



# *technical service manual*



*This Technical Service Manual includes information for the following oven models:*

- **PS200/220/224 Series**
- **PS310/360 Series**
- **PS555/570 Series**



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Middleby is proud to support the Commercial Food Equipment Service Association (CFESA). We recognize and applaud CFESA's ongoing efforts to improve the quality of technical service in the industry.



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P/N 47829 • Rev. C • V1 • 4/02



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## WARNING

Improper installation, adjustment, alteration, service or maintenance can cause property damage, injury or death. Read the installation, operating and maintenance instructions thoroughly before installing or servicing this equipment.

## WARNING

DISCONNECT THE OVEN FROM ITS ELECTRICAL POWER SUPPLY BEFORE SERVICING.

## NOTICE

During the warranty period, ALL parts replacement and servicing should be performed by your Middleby Marshall Authorized Service Agent. Service that is performed by parties other than your Middleby Marshall Authorized Service Agent may void your warranty.

## NOTICE

Using any parts other than genuine Middleby Marshall factory manufactured parts relieves the manufacturer of all warranty and liability.

## NOTICE

Middleby Marshall reserves the right to change specifications at any time.

# TABLE OF CONTENTS

Section 1 - Sequence of Operation .....	4	F. Initial Troubleshooting .....	18
I. Gas Oven Sequence of Operation .....	4	G. Conveyor Control Pickup Test .....	19
II. Electric Oven Sequence of Operation .....	6	H. Conveyor Motor Test .....	19
		I. Replacing the Magnetic Pickup .....	19
Section 2 - Air Flow and Heat Transfer .....	7	J. Unshielded Pickup Wires on Early PS360-series Ovens ..	19
I. Types of Heat Transfer .....	7	K. Appendices .....	20
II. Blowers and Blower Speed .....	7	• Conveyor sensor wiring changes for PS360-series	
A. PS200-series ovens .....	7	and PS570S, 10/95 .....	20
B. PS360-series ovens .....	8	• Service Bulletin MM-133B - Installation Instructions	
C. PS555/570-series ovens .....	8	for Conveyor Speed Controller Kit with Thumbwheel,	
III. Air Fingers .....	8	P/N 42810-0133, 4/95 .....	21
A. Description and Function .....	8	• Instructions for Service Kit 42810-0133- Conveyor	
B. Configuration and Alignment .....	9	Speed Controller Kit with Thumbwheel, 4/95 .....	23
C. Performing a Test Bake .....	9	• Service Bulletin MM-177 - Introduction and Compat-	
D. PS300/350 Air Finger Shutter Adjustment .....	10	ibility of Conveyor Speed Controller with Digital	
IV. Oven Capacity .....	12	Display, P/N 37337, 8/00 .....	27
A. Conveyor Speed and Bake Time .....	12	• Instructions for Service Kit 44756 - Conveyor Speed	
B. Belt Time .....	12	Controller Kit for PS200R68-series Ovens, 2/02 ...	28
C. Time of Delivery (TOD) .....	12	• Service Bulletin MM-189 - New Conveyor Gear	
		Motors, Brushes, and Pickup Clamps, 8/01 .....	29
		• DIP switch settings for Conveyor Speed Controller	
Section 3 - Troubleshooting and Servicing Components		with Digital Display (P/N 37337), 4/02 .....	30
I. Conveyor Speed Controller and Drive Motor .....	13	II. Temperature Controller .....	30
A. Part Number Reference - Speed Controllers .....	13	A. Part Number Reference - Temperature Controllers .....	31
B. Part Number Reference - Pickup Assemblies .....	14	B. Description .....	32
C. Preparing to Service the Speed Controller .....	14	C. High Limit/Cooldown Functions .....	32
D. Controller/Motor Failure .....	15	D. Troubleshooting .....	32
E. Basic Troubleshooting Flowcharts .....	16	E. Appendices .....	32
• If the Conveyor Runs at Full Speed .....	16	• Temperature Controller Terminal	
• If the Conveyor Will Not Run at All .....	17	Cross-Reference, 4/02 .....	32
		• Instructions for Service Kit 47321 - Digital	
		Temperature Controller Kit, 2/02 .....	33
		• Service Bulletin MM-136 - Electrical Noise Filter	
		Capacitor Assembly on Temperature Controllers,	
		9/93 .....	43

# TABLE OF CONTENTS (continued)

<table border="0" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 5%;">III.</td> <td style="width: 85%;">High Limit Control Module .....</td> <td style="width: 10%; text-align: right;">45</td> </tr> <tr> <td style="width: 5%;">A.</td> <td style="width: 85%;">Part Number Reference - High Limit Control Modules .....</td> <td style="width: 10%; text-align: right;">45</td> </tr> <tr> <td style="width: 5%;">B.</td> <td style="width: 85%;">Location .....</td> <td style="width: 10%; text-align: right;">45</td> </tr> <tr> <td style="width: 5%;">C.</td> <td style="width: 85%;">Troubleshooting .....</td> <td style="width: 10%; text-align: right;">45</td> </tr> <tr> <td style="width: 5%;">D.</td> <td style="width: 85%;">Appendices .....</td> <td style="width: 10%; text-align: right;">46</td> </tr> <tr> <td></td> <td style="padding-left: 20px;">• <i>Instructions for Service Kit 39733 - High Limit Conversion Kit for PS300, 310, 350 &amp; 360 Ovens, 5/99</i> .....</td> <td style="width: 10%; text-align: right; vertical-align: bottom;">46</td> </tr> <tr> <td style="width: 5%;">IV.</td> <td style="width: 85%;">Thermocouples .....</td> <td style="width: 10%; text-align: right;">54</td> </tr> <tr> <td style="width: 5%;">A.</td> <td style="width: 85%;">Part Number Reference - Thermocouples .....</td> <td style="width: 10%; text-align: right;">54</td> </tr> <tr> <td style="width: 5%;">B.</td> <td style="width: 85%;">Thermocouple Functions .....</td> <td style="width: 10%; text-align: right;">54</td> </tr> <tr> <td style="width: 5%;">C.</td> <td style="width: 85%;">Troubleshooting .....</td> <td style="width: 10%; text-align: right;">54</td> </tr> <tr> <td style="width: 5%;">D.</td> <td style="width: 85%;">Appendices .....</td> <td style="width: 10%; text-align: right;">56</td> </tr> <tr> <td></td> <td style="padding-left: 20px;">• <i>Instructions for Service Kits 33984 and 33985 - Oven Thermocouple Kit, 11/01</i> .....</td> <td style="width: 10%; text-align: right; vertical-align: bottom;">56</td> </tr> <tr> <td style="width: 5%;">V.</td> <td style="width: 85%;">Blowers .....</td> <td style="width: 10%; text-align: right;">68</td> </tr> <tr> <td style="width: 5%;">A.</td> <td style="width: 85%;">PS200-series ovens .....</td> <td style="width: 10%; text-align: right;">68</td> </tr> <tr> <td style="width: 5%;">B.</td> <td style="width: 85%;">PS360-series ovens .....</td> <td style="width: 10%; text-align: right;">74</td> </tr> <tr> <td style="width: 5%;">C.</td> <td style="width: 85%;">PS555/570-series ovens .....</td> <td style="width: 10%; text-align: right;">76</td> </tr> <tr> <td style="width: 5%;">VI.</td> <td style="width: 85%;">Blower Motor Centrifugal Safety Switch (PS360-series) .....</td> <td style="width: 10%; text-align: right;">80</td> </tr> <tr> <td style="width: 5%;">A.</td> <td style="width: 85%;">Part Number Reference - Blower Centrifugal Switch .....</td> <td style="width: 10%; text-align: right;">80</td> </tr> <tr> <td style="width: 5%;">B.</td> <td style="width: 85%;">Troubleshooting .....</td> <td style="width: 10%; text-align: right;">80</td> </tr> <tr> <td style="width: 5%;">VII.</td> <td style="width: 85%;">Burner Blower Motor Centrifugal Safety Switch (PS200-series gas, PS310, PS314, PS360, PS360WB, PS570S) .....</td> <td style="width: 10%; text-align: right;">80</td> </tr> <tr> <td style="width: 5%;">VIII.</td> <td style="width: 85%;">Air Pressure Safety Switch (PS200-series, PS555/570-series, PS360EWB, PS360WB70) .....</td> <td style="width: 10%; text-align: right;">81</td> </tr> <tr> <td style="width: 5%;">A.</td> <td style="width: 85%;">Part Number Reference - Air Switches .....</td> <td style="width: 10%; text-align: right;">81</td> </tr> <tr> <td style="width: 5%;">B.</td> <td style="width: 85%;">Troubleshooting .....</td> <td style="width: 10%; text-align: right;">82</td> </tr> <tr> <td style="width: 5%;">C.</td> <td style="width: 85%;">Appendices .....</td> <td style="width: 10%; text-align: right;">83</td> </tr> <tr> <td></td> <td style="padding-left: 20px;">• <i>Instructions for Service Kits 35624 and 35625 - Air Pressure Switch Replacement Kits, 1/97</i> .....</td> <td style="width: 10%; text-align: right; vertical-align: bottom;">83</td> </tr> <tr> <td></td> <td style="padding-left: 20px;">• <i>Instructions to Replace an "Alternate" Air Switch P/N 36194 with Service Kit P/N 35624, 3/97</i> .....</td> <td style="width: 10%; text-align: right; vertical-align: bottom;">85</td> </tr> <tr> <td style="width: 5%;">IX.</td> <td style="width: 85%;">PS570/570S Flame Gate .....</td> <td style="width: 10%; text-align: right;">87</td> </tr> <tr> <td style="width: 5%;">A.</td> <td style="width: 85%;">Part Number Reference - Flame Gate .....</td> <td style="width: 10%; text-align: right;">87</td> </tr> <tr> <td style="width: 5%;">B.</td> <td style="width: 85%;">Flame Gate Orientation .....</td> <td style="width: 10%; text-align: right;">87</td> </tr> <tr> <td style="width: 5%;">X.</td> <td style="width: 85%;">Gas Train and Burner System .....</td> <td style="width: 10%; text-align: right;">88</td> </tr> <tr> <td style="width: 5%;">A.</td> <td style="width: 85%;">Part Number Reference - Gas Train Components .....</td> <td style="width: 10%; text-align: right;">88</td> </tr> <tr> <td style="width: 5%;">B.</td> <td style="width: 85%;">Part Number Reference - Gas Orifices and Gas Conversion Kits .....</td> <td style="width: 10%; text-align: right;">91</td> </tr> <tr> <td style="width: 5%;">C.</td> <td style="width: 85%;">Component Identification .....</td> <td style="width: 10%; text-align: right;">92</td> </tr> <tr> <td style="width: 5%;">D.</td> <td style="width: 85%;">Pilot/Ignitor Assembly .....</td> <td style="width: 10%; text-align: right;">93</td> </tr> <tr> <td style="width: 5%;">E.</td> <td style="width: 85%;">Burner Blower Motor .....</td> <td style="width: 10%; text-align: right;">95</td> </tr> <tr> <td style="width: 5%;">F.</td> <td style="width: 85%;">Air Shutter .....</td> <td style="width: 10%; text-align: right;">95</td> </tr> <tr> <td style="width: 5%;">G.</td> <td style="width: 85%;">Burner Transformer .....</td> <td style="width: 10%; text-align: right;">96</td> </tr> <tr> <td style="width: 5%;">H.</td> <td style="width: 85%;">Burner Motor Relay .....</td> <td style="width: 10%; text-align: right;">96</td> </tr> <tr> <td style="width: 5%;">I.</td> <td style="width: 85%;">High Flame Solenoid Valve .....</td> <td style="width: 10%; text-align: right;">96</td> </tr> <tr> <td style="width: 5%;">J.</td> <td style="width: 85%;">Bypass (Low Flame) Orifice .....</td> <td style="width: 10%; text-align: right;">96</td> </tr> <tr> <td style="width: 5%;">K.</td> <td style="width: 85%;">Modulating Gas Valve .....</td> <td style="width: 10%; text-align: right;">97</td> </tr> <tr> <td style="width: 5%;">L.</td> <td style="width: 85%;">Amplifier Board .....</td> <td style="width: 10%; text-align: right;">97</td> </tr> <tr> <td style="width: 5%;">M.</td> <td style="width: 85%;">Combination Gas Control Valve .....</td> <td style="width: 10%; text-align: right;">98</td> </tr> <tr> <td style="width: 5%;">N.</td> <td style="width: 85%;">Ignition Module .....</td> <td style="width: 10%; text-align: right;">99</td> </tr> <tr> <td style="width: 5%;">O.</td> <td style="width: 85%;">Gas Conversion Kits .....</td> <td style="width: 10%; text-align: right;">100</td> </tr> <tr> <td style="width: 5%;">P.</td> <td style="width: 85%;">Burner and Gas Train Troubleshooting .....</td> <td style="width: 10%; text-align: right;">100</td> </tr> <tr> <td style="width: 5%;">Q.</td> <td style="width: 85%;">Checking the Gas Pressures .....</td> <td style="width: 10%; text-align: right;">102</td> </tr> </table>	III.	High Limit Control Module .....	45	A.	Part Number Reference - High Limit Control Modules .....	45	B.	Location .....	45	C.	Troubleshooting .....	45	D.	Appendices .....	46		• <i>Instructions for Service Kit 39733 - High Limit Conversion Kit for PS300, 310, 350 &amp; 360 Ovens, 5/99</i> .....	46	IV.	Thermocouples .....	54	A.	Part Number Reference - Thermocouples .....	54	B.	Thermocouple Functions .....	54	C.	Troubleshooting .....	54	D.	Appendices .....	56		• <i>Instructions for Service Kits 33984 and 33985 - Oven Thermocouple Kit, 11/01</i> .....	56	V.	Blowers .....	68	A.	PS200-series ovens .....	68	B.	PS360-series ovens .....	74	C.	PS555/570-series ovens .....	76	VI.	Blower Motor Centrifugal Safety Switch (PS360-series) .....	80	A.	Part Number Reference - Blower Centrifugal Switch .....	80	B.	Troubleshooting .....	80	VII.	Burner Blower Motor Centrifugal Safety Switch (PS200-series gas, PS310, PS314, PS360, PS360WB, PS570S) .....	80	VIII.	Air Pressure Safety Switch (PS200-series, PS555/570-series, PS360EWB, PS360WB70) .....	81	A.	Part Number Reference - Air Switches .....	81	B.	Troubleshooting .....	82	C.	Appendices .....	83		• <i>Instructions for Service Kits 35624 and 35625 - Air Pressure Switch Replacement Kits, 1/97</i> .....	83		• <i>Instructions to Replace an "Alternate" Air Switch P/N 36194 with Service Kit P/N 35624, 3/97</i> .....	85	IX.	PS570/570S Flame Gate .....	87	A.	Part Number Reference - Flame Gate .....	87	B.	Flame Gate Orientation .....	87	X.	Gas Train and Burner System .....	88	A.	Part Number Reference - Gas Train Components .....	88	B.	Part Number Reference - Gas Orifices and Gas Conversion Kits .....	91	C.	Component Identification .....	92	D.	Pilot/Ignitor Assembly .....	93	E.	Burner Blower Motor .....	95	F.	Air Shutter .....	95	G.	Burner Transformer .....	96	H.	Burner Motor Relay .....	96	I.	High Flame Solenoid Valve .....	96	J.	Bypass (Low Flame) Orifice .....	96	K.	Modulating Gas Valve .....	97	L.	Amplifier Board .....	97	M.	Combination Gas Control Valve .....	98	N.	Ignition Module .....	99	O.	Gas Conversion Kits .....	100	P.	Burner and Gas Train Troubleshooting .....	100	Q.	Checking the Gas Pressures .....	102	<table border="0" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 5%;">R.</td> <td style="width: 85%;">Troubleshooting Flowcharts .....</td> <td style="width: 10%; text-align: right;">103</td> </tr> <tr> <td></td> <td style="padding-left: 20px;">• <i>Intermittent Pilot System Troubleshooting Table</i> .....</td> <td style="width: 10%; text-align: right; vertical-align: bottom;">103</td> </tr> <tr> <td></td> <td style="padding-left: 20px;">• <i>No Spark, System Does Not Work</i> .....</td> <td style="width: 10%; text-align: right; vertical-align: bottom;">104</td> </tr> <tr> <td></td> <td style="padding-left: 20px;">• <i>Spark is Present, Pilot Will Not Light</i> .....</td> <td style="width: 10%; text-align: right; vertical-align: bottom;">105</td> </tr> <tr> <td></td> <td style="padding-left: 20px;">• <i>Pilot Lights, Main Valve Will Not Come On</i> .....</td> <td style="width: 10%; text-align: right; vertical-align: bottom;">106</td> </tr> <tr> <td style="width: 5%;">S.</td> <td style="width: 85%;">Appendices .....</td> <td style="width: 10%; text-align: right;">107</td> </tr> <tr> <td></td> <td style="padding-left: 20px;">• <i>Instructions for Service Kit 42810-0117 - Pilot/Ignitor Kit, 7/91</i> .....</td> <td style="width: 10%; text-align: right; vertical-align: bottom;">107</td> </tr> <tr> <td></td> <td style="padding-left: 20px;">• <i>Instructions for Service Kit 30185 - Pilot Tee, 3/94</i> .....</td> <td style="width: 10%; text-align: right; vertical-align: bottom;">108</td> </tr> <tr> <td></td> <td style="padding-left: 20px;">• <i>Instructions for Service Kit 42810-0121 - Combination Gas Valve, 1/92</i> .....</td> <td style="width: 10%; text-align: right; vertical-align: bottom;">112</td> </tr> <tr> <td></td> <td style="padding-left: 20px;">• <i>Instructions for Service Kit 42810-0114 - Ignition Module, 11/90</i> .....</td> <td style="width: 10%; text-align: right; vertical-align: bottom;">116</td> </tr> <tr> <td></td> <td style="padding-left: 20px;">• <i>Position of Combination Gas Valve Components during Burner Operation, 4/02</i> .....</td> <td style="width: 10%; text-align: right; vertical-align: bottom;">118</td> </tr> <tr> <td></td> <td style="padding-left: 20px;">• <i>Instructions for All Gas Conversion Kits for Ovens with Wayne Burner, Natural Gas to Propane, 8/00</i> .....</td> <td style="width: 10%; text-align: right; vertical-align: bottom;">119</td> </tr> <tr> <td></td> <td style="padding-left: 20px;">• <i>Instructions for All Gas Conversion Kits for Ovens with Wayne Burner, Propane to Natural Gas, 8/00</i> .....</td> <td style="width: 10%; text-align: right; vertical-align: bottom;">125</td> </tr> <tr> <td></td> <td style="padding-left: 20px;">• <i>Instructions for Service Kit 36856 - Gas Conversion Kit for PS360EWB/WB70 with Midco Burner, Natural Gas to Propane, 1/98</i> .....</td> <td style="width: 10%; text-align: right; vertical-align: bottom;">131</td> </tr> <tr> <td></td> <td style="padding-left: 20px;">• <i>Instructions for Service Kit 36863 - Gas Conversion Kit for PS360EWB/WB70 with Midco Burner, Propane to Natural Gas, 1/98</i> .....</td> <td style="width: 10%; text-align: right; vertical-align: bottom;">135</td> </tr> <tr> <td></td> <td style="padding-left: 20px;">• <i>Equivalent Orifice Sizes at High Altitudes, 4/02</i> .....</td> <td style="width: 10%; text-align: right; vertical-align: bottom;">139</td> </tr> <tr> <td style="width: 5%;">XI.</td> <td style="width: 85%;">Electric Oven Heating System .....</td> <td style="width: 10%; text-align: right;">140</td> </tr> <tr> <td style="width: 5%;">A.</td> <td style="width: 85%;">PS200-series ovens .....</td> <td style="width: 10%; text-align: right;">140</td> </tr> <tr> <td style="width: 5%;">B.</td> <td style="width: 85%;">PS310/360-series ovens .....</td> <td style="width: 10%; text-align: right;">142</td> </tr> <tr> <td style="width: 5%;">C.</td> <td style="width: 85%;">PS555 ovens .....</td> <td style="width: 10%; text-align: right;">144</td> </tr> <tr> <td style="width: 5%;">D.</td> <td style="width: 85%;">Electric Oven Mercury Contactor Replacement .....</td> <td style="width: 10%; text-align: right;">146</td> </tr> <tr> <td></td> <td style="padding-top: 10px;">Section 4 - Electrical Wiring Diagrams .....</td> <td style="width: 10%; text-align: right; vertical-align: bottom;">149</td> </tr> <tr> <td style="width: 5%;">I.</td> <td style="width: 85%;">Component Wiring .....</td> <td style="width: 10%; text-align: right;">149</td> </tr> <tr> <td style="width: 5%;">A.</td> <td style="width: 85%;">Temperature Controllers .....</td> <td style="width: 10%; text-align: right;">149</td> </tr> <tr> <td style="width: 5%;">B.</td> <td style="width: 85%;">Ignition Modules .....</td> <td style="width: 10%; text-align: right;">150</td> </tr> <tr> <td style="width: 5%;">II.</td> <td style="width: 85%;">PS200-series Ovens .....</td> <td style="width: 10%; text-align: right;">151</td> </tr> <tr> <td style="width: 5%;">III.</td> <td style="width: 85%;">PS310/360-series Ovens .....</td> <td style="width: 10%; text-align: right;">160</td> </tr> <tr> <td style="width: 5%;">IV.</td> <td style="width: 85%;">PS555/570-series Ovens .....</td> <td style="width: 10%; text-align: right;">166</td> </tr> <tr> <td></td> <td style="padding-top: 10px;">Section 5 - Reference .....</td> <td style="width: 10%; text-align: right; vertical-align: bottom;">172</td> </tr> <tr> <td></td> <td style="padding-left: 20px;">• <i>25-point preventative maintenance checklist</i> .....</td> <td style="width: 10%; text-align: right; vertical-align: bottom;">172</td> </tr> <tr> <td></td> <td style="padding-left: 20px;">• <i>Fractional inches to decimal and millimeter equivalents</i> ...</td> <td style="width: 10%; text-align: right; vertical-align: bottom;">173</td> </tr> <tr> <td></td> <td style="padding-left: 20px;">• <i>Decimal equivalents of drill sizes</i> .....</td> <td style="width: 10%; text-align: right; vertical-align: bottom;">173</td> </tr> <tr> <td></td> <td style="padding-left: 20px;">• <i>General conversion factors</i> .....</td> <td style="width: 10%; text-align: right; vertical-align: bottom;">174</td> </tr> <tr> <td></td> <td style="padding-left: 20px;">• <i>Pressure conversions</i> .....</td> <td style="width: 10%; text-align: right; vertical-align: bottom;">174</td> </tr> <tr> <td></td> <td style="padding-left: 20px;">• <i>Pressure conversion chart</i> .....</td> <td style="width: 10%; text-align: right; vertical-align: bottom;">175</td> </tr> <tr> <td></td> <td style="padding-left: 20px;">• <i>Ohm's Law equation wheel</i> .....</td> <td style="width: 10%; text-align: right; vertical-align: bottom;">175</td> </tr> <tr> <td></td> <td style="padding-left: 20px;">• <i>Common electrical wiring diagram symbols</i> .....</td> <td style="width: 10%; text-align: right; vertical-align: bottom;">176</td> </tr> </table>	R.	Troubleshooting Flowcharts .....	103		• <i>Intermittent Pilot System Troubleshooting Table</i> .....	103		• <i>No Spark, System Does Not Work</i> .....	104		• <i>Spark is Present, Pilot Will Not Light</i> .....	105		• <i>Pilot Lights, Main Valve Will Not Come On</i> .....	106	S.	Appendices .....	107		• <i>Instructions for Service Kit 42810-0117 - Pilot/Ignitor Kit, 7/91</i> .....	107		• <i>Instructions for Service Kit 30185 - Pilot Tee, 3/94</i> .....	108		• <i>Instructions for Service Kit 42810-0121 - Combination Gas Valve, 1/92</i> .....	112		• <i>Instructions for Service Kit 42810-0114 - Ignition Module, 11/90</i> .....	116		• <i>Position of Combination Gas Valve Components during Burner Operation, 4/02</i> .....	118		• <i>Instructions for All Gas Conversion Kits for Ovens with Wayne Burner, Natural Gas to Propane, 8/00</i> .....	119		• <i>Instructions for All Gas Conversion Kits for Ovens with Wayne Burner, Propane to Natural Gas, 8/00</i> .....	125		• <i>Instructions for Service Kit 36856 - Gas Conversion Kit for PS360EWB/WB70 with Midco Burner, Natural Gas to Propane, 1/98</i> .....	131		• <i>Instructions for Service Kit 36863 - Gas Conversion Kit for PS360EWB/WB70 with Midco Burner, Propane to Natural Gas, 1/98</i> .....	135		• <i>Equivalent Orifice Sizes at High Altitudes, 4/02</i> .....	139	XI.	Electric Oven Heating System .....	140	A.	PS200-series ovens .....	140	B.	PS310/360-series ovens .....	142	C.	PS555 ovens .....	144	D.	Electric Oven Mercury Contactor Replacement .....	146		Section 4 - Electrical Wiring Diagrams .....	149	I.	Component Wiring .....	149	A.	Temperature Controllers .....	149	B.	Ignition Modules .....	150	II.	PS200-series Ovens .....	151	III.	PS310/360-series Ovens .....	160	IV.	PS555/570-series Ovens .....	166		Section 5 - Reference .....	172		• <i>25-point preventative maintenance checklist</i> .....	172		• <i>Fractional inches to decimal and millimeter equivalents</i> ...	173		• <i>Decimal equivalents of drill sizes</i> .....	173		• <i>General conversion factors</i> .....	174		• <i>Pressure conversions</i> .....	174		• <i>Pressure conversion chart</i> .....	175		• <i>Ohm's Law equation wheel</i> .....	175		• <i>Common electrical wiring diagram symbols</i> .....	176
III.	High Limit Control Module .....	45																																																																																																																																																																																																																																																											
A.	Part Number Reference - High Limit Control Modules .....	45																																																																																																																																																																																																																																																											
B.	Location .....	45																																																																																																																																																																																																																																																											
C.	Troubleshooting .....	45																																																																																																																																																																																																																																																											
D.	Appendices .....	46																																																																																																																																																																																																																																																											
	• <i>Instructions for Service Kit 39733 - High Limit Conversion Kit for PS300, 310, 350 &amp; 360 Ovens, 5/99</i> .....	46																																																																																																																																																																																																																																																											
IV.	Thermocouples .....	54																																																																																																																																																																																																																																																											
A.	Part Number Reference - Thermocouples .....	54																																																																																																																																																																																																																																																											
B.	Thermocouple Functions .....	54																																																																																																																																																																																																																																																											
C.	Troubleshooting .....	54																																																																																																																																																																																																																																																											
D.	Appendices .....	56																																																																																																																																																																																																																																																											
	• <i>Instructions for Service Kits 33984 and 33985 - Oven Thermocouple Kit, 11/01</i> .....	56																																																																																																																																																																																																																																																											
V.	Blowers .....	68																																																																																																																																																																																																																																																											
A.	PS200-series ovens .....	68																																																																																																																																																																																																																																																											
B.	PS360-series ovens .....	74																																																																																																																																																																																																																																																											
C.	PS555/570-series ovens .....	76																																																																																																																																																																																																																																																											
VI.	Blower Motor Centrifugal Safety Switch (PS360-series) .....	80																																																																																																																																																																																																																																																											
A.	Part Number Reference - Blower Centrifugal Switch .....	80																																																																																																																																																																																																																																																											
B.	Troubleshooting .....	80																																																																																																																																																																																																																																																											
VII.	Burner Blower Motor Centrifugal Safety Switch (PS200-series gas, PS310, PS314, PS360, PS360WB, PS570S) .....	80																																																																																																																																																																																																																																																											
VIII.	Air Pressure Safety Switch (PS200-series, PS555/570-series, PS360EWB, PS360WB70) .....	81																																																																																																																																																																																																																																																											
A.	Part Number Reference - Air Switches .....	81																																																																																																																																																																																																																																																											
B.	Troubleshooting .....	82																																																																																																																																																																																																																																																											
C.	Appendices .....	83																																																																																																																																																																																																																																																											
	• <i>Instructions for Service Kits 35624 and 35625 - Air Pressure Switch Replacement Kits, 1/97</i> .....	83																																																																																																																																																																																																																																																											
	• <i>Instructions to Replace an "Alternate" Air Switch P/N 36194 with Service Kit P/N 35624, 3/97</i> .....	85																																																																																																																																																																																																																																																											
IX.	PS570/570S Flame Gate .....	87																																																																																																																																																																																																																																																											
A.	Part Number Reference - Flame Gate .....	87																																																																																																																																																																																																																																																											
B.	Flame Gate Orientation .....	87																																																																																																																																																																																																																																																											
X.	Gas Train and Burner System .....	88																																																																																																																																																																																																																																																											
A.	Part Number Reference - Gas Train Components .....	88																																																																																																																																																																																																																																																											
B.	Part Number Reference - Gas Orifices and Gas Conversion Kits .....	91																																																																																																																																																																																																																																																											
C.	Component Identification .....	92																																																																																																																																																																																																																																																											
D.	Pilot/Ignitor Assembly .....	93																																																																																																																																																																																																																																																											
E.	Burner Blower Motor .....	95																																																																																																																																																																																																																																																											
F.	Air Shutter .....	95																																																																																																																																																																																																																																																											
G.	Burner Transformer .....	96																																																																																																																																																																																																																																																											
H.	Burner Motor Relay .....	96																																																																																																																																																																																																																																																											
I.	High Flame Solenoid Valve .....	96																																																																																																																																																																																																																																																											
J.	Bypass (Low Flame) Orifice .....	96																																																																																																																																																																																																																																																											
K.	Modulating Gas Valve .....	97																																																																																																																																																																																																																																																											
L.	Amplifier Board .....	97																																																																																																																																																																																																																																																											
M.	Combination Gas Control Valve .....	98																																																																																																																																																																																																																																																											
N.	Ignition Module .....	99																																																																																																																																																																																																																																																											
O.	Gas Conversion Kits .....	100																																																																																																																																																																																																																																																											
P.	Burner and Gas Train Troubleshooting .....	100																																																																																																																																																																																																																																																											
Q.	Checking the Gas Pressures .....	102																																																																																																																																																																																																																																																											
R.	Troubleshooting Flowcharts .....	103																																																																																																																																																																																																																																																											
	• <i>Intermittent Pilot System Troubleshooting Table</i> .....	103																																																																																																																																																																																																																																																											
	• <i>No Spark, System Does Not Work</i> .....	104																																																																																																																																																																																																																																																											
	• <i>Spark is Present, Pilot Will Not Light</i> .....	105																																																																																																																																																																																																																																																											
	• <i>Pilot Lights, Main Valve Will Not Come On</i> .....	106																																																																																																																																																																																																																																																											
S.	Appendices .....	107																																																																																																																																																																																																																																																											
	• <i>Instructions for Service Kit 42810-0117 - Pilot/Ignitor Kit, 7/91</i> .....	107																																																																																																																																																																																																																																																											
	• <i>Instructions for Service Kit 30185 - Pilot Tee, 3/94</i> .....	108																																																																																																																																																																																																																																																											
	• <i>Instructions for Service Kit 42810-0121 - Combination Gas Valve, 1/92</i> .....	112																																																																																																																																																																																																																																																											
	• <i>Instructions for Service Kit 42810-0114 - Ignition Module, 11/90</i> .....	116																																																																																																																																																																																																																																																											
	• <i>Position of Combination Gas Valve Components during Burner Operation, 4/02</i> .....	118																																																																																																																																																																																																																																																											
	• <i>Instructions for All Gas Conversion Kits for Ovens with Wayne Burner, Natural Gas to Propane, 8/00</i> .....	119																																																																																																																																																																																																																																																											
	• <i>Instructions for All Gas Conversion Kits for Ovens with Wayne Burner, Propane to Natural Gas, 8/00</i> .....	125																																																																																																																																																																																																																																																											
	• <i>Instructions for Service Kit 36856 - Gas Conversion Kit for PS360EWB/WB70 with Midco Burner, Natural Gas to Propane, 1/98</i> .....	131																																																																																																																																																																																																																																																											
	• <i>Instructions for Service Kit 36863 - Gas Conversion Kit for PS360EWB/WB70 with Midco Burner, Propane to Natural Gas, 1/98</i> .....	135																																																																																																																																																																																																																																																											
	• <i>Equivalent Orifice Sizes at High Altitudes, 4/02</i> .....	139																																																																																																																																																																																																																																																											
XI.	Electric Oven Heating System .....	140																																																																																																																																																																																																																																																											
A.	PS200-series ovens .....	140																																																																																																																																																																																																																																																											
B.	PS310/360-series ovens .....	142																																																																																																																																																																																																																																																											
C.	PS555 ovens .....	144																																																																																																																																																																																																																																																											
D.	Electric Oven Mercury Contactor Replacement .....	146																																																																																																																																																																																																																																																											
	Section 4 - Electrical Wiring Diagrams .....	149																																																																																																																																																																																																																																																											
I.	Component Wiring .....	149																																																																																																																																																																																																																																																											
A.	Temperature Controllers .....	149																																																																																																																																																																																																																																																											
B.	Ignition Modules .....	150																																																																																																																																																																																																																																																											
II.	PS200-series Ovens .....	151																																																																																																																																																																																																																																																											
III.	PS310/360-series Ovens .....	160																																																																																																																																																																																																																																																											
IV.	PS555/570-series Ovens .....	166																																																																																																																																																																																																																																																											
	Section 5 - Reference .....	172																																																																																																																																																																																																																																																											
	• <i>25-point preventative maintenance checklist</i> .....	172																																																																																																																																																																																																																																																											
	• <i>Fractional inches to decimal and millimeter equivalents</i> ...	173																																																																																																																																																																																																																																																											
	• <i>Decimal equivalents of drill sizes</i> .....	173																																																																																																																																																																																																																																																											
	• <i>General conversion factors</i> .....	174																																																																																																																																																																																																																																																											
	• <i>Pressure conversions</i> .....	174																																																																																																																																																																																																																																																											
	• <i>Pressure conversion chart</i> .....	175																																																																																																																																																																																																																																																											
	• <i>Ohm's Law equation wheel</i> .....	175																																																																																																																																																																																																																																																											
	• <i>Common electrical wiring diagram symbols</i> .....	176																																																																																																																																																																																																																																																											



