

NATIONAL AEROSPACE STANDARD

AEROSPACE INDUSTRIES ASSOCIATION OF AMERICA, INC., 1725 DE SALES STREET, N. W., WASHINGTON, D. C. 20036

1.0 SCOPE1.1 PURPOSE:

THIS SPECIFICATION PROVIDES A STANDARD FOR THE SELECTION OF CUTTING TESTS REQUIRED TO EVALUATE THE PERFORMANCE OF CONVENTIONAL AND NUMERICALLY CONTROLLED MACHINE TOOLS NOTED IN PARAGRAPH 1.2, EXCLUDING DRILLING AND TURNING MACHINES, AND TO PROVIDE A STANDARD FORMAT FOR RECORDING AND REPORTING ACTUAL PERFORMANCE RESULTS.

1.2 CLASSIFICATION:

THE MACHINES APPLICABLE TO THIS SPECIFICATION WILL BE CONSIDERED IN ONE OF THE FOLLOWING CATEGORIES:

1.2.1 MANUALLY CONTROLLED AND/OR TEMPLATE TRACING MACHINES, HIGH SPEED, LOW SPEED, OR FULL RANGE, INCLUDE THE FOLLOWING:

1.2.1.1 MILLING MACHINES - KNEE OR BED TYPE - HORIZONTAL AND VERTICAL SPINDLES.

1.2.1.2 MANUALLY OPERATED - HORIZONTAL AND VERTICAL BORING, DRILLING, AND MILLING MACHINES.

1.2.1.3 MILLING MACHINES - HORIZONTAL AND VERTICAL PROFILING AND CONTOURING.

1.2.2 NUMERICALLY CONTROLLED MACHINES, HIGH SPEED, LOW SPEED, OR FULL RANGE, INCLUDE THE FOLLOWING:

1.2.2.1 AUTOMATIC HORIZONTAL AND VERTICAL BORING, DRILLING, AND MILLING MACHINES.

1.2.2.2 MILLING MACHINES - NUMERICALLY CONTROLLED PROFILING, CONTOURING, AND STRAIGHT CUT.

1.2.2.3 MILLING MACHINES - MULTI-AXIS, TRAVELING GANTRY/TABLE.

LIST OF CURRENT SHEETS

NO.	REV	NO.	REV	NO.	REV	NO.	REV	NO.	REV	NO.	REV
1	1	11	1	21	1	31	1	41	NEW	51	NEW
2	1	12	1	22	1	32	1	42	NEW	52	NEW
3	1	13	1	23	1	33	1	43	NEW	53	NEW
4	1	14	1	24	1	34	1	44	NEW	54	NEW
5	1	15	1	25	1	35	1	45	NEW	55	NEW
6	1	16	1	26	1	36	1	46	NEW	56	NEW
7	1	17	1	27	1	37	1	47	NEW	57	NEW
8	1	18	1	28	1	38	1	48	NEW	58	NEW
9	1	19	1	29	1	39	1	49	NEW	59	NEW
10	1	20	1	30	1	40	NEW	50	NEW		

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CUSTODIAN:

MANUFACTURING COMMITTEE

PROCUREMENT
SPECIFICATION

TITLE

UNIFORM CUTTING TESTS - NAS SERIES
METAL CUTTING EQUIPMENT SPECIFICATIONS

CLASSIFICATION
SPECIFICATION

NAS 979

SHEET 1 OF 59

AIA AND ITS COMMITTEES WILL NOT INVESTIGATE THE APPLICABILITY OF PATENTS TO THE SUBJECT MATTER OF NAS STANDARDS AND IN RESPECT THEREOF DO NOT ASSUME ANY LIABILITY TO PATENT OWNERS OR TO PROSPECTIVE USERS.

THIS DRAWING SUPERSEDES ALL ANTECEDENT STANDARD DRAWINGS FOR THE SAME PRODUCT AND SHALL BECOME EFFECTIVE NO LATER THAN SIX MONTHS FROM THE LAST DATE OF APPROVAL SHOWN HEREON.

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1.3 INTENDED USE:

THE CUTTING TESTS DESCRIBED BY THIS SPECIFICATION ARE INTENDED FOR USE IN EVALUATING MACHINES PROCURED FOR THE AEROSPACE MANUFACTURING INDUSTRY. AT TIME OF BID REQUEST, THE CUSTOMER SHALL SELECT AND SPECIFY APPLICABLE TESTS, OPTIONS, AND DEVIATIONS.

2.0 APPLICABLE SPECIFICATIONS

THE DETAILED REQUIREMENTS SELECTED FROM THIS SPECIFICATION SHALL BE AS DEFINED IN TABLE II OF NAS SPECIFICATIONS APPLICABLE TO THE MACHINES REFERRED TO IN SECTION 1.2.

3.0 REQUIREMENTS

- 3.1 THE MANUFACTURER SHALL BE CONTRACTUALLY OBLIGATED TO PERFORM AND EVALUATE THE CUTTING TESTS SPECIFIED BY THE CUSTOMER PER DETAILS AND DESCRIPTIVE DRAWINGS. THESE TESTS SHALL BE USED TO EVALUATE THE FUNCTIONAL ACCURACY AND DYNAMIC RESPONSE OF THE MACHINE UNDER ACTUAL CUTTING CONDITIONS TO THE REQUIRED DIMENSIONS AND TOLERANCES AS SPECIFIED ON THE TEST SHEETS.
- 3.2 ALL INSPECTION SHEETS, LISTING THE TEST RESULTS, CERTIFIED BY AUTHORIZED PERSONNEL, SHALL BE PRESENTED TO THE CUSTOMER TO DETERMINE THE ACCEPTANCE OF THE MACHINE FOR SHIPMENT.
- 3.2.1 DATA ON THE INSPECTION SHEET SHALL BE WRITTEN IN THE SAME FORM AS PRESENTED IN THE TEST DETAIL SECTION 4.3.

4.0 INSPECTION AND ACCEPTANCE4.1 CLASSIFICATION OF TESTS:

EACH MACHINE SHALL BE SUBJECTED TO THE CUTTING TESTS SELECTED BY THE CUSTOMER IN ORDER TO ESTABLISH COMPLIANCE WITH THIS SPECIFICATION. DEVIATIONS MUST HAVE CUSTOMER APPROVAL PRIOR TO ACCEPTANCE TESTING.

4.2 TEST CONDITIONS:

EACH MACHINE SHALL BE TESTED UNDER THE FOLLOWING CONDITIONS UNLESS APPROVED DEVIATION IS OBTAINED FROM THE CUSTOMER.

- 4.2.1 AT MANUFACTURER'S PLANT BY MANUFACTURER WITH VERIFIED AND CERTIFIED TEST RESULTS FURNISHED TO CUSTOMER.
- 4.2.2 AT MANUFACTURER'S PLANT, ACCOMPLISHED BY THE MANUFACTURER AND WITNESSED BY THE CUSTOMER.
- 4.2.3 AT CUSTOMER'S PLANT, OR DESIGNATED POINT OF INSTALLATION, AS SPECIFIED BY THE CUSTOMER.
- 4.2.4 MEASURING EQUIPMENT, HAVING EVIDENCE OF CALIBRATION TRACEABLE TO THE NATIONAL BUREAU OF STANDARDS, WHICH IS ACCEPTABLE TO THE CUSTOMER SUCH AS OPTICAL, ELECTRONIC OR AIR GAUGING MUST BE USED TO VALIDATE RESULTS. MANUFACTURER TO FURNISH CHECKOUT EQUIPMENT FOR TESTS CONDUCTED AT THE MANUFACTURER'S PLANT. CUSTOMER TO FURNISH CHECKOUT EQUIPMENT FOR TESTS CONDUCTED AT THE CUSTOMER'S PLANT.

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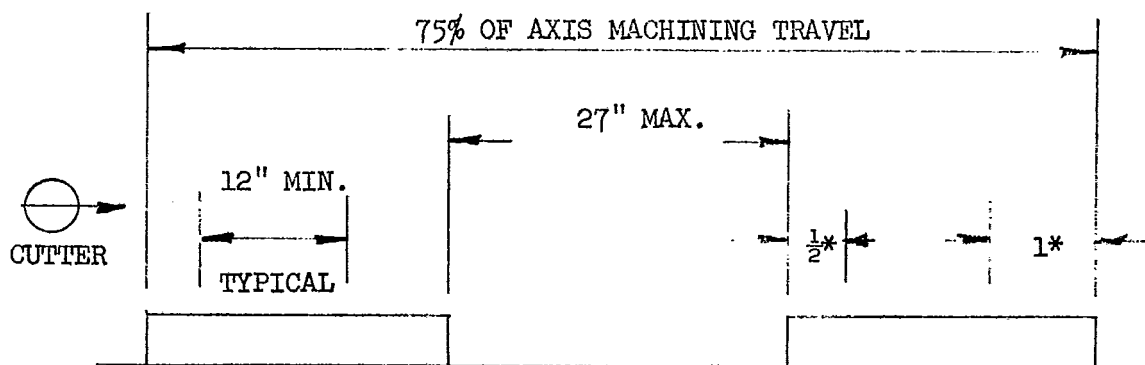
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- 4.2.4.1 VERIFICATION OF FEED RATE SHALL BE ACCOMPLISHED BY DISTANCE VS TIME MEASUREMENT.
- 4.2.4.2 VERIFICATION OF SPINDLE SPEEDS SHALL BE ACCOMPLISHED BY THE USE OF A TACHOMETER APPLIED TO THE SPINDLE.
- 4.2.4.3 VERIFICATION OF INPUT OF APPLIED HORSEPOWER SHALL BE DETERMINED WITH AN INDICATING WATTMETER CONNECTED TO THE SPINDLE MOTOR, OR BY OTHER MUTUALLY ACCEPTABLE MEANS.
- 4.2.5 FACE MILL CUTTERS, DETAILED IN TABLE 1, SHEET 7, SHALL BE AS SPECIFIED IN THE PERFORMANCE OF HIGH TORQUE, MAXIMUM HORSEPOWER, AND MAXIMUM FEED RATE CUTTING TESTS UNLESS APPROVED DEVIATION IS OBTAINED FROM THE CUSTOMER.
- 4.2.6 ONCE STARTED, HIGH TORQUE, MAXIMUM HORSEPOWER, OR MAXIMUM FEED RATE CUTTING TESTS SHALL CONTINUE TO COMPLETION OR TEST MUST BE RESTARTED. THE CUTTER TEETH MAY BE CHANGED AFTER EACH BLOCK CUT IF TEST MATERIAL IS SEPARATED IN ACCORDANCE WITH SECTION 4.3.2.4.
- 4.2.7 AT CUSTOMER'S OPTION, SPINDLE QUILL AND/OR DEPTH SLIDE, SHALL BE EXTENDED AT LEAST 50% OF TRAVEL DURING SPECIFIED TESTS.
- 4.2.8 MEASURING INSTRUMENT ANVILS, CONTACT POINTS, OR SPINDLES SHALL BE 3/16 MAXIMUM DIAMETER UNLESS OTHERWISE SPECIFIED.
- 4.3 TEST DETAILS:
 - 4.3.1 TEST MATERIALS, TEST TAPE PACKAGE, TEMPLATES, TOOLING AND CUTTERS SHALL BE FURNISHED BY MANUFACTURER FOR TESTS CONDUCTED AT THEIR PLANT.
 - 4.3.1.1 THE CUTTING TEST TAPE PACKAGE SHALL BECOME THE PROPERTY OF THE CUSTOMER AND SHALL INCLUDE:
 - 4.3.1.1.1 COMPUTER INPUT PART PROGRAM (MANUSCRIPT) WRITTEN IN LANGUAGE SPECIFIED BY CUSTOMER.
 - 4.3.1.1.2 PRINTOUT OF THE COMPUTER OUTPUT.
 - 4.3.1.1.3 PRINTOUT OF THE INFORMATION CONTAINED IN THE TEST TAPE.
 - 4.3.1.1.4 TEST TAPES PREPARED BY USE OF THE CUSTOMER'S SPECIFIED POSTPROCESSOR, AND PUNCHED IN MYLAR AND/OR CODED ON MAGNETIC TAPE AS APPLICABLE TO THE MACHINE TOOL-CONTROLLER COMBINATION.
 - 4.3.1.2 HAND PROGRAMMING OF CORRECTIONS OR CHANGES INSERTED IN OR REMOVED FROM THE OUTPUT DATA OF THE COMPUTER AND THE DATA ON THE MACHINE CONTROL MEDIA IS NOT PERMISSIBLE WITHOUT CUSTOMER APPROVAL. THE TEST TAPE PACKAGE SHALL BECOME THE PROPERTY OF THE CUSTOMER.
 - 4.3.1.3 TESTS SHALL BE PROCESSED TO GIVE THE MACHINE COMMON USAGE OF HOLDING DEVICES AND CUTTING TOOLS THROUGHOUT THE VARIOUS TESTS. EXPENSIVE AND/OR ELABORATE FIXTURES SHALL BE AVOIDED.

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- 4.3.1.4 FACE MILLED SURFACES SHALL BE EXEMPT FROM EVALUATION IN AN AREA EQUAL TO ONE-HALF THE DIAMETER OF THE CUTTER AT THE START AND EQUAL TO THE CUTTER DIAMETER AT THE FINISH OF CUT.
- 4.3.1.5 ON MULTIPLE SPINDLE MACHINES, TESTS SHALL BE RUN ON ALL SPINDLES SIMULTANEOUSLY, OR AS SPECIFIED BY THE CUSTOMER.
- 4.3.1.6 MATERIAL REMOVED FOR FINISH CUTS SHALL BE NOT LESS THAN .010 WHERE ROUGH AND FINISH CUTS ARE ALLOWED.
- 4.3.1.7 EVALUATION OF PERFORMANCE TEST RESULTS FOR TEMPLATE TRACING MACHINES SHALL BE A COMPARISON BETWEEN FINISH CUT AND TEMPLATE AND SHALL BE WITHIN LIMITS SPECIFIED.
- 4.3.2 THE MANUFACTURER SHALL BE PERMITTED TO DEVIATE WITHOUT CUSTOMER APPROVAL FROM THE TEST PARAMETERS SPECIFIED IN SECTION 4.3.3 AS FOLLOWS:
- 4.3.2.1 HORSEPOWER (AVERAGE) + NO LIMIT
- 5%
- 4.3.2.2 SPINDLE SPEED + 10% OF SPECIFIED OR OF THE NEAREST AVAILABLE SPEED.
- 4.3.2.3 FEEDRATE + 5% OF SPECIFIED OR OF THE NEAREST AVAILABLE FEEDRATE.
- 4.3.2.4 TESTS REQUIRING EVALUATION OF 75% OF THE SPECIFIED AXIS MACHINING TRAVEL SHALL HAVE THE WORK PIECES CENTRALLY LOCATED ON THE WORKING SURFACE IN BOTH X AND Y AXIS. AT THE MANUFACTURER'S DISCRETION, TEST PIECES MAY BE ADJOINED OR SEPARATED WITHIN THE LIMITS SPECIFIED.



* CUTTER DIAMETER TYPICAL

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4.3.3 CUTTING TESTS:

CUTTING TESTS SHALL MEET THE FOLLOWING REQUIREMENTS AND, IN PARTICULAR, TEST THE FUNCTIONAL ACCURACY OF THE MACHINE UNDER ACTUAL OPERATING CONDITIONS. TESTS ARE TO BE MADE PER DESCRIPTIVE DRAWINGS UNDER SECTIONS NOTED AS SPECIFIED BY CUSTOMER. ALL DIMENSIONS AND TOLERANCES APPEARING IN THIS SPECIFICATION ARE IN INCHES UNLESS OTHERWISE STATED.

4.3.3.1 MAXIMUM TORQUE - LOW SPEED:

TEST DATA IN SECTION 4.3.3.1.1 WILL BE PERFORMED TO VERIFY THE DYNAMIC STIFFNESS OF THE MACHINE FOR RESISTANCE TO TOOL CHATTER VIBRATION AND ABILITY TO MAINTAIN TOLERANCE WHEN OPERATING AT HIGH TORQUE.

4.3.3.2 MAXIMUM RATED HORSEPOWER:

TESTS WILL BE PERFORMED TO VERIFY THE RIGIDITY OF THE MACHINE AND ITS ABILITY TO MAINTAIN SPECIFIED TOLERANCES WHEN OPERATING AT FULL RATED HORSEPOWER.

HIGH SPEED (MAXIMUM HORSEPOWER AND FEEDRATE): TESTS TO BE PERFORMED PER SECTION 4.3.3.2.1.

LOW SPEED: TESTS TO BE PERFORMED PER SECTION 4.3.3.2.2.

4.3.3.3 MAXIMUM FEED RATE - LOW SPEED:

TEST DATA IN SECTION 4.3.3.3.1 WILL BE PERFORMED TO VERIFY THE RIGIDITY OF THE MACHINE AND ITS ABILITY TO MAINTAIN TOLERANCES WHEN OPERATING AT SPECIFIED MAXIMUM FEED RATE.

4.3.3.4 OVERSHOOT AND UNDERCUT:

TEST DATA IN SECTION 4.3.3.4.1 AND 4.3.3.4.2 WILL BE PERFORMED TO VERIFY DYNAMIC SERVO RESPONSE OF THE MACHINE AND CONTROL.

4.3.3.5 COMPOSITE CUTTING TEST:

TEST DATA IN SECTION 4.3.3.5.1 WILL BE PERFORMED TO VERIFY ACCURACY OF MOTIONS FOR TWO AND THREE AXIS MACHINES UNDER CUTTING LOADS.

4.3.3.6 TRANSVERSE TILT CUTTING TEST:

TEST DATA IN SECTION 4.3.3.6.1 AND 4.3.3.6.2 WILL BE PERFORMED TO VERIFY ACCURACY OF TRANSVERSE TILT MOTION OF FOUR OR FIVE AXIS MACHINES UNDER CUTTING LOADS.

4.3.3.7 LONGITUDINAL TILT CUTTING TEST:

TEST DATA IN SECTION 4.3.3.7.1 WILL BE PERFORMED TO VERIFY ACCURACY OF LONGITUDINAL TILT MOTION OF FOUR OR FIVE AXIS MACHINES UNDER CUTTING LOADS.

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4.3.3.8 PROFILE - CONE FRUSTUM CUTTING TEST:

TEST DATA IN SECTION 4.3.3.8.1 WILL BE PERFORMED TO VERIFY ACCURACIES OF FIVE COMBINED AXES OF MOTION (THREE LINEAR AND TWO TILT) FOR FIVE AXIS MACHINES UNDER CUTTING LOADS.

4.3.3.9 BORING TEST:

TEST DATA IN SECTION 4.3.3.9.1 WILL BE PERFORMED TO VERIFY SPINDLE PRECISION AND ACCURACY UNDER CUTTING LOADS.

4.3.3.10 BORE AND COUNTERBORE TEST:

TEST DATA IN SECTION 4.3.3.10.1 WILL BE PERFORMED TO VERIFY 2 AXIS POSITIONING, DEPTH AND SPINDLE ACCURACIES UNDER CUTTING LOADS.

4.3.3.11 ACCURACY AND REPEATABILITY CUTTING TEST:

TEST DATA IN SECTIONS 4.3.3.11.1, 4.3.3.11.2, AND 4.3.3.11.3 WILL BE PERFORMED TO VERIFY THE MACHINE AND CONTROL SYSTEMS ABILITY TO HOLD DIMENSIONAL ACCURACY AND REPEAT UNDER CUTTING CONDITIONS.

4.3.3.12 FLATNESS AND MISMATCH CUTTING TEST:

TEST DATA IN SECTION 4.3.3.12.1 AND 4.3.3.12.2 WILL BE PERFORMED TO VERIFY THE RIGIDITY OF THE MACHINE AND CONTROL SYSTEM AND ITS ABILITY TO MAINTAIN TOLERANCE WHEN MAKING TWO SUCCESSIVE FINISH CUTS IN OPPOSITE DIRECTIONS.

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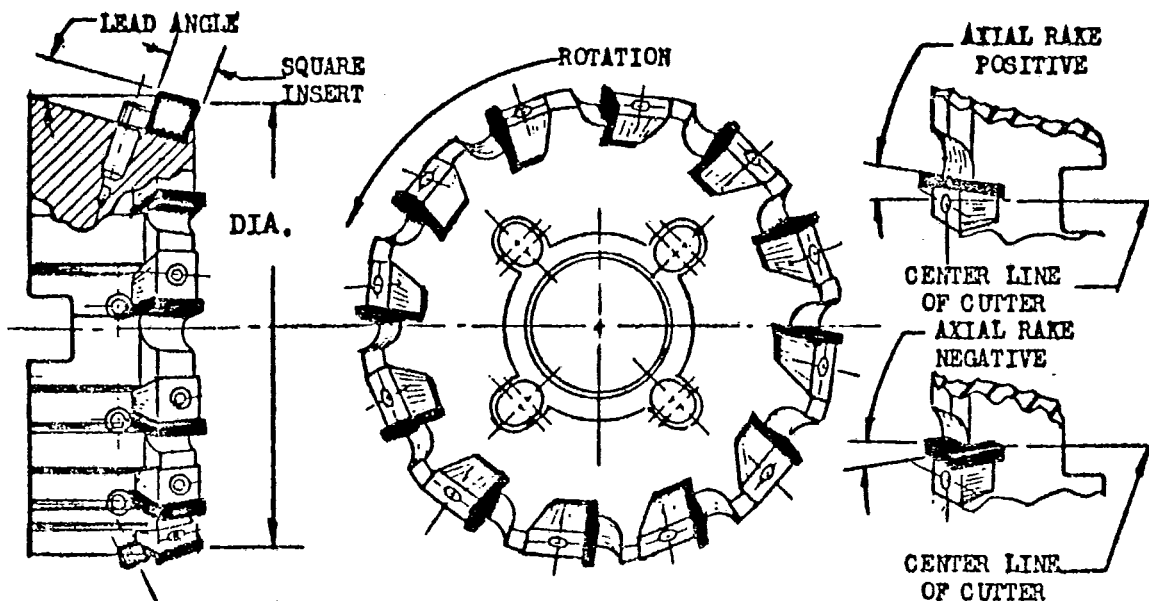
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TABLE 1

FACE MILLING CUTTER SPECIFICATIONS

CUTTER TYPES: TO BE USED AS SPECIFIED IN DETAILED CUTTING TESTS



CUTTER TYPE	LEAD ANGLE	CUTTER DIAMETER	NUMBER OF TEETH	INSERT SIZE SEE NOTE #1	CORNER RADIUS	RADIAL AND AXIAL RAKE	INSERT MAT'L SEE NOTE #2
I	15°	8"	4	1/2 MIN.	.062	5° POS.	C2
II	15°	10"	4	1/2 MIN.	.062	5° POS.	C2
III	15°	12"	4	1/2 MIN.	.062	5° POS.	C2
IV	15° 45°	8"	10	1/2 MIN.	.062	7° NEG.	C5-C6
V	15° 45°	10"	12	1/2 MIN.	.062	7° NEG.	C5-C6
VI	15° 45°	12"	14	1/2 MIN.	.062	7° NEG.	C5-C6
VII	15°	12"	8	1/2 MIN.	.062	5° POS.	C2
VIII	45°	8"	10	1/2 MIN.	WIPER	7° NEG.	C5-C6
IX	45°	4"	6	1/2 MIN.	WIPER	7° NEG.	C5-C6
X	15°	4"	6	1/2 MIN.	.062	5° POS.	C2
XI	15°	12"	2	3/4 MIN.	.062	5° POS.	C2

NOTES: 1. THE MINIMUM INSERT SIZE SHALL EXCEED THE DEPTH OF CUT PLUS .090.

