

1.0 PURPOSE

1.1 To describe the steps necessary to manually calibrate the TS150e.

2.0 SCOPE

2.1 This protocol is relevant to the calibration of the TS150*e*.

3.0 APPLICABILITY

3.1 This protocol is applicable to any department calibrating the TS150*e*.

4.0 SUMMARY OF CHANGES / JUSTIFICATIONS OF CHANGES SINCE LAST REVISION

		REVISION STATUS
Rev.	Effective Date	Description & Justifications of Change(s)
1.0	MAY 01 2017	Initial Release / The new TS150e requires documentation to calibrate the CNC.

5.0 **DEFINITIONS**

- 5.1 BRadius (R) Radius between B-axis center of rotation and material
- 5.2 Center Offset (D) distance between center of rotation between A-axis and B-axis
- 5.3 M1_Home_Offset (AHO) A axis home offset
- 5.4 M2_Home_Offset (BHO) B axis home offset
- 5.5 G54_OffsetX offset between machine X-axis zero and G54 X-axis zero
- 5.6 G54_OffsetY offset between machine Y-axis zero and G54 Y-axis zero
- 5.7 G54_OffsetZ offset between machine Z-axis zero and G54 Z-axis zero
- 5.8 CtsPerDegA Counts per degree of A-axis
- 5.9 CtsPerDegB Counts per degree of B-axis
- 5.10 OringOffsetX Machine offset in X-axis
- 5.11 OringOffsetY Machine offset in Y-axis
- 5.12 XAxisScaleCorrection set to 1
- 5.13 XAxisCorrectionAng set to 0

6.0 **REFERENCES**

- 6.1 None.
- 7.0 **RESPONSIBILITIES**
 - 7.1 N/A

8.0 MATERIAL/EQUIPMENT

- 8.1 Digital Caliper
- 8.2 TS150 Calibration Software



- 8.3 PMMA Calibration Blocks -- IOS P/N 40820-01
- 8.4 4mm Carbide Cutting Tool
- 8.5 11mm torque wrench set at 3.95 Nm (for tightening collet/tool)
- 8.6 2.5mm screwdriver hex
- 8.7 Distilled water
- 8.8 3.00mm collet
- 8.9 Micrometer

9.0 PROCESS MAP/FLOW CHARTS

9.1 N/A

10.0 PROCEDURE

Overview: Calibration is achieved by adjusting the calibration parameters of the mill. An initial calibration cube is milled to check the status of the machine. When the mill is not calibrated, the cube will appear distorted and may have a step or twist. When the mill is calibrated, the cube has no distortions and nominally has the dimensions shown below. During the calibration process, measurements of the cube are entered into the calibration software to create new calibration parameters. Iterating this process 3-6 times will calibrate a machine.





- 10.1 Remove the coolant and fill reservoir with plain, distilled water. The distilled water is less viscous than the coolant and will help prevent clogging of the coolant pumps with PMMA.
- 10.2 Remove the top filter from the trough to prevent clogging.



10.3 Open the mill program and click on the **service button**. The password is: 1234.

IOS Technologies Chair-Side Mill 2.0.0.11	
LOAD PROGRAM	IDEW/ELL RATORIES
Patient Info	Material:
(none)	Obsidian
STATUS: Program Cancelled:	
FILE C:\NC\TS150 Calibration Block REV3\ts-150-calibration-block-	rev3.NC
Obsidian	



