



MAKINO

VERTICAL MACHINING CENTER

S-Series

MAINTENANCE MANUAL



V0718I-M1E-XA



WARNING

1. Do not maintain, inspect or repair this machine before carefully reading and understanding this Maintenance Manual
2. Store this manual in a clearly marked location for easy reference when maintaining, inspecting or repairing this machine

Contents

1.	Introduction	7
1.1	Machine Characteristics.....	8
1.2	Components and Machine Function	9
1.3	Makino Service Contact.....	10
2.	Safety Precautions.....	11
2.1	Introduction.....	11
2.2	General Safety.....	11
2.3	Danger, Warning, Caution Statements and Symbols.....	12
2.4	Personal and Professional Safety.....	14
2.5	Environmental Safety.....	15
2.6	Mechanical Maintenance Safety.....	16
2.7	Electrical Maintenance Safety.....	17
2.8	Tooling Safety.....	17
2.9	Coolant Safety.....	18
2.10	Installation Safety.....	19
2.11	Lifting Safety.....	19
2.12	First Aid.....	21
3.	Specifications.....	22
3.1	Introduction.....	22
3.2	Mechanical and Electrical Specification.....	24
3.3	Makino Professional-3 Control Specifications.....	26
4.	Periodic Maintenance.....	32
4.1	Daily Maintenance.....	33
4.2	Every 500 Hrs Maintenance.....	34
4.3	Every 1000 Hrs Maintenance.....	35
4.4	Every 2000 Hrs Maintenance.....	35
4.5	Every 6000 Hrs Maintenance.....	36
4.6	Periodic Maintenance Procedures.....	37
4.6.1	X, Y, Z-Axis.....	37
4.6.2	Spindle Oil Temperature Controller.....	50
4.6.3	Automatic Tool Changer (ATC).....	56
4.6.4	Automatic Pallet Changer (APC).....	56
4.6.5	Coolant tank & Chip conveyor.....	58
4.6.6	Hydraulic Unit.....	61
4.7	Oil and Grease Requirements.....	62
5.	Technical Specifications.....	63
5.1	Introduction.....	63
5.2	Troubleshooting on Spindle.....	66
5.2.1	Introduction.....	66
5.2.2	Spindle Motor.....	69
5.2.3	Spindle Tool Clamp/ Unclamp.....	70
5.2.4	Clamp/ Unclamp Limit Switches.....	70
5.2.5	Limit Switch Adjustment.....	71
5.2.6	Spindle Orientation.....	72
5.2.7	Emergency Stop Button Is Pressed During Spindle Rotation.....	72
5.2.8	Spindle Start / Stop Malfunction.....	73
5.2.9	Spindle Speed Range Switching.....	74
5.2.10	Spindle Oil Temperature Controller (12K/13K).....	74
5.2.11	Trouble and Corrective Measures.....	80