2. RECOMMENDATION FOR GRADES OF CARBIDE FOR HEAVY ROUGHING CUTS.

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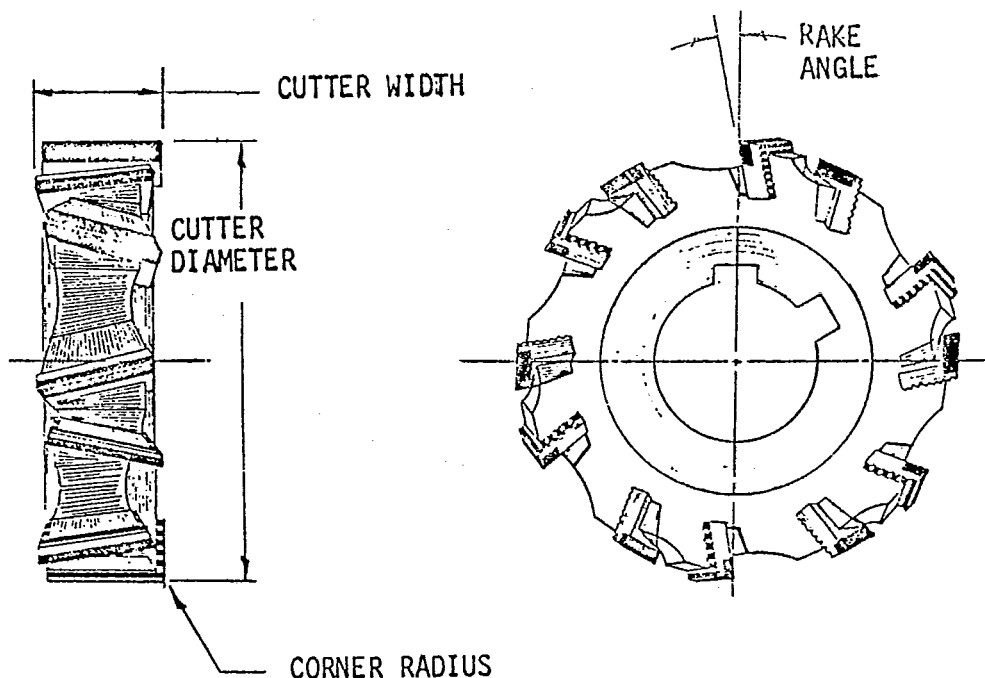
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TABLE 2

STAGGER TOOTH SIDE MILL CUTTER SPECIFICATIONS

CUTTER TYPES: TO BE USED AS SPECIFIED IN DETAILED CUTTING TESTS



CUTTER TYPE	CUTTER DIAMETER	CUTTER WIDTH	NUMBER OF TEETH	CORNER RADIUS	RADIAL AND AXIAL RAKE	CUTTER TEETH MATERIAL
I	8	2	10	.062	SEE NOTE #1	C2 SEE NOTE #3
II	12	2	16	.062	SEE NOTE #1	SEE NOTE #3
III	12	2	20	.062	SEE NOTE #2	C6

- NOTES:
1. POSITIVE RAKE PER MANUFACTURER'S STANDARD FOR CUTTING ALUMINUM.
 2. NEGATIVE RAKE PER MANUFACTURER'S STANDARD FOR CUTTING ALLOY STEEL.
 3. MILL CUTTERS FOR CUTTING ALUMINUM MAY BE BRAZED SOLID CARBIDE TIPPED OR INSERTED BLADE CARBIDE TIPPED (ILLUSTRATED).

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4.3.3.1.1

MAXIMUM TORQUE CUTTING TESTMACHINE TYPE: ALL LOW SPEED AND FULL RANGE MACHINES.TEST CRITERIA:

	REQUIREMENTS		ACTUALS
	TEST I .5 HP/RPM	TEST II .250 HP/RPM	
HORSEPOWER	RPM X TORQUE	RPM X TORQUE	
CUTTER TABLE I	TYPE VIII	TYPE VIII	
SPINDLE SPEED	40 RPM	40 RPM	
FEED RATE	20 IPM REF.	20 IPM REF.	
CHIP LOAD/TOOTH	.050 REF.	.050 REF.	
DEPTH OF CUT	.100 REF.	.050 REF.	
WIDTH OF CUT	FULL	FULL	
MATERIAL 4340	2½ x 8½ x 24	2½ x 8½ x 24	
300 TO 350 BRINELL	MIN. SIZE	MIN. SIZE	

EVALUATE: A STRAIGHT CUT OF LONGITUDINAL TRAVEL AT SPECIFIED TORQUE (HP/RPM).

	REQUIREMENTS	ACTUALS
TORQUE (HP/RPM)		
SURFACE CONDITION	CHATTER FREE, FEED MOTIONS SMOOTH AND EVEN	
FEED RATE	TO LOAD MACHINE	
FLATNESS PER/FT. TIR	LONG .005/FT. TIR TRANS. .005/.5 FT.	

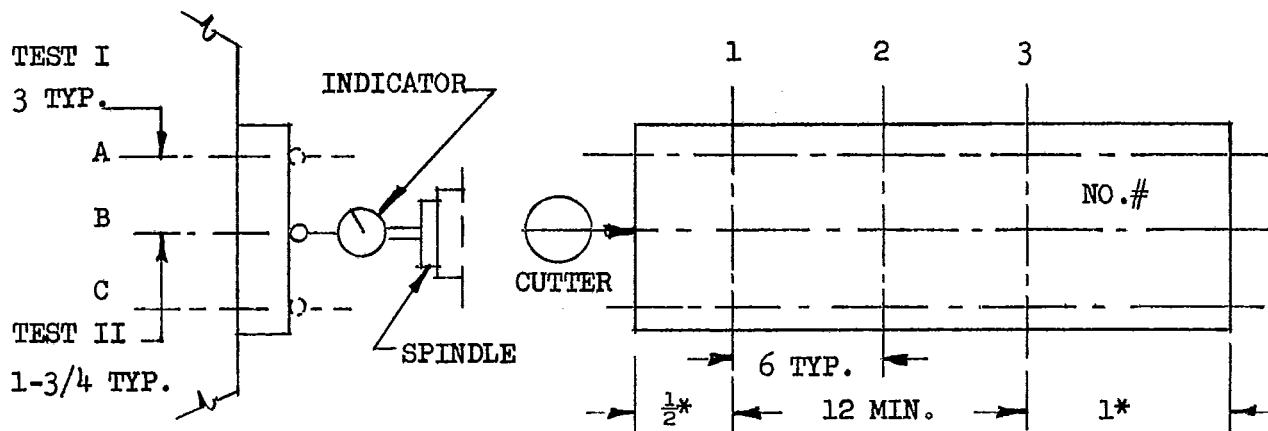
- NOTES: 1. DEPTH OF CUT MAY BE VARIED TO MEET OTHER SPECIFIED MAXIMUM TORQUE REQUIREMENTS.
2. NO CHANGES OR MACHINE ADJUSTMENTS SHALL BE MADE DURING TEST.
3. FLATNESS TO BE INSPECTED ON THE MACHINE PRIOR TO UNCLAMPING THE PART.
4. AT CUSTOMER'S OPTION, TEST MAY BE RUN AS SPECIFIED EXCEPT WITH MATERIAL AT 45° ANGLE.

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4.3.3.1.1 (CONTINUED)

RECORD: ACTUALS EVERY 6" LONGITUDINAL AND EACH 3" TRANSVERSELY.
IDENTIFY TEST PIECE BY NUMBER.



* CUTTER DIAMETER

	TEST PIECE #			MAX. VAR. PER FT. LONGT.
	1	2	3	
A				
B				
C				
MAX. VAR. TRANSV.				

CERTIFIED BY: MANUFACTURER _____

CUSTOMER _____

GOVERNMENT _____

APPROVED DATE _____

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4.3.3.2.1

MAXIMUM RATED HORSEPOWER AND FEED RATE CUTTING TESTMACHINE TYPE: ALL HIGH SPEED AND FULL RANGE MACHINES.TEST CRITERIA:

HORSEPOWER	10	15	20	10	15	20	30	25	30
DEPTH OF CUT	.167	.240	.320	AS REQ'D			.400	.208	.250
WIDTH OF CUT	10			4			10	5	
FEED RATE	25 IPM			75 TO 120 IPM			25 IPM	100 TO 120 IPM	
SPINDLE SPEED	1000 RPM			3600 RPM			1000 RPM	3600 RPM	
CUTTER	TABLE I TYPE III			TABLE I TYPE X			TABLE I TYPE III	TABLE I TYPE I	
CHIP LOAD/TOOTH	.0063			.0035/.0055			.0063	.0069	
MATERIAL	2 1/2 x 10			2 1/2 x 4			2 1/2 x 10	2 1/2 x 3	
7075-T6 ALUM.	30 MIN. SIZE			18 MIN. SIZE			30 MIN. SIZE	24 MIN. SIZE	

HORSEPOWER	40		40		50		50	
DEPTH OF CUT	.267		.053		.208		.666	
WIDTH OF CUT	2		10		8		12	
FEED RATE	300 IPM		300 IPM		120 IPM		25 IPM	
SPINDLE SPEED	3600 RPM		3600 RPM		3600 RPM		3600 RPM	
CUTTER	TABLE II TYPE I		TABLE I TYPE VII		TABLE I TYPE II		TABLE I TYPE XI	
CHIP LOAD/TOOTH	.0083		.0104		.0083		.0035	
MATERIAL	2 1/2 x 6		2 1/2 x 10		2 1/2 x 8		2 1/2 x 12	
7075-T6 ALUM.	20 MIN. SIZE		24 MIN. SIZE		27 MIN. SIZE		30 MIN. SIZE	

HORSEPOWER	60		100		100		200	
DEPTH OF CUT	.133		.333		.200		1.333	
WIDTH OF CUT	6		10		8		2	
FEED RATE	300 IPM		120 IPM		200 IPM		300 IPM	
SPINDLE SPEED	7200 RPM		3600 RPM		3600 RPM		3600 RPM	
CUTTER	TABLE I TYPE I		TABLE I TYPE III		TABLE I TYPE VII		TABLE II TYPE II	
CHIP LOAD/TOOTH	.0104		.0083		.0069		.0052	
MATERIAL	2 1/2 x 6		2 1/2 x 10		2 1/2 x 8		4 x 6	
7075-T6 ALUM.	24 MIN. SIZE		30 MIN. SIZE		30 MIN. SIZE		24 MIN. SIZE	

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SHEET 11

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APPROVAL DATE APRIL 1966 REVISION ① 15 Jan. 1969

4.3.3.2.1 (CONTINUED)

EVALUATE:

A STRAIGHT CUT 75% OF LONGITUDINAL AND TRANSVERSE TRAVEL AT FULL RATED HORSEPOWER AND MAXIMUM FEED RATE. (ROUGHING CUT)

	REQUIREMENTS	LONGITUDINAL ACTUAL	TRANSVERSE ACTUAL
HORSEPOWER	RATED HP	HP	HP
FINISH	100 RHR	RHR	RHR
FEED RATE	(SEE NOTE 5)	IPM	IPM
FLATNESS PER/FT.	.002/FT. TIR	/FT. TIR	/FT. TIR
FLATNESS OVER 75% AXIS MACHINING TRAVEL	.002 PLUS .0002 x LENGTH OF TRAVEL IN FT. NOT TO EXCEED .005 TIR	TIR	TIR

NOTES:

1. DEPTH OF CUT SHALL BE SET TO ATTAIN FULL HORSEPOWER.
2. CUTTER TEETH MAY BE CHANGED AFTER EACH BLOCK CUT. NO OTHER CHANGES OR MACHINE ADJUSTMENTS SHALL BE MADE DURING THE CUTS.
3. FLATNESS TO BE INSPECTED ON THE MACHINE PRIOR TO UNCLAMPING THE PART.
4. AT CUSTOMER'S OPTION, LONGITUDINAL AND TRANSVERSE TEST MAY BE COMBINED BY LOCATING MATERIAL AT 45° TO LONGITUDINAL TRAVEL AND EVALUATE AS SPECIFIED FOR 75% TRAVEL OF ONE AXIS.
5. CUTTING TEST TO BE RUN USING MAXIMUM SPECIFIED FEED RATE.

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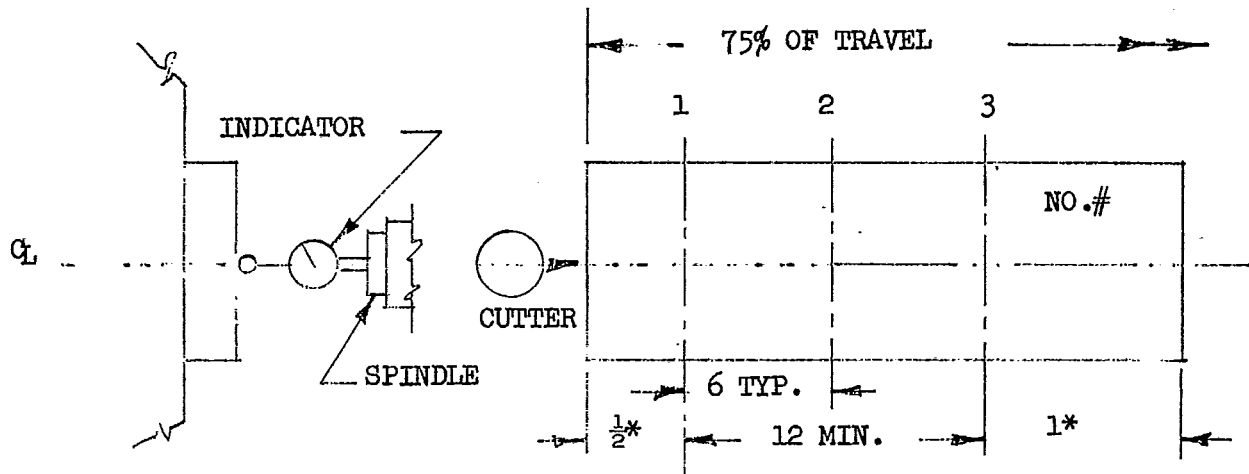
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4.3.3.2.1 (CONTINUED)

RECORD: ACTUALS EVERY 6" FOR LONGITUDINAL AND TRANSVERSE CUTS. IDENTIFY TEST PIECES BY NUMBER AND DIRECTION.



*CUTTER DIAMETER

	LONGITUDINAL TEST PIECE #			MAX. VAR. PER FT. LONGT.	LONGITUDINAL TEST PIECE #			MAX. VAR. PER FT. LONGT.
	1	2	3		1	2	3	
CL L.								
	LONGITUDINAL TEST PIECE #			MAX. VAR. PER FT. LONGT.	LONGITUDINAL TEST PIECE #			MAX. VAR. PER FT. LONGT.
	1	2	3		1	2	3	
CL L.								
	TRANSVERSE TEST PIECE #			MAX. VAR. PER FT. TRANSV.	TRANSVERSE TEST PIECE #			MAX. VAR. PER FT. TRANSV.
	1	2	3		1	2	3	
CL T.								
	TRANSVERSE TEST PIECE #			MAX. VAR. PER FT. TRANSV.	TRANSVERSE TEST PIECE #			MAX. VAR. PER FT. TRANSV.
	1	2	3		1	2	3	
CL T.								

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 SHEET 13

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4.3.3.2.2

MAXIMUM RATED HORSEPOWER CUTTING TESTSMACHINE TYPE: ALL LOW SPEED AND FULL RANGE MACHINES.TEST CRITERIA:

HORSEPOWER	10	15	20	25	30	40	10	15	20	40
DEPTH OF CUT	.109	.164	.218	.273	.327	.397	.188	.281	.375	.120
WIDTH OF CUT	10						4		2	
FEED RATE	5.5 IPM						8 IPM		10 IPM	
SPINDLE SPEED	80 RPM						250 RPM		80 RPM	
CUTTER	TABLE I TYPE VI						TABLE I TYPE IX		TABLE II TYPE III	
CHIP LOAD/TOOTH	.0049						.0053		.0063	
MATERIAL 4340	2 1/2 x 10 30 MIN. SIZE						2 1/2 x 4 18 MIN. SIZE		2 1/2 x 4 24 MIN. SIZE	
300 TO 350										
BRINELL										

EVALUATE: A STRAIGHT CUT 75% OF LONGITUDINAL AND TRANSVERSE TRAVEL AT FULL RATED HORSEPOWER. (ROUGHING CUT).

	REQUIREMENTS	LONGITUDINAL ACTUAL	TRANSVERSE ACTUAL
HORSEPOWER	RATED HP	HP	HP
FEED RATE	IPM	IPM	IPM
FINISH	150 RHR	RHR	RHR
FLATNESS PER FT.	.003/FT. TIR	/FT. TIR	/FT. TIR
FLATNESS OVER 75% AXIS MACHINING TRAVEL	.003 PLUS .0003 x LENGTH OF TRAVEL IN FT. NOT TO EXCEED .0075 TIR	TIR	TIR

NOTES:

1. DEPTH OF CUT SHALL BE SET TO ATTAIN FULL HORSEPOWER.
2. CUTTER TEETH MAY BE CHANGED AFTER EACH BLOCK CUT. NO OTHER CHANGES OR MACHINE ADJUSTMENTS SHALL BE MADE DURING THE CUTS.
3. FLATNESS TO BE INSPECTED ON THE MACHINE PRIOR TO UNCLAMPING THE PART.
4. AT CUSTOMER'S OPTION, LONGITUDINAL AND TRANSVERSE TEST MAY BE COMBINED BY LOCATING MATERIAL AT 45° TO LONGITUDINAL TRAVEL AND EVALUATE AS SPECIFIED FOR 75% TRAVEL OF ONE AXIS.
5. MAINTAINING A UNIFORM AVERAGE HORSEPOWER BY FEED RATE VARIATION IS PERMISSIBLE.

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SHEET 14

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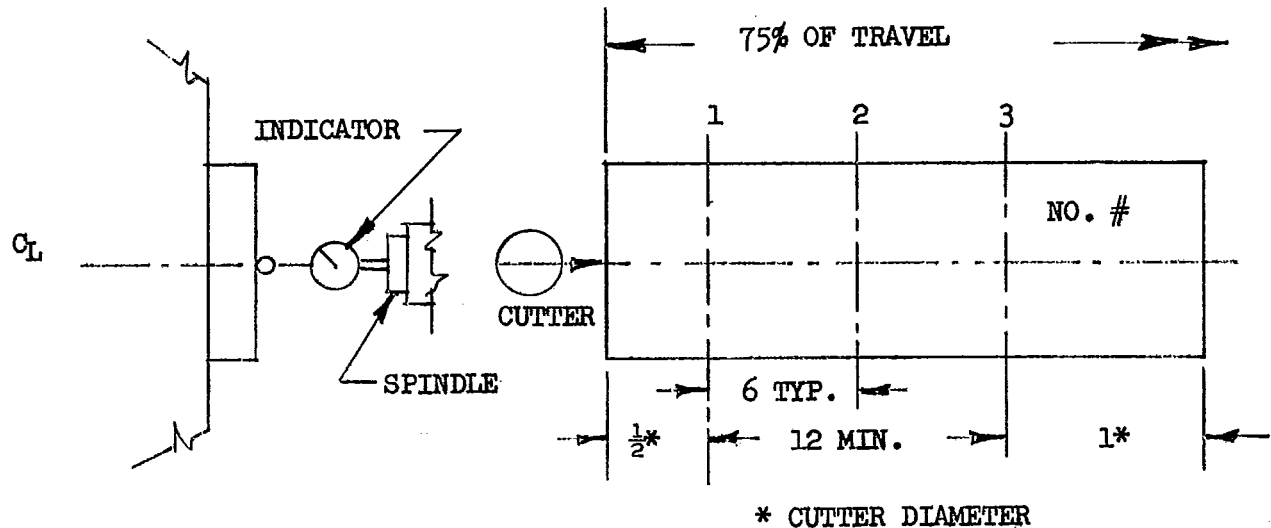
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4.3.3.2.2 (CONTINUED)

RECORD: 'ACTUALS EVERY 6" FOR LONGITUDINAL AND TRANSVERSE CUTS.
IDENTIFY TEST PIECES BY NUMBER AND DIRECTION.



