9997337
GOTO / 0.1363726, 0.0000000, 0.3747306
PTMEAS / CART,  0.3757422, 0.0000000, 0.3742563,  $
-0.9999980374, 0.0000000000, 0.0019812141
PTMEAS / CART,  -0.2644216, 0.2651650, 0.3755246,  $
0.7071053934, -0.7071067812, -0.0014009300
PTMEAS / CART,  0.0007430, -0.3750000, 0.3749993,  $
```

```
0.0000000000, 1.0000000000, -0.0000000000
ENDMES
GOTO / 0.0007430, -0.1356299, 0.3749993
GOTO / 0.0007430, -0.1356299, 2.0000025
$$-> END /
$$-> FEATNO / 372
D(REF_CSYS04)= TRANS / XORIG,  FA(PROBE_TERTIARY),  YORIG,  $
FA(PROBE_TERTIARY)
$$-> END /
$$-> FEATNO / 376
MODE / PROG,  MAN
$$FEDRAT / MESVEL,  PCENT,  0.0070000000
$$FEDRAT / POSVEL,  PCENT,  0.2000000000
$$ACLRAT / MESACL,  PCENT,  0.1000000000
$$ACLRAT / POSACL,  PCENT,  0.1000000000
PRCOMP / ON
$$SNSET / APPRCH, 0.1000000000
$$SNSET / RETRCT, 0.1000000000
$$SNSET / CLRSRF, 0.1000000000
F(REMEASURE_PRIMARY)= FEAT / PLANE,  CART,  $
-5.3757324, -5.3750000, 0.0106490,  $
0.0019812141, 0.0000000000, 0.9999980374
F(BND_92)= FEAT / PLANE,  CART,  5.3742465, -5.3750000, -0.0106490,  $
0.0000000000, -1.0000000000, 0.0000000000
F(BND_93)= FEAT / PLANE,  CART,  5.3742465, 5.3750000, -0.0106490,  $
0.9999980374, 0.0000000000, -0.0019812141
F(BND_94)= FEAT / PLANE,  CART,  -5.3757324, 5.3750000, 0.0106490,  $
0.0000000000, 1.0000000000, 0.0000000000
F(BND_95)= FEAT / PLANE,  CART,  -5.3757324, -5.3750000, 0.0106490,  $
-0.9999980374, 0.0000000000, 0.0019812141
BOUND / F(REMEASURE_PRIMARY),  F(BND_92),  F(BND_93),  F(BND_94),  $
F(BND_95)
MEAS / PLANE,  F(REMEASURE_PRIMARY),  12
GOTO / 4.0263544, -4.7954786, 1.9920254
GOTO / 4.0263544, -4.7954786, 0.2313920
PTMEAS / CART,  4.0258802, -4.7954786, -0.0079776,  $
0.0019812141, 0.0000000000, 0.9999980374
PTMEAS / CART,  1.4203538, -4.2677623, -0.0028155,  $
0.0019812141, 0.0000000000, 0.9999980374
PTMEAS / CART,  -0.7650186, -5.1185163, 0.0015142,  $
0.0019812141, 0.0000000000, 0.9999980374
PTMEAS / CART,  -5.0600357, -3.6971158, 0.0100236,  $
0.0019812141, 0.0000000000, 0.9999980374
PTMEAS / CART,  -4.3801881, -1.2539513, 0.0086766,  $
0.0019812141, 0.0000000000, 0.9999980374
PTMEAS / CART,  -5.2589014, 1.2922617, 0.0104176,  $
0.0019812141, 0.0000000000, 0.9999980374
PTMEAS / CART,  -3.7347482, 5.1724713, 0.0073979,  $
0.0019812141, 0.0000000000, 0.9999980374
PTMEAS / CART,  -1.7462434, 4.3742502, 0.0034582,  $
0.0019812141, 0.0000000000, 0.9999980374
PTMEAS / CART,  0.6568739, 5.1383130, -0.0013029,  $
0.0019812141, 0.0000000000, 0.9999980374
PTMEAS / CART,  4.9776883, 3.6140884, -0.0098634,  $
0.0019812141, 0.0000000000, 0.9999980374
PTMEAS / CART,  4.2876876, 1.7030881, -0.0084963,  $
0.0019812141, 0.0000000000, 0.9999980374
```

```
PTMEAS / CART,  4.9653049, -0.1658455, -0.0098388,  $
0.0019812141, 0.0000000000, 0.9999980374
ENDMES

GOTO / 4.9657792, -0.1658455, 0.2295308

GOTO / 4.9657792, -0.1658455, 1.9901642
$$-> END /
$$-> FEATNO / 1365
DATDEF / FA(REMEASURE_PRIMARY),  DAT(C)
D(REF_CSYS05)= DATSET / DAT(C),  ZDIR
$$-> END /
$$-> FEATNO / 1425
D(REF_CSYS06)= TRANS / ZORIG,  FA(REMEASURE_PRIMARY)
$$-> END /
$$-> FEATNO / 479
$$ Verify Gtol g43
T(VERIFY_DATUM_A_FLATNESS)= TOL / FLAT,  0.0100000000
OUTPUT / FA(REMEASURE_PRIMARY),  TA(VERIFY_DATUM_A_FLATNESS)
$$-> END /
$$-> FEATNO / 1428
MODE / PROG,  MAN
$$FEDRAT / MESVEL,  PCENT,  0.0070000000
$$FEDRAT / POSVEL,  PCENT,  0.2000000000
$$ACLRAT / MESACL,  PCENT,  0.1000000000
$$ACLRAT / POSACL,  PCENT,  0.1000000000
PRCOMP / ON
$$SNSET / APPRCH, 0.1000000000
$$SNSET / RETRCT, 0.1000000000
$$SNSET / CLRSRF, 0.1000000000
F(REMEASURE_SECONDARY)= FEAT / LINE,  BND,  CART,  $
-4.3158153, -5.3750000, -0.1052434,  4.2798541, -5.3750000, -0.1177308,  $
0.0000000000, -1.0000000000, 0.0000000000
MEAS / LINE,  F(REMEASURE_SECONDARY),  9
GOTO / -4.3158408, -5.6143701, 2.0085531
GOTO / -4.3158408, -5.6143701, -0.1228278
PTMEAS / CART,  -4.3158408, -5.3750000, -0.1228278,  $
0.0000000000, -1.0000000000, 0.0000000000
PTMEAS / CART,  -3.2383343, -5.3750000, -0.0809597,  $
0.0000000000, -1.0000000000, 0.0000000000
PTMEAS / CART,  -2.1557736, -5.3750000, -0.1112315,  $
0.0000000000, -1.0000000000, 0.0000000000
PTMEAS / CART,  -1.0842284, -5.3750000, -0.1297616,  $
0.0000000000, -1.0000000000, 0.0000000000
PTMEAS / CART,  -0.0058795, -5.3750000, -0.0999168,  $
0.0000000000, -1.0000000000, 0.0000000000
PTMEAS / CART,  1.0773291, -5.3750000, -0.1030657,  $
0.0000000000, -1.0000000000, 0.0000000000
PTMEAS / CART,  2.1411959, -5.3750000, -0.1120204,  $
0.0000000000, -1.0000000000, 0.0000000000
PTMEAS / CART,  3.2095661, -5.3750000, -0.1216034,  $
0.0000000000, -1.0000000000, 0.0000000000
PTMEAS / CART,  4.2798478, -5.3750000, -0.1220984,  $
0.0000000000, -1.0000000000, 0.0000000000
ENDMES
GOTO / 4.2798478, -5.6143701, -0.1220984
GOTO / 4.2798478, -5.6143701, 1.9915231
```

```
$$-> END /
$$-> FEATNO / 1450
DATDEF / FA(REMEASURE_SECONDARY),  DAT(D)
D(REF_CSYS07)= DATSET / DAT(D),  XDIR
$$-> END /
$$-> FEATNO / 1502
MODE / PROG,  MAN
$$FEDRAT / MESVEL,  PCENT,  0.0070000000
$$FEDRAT / POSVEL,  PCENT,  0.2000000000
$$ACLRAT / MESACL,  PCENT,  0.1000000000
$$ACLRAT / POSACL,  PCENT,  0.1000000000
PRCOMP / ON
$$SNSET / APPRCH, 0.1000000000
$$SNSET / RETRCT, 0.1000000000
$$SNSET / CLRSRF, 0.1000000000
F(REMEASURE_TERTIARY)= FEAT / CIRCLE,  INNER,  CART,  $
-0.0005448, 0.0000000, 0.3750003,  $
0.0005284518, 0.0000000000, 0.9999998604,  0.7500000000
MEAS / CIRCLE,  F(REMEASURE_TERTIARY),  8

GOTO / 0.1350851, 0.0000000, 1.9999289
GOTO / 0.1359439, 0.0000000, 1.9999284
GOTO / 0.1350851, 0.0000000, 0.3749287
PTMEAS / CART,  0.3744552, 0.0000000, 0.3748022,  $
-0.9999998604, 0.0000000000, 0.0005284518
PTMEAS / CART,  0.2646202, 0.2651650, 0.3748602,  $
-0.7071066825, -0.7071067812, 0.0003736719
PTMEAS / CART,  -0.0005448, 0.3750000, 0.3750003,  $
-0.0000000000, -1.0000000000, 0.0000000000
PTMEAS / CART,  -0.2657098, 0.2651650, 0.3751405,  $
0.7071066825, -0.7071067812, -0.0003736719
PTMEAS / CART,  -0.3755447, 0.0000000, 0.3751985,  $
0.9999998604, 0.0000000000, -0.0005284518
PTMEAS / CART,  -0.2657098, -0.2651650, 0.3751405,  $
0.7071066825, 0.7071067812, -0.0003736719
PTMEAS / CART,  -0.0005448, -0.3750000, 0.3750003,  $
0.0000000000, 1.0000000000, -0.0000000000
PTMEAS / CART,  0.2646202, -0.2651650, 0.3748602,  $
-0.7071066825, 0.7071067812, 0.0003736719
GOTO / 0.0953600, -0.0959048, 0.3749497
GOTO / 0.0962188, -0.0959048, 1.9999494
GOTO / 0.0953600, -0.0959048, 1.9999499
ENDMES
$$-> END /
$$-> FEATNO / 1532
D(REF_CSYS08)= TRANS / XORIG,  FA(REMEASURE_TERTIARY),  YORIG,  $
FA(REMEASURE_TERTIARY)
$$-> END /
$$-> FEATNO / 756
MODE / PROG,  MAN
$$FEDRAT / MESVEL,  PCENT,  0.0070000000
$$FEDRAT / POSVEL,  PCENT,  0.2000000000
$$ACLRAT / MESACL,  PCENT,  0.1000000000
$$ACLRAT / POSACL,  PCENT,  0.1000000000
PRCOMP / ON
$$SNSET / APPRCH, 0.1000000000
$$SNSET / RETRCT, 0.1000000000
```