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Calibration of the TS150e

10.4 Click the **settings tab** to view the initial calibration parameters. If prompted, enter the password IOSTECH.

ervice	Advanced	Settings	Messages	MessageArchive	Burn In Control	UI Colors			
⊿ Burr	n In Settings	3						*	ND X ()
Burn	InDelay				10				X Position (mm)
Burn	InFile								-0.667
Burn	InTime				21:58:30			-	Y Position (mm)
Calif	bration Sett	ings						=	8.496
AAxis	sTotalCounts	-			29153				
BAxis	sTotalCounts				69175				Z Position (mm)
BRad	dius				30.36623377				-0.001
Cente	terOffset				41.12797568				A Desilier (des
CtsP	erDegA				222.38790751				A Position (deg
CtsP	erDegB				222.13825262				-43.800
G54_	OffsetX				0.08				Tool Offset
G54_	_OffsetY				-9.735				-19.761
G54_	_OffsetZ				1.642				
G55_	_OffsetX				0				
G55_	_OffsetY				0				
G55_	_OffsetZ				0				
G56_	_OffsetX				0				
G56	OffsetY				0				
G56_	_OffsetZ				0				
Origi	inOffsetX				0				
Origi	inOffsetY				20.9269873				
XAxis	sScaleCorrec	tion			1.022				
YAxis	sCorrectionAr	ng			1.3				
ZAxis	sTotalCounts				25000			*	
ontrolle to the c effec	er settings are operator scre ct the next time	e download en. Most ot e that the p	ed when retur her settings ta rogram is run	ning ake		Export	Restore Default Settin	ngs	DONE

10.5 Enter the starting calibration parameters below.

Table 1

B Radius	Center Offset	M1 Home Offset	M2 Home Offset	G54X	G54Y	G54Z	Origin Offset X	Origin Offset Y	CtsPerDegA	CtsPerDegB
29.8	40	15100	-42000	0	-10.0	1.300	0	21	222.2222	222.2222

10.6 **Important**: On all machines, set the following parameters. These values won't change during calibration:

Table 2

XAxisScaleCorrection	YAxisCorrectionAng	CtsPerDegA	CtsPerDegB
1	0	222.2222	222.2222



10.7 Click done.

#1K #2K

10.8 Click the **Advanced Tab** to gain access to the **Command Line**. In the **Command Line** enter these four separate commands.

#211			
I7010=3			
17020=3			
IOS Technologies Chair-Side Mill 2.0.0.10			_ _ ×
Service Advanced Settings Messages M	lessageArchive Burn In Control UI Colors		- 2
Axis mm/degrees Counts ▲ X 0.045		GUI Version: 2.0.0 10 A	X Position (mm) 0.045 Y Position (mm) 9.508
Command Line	Inputs	Outputs	Z Position (mm) 0.000
A Set	 0: Air Pressure Good (goes on when pressure is above 70psi) 1: Door Closed 2: Unused 3: Oil Level (jumper in place = ON. removed = OFF) 	 0: Indexer Direction 1: Indexer Motor 2: High Speed Air 3: Door Lock Valve 	A Position (deg) -42.314 Tool Offset -16.973
B Set Z Set X mm Set	4: Trough Loaded 5: Coolant Pressure OK 6: Unused	 4: Coolant Pump 5: Oil Pump 6: Low Speed Air 	
Y mm Send Command NC File Stats Watch	7: Indexer Moving	7: Unused	
•	m	4	DONE

10.9 Rotate the A Axis all the way to one of its hard stops. Record the **Counts Value**.

🛐 IOS T	echnologies Chair-	Side Mill 2.0.	0.10					
Servic	e Advanced	Settings	Messages	MessageArchive	Burn In Control	II Colors		
Axis X Y Z A B	mm/degrees 0.045 9.508 0.000 -42.314 42.275 "	Counts 0 174 -9394.662 9395.809		Jog -	Axis A	Jog +	GUI Version: 2.0.0.10 PLC/Motion SW Version	X Position (mm) 0.045 Y Position (mm) 9.508 Z Position (mm) 0.000
Comr #1K	and Line			0: Air 0: whe	Pressure Good (go an pressure is abov or Closed	es on re 70psi)	0: Indexer Direction 1: Indexer Motor	A Position (deg) -42.314
Move	,			2: Uni	used	- ON	2: High Speed Air	-16.973
A B			▼ Set▼ Set	3: on 3: rem 4: Tro	vugh Loaded	ace – ON,	3: Door Lock Valve 4: Coolant Pump	
z			▼ Set	5: Coo	plant Pressure OK		5: Oil Pump	
Y Y	m	m M		6: Uni	used exer Moving		6: Low Speed Air 7: Unused	
■ 1	C File Stats	- Se	nd Command Watch	Tool Tool	uch			