CL L.	LONGITUDINAL TEST PIECE #			MAX. VAR. PER FT. LONGT.	LONGITUDINAL TEST PIECE #			MAX. VAR. PER FT. LONGT.
	1	2	3		1	2	3	

CL L.	LONGITUDINAL TEST PIECE #			MAX. VAR. PER FT. LONGT.	LONGITUDINAL TEST PIECE #			MAX. VAR. PER FT. LONGT.
	1	2	3		1	2	3	

CL T.	TRANSVERSE TEST PIECE #			MAX. VAR. PER FT. TRANSV.	TRANSVERSE TEST PIECE #			MAX. VAR. PER FT. TRANSV.
	1	2	3		1	2	3	

CL T.	TRANSVERSE TEST PIECE #			MAX. VAR. PER FT. TRANSV.	TRANSVERSE TEST PIECE #			MAX. VAR. PER FT. TRANSV.
	1	2	3		1	2	3	

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SHEET 15

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4.3.3.3.1

MAXIMUM FEED RATE CUTTING TESTMACHINE TYPE: ALL LOW SPEED MACHINES.TEST CRITERIA:

HORSEPOWER	10	15	20	30	10	15	20	20	30
DEPTH OF CUT	.145	.218	.290	.436	.088	.133	.178	.111	.167
WIDTH OF CUT	11				6			6	
FEED RATE	25 IPM				75 IPM			120 IPM	
SPINDLE SPEED	1200 RPM				2400 RPM			1800 RPM	
CUTTER	TABLE I TYPE III				TABLE I TYPE I			TABLE I TYPE VII	
CHIP LOAD/TOOTH	.0052				.0078			.0083	
MATERIAL	2 1/2 x 11				2 1/2 x 6			2 1/2 x 6	
7075-T6 ALUM.	30 MIN. SIZE				24 MIN. SIZE			30 MIN. SIZE	

HORSEPOWER	25	30	30	40	40	40
DEPTH OF CUT	.100	.120	.040	.053	.267	.080
WIDTH OF CUT	10		10		2	10
FEED RATE	100 IPM		300 IPM		300 IPM	200 IPM
SPINDLE SPEED	1800 RPM		1800 RPM		1800 RPM	2400 RPM
CUTTER	TABLE I TYPE VII		TABLE I TYPE VII		TABLE II TYPE II	TABLE I TYPE VII
CHIP LOAD/TOOTH	.0069		.0208		.0109	.0104
MATERIAL	2 1/2 x 10		2 1/2 x 10		2 1/2 x 4	2 1/2 x 10
7075-T6 ALUM.	30 MIN. SIZE		30 MIN. SIZE		30 MIN. SIZE	30 MIN. SIZE

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4.3.3.3.1 (CONTINUED)

EVALUATE: A STRAIGHT CUT 75% OF LONGITUDINAL AND TRANSVERSE TRAVEL AT MAXIMUM FEED RATE. (ROUGHING CUT)

	*REQUIREMENTS	LONGITUDINAL ACTUAL	TRANSVERSE ACTUAL
MAX. FEED RATE	IPM	IPM	IPM
50% RATED HORSEPOWER	HP MIN.	HP	HP
FINISH	100 RHR	RHR	RHR
FLATNESS PER FT.	.002/FT. TIR	/FT. TIR	/FT. TIR
FLATNESS OVER 75% AXIS MACHINING TRAVEL	.002 PLUS .0002 x LENGTH OF TRAVEL IN FT. NOT TO EXCEED .005 TIR	TIR	TIR

* FEED RATE AND HORSEPOWER REQUIREMENTS ARE TO BE OBTAINED AND NOTED FROM TEST CRITERIA CHARTS

NOTES:

1. DEPTH OF CUT SHALL BE SET TO ATTAIN A MINIMUM OF 50% FULL RATED HORSEPOWER.
2. CUTTER TEETH MAY BE CHANGED AFTER EACH BLOCK CUT. NO OTHER CHANGES OR MACHINE ADJUSTMENTS SHALL BE MADE DURING THE CUTS.
3. FLATNESS TO BE INSPECTED ON THE MACHINE PRIOR TO UNCLAMPING THE PART.
4. AT CUSTOMER'S OPTION, LONGITUDINAL AND TRANSVERSE TEST MAY BE COMBINED BY LOCATING MATERIAL AT 45° TO LONGITUDINAL TRAVEL AND EVALUATE AS SPECIFIED FOR 75% TRAVEL OF ONE AXIS.

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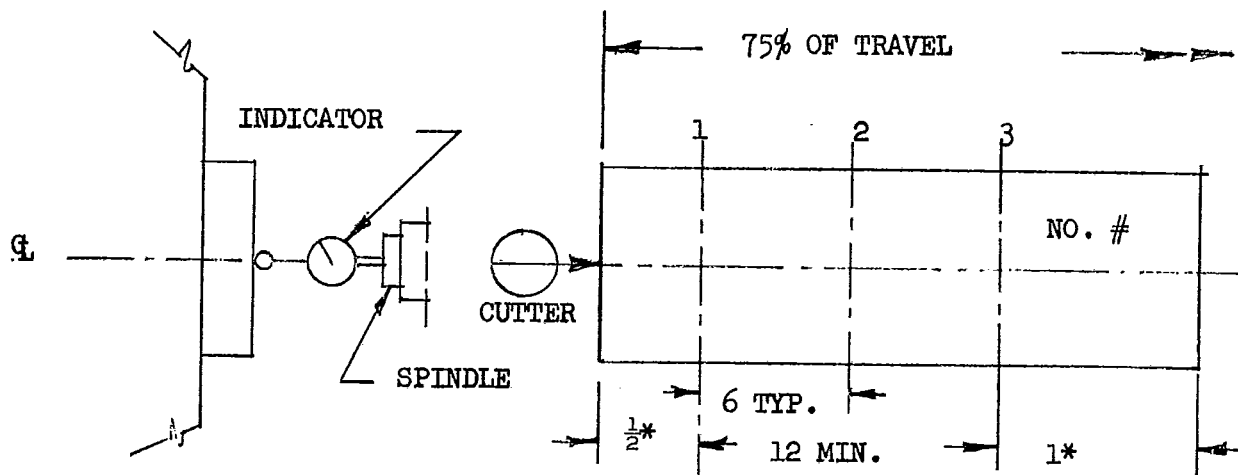
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4.3.3.3.1 (CONTINUED)

RECORD: ACTUALS EVERY 6" FOR LONGITUDINAL AND TRANSVERSE CUTS.
IDENTIFY TEST PIECES BY NUMBER AND DIRECTION.



CL L.	LONGITUDINAL TEST PIECE #			MAX. VAR. PER FT. LONGT.	LONGITUDINAL TEST PIECE #			MAX. VAR. PER FT. LONGT.
	1	2	3		1	2	3	

CL L.	LONGITUDINAL TEST PIECE #			MAX. VAR. PER FT. LONGT.	LONGITUDINAL TEST PIECE #			MAX. VAR. PER FT. LONGT.
	1	2	3		1	2	3	

CL T.	TRANSVERSE TEST PIECE #			MAX. VAR. PER FT. TRANSV.	TRANSVERSE TEST PIECE #			MAX. VAR. PER FT. TRANSV.
	1	2	3		1	2	3	

CL T.	TRANSVERSE TEST PIECE #			MAX. VAR. PER FT. TRANSV.	TRANSVERSE TEST PIECE #			MAX. VAR. PER FT. TRANSV.
	1	2	3		1	2	3	

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SHEET 18

4.3.3.4.1 OVERSHOOT AND UNDERCUT TEST

MACHINE TYPE: ALL PROFILING AND CONTOURING MACHINES.

TEST CRITERIA:

MATERIAL: 7075-T6 ALUMINUM - 12 x 12 x 1.

CUTTER: 1 INCH DIA. - 2 FLUTE HSS END MILL - RIGHT HAND CUT -
 RIGHT HAND HIGH HELIX - 1 5/8 MAX. LENGTH OF CUTTER TO
 MINIMIZE CUTTER DEFLECTION

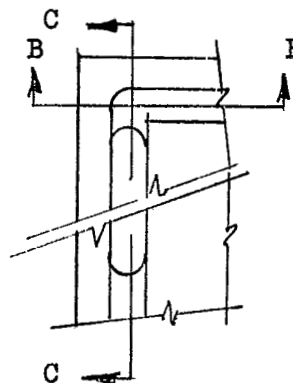
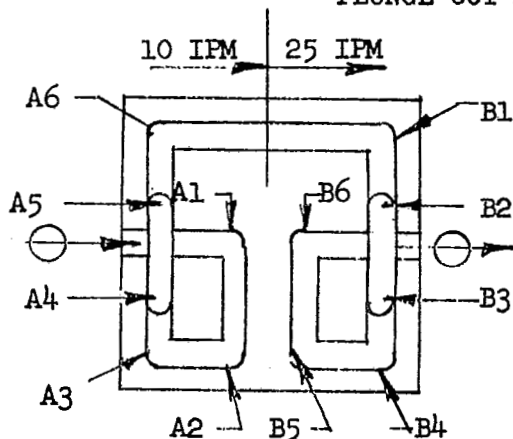
SPINDLE SPEED: MAXIMUM RPM OF MACHINE

FEED RATE: TEST "A" TEST "B"
 10 IPM 25 IPM

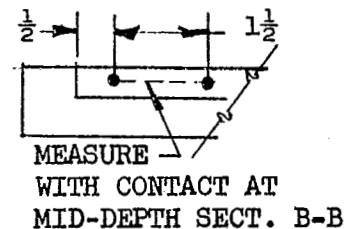
SPECIFIED FEED RATE TO BE CONSTANT WITHOUT PROGRAMMED
 SLOWDOWN. TEST SHALL BE CONDUCTED WITH THE SAME MACHINE
 CONTROL UNIT SETTINGS AS THOSE OF THE MAXIMUM HORSEPOWER
 TEST.

DEPTH OF CUT: .300 X AND Y .300 PLUNGE

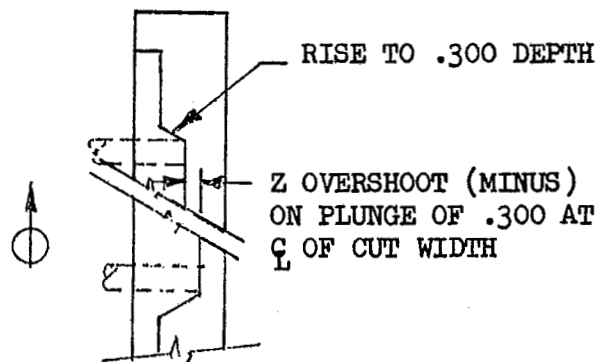
EVALUATE: OVERSHOOT OR UNDERCUT ERROR AT EACH 90° CORNER AND EACH
 PLUNGE CUT AS NOTED.



OVERSHOOT OR UNDERCUT
 90° CORNER (TYP.) X-Y AXES

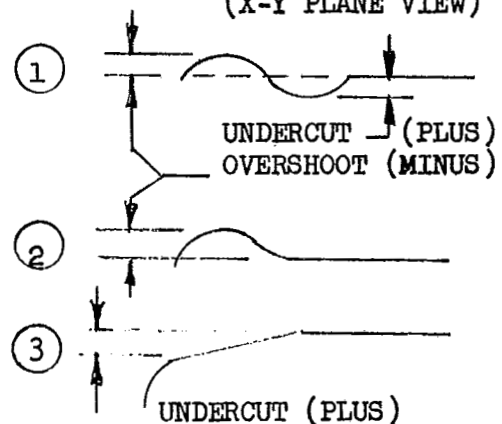


OVERSHOOT Z AXIS



SECT. C-C

EXAMPLES
 (X-Y PLANE VIEW)



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SHEET 19

4.3.3.4.1 OVERTHOOT AND UNDERCUT TEST (CONTINUED)

INSPECTION CRITERIA:

USE SHARP POINTED CONTACT POINT.

THE DIMENSION TO BE RECORDED IS THE MAXIMUM DEPARTURE FROM THE CUT SURFACE BEYOND THE THEORETICAL SURFACE FOR OVERTHOOT, AND THE MAXIMUM DEPARTURE INSIDE THE THEORETICAL SURFACE FOR UNDERCUT.

RECORD:

X-Y AXIS OVERTHOOT OR UNDERCUT			
TEST "A"		TEST "B"	
TOLERANCE	ACTUAL	TOLERANCE	ACTUAL
0.0015 MAX.	A1	0.002 MAX.	B1
	A2		B4
	A3		B5
	A6		B6

"Z" AXIS OVERTHOOT			
TEST "A"		TEST "B"	
TOLERANCE	ACTUAL	TOLERANCE	ACTUAL
0.0015 MAX.	A4	0.002 MAX.	B2

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MANUFACTURER _____

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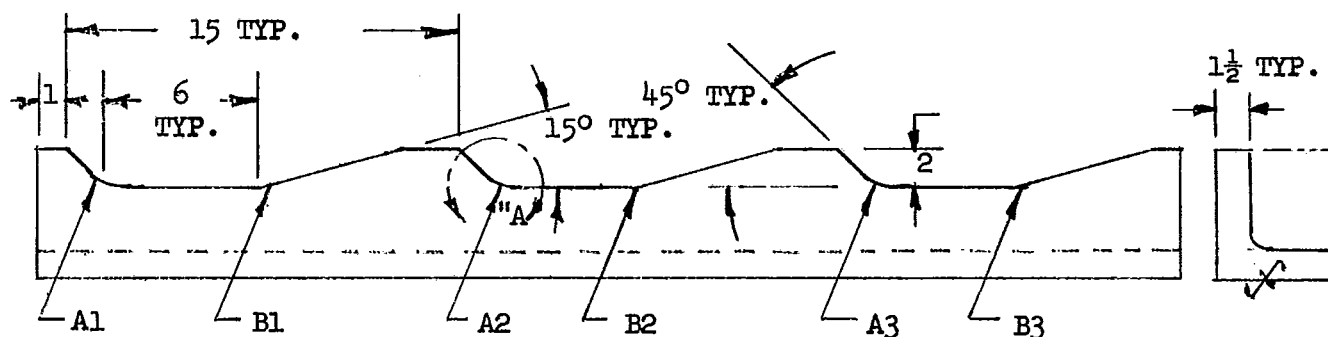
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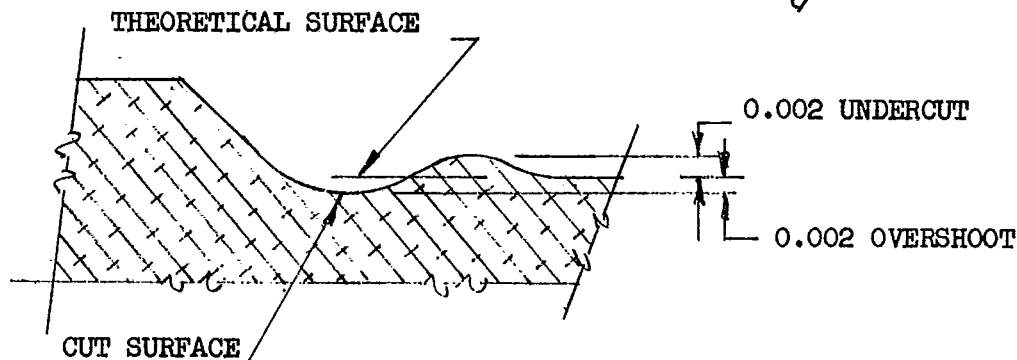
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4.3.3.4.2 OVERSHOOT AND UNDERCUT TESTMACHINE TYPE: HORIZONTAL SPINDLE PROFILE MACHINES.TEST CRITERIA:MATERIAL: 7075-T6 ALUMINUM 6 x 8 x 48 MIN.
(PREPARED PER DIAGRAM)CUTTER: 8 INCH DIA. - 4 FLUTE, 30° HELIX, CARBIDE BLADES.SPINDLE SPEED: 3600 RPM.FEED RATE: 25 IPMSPECIFIED FEED RATE TO BE CONSTANT WITHOUT PROGRAMMED SLOW DOWN.
TEST SHALL BE CONDUCTED WITH THE SAME MACHINE CONTROL SETTINGS
AS THOSE OF THE MAXIMUM HORSEPOWER TEST.DEPTH OF CUT: PER DIAGRAM.DIAGRAM:

R = 64 RHR



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4.3.3.4.2 OVERTHOOT AND UNDERCUT TEST. (CONTINUED)

EVALUATE: X AND Y AXIS OVERTHOOT AND UNDERCUT, AND SURFACE FINISH TIR.INSPECTION CRITERIA:

USE SHARP POINTED CONTACT POINT FOR OVERTHOOT AND UNDERCUT.

THE DIMENSION TO BE RECORDED IS THE MAXIMUM DEPARTURE FROM THE CUT SURFACE BEYOND THE THEORETICAL SURFACE FOR OVERTHOOT, AND THE MAXIMUM DEPARTURE INSIDE THE THEORETICAL SURFACE FOR UNDERCUT.

RECORD:

X-Y AXIS OVERTHOOT OR UNDERCUT			
TOLERANCE	ACTUAL	TOLERANCE	ACTUAL
+ 0.002 MAX.	A1	+ 0.002 MAX.	B1
	A2		B2
	A3		B3

SURFACE FINISH	
REQUIRED	ACTUAL
64 RHR TIR	TIR

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SHEET 22

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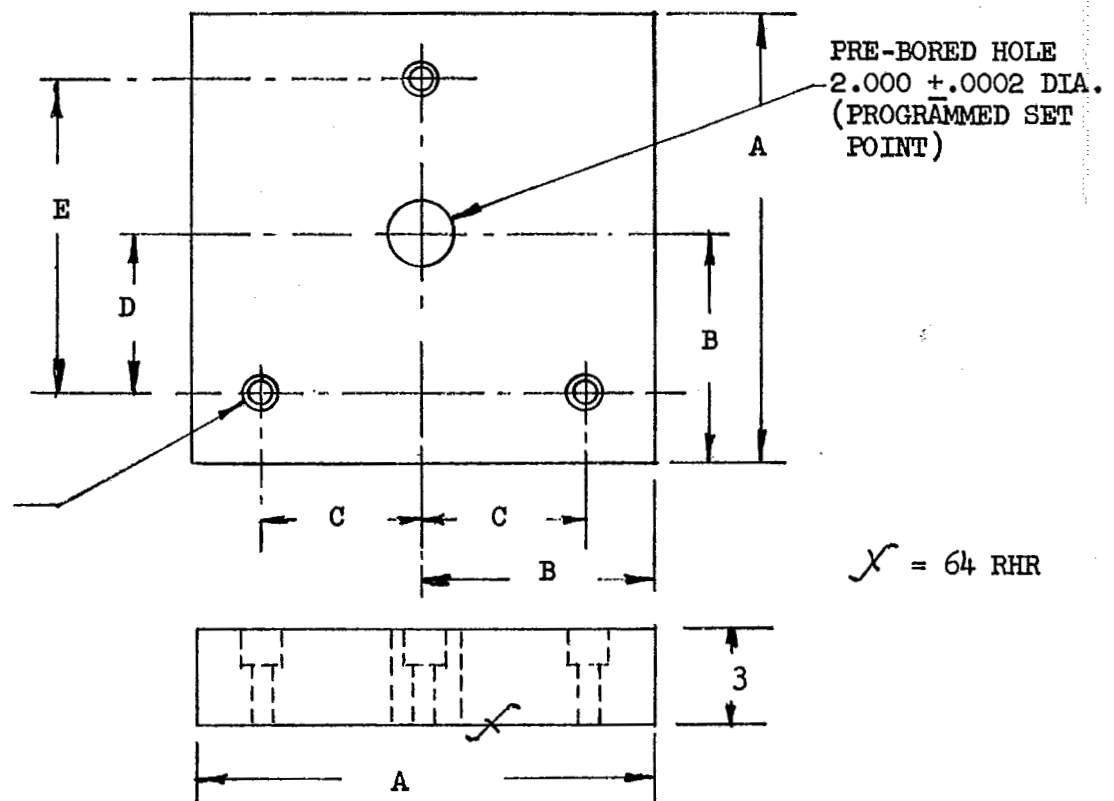
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4.3.3.5.1

COMPOSITE CUTTING TESTMACHINE TYPE: ALL PROFILING AND CONTOURING MACHINES.TEST CRITERIA:MATERIAL: 7075-T6 ALUMINUMCUTTER: 2.000 INCH DIAMETER, 2 FLUTE END MILL, HSS, RIGHT HAND CUT, HIGH HELIX, 6 INCH MAXIMUM LENGTH TO MINIMIZE CUTTER DEFLECTION.WIDTH AND DEPTH OF CUT: AS REQUIRED PER DIAGRAM - ROUGH AND FINISH CUTS ALLOWED.WORK LOCATION: WORK PIECE TO BE CENTRALLY LOCATED ON THE TABLE WITH SIDES PARALLEL WITH MACHINE AXIS. PRE-BORED 2 INCH DIAMETER HOLE SHALL BE USED AS THE PROGRAMMED SET POINT.BLANK PREPARATION:

DIM.	A	B	C	D	E
TYPE I	14	7	4 3/4	5	10.000 ± .010
TYPE II	8	4	USE MILL VISE FOR MAT. HOLD DOWN		

DRILL 11/16
C BORE 15/16
DEPTH 1 3/4
TYP: 3 PLCS.



NOTE: SURFACE AREA $\frac{1}{4}$ INCH FROM CORNERS SHALL BE EXEMPT FROM EVALUATION. COMPLETELY REVISED ①

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SHEET 23

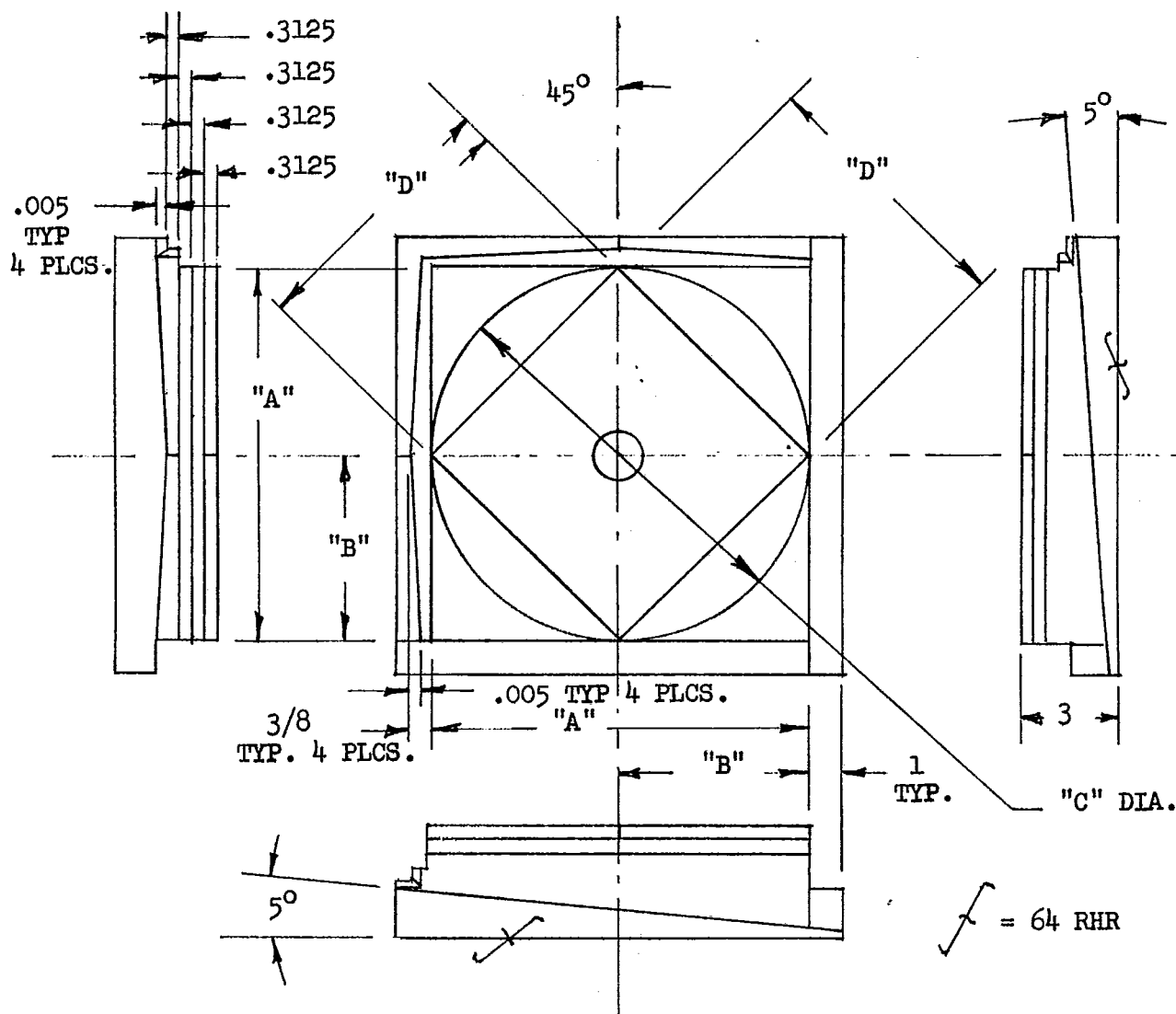
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4.3.3.5.1 (CONTINUED)

DIAGRAM:

NOTE: SURFACE AREA $\frac{1}{4}$ INCH FROM CORNERS SHALL BE EXEMPT FROM EVALUATION.