5.2.12	Spindle Oil Temperature Controller (20K).....	82
5.2.13	Circuit Breakers and Circuit Protectors.....	85
5.3	Machine Axes.....	86
5.3.1	Introduction.....	86
5.3.2	General view and components.....	87
5.3.3	Axes Configuration.....	89
5.3.3.1	Standard Machine (Without Scales).....	89
5.3.3.2	Standard Machine (With Scales).....	90
5.3.4	Axes Limit switches and Signals.....	91
5.3.5	Axes Stroke Limits.....	96
5.3.6	Axes Stroke Setting Procedure.....	96
5.3.7	X-axis Reference Position setting.....	96
5.3.8	Y-axis Reference Position setting.....	97
5.3.9	Z-axis Reference Position setting.....	97
5.3.10	Over Travel OT2 setting for X, Y and Z -axis.....	98
5.3.11	Grid Shift Parameter Input Procedure.....	98
5.3.12	Axes Support and Guide Mechanism.....	98
5.3.13	Periodic Maintenance.....	101
5.3.14	Feed Axis.....	101
5.3.15	Feed Axis Fails to Move in Manual Mode.....	101
5.3.16	Servo Alarm Is Triggered During Operation.....	102
5.3.17	Feed Axis Runs Until Hitting Mechanical Stop.....	102
5.3.18	Positioning Accuracy Not Achieved.....	102
5.3.19	Abnormal Noise or Vibration Is Generated When Axis Is Operated.....	103
5.4	Automatic Tool Changer.....	103
5.4.1	Introduction.....	103
5.4.2	ATC Stand-By.....	104
5.4.3	ATC Sequence.....	104
5.4.4	Tool Pot Up/Down.....	108
5.4.5	ATC Cam switch.....	109
5.4.6	Magazine Tool Loading and Unloading.....	109
5.4.7	Tool Magazine Reference Point Return.....	110
5.4.8	Automatic Tool Changing in MDI.....	110
5.4.9	ATC Stand-by restoring procedure.....	110
5.4.10	PC Screen Maintenance Mode.....	111
5.4.11	ATC Manual Operation.....	111
5.4.12	ATC Periodic Maintenance.....	112
5.4.13	Other Important checks.....	112
5.4.14	Registering Tool Number.....	113
5.4.15	Emergency Stop Button Pressed During ATC.....	114
5.4.16	Tool Exchange Operation Does Not Start.....	114
5.4.17	Tool Dropped During Tool Exchange.....	115
5.4.18	ATC Standby Condition.....	115
5.4.19	Moving ATC to Standby Condition.....	116
5.5	Automatic Pallet Changer (APC).....	117
5.5.2	Pallet Loading Station.....	117
5.5.3	APC Operation Panel.....	117
5.5.4	APC Safety Guard (Option).....	117
5.5.5	Pallet Change (APC) Operation.....	117
5.5.6	APC to Standby Condition.....	119
5.5.7	Locating Cone cleaning Air.....	122

5.5.8	APC Adjustments.....	122
5.5.8.1	Y axis Pallet Change Position Adjustment.....	122
5.5.8.2	APC Operation LS101/102/103 Adjustment	122
5.5.9	Hydraulic circuit	125
5.5.10	APC Periodic Maintenance.....	125
5.5.11	APC Alarms	126
5.5.12	APC Flow Chart.....	134
5.5.13	Manual Recovery Procedure for APC.....	135
5.6	Pneumatic System.....	136
5.6.1	Machine Air Requirements	136
5.6.2	Pneumatic Elements.....	142
5.6.2.1	Air Filter	142
5.6.2.2	Lubricator.....	142
5.6.2.3	Air Pressure Switch	142
5.6.2.4	Pneumatic Piping.....	145
5.6.3	Air Supply Trouble Shooting:	146
5.7	Air Dyer.....	153
5.8	Hydraulic System.....	158
5.8.1	Hydraulic System in Automatic Pallet Changer (APC):.....	158
5.8.2	Adjustment and Set up of Components	159
5.8.2.1	Pressure Adjustment and Hydraulic Unit Flow.....	159
5.8.3	Hydraulic System for Tool Clamp/Unclamp (20K) machines:	163
5.8.4	Hydraulic Power unit.....	164
5.8.5	Valve block assembly	164
5.8.6	Periodic Replacement Or Supply Of Hydraulic Oil.....	166
5.8.7	Troubleshooting.....	166
5.8.8	Hydraulic Oil Level Drops In A Short Period	166
5.8.9	Hydraulic Unit Pressure Doesn't Rise.....	166
5.8.10	Hydraulic Unit Pump Emits Abnormal Noise.....	167
5.8.11	Hydraulic Oil Leakage.....	167
5.8.12	Hydraulic Unit Motor Does Not Start.....	167
5.9	Options	168
5.9.1	Thermal Overload Relays	168
5.9.2	Main Air Pressure Switch.....	169
5.9.3	Emergency and Overtravel Limits.....	169
5.9.4	Fixture Hydraulics.....	169
5.9.5	Through Spindle Coolant (TSC).....	170
5.9.6	Auto Door	171
5.9.7	Lift Up Chip Conveyor.....	171
6.	Trouble Shooting and Diagnosis on CNC Unit.....	172
6.1	DI/DO Address and Bit Display.....	173
6.2	Inputting/Outputting Data.....	174
6.2.1	Parameter for Data Input/Output.....	174
6.2.2	Outputting CNC Parameters.....	176
6.2.3	Outputting Pitch Error Compensation Amount.....	176
6.2.4	Outputting Custom Macro Variable Values.....	176
6.2.5	Outputting Tool Compensation Amount.....	176
6.2.6	Outputting Part Program.....	176
6.2.7	Inputting CNC Parameters.....	177
6.2.8	Inputting Pitch Error Compensation Amount.....	177
6.2.9	Inputting Custom Macro Variable Values.....	177