- 10.10 Rotate the A Axis to its other stop. Record the Counts Value again.
- 10.11 Calculate the difference by taking the larger number and subtracting the smaller value. Example:

	10000
_	-15000
	25000

- 10.12 Enter this number as **AAxis TotalCounts** in the **Settings Tab.** Click **Done.**
- 10.13 Repeat steps 10.10 through 10.13 for the B Axis, updating the **BAxis TotalCounts** setting.
- 10.14 Close the GUI and cycle the power with the **Rear Rocker Switch**.
- 10.15 Run the calibration program. Click Load Program to find the NC file.

LOAD PROGRAM	LIDEWELL RATORIES
Patient Info	Material:
(none)	Obsidian
STATUS: Program Cancelled:	
FILE C:NC\TS150 Calibration Block REV3\ts-150-calibration-block	ock-rev3.NC
Obsidian	

10.16 Choose TS150e Calibration Block 4mm.NC for the TS150e. Take care to ensure the correct file is chosen for the mill.

Burn	New folder				
;	Name	Date modified	Туре	Size	
р	block-lacing	8/3/2016 3:43 PM	Text Document	21 KB	
oads	ts-150e-calibration-block-rev3.NC	8/3/2016 5:05 PM	NC File	1 KB	
ULT					
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Places					
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10.17 Load a PMMA calibration block and a 4mm carbide cutting tool using the precalibrated torque wrench.





10.18 When milling is complete, open the TS150 calibration program.

TS150 Calibration	Program V0.4		-	-	the locations in	and an other		- X
Measured Values								
Top:	13	Top Step Dir:	No Step	•				~
Bottom:	13	Bot Step Dir:	No Step	•				TOP STEP
Top Step:	13	Block-Mandrel:	35.665				\wedge	>
Bottom Step:	13	Z Dim:	13		TOP	\sim	\times	
GUI Calibration Para	ameters					\sim	\sim	¥
Center Offset:	40	G54X:	0				É.	BAC
B Radius:	29.8	G54Y:	-10				FRO	
M1 Home Off:	15100	G54Z:	1.65		1	\checkmark		
M2 Home Off:	-42000	Origin Off. X:	0			Bot		
Cts. Per Deg A:	222.2222	Origin Off. Y:	21		B	Sot Step		2-011
Cts. Per Deg B:	222.2222]				Y	l Q	
New Calibration Par	ameters						\bigcirc	
	Genera	ate Cal. Param.			BLOCK-MANDREL			
						/		
Center Offset:		G54X:		_				
B Radius:		G54Y:						
M1 Home Off:		G54Z:			+			
M2 Home Off:								

10.19 Using a digital caliper, measure the following dimensions on the finished block:





10.20 Enter the new measurements into the calibration program.

Measured Values										
Top:	13	Top Step Dir:	No Step	•					~	
Bottom:	13	Bot Step Dir:	No Step	•				/	7	OP STEP
Top Step:	13	Block-Mandrel:	35.665		L			\square		
Bottom Step:	13	Z Dim:	13		L	TOP		>	\supset	/
GUI Calibration Para	ameters						\sim	\searrow	Tr	
Center Offset:	40	G54X:	0			/			BAC	
B Radius:	29.8	G54Y:	-10						PH C	
M1 Home Off:	15100	G54Z:	1.65		1	É ,	\sim			~
M2 Home Off:	-42000	Origin Off. X:	0			\langle	Bot			
Cts. Per Deg A:	222 2222	Origin Off. Y:	21			Bot	Step	7	\sum	2-014
Cts. Per Deg B:	222.2222						$\mathbf{\mathbf{v}}$	6	3	
Vew Calibration Par	ameters									
	Ger	nerate Cal. Param.			BLUCK M	MUREL		/		
Center Offset:		G54X:					/			
B Radius:		G54Y:								
M1 Home Off:		G54Z:								
M2 Home Off:										

- 10.21 For Top Step Direction, when facing the set screw hole, enter whether the front or back face protrudes higher at the top side of the block; towards you is higher. For Bottom Step Direction enter whether the front or back face protrudes higher for the bottom side of the block. Example: image above shows the top step direction is back higher, and the bottom step direction is also back higher.
- 10.22 Enter the GUI parameters used for milling the calibration block into the calibration program.