DIM.	"A"	"B"	"C"	"D"
TYPE I	12.0000	6.0000	12.0000	8.4853
TYPE II	6.0000	3.0000	6.0000	4.2426

VISUALLY INSPECT THE X, Y, AND Z AXES .005 RAMP AND TAPER CUTS FOR UNIFORMITY OF SERVO RESPONSE AND SLIDE STICTION.

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SHEET 24

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4.3.3.5.1 (CONTINUED)

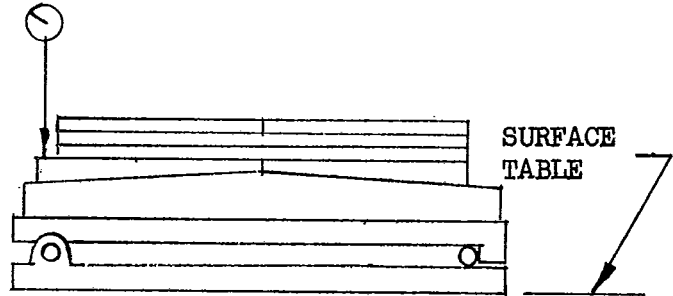
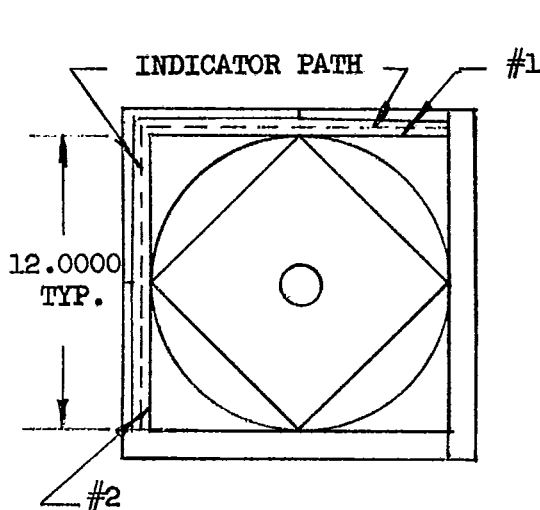
EVALUATE: THE CUTTING OF OUTSIDE SQUARE FOR DIMENSIONAL ACCURACY, FINISH, FLATNESS, SQUARENESS, AND PARALLELISM.

THE RAMP CUTTING OF 5° PLUNGE AND RISE FOR ANGULAR DEVIATION.

THE CIRCLE FOR DIMENSIONAL ACCURACY, ROUNDNESS, DIAMETER VARIATION, AND FINISH.

THE CENTER 45° CANTED SQUARE FOR DIMENSIONAL ACCURACY, SQUARENESS, PARALLELISM AND FINISH.

OUTSIDE SQUARE: DIMENSIONAL ACCURACY, FINISH, AND FLATNESS.



INSPECTION SETUP

WITH TEST PIECE LOCATED ON SINE PLATE AND WITH RISE RAMP CUT OPPOSITE TO HINGE END, INDICATE THE TWO FLAT SURFACES FOR FLATNESS AS SHOWN.

RECORD:

	REQUIRED	SURFACE #1 ACTUAL	SURFACE #2 ACTUAL
FEED RATE	25 IPM	IPM	IPM
SPINDLE SPEEDS	1800 RPM	RPM	RPM
FLATNESS	MAX. DEVIATION .002 TIR	TIR	TIR
FINISH	35 RHR MAX.	RHR	RHR
DIM. ACCURACY	12.0000 ±.0025 TYPE I		
	6.0000 ±.0025 TYPE II		

NOTE:

TWO AND THREE AXES STRAIGHT LINE MILLING MACHINES SHALL PERFORM THE 5° RAMP CUTS AND/OR THE "A" X "A" OUTSIDE SQUARE. EVALUATION FOR ANGULAR DEVIATION, DIMENSIONAL ACCURACY, FINISH, FLATNESS, SQUARENESS, AND PARALLELISM SHALL BE PERFORMED AS SPECIFIED IN THIS TEST.

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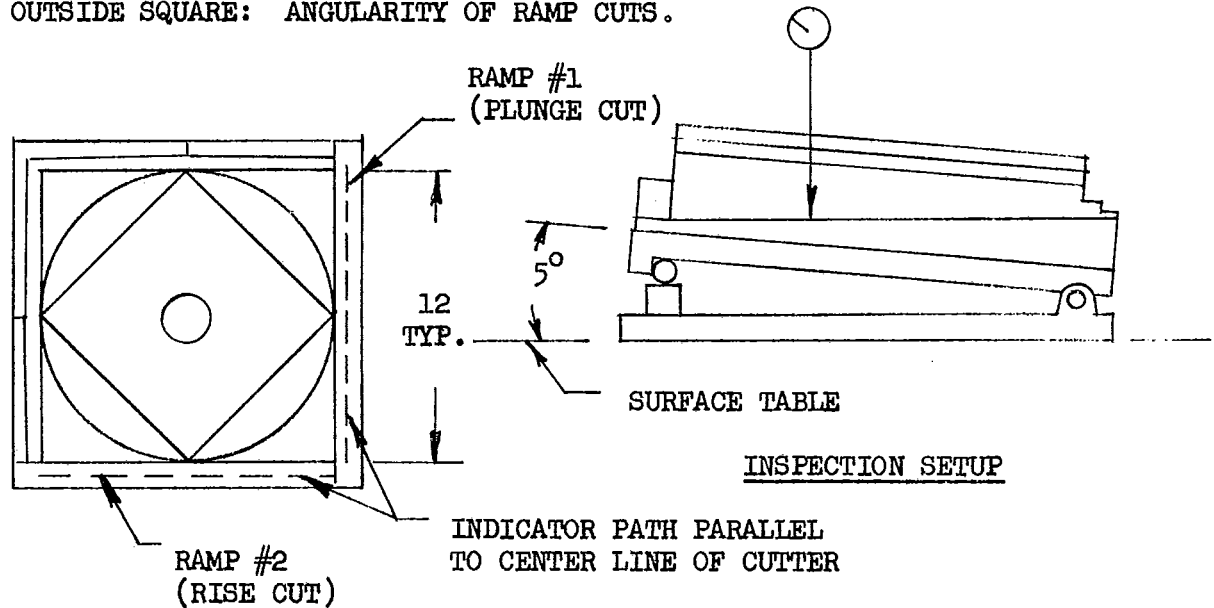
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4.3.3.5.1

EVALUATE: (CONTINUED)

OUTSIDE SQUARE: ANGULARITY OF RAMP CUTS.



RIG SINE PLATE TO 5°. LOCATE TEST PIECE AS SHOWN FOR ANGULARITY EVALUATION OF RAMP CUT #1. ROTATE TEST PIECE 90° FOR ANGULARITY EVALUATION OF RAMP CUT #2.

RECORD:

	REQUIRED	RAMP CUT #1 ACTUAL	RAMP CUT #2 ACTUAL
FEED RATE	25 IPM	IPM	IPM
SPINDLE SPEED	1800 RPM	RPM	RPM
ANGULARITY	.0025 TIR	TIR	TIR

NOTE:

CUTTING OF "5° PLUNGE AND RISE RAMPS" IS REQUIRED FOR MACHINES HAVING 3 OR MORE AXES OF CONTROLLED MOTION ONLY. RAMP CUTTING IS TO BE PERFORMED WITHOUT USE OF TILT MOTIONS.

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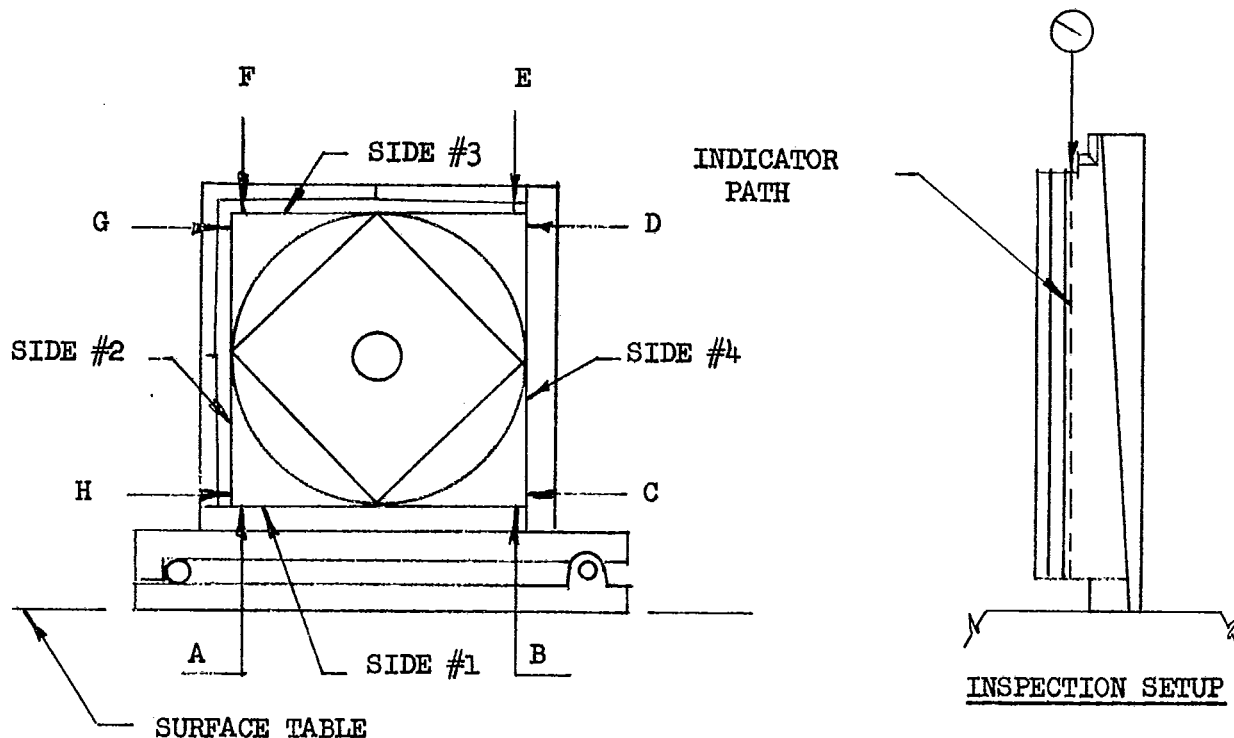
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4.3.3.5.1

EVALUATE: (CONTINUED)

OUTSIDE SQUARE: SQUARENESS AND PARALLELISM.



RIG SINE PLATE AND TEST PIECE SO THAT "A" AND "B", SIDE #1, INDICATE ZERO.

RECORD SQUARENESS OF SIDES #2 AND #4 TO SIDE #1 BY SETTING INDICATOR TO ZERO AT "H" AND INDICATE TIR TO "G", SIDE #2. REPEAT FOR TIR FROM "C" TO "D", SIDE #4.

RECORD PARALLELISM OF SIDE #3 TO #1 BY SETTING INDICATOR TO ZERO AT "E" AND INDICATE TIR TO "F", SIDE #3.

	REQUIRED	SIDE #2 ACTUAL	SIDE #3 ACTUAL	SIDE #4 ACTUAL
SQUARENESS MAX. DEVIATION	.002 TIR	TIR	XXXXXXX	TIR
PARALLELISM MAX. DEVIATION	.002 TIR	XXXXXXX	TIR	XXXXXXX

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SHEET 27

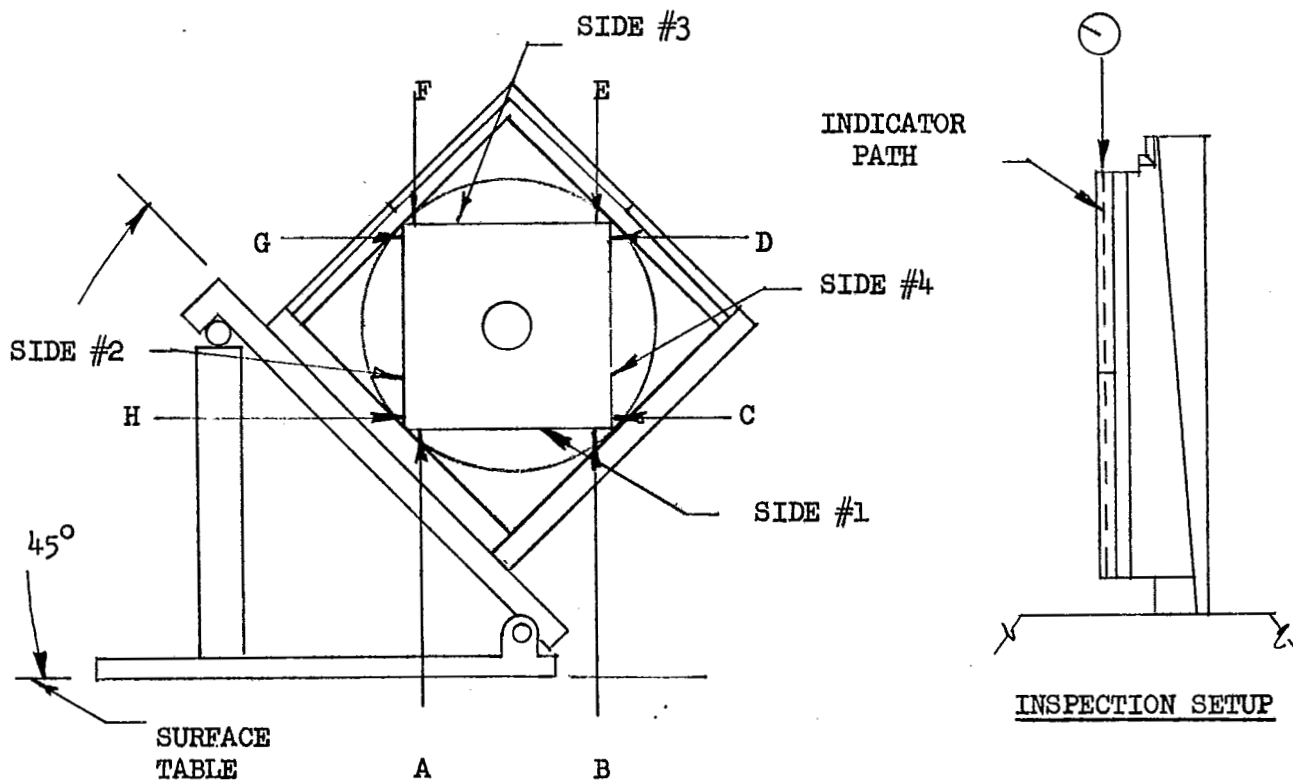
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4.3.3.5.1

EVALUATE: (CONTINUED)

CENTER CANTED SQUARE: DIMENSIONAL ACCURACY, SQUARENESS, PARALLELISM, AND FINISH.



RIG SINE PLATE AND TEST PIECE SO THAT "A" AND "B" SIDE #1 INDICATE ZERO.

RECORD SQUARENESS OF SIDES #2 AND #4 TO SIDE #1 BY SETTING INDICATOR TO ZERO AT "H" AND INDICATE TIR TO "G", SIDE #2. REPEAT FOR TIR FROM "C" TO "D", SIDE #4.

RECORD PARALLELISM OF SIDE #3 TO #1 BY SETTING INDICATOR TO ZERO AT "E" AND INDICATE TIR TO "F", SIDE #3.

RECORD FINISH READINGS FOR SIDES #1, #2, #3, AND #4.

	REQUIRED	SIDE #1 ACTUAL	SIDE #2 ACTUAL	SIDE #3 ACTUAL	SIDE #4 ACTUAL
FEED RATE	25 IPM	IPM	IPM	IPM	IPM
SPINDLE SPEED	1800 RPM	RPM	RPM	RPM	RPM
SQUARENESS MAX. DEV.	.0015 TIR	XXXXXXX	TIR	XXXXXXX	TIR
PARALLELISM MAX. DEV.	.0015 TIR	XXXXXXX	XXXXXXX	TIR	XXXXXXX
FINISH	35 RHR MAX.	RHR	RHR	RHR	RHR
DIMENSIONAL ACCURACY	8.4853 \pm .0025 TYPE I				
	4.2426 \pm .0025 TYPE II				

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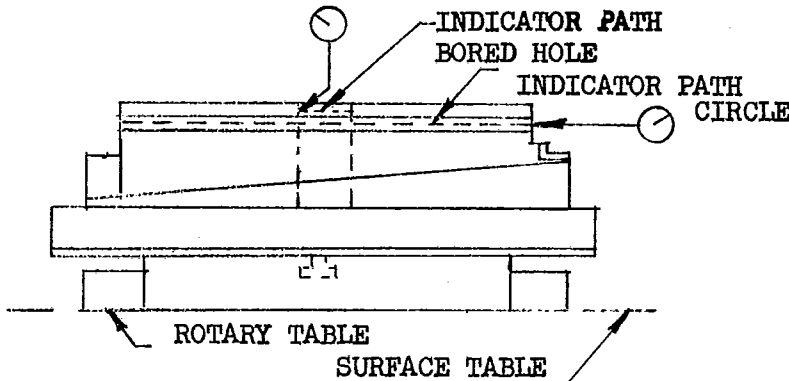
NAS 979

SHEET 28

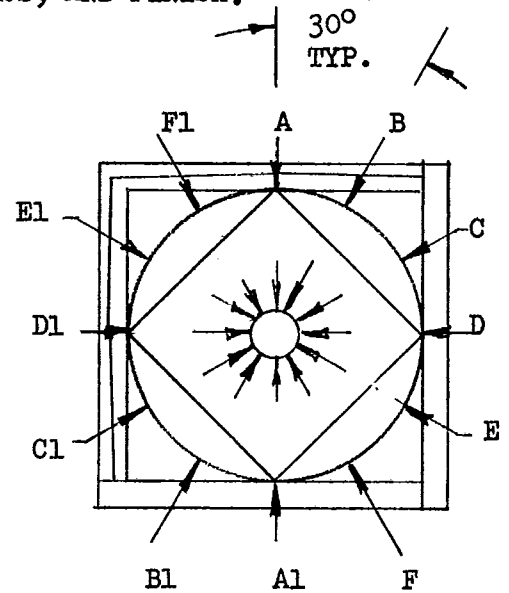
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4.3.3.5.1

EVALUATE: (CONTINUED)CIRCLE: DIAMETER ACCURACY (B_1/B), ROUNDNESS, AND FINISH.

ROUNDNESS AND FINISH SETUP



RADIAL DIFFERENCE SETUP

RIG THE TEST PIECE ON THE PRECISION ROTARY TABLE, AND CENTER THE MACHINED SURFACE OF THE CIRCLE RELATIVE TO THE AXIS OF THE ROTARY TABLE. SELECT FOUR (4) QUADRANTS FOR CENTERING ON THE BASIS OF THE MOST SIGNIFICANT OUT-OF-ROUNDNESS (AN ELLIPTICAL FIGURE WOULD BE CENTERED AT THE INTERSECTION OF THE MAJOR AND MINOR AXES) AND SO AS TO REDUCE RADIAL DIFFERENCES TO A MINIMUM FOR THE CIRCLE.

ROUNDNESS ERROR FOR THE MACHINED CIRCLE IS THE RADIAL DIFFERENCE BETWEEN THE MAXIMUM AND MINIMUM RADII AT ANY OF THE 30° POINTS OF THE CIRCLE, OR ON A ROUNDNESS MEASURING MACHINE, THE DIFFERENCE IN RADII OF TWO CONCENTRIC CIRCLES WHICH CONTAIN THE PROFILE OF THE SURFACE OF THE CIRCLE ON THE POLAR CHART IS THE ERROR IN ROUNDNESS.

CONCENTRICITY: WITH TEST PIECE CENTERED ON THE MACHINED CIRCLE AS ABOVE, READ RADIAL DIFFERENCES FOR EACH 30° POINT AROUND THE PRE-BORED HOLE AND CALCULATE CONCENTRICITY, OR ON A ROUNDNESS MEASURING MACHINE, CHART THE HOLE PROFILE ON THE SAME POLAR CHART WITH THE CIRCLE AND THE LARGEST RADIAL DIFFERENCE BETWEEN PROFILES LESS THE SMALLEST RADIAL DIFFERENCE BETWEEN PROFILES OF CIRCLE AND HOLE IS CONCENTRICITY.

DIA. ACCURACY B_1/B		
TYPE	REQUIRED	ACTUAL
I	12.0000 \pm .0025	
II	6.0000 \pm .0025	

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4.3.3.5.1 (CONTINUED)

RECORD:INDICATOR RADIAL READINGS, AT 30° POINTS,
FOR RADIAL DIFFERENCE VALUES (SEE NOTES 1 & 2)

	A	B	C	D	E	F	A1	B1	C1	D1	E1	F1
RADIAL DIFFERENCE -CIRCLE												
RADIAL DIFFERENCE -HOLE												
SUM OF RADIAL DIFFERENCES												

	REQUIRED	ACTUAL
FEED RATE	25 IPM	IPM
SPINDLE SPEED	1800 RPM	RPM
FINISH MAXIMUM	35 RHR	RHR
ROUNDNESS ERROR	.002 MAX.	