# SECTION 1

## SEQUENCE OF OPERATION

### I. GAS OVEN SEQUENCE OF OPERATION

#### A. Electrical Supply

Gas heated ovens operate on 208/240V, single phase. Standard incoming power configurations are:

1. 4-wire system (PS200 series, PS310/360 series, PS570, PS570S) - 2 single phase 208/240V supply (hot) lines, 1 neutral and 1 ground.
2. 3-wire system (PS360WB70, PS360EWB, PS555, PS570G, PS536) - 2 single phase 208/240V supply (hot) lines and 1 ground.

For all wiring configurations, the voltage when measured from either hot line to neutral should never exceed 130V.

#### B. Door Switch

Closing the control cabinet door (or machinery compartment door, as appropriate for the oven model) will close the door switch and allow the oven to operate.

**Note that the electrical systems will still be “live” if the switch is open, although the oven cannot operate.**

The door switch has a bypass position to enable service operation with the door opened. When the door is open, grasp the switch actuator and pull it out as far as possible. This will close the door switch and permit troubleshooting. Closing the control cabinet door will reset the switch.

1. Closing the door switch permits a circuit to go through a fuse (or circuit breaker, as appropriate for the oven model) to one side of the conveyor switch, blower motor switch, cooldown relay and heat switch.
2. Closing the door switch permits a circuit to go through the motor fuse (two 9A or 15A fuses per motor).

#### C. Conveyor Switch

Closing the conveyor switch permits a circuit to go to the Conveyor Speed Control Module, which:

1. Sends power to the gear motor (conveyor drive motor). The 120VAC signal to the Conveyor Speed Control Module is rectified to a 90VDC signal which is then sent to the gear motor.
2. Allows regulation of conveyor speed. Adjusting the thumbwheel (or digital pushbutton display unit, as appropriate) to the desired conveyor belt speed instructs the Conveyor Speed Control Module to regulate the output to the gear motor. This increases or decreases the conveyor speed as necessary to match the speed setting shown on the thumbwheel or display unit.

#### D. Blower Switch

Closing the blower switch energizes:

1. The cooling (axial) fan(s).
2. The blower motor contactor (s).

Closing this contactor starts the blower motor(s). When both blower motors are up to speed, centrifugal switches located inside the blower motors (or air switches detecting blower operation, as appropriate for the oven model) will close, setting up the heat circuit.

3. The Temperature Controller.

#### E. Heat Switch

Closing the heat switch completes a circuit:

1. Through the heat switch.
2. Through the blower motor centrifugal switches (or air switches, as appropriate for the oven model).
3. Through the high limit switch.
4. One circuit then goes to the:
  - a. Burner (L1).
  - b. Transformer (110V to 24V).
  - c. Motor relay coil. On a cold start the heater on this relay takes about 30 seconds to warm up before the relay will energize. This gives an additional prepurge. The relay is not used on ovens with 208/240V burner blower motors.
  - d. Burner blower motor. As the motor reaches full operating speed, the centrifugal switch (or air flow switch, as appropriate for the oven model) closes and applies voltage to the burner control. This energizes the ignitor control spark transformer and the pilot valve. The spark then lights the pilot. The flame sensor proves the presence of the pilot flame, and the ignitor control then shuts off the spark. At the same time, the main burner valve is opened. The main burner is then ignited.

If the pilot does not light within approximately 90 seconds, the oven will shut down.

The pilot and main gas valve will stay on (open) as long as the heat switch is ON and the flame is proven. If the flame goes out for any reason, the pilot will try to light for 90 seconds, and then go into automatic lockout. To relight the pilot after it has gone into automatic lockout, the burner must be turned OFF for 5 minutes and then turned ON again.

- e. For ovens with an On-Off gas regulation system (with solenoid valve): Temperature Controller terminals 4 & 5 (power for the primary relay contacts for the high flame solenoid valve).

For PS360EWB ovens with a modulating gas system and Temperature Controller P/N 32571: Temperature Controller terminals 4 & 5 (input signal to amplifier board).

For all other ovens with a modulating gas system: Temperature Controller terminals 15 & 16 (input signal to amplifier board).

In all ovens, the temperature-sensing thermocouple(s) send a millivolt signal to the temperature controller. As long as the temperature inside the oven is below the set point of the Temperature Controller, the Controller will do the following:

1. For ovens with an On-Off gas regulation system: If the temperature sensed by the thermocouple(s) is below the set point on the Temperature Controller, the Controller energizes the high flame solenoid. When the solenoid is energized, the solenoid valve permits 100% gas flow. Power to the solenoid is cut when the temperature reaches the set point, which closes the valve. This permits on-off gas flow to the burner.

When power is cut to the high flame solenoid, the burner will remain ON in the low flame mode. When the temperature drops a few degrees, the Temperature Controller will again energize the high flame solenoid, which opens the valve and restores gas flow to 100%.

An indicator on the Temperature Controller will show whether the high flame solenoid is energized (or whether the burner is activated, which is effectively the same). This indicator varies by Temperature Controller model. Refer to the instructions for the appropriate Temperature Controller for an illustration and description of this indicator.

2. For ovens with a modulating gas system: In response to the signal from the thermocouple(s), the Temperature Controller sends a 4-20mA signal to the amplifier board. The amplifier board converts this to a 0-20VDC signal which is sent to the modulating gas valve. The valve opens or closes in proportion to the signal from the amplifier board, allowing the gas flow to be regulated as required from 0-100%.

An indicator on the Temperature Controller will show whether the burner is activated. This indicator varies by Temperature Controller model. Refer to the instructions for the appropriate Temperature Controller for an illustration and description of this indicator.

#### F. High Limit

**NOTE:** Most PS200-Series and PS360-series gas ovens use the high limit feature of the Temperature Controller. All other oven models use a separate High Limit Control Module. Refer to the wiring diagram for the appropriate oven model to check whether a separate High Limit Control Module is used.

The high limit relay will shut the oven burner OFF:

1. If the high limit thermocouple senses an oven temperature above 650°F.
2. If the signal from the high limit thermocouple is lost.

An indicator on the Temperature Controller will show a high limit condition. This indicator varies by Temperature Controller model. Refer to the instructions for the appropriate Temperature Controller for an illustration and description of this indicator.

#### G. Cooldown

**NOTE:** PS200VL-series ovens do not include a cooldown feature.

When the heat and blower Switches are turned OFF the cooldown relay will allow the blowers to remain ON until the oven temperature falls to 200°F (93°C).

During cooldown, the Temperature Controller will continue to show the oven temperature.

## SECTION 1 - SEQUENCE OF OPERATION

### II. ELECTRIC OVEN SEQUENCE OF OPERATION

#### A. Electrical Supply

Most electrically heated ovens operate on a 208/230/380/440V, 3 phase, 4 wire system. The fourth wire is for a 120 V neutral ground. This 120 V neutral ground eliminates the need for a control transformer. Where a neutral is not available, a 240/110V transformer is supplied.

#### B. Door Switch

Closing the control cabinet door (or machinery compartment door, as appropriate for the oven model) will close the door switch and allow the oven to operate.

**Note that the electrical systems will still be “live” if the switch is open, although the oven cannot operate.**

The door switch has a bypass position to enable service operation with the door opened. When the door is open, grasp the switch actuator and pull it out as far as possible. This will close the door switch and permit troubleshooting. Closing the control cabinet door will reset the switch.

Closing the door switch permits a circuit to go through a fuse (or circuit breaker, as appropriate for the oven model) to one side of the conveyor switch, blower motor switch and to the heat switch.