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Service Advanced Settings Messages Messag	eventive Bars In Control UII Colors							
Purrin/Living Durini/Living Calibration Statings Adual SoliChurds Data StatiChurds CalibraChuid Chuid Chu	10 21:63:30 29:953 30:24420377 41:12795480 2023 30796591 2023 30796591 2023 30796591 2023 30796591 2023 30796591 2023 30796591 2023 3079659 2023 3079659 2024 3079659 20240000000000000000000000000000000000	, XP 2 P 2 P	Validar (HH) 6.467 8.456 8.456 4.041 4.	 11 11 11 11 11 12 14 124 124 125 4700 125,000 125,000 	Ma Bay Sr. Ye Bay Book Marane II 444 2 Star II Star II Star II Star II Star II Star II Star II Star II Star II Star II	1		the second secon
GBL_ONLY GBL_ONLY GBL_ONLY Association Ass	0 0 20 (000073) 1.02 1.3 20000 Kapont	- Restore Defeat Suffings	Concernance Concer		state Cal Pases State State State	ļ	- /	



TS150 Calibration	Program V0.4	per chi canal	-	-			
Measured Values							
Top:	13	Top Step Dir:	No Step	-			
Bottom:	13	Bot Step Dir:	No Step				/
Top Step:	13	Block-Mandrel:	35.665				\wedge
Bottom Step:	13	Z Dim:	13		TOP	\sim	\searrow
GUI Calibration Para	ameters				×	$\!$	\searrow
Center Offset:	40	G54X:	0		/	$ \land \checkmark $	E
B Radius:	29.8	G54Y:	-10				L R
M1 Home Off:	15100	G54Z:	1.65		1		
M2 Home Off:	-42000	Origin Off. X:	0		$\langle \langle \rangle$	Bot	XV
Cts. Per Deg A:	222 2222	Origin Off. Y:	21		Bot St	•	
Cts. Per Deg B:	222 2222					$\mathbf{\mathbf{Y}}$	10
New Calibration Rev	ameters						G
	Ger	nerate Cal. Param.			LOCK-MANDREL	/	\succ
Center Offset:	1	G54X:					
B Radius:		G54Y:					
M1 Home Off:		G54Z:					
M2 Home Off:					-		

- 10.24 Click the **settings tab** to view the previous calibration parameters. Enter the new calibration parameters into the mill settings. Keep settings the same from Table 2 Click **done**. Click **reset controller button**, then click **yes**. This will make the changes effective.
- 10.25 Run a new calibration block on the machine with the new parameters. (Section 10.16 10.26). With each iteration, the mill will get closer to being calibrated. It may take 3 to 6 blocks to fully calibrate a machine.
- 10.26 When the step has been eliminated and the top and bottom measurements are in spec, input 13.00 for top, top step, bottom and bottom step and continue calibration.
- 10.27 Repeat the process until a block with no distortions and all the correct dimensions (see below) is produced. The mill is calibrated. Please note that we should get as close to nominal measurements as possible since over time the machine may lose calibration. This calibration process can get within 20 microns of the nominal measurements but the machine is considered calibrated if the machine is within the tolerances in the figure below. Note there is a parallelism tolerance of 20 microns between surfaces along the x axis. The parallelism tolerance is the difference in measurement in the x dimension between top and bottom of the block.

Measurements	(mm)
Тор	13±0.05
Bottom	13±0.05
Top Step	13±0.05
Bottom Step	13±0.05
Z-Dimension	13-13.05
Block-Mandrel Dimension	35.665±0.10
X-Dimension Planar Tolerance	0.020



11.0 REQUIRED PROPERITES

11.1 See section 10.22.

12.0 DOCUMENTATION

12.1 None.

END OF DOCUMENT