```
$$SNSET / CLRSRF, 0.1000000000
F(MEASURE_CYLINDER)= FEAT / CYLNDR,  INNER,  CART,  $
0.0002477, 0.0000000, 0.4999990,  $
-0.0019812141, 0.0000000000, -0.9999980374,  0.7500000000
F(BND_128)= FEAT / PLANE,  CART,  0.0002477, 0.0000000, 0.4999990,  $
0.0019812141, 0.0000000000, 0.9999980374
F(BND_129)= FEAT / PLANE,  CART,  -0.0037148, 0.0000000, -1.4999971,  $
-0.0019812141, 0.0000000000, -0.9999980374
BOUND / F(MEASURE_CYLINDER),  F(BND_128),  F(BND_129)
MEAS / CYLNDR,  F(MEASURE_CYLINDER),  30
GOTO / 0.0959542, 0.0959048, 1.9998123
GOTO / 0.0959542, 0.0959048, 0.3998092
PTMEAS / CART,  0.2652141, 0.2651650, 0.3994739,  $
-0.7071053934, -0.7071067812, 0.0014009300
PTMEAS / CART,  0.0000495, 0.3750000, 0.3999992,  $
-0.0000000000, -1.0000000000, 0.0000000000
PTMEAS / CART,  -0.2651150, 0.2651650, 0.4005246,  $
0.7071053934, -0.7071067812, -0.0014009300
PTMEAS / CART,  -0.2651150, -0.2651650, 0.4005246,  $
0.7071053934, 0.7071067812, -0.0014009300
PTMEAS / CART,  0.0000495, -0.3750000, 0.3999992,  $
0.0000000000, 1.0000000000, -0.0000000000
PTMEAS / CART,  0.2652141, -0.2651650, 0.3994739,  $
-0.7071053934, 0.7071067812, 0.0014009300
PTMEAS / CART,  0.2643225, 0.2651650, -0.0505253,  $
-0.7071053934, -0.7071067812, 0.0014009300
PTMEAS / CART,  -0.0008420, 0.3750000, -0.0499999,  $
-0.0000000000, -1.0000000000, 0.0000000000
PTMEAS / CART,  -0.2660065, 0.2651650, -0.0494746,  $
0.7071053934, -0.7071067812, -0.0014009300
PTMEAS / CART,  -0.2660065, -0.2651650, -0.0494746,  $
0.7071053934, 0.7071067812, -0.0014009300
PTMEAS / CART,  -0.0008420, -0.3750000, -0.0499999,  $
0.0000000000, 1.0000000000, -0.0000000000
PTMEAS / CART,  0.2643225, -0.2651650, -0.0505253,  $
-0.7071053934, 0.7071067812, 0.0014009300
PTMEAS / CART,  0.2634310, 0.2651650, -0.5005244,  $
-0.7071053934, -0.7071067812, 0.0014009300
PTMEAS / CART,  -0.0017336, 0.3750000, -0.4999990,  $
-0.0000000000, -1.0000000000, 0.0000000000
PTMEAS / CART,  -0.2668981, 0.2651650, -0.4994737,  $
0.7071053934, -0.7071067812, -0.0014009300
PTMEAS / CART,  -0.2668981, -0.2651650, -0.4994737,  $
0.7071053934, 0.7071067812, -0.0014009300
PTMEAS / CART,  -0.0017336, -0.3750000, -0.4999990,  $
0.0000000000, 1.0000000000, -0.0000000000
PTMEAS / CART,  0.2634310, -0.2651650, -0.5005244,  $
-0.7071053934, 0.7071067812, 0.0014009300
PTMEAS / CART,  0.2625394, 0.2651650, -0.9505235,  $
-0.7071053934, -0.7071067812, 0.0014009300
PTMEAS / CART,  -0.0026251, 0.3750000, -0.9499981,  $
-0.0000000000, -1.0000000000, 0.0000000000
PTMEAS / CART,  -0.2677896, 0.2651650, -0.9494728,  $
0.7071053934, -0.7071067812, -0.0014009300
PTMEAS / CART,  -0.2677896, -0.2651650, -0.9494728,  $
0.7071053934, 0.7071067812, -0.0014009300
PTMEAS / CART,  -0.0026251, -0.3750000, -0.9499981,  $
```

```
0.0000000000, 1.0000000000, -0.0000000000
PTMEAS / CART,  0.2625394, -0.2651650, -0.9505235,  $
-0.7071053934, 0.7071067812, 0.0014009300
PTMEAS / CART,  0.2616479, 0.2651650, -1.4005226,  $
-0.7071053934, -0.7071067812, 0.0014009300
PTMEAS / CART,  -0.0035167, 0.3750000, -1.3999973,  $
-0.0000000000, -1.0000000000, 0.0000000000
PTMEAS / CART,  -0.2686812, 0.2651650, -1.3994719,  $
0.7071053934, -0.7071067812, -0.0014009300
PTMEAS / CART,  -0.2686812, -0.2651650, -1.3994719,  $
0.7071053934, 0.7071067812, -0.0014009300
PTMEAS / CART,  -0.0035167, -0.3750000, -1.3999973,  $
0.0000000000, 1.0000000000, -0.0000000000
PTMEAS / CART,  0.2616479, -0.2651650, -1.4005226,  $
-0.7071053934, 0.7071067812, 0.0014009300
ENDMES
GOTO / 0.0923880, -0.0959048, -1.4001873
GOTO / 0.0923880, -0.0959048, 1.9998194
$$-> END /
$$-> FEATNO / 783
$$ Verify Gtol g25
T(VERIFY_CYLINDRICITY)= TOL / CYLCTY,  0.0100000000
OUTPUT / FA(MEASURE_CYLINDER),  TA(VERIFY_CYLINDRICITY)
$$-> END /
$$-> FEATNO / 784
$$ Verify Gtol g26
T(VERIFY_CYL_PERPENDIC)= TOL / PERP,  0.0100000000,  FA(REMEASURE_PRIMARY)
OUTPUT / FA(MEASURE_CYLINDER),  TA(VERIFY_CYL_PERPENDIC)
$$-> END /
$$-> FEATNO / 723
MODE / PROG,  MAN
$$FEDRAT / MESVEL,  PCENT,  0.0070000000
$$FEDRAT / POSVEL,  PCENT,  0.2000000000
$$ACLRAT / MESACL,  PCENT,  0.1000000000
$$ACLRAT / POSACL,  PCENT,  0.1000000000
PRCOMP / ON
$$SNSET / APPRCH, 0.1000000000
$$SNSET / RETRCT, 0.1000000000
$$SNSET / CLRSRF, 0.1000000000
F(MEASURE_CIRCLE)= FEAT / CIRCLE,  OUTER,  CART,  $
0.0000000, 0.0000000, 0.3749993,  $
-0.0019812141, 0.0000000000, -0.9999980374,  8.0000000000
MEAS / CIRCLE,  F(MEASURE_CIRCLE),  8
GOTO / -4.2393618, 0.0000000, 2.0084016
GOTO / -4.2393618, 0.0000000, 0.3833984
PTMEAS / CART,  -3.9999921, 0.0000000, 0.3829241,  $
-0.9999980374, 0.0000000000, 0.0019812141
PTMEAS / CART,  -2.8284216, 2.8284271, 0.3806030,  $
-0.7071053934, 0.7071067812, 0.0014009300
PTMEAS / CART,  0.0000000, 4.0000000, 0.3749993,  $
0.0000000000, 1.0000000000, -0.0000000000
PTMEAS / CART,  2.8284216, 2.8284271, 0.3693955,  $
0.7071053934, 0.7071067812, -0.0014009300
PTMEAS / CART,  3.9999921, -0.0000000, 0.3670744,  $
0.9999980374, -0.0000000000, -0.0019812141
PTMEAS / CART,  2.8284216, -2.8284271, 0.3693955,  $
0.7071053934, -0.7071067812, -0.0014009300
```

```
PTMEAS / CART,  -0.0000000, -4.0000000, 0.3749993,  $
-0.0000000000, -1.0000000000, 0.0000000000
PTMEAS / CART,  -2.8284216, -2.8284271, 0.3806030,  $
-0.7071053934, -0.7071067812, 0.0014009300
ENDMES
GOTO / -2.9976814, -2.9976873, 0.3809383
GOTO / -2.9976814, -2.9976873, 2.0059415
$$-> END /
$$-> FEATNO / 752
$$ Verify Gtol g51
T(VERIFY_CIRCULARITY)= TOL / CIRLTY,  0.0100000000
OUTPUT / FA(MEASURE_CIRCLE),  TA(VERIFY_CIRCULARITY)
$$-> END /
$$-> FEATNO / 481
MODE / PROG,  MAN
$$FEDRAT / MESVEL,  PCENT,  0.0070000000
$$FEDRAT / POSVEL,  PCENT,  0.2000000000
$$ACLRAT / MESACL,  PCENT,  0.1000000000
$$ACLRAT / POSACL,  PCENT,  0.1000000000
PRCOMP / ON
$$SNSET / APPRCH, 0.1000000000
$$SNSET / RETRCT, 0.1000000000
$$SNSET / CLRSRF, 0.1000000000
F(MEASURE_DATUM_B)= FEAT / LINE,  BND,  CART,  $
-4.7876931, -5.3750000, -0.0756873,  5.0322779, -5.3750000, -0.1074994,  $
0.0000000000, -1.0000000000, 0.0000000000
MEAS / LINE,  F(MEASURE_DATUM_B),  7
GOTO / -4.7877447, -5.6143701, 2.0094880
GOTO / -4.7877447, -5.6143701, -0.0916129
PTMEAS / CART,  -4.7877447, -5.3750000, -0.0916129,  $
0.0000000000, -1.0000000000, 0.0000000000
PTMEAS / CART,  -3.0285838, -5.3750000, -0.0801788,  $
0.0000000000, -1.0000000000, 0.0000000000
PTMEAS / CART,  -1.2413181, -5.3750000, -0.0911279,  $
0.0000000000, -1.0000000000, 0.0000000000
PTMEAS / CART,  0.3613097, -5.3750000, -0.0769265,  $
0.0000000000, -1.0000000000, 0.0000000000
PTMEAS / CART,  2.0227084, -5.3750000, -0.0705359,  $
0.0000000000, -1.0000000000, 0.0000000000
PTMEAS / CART,  3.5166453, -5.3750000, -0.0910949,  $
0.0000000000, -1.0000000000, 0.0000000000
PTMEAS / CART,  5.0321629, -5.3750000, -0.1429782,  $
0.0000000000, -1.0000000000, 0.0000000000
ENDMES
GOTO / 5.0321629, -5.6143701, -0.1429782
GOTO / 5.0321629, -5.6143701, 1.9900326
$$-> END /
$$-> FEATNO / 504
$$ Verify Gtol g0
T(VERIFY_DATUM_B_STRAIGHT)= TOL / STRGHT,  0.0100000000
OUTPUT / FA(MEASURE_DATUM_B),  TA(VERIFY_DATUM_B_STRAIGHT)
$$-> END /
GOTO / 5.0321629, -5.6143701, 2.0000000
GOTO / 5.6133684, -4.8634912, 2.0000000
$$-> FEATNO / 506
MODE / PROG,  MAN
$$FEDRAT / MESVEL,  PCENT,  0.0070000000
```