#### C. Conveyor Switch

Closing the conveyor switch permits a circuit to go to the Conveyor Speed Control Module, which:

1. Sends power to the gear motor (conveyor drive motor). The 120VAC signal to the Conveyor Speed Control Module is rectified to a 90VDC signal which is then sent to the gear motor.
2. Allows regulation of conveyor speed. Adjusting the thumbwheel (or digital pushbutton display unit, as appropriate) to the desired conveyor belt speed instructs the Conveyor Speed Control Module to regulate the output to the gear motor. This increases or decreases the conveyor speed as necessary to match the speed setting shown on the thumbwheel or display unit.

#### D. Blower Switch

Closing the blower switch energizes:

1. The cooling (axial) fan(s).
2. The blower motor contactor (s).

Closing this contactor starts the blower motor(s). When both blower motors are up to speed, centrifugal switch(es) located inside the rear end of the motor(s) (or air flow switch[es], as appropriate for the oven model) will close, setting up the heat circuit.

3. The Temperature Controller.

#### E. Heat Switch

Closing the heat switch completes a circuit:

1. Through the heat switch.
2. Through the blower motor centrifugal switch.
3. Through the high limit switch.
4. For ovens with on On-Off heater activation mode: To the primary relay contacts of the Temperature Controller (terminals 4 and 5 for digital controllers, terminals 5 and 6 for analog controllers).

When the temperature-sensing thermocouple(s) indicate that the oven temperature is below the set point on the Temperature Controller, the Temperature Controller will energize the contactor(s) which in turn energize the heaters.

When the oven temperature reaches the set point of the Temperature Controller, the Temperature Controller will cut power to the heaters. When the temperature drops a few degrees, the Temperature Controller will again energize the heaters.

An indicator on the Temperature Controller will show whether the Controller is calling for heat. This indicator varies by Temperature Controller model. Refer to the instructions for the appropriate Temperature Controller for an illustration and description of this indicator.

5. For ovens with a Variable Pulse heater activation system: To terminals 15 and 16 on the temperature controller. In response to the signal from the thermocouple(s), Terminals 15 and 16 send a 4-20mA signal to a controller module that contains an amplifier board and two solid state relays. The relays activate the heating elements at 100% power on a fixed cycle time, for a length of time proportional to the signal from the temperature controller.

A “HEAT ON” indicator on the Temperature Controller will light to show whether the Controller is calling for heat.

#### F. High Limit

**NOTE:** *Electric oven models use a separate High Limit Control Module.*

The High Limit relay will shut the oven burner OFF:

1. If the high limit thermocouple senses an oven temperature above 650°F.
2. If the signal from the high limit thermocouple is lost.

An indicator on the Temperature Controller will show a high limit condition. This indicator varies by Temperature Controller model. Refer to the instructions for the appropriate Temperature Controller for an illustration and description of this indicator.

#### G. Cooldown

When the heat and blower switches are turned OFF the cooldown relay will allow the blowers to remain ON until the oven temperature falls to 200°F (93°C).

During cooldown, the Temperature Controller will continue to show the oven temperature.

## SECTION 2

# AIR FLOW AND HEAT TRANSFER

### I. TYPES OF HEAT TRANSFER

Heat constantly moves from a warm object to a cold object. Heat moves in three different ways: through conduction, through radiation, and through convection. Middleby Marshall conveyor ovens use all three of these paths to cook the product.

- **Conduction** - Heat is transferred through surface contact (such as pizza dough in contact with a pan).
- **Radiation** - Heat is transferred from light-colored objects to dark-colored objects. The darker the color of an object, the greater the amount of heat that it absorbs. The lighter the color of an object, the greater the amount of heat that it reflects. Middleby ovens use light-colored interiors (aluminized or stainless steel, depending on the oven model) to reflect as much heat as possible to the product.
- **Convection** - Heated air will transfer heat to objects with which it comes into contact. Unless the air flow is controlled, hot air will rise and be replaced by cooler air. Middleby Marshall ovens use blowers (one or two large fans, depending on the oven model) to force air through adjustable air fingers onto the product.

The intensity of the heat at the point at which it is sensed is called temperature. The difference in temperature between the food product and the heat source - that is, the pan, oven interior, or heated air, as described above - determines the speed at which the heat flows. The greater the difference in temperature, the faster the heat flows to the product.

In Middleby Marshall conveyor ovens, the heat transfer from conduction is greatly dependent on the customer's product and cooking surface (pans, etc.). Likewise, the heat transfer from radiation is effectively constant, because the color of the oven interior cannot be changed. For these reasons, the best way to optimize heat transfer is by regulating the convection air. This can be done in two ways:

- Adjusting the **blowers** and **blower speed** to change the quantity and velocity of air delivered onto the product.
- Adjusting the **air finger configuration** to change the pattern in which the vertical columns of air are delivered to the product.

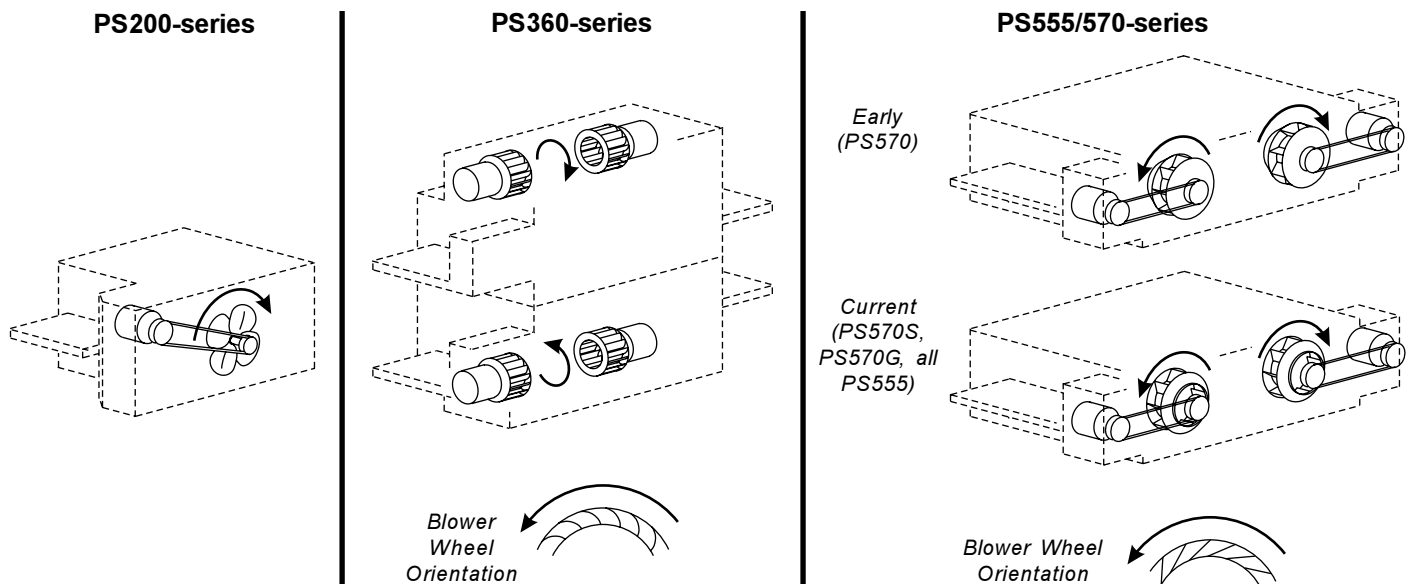
### II. BLOWERS AND BLOWER SPEED

#### A. PS200-series ovens

PS200-series ovens have a single blower motor mounted inside the machinery compartment, with a pulley on the end of the motor shaft. A belt connects this pulley to another on the shaft of the blower fan. The air velocity can be changed by using a larger or smaller pulley on the motor shaft, and changing the length of the belt to match the new pulley. See Figure 1.

However, note that there are only two approved belt/pulley combinations for PS200-series ovens; one for 60Hz ovens, and one for 50Hz ovens. Field modifications to these approved combinations are not permitted unless under the specific directions of the Middleby Technical Service Department. Any changes to convection air delivery **MUST** be made using the air fingers.

**Figure 1**  
**Blowers, belts and pulleys**



SECTION 2 - AIR FLOW AND HEAT TRANSFER

B. PS360-series ovens

PS360-series ovens feature two blower motors. A blower wheel is fastened onto the end of the motor shaft. In order to adjust the amount and speed of heated air that is directed by the blower wheels, it is necessary to change the size of the wheels and/or change the speed of the motor. See Figure 1.

Each PS360-series oven model has a specific combination of blower motor and blower wheel. Field modifications to these approved combinations are not permitted unless under the specific directions of the Middleby Technical Service Department. Any changes to convection air delivery **MUST** be made using the air fingers.

C. PS555/570-series ovens

PS555/570-series ovens have one blower motor mounted inside each of the end compartments of the oven, with a pulley on the end of the motor shaft. The oven has two blower wheels; a belt connects each motor pulley to a pulley on the end of one of the blower wheel shafts. The air velocity can be changed by using a larger or smaller pulley on the motor shaft, and changing the length of the belt to match the new pulley. See Figure 1.

Some customers have a specific belt/pulley combination approved by Middleby Marshall, while others use a "standard" configuration. Field modifications to these approved combinations are not permitted unless under the specific directions of the Middleby Technical Service Department.

III. AIR FINGERS

A. Description and Function

Air fingers direct the heated air from the blowers into vertical jets that are directed at the top and bottom of the conveyor belt. Each air finger configuration has been tested to optimally cook a specific customer's product. As a rule, air finger configurations should **NOT** be changed from customer specifications without direct instructions from the Middleby Technical Services Department.

Middleby uses two main types of air fingers:

- PS300/350 and early PS310/360 ovens used a shutter-type air finger assembly. The finger is assembled from a manifold, inner plate and outer plate. The inner plate is assembled from two separate plates, each with a series of holes, that are riveted together. The plates can be repositioned relative to each other to restrict the air flow through the holes as necessary. These fingers are no longer in general use, but may still be found in older ovens in the field. See Figure 3.
- All current ovens use an air finger which is composed of a manifold, inner plate, and outer plate. No adjustments are necessary or possible to these fingers, but a wide variety of styles is available to meet different customers' baking needs. See Figure 4.

Figure 2  
Air finger operation

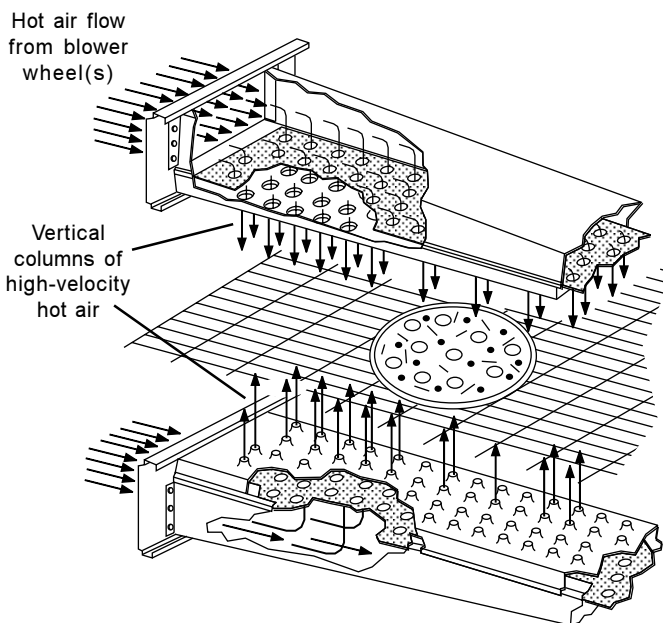


Figure 3  
PS300/350 air finger with shutter plate

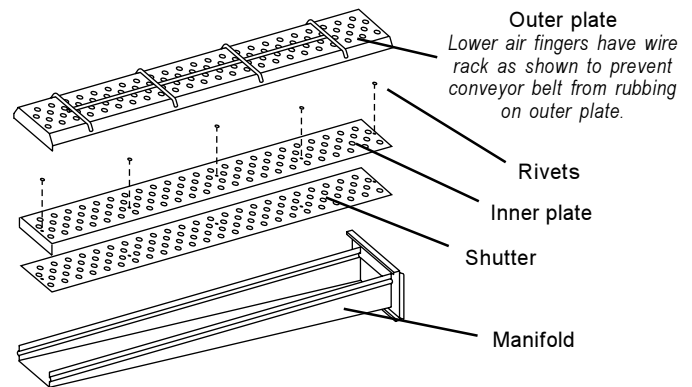
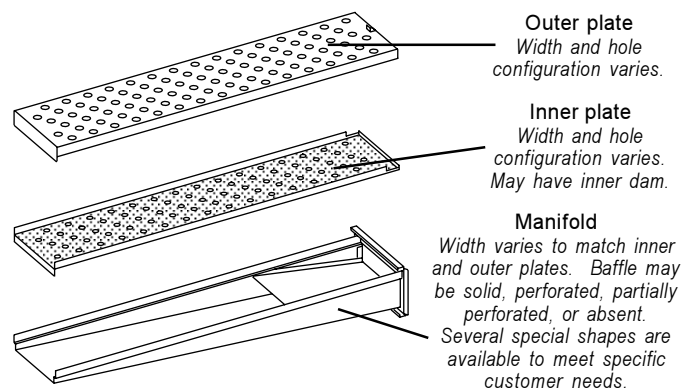


Figure 4  
Current standard air finger (all oven models)





**B. Configuration and Alignment**

To ensure proper baking of the product, the air flow MUST be properly aligned as it exits the air fingers.

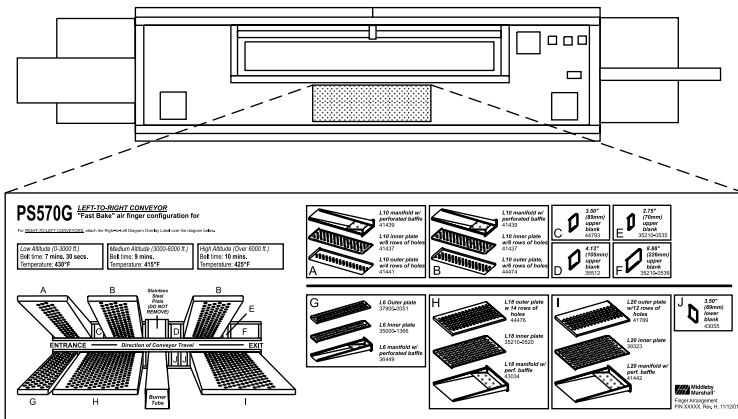
Because air finger configurations are tested at the factory for a specific customer's product, severe bake problems related to the air fingers are rare. If you encounter a problem, check the following:

1. Check that the air fingers are properly assembled, cleaned and free of obstructions. For the standard air fingers shown in Figure 4, a variety of styles are available for each of the three components. It is often possible to assemble these components incorrectly, as they are designed to be modular. This will affect the quality of the bake.

If you need information on the correct air finger configuration of the oven, check the following:

- **3D air finger label or card.** Many current ovens will have a three-dimensional drawing on the front panel of the oven that shows the correct air finger configuration, as shown in Figure 5. Other ovens may have this information on a laminated card attached to the oven.
- **Internal air finger chart.** All Middleby ovens have a chart similar to the one shown in Figure 6 attached inside the machinery compartment door. Note that if the air finger configuration has been updated since the oven was installed, this chart may no longer be correct.
- If there is no label present on the oven, and the chart inside the machinery compartment is incorrect, contact Middleby Technical Service for assistance.

**Figure 5**  
3D air finger label (if present)



**NOTE:** Labels of this type are not used on all ovens. Label placement and design will vary based on customer preference.

2. Check that the bake time and temperature settings of the oven match the customer's specifications. Most customers have an acceptable range for bake time and temperature to allow for local variations in altitude, humidity, etc.
3. If these checks fail to correct the problem, you should perform a test bake to pinpoint the type of baking problem that is present.

**C. Performing a Test Bake**

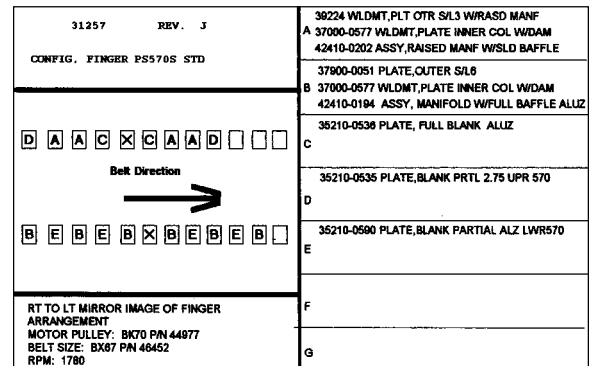
Before you attempt to correct any problem, please CONFIRM THAT THERE IS ACTUALLY A PROBLEM. It is extremely difficult to tell if an oven is baking unevenly by simply looking at a pizza with ingredients, especially if the pizza is a large combination-type. Often, the ingredients and toppings themselves can cause an uneven bake.

The best way to check for an uneven bake is to make a test bake with a consistent, "predictable" product and then read it. We recommend using the customer's dough (for a pizza product) OR a commercially-available pancake mix (for customers with a variety of products). The pancake mix is generally more sensitive to variations in temperature and thus provides more accurate results than the dough test.

When interpreting the results of the test, consistently uneven baking on the top of the product may indicate a problem with the upper air fingers. Likewise, consistently uneven baking on the bottom of the product may indicate a problem with the lower air fingers.

The most common bake problem is a "front-to-back" bake issue. This problem occurs when the "front" of the conveyor belt (towards the window) receives more heat than the rear, or vice-versa. This results in uneven baking for the product based on where it is placed on the conveyor.

**Figure 6**  
Internal air finger chart



**NOTE:** All ovens use a chart of this type inside the machinery compartment. Changes to the air finger configuration after oven installation MAY NOT BE INDICATED.

## SECTION 2 - AIR FLOW AND HEAT TRANSFER

To perform the test bake:

1. Select identical pans for the test. Choose the pans based on the width of the conveyor; you should space the pans in line completely across the conveyor without having them touch each other. For instance, for a 32" /813mm-wide conveyor, you could use three 10" /254mm pans or two 15" /381mm pans.

You will need enough pans to have three complete rows. This eliminates the possibility of a single row distorting the results. If necessary, the test can be run with only 1 row of pans, but the results are not as reliable.

2. For a pancake batter test, mix the pancake batter as instructed by the manufacturer. Pour the batter **EVENLY** into the test pans to a depth of 1/4" (6mm). You may use any type of pancake mix that is available, **AS LONG AS YOU USE THE SAME TYPE THROUGHOUT THE TEST.**

For a dough test, have the customer make up a thin crust dough in each pan. The dough should be of a consistent thickness in each pan and should be no thicker than 1/4" (6mm). Thicker doughs will provide too great a "cushion" and will distort the test results.

3. Place the pans side-by-side on the conveyor. The front and rear edges of the pans should be aligned so that it is easier to see if there is a front-to-back bake problem. **DO NOT** stagger the rows of pans diagonally. Also, check that the pans do not touch each other; this can transfer heat to the test product and distort the results.
4. Run the products through the conveyor at the customer's normal bake time and temperature settings.
5. "Read" the results of the test. Each pan of product should have the same coloration.

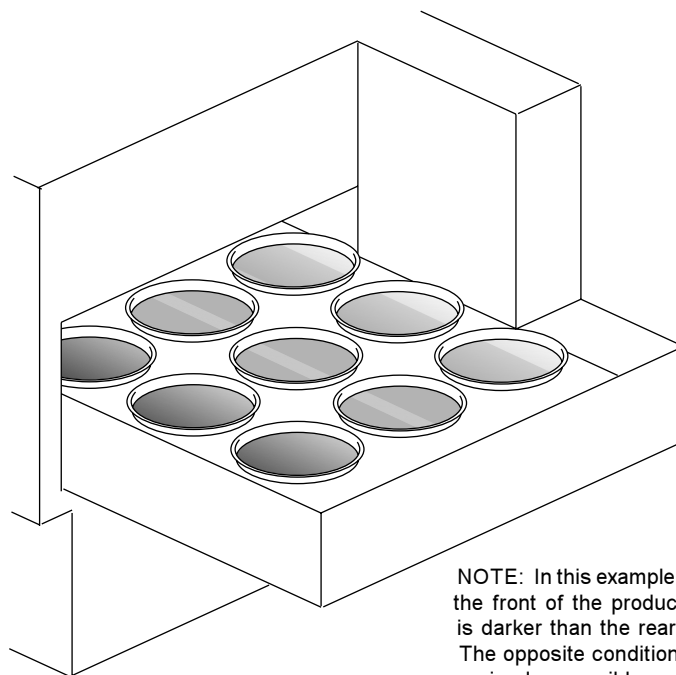
If you used pancake batter, the sugar in the mix will brown very rapidly if over-baked. This highlights an out-of-balance oven.