6.2.10	Inputting Tool Compensation Amount.....	178
6.2.11	Inputting Part Programs.....	178
6.3	Troubleshooting the CNC Unit.....	179
6.3.1	Neither Manual Operation nor Automatic Operation can be Executed	179
6.3.2	Jog Operation cannot be performed	182
6.3.3	Handle Operation cannot be performed.....	182
6.3.4	Automatic Operation Cannot be Performed.....	184
6.3.5	Cycle Start LED Signal has Turned OFF	189
6.3.6	Nothing is Displayed on LCD	191
6.4	Interface between CNC and PMC.....	191
7.	CNC Alarms.....	209
7.1	Introduction	209
7.2	CNC Alarm Display	210
7.3	CNC Alarm History Display.....	210
7.4	List of CNC Alarms	211
7.4.1	Alarms on Programs and Operation	211
7.4.2	Background Edit Alarm	227
7.4.3	Absolute Pulse Coder (APC) Alarm	227
7.4.4	Serial Pulse Coder (SPC) Alarms.....	228
7.4.5	Servo Alarms	230
7.4.6	Overtravel Alarms.....	233
7.4.7	Overheat Alarms.....	234
7.4.8	Rigid Tapping Alarm	234
7.4.9	Spindle Alarms.....	235
7.4.10	System Alarms.....	238
8.	PMC Operator Alarms.....	240
8.1	Introduction	240
8.2	PMC Alarm Screen	240
8.3	PMC Alarm History Display.....	241
8.4	Alarm Listings	242
8.4.1	Alarm Listing of I/O unit	242
8.4.2	Alarm of pallet changer.....	242
8.4.3	Alarm of transportation I/F and pallet magazine	244
8.4.4	Alarm of ATC Magazine (First Axis).....	245
8.4.5	Alarm sub of ATC	246
8.4.6	Alarm of ATC	247
8.4.7	Alarm of spindle.....	251
8.4.8	Alarm of Index table of B-axis.....	252
8.4.9	Alarm of coolant.....	252
8.4.10	Alarm of dump machine parameter and tool data.....	253
8.4.11	Alarm of thermal and flow switch etc	253
8.4.12	Alarm of measurement system and feed shaft	256
8.4.13	Alarm of serial communication.....	256
8.4.14	Alarm of pallet changer operation board.....	257
8.4.15	Alarm of ATC operation panel.....	257
8.4.16	Alarm of tool searching code (T – code)	259
8.4.17	Alarm of automatic tool monitor	259
8.4.18	Alarm cycle and random operation	260
8.4.19	Alarm of one touch function	261
8.4.20	Alarm of operation of tool searching	261
8.4.21	Alarm of machine state monitor	263