```
$$FEDRAT / POSVEL,  PCENT,  0.2000000000
$$ACLRAT / MESACL,  PCENT,  0.1000000000
$$ACLRAT / POSACL,  PCENT,  0.1000000000
PRCOMP / ON
$$SNSET / APPRCH, 0.1000000000
$$SNSET / RETRCT, 0.1000000000
$$SNSET / CLRSRF, 0.1000000000
F(MEASURE_RIGHT_SIDE)= FEAT / LINE,  BND,  CART,  $
5.3740149, -4.8635095, -0.1275213,  5.3740555, 4.2206792, -0.1070541,  $
0.9999980374, 0.0000000000, -0.0019812141
MEAS / LINE,  F(MEASURE_RIGHT_SIDE),  6
GOTO / 5.6133684, -4.8634912, 1.9888811
GOTO / 5.6133684, -4.8634912, -0.1361281
PTMEAS / CART,  5.3739988, -4.8634912, -0.1356539,  $
0.9999980374, 0.0000000000, -0.0019812141
PTMEAS / CART,  5.3740007, -2.8364765, -0.1347263,  $
0.9999980374, 0.0000000000, -0.0019812141
PTMEAS / CART,  5.3740582, -0.9422093, -0.1056712,  $
0.9999980374, 0.0000000000, -0.0019812141
PTMEAS / CART,  5.3740650, 0.7280720, -0.1022476,  $
0.9999980374, 0.0000000000, -0.0019812141
PTMEAS / CART,  5.3740920, 2.2351930, -0.0886161,  $
0.9999980374, 0.0000000000, -0.0019812141
PTMEAS / CART,  5.3739986, 4.2207438, -0.1357516,  $
0.9999980374, 0.0000000000, -0.0019812141
ENDMES
GOTO / 5.6133682, 4.2207438, -0.1362258
GOTO / 5.6133682, 4.2207438, 1.9888811
$$-> END /
$$-> FEATNO / 529
$$ Verify Gtol g1
T(VERIFY_RT_SIDE_STRAIGHT)= TOL / STRGHT,  0.0100000000
OUTPUT / FA(MEASURE_RIGHT_SIDE),  TA(VERIFY_RT_SIDE_STRAIGHT)
$$-> END /
$$-> FEATNO / 532
$$ Verify Gtol g2
T(VERIFY_RT_SIDE_SQUARE)= TOL / PERP,  0.0100000000,  FA(MEASURE_DATUM_B)
OUTPUT / FA(MEASURE_RIGHT_SIDE),  TA(VERIFY_RT_SIDE_SQUARE)
$$-> END /
$$-> FEATNO / 533
MODE / PROG,  MAN
$$FEDRAT / MESVEL,  PCENT,  0.0070000000
$$FEDRAT / POSVEL,  PCENT,  0.2000000000
$$ACLRAT / MESACL,  PCENT,  0.1000000000
$$ACLRAT / POSACL,  PCENT,  0.1000000000
PRCOMP / ON
$$SNSET / APPRCH, 0.1000000000
$$SNSET / RETRCT, 0.1000000000
$$SNSET / CLRSRF, 0.1000000000
F(MEASURE_LEFT_SIDE)= FEAT / LINE,  BND,  CART,  $
-5.3759226, 4.9750138, -0.0853351,  -5.3759655, -4.9321038, -0.1069804,  $
-0.9999980374, 0.0000000000, 0.0019812141
MEAS / LINE,  F(MEASURE_LEFT_SIDE),  7
GOTO / -5.6152791, 4.9749994, 2.0111275
GOTO / -5.6152791, 4.9749994, -0.0782601
PTMEAS / CART,  -5.3759095, 4.9749994, -0.0787343,  $
-0.9999980374, 0.0000000000, 0.0019812141
```

```
PTMEAS / CART,  -5.3759404, 3.7489529, -0.0943513,  $
-0.9999980374, 0.0000000000, 0.0019812141
PTMEAS / CART,  -5.3759289, 2.0689574, -0.0885101,  $
-0.9999980374, 0.0000000000, 0.0019812141
PTMEAS / CART,  -5.3759654, 0.3837899, -0.1069486,  $
-0.9999980374, 0.0000000000, 0.0019812141
PTMEAS / CART,  -5.3759396, -1.4475218, -0.0939546,  $
-0.9999980374, 0.0000000000, 0.0019812141
PTMEAS / CART,  -5.3759468, -2.8408356, -0.0975775,  $
-0.9999980374, 0.0000000000, 0.0019812141
PTMEAS / CART,  -5.3759696, -4.9320992, -0.1090818,  $
-0.9999980374, 0.0000000000, 0.0019812141
ENDMES
GOTO / -5.6153392, -4.9320992, -0.1086076
GOTO / -5.6153392, -4.9320992, 2.0111277
$$-> END /
$$-> FEATNO / 559
$$ Verify Gtol g3
T(VERIFY_LEFT_SIDE_STRAIGHT)= TOL / STRGHT,  0.0100000000
OUTPUT / FA(MEASURE_LEFT_SIDE),  TA(VERIFY_LEFT_SIDE_STRAIGHT)
$$-> END /
$$-> FEATNO / 560
$$ Verify Gtol g4
T(VERIFY_LEFT_SIDE_SQUARE)= TOL / PERP,  0.0100000000,  $
FA(MEASURE_DATUM_B)
OUTPUT / FA(MEASURE_LEFT_SIDE),  TA(VERIFY_LEFT_SIDE_SQUARE)
$$-> END /
$$-> FEATNO / 634
MODE / PROG,  MAN
$$FEDRAT / MESVEL,  PCENT,  0.0070000000
$$FEDRAT / POSVEL,  PCENT,  0.2000000000
$$ACLRAT / MESACL,  PCENT,  0.1000000000
$$ACLRAT / POSACL,  PCENT,  0.1000000000
PRCOMP / ON
$$SNSET / APPRCH, 0.1000000000
$$SNSET / RETRCT, 0.1000000000
$$SNSET / CLRSRF, 0.1000000000
F(MEASURE_TOP_SIDE)= FEAT / LINE,  BND,  CART,  $
5.0084262, 5.3750000, -0.0968715,  -5.1537509, 5.3750000, -0.0844297,  $
0.0000000000, 1.0000000000, 0.0000000000
MEAS / LINE,  F(MEASURE_TOP_SIDE),  7
GOTO / 5.0084635, 5.6143701, 1.9900796
GOTO / 5.0084635, 5.6143701, -0.0663666
PTMEAS / CART,  5.0084635, 5.3750000, -0.0663666,  $
0.0000000000, 1.0000000000, 0.0000000000
PTMEAS / CART,  3.5642552, 5.3750000, -0.0970196,  $
0.0000000000, 1.0000000000, 0.0000000000
PTMEAS / CART,  1.5833661, 5.3750000, -0.1050769,  $
0.0000000000, 1.0000000000, 0.0000000000
PTMEAS / CART,  0.0160573, 5.3750000, -0.1194612,  $
0.0000000000, 1.0000000000, 0.0000000000
PTMEAS / CART,  -1.6103675, 5.3750000, -0.0897847,  $
0.0000000000, 1.0000000000, 0.0000000000
PTMEAS / CART,  -3.2613660, 5.3750000, -0.1172742,  $
0.0000000000, 1.0000000000, 0.0000000000
PTMEAS / CART,  -5.1536970, 5.3750000, -0.0403733,  $
0.0000000000, 1.0000000000, 0.0000000000
```

```
ENDMES
GOTO / -5.1536970, 5.6143701, -0.0403733
GOTO / -5.1536970, 5.6143701, 2.0102131
$$-> END /
$$-> FEATNO / 656
$$ Verify Gtol g5
T(VERIFY_TOP_SIDE_STRAIGHT)= TOL / STRGHT,  0.0100000000
OUTPUT / FA(MEASURE_TOP_SIDE),  TA(VERIFY_TOP_SIDE_STRAIGHT)
$$-> END /
$$-> FEATNO / 677
$$ Verify Gtol g6
T(VERIFY_TOP_SIDE_PARALLEL)= TOL / PARLEL,  0.0100000000,  $
FA(MEASURE_DATUM_B)
OUTPUT / FA(MEASURE_TOP_SIDE),  TA(VERIFY_TOP_SIDE_PARALLEL)
$$-> END /
$$-> FEATNO / 563
MODE / PROG,  MAN
$$FEDRAT / MESVEL,  PCENT,  0.0070000000
$$FEDRAT / POSVEL,  PCENT,  0.2000000000
$$ACLRAT / MESACL,  PCENT,  0.1000000000
$$ACLRAT / POSACL,  PCENT,  0.1000000000
PRCOMP / ON
$$SNSET / APPRCH, 0.1000000000
$$SNSET / RETRCT, 0.1000000000
$$SNSET / CLRSRF, 0.1000000000
F(MEASURE_DATUM_E)= FEAT / LINE,  BND,  CART,  $
-2.6078096, -5.0985772, 0.1759950,  4.8120901, -3.1104077, 0.1434066,  $
0.2588185371, -0.9659258263, -0.0005127760
MEAS / LINE,  F(MEASURE_DATUM_E),  6
GOTO / -2.5457882, -5.3297813, 2.0050462
GOTO / -2.5457882, -5.3297813, 0.1919384
PTMEAS / CART,  -2.6077416, -5.0985675, 0.1920612,  $
0.2588185371, -0.9659258263, -0.0005127760
PTMEAS / CART,  -1.0184302, -4.6726914, 0.1500762,  $
0.2588185371, -0.9659258263, -0.0005127760
PTMEAS / CART,  0.5725209, -4.2464017, 0.1567785,  $
0.2588185371, -0.9659258263, -0.0005127760
PTMEAS / CART,  2.0881749, -3.8402909, 0.1692693,  $
0.2588185371, -0.9659258263, -0.0005127760
PTMEAS / CART,  3.3810906, -3.4938364, 0.1326365,  $
0.2588185371, -0.9659258263, -0.0005127760
PTMEAS / CART,  4.8121378, -3.1104009, 0.1546822,  $
0.2588185371, -0.9659258263, -0.0005127760
ENDMES
GOTO / 4.8740913, -3.3416146, 0.1545595
GOTO / 4.8740913, -3.3416146, 1.9903458
$$-> END /
$$-> FEATNO / 585
$$ Verify Gtol g21
T(VERIFY_DATUM_E_STRAIGHT)= TOL / STRGHT,  0.0100000000
OUTPUT / FA(MEASURE_DATUM_E),  TA(VERIFY_DATUM_E_STRAIGHT)
$$-> END /
$$-> FEATNO / 586
$$ Verify Gtol g22
T(VERIFY_DATUM_E_ANGLE)= TOL / ANGLR,  0.0100000000,  FA(MEASURE_DATUM_B)
OUTPUT / FA(MEASURE_DATUM_E),  TA(VERIFY_DATUM_E_ANGLE)
$$-> END /
```