If the product lightens or darkens slightly from front-to-back in only one row, there is probably not a significant front-to-back bake problem. If the product is noticeably lighter or darker at the front or back in **ALL** of the rows of pans, there is a front-to-back bake problem. See Figure 7.

Also, remember that consistently uneven baking on the top of the product may indicate a problem with the upper air fingers. Likewise, consistently uneven baking on the bottom of the product may indicate a problem with the lower air fingers.

- If the oven has the current standard air finger type, you should contact Middleby Technical Services for assistance.
- If the oven has the PS300/350-style air fingers with a shutter plate, it is possible to adjust the positions of the air shutters to correct a front-to-back bake problem. Proceed to Step D, "PS300/350 Air

**Figure 7**  
**Front-to-back uneven bake**



NOTE: In this example, the front of the product is darker than the rear. The opposite condition is also possible.

Finger Shutter Adjustment."

### D. PS300/350 Air Finger Shutter Adjustment

Before attempting to properly balance a Middleby Marshall oven equipped with shutter fingers, you should understand the principles of operation of this type of finger.

The oven moves approximately 2000 ft.<sup>3</sup> of air per minute. When this large amount of air is moved through the plenum and fingers it rushes through the plenum and to the end of the air finger. This creates a back pressure of air inside the finger and tends to deliver more air onto the product at the front of the air finger.

The inner plate has a separate shutter plate riveted to it at a slight angle. Since there is more pressure at the end of the fingers (front of the oven) than at the plenum (rear of the oven), the shutter plate is angled to restrict the air flow near the front of the oven. This creates a proper balance permitting an even amount of air to exit out of the holes across the width of the conveyor. See Figure 8.

Before adjusting the shutters, it is necessary to determine if the finger is providing a balanced air delivery across the width of the conveyor. This is the purpose

of making a test to "read" the bake.

1. Remove all upper air fingers from the oven.

**NOTE:** As the air fingers are removed, use a felt pen to mark all parts of the fingers. This includes the manifold, inner plate and outer plate. If a blank or choke plate is used, mark that plate also. Fingers are marked in the order shown below, as viewed from the front of the oven. If there are upper and lower oven cavities, you should mark the fingers for the upper oven with a "U" and those for the lower oven with a "L."

**VERY IMPORTANT:** When the ovens were shipped from the factory, all of the shutters were pre-adjusted for their location within the oven. All parts of the fingers must be marked as explained above and reassembled into their original position.

2. Check the size of the openings at the front of the shutter plates by inserting a drill into the opening. The factory setting is a #46 drill (0.081"/2.06mm).
  3. Drill out the four 1/8" pop rivets that are located toward the front of the fingers. See Figure 8.
- NOTE:** DO NOT drill out the rivet at the back of the air finger. This is the pivot for the shutter.
4. If the product is lighter at the front of the oven, increase the opening by 1/16"/1.59mm. If the product is darker at the front of the oven, decrease the opening by 1/16"/1.59mm.

The best way to check the size of the openings is to use numbered drills as a gauge. An orifice drill set is ideal for making this adjustment. For example, to increase the opening by 1/16", you would use a #30 drill (0.1285"/3.26mm), which is approximately 1/16" larger than the original setting measured with the #46 drill (0.081"/2.06mm).

Be sure that the measurement is taken at the largest

point of the opening. See Figure 8.

5. While holding the new adjustment, clamp the two shutter plates together (two pairs of vice grip pliers are ideal) and drill holes for new pop rivets.

**NOTE:** Most of the old rivet holes can be reused if the old hole is simply elongated. However, if the hole is not properly elongated, the new rivets may pull the plates out of adjustment when they are installed.

**IMPORTANT:** Aluminum 1/8" pop rivets are ideal for use here. They are much easier to drill out than stainless steel rivets.

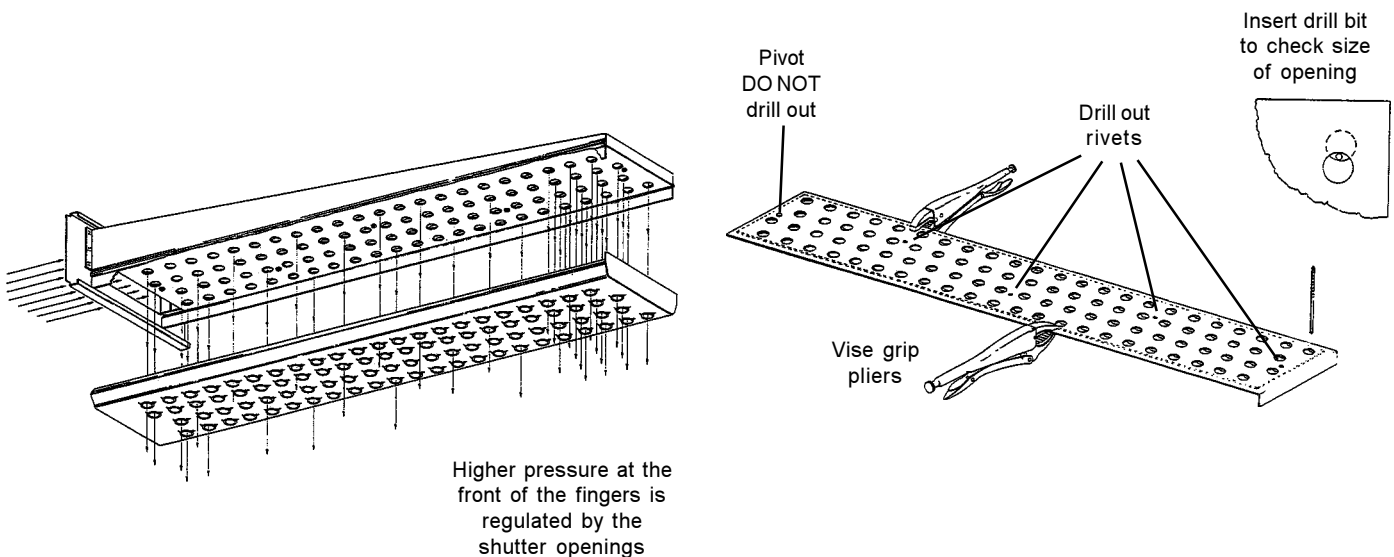
6. Repeat these steps to adjust all upper air fingers. Then, reinstall the fingers into the oven.
7. Perform another test bake.

**IMPORTANT:** This test bake must be an exact duplicate of the first test bake. If you change any of the conditions you will change the results.

- If the test indicates an even bake, your adjustment is complete.
- If the test indicates that the bake is still uneven, you will need to repeat the adjustment procedure until an even bake is obtained. By keeping the tests identical, you should be able to determine how much more the shutter plates should be opened or closed to achieve a balanced bake without removing the fingers for a third time.

**VERY IMPORTANT:** After attaining a proper adjustment of the fingers, each air finger should be marked with a metal stamp showing its position inside the oven. This will eliminate future problems of operators mixing the adjusted fingers when cleaning the oven.

**Figure 8**  
**PS300/350-style air finger with adjustable shutter plate**



SECTION 2 - AIR FLOW AND HEAT TRANSFER

IV. OVEN CAPACITY

Oven capacity is generally not a service issue. However, when reporting a service problem, customers may use terms relating to capacity, such as bake time, belt time, time of delivery, etc. This information is provided as a reference for understanding these terms.

A. Conveyor Speed and Bake Time

Middleby Marshall conveyor ovens display the Conveyor Speed on the Thumbwheel (or on the display of the Digital Speed Controller, as appropriate for the oven model). Conveyor Speed is also called Bake Time.

Conveyor Speed (Bake Time) is a *leading edge to leading edge* measurement. That is, it is the elapsed time from the leading edge of the product entering the bake chamber to the leading edge of the product leaving the bake chamber. See Figure 9.

B. Belt Time

Belt Time is a measurement used by several customers. It is a *trailing edge to trailing edge* measurement. That is, it is the elapsed time from the trailing edge of the product entering the bake chamber to the trailing edge of the product leaving the bake chamber. See Figure 10.

Note that belt time is equal in length to conveyor speed (bake time), although the time is measured during a different period of the baking process.

C. Time of Delivery (TOD)

Time of delivery (TOD) is a *leading edge to trailing edge* measurement. That is, it is the elapsed time from when the leading edge of the product enters the bake chamber to when the trailing edge of the product leaves the bake chamber. See Figure 11.

Figure 9 - Conveyor Speed (Bake Time)

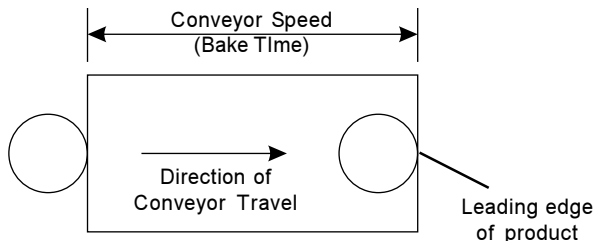


Figure 10 - Belt Time

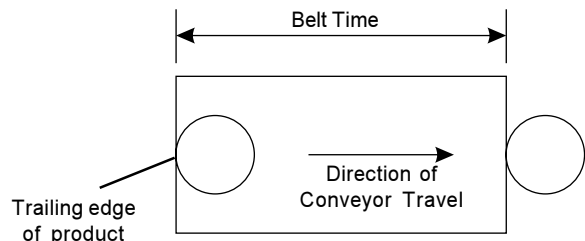
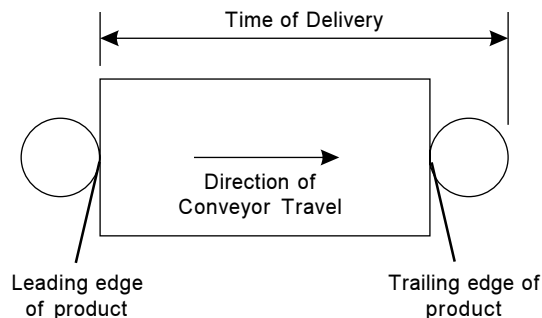


Figure 11 - Time of Delivery



D. Formulas for Determining Time of Delivery (TOD) and Oven Capacity per Hour

1. Time of Delivery (TOD)

$$\text{Time of Delivery (TOD)} = \frac{\text{Conveyor Speed}}{\text{Bake Chamber Length}} \times (\text{Bake Chamber Length} + \text{Product Diameter})$$

Example: PS570S Oven, 7:00 Bake Time, 16" Product Diameter =  $\frac{7 \text{ mins.}}{70"} \times (70" + 16") = 8.6 \text{ mins. (8:36)}$

2. Oven Capacity/Hour

$$\text{Oven Capacity/Hour} = \frac{(\text{Bake Chamber Length} + \text{Product Diameter}) \times \text{Bake Chamber Depth}}{\text{Product Diameter}^2} \times \frac{60 \text{ min./hr.}}{\text{TOD}}$$

Example: PS570S Oven, 7:00 Bake Time, 16" Product Diameter =  $\frac{(70" + 16") \times 32"}{256 \text{ in.}^2} \times 6.98 = 75 \text{ pizzas/hr.}$

## SECTION 3

# SERVICING COMPONENTS

### I. CONVEYOR SPEED CONTROLLER AND DRIVE MOTOR

The Conveyor Speed Controller is used to set and monitor the speed of the conveyor. The Controller consists of three components:

- Control Module

Early units used a module which featured a microcomputer that was unique to each oven model. Using this control module required verifying that the correct microcomputer was installed.

Later units use DIP switches to set up the controller for a particular oven model. This later model was initially available with a thumbwheel unit (either 4 or 8 DIP switches). Current models feature a digital display with keypad (8 DIP switches).

- Thumbwheel Unit (or Digital Display with Keypad)

This module displays the conveyor speed and allows it to be adjusted by the operator. It is connected to the control module by a ribbon cable.

- Pickup Assembly

The pickup assembly consists of a magnetic wheel on the end of the gear motor (conveyor drive motor) shaft, and a Hall Device sensor that provides feedback to the control module.

As the magnetic wheel turns, the revolutions of the magnet are monitored by the Hall Device sensor. The signals are sent to the control module, which compares the motor speed with the speed shown on the thumbwheel or digital display. The control module increases or decreases the voltage to the gear motor (conveyor drive motor) depending on the signal.

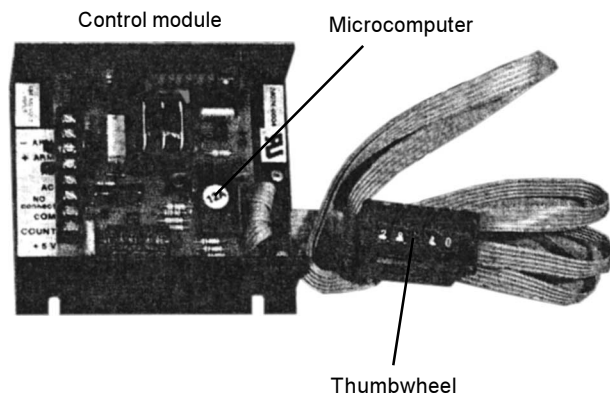
**Figure 12**

#### Original-style speed controller

*Produced with thumbwheel only.*

*Interchangeable microcomputer selects oven model.*

**THIS CONTROLLER IS OBSOLETE AND NO LONGER AVAILABLE.**



### A. Part Number Reference - Speed Controllers

- Original-style speed controller with interchangeable microcomputer and thumbwheel.* This unit is no longer available and part numbers are provided for reference only. Servicing this unit is beyond the scope of this manual. If this controller is in need of service, we recommend simply installing a current unit (see below).

P/N	Description
28174-0004	PS360 controller, yellow (12A) microcomputer
28074-0006	PS360 microcomputer, yellow (12A)
27170-0232	PS360 microcomputer w/emulator, yellow (12A)
28074-0007	PS314 controller, orange (13A) microcomputer
28074-0008	PS314 microcomputer, orange (13A)
27170-0233	PS314 microcomputer w/emulator, orange (13A)
28074-0013	PS200 microcomputer, pink (15A)

- Current-style speed controller with either 4 or 8 DIP switch settings and thumbwheel.* This unit is no longer available from the factory, but may still be stocked by service agencies.

P/N	Description
42810-0133	Controller assembly with thumbwheel
42810-0118	Thumbwheel only

- Current-style speed controller with 8 DIP switch settings and digital display/keypad.* Note that the two types of controllers ARE NOT compatible - the controller and display unit MUST be of the same type.

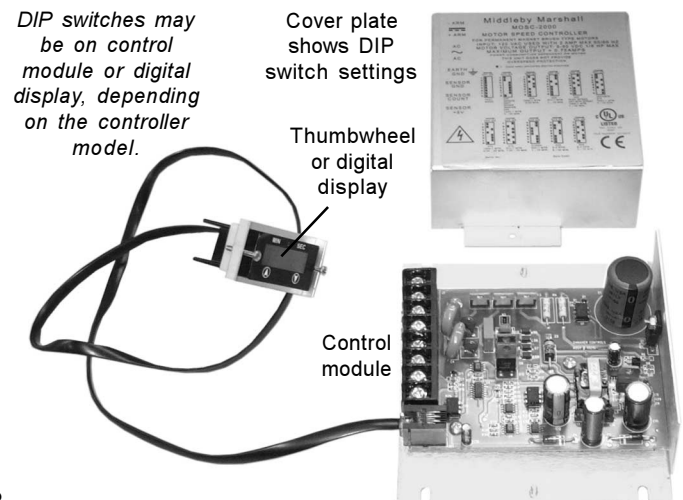
P/N	Description
37337	Controller assembly with digital display/keypad, NCC (8/00-current)
37503	Digital display/keypad unit only, NCC
45133	Controller assembly with digital display/keypad, Danaher (2/02-current)

**Figure 13**

#### Current-style speed controller

*Produced with Thumbwheel or digital display.*

*4 or 8 DIP switches select oven model.*





SECTION 3 - SERVICING COMPONENTS

**B. Part Number Reference - Pickup Assemblies**

1. *PS350-style pickup assembly or old-style pickup assembly (see Figures 14-15).* These parts use the same part number. They are no longer available from the factory, but may still be stocked by some service agencies.

P/N	Description
28074-0005	Pickup assembly, PS350-style or old-style

2. *Current-style pickup assembly (see Figures 16-17)*

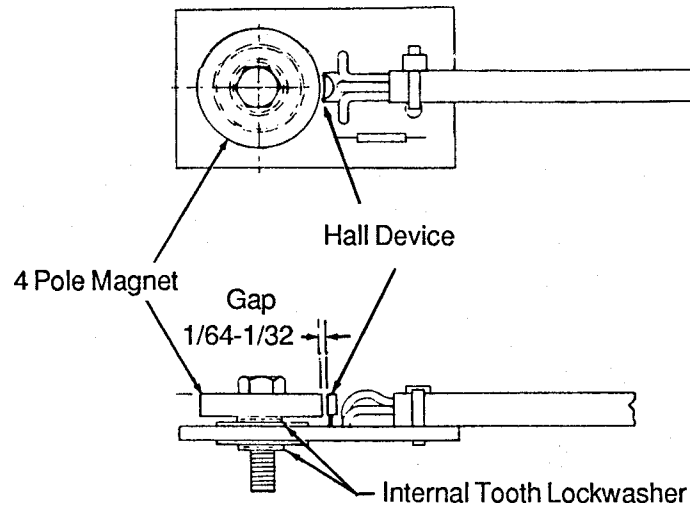
P/N	Description
27170-0263	Pickup assembly, current

**C. Preparing to Service the Speed Controller**

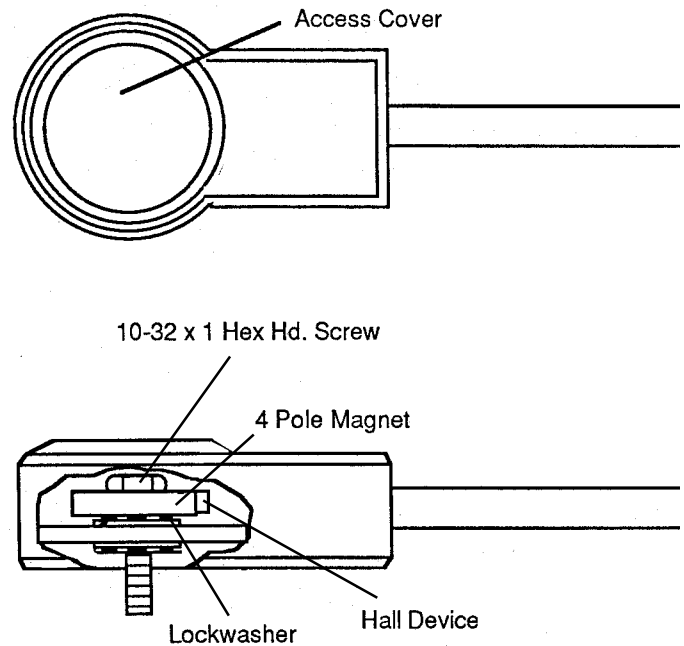
**NOTE:** To properly service this equipment, you must use a digital meter. An analog meter will not work.

1. Before troubleshooting the conveyor speed controller, check the following:
  - a. Conveyor belt is tight.
  - b. Drive chain is tight and aligned.
  - c. Set screws on drive sprockets are tight.
  - d. Axial fan(s) are running and clean of dust and debris.
  - e. Motor and pickup wires are secure at the Conveyor Terminal Block (location of the block varies by oven model).
  - f. Wire connections on conveyor speed control module (including the ribbon cable to the thumbwheel/display unit) are secure.
2. Check the pickup for the following (see Figures 14-17):
  - a. Pickup is secure.
  - b. Magnet is not cracked or chipped.
  - c. Magnet is not rubbing on plastic housing.
  - d. Mounting bolt is not worn or bent.
  - e. Pickup bearing in good condition.
  - f. On PS350-style pickup (Fig. 14), gap between magnet and Hall Device is spaced approximately 1/64"-1/32" (0.4-0.8mm, or a business card thickness).