8.4.22	Alarm GI and NC function.....	263
8.4.23	Alarm of processing of MST code.....	264
8.4.24	Alarm of ATC side BTS.....	267
8.4.25	Alarm of serial communication (channel B).....	267
8.4.26	Alarm of FA network.....	267
9.	Trouble Shooting Servo System.....	268
9.1	Introduction.....	268
9.1.1	Servo Alarm List.....	269
9.1.2	Spindle Alarm List.....	270
9.2	Power Supply Module Trouble Shooting.....	271
9.2.1	Alarm Code 01.....	271
9.2.2	Alarm Code 02.....	271
9.2.3	Alarm Code 03.....	272
9.2.4	Alarm Code 04.....	272
9.2.5	Alarm Code 05.....	272
9.2.6	Alarm Code 06.....	273
9.2.7	Alarm Code 07.....	273
9.3	Servo Amplifier Troubleshooting.....	273
9.3.1	Abnormal Current Alarms (8,9,A,B,C,D,E).....	274
9.3.2	IPM Alarms (8.,9.,A.,b.,C.,d. and E.).....	274
9.3.3	Control Power Supply Under Voltage Alarm (2 in the LED display).....	275
9.3.4	DC Link Under Voltage Alarm (5 in the LED display).....	275
9.3.5	Fan Stopped Alarm (1 in the LED display).....	275
9.3.6	Current Conversion Error Alarm.....	276
9.3.7	Overload Alarm.....	276
9.3.8	Feedback Disconnected Alarm.....	276
9.3.9	Motor Overheat Alarm.....	277
9.3.10	Invalid Servo Parameter Setting.....	277
9.3.11	Pulse Coder Error Alarm.....	277
9.3.12	Rotation Speed Data Error Alarm.....	277
9.3.13	Pulse Coder Communication Error Alarm.....	278
9.4	Spindle Amplifier Module Troubleshooting.....	278
9.4.1	Alarm A0, A1.....	279
9.4.2	Alarm AL-01.....	279
9.4.3	Alarm AL-02.....	280
9.4.4	Alarm AL-03.....	280
9.4.5	Alarm AL-07.....	281
9.4.6	Alarm AL-09.....	281
9.4.7	Alarm AL-12.....	281
9.4.8	Alarm AL-13.....	282
9.4.9	Alarm AL-15.....	282
9.4.10	Alarm AL-16.....	282
9.4.11	Alarm AL-19.....	283
9.4.12	Alarm AL-20.....	283
9.4.13	Alarm AL-24.....	283
9.4.14	Alarm AL-25.....	284
9.4.15	Alarm AL-26.....	284
9.4.16	Alarm AL-27.....	285
9.4.17	Alarm AL-28.....	285
9.4.18	Alarm AL-29.....	286
9.4.19	Alarm AL-31.....	286

9.4.20	Alarm AL-32.....	287
9.4.21	Alarm AL-34.....	287
9.4.22	Alarm AL-35.....	287
9.4.23	Alarm AL-36.....	287
9.4.24	Alarm AL-37.....	288
9.4.25	Alarm AL-39.....	288
9.4.26	Alarm AL-40.....	289
9.4.27	Alarm AL-41.....	289
9.4.28	Alarm AL-42.....	290
9.4.29	Alarm AL-43.....	290
9.4.30	Alarm AL-44.....	291
9.4.31	Alarm AL-46.....	291
9.4.32	Alarm AL-47.....	291
9.4.33	Alarm AL-49.....	292
9.4.34	Alarm AL-50.....	292
9.4.35	Alarm AL-52, AL-53	292
9.4.36	Alarm AL-54.....	293
9.4.37	Alarm AL-55.....	293
9.4.38	Alarm AL-56.....	293
10.	Appendix 1.....	295
10.1	Limit Switches and Solenoid Valves	295
11.	Appendix 2.....	297
11.1	DI/DO List	297
11.1.1	Machine I/O List.....	297
11.1.2	Operator Panel I/O List.....	302
12.	Appendix 3.....	306
12.1	Connector Location and Application in FS18I Controller.....	306
12.2	Connector and Relay locations on RELAY PCB.....	307
12.3	Connector and Relay locations on Option PCB (Option)	308
12.4	Connector and Relay locations on Automatic Pallet Changer PCB (Option)	308
12.5	Connector and relay locations for Operator PCB's.	309
13.	Appendix 4.....	312
13.1	Spindle Head Unit.....	312
13.2	Y Axis Signal.....	312
13.3	Axis Motor & X Axis Signal	313
13.4	ATC.....	313
13.5	Oilmatic.....	314
13.6	ATC Magazine	314
13.7	Spindle Terminal box, Heat Sink, Main Circuit Breaker, RS232 Connector.....	315
13.8	MTC Cabinet.....	316
13.9	Operator Panel	320