```
GOTO / 4.8740913, -3.3416146, 2.0000000
GOTO / 5.3475045, -2.6131880, 2.0000000
$$-> FEATNO / 587
MODE / PROG,  MAN
$$FEDRAT / MESVEL,  PCENT,  0.0070000000
$$FEDRAT / POSVEL,  PCENT,  0.2000000000
$$ACLRAT / MESACL,  PCENT,  0.1000000000
$$ACLRAT / POSACL,  PCENT,  0.1000000000
PRCOMP / ON
$$SNSET / APPRCH, 0.1000000000
$$SNSET / RETRCT, 0.1000000000
$$SNSET / CLRSRF, 0.1000000000
F(MEASURE_RT_DIAMOND_SIDE)= FEAT / LINE,  BND,  CART,  $
5.1162744, -2.6751706, 0.1381763,  3.1387050, 4.7050963, 0.1235527,  $
0.9659239306, 0.2588190451, -0.0019137059
MEAS / LINE,  F(MEASURE_RT_DIAMOND_SIDE),  6
GOTO / 5.3475045, -2.6131880, 1.9894079
GOTO / 5.3475045, -2.6131880, 0.1501325
PTMEAS / CART,  5.1162912, -2.6751415, 0.1505906,  $
0.9659239306, 0.2588190451, -0.0019137059
PTMEAS / CART,  4.7458075, -1.2927428, 0.1150710,  $
0.9659239306, 0.2588190451, -0.0019137059
PTMEAS / CART,  4.3243900, 0.2802292, 0.1453191,  $
0.9659239306, 0.2588190451, -0.0019137059
PTMEAS / CART,  3.8999407, 1.8642529, 0.1399511,  $
0.9659239306, 0.2588190451, -0.0019137059
PTMEAS / CART,  3.5991879, 2.9863315, 0.0934541,  $
0.9659239306, 0.2588190451, -0.0019137059
PTMEAS / CART,  3.1387289, 4.7051378, 0.1412403,  $
0.9659239306, 0.2588190451, -0.0019137059
ENDMES
GOTO / 3.3699422, 4.7670913, 0.1407822
GOTO / 3.3699422, 4.7670913, 1.9933259
$$-> END /
$$-> FEATNO / 610
$$ Verify Gtol g15
T(VERIFY_RT_DIAMOND_STRAIGHT)= TOL / STRGHT,  0.0100000000
OUTPUT / FA(MEASURE_RT_DIAMOND_SIDE),  TA(VERIFY_RT_DIAMOND_STRAIGHT)
$$-> END /
$$-> FEATNO / 611
$$ Verify Gtol g16
T(VERIFY_RT_DIAMOND_SQUARE)= TOL / PERP,  0.0100000000,  $
FA(MEASURE_DATUM_E)
OUTPUT / FA(MEASURE_RT_DIAMOND_SIDE),  TA(VERIFY_RT_DIAMOND_SQUARE)
$$-> END /
$$-> FEATNO / 612
MODE / PROG,  MAN
$$FEDRAT / MESVEL,  PCENT,  0.0070000000
$$FEDRAT / POSVEL,  PCENT,  0.2000000000
$$ACLRAT / MESACL,  PCENT,  0.1000000000
$$ACLRAT / POSACL,  PCENT,  0.1000000000
PRCOMP / ON
$$SNSET / APPRCH, 0.1000000000
$$SNSET / RETRCT, 0.1000000000
$$SNSET / CLRSRF, 0.1000000000
F(MEASURE_LEFT_DIAMOND_SIDE)= FEAT / LINE,  BND,  CART,  $
-5.1394391, 2.7580334, 0.1264676,  -3.0876656, -4.8991148, 0.1480400,  $
```

```
-0.9659239306, -0.2588190451, 0.0019137059
MEAS / LINE,  F(MEASURE_LEFT_DIAMOND_SIDE),  6
GOTO / -5.3706486, 2.6960899, 2.0106429
GOTO / -5.3706486, 2.6960899, 0.1301603
PTMEAS / CART,  -5.1394354, 2.7580435, 0.1297022,  $
-0.9659239306, -0.2588190451, 0.0019137059
PTMEAS / CART,  -4.7792882, 1.4139117, 0.1233807,  $
-0.9659239306, -0.2588190451, 0.0019137059
PTMEAS / CART,  -4.2855343, -0.4286515, 0.1433289,  $
-0.9659239306, -0.2588190451, 0.0019137059
PTMEAS / CART,  -3.8436163, -2.0779391, 0.1392407,  $
-0.9659239306, -0.2588190451, 0.0019137059
PTMEAS / CART,  -3.3896341, -3.7722721, 0.1322505,  $
-0.9659239306, -0.2588190451, 0.0019137059
PTMEAS / CART,  -3.0876551, -4.8990860, 0.1572615,  $
-0.9659239306, -0.2588190451, 0.0019137059
ENDMES
GOTO / -3.3188684, -4.9610395, 0.1577196
GOTO / -3.3188684, -4.9610395, 2.0065779
$$-> END /
$$-> FEATNO / 678
$$ Verify Gtol g17
T(VERIFY_LEFT_DIAMOND_STRAIGHT)= TOL / STRGHT,  0.0100000000
OUTPUT / FA(MEASURE_LEFT_DIAMOND_SIDE),  TA(VERIFY_LEFT_DIAMOND_STRAIGHT)
$$-> END /
$$-> FEATNO / 679
$$ Verify Gtol g18
T(VERIFY_LEFT_DIAMOND_SQUARE)= TOL / PERP,  0.0100000000,  $
FA(MEASURE_DATUM_E)
OUTPUT / FA(MEASURE_LEFT_DIAMOND_SIDE),  TA(VERIFY_LEFT_DIAMOND_SQUARE)
$$-> END /
$$-> FEATNO / 680
MODE / PROG,  MAN
$$FEDRAT / MESVEL,  PCENT,  0.0070000000
$$FEDRAT / POSVEL,  PCENT,  0.2000000000
$$ACLRAT / MESACL,  PCENT,  0.1000000000
$$ACLRAT / POSACL,  PCENT,  0.1000000000
PRCOMP / ON
$$SNSET / APPRCH, 0.1000000000
$$SNSET / RETRCT, 0.1000000000
$$SNSET / CLRSRF, 0.1000000000
F(MEASURE_TOP_DIAMOND)= FEAT / LINE,  BND,  CART,  $
2.6422856, 5.1080383, 0.1533478,  -4.8869457, 3.0905933, 0.1487973,  $
-0.2588185371, 0.9659258263, 0.0005127760
MEAS / LINE,  F(MEASURE_TOP_DIAMOND),  6
GOTO / 2.5803284, 5.3392465, 1.9948903
GOTO / 2.5803284, 5.3392465, 0.1620851
PTMEAS / CART,  2.6422818, 5.1080328, 0.1619624,  $
-0.2588185371, 0.9659258263, 0.0005127760
PTMEAS / CART,  1.0838106, 4.6904535, 0.1411659,  $
-0.2588185371, 0.9659258263, 0.0005127760
PTMEAS / CART,  -0.7301077, 4.2044144, 0.1451964,  $
-0.2588185371, 0.9659258263, 0.0005127760
PTMEAS / CART,  -2.2683852, 3.7922252, 0.1636458,  $
-0.2588185371, 0.9659258263, 0.0005127760
PTMEAS / CART,  -3.7739562, 3.3888203, 0.1431124,  $
-0.2588185371, 0.9659258263, 0.0005127760
```

```
PTMEAS / CART,  -4.8869464, 3.0905921, 0.1506276,  $
-0.2588185371, 0.9659258263, 0.0005127760
ENDMES
GOTO / -4.9488999, 3.3218058, 0.1507503
GOTO / -4.9488999, 3.3218058, 2.0098073
$$-> END /
$$-> FEATNO / 702
$$ Verify Gtol g19
T(VERIFY_TOP_DIAMOND_STRAIGHT)= TOL / STRGHT,  0.0100000000
OUTPUT / FA(MEASURE_TOP_DIAMOND),  TA(VERIFY_TOP_DIAMOND_STRAIGHT)
$$-> END /
$$-> FEATNO / 720
$$ Verify Gtol g20
T(VERITY_TOP_DIAMOND_PARALLEL)= TOL / PARLEL,  0.0100000000,  $
FA(MEASURE_DATUM_E)
OUTPUT / FA(MEASURE_TOP_DIAMOND),  TA(VERITY_TOP_DIAMOND_PARALLEL)
$$-> END /
$$-> FEATNO / 786
MODE / PROG,  MAN
$$FEDRAT / MESVEL,  PCENT,  0.0070000000
$$FEDRAT / POSVEL,  PCENT,  0.2000000000
$$ACLRAT / MESACL,  PCENT,  0.1000000000
$$ACLRAT / POSACL,  PCENT,  0.1000000000
PRCOMP / ON
$$SNSET / APPRCH, 0.1000000000
$$SNSET / RETRCT, 0.1000000000
$$SNSET / CLRSRF, 0.1000000000
F(MEASURE_D1)= FEAT / CIRCLE,  INNER,  CART,  $
-4.7514766, -4.7500000, -0.3655885,  $
-0.0019812141, 0.0000000000, -0.9999980374,  0.6300000000
MEAS / CIRCLE,  F(MEASURE_D1),  8
GOTO / -4.8271064, -4.7500000, 2.0095660
GOTO / -4.8271064, -4.7500000, -0.3654387
PTMEAS / CART,  -5.0664760, -4.7500000, -0.3649644,  $
0.9999980374, 0.0000000000, -0.0019812141
PTMEAS / CART,  -4.9742148, -4.5272614, -0.3651472,  $
0.7071053934, -0.7071067812, -0.0014009300
PTMEAS / CART,  -4.7514766, -4.4350000, -0.3655885,  $
0.0000000000, -1.0000000000, -0.0000000000
PTMEAS / CART,  -4.5287384, -4.5272614, -0.3660298,  $
-0.7071053934, -0.7071067812, 0.0014009300
PTMEAS / CART,  -4.4364772, -4.7500000, -0.3662126,  $
-0.9999980374, 0.0000000000, 0.0019812141
PTMEAS / CART,  -4.5287384, -4.9727386, -0.3660298,  $
-0.7071053934, 0.7071067812, 0.0014009300
PTMEAS / CART,  -4.7514766, -5.0650000, -0.3655885,  $
-0.0000000000, 1.0000000000, 0.0000000000
PTMEAS / CART,  -4.9742148, -4.9727386, -0.3651472,  $
0.7071053934, 0.7071067812, -0.0014009300
ENDMES
GOTO / -4.8049549, -4.8034784, -0.3654825
GOTO / -4.8049549, -4.8034784, 2.0095221
$$-> END /
$$-> FEATNO / 849
$$ Verify Gtol g27
$$ X = -4.7514765882 Y = -4.7500000000 Z = -0.3655884969
T(VERIFY_D1_TP)= TOL / POS,  2D,  0.0100000000,  FA(REMEASURE_PRIMARY),  $
```