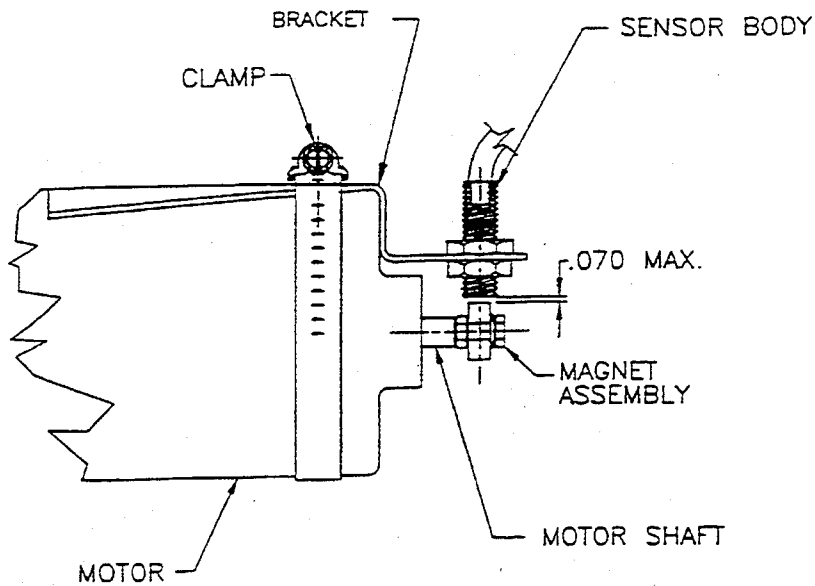
**Figure 14**  
**PS350-style pickup assembly**  
**(used on early PS360)**



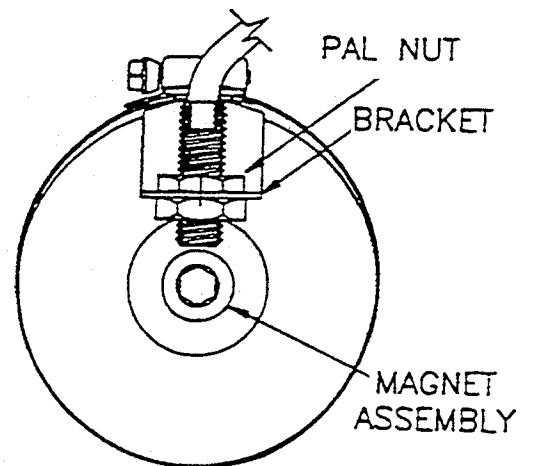
**Figure 15**  
**Old-style pickup assembly**



**Figure 16**  
Current pickup assembly - side view



**Figure 17**  
Current pickup assembly - end view



#### D. Controller/Motor Failure

When the conveyor speed controller fails, it is very possible that a shorted conveyor motor caused the problem. Unless the motor is changed, the installation of another conveyor speed controller will simply burn up the new controller.

You are **STRONGLY ADVISED** to bypass the speed controller and install the tester unit shown in Figure 18 before replacing any speed controller that has burned out. This will identify the source of the problem - the speed controller or the motor. It is much less expensive to burn out the tester than another speed controller.

The components for this tester can be purchased at any electrical supply store. The tester is not as accurate or sensitive as the speed controller, and so should **NOT** be left in place on the oven after servicing!

*Components needed for the field tester:*

- Full-wave AC-DC bridge, 400V, 4A
- Light dimmer switch, 5A
- In-line 5A AC fuse enclosed in plastic case
- 2 alligator clips

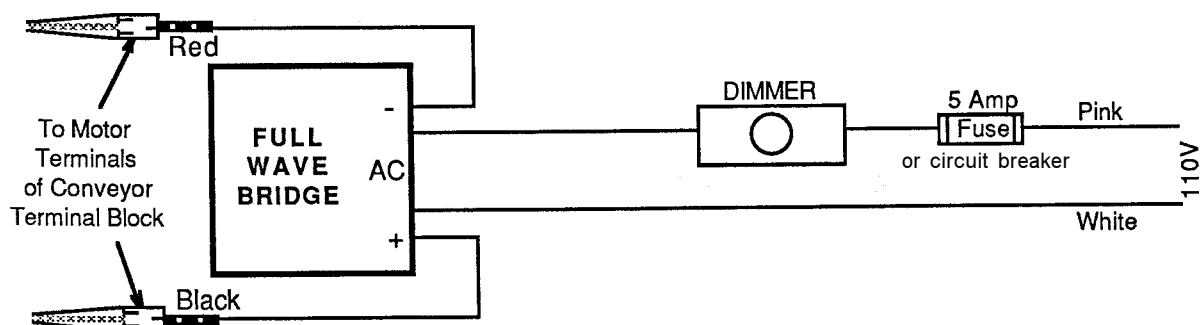
**CAUTION: DO NOT turn the conveyor switch ON while the field tester is connected!**

1. Disconnect the motor lead wires and attach to the field tester as shown in Figure 18. Depending on the oven model, you can simply use the black and red gear motor leads, or the remote leads at the terminal block connection.

To reverse the conveyor motor direction, simply interchange the black and red leads.

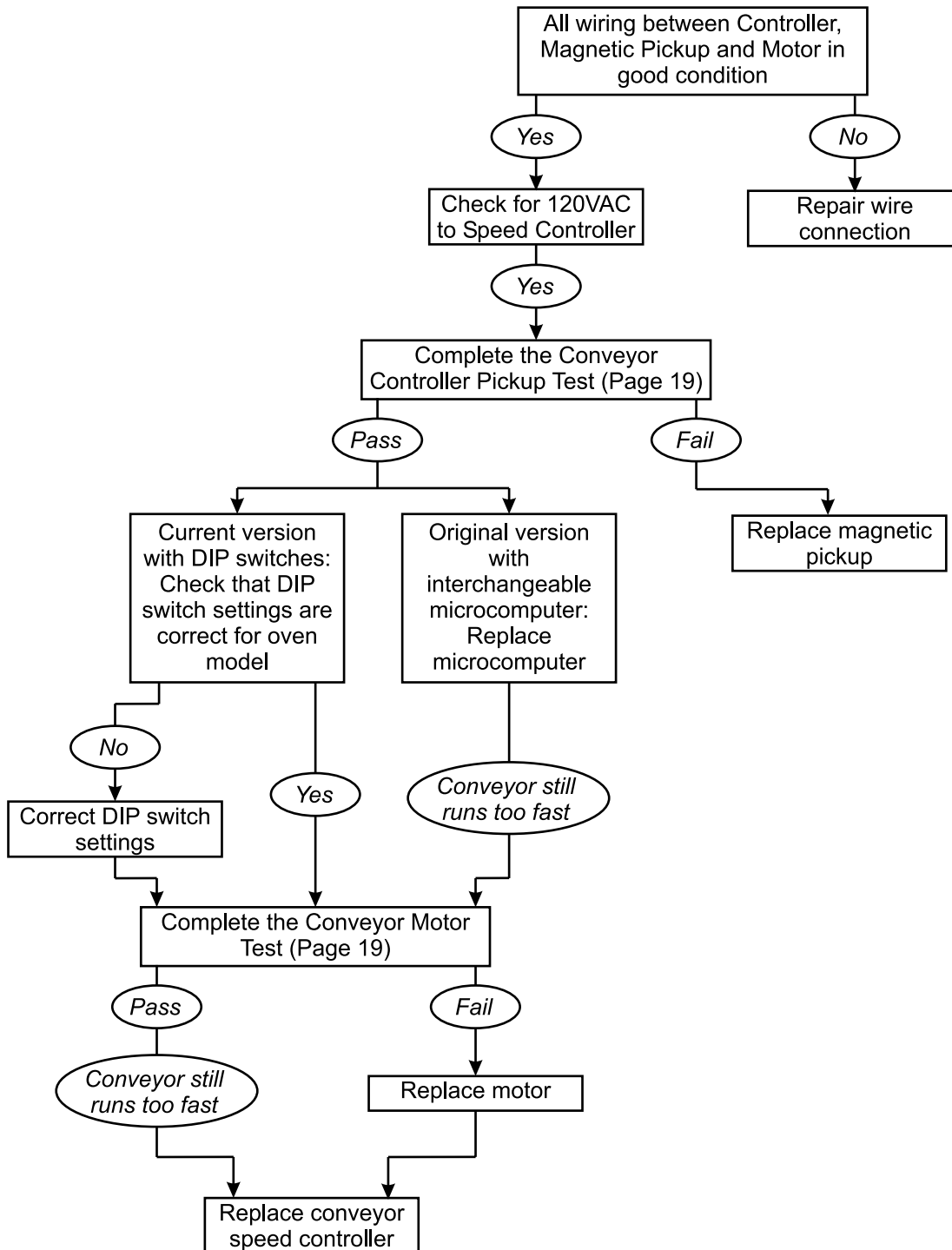
2. To start the test, the dimmer switch should be turned until the motor begins to operate. The switch can then be turned down to the desired motor speed.

**Figure 18**  
Field Tester for Conveyor Drive Motor



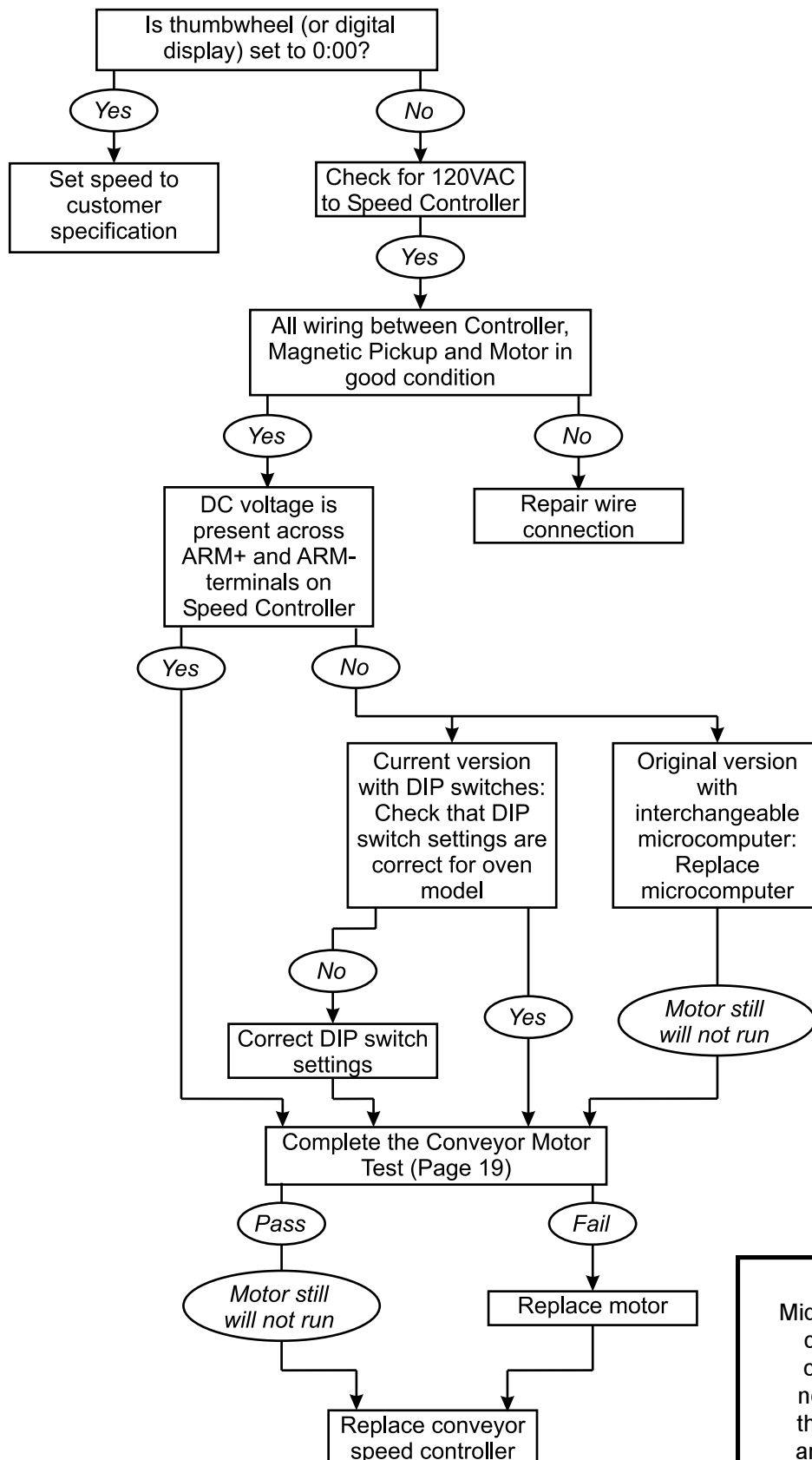
E. Basic Troubleshooting Flowcharts

1. IF THE GEAR MOTOR RUNS AT FULL SPEED:



**NOTE:**  
 Middleby no longer stocks parts for the original speed controller with interchangeable microcomputer. If it is necessary to replace this version of the controller or the microcomputer, and the service agent does not have the parts in stock, it will be necessary to replace the entire speed controller with a current model.

## 2. IF THE GEAR MOTOR WILL NOT RUN AT ALL:

**NOTE:**

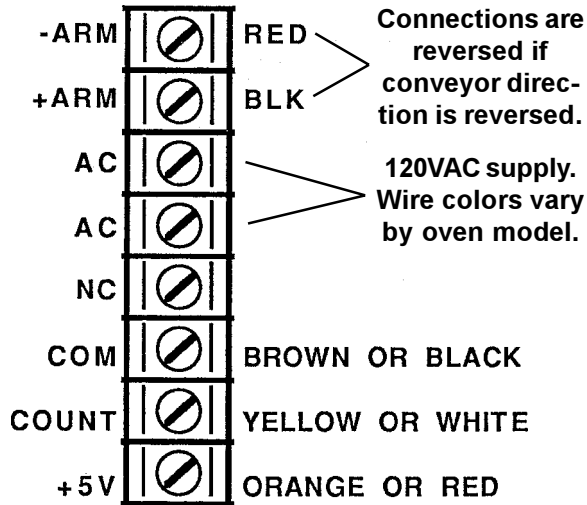
Middleby no longer stocks parts for the original speed controller with interchangeable microcomputer. If it is necessary to replace this version of the controller or the microcomputer, and the service agent does not have the parts in stock, it will be necessary to replace the entire speed controller with a current model.

SECTION 3 - SERVICING COMPONENTS

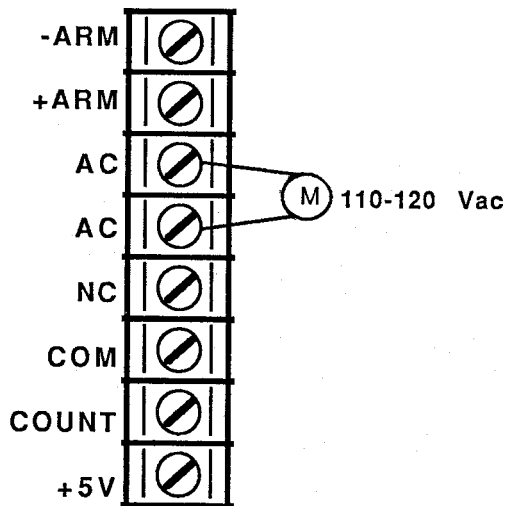
F. Initial Troubleshooting

NOTE: When changing the conveyor speed on a controller with a thumbwheel, it is advisable to turn the conveyor switch OFF before adjusting the thumbwheel. Note that this cannot be done on a digital keypad, as switching the conveyor switch OFF will also turn off the display.

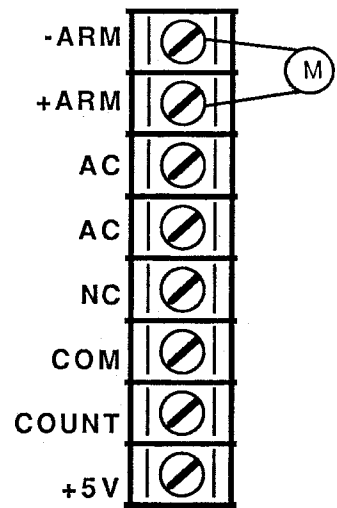
1. Check all connections at the terminals on the conveyor speed control module to ensure that they are correct and tight. Connections are shown in the drawing. Correct the connections if necessary.



2. Ensure that there is power to the controller. Use a digital multimeter to read the voltage between the terminals marked "AC." The voltage should read between 110-120VAC. If the power is not present or of an incorrect voltage, check the power source.



3. With the AC power on, check the DC voltage to the conveyor motor. Match the measured voltage with those shown on the chart below. If the voltage reading is more than  $\pm 5\text{VDC}$  of that shown on the chart, complete the Motor Test on the next page.



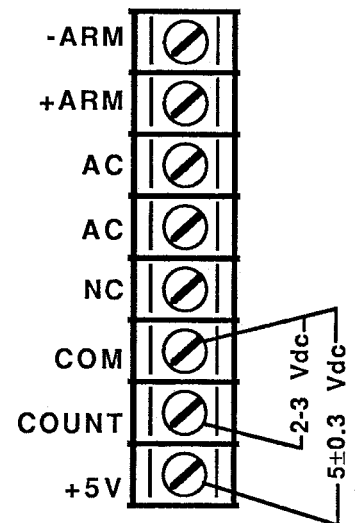
Thumbwheel/ Display Setting	DC Motor Voltage	
	PS200, 570, 360WB70	PS310, 360, 360WB, 360EWB
3 mins.	84VDC	67VDC
4 mins.	63VDC	50VDC
5 mins.	51VDC	40VDC
6 mins.	43VDC	34VDC
7 mins.	37VDC	28VDC
8 mins.	32VDC	25VDC
9 mins.	29VDC	22VDC
10 mins.	27VDC	20VDC
11 mins.	24VDC	18VDC
12 mins.	22VDC	17VDC
13 mins.	19VDC	14VDC
15 mins.	18VDC	13VDC

4. Check the magnetic pickup on the motor.

If the pickup is in good condition, check that the conveyor is running and then check the voltage between the "COM" and " $\pm 5\text{VDC}$ " terminals on the controller. On controllers with thumbwheels, the voltage should read 5VDC,  $\pm 0.3\text{VDC}$ . Digital controllers should read 5VDC,  $\pm 1.0\text{VDC}$ .

Next, check the voltage between the "COM" and "COUNT" terminals. The reading should stay between 2 and 3VDC.

If EITHER of these two readings are incorrect, perform the Conveyor Control Pickup Test on the next page.

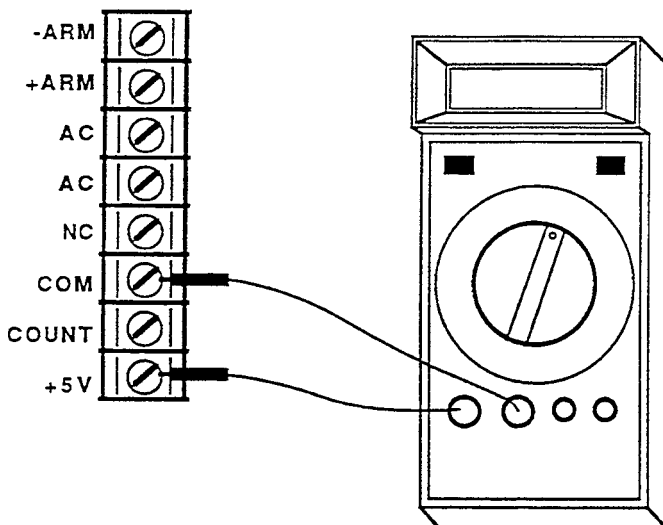




**G. Conveyor Control Pickup Test**

- Visually check the pickup for the following:
  - The magnet is clean and the bearing is in good condition.
  - There are no chips or cracks on the magnet.
  - If using a PS350-style pickup (see Figure 14), there is a 1/64" to 1/32" (0.4-0.8mm, or a business card thickness) gap between magnet and hall device.
- Set the multimeter to the VDC scale, then connect the meter probes as shown in Figure 19. The black (-common) probe should connect to the "COM" terminal on the speed control board, while the red (+V $\Omega$ ) probe connects to the "+5V" terminal. +5VDC should be present at all times when the conveyor is operating.
  - If +5VDC is present, proceed to Step 3.
  - If +5VDC is not present, disconnect the three pickup wires (connected to the "COM," "SIGNAL," and "+5V" terminals) and again check for +5VDC.
    - If +5VDC is present with the pickup disconnected, replace the pickup assembly.
    - If +5VDC is still not present, replace the conveyor speed controller.
- Connect the multimeter's red (+) lead to the "SIGNAL" terminal; then, disconnect the motor wires from the "-ARM" and "+ARM" terminals. Using a 5/16" open-end wrench, very slowly rotate the motor pickup shaft while observing the multimeter. Two (2) changes from +5VDC to 0VDC should occur for each motor revolution.
  - If the signal is always at 0VDC, go to Step 4.
  - If the signal is always at 5VDC, OR if the signal changes more than 2 times per revolution, replace the pickup assembly.
- Disconnect the pickup signal wire from the speed controller and check for +5VDC at the "SIGNAL" terminal of the controller.
  - If +5VDC is present, replace the pickup assembly.
  - If 0VDC is present, replace speed control.

**Figure 19**  
**Connections for pickup test**

**H. Conveyor Motor Test**

- Disconnect the gear motor wires from the Speed Controller terminals ("-ARM" and "+ARM").
- Remove the brush retainer caps from the gear motor. DO NOT remove the brushes.
- Set the multimeter to the lowest Ohm scale. Then, place one meter probe on each brush retaining plate. BE SURE THAT NEITHER PROBE TOUCHES THE MOTOR CASING.
- Using a 5/16" open-end wrench, very slowly rotate the motor pickup shaft while observing the multimeter. During a 1/2 rotation:
  - The Ohm reading should stay between 3-5 $\Omega$ .
  - There should NEVER be a complete short.
  - There should never be a high Ohm reading.
 If the motor fails any of these tests, replace the motor.