CONCENTRICITY CALCULATION

ENTER LARGEST "SUM OF RADIAL DIFFERENCES" VALUE

SUBTRACT SMALLEST "SUM OF RADIAL DIFFERENCES" VALUE

CONCENTRICITY	REQUIRED	.002	ACTUAL

NOTES:

1. SET DIAL INDICATOR READING TO ZERO AT LARGEST RADIUS OF THE CIRCLE AND RECORD ALL RADIAL DIFFERENCES AS POSITIVE VALUES.
2. SET DIAL INDICATOR READING TO ZERO AT SMALLEST RADIAL VALUE IN PRE-BORED HOLE AND RECORD ALL RADIAL DIFFERENCES AS POSITIVE VALUES.
3. RECORDED DIAL INDICATOR READINGS ARE TO BE THE AVERAGE OVER A PLUS OR MINUS 2° RADIAL AREA AT EACH 30° POINT.

CERTIFIED BY: MANUFACTURER _____

CUSTOMER _____

GOVERNMENT _____

APPROVED DATE _____

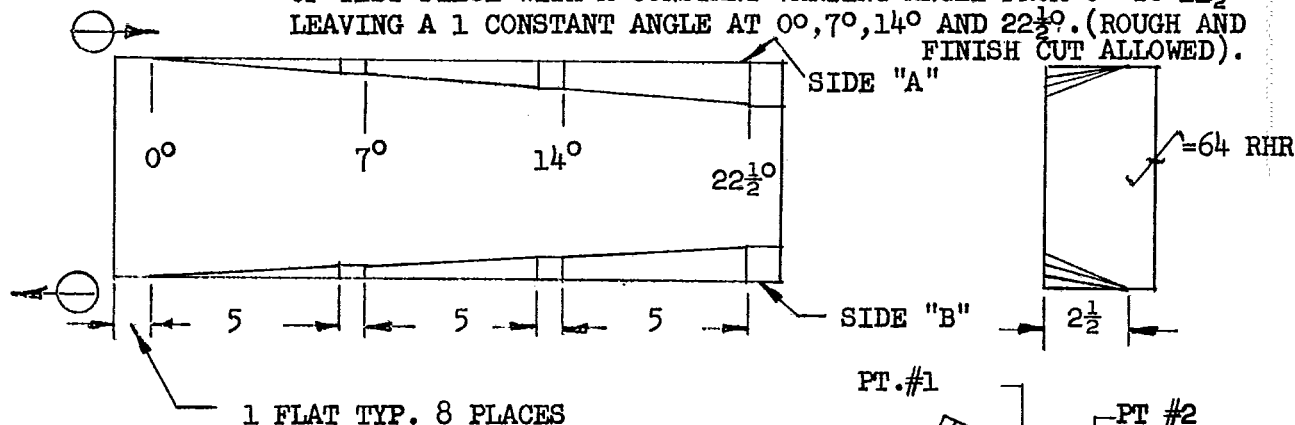
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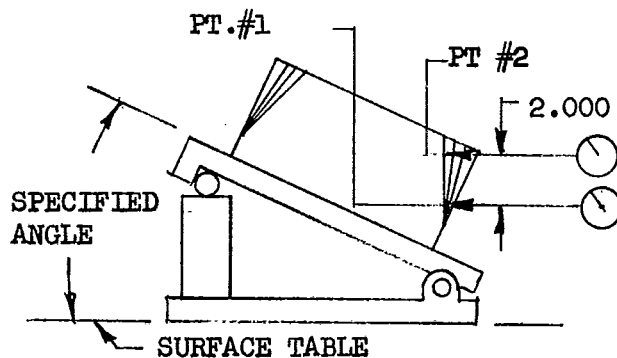
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4.3.3.6.1

TRANSVERSE TILT TESTMACHINE TYPE: ALL MACHINES HAVING FOUR OR FIVE AXES OF CONTROLLED MOTION.TEST CRITERIA:MATERIAL: 7075-T6 ALUMINUM 4 x 19 x 3 MINIMUM SIZE.CUTTER: 2 INCH DIAMETER, 2 FLUTE END MILL, HSS, RIGHT HAND CUT, HIGH HELIX.SPINDLE SPEED: MAXIMUM AVAILABLE RPM. FEED RATE: 25 IPMEVALUATE: ANGULAR ACCURACY OF TILT MOTION. PROFILE MILL TWO (2) SIDES OF TEST PIECE WITH A CONSTANT VARYING ANGLE FROM 0° TO $22\frac{1}{2}^{\circ}$ LEAVING A 1 CONSTANT ANGLE AT 0° , 7° , 14° AND $22\frac{1}{2}^{\circ}$. (ROUGH AND FINISH CUT ALLOWED).NOTE:

RIG SINE PLATE TO EACH SPECIFIED ANGLE. SET INDICATOR TO ZERO AT PT.#1. RECORD INDICATOR READING AT PT.#2.

RECORD:

		SIDE "A"	SIDE "B"
		ACTUAL	ACTUAL
	REQUIRED	POINT #2	POINT #2
7°			
14°	$\pm .0012$		
$22\frac{1}{2}^{\circ}$			

INSPECTION SETUP

CERTIFIED BY: MANUFACTURER _____
 CUSTOMER _____
 GOVERNMENT _____
 APPROVED DATE _____

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SHEET 31

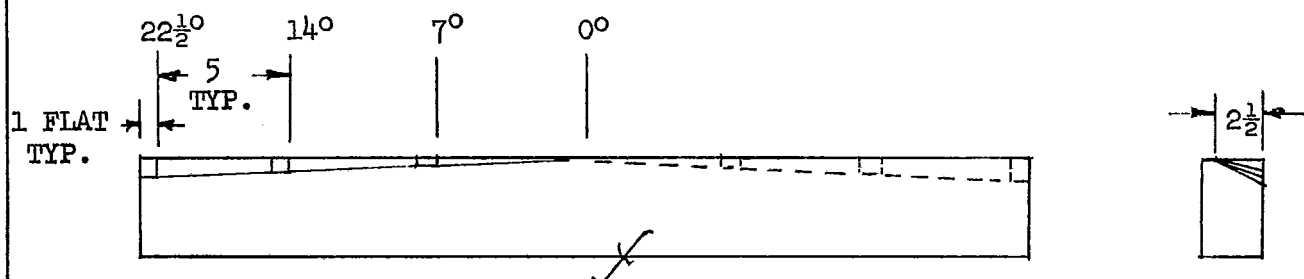
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4.3.3.6.2

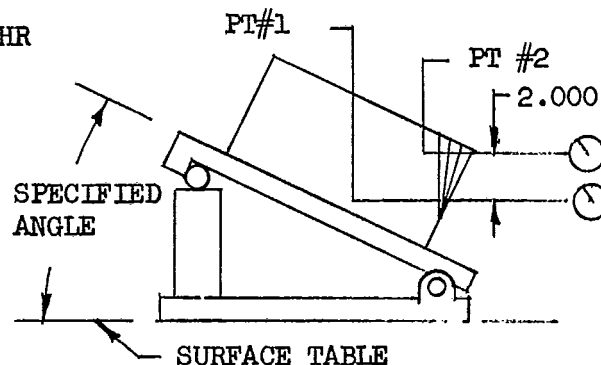
TRANSVERSE TILT TESTMACHINE TYPE: ALL MACHINES HAVING FOUR OR FIVE AXES OF CONTROLLED MOTION.TEST CRITERIAMATERIAL: 7075-T6 ALUMINUM 4 x 37 x 3 MINIMUM SIZE.CUTTER: 2 DIAMETER, 2 FLUTE END MILL, HSS, RIGHT HAND CUT, HIGH HELIX.SPINDLE SPEED: MAXIMUM AVAILABLE RPM. FEED RATE: 25 IPM.

EVALUATE: ANGULAR ACCURACY OF TILT MOTION. PROFILE MILL ONE SIDE OF TEST PIECE WITH CONSTANT VARYING ANGLE FROM $22\frac{1}{2}^{\circ}$ TO 0° IN ONE TILT DIRECTION AND 0° TO $22\frac{1}{2}^{\circ}$ IN THE OPPOSITE TILT DIRECTION, LEAVING A 1 CONSTANT ANGLE AT $22\frac{1}{2}^{\circ}$, 14° , 7° , 0° , 7° , 14° , AND $22\frac{1}{2}^{\circ}$. (ROUGH AND FINISH CUT ALLOWED)

RECORD:

	REQUIRED	ACTUAL POINT #2
$22\frac{1}{2}^{\circ}$	$\pm .0012$	
14°		
7°		
0°		
7°		
14°		
$22\frac{1}{2}^{\circ}$		

= 64 RHR

NOTE:

RIG SINE PLATE TO EACH SPECIFIED ANGLE. SET INDICATOR TO ZERO AT PT. #1.
RECORD INDICATOR READING AT PT. #2.

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SHEET 32

4.3.3.7.1

LONGITUDINAL TILT

MACHINE TYPE: ALL MACHINES HAVING FOUR OR FIVE AXES OF CONTROLLED MOTION.

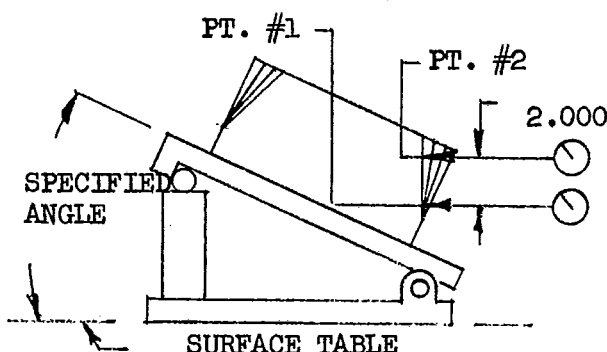
TEST CRITERIA:

MATERIAL: 7075-T6 ALUMINUM 6 x 21 x 3 MINIMUM SIZE

CUTTER: 2 DIAMETER, 2 FLUTE END MILL, HSS, RIGHT HAND CUT, HIGH HELIX.

SPINDLE SPEED: MAXIMUM AVAILABLE RPM FEED RATE: 25 IPM

EVALUATE: ANGULAR ACCURACY OF TILT MOTIONS. PROFILE SIDE "A" WITH A CONSTANT VARYING ANGLE FROM 0° TO 48° LEAVING A 1 CONSTANT ANGLE AT 0°, 12°, 24°, 36° AND 48°. PROFILE SIDE "B" WITH A CONSTANT VARYING ANGLE FROM 22½° TO 0° LEAVING A 1 CONSTANT ANGLE AT 22½°, 15°, 10°, 5° AND 0°. (ROUGH AND FINISH CUT ALLOWED).



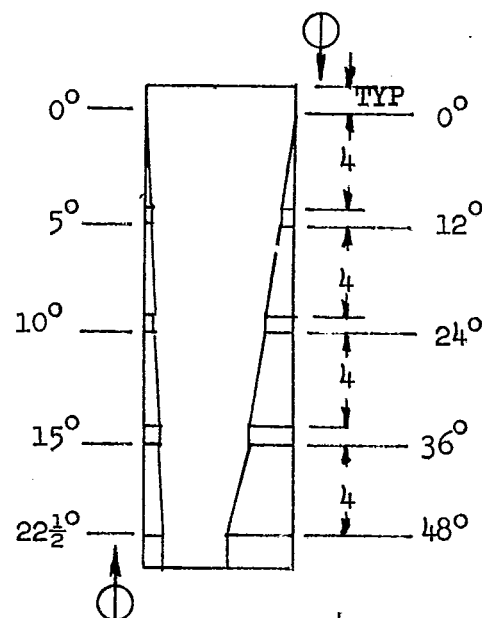
INSPECTION SETUP

NOTE:

RIG SINE ANGLE PLATE TO EACH SPECIFIED ANGLE.
 SET INDICATOR TO ZERO AT PT. #1.
 RECORD INDICATOR READING AT PT. #2.

RECORD:

		SIDE "A" ACTUAL	SIDE "B" ACTUAL	
	REQUIRED	POINT #2	POINT #2	
12°	+ .0012			5°
24°	IN 2			10°
36°	INCHES			15°
48°				22½°



$f = 64 \text{ RHR}$

CERTIFIED BY: MANUFACTURER _____

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GOVERNMENT _____

APPROVED DATE _____

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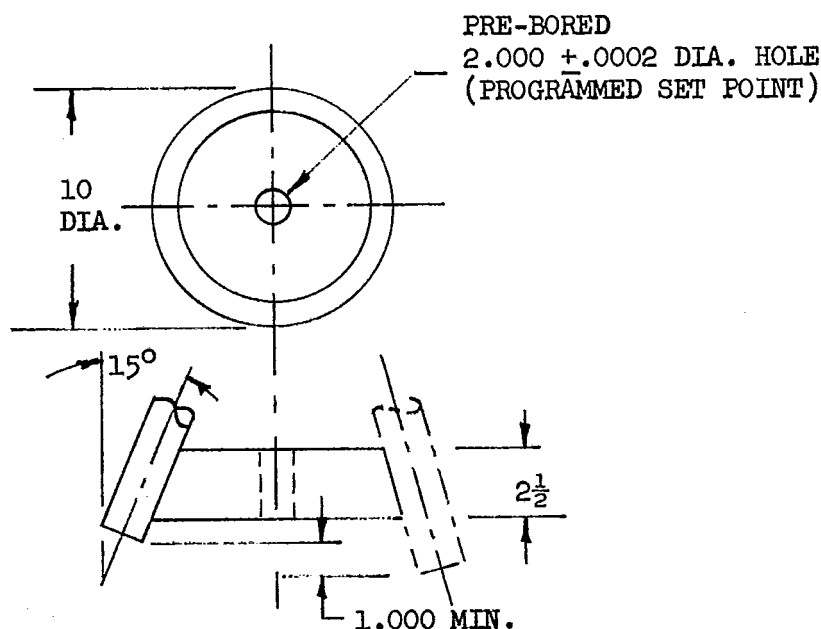
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 SHEET 33

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APPROVAL DATE APRIL 1966 REVISION ① 15 Jan. 1969

4.3.3.8.1

PROFILE - CONE FRUSTUMMACHINE TYPE: FIVE AXIS MACHINE ONLY.TEST CRITERIA:MATERIAL: 7075-T6 ALUMINUM - $2\frac{1}{2}$ THICK.CUTTER: 2 DIAMETER, 2 FLUTE END MILL, HSS, RIGHT HAND HELIX. 6 MAX. LENGTH OF MINIMIZE CUTTER DEFLECTION.FEED RATE: 25 IPMSPINDLE SPEED: 1800 RPMWORK LOCATION: WORK PIECE TO BE CENTRALLY LOCATED ON WORK SURFACE, EXCEPT THAT WORK PIECE TO SPINDLE RELATION MUST BE SUCH THAT ALL FIVE AXIS MUST ACTUATE IN THE PERFORMANCE OF THIS TEST.DIAGRAM:

PROFILE MILL THE FRUSTUM OF A 10 INCH DIAMETER CONE WITH AN APEX ANGLE OF 30 DEGREES. THE Z AXIS SHALL RISE 1.000 INCH MIN. WHILE TRAVERSING 180° OF CIRCUMFERENCE AND FALL 1.000 INCH MIN. WHILE TRAVERSING THE REMAINING 180°. THE Z AXIS MOTION TO BE MEASURED ALONG THE CENTER LINE OF CUTTER. (ROUGH AND FINISH CUT ALLOWED.)

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SHEET 34

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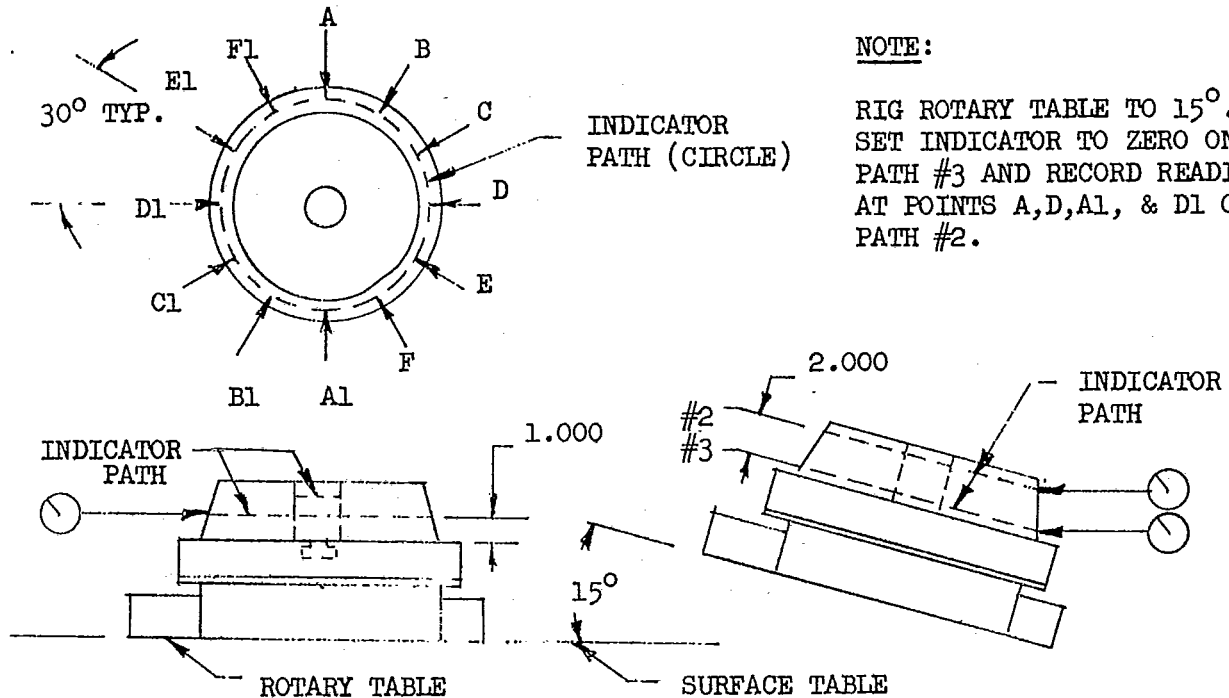
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4.3.3.8.1 (CONTINUED)

EVALUATE: SURFACE OF THE 10 DIAMETER FRUSTUM OF A CONE FOR FINISH, ROUNDNESS, AND ANGULARITY.

NOTE:

RIG ROTARY TABLE TO 15°. SET INDICATOR TO ZERO ON PATH #3 AND RECORD READINGS AT POINTS A, D, A1, & D1 ON PATH #2.

INSPECTION SETUP FOR FINISH
ROUNDNESS AND RADIAL DIFFERENCES

INSPECTION SETUP FOR ANGULARITY

RIG TEST PIECE FOR INSPECTION OF FINISH, ROUNDNESS, AND RADIAL DIFFERENCES ON THE PRECISION ROTARY TABLE. CENTER THE MACHINED SURFACE OF THE FRUSTUM (CIRCULAR PATH OF THE INDICATOR) RELATIVE TO THE AXIS OF THE ROTARY TABLE. SELECT FOUR (4) QUADRANTS FOR CENTERING ON THE BASIS OF THE MOST SIGNIFICANT OUT-OF-ROUNDNESS (AN ELLIPTICAL FIGURE WOULD BE CENTERED AT THE INTERSECTION OF THE MAJOR AND MINOR AXES) SO AS TO REDUCE RADIAL DIFFERENCES TO A MINIMUM FOR THE CIRCLE.

ROUNDNESS ERROR FOR THE MACHINED FRUSTUM IS THE RADIAL DIFFERENCE BETWEEN THE MAXIMUM AND MINIMUM RADII AT ANY OF THE 30° POINTS OF THE CIRCLE, OR ON A ROUNDNESS MEASURING MACHINE THE DIFFERENCE IN RADII OF TWO CONCENTRIC CIRCLES WHICH CONTAIN THE PROFILE OF THE CIRCLE ON THE POLAR CHART IS THE ERROR IN ROUNDNESS.

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SHEET 35

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4.3.3.8.1

EVALUATE: (CONTINUED)

CONCENTRICITY: WITH THE TEST PIECE CENTERED ON THE MACHINED FRUSTUM AS ABOVE, READ RADIAL DIFFERENCES FOR EACH 30° POINT AROUND THE PRE-BORED HOLE AND CALCULATE CONCENTRICITY, OR ON A ROUNDNESS MEASURING MACHINE, CHART THE HOLE PROFILE ON THE SAME POLAR CHART WITH THE CIRCLE AND THE LARGEST RADIAL DIFFERENCE BETWEEN PROFILES LESS THE SMALLEST RADIAL DIFFERENCE BETWEEN PROFILES OF CIRCLE AND HOLE IS CONCENTRICITY.

RECORD:

	INDICATOR RADIAL READINGS, AT 30° POINTS, FOR RADIAL DIFFERENCE VALUES (SEE NOTES 1 & 2)											
	A	B	C	D	E	F	A1	B1	C1	D1	E1	F1
RADIAL DIFFERENCE -CIRCLE												
RADIAL DIFFERENCE -HOLE												
SUM OF RADIAL DIFFERENCES												

	REQUIRED	ACTUAL
FEED RATE	25 IPM	IPM.
SPINDLE SPEED	1800 RPM	RPM
FINISH MAXIMUM	35 RHR	RHR
ROUNDNESS ERROR	.004 MAX.	

CONCENTRICITY CALCULATION

ENTER LARGEST "SUM OF RADIAL DIFFERENCES" VALUE	
SUBTRACT SMALLEST "SUM OF RADIAL DIFFERENCES" VALUE	
CONCENTRICITY	REQUIRED .004 ACTUAL

	POINT A #2	POINT D #2	POINT A1 #2	POINT D1 #2
REQUIRED	ACTUAL	ACTUAL	ACTUAL	ACTUAL
ANGULAR ACCURACY	±.0012			

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SHEET 36

APPROVAL DATE APRIL 1966 REVISION ① 15 Jan. 1969

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4.3.3.8.1 (CONTINUED)

NOTES:

1. SET DIAL INDICATOR READING TO ZERO AT LARGEST RADIUS OF THE CIRCLE AND RECORD ALL RADIAL DIFFERENCES AS POSITIVE VALUES.
2. SET DIAL INDICATOR READING TO ZERO AT SMALLEST RADIAL VALUE IN PRE-BORED HOLE AND RECORD ALL RADIAL DIFFERENCES AS POSITIVE VALUES.
3. RECORDED DIAL INDICATOR READINGS ARE TO BE THE AVERAGE OVER A PLUS OR MINUS 2° RADIAL AREA AT EACH 30° POINT.