```
FA(MEASURE_DATUM_B),  FA(PROBE_TERTIARY)
OUTPUT / FA(MEASURE_D1),  TA(VERIFY_D1_TP)
$$-> END /
$$-> FEATNO / 818
MODE / PROG,  MAN
$$FEDRAT / MESVEL,  PCENT,  0.0070000000
$$FEDRAT / POSVEL,  PCENT,  0.2000000000
$$ACLRAT / MESACL,  PCENT,  0.1000000000
$$ACLRAT / POSACL,  PCENT,  0.1000000000
PRCOMP / ON
$$SNSET / APPRCH, 0.1000000000
$$SNSET / RETRCT, 0.1000000000
$$SNSET / CLRSRF, 0.1000000000
F(MEASURE_D1_CBORE)= FEAT / CIRCLE,  INNER,  CART,  $
-4.7509813, -4.7500000, -0.1155890,  $
-0.0019812141, 0.0000000000, -0.9999980374,  0.7500000000
MEAS / CIRCLE,  F(MEASURE_D1_CBORE),  8
GOTO / -4.8866109, -4.7500000, 2.0096839
GOTO / -4.8866109, -4.7500000, -0.1153203
PTMEAS / CART,  -5.1259805, -4.7500000, -0.1148460,  $
0.9999980374, 0.0000000000, -0.0019812141
PTMEAS / CART,  -5.0161458, -4.4848350, -0.1150636,  $
0.7071053934, -0.7071067812, -0.0014009300
PTMEAS / CART,  -4.7509813, -4.3750000, -0.1155890,  $
0.0000000000, -1.0000000000, -0.0000000000
PTMEAS / CART,  -4.4858168, -4.4848350, -0.1161143,  $
-0.7071053934, -0.7071067812, 0.0014009300
PTMEAS / CART,  -4.3759820, -4.7500000, -0.1163319,  $
-0.9999980374, 0.0000000000, 0.0019812141
PTMEAS / CART,  -4.4858168, -5.0151650, -0.1161143,  $
-0.7071053934, 0.7071067812, 0.0014009300
PTMEAS / CART,  -4.7509813, -5.1250000, -0.1155890,  $
-0.0000000000, 1.0000000000, 0.0000000000
PTMEAS / CART,  -5.0161458, -5.0151650, -0.1150636,  $
0.7071053934, 0.7071067812, -0.0014009300
ENDMES
GOTO / -4.8468859, -4.8459048, -0.1153990
GOTO / -4.8468859, -4.8459048, 2.0096052
$$-> END /
$$-> FEATNO / 850
$$ Verify Gtol g35
$$ X = -4.7509812847 Y = -4.7500000000 Z = -0.1155889875
T(VERIFY_D1_CBORE_TP)= TOL / POS,  2D,  0.0100000000,  $
FA(REMEASURE_PRIMARY),  FA(MEASURE_DATUM_B),  FA(MEASURE_D1)
OUTPUT / FA(MEASURE_D1_CBORE),  TA(VERIFY_D1_CBORE_TP)
$$-> END /
$$-> FEATNO / 856
MODE / PROG,  MAN
$$FEDRAT / MESVEL,  PCENT,  0.0070000000
$$FEDRAT / POSVEL,  PCENT,  0.2000000000
$$ACLRAT / MESACL,  PCENT,  0.1000000000
$$ACLRAT / POSACL,  PCENT,  0.1000000000
PRCOMP / ON
$$SNSET / APPRCH, 0.1000000000
$$SNSET / RETRCT, 0.1000000000
$$SNSET / CLRSRF, 0.1000000000
F(MEASURE_D2)= FEAT / CIRCLE,  INNER,  CART,  $
```

```
-4.7514766, 4.7500000, -0.3655885,  $
-0.0019812141, 0.0000000000, -0.9999980374,  0.6300000000
MEAS / CIRCLE,  F(MEASURE_D2),  8
GOTO / -4.8271064, 4.7500000, 2.0095660
GOTO / -4.8271064, 4.7500000, -0.3654387
PTMEAS / CART,  -5.0664760, 4.7500000, -0.3649644,  $
0.9999980374, 0.0000000000, -0.0019812141
PTMEAS / CART,  -4.9742148, 4.9727386, -0.3651472,  $
0.7071053934, -0.7071067812, -0.0014009300
PTMEAS / CART,  -4.7514766, 5.0650000, -0.3655885,  $
0.0000000000, -1.0000000000, -0.0000000000
PTMEAS / CART,  -4.5287384, 4.9727386, -0.3660298,  $
-0.7071053934, -0.7071067812, 0.0014009300
PTMEAS / CART,  -4.4364772, 4.7500000, -0.3662126,  $
-0.9999980374, 0.0000000000, 0.0019812141
PTMEAS / CART,  -4.5287384, 4.5272614, -0.3660298,  $
-0.7071053934, 0.7071067812, 0.0014009300
PTMEAS / CART,  -4.7514766, 4.4350000, -0.3655885,  $
-0.0000000000, 1.0000000000, 0.0000000000
PTMEAS / CART,  -4.9742148, 4.5272614, -0.3651472,  $
0.7071053934, 0.7071067812, -0.0014009300
ENDMES
GOTO / -4.8049549, 4.6965216, -0.3654825
GOTO / -4.8049549, 4.6965216, 2.0095221
$$-> END /
$$-> FEATNO / 886
$$ Verify Gtol g29
$$ X = -4.7514765882 Y = 4.7500000000 Z = -0.3655884969
T(VERIFY_D2_TP)= TOL / POS,  2D,  0.0100000000,  FA(REMEASURE_PRIMARY),  $
FA(MEASURE_DATUM_B),  FA(PROBE_TERTIARY)
OUTPUT / FA(MEASURE_D2),  TA(VERIFY_D2_TP)
$$-> END /
$$-> FEATNO / 887
MODE / PROG,  MAN
$$FEDRAT / MESVEL,  PCENT,  0.0070000000
$$FEDRAT / POSVEL,  PCENT,  0.2000000000
$$ACLRAT / MESACL,  PCENT,  0.1000000000
$$ACLRAT / POSACL,  PCENT,  0.1000000000
PRCOMP / ON
$$SNSET / APPRCH, 0.1000000000
$$SNSET / RETRCT, 0.1000000000
$$SNSET / CLRSRF, 0.1000000000
F(MEASURE_D2_CBORE)= FEAT / CIRCLE,  INNER,  CART,  $
-4.7509813, 4.7500000, -0.1155890,  $
-0.0019812141, 0.0000000000, -0.9999980374,  0.7500000000
MEAS / CIRCLE,  F(MEASURE_D2_CBORE),  8
GOTO / -4.8866109, 4.7500000, 2.0096839
GOTO / -4.8866109, 4.7500000, -0.1153203
PTMEAS / CART,  -5.1259805, 4.7500000, -0.1148460,  $
0.9999980374, 0.0000000000, -0.0019812141
PTMEAS / CART,  -5.0161458, 5.0151650, -0.1150636,  $
0.7071053934, -0.7071067812, -0.0014009300
PTMEAS / CART,  -4.7509813, 5.1250000, -0.1155890,  $
0.0000000000, -1.0000000000, -0.0000000000
PTMEAS / CART,  -4.4858168, 5.0151650, -0.1161143,  $
-0.7071053934, -0.7071067812, 0.0014009300
PTMEAS / CART,  -4.3759820, 4.7500000, -0.1163319,  $
```

```
-0.9999980374, 0.0000000000, 0.0019812141
PTMEAS / CART,  -4.4858168, 4.4848350, -0.1161143,  $
-0.7071053934, 0.7071067812, 0.0014009300
PTMEAS / CART,  -4.7509813, 4.3750000, -0.1155890,  $
-0.0000000000, 1.0000000000, 0.0000000000
PTMEAS / CART,  -5.0161458, 4.4848350, -0.1150636,  $
0.7071053934, 0.7071067812, -0.0014009300
ENDMES
GOTO / -4.8468859, 4.6540952, -0.1153990
GOTO / -4.8468859, 4.6540952, 2.0096052
$$-> END /
$$-> FEATNO / 916
$$ Verify Gtol g37
$$ X = -4.7509812847 Y = 4.7500000000 Z = -0.1155889875
T(VERIFY_D2_CBORE_TP)= TOL / POS,  2D,  0.0100000000,  $
FA(REMEASURE_PRIMARY),  FA(MEASURE_DATUM_B),  FA(MEASURE_D2)
OUTPUT / FA(MEASURE_D2_CBORE),  TA(VERIFY_D2_CBORE_TP)
$$-> END /
$$-> FEATNO / 917
MODE / PROG,  MAN
$$FEDRAT / MESVEL,  PCENT,  0.0070000000
$$FEDRAT / POSVEL,  PCENT,  0.2000000000
$$ACLRAT / MESACL,  PCENT,  0.1000000000
$$ACLRAT / POSACL,  PCENT,  0.1000000000
PRCOMP / ON
$$SNSET / APPRCH, 0.1000000000
$$SNSET / RETRCT, 0.1000000000
$$SNSET / CLRSRF, 0.1000000000
F(MEASURE_D3)= FEAT / CIRCLE,  INNER,  CART,  $
4.7485048, 4.7500000, -0.3844100,  $
-0.0019812141, 0.0000000000, -0.9999980374,  0.6300000000
MEAS / CIRCLE,  F(MEASURE_D3),  8
GOTO / 4.6728750, 4.7500000, 1.9907445
GOTO / 4.6728750, 4.7500000, -0.3842602
PTMEAS / CART,  4.4335054, 4.7500000, -0.3837859,  $
0.9999980374, 0.0000000000, -0.0019812141
PTMEAS / CART,  4.5257666, 4.9727386, -0.3839687,  $
0.7071053934, -0.7071067812, -0.0014009300
PTMEAS / CART,  4.7485048, 5.0650000, -0.3844100,  $
0.0000000000, -1.0000000000, -0.0000000000
PTMEAS / CART,  4.9712430, 4.9727386, -0.3848513,  $
-0.7071053934, -0.7071067812, 0.0014009300
PTMEAS / CART,  5.0635041, 4.7500000, -0.3850341,  $
-0.9999980374, 0.0000000000, 0.0019812141
PTMEAS / CART,  4.9712430, 4.5272614, -0.3848513,  $
-0.7071053934, 0.7071067812, 0.0014009300
PTMEAS / CART,  4.7485048, 4.4350000, -0.3844100,  $
-0.0000000000, 1.0000000000, 0.0000000000
PTMEAS / CART,  4.5257666, 4.5272614, -0.3839687,  $
0.7071053934, 0.7071067812, -0.0014009300
ENDMES
GOTO / 4.6950264, 4.6965216, -0.3843041
GOTO / 4.6950264, 4.6965216, 1.9907006
$$-> END /
$$-> FEATNO / 946
$$ Verify Gtol g32
$$ X = 4.7485047670 Y = 4.7500000000 Z = -0.3844100312
```