**I. Replacing the Magnetic Pickup**

If you need to replace the magnetic pickup on a gear motor shaft:

- Apply Loctite Removable #242 (or equivalent) sparingly to the threads.
- Turn the mounting screw until it is finger tight, then turn it an additional 1/4 turn with a wrench.

**J. Unshielded Pickup Wires on Early PS360-series ovens**

The conveyor speed controller can be affected by electrical noise transmitted by other electrical components or wiring. Early PS360-series ovens used an unshielded connection between the pickup assembly and the control module. On these ovens, the unshielded wiring can pick up the noise and transmit it to the control module. The problem is most easily seen when the conveyor fails during burner spark ignition.

There are two remedies for this problem:

- Turn the conveyor switch to the OFF position, and then back to the ON position, after the burner has ignited. The controller should reset and allow normal operation. This should be used as a stop-gap measure ONLY to allow the oven to continue operation.
- Replace the pickup wiring between the control module and the terminal block with a new shielded cable (P/N 42400-0334). When installing the shielded cable, follow the color code change shown here:

Old Wiring	Shielded Cable
Brown	Black
Orange	Red
Yellow	White

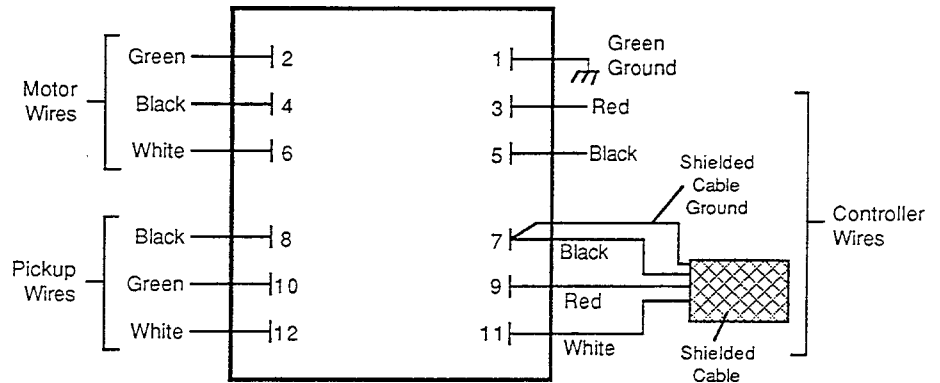
Wiring diagrams are also provided in Figures 20 and 21 on the next page.

There is a fourth lead on one end of the shielded cable. This is a ground lead which is attached to the black wire of the cable. The ground lead should be connected to the terminal block inside the motor compartment.

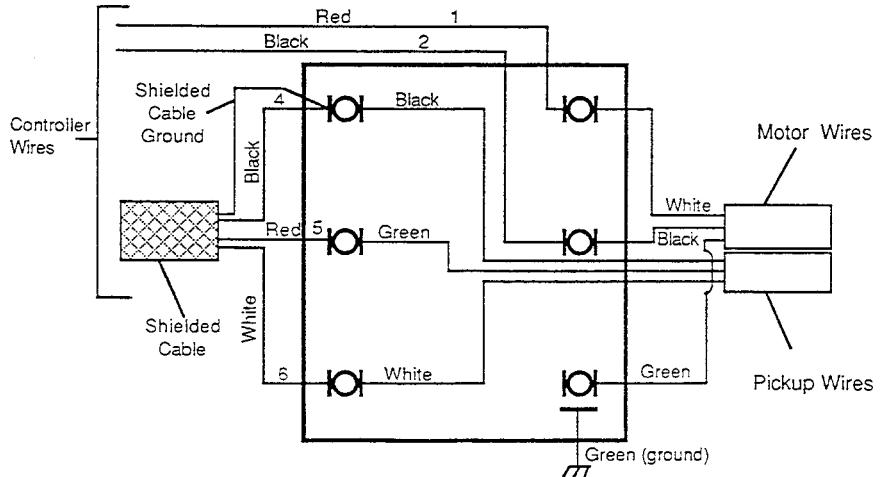
Current PS360-series ovens have the shielded cable installed at the factory and do not require this retrofit.

SECTION 3 - SERVICING COMPONENTS

**Figure 20**  
**Wiring for PS360 Shielded Pickup Cable - early terminal block design**

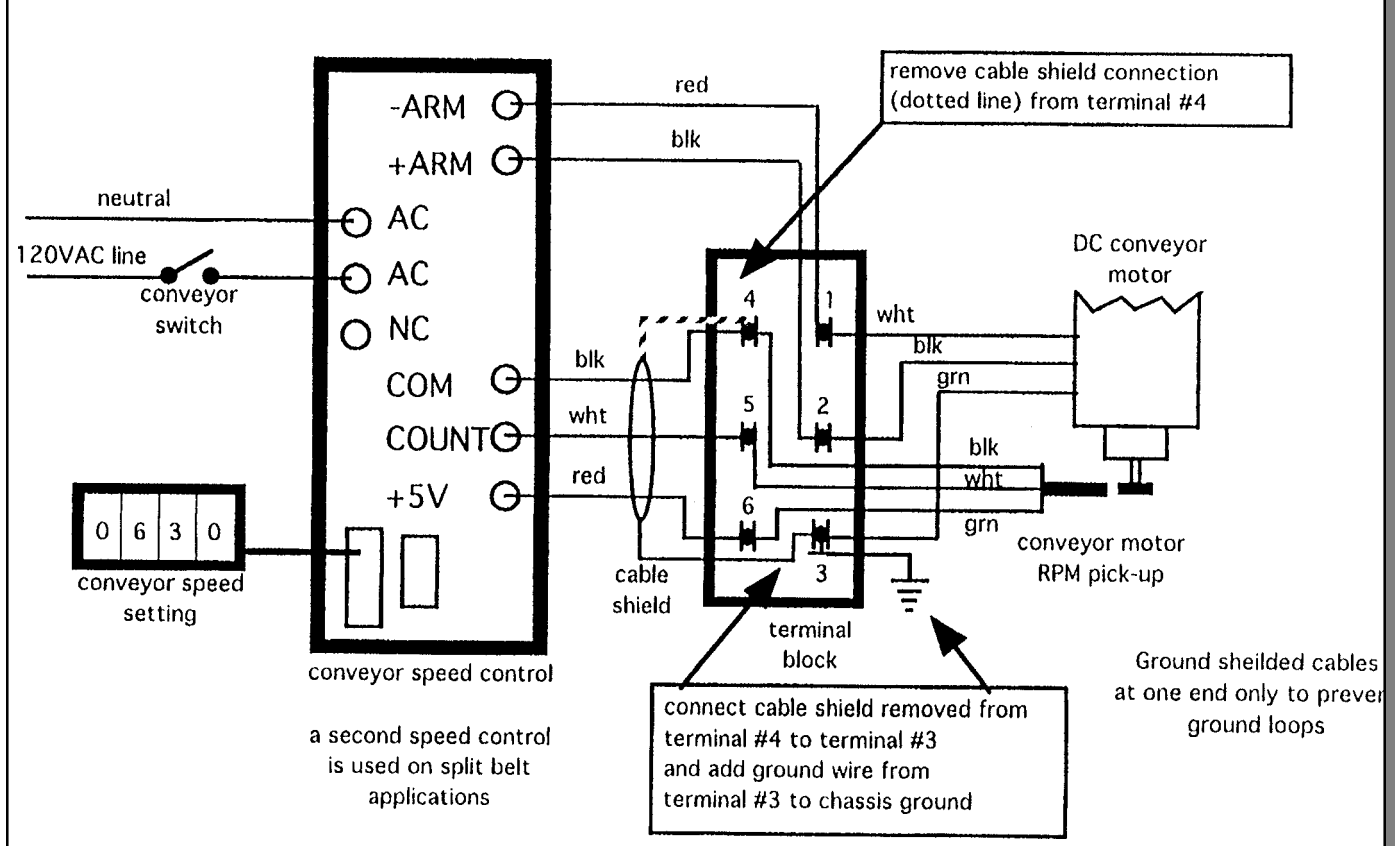


**Figure 21**  
**Wiring for PS360 Shielded Pickup Cable - late terminal block design**



K. Appendices

**Appendix - Conveyor sensor wiring changes for PS360-series and PS570S, 10/95**



## Appendix - Service Bulletin MM-133B - Installation Instructions for Conveyor Speed Controller Kit with Thumbwheel, P/N 42810-0133, 4/95



**Toastmaster**®

**Bus Boy**



Middleby Cooking Systems Group

Bulletin No. MM-133B

Date 04/07/95

1400 Toastmaster Drive ■ Elgin, Illinois 60120  
(708) 741-3300 ■ Service & Parts (708) 741-4406



## Service Bulletin

**Subject** Installation and Diagnostic Instructions  
DIP Switch Conveyor Control Assembly  
Part Number 42810-0133

### Application

This service bulletin describes the original DIP switch conveyor control, Part Number 28074-0018, the new DIP switch conveyor speed control, Part Number 31020 and introduces the latest instructions for installation and set up. Either control can be contained in Kit Part Number 42810-0133. Both controls use advanced digital electronics to improve reliability and provide diagnostic features. The installation and operation of these controls are identical to each other and both replace prior non-DIP switch model controls.

Both control's printed circuit boards are housed in metal covers and both have detachable/replaceable and interchangeable thumbwheel switches.

The distinguishing features between the original and the current control are the DIP switch blocks and the markings on their metal covers.

Control PN 28074-0018 has a 4 position DIP switch and the control PN 31020 has an 8 position DIP switch. Control PN 31020 has its individual DIP switch program settings silk screened on the metal cover for easy reference.

### Features

1. Control Part Number 31020 has enhanced tolerance to electrical systems that have unstable frequency control (50 or 60 cycles). This control also continuously monitors the cycles and adjusts itself accordingly. If an unstable frequency utility is common to the area, it is recommended to use the PN 31020 control.
2. All DIP switch Conveyor Speed Controls provide a variable DC voltage output determined by the thumbwheel setting and the frequency input from the speed control pick-up assembly.
3. DIP switch control PN 28074-0018 (REV. B)\* and DIP switch control PN 31020 contain the program settings for all Middleby Marshall Ovens that use digital conveyor controls.
4. Both controls have built-in diagnostics to assist the service technician.

## **Appendix - Service Bulletin MM-133B - Installation Instructions for Conveyor Speed Controller Kit with Thumbwheel, P/N 42810-0133, 4/95**

### Features Continued

5. Both controls are protected against gear motor shorts.
6. Both controls have metal housing covers that guard against handling damage and minimizes radio frequency interference (RFI).

\*Note: Control PN 28074-0018 REVISION B contains all current DIP switch settings currently used in the field. Prior to REV B, this control was not compatible with the 570 Series conveyor chain driven ovens. The revision letter is printed on the controls label should you be concerned if your inventory is not updated.

### **Compatibility**

Both the above referenced controls are compatible with all current and previous Middleby Marshall digital conveyor controls, gear motors and pick-ups. Consult the gear motor/sprocket combinations chart - contained in the attached instructions - for optional conveyor speed set ups. The replacement thumb wheels used on both DIP switch controls can be interchanged.

### **Availability**

All orders for replacement controls will be filled with control PN 31020. All newly manufactured ovens are fitted with control PN 31020. Continue to order replacement controls under kit PN 42810-0133 which will contain the attached updated instructions along with control PN 31020.

## Appendix - Instructions for Service Kit 42810-0133- Conveyor Speed Controller Kit with Thumbwheel, 4/95

DIP Switch Conveyor Control Installation and Diagnostic Instructions  
Part Number 88210-0077

### General

The following provides instructions for the Installation and Diagnostics of the DIP Switch Conveyor Control Part Number 28074-0018 or Part Number 31020 contained in kit Part Number 42810-0133. Either of these controls can be installed into the PS200, 300, and the 500 Series Ovens. Note: If installing PN 28074-0018 control into a PS570(S) chain driven conveyor oven, be sure the control is marked "Revision B" on the label.

### A. DIP Switch Conveyor Control Installation

The DIP Switch Conveyor Control Module is installed and secured with Phillips Head Screws and External Tooth Lockwashers (not supplied) in the oven control compartment. The Thumb Wheel is installed in a rectangular opening on the oven front panel. The ribbon cable from the Thumb Wheel is connected to the 14-pin connector on the control module.

Terminals on the specific control are arranged and marked to show electrical connections (See Figure 1). Consult the specific oven model wire schematic for further wiring details especially for magnetic pick - up wire color codes. The oven application must be selected by setting the "DIP" switches on the specific control to the proper positions. The LED is used for diagnostics.

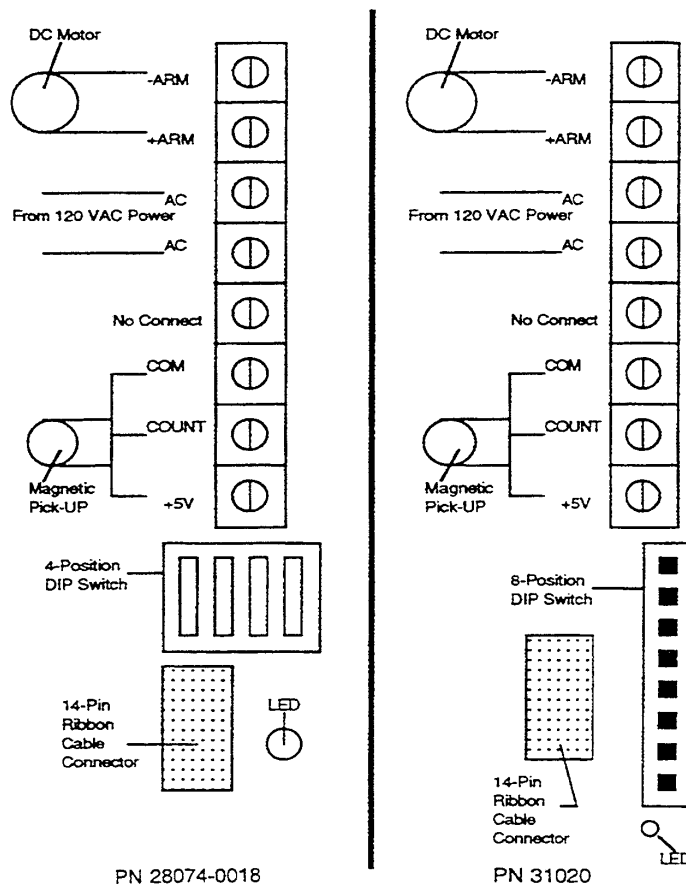


FIGURE 1



## Appendix - Instructions for Service Kit 42810-0133- Conveyor Speed Controller Kit with Thumbwheel, 4/95

**DIP SWITCH SETTINGS  
FOR BOTH CONTROLS**

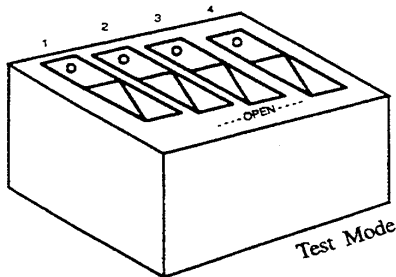
**Control PN 28074-0018 (REV. B)**

Standard Conveyor Speed Settings

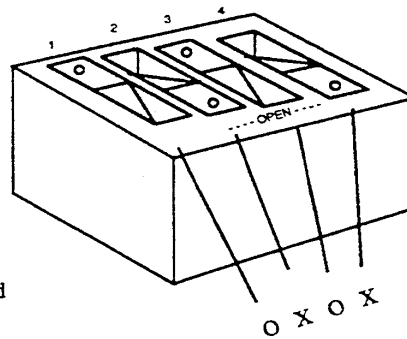
MODEL(S)	OVEN TIMES(MIN/MAX)	SWITCH SETTING			
		1	2	3	4
PS200 PS200SB PS200-20 PS224 PS200T	2:40 MIN TO 29:50 MIN	X	O	X	X
PS360 PS310 PS350 PS360SB PS360T PS360WB	2:40 MIN TO 29:50 MIN	O	X	X	X
PS570 PS570S PS360WB70	2:40 MIN TO 29:50 MIN	O	X	X	O
PS570-SB PS570S-SB	4:30 MIN TO 30 MIN EXTENDED BAKE	X	X	X	O

High Speed Option Conveyor Settings

MODEL(S)	OVEN TIME(MIN/MAX)	SWITCH SETTING			
		1	2	3	4
PS200 (1 MIN)	40 SEC TO 10 MIN	O	O	X	X
PS333FB PS310F	1:30 MIN TO 10 MIN	X	X	O	X
PS360SS	1 MIN TO 10 MIN	O	X	O	X
PS570-SB PS570S-SB	HIGH SPEED OPT. 1:30 TO 10 MIN	X	O	X	O



Switches All In Open Position



Sample Mode PS360SS

O = Open  
X = Closed

**Control PN 31020**

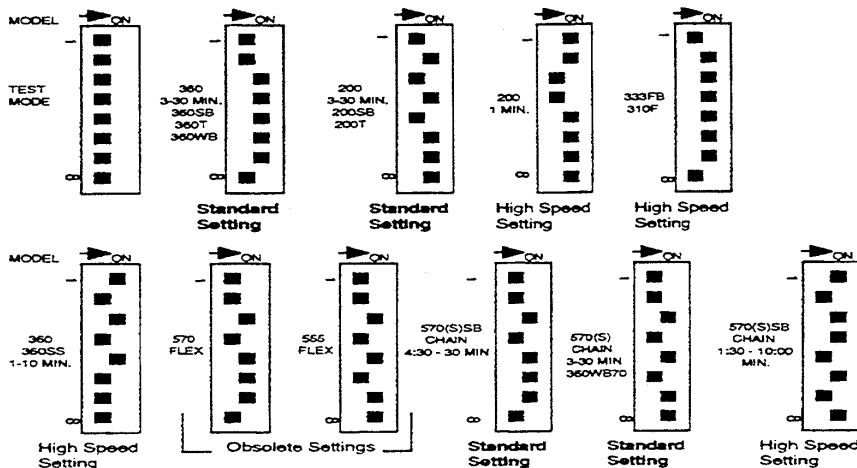


FIGURE 2

## Appendix - Instructions for Service Kit 42810-0133- Conveyor Speed Controller Kit with Thumbwheel, 4/95

### B. Replacement Thumb Wheel Switch Installation

1. Disconnect the power to the conveyor control by turning the conveyor switch to the "off" (O) position and additionally by turning off the main power disconnect to the oven.
2. Remove the two screws that secure the failed switch body to the control door. Remove the switch body from the door.
3. Locate the ribbon cable connector that links the thumb wheel switch to the controller. Note the orientation of the cable for replacement. Grasp the connector firmly and pull it away from the control.
4. The thumb wheel connector is a polarized interlocking type connector that can only be installed in the correct orientation. Locate the connector to the terminal strip so that the polarized interlocking lug on the connector is aligned with the mating slot on the terminal and use your thumb to press the connector firmly into the terminal.
5. Locate the switch body to the control panel and assemble the switch body to the panel using the screws from step 2.
6. Set the switches on the control to "diagnostic mode" in Figure 2.
7. Run diagnostic tests to determine performance to the control. (see diagnostic instructions below)
8. Set the mode switches back to the correct settings for the oven type and control version (see switch setting instructions in Figure 2).

### Appendix - Instructions for Service Kit 42810-0133- Conveyor Speed Controller Kit with Thumbwheel, 4/95

#### D. Gear Motor/Sprocket Combinations

The chart reference below lists the different motor sprocket combinations used with the DIP switch conveyor control system.