CERTIFIED BY:

MANUFACTURER _____

CUSTOMER _____

GOVERNMENT _____

APPROVED DATE _____

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NAS 979
SHEET 37

4.3.3.9.1 BORING TEST

MACHINE TYPE: ALL PRECISION BORING MACHINES.

TEST CRITERIA:

MATERIAL: STEEL 4340, 250-300 BRINELL.

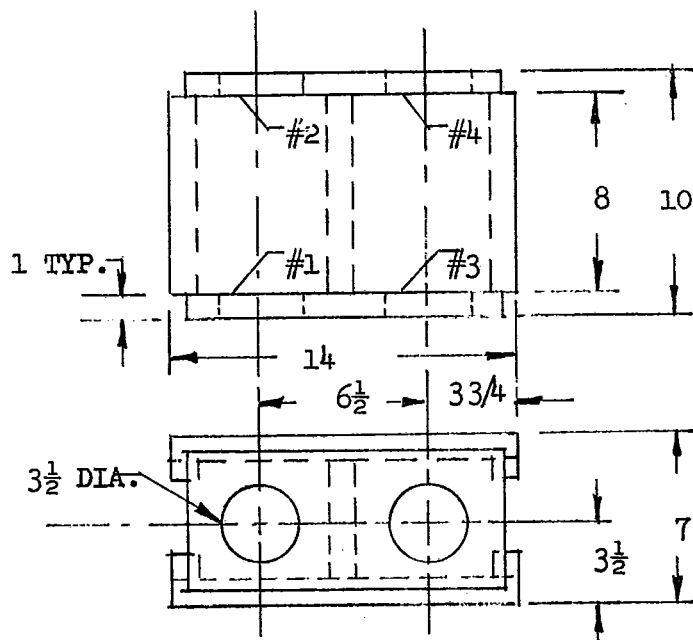
CUTTER: SINGLE POINT T.C.

SPINDLE SPEED: 250 RPM.

FEED RATE: .005 IPR.

DEPTH OF CUT: .010 APPROXIMATE.

WORK LOCATION: WORK PIECE TO BE CENTRALLY LOCATED ON WORK SURFACE.

DIAGRAM:

FOUR $3\frac{1}{2}$ DIAMETER HOLES BORED THROUGH A BOX MADE OF 1 THICK STEEL PLATES PER DIAGRAM. (ROUGH AND FINISH CUTS ALLOWED).

COMPLETELY REVISED ①

NAS 979
SHEET 38

15 Jan. 1969

APPROVAL DATE APRIL 1966 REVISION ①

AIA AND ITS COMMITTEES WILL NOT INVESTIGATE THE APPLICABILITY OF PATENTS TO THE SUBJECT MATTER OF NAS STANDARDS AND IN RESPECT THEREOF DO NOT ASSUME ANY LIABILITY TO PATENT OWNERS OR TO PROSPECTIVE USERS

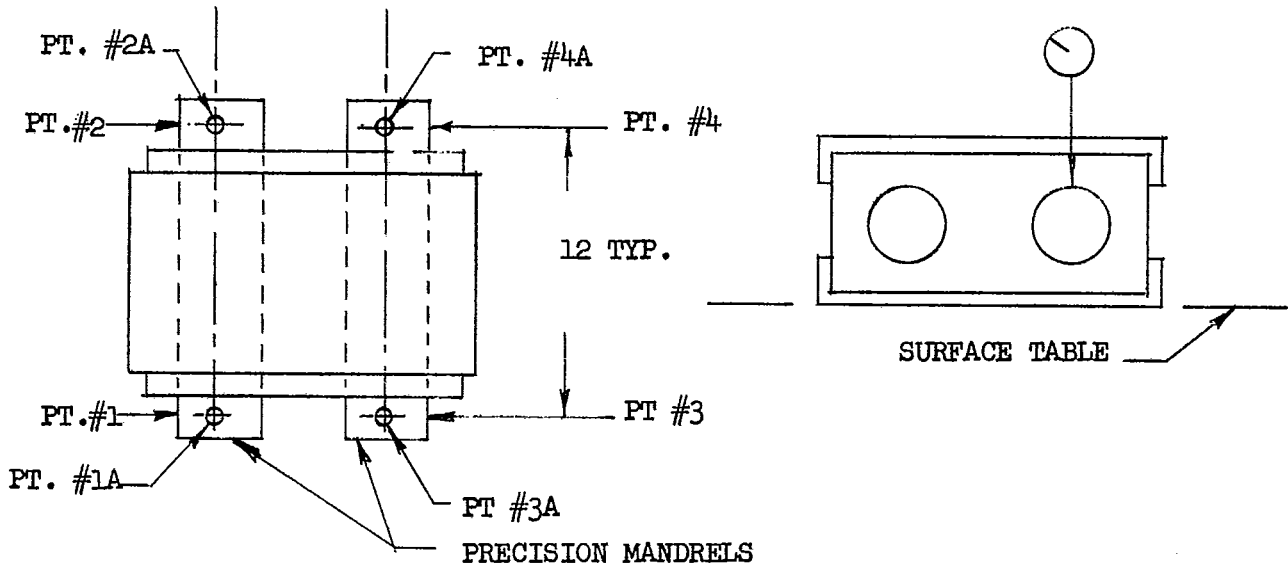
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NATIONAL AEROSPACE STANDARD

AEROSPACE INDUSTRIES ASSOCIATION OF AMERICA, INC., 1725 DE SALES STREET, N. W., WASHINGTON, D. C. 20036

4.3.3.9.1 (CONTINUED)

EVALUATE: FOUR BORED HOLES FOR FINISH AND ALIKENESS OF DIAMETERS, AND THE CENTERLINE OF ONE PAIR OF IN-LINE BORED HOLES AS REFERENCE TO DETERMINE DEVIATION FROM PARALLELISM OF SECOND PAIR OF IN-LINE BORED HOLES IN BOTH HORIZONTAL AND VERTICAL PLANES.

**INSPECTION SETUP - PARALLELISM**

FINISH ROUNDNESS, AND ALIKENESS OF DIAMETERS: RIG TEST PIECE ON ROTARY TABLE CENTERING HOLE #1 AND RECORD READINGS OF FINISH, DIAMETER ALIKENESS, AND ROUNDNESS TIR. REPEAT FOR HOLES #2, #3, AND #4.

PARALLELISM: RIG TEST PIECE AS SHOWN WITH PRECISION MANDRELS IN EACH PAIR OF BORED HOLES, AND SO THAT POINTS 1A AND 2A ARE AT THE SAME HEIGHT ABOVE SURFACE TABLE. SET INDICATOR TO ZERO AT POINT #3A AND RECORD INDICATOR READING AT POINT #4A FOR HORIZONTAL PARALLELISM. USING POINTS #1 AND #2 AS ZERO REFERENCE SET INDICATOR TO ZERO AT POINT #3 AND RECORD INDICATOR READING AT POINT #4 FOR VERTICAL PARALLELISM.

RECORD:

	REQUIRED	ACTUAL			
		HOLE #1	HOLE #2	HOLE #3	HOLE #4
ROUNDNESS	.0005 TIR MAX.				
FINISH	35 RHR MAX.				
DIAMETERS ALIKE	WITHIN .0005				
HORIZ. PARALLEL	.0005 MAX/FT.	.0000 REFERENCE			
VERT. PARALLEL	.0005 MAX/FT.	.0000 REFERENCE			

CERTIFIED BY: MANUFACTURER _____

CUSTOMER _____

GOVERNMENT _____

APPROVED DATE _____

COMPLETELY REVISED ①

NAS 979
SHEET 39

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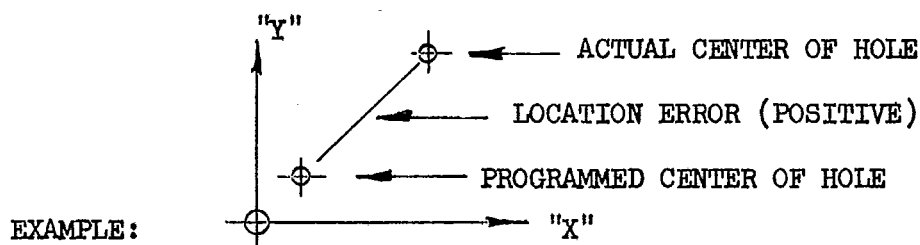
AEROSPACE INDUSTRIES ASSOCIATION OF AMERICA, INC., 1725 DE SALES STREET, N. W., WASHINGTON, D. C. 20036

4.3.3.10.1 BORE AND COUNTERBORE TEST

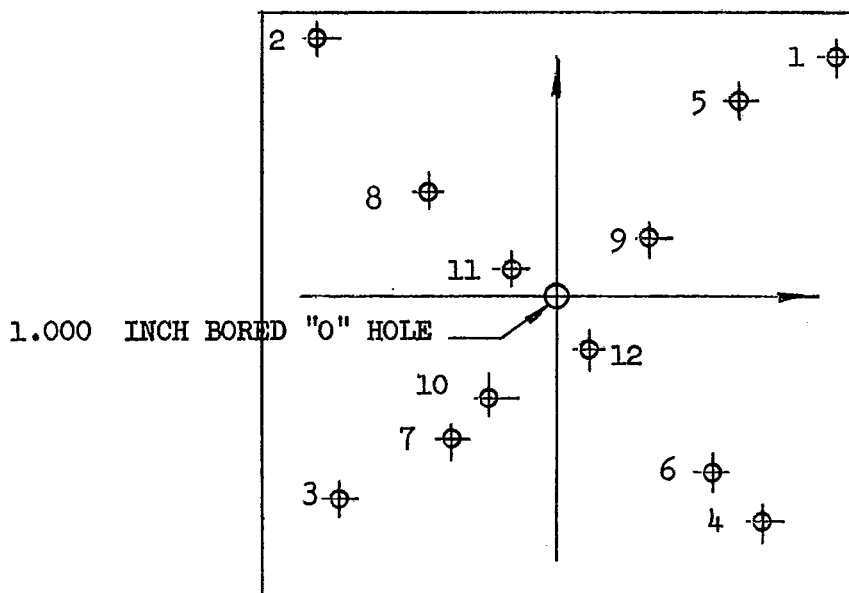
MACHINES: ALL COMBINATION BORING, DRILLING AND MILLING MACHINES.

TEST CRITERIAMATERIAL: 7075-T6 ALUMINUM OR CLASS 30 CAST IRON 24 x 24 x 2½
MINIMUM SIZE.

WORK LOCATION: WORK PIECE TO BE CENTRALLY LOCATED ON WORK SURFACE.

INSPECTION: CENTER LINE OF BORED HOLES MUST BE WITHIN .001 OF
PROGRAMMED CENTER LINE. (.001 RADIAL TOLERANCE.)

$$\text{LOCATION ERROR} = \sqrt{(\text{X ERROR})^2 + (\text{Y ERROR})^2}$$

EVALUATE: ACCURACY OF TWELVE BORED AND COUNTERBORED HOLES BORED
BY 1.125 DIA. BORING BAR AND COUNTERBORED BY A 1.375
DIA. UNPILOTED COUNTERBORE IN THE SEQUENCE SHOWN.NAS 979
SHEET 40AIA AND ITS COMMITTEES WILL NOT INVESTIGATE THE APPLICABILITY OF
PATENTS TO THE SUBJECT MATTER OF NAS STANDARDS AND IN RESPECT THEREOF
DO NOT ASSUME ANY LIABILITY TO PATENT OWNERS OR TO PROSPECTIVE USERSTHIS DRAWING SUPERSEDES ALL ANTECEDENT STANDARD DRAWINGS
FOR THE SAME PRODUCT AND SHALL BECOME EFFECTIVE NO LATER
THAN SIX MONTHS FROM THE LAST DATE OF APPROVAL SHOWN HEREON

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4.3.3.10.1 (CONTINUED)

RECORD:

ACTUAL HOLE LOCATION, RESULTING ERROR AND CALCULATED LOCATION ERROR.

HOLE NO.	PROGRAMMED		ACTUAL		ERROR		LOCATION ERROR
	X	Y	X	Y	X	Y	
1	+11.132	+10.111					
2	-10.213	+11.222					
3	-9.321	-8.333					
4	+8.123	-9.231					
5	+7.465	+8.444					
6	+6.456	-7.564					
7	-4.654	-5.666					
8	-5.546	+4.555					
9	+3.798	+2.777					
10	-2.987	-3.999					
11	-1.897	+0.888					
12	+0.769	-1.897					
0	00.000	00.000					

COUNTERBORE DEPTH +.001

CONCENTRICITY .0005 TIR

HOLE NO.	PROG. DEPTH		ACTUAL DEPTH	ACTUAL CONCEN.
	2 AXIS	3 AXIS		
1		.375		
2	ALL HOLES .500 DEEP	.500		
3		.625		
4		.875		
5		1.000		
6		1.125		
7		1.250		
8		1.375		
9		1.500		
10		1.625		
11		1.625		
12		2.000		

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CUSTOMER _____

GOVERNMENT _____

APPROVED DATE _____

NAS 979
SHEET 41

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NATIONAL AEROSPACE STANDARD

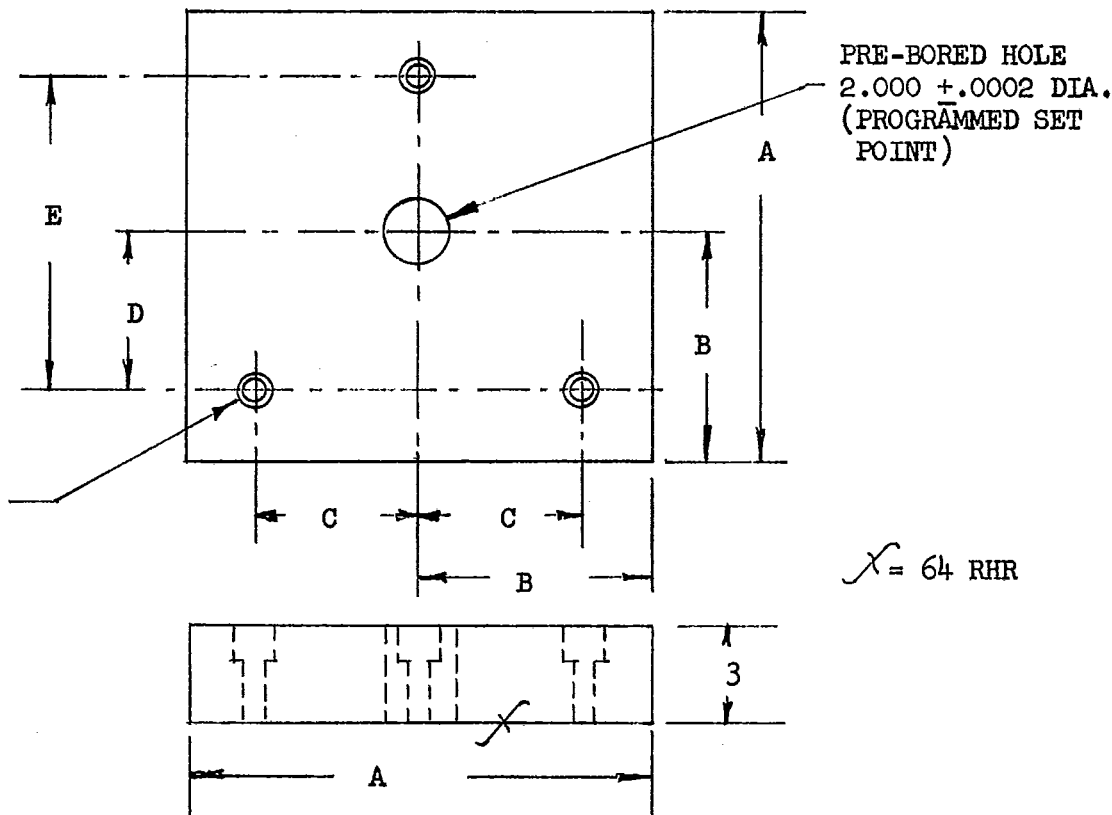
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4.3.3.11.1

ACCURACY AND REPEATABILITY CUTTING TESTMACHINE TYPE: ALL PROFILING AND CONTOURING MACHINES.TEST CRITERIA:MATERIAL: 7075-T6 ALUMINUMCUTTER: 2.000 INCH DIAMETER, 2 FLUTE END MILL, HSS, RIGHT HAND CUT, HIGH HELIX, 6 INCH MAXIMUM LENGTH TO MINIMIZE CUTTER DEFLECTION.WIDTH AND DEPTH OF CUT: AS REQUIRED PER DIAGRAM - ROUGH AND FINISH CUTS ALLOWED.WORK LOCATION: WORK PIECE TO BE CENTRALLY LOCATED ON THE TABLE WITH SIDES PARALLEL WITH MACHINE AXIS. PRE-BORED 2 INCH DIAMETER HOLE SHALL BE USED AS THE PROGRAMMED SET POINT.BLANK PREPARATION:

DIM.	A	B	C	D	E
TYPE I	14	7	4 3/4	5	10.000 \pm .010
TYPE II	8	4	USE MILL VISE FOR MAT. HOLD DOWN		

DRILL 11/16
C BORE 15/16
DEPTH 1 3/4
TYP. 3 PLCS.



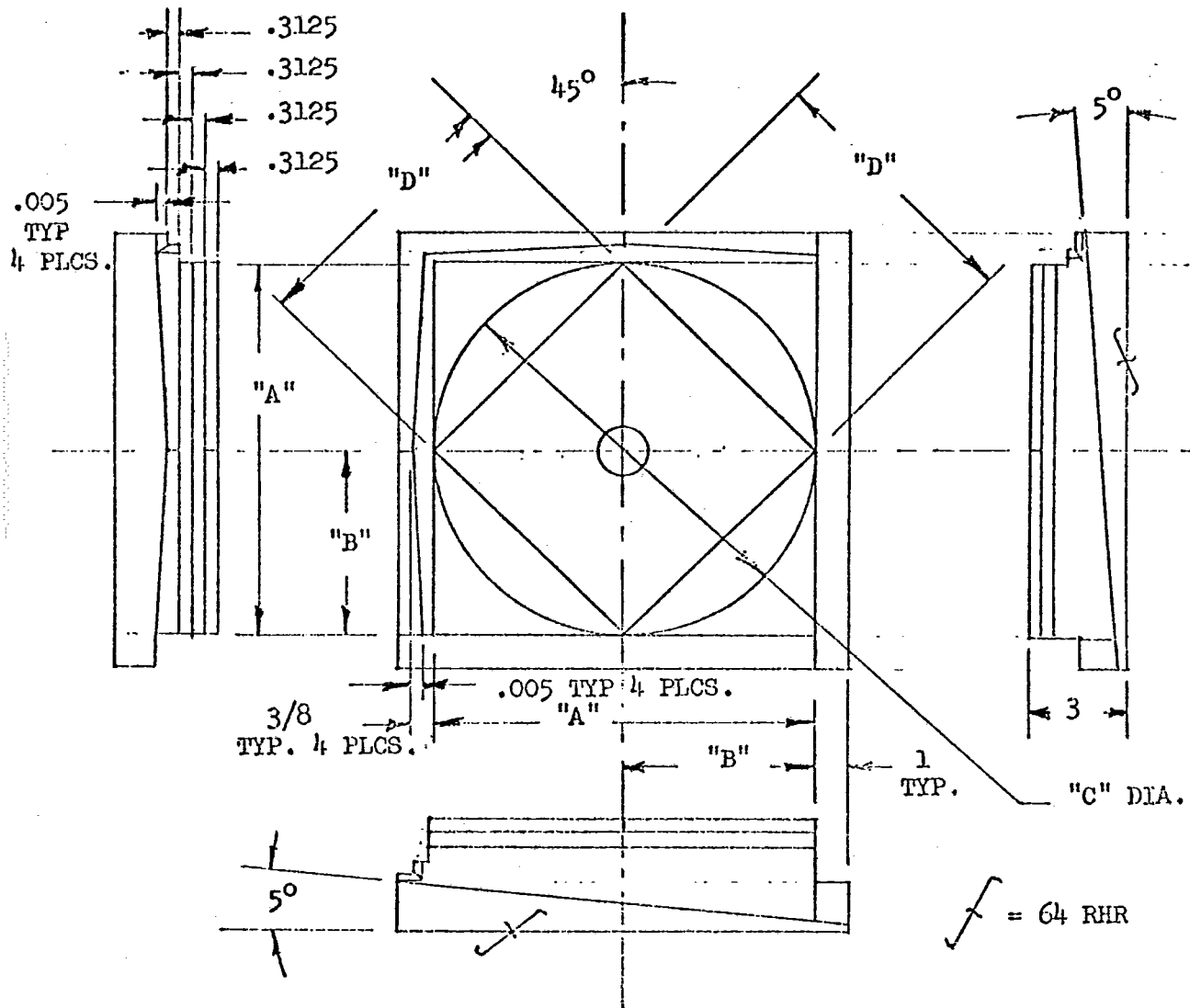
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SHEET 42

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4.3.3.11.1 (CONTINUED)

DIAGRAM:

NOTE: SURFACE AREA $\frac{1}{4}$ INCH FROM CORNERS SHALL BE EXEMPT FROM EVALUATION.

DIM.	"A"	"B"	"C"	"D"
TYPE I	12.0000	6.0000	12.0000	8.4853
TYPE II	6.0000	3.0000	6.0000	4.2426

NAS 979
SHEET 43

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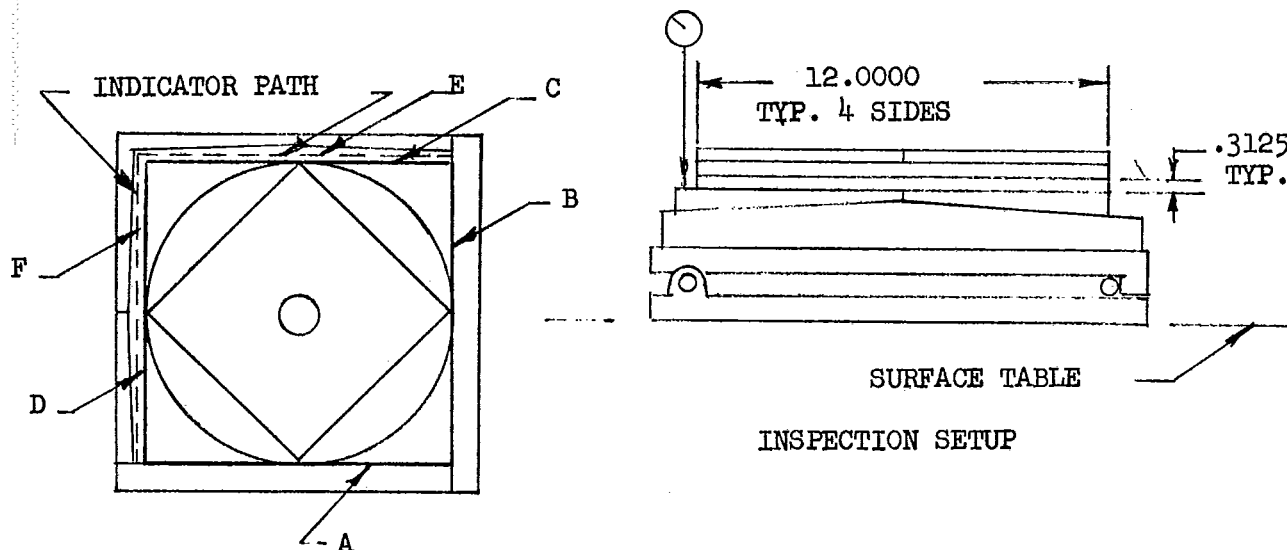
4.3.3.11.1 (CONTINUED)

EVALUATE:

DIMENSIONAL ACCURACY - PART TO DIAGRAM.