```
T(VERIFY_D3_TP)= TOL / POS,  2D,  0.0100000000,  FA(REMEASURE_PRIMARY),  $
FA(MEASURE_DATUM_B),  FA(PROBE_TERTIARY)
OUTPUT / FA(MEASURE_D3),  TA(VERIFY_D3_TP)
$$-> END /
GOTO / 4.6950264, 4.6965216, 2.0000000
GOTO / 4.6133704, 4.7500000, 2.0000000
$$-> FEATNO / 947
MODE / PROG,  MAN
$$FEDRAT / MESVEL,  PCENT,  0.0070000000
$$FEDRAT / POSVEL,  PCENT,  0.2000000000
$$ACLRAT / MESACL,  PCENT,  0.1000000000
$$ACLRAT / POSACL,  PCENT,  0.1000000000
PRCOMP / ON
$$SNSET / APPRCH, 0.1000000000
$$SNSET / RETRCT, 0.1000000000
$$SNSET / CLRSRF, 0.1000000000
F(MEASURE_D3_CBORE)= FEAT / CIRCLE,  INNER,  CART,  $
4.7490001, 4.7500000, -0.1344105,  $
-0.0019812141, 0.0000000000, -0.9999980374,  0.7500000000
MEAS / CIRCLE,  F(MEASURE_D3_CBORE),  8
GOTO / 4.6133704, 4.7500000, 1.9908624
GOTO / 4.6133704, 4.7500000, -0.1341418
PTMEAS / CART,  4.3740008, 4.7500000, -0.1336676,  $
0.9999980374, 0.0000000000, -0.0019812141
PTMEAS / CART,  4.4838355, 5.0151650, -0.1338852,  $
0.7071053934, -0.7071067812, -0.0014009300
PTMEAS / CART,  4.7490001, 5.1250000, -0.1344105,  $
0.0000000000, -1.0000000000, -0.0000000000
PTMEAS / CART,  5.0141646, 5.0151650, -0.1349359,  $
-0.7071053934, -0.7071067812, 0.0014009300
PTMEAS / CART,  5.1239993, 4.7500000, -0.1351535,  $
-0.9999980374, 0.0000000000, 0.0019812141
PTMEAS / CART,  5.0141646, 4.4848350, -0.1349359,  $
-0.7071053934, 0.7071067812, 0.0014009300
PTMEAS / CART,  4.7490001, 4.3750000, -0.1344105,  $
-0.0000000000, 1.0000000000, 0.0000000000
PTMEAS / CART,  4.4838355, 4.4848350, -0.1338852,  $
0.7071053934, 0.7071067812, -0.0014009300
ENDMES
GOTO / 4.6530954, 4.6540952, -0.1342205
GOTO / 4.6530954, 4.6540952, 1.9907837
$$-> END /
$$-> FEATNO / 976
$$ Verify Gtol g39
$$ X = 4.7490000705 Y = 4.7500000000 Z = -0.1344105218
T(VERIFY_D3_CBORE_TP)= TOL / POS,  2D,  0.0100000000,  $
FA(REMEASURE_PRIMARY),  FA(MEASURE_DATUM_B),  FA(MEASURE_D3)
OUTPUT / FA(MEASURE_D3_CBORE),  TA(VERIFY_D3_CBORE_TP)
$$-> END /
GOTO / 4.6530954, 4.6540952, 2.0000000
GOTO / 4.6728750, -4.7500000, 2.0000000
$$-> FEATNO / 977
MODE / PROG,  MAN
$$FEDRAT / MESVEL,  PCENT,  0.0070000000
$$FEDRAT / POSVEL,  PCENT,  0.2000000000
$$ACLRAT / MESACL,  PCENT,  0.1000000000
$$ACLRAT / POSACL,  PCENT,  0.1000000000
```

```
PRCOMP / ON
$$SNSET / APPRCH, 0.1000000000
$$SNSET / RETRCT, 0.1000000000
$$SNSET / CLRSRF, 0.1000000000
F(MEASURE_D4)= FEAT / CIRCLE,  INNER,  CART,  $
4.7485048, -4.7500000, -0.3844100,  $
-0.0019812141, 0.0000000000, -0.9999980374,  0.6300000000
MEAS / CIRCLE,  F(MEASURE_D4),  8
GOTO / 4.6728750, -4.7500000, 1.9907445
GOTO / 4.6728750, -4.7500000, -0.3842602
PTMEAS / CART,  4.4335054, -4.7500000, -0.3837859,  $
0.9999980374, 0.0000000000, -0.0019812141
PTMEAS / CART,  4.5257666, -4.5272614, -0.3839687,  $
0.7071053934, -0.7071067812, -0.0014009300
PTMEAS / CART,  4.7485048, -4.4350000, -0.3844100,  $
0.0000000000, -1.0000000000, -0.0000000000
PTMEAS / CART,  4.9712430, -4.5272614, -0.3848513,  $
-0.7071053934, -0.7071067812, 0.0014009300
PTMEAS / CART,  5.0635041, -4.7500000, -0.3850341,  $
-0.9999980374, 0.0000000000, 0.0019812141
PTMEAS / CART,  4.9712430, -4.9727386, -0.3848513,  $
-0.7071053934, 0.7071067812, 0.0014009300
PTMEAS / CART,  4.7485048, -5.0650000, -0.3844100,  $
-0.0000000000, 1.0000000000, 0.0000000000
PTMEAS / CART,  4.5257666, -4.9727386, -0.3839687,  $
0.7071053934, 0.7071067812, -0.0014009300
ENDMES

GOTO / 4.6950264, -4.8034784, -0.3843041

GOTO / 4.6950264, -4.8034784, 1.9907006
$$-> END /
$$-> FEATNO / 1006
$$ Verify Gtol g34
$$ X = 4.7485047670 Y = -4.7500000000 Z = -0.3844100312
T(VERIFY_D4_TP)= TOL / POS,  2D,  0.0100000000,  FA(REMEASURE_PRIMARY),  $
FA(MEASURE_DATUM_B),  FA(PROBE_TERTIARY)
OUTPUT / FA(MEASURE_D4),  TA(VERIFY_D4_TP)
$$-> END /
GOTO / 4.6950264, -4.8034784, 2.0000000
GOTO / 4.6133704, -4.7500000, 2.0000000
$$-> FEATNO / 1007
MODE / PROG,  MAN
$$FEDRAT / MESVEL,  PCENT,  0.0070000000
$$FEDRAT / POSVEL,  PCENT,  0.2000000000
$$ACLRAT / MESACL,  PCENT,  0.1000000000
$$ACLRAT / POSACL,  PCENT,  0.1000000000
PRCOMP / ON
$$SNSET / APPRCH, 0.1000000000
$$SNSET / RETRCT, 0.1000000000
$$SNSET / CLRSRF, 0.1000000000
F(MEASURE_D4_CBORE)= FEAT / CIRCLE,  INNER,  CART,  $
4.7490001, -4.7500000, -0.1344105,  $
-0.0019812141, 0.0000000000, -0.9999980374,  0.7500000000
MEAS / CIRCLE,  F(MEASURE_D4_CBORE),  8
GOTO / 4.6133704, -4.7500000, 1.9908624
GOTO / 4.6133704, -4.7500000, -0.1341418
```

```
PTMEAS / CART,  4.3740008, -4.7500000, -0.1336676,  $
0.9999980374, 0.0000000000, -0.0019812141
PTMEAS / CART,  4.4838355, -4.4848350, -0.1338852,  $
0.7071053934, -0.7071067812, -0.0014009300
PTMEAS / CART,  4.7490001, -4.3750000, -0.1344105,  $
0.0000000000, -1.0000000000, -0.0000000000
PTMEAS / CART,  5.0141646, -4.4848350, -0.1349359,  $
-0.7071053934, -0.7071067812, 0.0014009300
PTMEAS / CART,  5.1239993, -4.7500000, -0.1351535,  $
-0.9999980374, 0.0000000000, 0.0019812141
PTMEAS / CART,  5.0141646, -5.0151650, -0.1349359,  $
-0.7071053934, 0.7071067812, 0.0014009300
PTMEAS / CART,  4.7490001, -5.1250000, -0.1344105,  $
-0.0000000000, 1.0000000000, 0.0000000000
PTMEAS / CART,  4.4838355, -5.0151650, -0.1338852,  $
0.7071053934, 0.7071067812, -0.0014009300
ENDMES

GOTO / 4.6530954, -4.8459048, -0.1342205

GOTO / 4.6530954, -4.8459048, 1.9907837
$$-> END /
$$-> FEATNO / 1036
$$ Verify Gtol g41
$$ X = 4.7490000705 Y = -4.7500000000 Z = -0.1344105218
T(VERIFY_D4_CBORE_TP)= TOL / POS,  2D,  0.0100000000,  $
FA(REMEASURE_PRIMARY),  FA(MEASURE_DATUM_B),  FA(MEASURE_D4)
OUTPUT / FA(MEASURE_D4_CBORE),  TA(VERIFY_D4_CBORE_TP)
$$-> END /
$$-> FEATNO / 1040
MODE / PROG,  MAN
$$FEDRAT / MESVEL,  PCENT,  0.0070000000
$$FEDRAT / POSVEL,  PCENT,  0.2000000000
$$ACLRAT / MESACL,  PCENT,  0.1000000000
$$ACLRAT / POSACL,  PCENT,  0.1000000000
PRCOMP / ON
$$SNSET / APPRCH, 0.1000000000
$$SNSET / RETRCT, 0.1000000000
$$SNSET / CLRSRF, 0.1000000000
F(MEASURE_D5)= FEAT / CIRCLE,  INNER,  CART,  $
-2.5009857, -4.0000000, -0.1200467,  $
-0.0019812141, 0.0000000000, -0.9999980374,  0.6300000000
MEAS / CIRCLE,  F(MEASURE_D5),  8