CONVEYOR MOTOR/SPROCKET COMBINATIONS					
MODEL & CHAMBER LENGTH	GEAR MOTOR	MOTOR SPROCKET	CONVEYOR SPROCKET	BAKE TIME PARAMETERS	
PS200 40.5" PS220FS PS224 (Standard)	1350:1 Ratio 27384-0011	15T 22151-0003	10T 22151-0002	2:40 Min to 29:50 Min	
PS200T 81" (Tandem)	1350:1 Ratio 27384-0011	30T 22159-0004	10T 22151-0002	2:40 Min to 29:50 Min	
PS200 1 Min 40.5" (High Speed)	311:1 Ratio 27384-0014	15T 22151-0003	10T 22151-0002	40 Sec to 10 Min	
PS200SB 40.5" (Split Belt)	1350:1 Ratio 27384-0011	30T 22159-0004	20T 22159-0003	2:40 Min to 29:50 Min	
PS360 54.5" PS310 PS314 PS360SB PS360WB PS350 (Standard)	1400:1 Ratio 27384-0008	15T 22152-0018	9T 22152-0017	2:40 Min to 29:50 Min	
PS360WB70 70" (Wide Body Stretch)	1400:1 Ratio 27384-0008	15T 22152-0018	9T 22152-0017	2:40 Min to 29:50 Min	
PS360SS 54.5" (High Speed)	1400:1 Ratio 27384-0008	45T 22152-0027	9T 22152-0017	1 Min to 10 Min	
PS360T 109" (Tandem)	1400:1 Ratio 27384-0008	30T 22152-0022	9T 22152-0017	2:40 Min to 29:50 Min	
PS570 70" PS570S (Standard)	1400:1 Ratio 27384-0008	15T 22152-0018	9T 22152-0017	2:40 Min to 29:50 Min	
PS570SB 70" (Standard)	1350:1 Ratio 27384-0011	15T 22152-0024	9T 22152-0017	4:30 Min to 29:50 Min	
PS570SB 70" (High Speed)	311:1 Ratio 27384-0014	15T 22152-0024	9T 22152-0017	1:30 Min to 10 Min	

## Appendix - Service Bulletin MM-177 - Introduction and Compatibility of Conveyor Speed Controller with Digital Display, P/N 37337, 8/00

Bulletin No. MM-177  
Date: 8/18/00

### Middleby Cooking Systems Group



1400 Toastmaster Drive • Elgin, IL 60120-9272 U. S. A. • Telephone: (847)741-3300 • Service and Parts Fax: (847)741-4406

## Middleby Marshall® Service Bulletin

### SUBJECT

Availability of Conveyor Speed Controller Kits

### GENERAL

Middleby Marshall is changing its standard Conveyor Speed Controller from the familiar thumbwheel control to a unit that features a digital display with pushbutton speed selectors. The part numbers of these components are summarized here:

#### *Speed Controller with Thumbwheel*

- Kit (includes control module and thumbwheel): 42810-0133
- Thumbwheel unit only: 42810-0118

#### *Speed Controller with Digital Display*

- Kit (includes control module and digital display): 37337
- Digital selector/display unit only: 37503

Because of this change, supplies of the previous speed controller are VERY LIMITED, and the separate thumbwheel is no longer available. Immediately stock the new Speed Controller units and save your remaining thumbwheel controls for use with the oven models that cannot use the new controller.

### APPLICATION

- Service agents should immediately begin to stock P/Ns 37337 and 37503 to fulfill their normal need for conveyor speed controllers. The new units can be used without modification on ALL OVENS EXCEPT THE PS200R68-SERIES.
- Your existing stock of P/Ns 42810-0133 and 42810-0118 should be used, whenever possible, ONLY for PS200R68-series ovens.
- The new speed controller and digital display are already in use on Middleby Marshall PS555 ovens; so, your Agency may already have some of these components in stock. Please check your existing stock of these components before placing additional orders.

### COMPATIBILITY

The Speed Controller with Digital Display is compatible with all Middleby Marshall ovens EXCEPT the PS200R68, PS220R68, and PS224R68.

### AVAILABILITY

- P/Ns 37337 and 37503 are available for immediate shipment.
- P/N 42810-0133 is available in very limited quantities. Note that some future orders may not be fulfilled.
- P/N 42810-0118 is no longer available.

## Appendix - Instructions for Service Kit 44756 - Conveyor Speed Controller Kit for PS200R68-series Ovens, 2/02

Middleby Cooking Systems Group • 1400 Toastmaster Drive • Elgin, IL 60120 • USA • (847) 741-3300 • FAX (847) 741-4406



### Instructions for Service Kit 44756 Conveyor Speed Controller Kit for PS200R68-series ovens

**KIT COMPONENTS:**

Qty.	P/N	Description
1	37337	Conveyor speed controller with digital display
1	44749	Cable assembly, PS200R68-series ovens
1	44757	Instructions, PS200R68-series oven conveyor speed controller kit

This Service Kit will update one Middleby Marshall PS200R68, PS220R68, or PS224R68 oven to operate using the current digital conveyor speed controller with keypad display (P/N 37337), instead of the previous controller with thumbwheel adjustment (P/N 42810-0133). If the oven is already equipped with controller P/N 37337, this Kit is not necessary; P/N 37337 may be used as a direct replacement for the existing controller.

**WARNING**  
BEFORE PERFORMING ANY SERVICE WORK, THE ELECTRICAL POWER SUPPLY AND THE GAS SUPPLY MUST BE TURNED OFF.

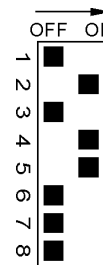
1. Disconnect the oven from its electrical power supply at the circuit breaker/fused disconnect. For gas ovens, shut off the gas supply to the oven.
2. Identify the 24-pin control cable (female at both ends) that connects the rear of the remote box (on top of the oven) to the rear of the machinery compartment (on the side of the oven).
3. Remove and discard the cable.
4. Open the machinery compartment door and locate the conveyor speed control module.
5. One at a time, disconnect the leads from the terminals on the existing speed control module and connect them to the corresponding terminals on the new control module.
6. Remove the ribbon cable plug from its socket on the old speed control module, and attach it to the corresponding socket on the new control module.
7. Remove and discard the old control module from the inside of the machinery compartment door.
8. Adjust the DIP switch settings on the new speed control module to the correct settings for the PS200-series oven with a 3-30 minute bake time range. These settings are shown on the case of the controller and are also provided in Figure 1.
9. Install the new module in place. Close and fasten the machinery compartment door.
10. Temporarily remove the remote box from the top of the oven. Open the remote box.
11. Disconnect the thumbwheel unit's ribbon cable plug from its socket on the remote board. Then, remove and discard the thumbwheel unit.
12. Install the new digital display unit in place. Connect its ribbon cable plug into its socket on the remote board.
13. Close the remote box and reinstall it atop the oven.
14. Install the new kit-supplied control cable between the back of the remote box and the back of the machinery compartment.
15. Restore the electrical and gas utility supplies to the oven.
16. Test the operation of the new conveyor speed controller to make certain that it is operating properly. The oven is now ready for operation.



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**Figure 1**  
DIP Switch Settings



P/N 44757 • Rev. C • V1 • 2/02

## Appendix - Service Bulletin MM-189 - New Conveyor Gear Motors, Brushes, and Pickup Clamps, 8/01

*Bulletin No.* MM-189  
*Date:* 8/24/01

### Middleby Cooking Systems Group



1400 Toastmaster Drive • Elgin, IL 60120-9272 U. S. A. • Telephone: (847)741-3300 • Service and Parts Fax: (847)741-4406

## Middleby Marshall® *Service Bulletin*

### SUBJECT

New conveyor gear motors, brushes, and pickup clamps for Middleby Marshall ovens

### GENERAL

The conveyor gear motors used on all Middleby Marshall ovens (except model PS536) have been redesigned by the vendor. Changes to the motors include:

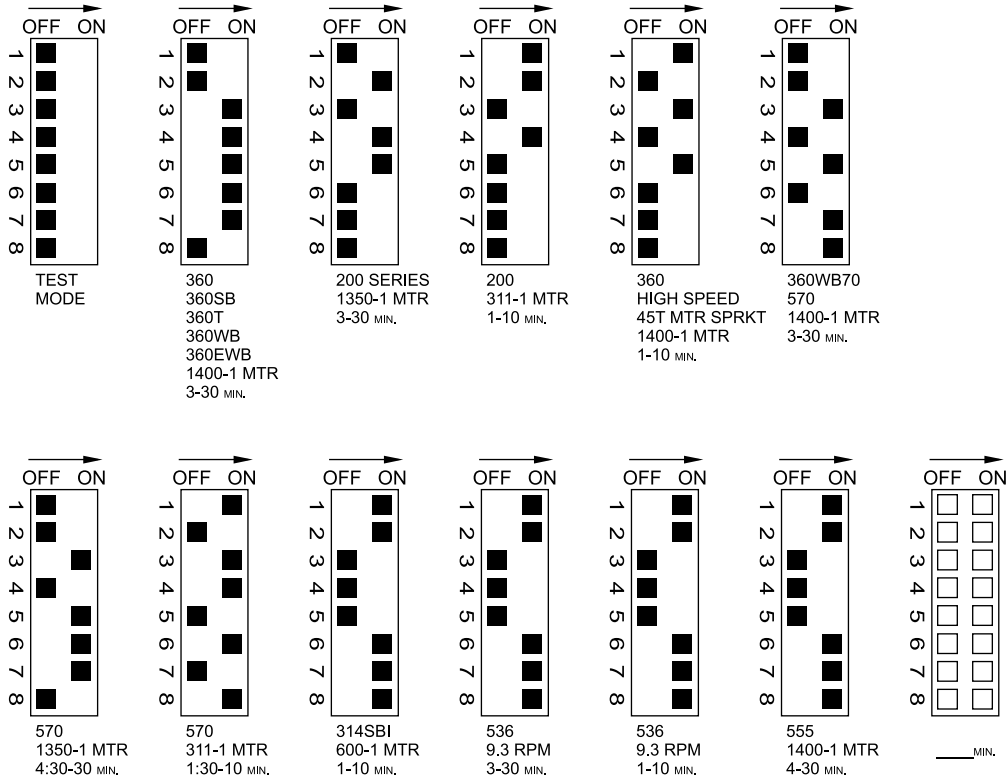
- A smaller-diameter motor casing.
- New motor brushes.
  - Old-style motors continue to use brush P/Ns **22450-0052** or **22450-0230** as shown in the table below.
  - All of the new motors use brush P/N **46658**.
- A shorter clamp to attach the pickup assembly. This accommodates the smaller diameter of the motor.
  - The pickup assembly with the original clamp is still available as P/N **27170-0263**. This kit is only available in limited quantities. After our stock of the old-style pickup assembly kit is exhausted, you will need to save the existing clamp to attach a new pickup assembly to an old-style motor.
  - The pickup assembly with the new, shorter clamp is available as P/N **46451**.
  - All of the new motors will be shipped in a kit that also includes the new clamp. This allows you to attach an existing pickup assembly to a new motor.
  - In 7/01 and 8/01, some of the new motors were shipped under the part numbers of the old motors. These parts shipped without the new clamp. In most of these cases, you can tighten the existing clamp to fit the new motor. Some older clamps, however, cannot be tightened enough to fit. To be sure that you can install the new motor in all ovens, you should add the new clamp, P/N **46602**, to your required parts stocking list, and carry a few spare clamps on each service vehicle.

Please be aware of these changes as you order your stocking parts. Some versions of the old motor, as well as the old-style pickup assembly, are still available in limited quantities. The brush for the old motor (P/N **22450-0052**) will remain available in order to maintain motors already in the field.

Ratio	Used on	Old Motor	Old Brush	Old Pickup	New Motor*	New Brush	New Pickup	New Clamp
1400:1	PS310	27384-0008	22450-0052	27170-0263	46603	46658	46451	46602
	PS314							
	PS360/360S							
	PS360SS High Speed							
	PS360T Tandem							
	PS360WB							
	PS360WB70							
	PS360EWB							
	PS555							
	PS570/570S Single Belt							
1350:1	PS200/220FS/224	27384-0011	22450-0230	27170-0263	46604	46658	46451	46602
	PS200VL/220VL/224VL							
	PS200R68/220R68/224R68							
	PS200T Tandem							
	PS570/570S Split Belt (Standard)							
600:1	PS314SBI	27384-0003	22450-0052	27170-0263	46605	46658	46451	46602
300:1	PS200/220FS/224 (High Speed)	27384-0014	22450-0230	27170-0263	46606	46658	46451	46602
	PS570/570S Split Belt (High Speed)							

\* "New Motor" part numbers shown in this table are kits that include both the motor and the new pickup clamp.

### Appendix - DIP switch settings for Conveyor Speed Controller with Digital Display (P/N 37337), 4/02



## II. TEMPERATURE CONTROLLER

The Temperature Controller is used to set and control the oven temperature. Depending on the oven, model, the controller has several functions:

- On gas ovens with On-Off gas valve operation, the temperature controller opens and closes the high flame solenoid. This allows 100% or 0% gas flow to the burner in response for the need for heat to maintain the set point temperature. The temperature controller has no effect on the low flame bypass or oven ignition.

For this operating mode, the temperature controller is set to the On-Off Mode as described in the Kit instructions.

- On gas ovens with modulated gas valve (PID) operation, the temperature controller sends a signal to the amplifier board which in turn controls the operation of the modulating valve. This allows a modulated gas flow of any necessary value from 0-100% in response for the need for heat to maintain the set point. The temperature controller has no effect on oven ignition.

For this operating mode, the temperature controller is set to the PID Mode as described in the Kit instructions.

- On electric ovens with On-Off heater activation (including most PS200-series and PS360-series electric ovens), the temperature controller permits or cuts power to the heating elements as necessary to maintain the set point temperature.

For this operating mode, the temperature controller is set to the On-Off Mode as described in the Kit instructions.

- On electric ovens with variable pulse heater activation (including PS555 electric ovens), the temperature controller sends its signal to a controller module that contains an amplifier board and two solid state relays. The relays activate the heating elements at 100% power on a fixed cycle time, for a length of time proportional to the signal from the temperature controller.

For this operating mode, the temperature controller is set to the PID Mode as described in the Kit instructions.

**Note that temperature controller P/N 46837 (inc. with Service Kit 47321) includes a dedicated variable pulse mode intended for the PS536 electric oven. This special mode is NOT used on the PS555.**

- The temperature controller regulates the cooldown function. *NOTE:* PS200VL-series ovens do not include a cooldown function.
- On most PS200-series and PS300-series gas ovens (except the PS200VL), the temperature controller monitors the high limit. All other oven models use a High Limit Control Module that is independent of the temperature controller.

**A. Part Number Reference - Temperature Controllers**

Middleby Marshall ovens have used several different models of temperature controllers. The current Digital Temperature Controller (P/N 46837, included in Service Kit 47321) is the only model currently available. All other controllers

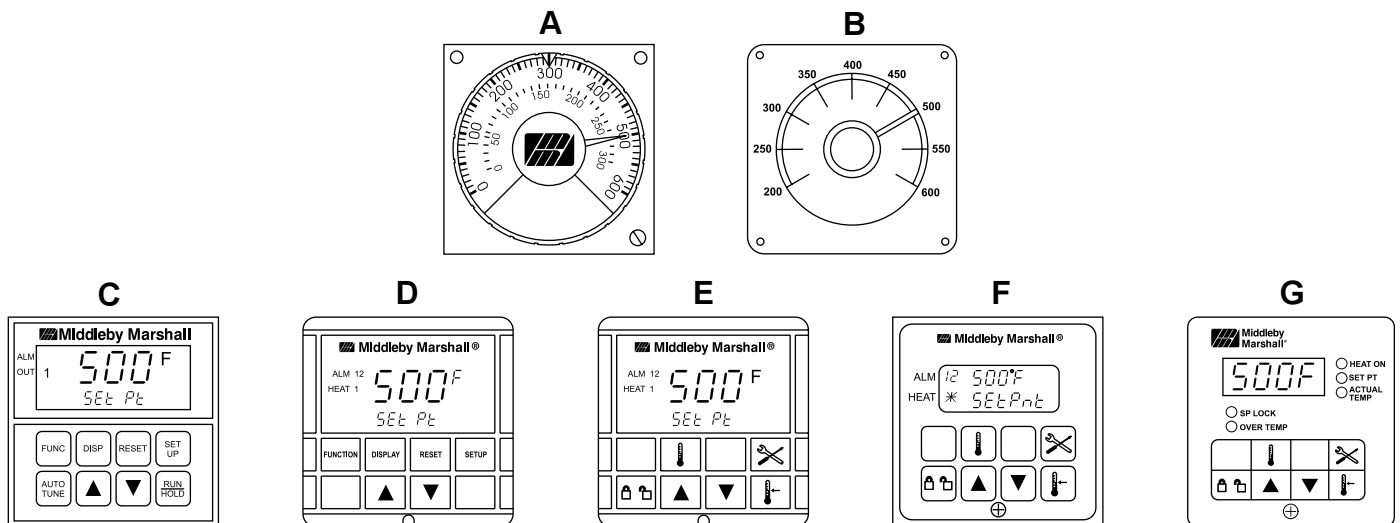
shown are no longer available and part numbers are provided for reference only. Servicing these units is beyond the scope of this manual. If one of these controllers is in need of service, we recommend simply installing a current unit (P/N 46837, included in Kit P/N 47321).

- **P/N 28071-0012 (A)**  
Analog Temperature Controller without high-limit and cooldown functions, 120V, on-off mode only.
- **P/N 28071-0018 (A)**  
Analog Temperature Controller with high-limit and cooldown functions, 120V, on-off mode only.
- **P/N 34983 (B)**  
Analog Temperature Controller without high-limit and cooldown functions, 120V, on-off mode only. *Used on PS200VL-series ovens only. PS200VL-series ovens equipped with this Temperature Controller do not have a cooldown feature and use a separate high limit control module.*
- **P/N 28071-0027 (C)**  
Digital Temperature Controller with blue plastic faceplate, 120V, on-off mode only.
- **P/N 28071-0028 (D)**  
Digital Temperature Controller with gray rubber faceplate and buttons with text, 120V, on-off mode only.
- **P/N 28071-0028 (E)**  
Digital Temperature Controller with gray rubber faceplate and buttons with symbols, 120V, on-off mode only.

- **P/N 30871 (E)**  
Digital Temperature Controller with gray rubber faceplate and buttons with symbols, 208-240V, on-off mode only. *Used on early PS360WB70 and some CE oven models.*
- **P/N 32571 (E)**  
Digital Temperature Controller with gray rubber faceplate and buttons with symbols, 208-240V, PID mode only. *Used on early PS360EWB.*
- **P/N 36021 (F)**  
Digital Temperature Controller with gray face plate (steel trim on edges), 120-240V, selectable on-off or PID modes.
- **P/N 36056 (G) - Service Kit P/N 36939**  
Digital Temperature Controller with black plastic faceplate, 120-240V, selectable on-off or PID modes.
- **P/N 46837 (G) - Service Kit P/N 47321**  
Digital Temperature Controller with black plastic faceplate, 120-240V, selectable on-off, PID and variable pulse modes.

Note that the dedicated variable pulse mode is used on the PS536 electric oven ONLY. Using this mode requires moving a jumper on one of the PC boards inside the controller. The PS555 variable pulse electric oven does NOT use this mode and should have the controller set to the PID mode as described in the Kit instructions.

**Figure 22 - Temperature controllers**





## SECTION 3 - SERVICING COMPONENTS

### B. Description

The temperature controller consists of two main components: a sleeve or case (metal or plastic) with terminal connections on the back, and a plug-in chassis that includes the faceplate and circuitry. The sleeve is mounted to the panel or door of the oven, and the chassis is inserted into the front of the sleeve.

**VERY IMPORTANT:** When replacing a controller, you should ALWAYS replace the sleeve as well. Some controller models have sleeves of a similar size, but with DIFFERENT CONNECTIONS. Using an incorrect sleeve can damage the controller and cause the oven to function incorrectly. Exception: The sleeve used on Controllers 36056 and 46837 is identical except for the information label.

### C. High Limit/Cooldown Functions

Except where noted in Section A (*Part Number Reference*), the temperature controller incorporates circuitry for the high limit and cooldown functions.

1. The High Limit function (terminals 11 and 12) will shut off the burner/heating elements if the oven temperature sensed by the thermocouple(s) exceeds 650°F/343°C. This function is used on most PS200-series and PS360-series gas ovens. All other oven models use a separate high limit control module.

If the high limit temperature is reached, an indicator on the controller will illuminate. The current controller (P/N 46837) has a lamp marked "OVERTEMP" to show this condition. Older controllers will have different indicators; you should refer to the operating instructions for the controller in question for assistance.

2. The Cooldown function allows the blowers to continue in operation after the operator switches off all operating switches on the control panel. The blowers will remain in operation until the cooldown switch opens (usually 180°F/82°C).

### E. Appendices

### D. Troubleshooting

1. Troubleshooting the Temperature Controller and Thermocouple(s) using the Altek Thermocouple Source (Middleby P/N 27170-0192)
  - Turn the heat switch OFF.
  - Disconnect the thermocouple leads from Terminals 7 and 8 on the temperature controller. Tape the ends to prevent shorting.
  - Connect the white lead of the Thermocouple Source to Terminal 8 (+). Connect the red lead of the Thermocouple Source to Terminal 7 (-).
  - Set the Thermocouple Source as close as possible to the customer's set point. Then, turn the BLOWER switch to the ON position.

The temperature controller should read close to the customer's set point. Failure indicates a problem with the temperature controller. If the temperature controller is functioning properly, check the thermocouples. Refer to Section IV, *Thermocouples*.

2. Troubleshooting the High Limit Switch

On ovens that use the high limit function of the temperature controller (most PS200-series and PS360-series ovens), an intermittent high limit switch will cause intermittent operation of the burner. If you suspect that this is a problem, a good check is to place a 1A fuse in parallel around the switch contacts (terminals 11 and 12).

If the switch is functioning properly, the fuse will never carry a load. The only time the switch would open would be under a no-load condition.

If the switch is trying to open intermittently, however, the full current load of the blowers will be carried by the fuse. Regardless of the oven model, this load is far greater than 1A, and the fuse will blow.