FIVE CONSECUTIVELY PROFILE MILLED PARTS, FROM A SINGLE TAPE, TO DETERMINE MACHINE AND CONTROL SYSTEMS ABILITY TO REPEAT UNDER CUTTING CONDITIONS.

OUTSIDE SQUARE: DIMENSIONAL ACCURACY, DEPTH, AND FLATNESS.



WITH TEST PIECE LOCATED ON SINE PLATE AND WITH RISE RAMP CUT OPPOSITE TO HINGE END, INDICATE THE TWO FLAT SURFACES FOR FLATNESS AS SHOWN.

NOMINAL DIM.	TOL.	SIDE	ACTUAL PART DIMENSIONS					MAX. DEVIATION	ALLOW. DEV.
			#1	#2	#3	#4	#5		
12.0000 or 6.0000	±.0025	A							0.001
		B							
		C							
		D							
.3125		A							
		B							
		C							
		D							
35 RHR MAX.	X	E						X	
		F							

NAS 979
SHEET 44

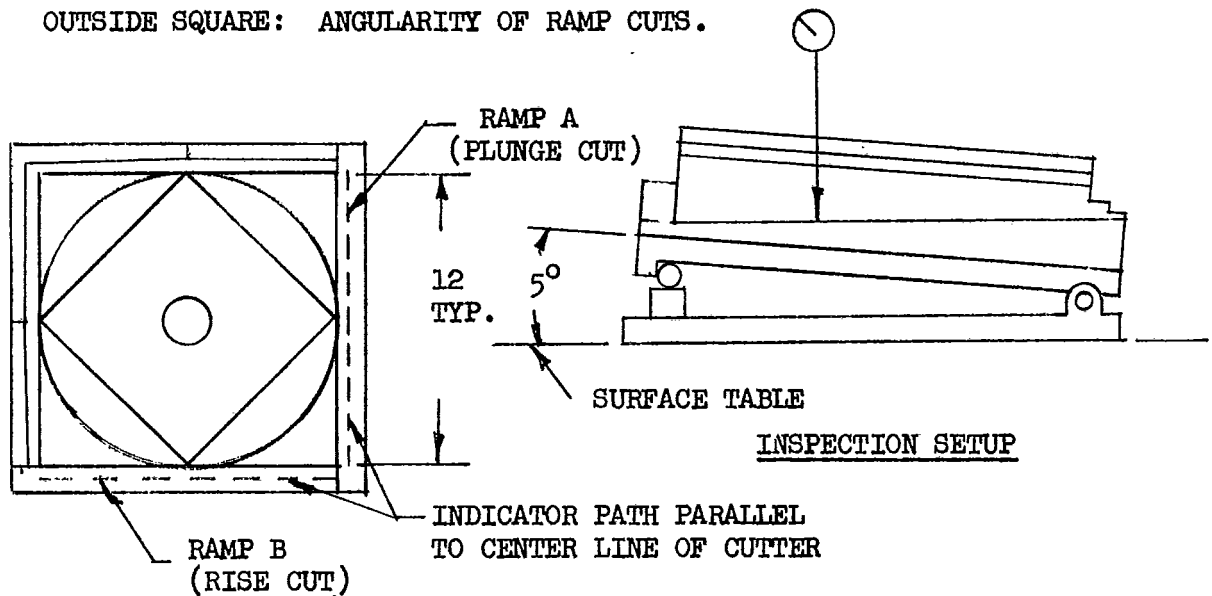
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4.3.3.11.1 (CONTINUED)

EVALUATE: (CONTINUED)

OUTSIDE SQUARE: ANGULARITY OF RAMP CUTS.



RIG SINE PLATE TO 5°. LOCATE TEST PIECE AS SHOWN FOR ANGULARITY EVALUATION OF RAMP CUT A. ROTATE TEST PIECE 90° FOR ANGULARITY EVALUATION OF RAMP CUT B.

RECORD:

RAMP CUT	TOL.	ACTUAL PART DIMENSION					MAX. DEVIATION	ALLOW. DEV.
		#1	#2	#3	#4	#5		
A	.0025 TIR							.001
B								

NOTE:

CUTTING OF "5° PLUNGE AND RISE RAMPS" IS REQUIRED FOR MACHINES HAVING 3 OR MORE AXES OF CONTROLLED MOTION ONLY. RAMP CUTTING IS TO BE PERFORMED WITHOUT USE OF TILT MOTIONS.

NAS 979
SHEET 45

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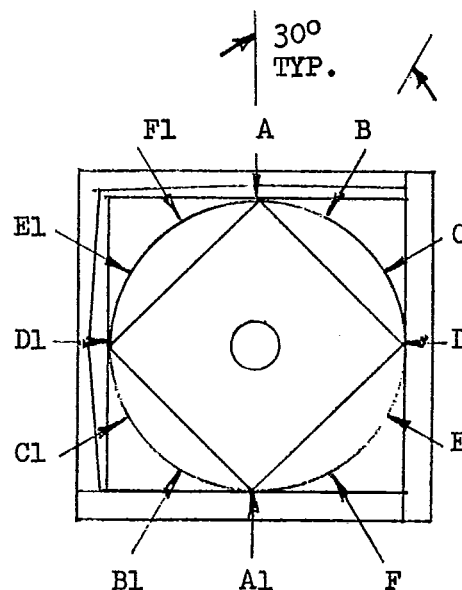
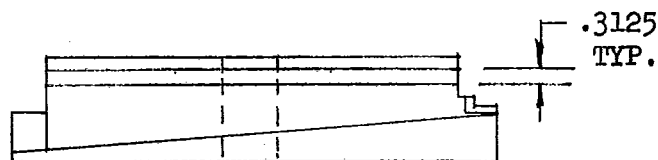
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4.3.3.11.1 (CONTINUED)

EVALUATE: (CONTINUED)

CIRCLE: DIAMETER ACCURACY AND DEPTH OF CUT.

RECORD:

NOMINAL DIM.	TOL.	PTS.	ACTUAL PART DIMENSION					MAX. DEV.	ALLOW. DEV.	
			#1	#2	#3	#4	#5			
TYPE I 12.0000 OR TYPE II 6.0000	±.0025	A-A1							.001	
		B-B1								
		C-C1								
		D-D1								
		E-E1								
		F-F1								
.3125		B								
		C								
		E								
		F								
		B1								
		C1								
		E1								
		F1								

NAS 979
SHEET 46

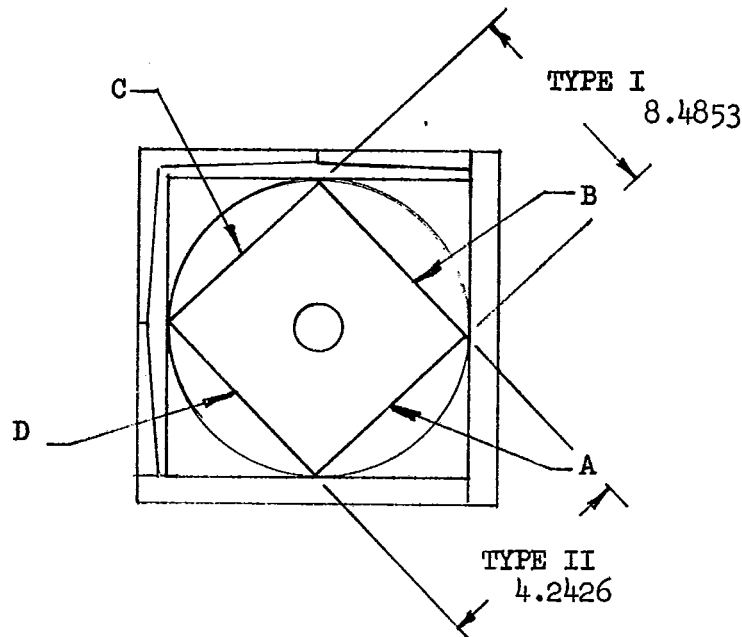
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4.3.3.11.1 (CONTINUED)

EVALUATE: (CONTINUED)

CENTER CANTED SQUARE: DIMENSIONAL ACCURACY.

RECORD:

NOMINAL DIM.	TOL.	SIDE	ACTUAL PART DIMENSION					MAX. DEVIATION	ALLOW. DEV.
			#1	#2	#3	#4	#5		
8.4853 OR 4.2426	±.0025	A							.001
		B							
		C							
		D							

CERTIFIED BY: MANUFACTURER _____

CUSTOMER _____

GOVERNMENT _____

APPROVED DATE _____

NAS 979

SHEET 47

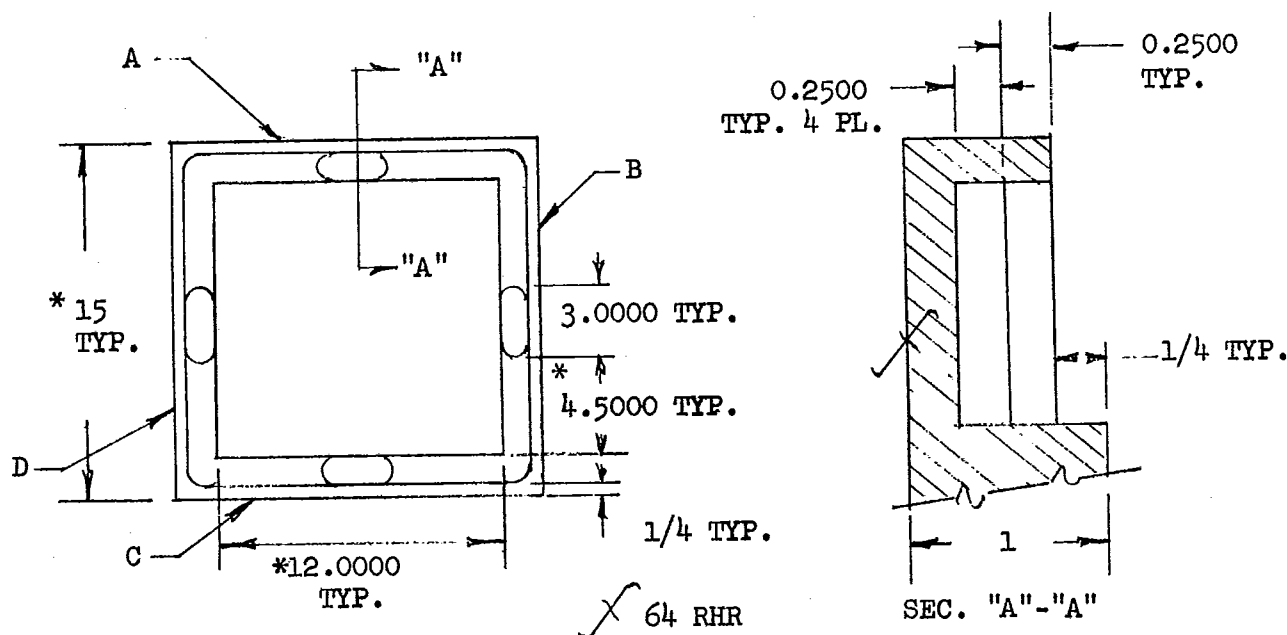
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4.3.3.11.2

ACCURACY AND REPEATABILITY CUTTING TESTMACHINE TYPE: ALL PROFILING AND CONTOURING MACHINES.TEST CRITERIA:MATERIAL: 7075-T6 ALUMINUM - 15 x 15 x 1 MINIMUM SIZE.CUTTER: 1.250 INCH DIAMETER, 2 FLUTE END MILL, RIGHT HAND CUT, HIGH HELIX, 3 INCH MAXIMUM LENGTH TO MINIMIZE CUTTER DEFLECTION.SPINDLE SPEED: 1800 RPMFEED RATE: 25 IPMWIDTH AND DEPTH OF CUT: AS REQUIRED PER DIAGRAM - ROUGH AND FINISH CUTS ALLOWED.WORK LOCATION: WORK PIECE TO BE CENTRALLY LOCATED ON THE TABLE WITH SIDES PARALLEL WITH MACHINE AXIS.DIAGRAM:EVALUATE: DIMENSIONAL ACCURACY - PART TO DIAGRAM.

FIVE CONSECUTIVELY PROFILE MILLED PARTS, FROM A SINGLE TAPE, TO DETERMINE MACHINE AND CONTROL SYSTEMS ABILITY TO REPEAT UNDER CUTTING CONDITIONS.

* DIMENSIONS SHALL BE REDUCED 50% FOR MACHINES HAVING AXES TRAVEL LESS THAN 14 INCHES.

NAS 979

SHEET 48

NATIONAL AEROSPACE STANDARD

AEROSPACE INDUSTRIES ASSOCIATION OF AMERICA, INC., 1725 DE SALES STREET, N. W., WASHINGTON, D. C. 20036

4.3.3.11.2 (CONTINUED)

RECORD:

NOMINAL DIMENSION	TOL.	SIDE	ACTUAL DIMENSIONS PARTS					MAX. DEVIATION	ALLOW. DEV.
			#1	#2	#3	#4	#5		
12.0000	+ .0025	A							0.001
		B							
		C							
		D							
4.5000		A							
		B							
		C							
		D							
3.0000		A							
		B							
		C							
		D							
0.2500		A							
		B							
		C							
		D							
0.2500 (PLUNGE)		A							
		B							
		C							
		D							

CERTIFIED BY: MANUFACTURER _____

CUSTOMER _____

GOVERNMENT _____

APPROVED DATE _____

NAS 979
SHEET 49

NATIONAL AEROSPACE STANDARD

AEROSPACE INDUSTRIES ASSOCIATION OF AMERICA, INC., 1725 DE SALES STREET, N. W., WASHINGTON, D. C. 20036

4.3.3.11.3

ACCURACY AND REPEATABILITY CUTTING TEST

MACHINE TYPE: LOW SPEED, HIGH SPEED AND FULL RANGE PROFILERS HAVING FOUR OR FIVE AXES OF CONTROLLED MOTION.

TEST CRITERIA:

MATERIAL: 7075-T6 ALUMINUM - 6 x 6 x 108

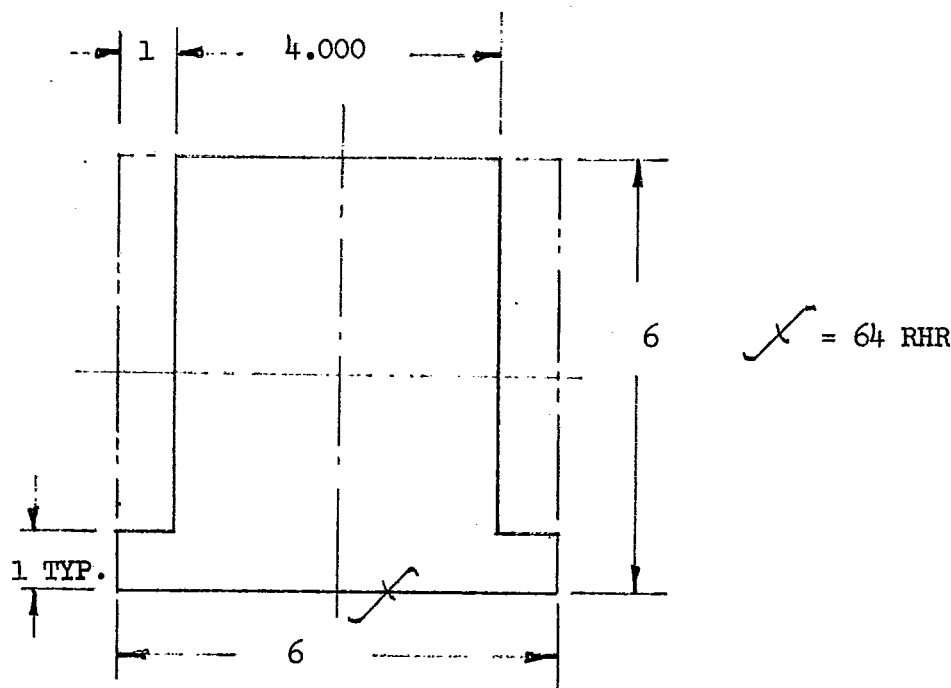
CUTTERS: HORIZONTAL SPINDLE - TABLE II TYPE II
VERTICAL SPINDLE - 2.500 INCH DIAMETER, 2 FLUTE END MILL, HSS,
RIGHT HAND CUT, HIGH HELIX, 6 INCH MAXIMUM LENGTH TO MINIMIZE
CUTTER DEFLECTION.

SPINDLE SPEED: HORIZONTAL SPINDLE - 1800 RPM
VERTICAL SPINDLE - 3600 RPM (HIGH SPEED)
1800 RPM (ALL OTHERS)

FEED RATE: HORIZONTAL SPINDLE - 100 IPM
VERTICAL SPINDLE - 40 IPM (HIGH SPEED)
25 IPM (ALL OTHERS)

WIDTH AND DEPTH OF CUTS: AS REQUIRED PER DIAGRAM -
ROUGH AND FINISH CUTS ALLOWED.

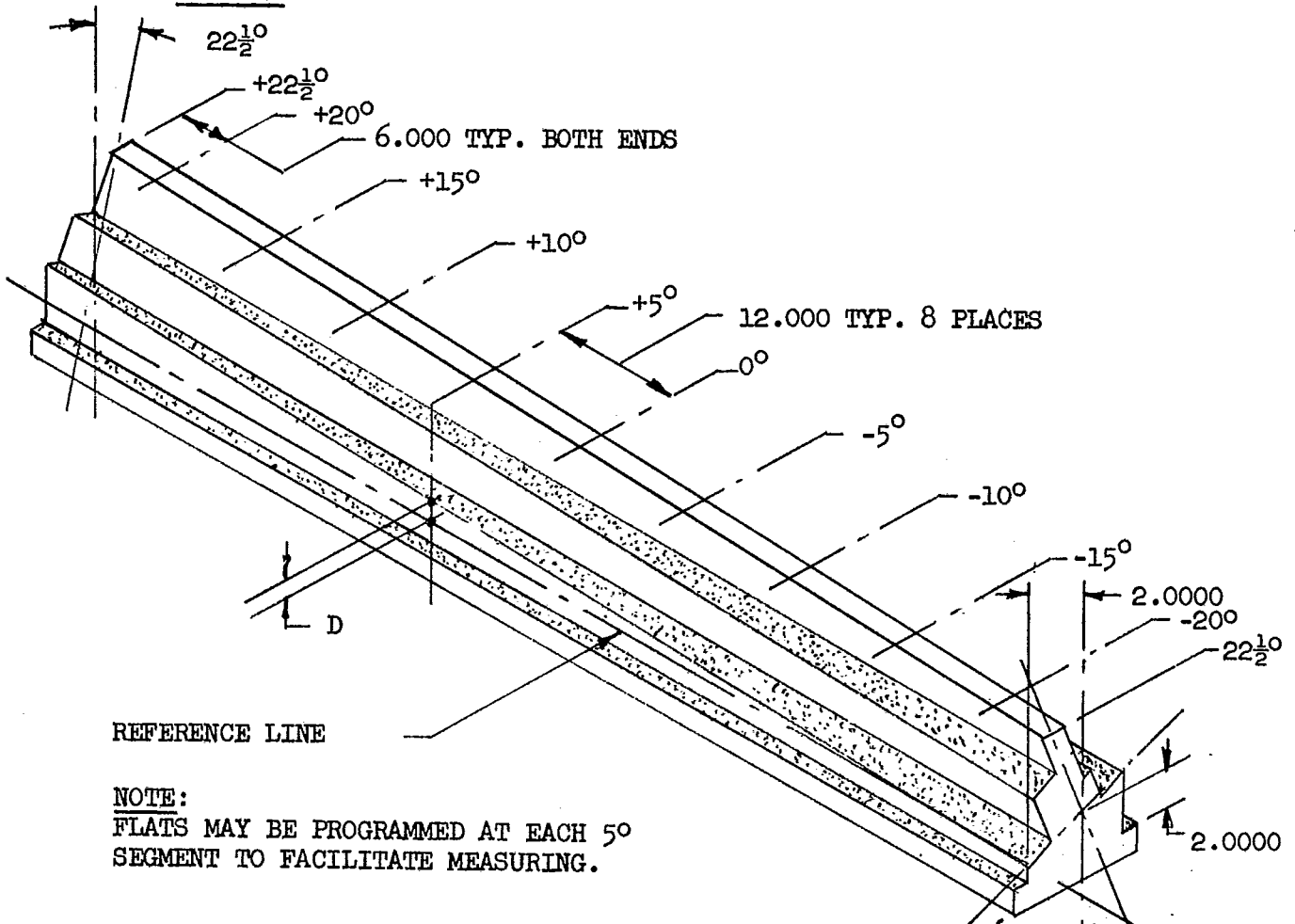
WORK LOCATION: WORK PLACE TO BE CENTRALLY LOCATED ON THE WMS WITH SIDES
PARALLEL WITH MACHINE AXIS.