GOTO / -2.5766155, -4.0000000, 2.0051073

GOTO / -2.5766155, -4.0000000, -0.1198969
PTMEAS / CART,  -2.8159851, -4.0000000, -0.1194226,  $
0.9999980374, 0.0000000000, -0.0019812141
PTMEAS / CART,  -2.7237239, -3.7772614, -0.1196054,  $
0.7071053934, -0.7071067812, -0.0014009300
PTMEAS / CART,  -2.5009857, -3.6850000, -0.1200467,  $
0.0000000000, -1.0000000000, -0.0000000000
PTMEAS / CART,  -2.2782475, -3.7772614, -0.1204880,  $
-0.7071053934, -0.7071067812, 0.0014009300
PTMEAS / CART,  -2.1859863, -4.0000000, -0.1206708,  $
-0.9999980374, 0.0000000000, 0.0019812141
```

```
PTMEAS / CART,  -2.2782475, -4.2227386, -0.1204880,  $
-0.7071053934, 0.7071067812, 0.0014009300
PTMEAS / CART,  -2.5009857, -4.3150000, -0.1200467,  $
-0.0000000000, 1.0000000000, 0.0000000000
PTMEAS / CART,  -2.7237239, -4.2227386, -0.1196054,  $
0.7071053934, 0.7071067812, -0.0014009300
ENDMES

GOTO / -2.5544640, -4.0534784, -0.1199408

GOTO / -2.5544640, -4.0534784, 2.0050634
$$-> END /
$$-> FEATNO / 1069
$$ Verify Gtol g30
$$ X = -2.5009857006 Y = -4.0000000000 Z = -0.1200467193
T(VERIFY_D5_TP)= TOL / POS,  2D,  0.0100000000,  FA(REMEASURE_PRIMARY),  $
FA(MEASURE_DATUM_B),  FA(PROBE_TERTIARY)
OUTPUT / FA(MEASURE_D5),  TA(VERIFY_D5_TP)
$$-> END /
$$-> FEATNO / 1073
MODE / PROG,  MAN
$$FEDRAT / MESVEL,  PCENT,  0.0070000000
$$FEDRAT / POSVEL,  PCENT,  0.2000000000
$$ACLRAT / MESACL,  PCENT,  0.1000000000
$$ACLRAT / POSACL,  PCENT,  0.1000000000
PRCOMP / ON
$$SNSET / APPRCH, 0.1000000000
$$SNSET / RETRCT, 0.1000000000
$$SNSET / CLRSRF, 0.1000000000
F(MEASURE_D5_CBORE)= FEAT / CIRCLE,  INNER,  CART,  $
-2.5004904, -4.0000000, 0.1299528,  $
-0.0019812141, 0.0000000000, -0.9999980374,  0.7500000000
MEAS / CIRCLE,  F(MEASURE_D5_CBORE),  8

GOTO / -2.6361201, -4.0000000, 2.0052252

GOTO / -2.6361201, -4.0000000, 0.1302215
PTMEAS / CART,  -2.8754897, -4.0000000, 0.1306957,  $
0.9999980374, 0.0000000000, -0.0019812141
PTMEAS / CART,  -2.7656549, -3.7348350, 0.1304781,  $
0.7071053934, -0.7071067812, -0.0014009300
PTMEAS / CART,  -2.5004904, -3.6250000, 0.1299528,  $
0.0000000000, -1.0000000000, -0.0000000000
PTMEAS / CART,  -2.2353259, -3.7348350, 0.1294274,  $
-0.7071053934, -0.7071067812, 0.0014009300
PTMEAS / CART,  -2.1254911, -4.0000000, 0.1292098,  $
-0.9999980374, 0.0000000000, 0.0019812141
PTMEAS / CART,  -2.2353259, -4.2651650, 0.1294274,  $
-0.7071053934, 0.7071067812, 0.0014009300
PTMEAS / CART,  -2.5004904, -4.3750000, 0.1299528,  $
-0.0000000000, 1.0000000000, 0.0000000000
PTMEAS / CART,  -2.7656549, -4.2651650, 0.1304781,  $
0.7071053934, 0.7071067812, -0.0014009300
ENDMES

GOTO / -2.5963950, -4.0959048, 0.1301428
```

```
GOTO / -2.5963950, -4.0959048, 2.0051465
$$-> END /
$$-> FEATNO / 1102
$$ Verify Gtol g36
$$ X = -2.5004903970 Y = -4.0000000000 Z = 0.1299527900
T(VERIFY_D5_CBORE_TP)= TOL / POS,  2D,  0.0100000000,  $
FA(REMEASURE_PRIMARY),  FA(MEASURE_DATUM_B),  FA(MEASURE_D5)
OUTPUT / FA(MEASURE_D5_CBORE),  TA(VERIFY_D5_CBORE_TP)
$$-> END /
$$-> FEATNO / 1103
MODE / PROG,  MAN
$$FEDRAT / MESVEL,  PCENT,  0.0070000000
$$FEDRAT / POSVEL,  PCENT,  0.2000000000
$$ACLRAT / MESACL,  PCENT,  0.1000000000
$$ACLRAT / POSACL,  PCENT,  0.1000000000
PRCOMP / ON
$$SNSET / APPRCH, 0.1000000000
$$SNSET / RETRCT, 0.1000000000
$$SNSET / CLRSRF, 0.1000000000
F(MEASURE_D6)= FEAT / CIRCLE,  INNER,  CART,  $
-4.0009828, 2.5000000, -0.1170749,  $
-0.0019812141, 0.0000000000, -0.9999980374,  0.6300000000
MEAS / CIRCLE,  F(MEASURE_D6),  8

GOTO / -4.0766125, 2.5000000, 2.0080791

GOTO / -4.0766125, 2.5000000, -0.1169251
PTMEAS / CART,  -4.3159821, 2.5000000, -0.1164508,  $
0.9999980374, 0.0000000000, -0.0019812141
PTMEAS / CART,  -4.2237210, 2.7227386, -0.1166336,  $
0.7071053934, -0.7071067812, -0.0014009300
PTMEAS / CART,  -4.0009828, 2.8150000, -0.1170749,  $
0.0000000000, -1.0000000000, -0.0000000000
PTMEAS / CART,  -3.7782446, 2.7227386, -0.1175162,  $
-0.7071053934, -0.7071067812, 0.0014009300
PTMEAS / CART,  -3.6859834, 2.5000000, -0.1176990,  $
-0.9999980374, 0.0000000000, 0.0019812141
PTMEAS / CART,  -3.7782446, 2.2772614, -0.1175162,  $
-0.7071053934, 0.7071067812, 0.0014009300
PTMEAS / CART,  -4.0009828, 2.1850000, -0.1170749,  $
-0.0000000000, 1.0000000000, 0.0000000000
PTMEAS / CART,  -4.2237210, 2.2772614, -0.1166336,  $
0.7071053934, 0.7071067812, -0.0014009300
ENDMES

GOTO / -4.0544611, 2.4465216, -0.1169689

GOTO / -4.0544611, 2.4465216, 2.0080352
$$-> END /
$$-> FEATNO / 1133
$$ Verify Gtol g28
$$ X = -4.0009827566 Y = 2.5000000000 Z = -0.1170748981
T(VERIFY_D6_TP)= TOL / POS,  2D,  0.0100000000,  FA(REMEASURE_PRIMARY),  $
FA(MEASURE_DATUM_B),  FA(PROBE_TERTIARY)
OUTPUT / FA(MEASURE_D6),  TA(VERIFY_D6_TP)
$$-> END /
$$-> FEATNO / 1134
```

```
MODE / PROG,  MAN
$$FEDRAT / MESVEL,  PCENT,  0.0070000000
$$FEDRAT / POSVEL,  PCENT,  0.2000000000
$$ACLRAT / MESACL,  PCENT,  0.1000000000
$$ACLRAT / POSACL,  PCENT,  0.1000000000
PRCOMP / ON
$$SNSET / APPRCH, 0.1000000000
$$SNSET / RETRCT, 0.1000000000
$$SNSET / CLRSRF, 0.1000000000
F(MEASURE_D6_CBORE)= FEAT / CIRCLE,  INNER,  CART,  $
-4.0004875, 2.5000000, 0.1329246,  $
-0.0019812141, 0.0000000000, -0.9999980374,  0.7500000000
MEAS / CIRCLE,  F(MEASURE_D6_CBORE),  8

GOTO / -4.1361171, 2.5000000, 2.0081970

GOTO / -4.1361171, 2.5000000, 0.1331933
PTMEAS / CART,  -4.3754867, 2.5000000, 0.1336676,  $
0.9999980374, 0.0000000000, -0.0019812141
PTMEAS / CART,  -4.2656520, 2.7651650, 0.1334500,  $
0.7071053934, -0.7071067812, -0.0014009300
PTMEAS / CART,  -4.0004875, 2.8750000, 0.1329246,  $
0.0000000000, -1.0000000000, -0.0000000000
PTMEAS / CART,  -3.7353229, 2.7651650, 0.1323993,  $
-0.7071053934, -0.7071067812, 0.0014009300
PTMEAS / CART,  -3.6254882, 2.5000000, 0.1321817,  $
-0.9999980374, 0.0000000000, 0.0019812141
PTMEAS / CART,  -3.7353229, 2.2348350, 0.1323993,  $
-0.7071053934, 0.7071067812, 0.0014009300
PTMEAS / CART,  -4.0004875, 2.1250000, 0.1329246,  $
-0.0000000000, 1.0000000000, 0.0000000000
PTMEAS / CART,  -4.2656520, 2.2348350, 0.1334500,  $
0.7071053934, 0.7071067812, -0.0014009300
ENDMES

GOTO / -4.0963921, 2.4040952, 0.1331146

GOTO / -4.0963921, 2.4040952, 2.0081183
$$-> END /
$$-> FEATNO / 1163
$$ Verify Gtol g38
$$ X = -4.0004874531 Y = 2.5000000000 Z = 0.1329246112
T(VERIFY_D6_CBORE_TP)= TOL / POS,  2D,  0.0100000000,  $
FA(REMEASURE_PRIMARY),  FA(MEASURE_DATUM_B),  FA(MEASURE_D6)
OUTPUT / FA(MEASURE_D6_CBORE),  TA(VERIFY_D6_CBORE_TP)
$$-> END /
$$-> FEATNO / 1238
MODE / PROG,  MAN
$$FEDRAT / MESVEL,  PCENT,  0.0070000000
$$FEDRAT / POSVEL,  PCENT,  0.2000000000
$$ACLRAT / MESACL,  PCENT,  0.1000000000
$$ACLRAT / POSACL,  PCENT,  0.1000000000
PRCOMP / ON
$$SNSET / APPRCH, 0.1000000000
$$SNSET / RETRCT, 0.1000000000
$$SNSET / CLRSRF, 0.1000000000
F(MEASURE_D7)= FEAT / CIRCLE,  INNER,  CART,  $
```

```
2.4990045, 4.0000000, -0.1299528,  $
-0.0019812141, 0.0000000000, -0.9999980374,  0.6300000000
MEAS / CIRCLE,  F(MEASURE_D7),  8