BLANK PREPARATION:

NAS 979
SHEET 50

4.3.3.11.3 (CONTINUED)

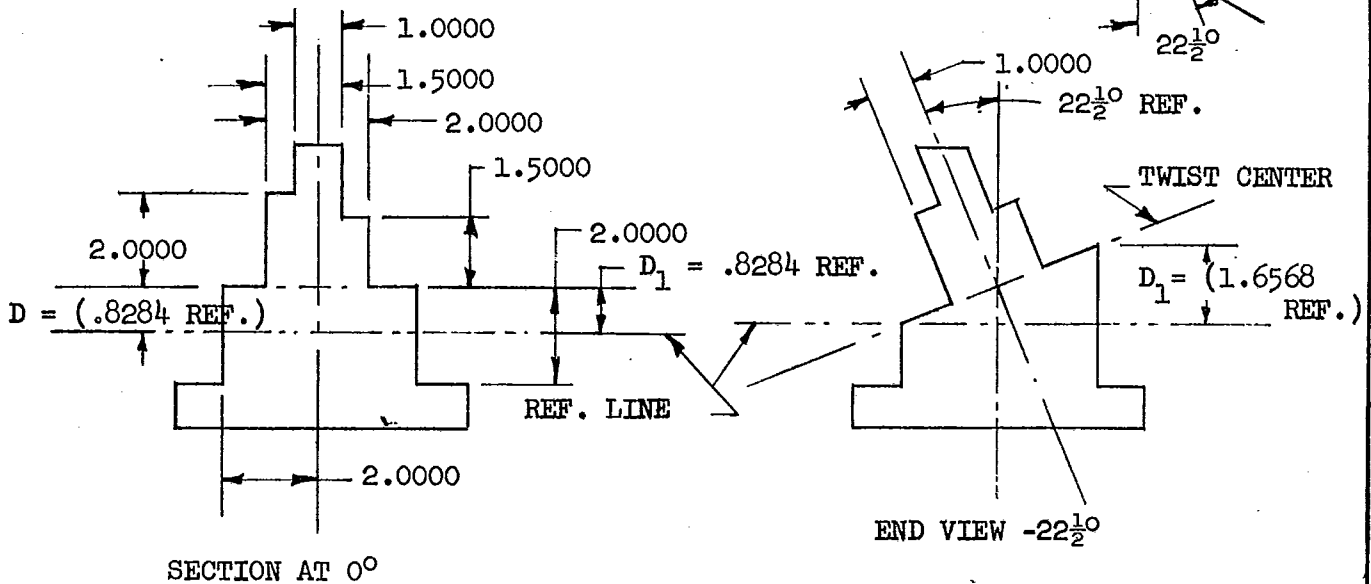
DIAGRAM:



REFERENCE LINE

NOTE:

FLATS MAY BE PROGRAMMED AT EACH 5° SEGMENT TO FACILITATE MEASURING.



SECTION AT 0°

END VIEW -22 1/2°

STEP MILL 45° TOTAL TWIST (TWIST TO BE 5° PER 12.0000 TRAVEL). ALL SURFACE FINISH TO BE 64 RHR MIN.

NAS 979

SHEET 51

NATIONAL AEROSPACE STANDARD

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4.3.3.11.3 (CONTINUED)

EVALUATE:

DIMENSIONAL ACCURACY - PART TO DIAGRAM

FIVE CONSECUTIVELY MILLED PARTS, FROM A SINGLE TAPE, TO DETERMINE MACHINE AND CONTROL SYSTEMS ABILITY TO REPEAT UNDER CUTTING CONDITIONS.

RECORD ANGULAR ACCURACY:

DEGREES	DIM.	REQUIRED	TOL.	ACTUAL PART DIMENSIONS					MAX. DEV.	ALLOW. DEV.
				#1	#2	#3	#4	#5		
-22 $\frac{1}{2}$ °	D	.0000	+ .0025 + 1							0.001
	D	1.6568								
-20°	D	.1005								
	D	1.5564								
-15°	D	.2925								
	D	1.3643								
-10°	D	.4758								
	D	1.1811								
-5°	D	.6534								
	D	1.0034								
-0°	D	.8284								
	D	.8284								
+5°	D	1.0034								
	D	.6534								
+10°	D	1.1811								
	D	.4758								
+15°	D	1.3643								
	D	.2925								
+20°	D	1.5564								
	D	.1005								
+22 $\frac{1}{2}$ °	D	1.6568								
	D	.0000								

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NAS 979
SHEET 52

NATIONAL AEROSPACE STANDARD

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4.3.3.11.3 (CONTINUED)

EVALUATE: (CONTINUED)

RECORD DIMENSIONAL ACCURACY:

NOMINAL DIM.	TOL.	DEGREES	#1	#2	#3	#4	#5	MAX. DEV.	ALLOW. DEV.
2.0000 (DEPTH)	+ .0025	-20°							0.001
		-10°							
		0°							
		+10°							
		+20°							
2.0000 (WIDTH)		-20°							
		-10°							
		0°							
		+10°							
		+20°							
1.5000 (DEPTH)		-20°							
		-10°							
		0°							
		+10°							
		+20°							
1.5000 (WIDTH)		-20°							
		-10°							
		0°							
		+10°							
		+20°							
1.0000 (WIDTH)	-20°								
	-10°								
	0°								
	+10°								
	+20°								

CERTIFIED BY:

MANUFACTURER _____

APPROVED DATE _____

CUSTOMER _____

GOVERNMENT _____

NAS 979
SHEET 53

NATIONAL AEROSPACE STANDARD

AEROSPACE INDUSTRIES ASSOCIATION OF AMERICA, INC., 1725 DE SALES STREET, N. W., WASHINGTON, D. C. 20036

4.3.3.12.1

FLATNESS AND MISMATCH CUTTING TESTMACHINE TYPE - ALL HIGH SPEED AND FULL RANGE MACHINES.TEST CRITERIA:

HORSEPOWER	AS REQUIRED
CUTTER TABLE I	TYPE I
SPINDLE SPEED	1800 RPM
FEED RATE	100 IPM
CHIP LOAD PER TOOTH	.015
DEPTH OF CUT	.060
WIDTH OF CUT	FULL
MATERIAL	2 1/2 x 14 x
7075-T6 ALUMINUM	28 MIN. SIZE

EVALUATE: THE DIFFERENCE BETWEEN TWO SUCCESSIVE FINISH CUTS OVER 75%
OF LONGITUDINAL AND TRANSVERSE TRAVEL.

	REQUIREMENTS	LONGITUDINAL, ACTUAL	TRANSVERSE ACTUAL
FINISH	64 RHR	RHR	RHR
MISMATCH	.0005 TIR	TIR	TIR
FLATNESS PER FT.	.0005/FT. TIR	/FT. TIR	/FT. TIR
FLATNESS OVER 75% AXIS MACHINING TRAVEL	.0005 PLUS .0001 x LENGTH OF TRAVEL IN FT. NOT TO EXCEED .002 TIR	TIR	TIR

NOTES:

1. FINISH CUT TO BE MADE FULL WIDTH OF CUTTER TRAVELING IN A PLUS DIRECTION AND REMAINING WIDTH OF BLOCK TO BE MADE IN A MINUS DIRECTION.
2. NO CHANGES MAY BE MADE DURING THE CUTS.
3. FLATNESS AND MISMATCH TO BE INSPECTED PRIOR TO UNCLAMPING PART.
4. AT CUSTOMER'S OPTION, LONGITUDINAL AND TRANSVERSE TEST MAY BE COMBINED BY LOCATING MATERIAL AT 45° TO LONGITUDINAL TRAVEL AND EVALUATE AS SPECIFIED FOR 75% OF ONE AXIS.
5. WIPER INSERT BLADE MAY BE USED IN THE CUTTER.

NAS 979

SHEET 54

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THIS DRAWING SUPERSEDES ALL ANTECEDENT STANDARD DRAWINGS FOR THE SAME PRODUCT AND SHALL BECOME EFFECTIVE NO LATER THAN SIX MONTHS FROM THE LAST DATE OF APPROVAL SHOWN HEREON

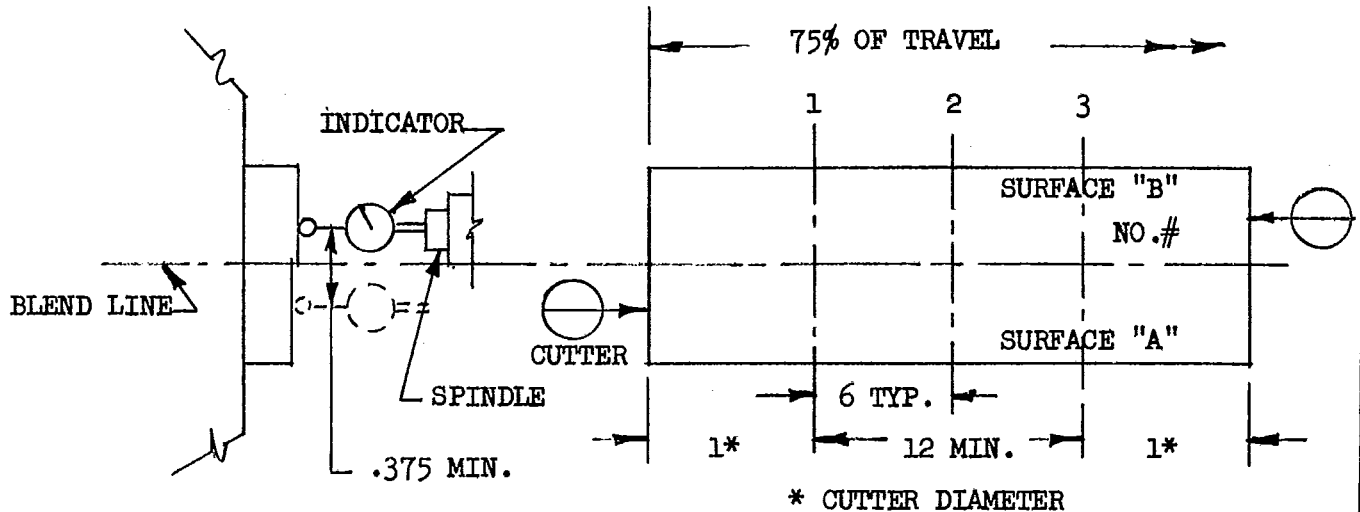
APPROVAL DATE Jan. 1969 REVISION

NATIONAL AEROSPACE STANDARD

AEROSPACE INDUSTRIES ASSOCIATION OF AMERICA, INC., 1725 DE SALES STREET, N. W., WASHINGTON, D. C. 20036

4.3.3.12.1 (CONTINUED)

RECORD: DIFFERENCE BETWEEN SURFACE "A" AND "B" EVERY 6". INDICATOR TO BE SET AT ZERO ON SURFACE "A". READ DIFFERENCE ON SURFACE "B". IDENTIFY TEST PIECES BY NUMBER, SURFACE, AND DIRECTION.



LONGITUDINAL TEST PIECE #			MAX. VAR. PER FT. LONGT.	LONGITUDINAL TEST PIECE #			MAX. VAR. PER FT. LONGT.
1	2	3		1	2	3	

LONGITUDINAL TEST PIECE #			MAX. VAR. PER FT. LONGT.	LONGITUDINAL TEST PIECE #			MAX. VAR. PER FT. LONGT.
1	2	3		1	2	3	

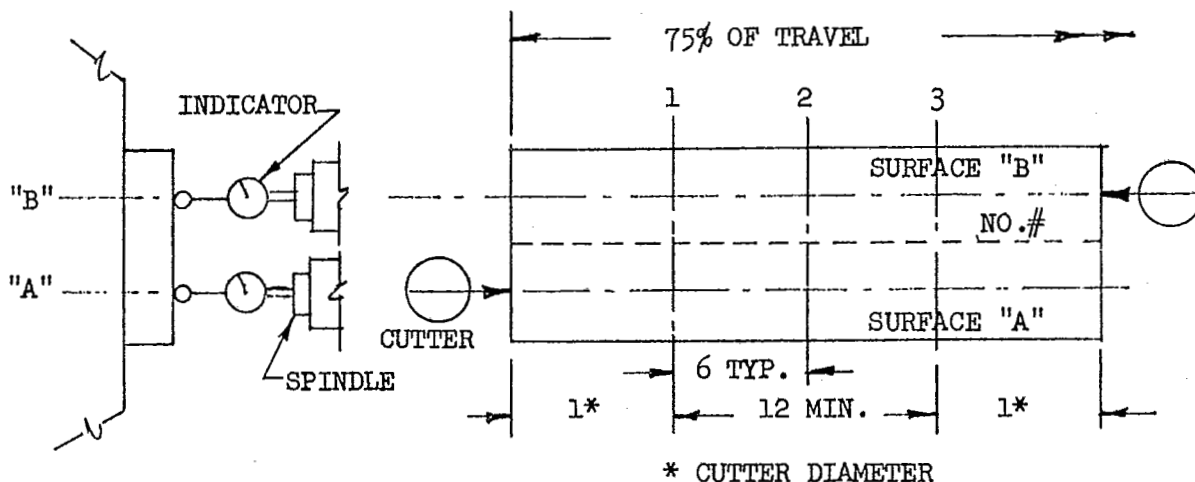
TRANSVERSE TEST PIECE #			MAX. VAR. PER FT. TRANSV.	TRANSVERSE TEST PIECE #			MAX. VAR. PER FT. TRANSV.
1	2	3		1	2	3	

TRANSVERSE TEST PIECE #			MAX. VAR. PER FT. TRANSV.	TRANSVERSE TEST PIECE #			MAX. VAR. PER FT. TRANSV.
1	2	3		1	2	3	

NAS 979
SHEET 55

4.3.3.12.1 (CONTINUED)

RECORD: FLATNESS EVERY 6" FOR BOTH SURFACE "A" AND "B".



	LONGITUDINAL TEST PIECE #			MAX. VAR. PER FT. LONGT.	LONGITUDINAL TEST PIECE #			MAX. VAR. PER FT. LONGT.
	1	2	3		1	2	3	
"A"								
"B"								

LONGITUDINAL TEST PIECE #			MAX. VAR. PER FT. LONGT.	LONGITUDINAL TEST PIECE #			MAX. VAR. PER FT. LONGT.
1	2	3		1	2	3	
"A"							
"B"							

	TRANSVERSE TEST PIECE #			MAX. VAR. PER FT. TRANSV.	TRANSVERSE TEST PIECE #			MAX. VAR. PER FT. TRANSV.
	1	2	3		1	2	3	
"A"								
"B"								

	TRANSVERSE TEST PIECE #			MAX. VAR. PER FT. TRANSV.	TRANSVERSE TEST PIECE #			MAX. VAR. PER FT. TRANSV.
	1	2	3		1	2	3	
"A"								
"B"								

CERTIFIED BY: MANUFACTURER

CUSTOMER

GOVERNMENT

APPROVED DATE

NAS 979

SHEET 56

	APPROVAL DATE	Jan. 1969	REVISION
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4.3.3.12.2

FLATNESS AND MISMATCH CUTTING TEST

MACHINE TYPE - ALL LOW SPEED AND FULL RANGE MACHINES.

TEST CRITERIA:

HORSEPOWER	AS REQUIRED
CUTTER TABLE I	TYPE VIII
SPINDLE SPEED	120 RPM
FEED RATE	3.6 IPM
CHIP LOAD PER TOOTH	.003
DEPTH OF CUT	.060
WIDTH OF CUT	FULL
MATERIAL 4340	2 1/2 x 14 x 28
300 TO 350 BRINELL	MIN. SIZE

EVALUATE: THE DIFFERENCE BETWEEN TWO SUCCESSIVE FINISH CUTS OVER 75% OF LONGITUDINAL AND TRANSVERSE TRAVEL.

	REQUIREMENTS	LONGITUDINAL ACTUAL	TRANSVERSE ACTUAL
FINISH	64 RHR	RHR	RHR
MISMATCH	.001 TIR	TIR	TIR
FLATNESS PER FT.	.001/FT. TIR	/FT. TIR	/FT. TIR
FLATNESS OVER 75% AXIS MACHINING TRAVEL	.001 PLUS .0001 x LENGTH OF TRAVEL IN FT. NOT TO EXCEED .0025 TIR	TIR	TIR

NOTES:

1. FINISH CUT TO BE MADE FULL WIDTH OF CUTTER TRAVELING IN A PLUS DIRECTION AND REMAINING WIDTH OF BLOCK TO BE MADE IN A MINUS DIRECTION.
2. NO CHANGES MAY BE MADE DURING THE CUTS.
3. FLATNESS AND MISMATCH TO BE INSPECTED PRIOR TO UNCLAMPING PART.
4. AT CUSTOMER'S OPTION, LONGITUDINAL AND TRANSVERSE TEST MAY BE COMBINED BY LOCATING MATERIAL AT 45° TO LONGITUDINAL TRAVEL AND EVALUATE AS SPECIFIED FOR 75% OF ONE AXIS.
5. WIPER INSERT BLADE MAY BE USED IN THE CUTTER.

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SHEET 57

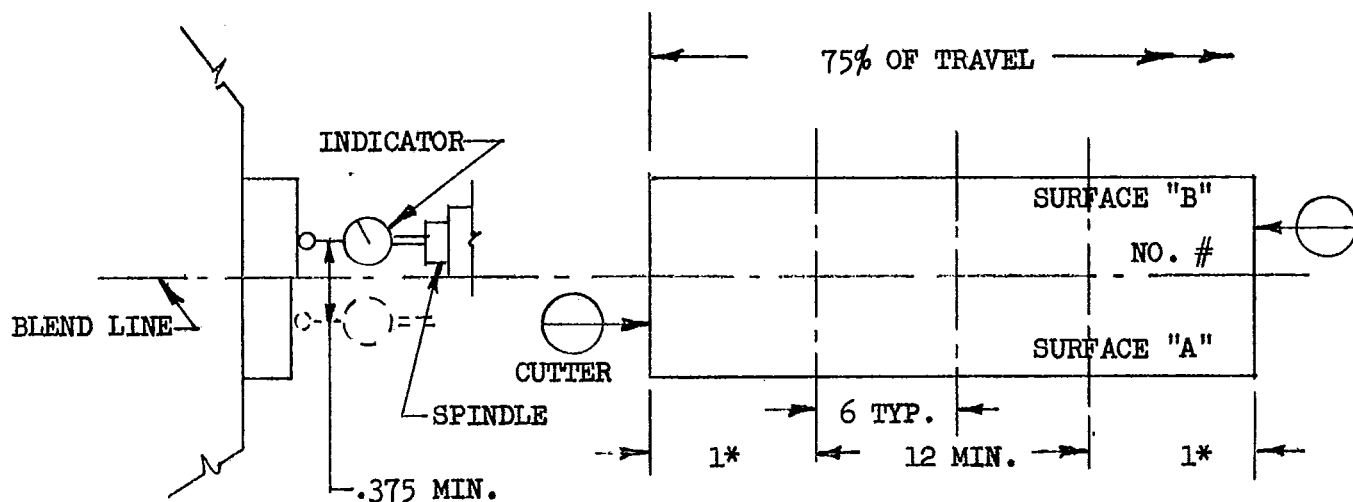
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APPROVAL DATE Jan. 1969 REVISION

4.3.3.12.2 (CONTINUED)

RECORD: DIFFERENCE BETWEEN SURFACE "A" AND "B" EVERY 6". INDICATOR TO BE SET AT ZERO ON SURFACE "A". READ DIFFERENCE ON SURFACE "B". IDENTIFY TEST PIECES BY NUMBER, SURFACE, AND DIRECTION.



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1	2	3		1	2	3	

TRANSVERSE TEST PIECE #			MAX. VAR. PER FT. TRANSV.	TRANSVERSE TEST PIECE #			MAX. VAR. PER FT. TRANSV.
1	2	3		1	2	3	

TRANSVERSE TEST PIECE #			MAX. VAR. PER FT. TRANSV.	TRANSVERSE TEST PIECE #			MAX. VAR. PER FT. TRANSV.
1	2	3		1	2	3	

NAS 979
SHEET 58

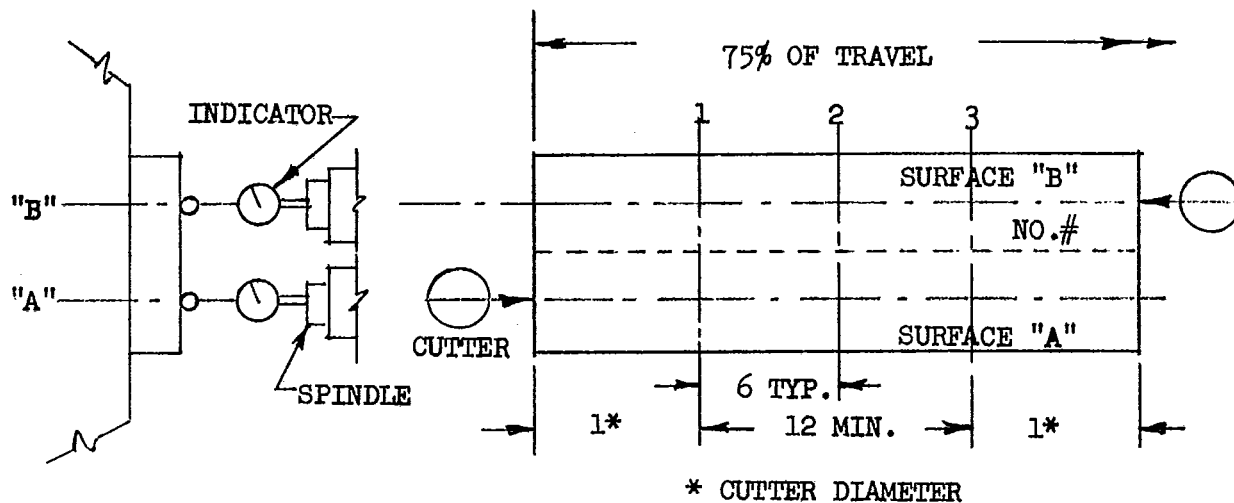
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4.3.3.12.2 (CONTINUED)

RECORD: FLATNESS EVERY 6" FOR BOTH SURFACE "A" AND "B".



	LONGITUDINAL TEST PIECE #			MAX. VAR. PER FT. LONGT.	LONGITUDINAL TEST PIECE #			MAX. VAR. PER FT. LONGT.
	1	2	3		1	2	3	
"A"								
"B"								

	LONGITUDINAL TEST PIECE #			MAX. VAR. PER FT. LONGT.	LONGITUDINAL TEST PIECE #			MAX. VAR. PER FT. LONGT.
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"A"								
"B"								

	TRANSVERSE TEST PIECE #			MAX. VAR. PER FT. TRANSV.	TRANSVERSE TEST PIECE #			MAX. VAR. PER FT. TRANSV.
	1	2	3		1	2	3	
"A"								
"B"								

	TRANSVERSE TEST PIECE #			MAX. VAR. PER FT. TRANSV.	TRANSVERSE TEST PIECE #			MAX. VAR. PER FT. TRANSV.
	1	2	3		1	2	3	
"A"								
"B"								

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CUSTOMER _____

GOVERNMENT _____

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NAS 979
SHEET 59

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