GOTO / 2.4233747, 4.0000000, 1.9952012

GOTO / 2.4233747, 4.0000000, -0.1298030
PTMEAS / CART,  2.1840051, 4.0000000, -0.1293287,  $
0.9999980374, 0.0000000000, -0.0019812141
PTMEAS / CART,  2.2762663, 4.2227386, -0.1295115,  $
0.7071053934, -0.7071067812, -0.0014009300
PTMEAS / CART,  2.4990045, 4.3150000, -0.1299528,  $
0.0000000000, -1.0000000000, -0.0000000000
PTMEAS / CART,  2.7217427, 4.2227386, -0.1303941,  $
-0.7071053934, -0.7071067812, 0.0014009300
PTMEAS / CART,  2.8140039, 4.0000000, -0.1305769,  $
-0.9999980374, 0.0000000000, 0.0019812141
PTMEAS / CART,  2.7217427, 3.7772614, -0.1303941,  $
-0.7071053934, 0.7071067812, 0.0014009300
PTMEAS / CART,  2.4990045, 3.6850000, -0.1299528,  $
-0.0000000000, 1.0000000000, 0.0000000000
PTMEAS / CART,  2.2762663, 3.7772614, -0.1295115,  $
0.7071053934, 0.7071067812, -0.0014009300
ENDMES

GOTO / 2.4455262, 3.9465216, -0.1298468

GOTO / 2.4455262, 3.9465216, 1.9951573
$$-> END /
$$-> FEATNO / 1267
$$ Verify Gtol g31
$$ X = 2.4990044864 Y = 4.0000000000 Z = -0.1299527900
T(VERIFY_D7_TP)= TOL / POS,  2D,  0.0100000000,  FA(REMEASURE_PRIMARY),  $
FA(MEASURE_DATUM_B),  FA(PROBE_TERTIARY)
OUTPUT / FA(MEASURE_D7),  TA(VERIFY_D7_TP)
$$-> END /

GOTO / 2.4455262, 3.9465216, 2.0000000

GOTO / 2.3638701, 4.0000000, 2.0000000
$$-> FEATNO / 1268
MODE / PROG,  MAN
$$FEDRAT / MESVEL,  PCENT,  0.0070000000
$$FEDRAT / POSVEL,  PCENT,  0.2000000000
$$ACLRAT / MESACL,  PCENT,  0.1000000000
$$ACLRAT / POSACL,  PCENT,  0.1000000000
PRCOMP / ON
$$SNSET / APPRCH, 0.1000000000
$$SNSET / RETRCT, 0.1000000000
$$SNSET / CLRSRF, 0.1000000000
F(MEASURE_D7_CBORE)= FEAT / CIRCLE,  INNER,  CART,  $
2.4994998, 4.0000000, 0.1200467,  $
-0.0019812141, 0.0000000000, -0.9999980374,  0.7500000000
MEAS / CIRCLE,  F(MEASURE_D7_CBORE),  8

GOTO / 2.3638701, 4.0000000, 1.9953191
```

```
GOTO / 2.3638701, 4.0000000, 0.1203154
PTMEAS / CART,  2.1245005, 4.0000000, 0.1207897,  $
0.9999980374, 0.0000000000, -0.0019812141
PTMEAS / CART,  2.2343353, 4.2651650, 0.1205721,  $
0.7071053934, -0.7071067812, -0.0014009300
PTMEAS / CART,  2.4994998, 4.3750000, 0.1200467,  $
0.0000000000, -1.0000000000, -0.0000000000
PTMEAS / CART,  2.7646643, 4.2651650, 0.1195214,  $
-0.7071053934, -0.7071067812, 0.0014009300
PTMEAS / CART,  2.8744991, 4.0000000, 0.1193038,  $
-0.9999980374, 0.0000000000, 0.0019812141
PTMEAS / CART,  2.7646643, 3.7348350, 0.1195214,  $
-0.7071053934, 0.7071067812, 0.0014009300
PTMEAS / CART,  2.4994998, 3.6250000, 0.1200467,  $
-0.0000000000, 1.0000000000, 0.0000000000
PTMEAS / CART,  2.2343353, 3.7348350, 0.1205721,  $
0.7071053934, 0.7071067812, -0.0014009300
ENDMES

GOTO / 2.4035951, 3.9040952, 0.1202367

GOTO / 2.4035951, 3.9040952, 1.9952404
$$-> END /
$$-> FEATNO / 1297
$$ Verify Gtol g40
$$ X = 2.4994997899 Y = 4.0000000000 Z = 0.1200467193
T(VERIFY_D7_CBORE_TP)= TOL / POS,  2D,  0.0100000000,  $
FA(REMEASURE_PRIMARY),  FA(MEASURE_DATUM_B),  FA(MEASURE_D7)
OUTPUT / FA(MEASURE_D7_CBORE),  TA(VERIFY_D7_CBORE_TP)
$$-> END /

GOTO / 2.4035951, 3.9040952, 2.0000000

GOTO / 3.9233718, -2.5000000, 2.0000000
$$-> FEATNO / 1298
MODE / PROG,  MAN
$$FEDRAT / MESVEL,  PCENT,  0.0070000000
$$FEDRAT / POSVEL,  PCENT,  0.2000000000
$$ACLRAT / MESACL,  PCENT,  0.1000000000
$$ACLRAT / POSACL,  PCENT,  0.1000000000
PRCOMP / ON
$$SNSET / APPRCH, 0.1000000000
$$SNSET / RETRCT, 0.1000000000
$$SNSET / CLRSRF, 0.1000000000
F(MEASURE_D8)= FEAT / CIRCLE,  INNER,  CART,  $
3.9990015, -2.5000000, -0.1329246,  $
-0.0019812141, 0.0000000000, -0.9999980374,  0.6300000000
MEAS / CIRCLE,  F(MEASURE_D8),  8

GOTO / 3.9233718, -2.5000000, 1.9922294

GOTO / 3.9233718, -2.5000000, -0.1327748
PTMEAS / CART,  3.6840022, -2.5000000, -0.1323005,  $
0.9999980374, 0.0000000000, -0.0019812141
PTMEAS / CART,  3.7762633, -2.2772614, -0.1324833,  $
0.7071053934, -0.7071067812, -0.0014009300
PTMEAS / CART,  3.9990015, -2.1850000, -0.1329246,  $
```

```
0.0000000000, -1.0000000000, -0.0000000000
PTMEAS / CART,  4.2217397, -2.2772614, -0.1333659,  $
-0.7071053934, -0.7071067812, 0.0014009300
PTMEAS / CART,  4.3140009, -2.5000000, -0.1335487,  $
-0.9999980374, 0.0000000000, 0.0019812141
PTMEAS / CART,  4.2217397, -2.7227386, -0.1333659,  $
-0.7071053934, 0.7071067812, 0.0014009300
PTMEAS / CART,  3.9990015, -2.8150000, -0.1329246,  $
-0.0000000000, 1.0000000000, 0.0000000000
PTMEAS / CART,  3.7762633, -2.7227386, -0.1324833,  $
0.7071053934, 0.7071067812, -0.0014009300
ENDMES

GOTO / 3.9455232, -2.5534784, -0.1328187

GOTO / 3.9455232, -2.5534784, 1.9921855
$$-> END /
$$-> FEATNO / 1327
$$ Verify Gtol g33
$$ X = 3.9990015425 Y = -2.5000000000 Z = -0.1329246112
T(VERIFY_D8_TP)= TOL / POS,  2D,  0.0100000000,  FA(REMEASURE_PRIMARY),  $
FA(MEASURE_DATUM_B),  FA(PROBE_TERTIARY)
OUTPUT / FA(MEASURE_D8),  TA(VERIFY_D8_TP)
$$-> END /

GOTO / 3.9455232, -2.5534784, 2.0000000

GOTO / 3.8638672, -2.5000000, 2.0000000
$$-> FEATNO / 1328
MODE / PROG,  MAN
$$FEDRAT / MESVEL,  PCENT,  0.0070000000
$$FEDRAT / POSVEL,  PCENT,  0.2000000000
$$ACLRAT / MESACL,  PCENT,  0.1000000000
$$ACLRAT / POSACL,  PCENT,  0.1000000000
PRCOMP / ON
$$SNSET / APPRCH, 0.1000000000
$$SNSET / RETRCT, 0.1000000000
$$SNSET / CLRSRF, 0.1000000000
F(MEASURE_D8_CBORE)= FEAT / CIRCLE,  INNER,  CART,  $
3.9994968, -2.5000000, 0.1170749,  $
-0.0019812141, 0.0000000000, -0.9999980374,  0.7500000000
MEAS / CIRCLE,  F(MEASURE_D8_CBORE),  8

GOTO / 3.8638672, -2.5000000, 1.9923473

GOTO / 3.8638672, -2.5000000, 0.1173436
PTMEAS / CART,  3.6244976, -2.5000000, 0.1178179,  $
0.9999980374, 0.0000000000, -0.0019812141
PTMEAS / CART,  3.7343323, -2.2348350, 0.1176002,  $
0.7071053934, -0.7071067812, -0.0014009300
PTMEAS / CART,  3.9994968, -2.1250000, 0.1170749,  $
0.0000000000, -1.0000000000, -0.0000000000
PTMEAS / CART,  4.2646614, -2.2348350, 0.1165495,  $
-0.7071053934, -0.7071067812, 0.0014009300
PTMEAS / CART,  4.3744961, -2.5000000, 0.1163319,  $
-0.9999980374, 0.0000000000, 0.0019812141
PTMEAS / CART,  4.2646614, -2.7651650, 0.1165495,  $
```

```
-0.7071053934, 0.7071067812, 0.0014009300
PTMEAS / CART,  3.9994968, -2.8750000, 0.1170749,  $
-0.0000000000, 1.0000000000, 0.0000000000
PTMEAS / CART,  3.7343323, -2.7651650, 0.1176002,  $
0.7071053934, 0.7071067812, -0.0014009300
ENDMES

GOTO / 3.9035922, -2.5959048, 0.1172649

GOTO / 3.9035922, -2.5959048, 1.9922686
$$-> END /
$$-> FEATNO / 1357
$$ Verify Gtol g42
$$ X = 3.9994968460 Y = -2.5000000000 Z = 0.1170748981
T(VERIFY_D8_CBORE_TP)= TOL / POS,  2D,  0.0100000000,  $
FA(REMEASURE_PRIMARY),  FA(MEASURE_DATUM_B),  FA(MEASURE_D8)
OUTPUT / FA(MEASURE_D8_CBORE),  TA(VERIFY_D8_CBORE_TP)
$$-> END /
ENDFIL
```

DISTRIBUTION

15	MS0958	Edwin (Tony) Bryce, 24313
1	MS0899	Technical Library, 9536 *(electronic copy)*


Sandia National Laboratories