#### Appendix - Temperature controller terminal cross-reference, 4/02

Terminal for 28071-0012 and 28071-0018	Terminal for 34983	Terminal for 36056 and 46837	Description
1	TC+	8	+ TC
2	TC-	7	- TC
5	COM	5	Input to Temperature Control Relay
6	NO	4	Output to High Flame Solenoid or Heater Contactors
L2	L2	L2	Neutral
L1	L1	L1	Power
G	G	⊕	Ground
13	--	9	Input to Cooldown Relay
14	--	10	Output from Cooldown Relay
15	--	11	Input to High Limit Relay
16	--	12	Output from High Limit Relay
--	--	15	PID or Variable Pulse Output
--	--	16	PID or Variable Pulse Output

## Appendix - Instructions for Service Kit 47321 - Digital Temperature Controller Kit, 2/02

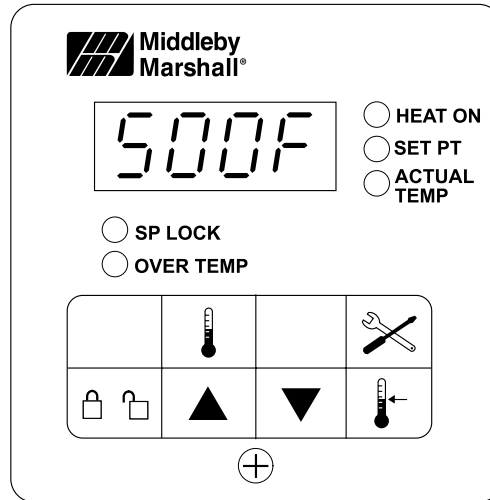
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## Instructions for Service Kit 47321

## Digital Temperature Controller

### Installation, Programming and Troubleshooting Instructions

**KIT COMPONENTS**

<i>Qty.</i>	<i>P/N</i>	<i>Description</i>
1	46837	Digital Temperature Controller (On/Off Gas & Electric, PID Gas, and Variable Pulse Electric operating modes), with mounting brackets
1	47322	Instructions

**TABLE OF CONTENTS**

Controller Types .....	2
Before You Begin .....	3
Installation .....	3
Electrical Connections .....	4
Jumper Setting .....	6
Programming .....	6
Diagnostic Error Messages .....	8
Operating Instructions ( <i>to be left with customer after installation</i> ) .....	9

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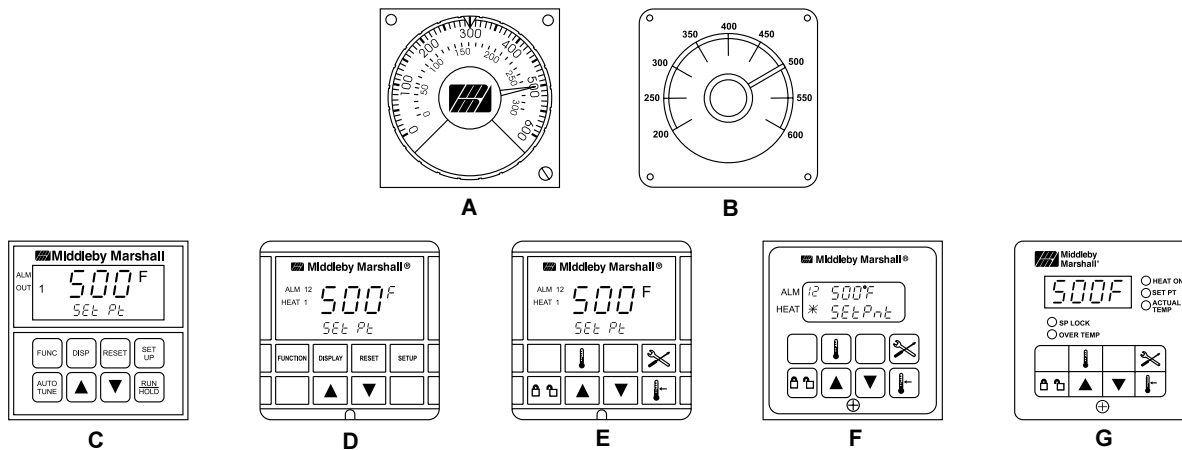
## Appendix - Instructions for Service Kit 47321 - Digital Temperature Controller Kit, 2/02

### Controller Types

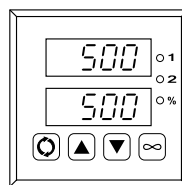
This Kit includes one Digital Temperature Controller (P/N 46837) that can operate at 120-240V, and can be programmed to operate in on-off, PID, or variable pulse modes. The Controller is shown in Figure 1G, below. By following these instructions, the Controller can be installed into any Middleby Marshall oven equipped with the following Controllers.

- **P/N 28071-0012 (Fig. 1A)**  
Analog Temperature Controller without high-limit and cooldown functions, operating at 120V, on-off mode only.
- **P/N 28071-0018 (Fig. 1A)**  
Analog Temperature Controller with high-limit and cooldown functions, operating at 120V, on-off mode only.
- **P/N 34983 (Fig. 1B)**  
Analog Temperature Controller without high-limit and cooldown functions, operating at 120V, on-off mode only. *Used on PS200VL models. As of 12/01, P/N 34983 is still available and should be used on these ovens if possible.*
- **P/N 28071-0027 (Fig. 1C)**  
Digital Temperature Controller with blue plastic face-plate, operating at 120V, on-off mode only.
- **P/N 28071-0028 (Fig. 1D)**  
Digital Temperature Controller with gray rubber face-plate and buttons with text, operating at 120V, on-off mode only.
- **P/N 28071-0028 (Fig. 1E)**  
Digital Temperature Controller with gray rubber face plate and buttons with symbols, operating at 120V, on-off mode only.
- **P/N 30871 (Fig. 1E)**  
Digital Temperature Controller with gray rubber face plate and buttons with symbols, operating at 208-240V, on-off mode only. *Used on early PS360WB70 and some CE oven models.*
- **P/N 32571 (Fig. 1E)**  
Digital Temperature Controller with gray rubber face plate and buttons with symbols, operating at 208-240V, PID mode only. *Used on early PS360EWB.*
- **P/N 36021 (Fig. 1F)**  
Digital Temperature Controller with gray face plate (steel trim on edges), operating at 120-240V, selectable on-off or PID modes.
- **P/N 36056 (Fig. 1G)**  
Digital Temperature Controller with black plastic face plate, operating at 120-240V, selectable on-off or PID modes.

Figure 1



This Kit CANNOT be installed in a PS536 oven equipped with the P/N 44783 (variable pulse electric) or P/N 44823 (PID gas) controller shown below.



H

## Appendix - Instructions for Service Kit 47321 - Digital Temperature Controller Kit, 2/02

**WARNING**

*BEFORE PERFORMING ANY SERVICE WORK, THE ELECTRICAL POWER SUPPLY AND THE GAS SUPPLY MUST BE TURNED OFF.*

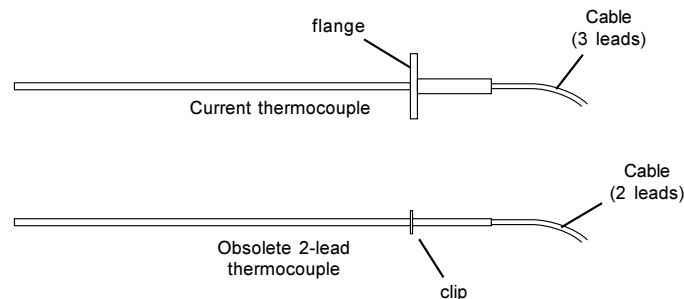
**Before you Begin**

1. This Temperature Controller requires a current-version thermocouple for proper operation. Check that the thermocouple(s) installed in the oven match the current three-lead, flanged versions **BEFORE** you begin to install the Temperature Controller. See Figure 2.

If the oven is not equipped with current thermocouples, you should replace them **BEFORE** you install the new Temperature Controller.

P/N 33984: Thermocouple kit for PS300-series, PS555 and PS570

P/N 33985: Thermocouple kit for PS200-series and PS536

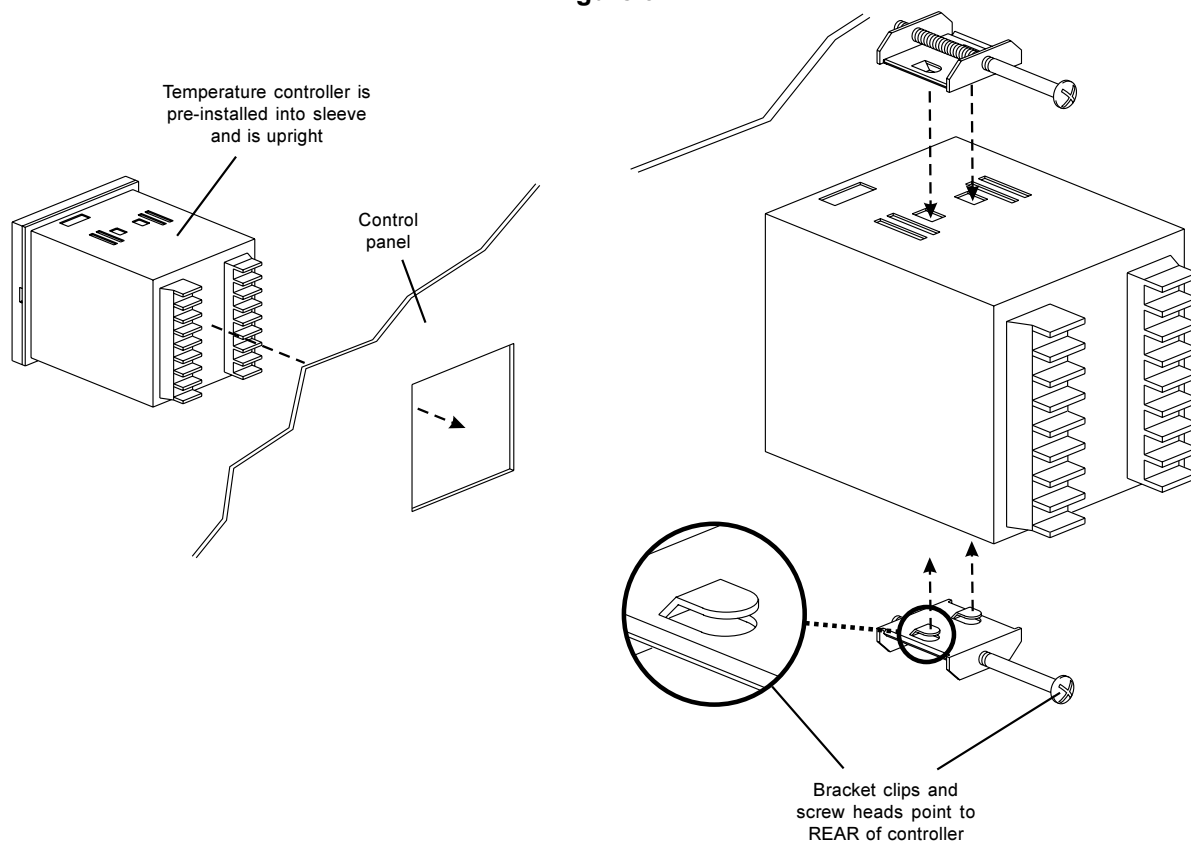
**Figure 2****Installation**

1. Check the oven's existing temperature controller, as shown on the previous page.
  - IF THE EXISTING CONTROLLER IS P/N 36056 OR P/N 46837 (shown in Figure 1G), the new controller can be installed directly into the existing sleeve as follows:
    - Loosen the Phillips screw at the bottom center of the faceplate.
    - Pull the old controller out of the sleeve.
    - Skip ahead to the **Jumper Setting** section of these instructions on Page 6 to set up the new controller. After the jumper is configured, the new controller can be installed directly into the existing sleeve.
  - IF THE EXISTING CONTROLLER IS OF ANY OTHER TYPE, the sleeve will have to be replaced with the one included in this Kit. Continue on to Step 2 in this section.
2. Access the back of the existing temperature controller. Tag each wire that connects to the controller with its terminal number. These numbers will be used later to wire the new controller.
3. Disconnect all wires from the terminals on the temperature controller. Be sure to retain any jumpers that are removed.
4. Remove the controller and sleeve from the oven as follows:
  - For analog controllers P/Ns 28071-0012 and 28071-0018 (Fig. 1A), remove the two bracket screws on the back of the control. Then, remove the bracket. Pull the controller and sleeve out through the front of the oven panel.
  - For all other controllers, remove the two screws and brackets that hold the controller in place. Then, pull the controller and sleeve out through the front of the panel.

## Appendix - Instructions for Service Kit 47321 - Digital Temperature Controller Kit, 2/02

5. Check that the new controller is mounted into its sleeve. Then, slide the assembly into the opening in the panel from the outside. Check that the controller is upright, with the display on top and the keypad on the bottom.
6. Locate the rectangular holes on the top and bottom of the new controller's sleeve. Attach the two kit-supplied mounting brackets against the inside panel of the oven, and into the holes in the sleeve, as shown in Figure 3. Check that the heads of the screws point to the rear of the controller.
7. Tighten the two screws evenly until the lip of the sleeve is seated tightly against the panel.
8. If there is a protective clear plastic strip on top of the display, remove it at this time.

Figure 3



### Electrical Connections

1. Wire the new controller as follows:
    - **If you are replacing an Analog Temperature Controller, P/Ns 28071-0012 or 28071-0018** (see Fig. 1A), refer to Figure 4A for a listing of the new terminal numbers.
    - **If you are replacing an Analog Temperature Controller P/N 34983** (Fig. 1B - PS200VL models only), refer to Figure 4B for a listing of the new terminal numbers.
    - **If you are replacing any Digital Temperature Controller**, simply reconnect ALL of the original wires and jumpers to the same terminals, as all terminals are numbered the same.
- EXCEPTION:* Controller P/N 32571 (Fig. 1E - used on early PS360EWB ovens only) uses Terminals 4 & 5 for the mA output to the amplifier board. The current controller uses Terminals 15 & 16 for these connections, as shown in Figure 5A.

Appendix - Instructions for Service Kit 47321 - Digital Temperature Controller Kit, 2/02

Figure 4a

Analog temperature controller (P/Ns 28071-0012 and 28071-0018) terminals

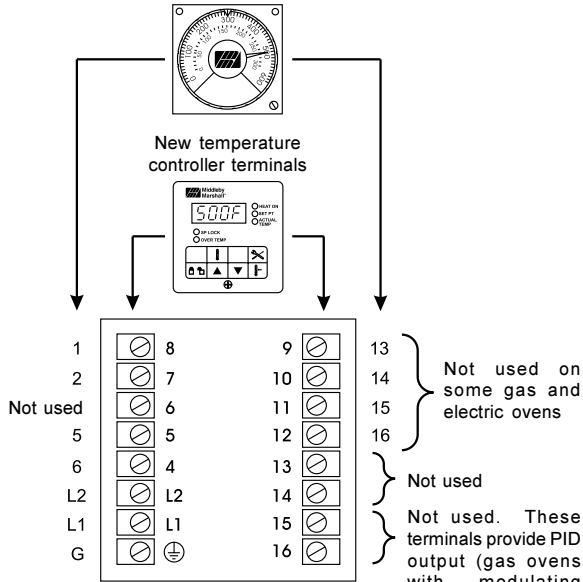
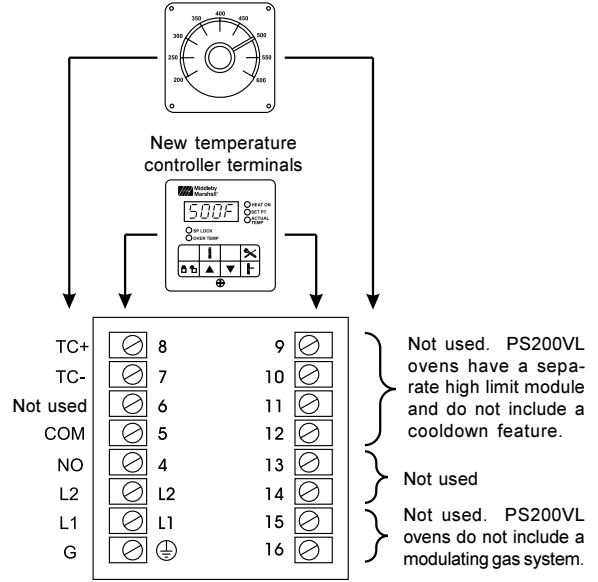


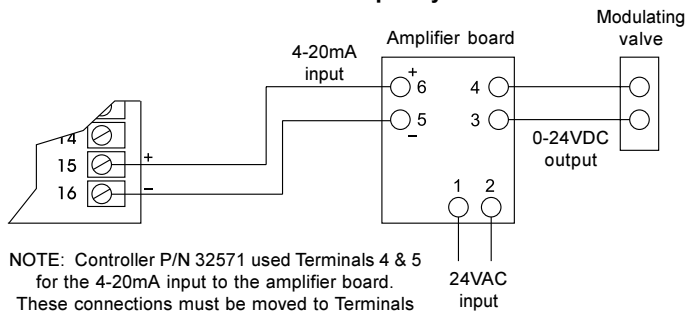
Figure 4b

Analog temperature controller (P/N 34983) terminals



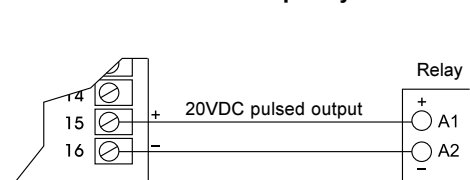
Terminal for 28071-0012 and 28071-0018	Terminal for 34983	Terminal for 46837	Description
1	TC+	8	+ TC
2	TC-	7	- TC
5	COM	5	Input to Temperature Control Relay
6	NO	4	Output to High Flame Solenoid or Heater Contactors
L2	L2	L2	Neutral
L1	L1	L1	Power
G	G	⊕	Ground
13	--	9	Input to Cooldown Relay
14	--	10	Output from Cooldown Relay
15	--	11	Input to High Limit Relay
16	--	12	Output from High Limit Relay
--	--	15	PID or Variable Pulse Output
--	--	16	PID or Variable Pulse Output

Figure 5a  
Modulated Gas Output System



NOTE: Controller P/N 32571 used Terminals 4 & 5 for the 4-20mA input to the amplifier board. These connections must be moved to Terminals 15 & 16 on the new controller as shown.

Figure 5b  
Variable Pulse Output System



NOTE: Safety switches may be placed between the temperature controller and the relay on some oven models.

## Appendix - Instructions for Service Kit 47321 - Digital Temperature Controller Kit, 2/02

### Jumper Setting

Loosen the Phillips screw at the bottom center of the faceplate. Then, pull the controller out of its sleeve. Next, access the jumper shown in Figure 6. This jumper affects the signal that is output from Terminals 15 and 16. The jumper MUST be set to the correct position for proper operation of the controller.

#### CAUTION

*If the jumper is incorrectly set, the oven will be unable to properly maintain temperature. In addition, DAMAGE MAY OCCUR TO THE CONTROLLER AND OTHER OVEN COMPONENTS. Always make sure that the jumper is correctly set BEFORE restoring power to the oven!*

- **For gas ovens equipped with the modulating gas system, the jumper must be set to the "W1" position.**

This instructs the controller to send a variable-current 4-20 mA signal from Terminals 15 and 16 to the amplifier board. The board converts this to a 0-24VDC signal which is sent to the modulating valve. The valve regulates the gas flow according to the need for heat to maintain the set point.

For gas ovens, you should always check inside the machinery compartment to see whether a modulating valve is present in the unit before setting this jumper.

- **For electric ovens equipped with the variable pulse system, the jumper must be set to the "W2" position.**

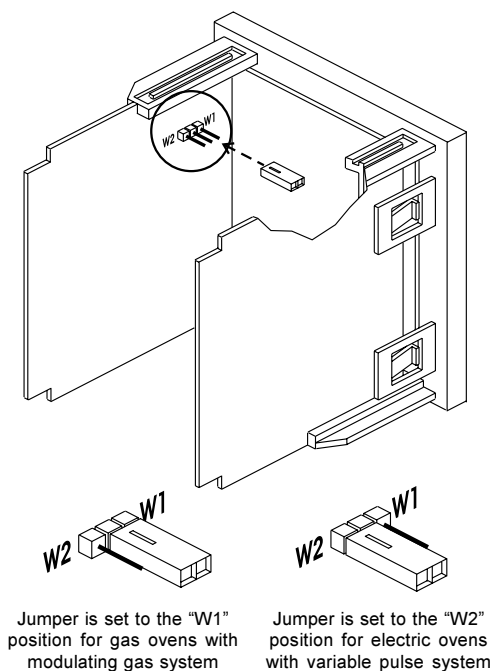
This instructs the controller to send a constant-current, pulsed 20VDC signal to the relay. Once per second, the signal "pulses" on proportional to the need for heat to maintain the set point.

As of 1/02, only the PS536 Electric oven uses the variable pulse system. Other oven models equipped with this system will be announced by Middleby as they become available.

- **For all other ovens - gas or electric - that use the on-off system, the jumper may be set to either position.**

After the jumper has been properly set, replace the controller into its sleeve and tighten the screw.

Figure 6

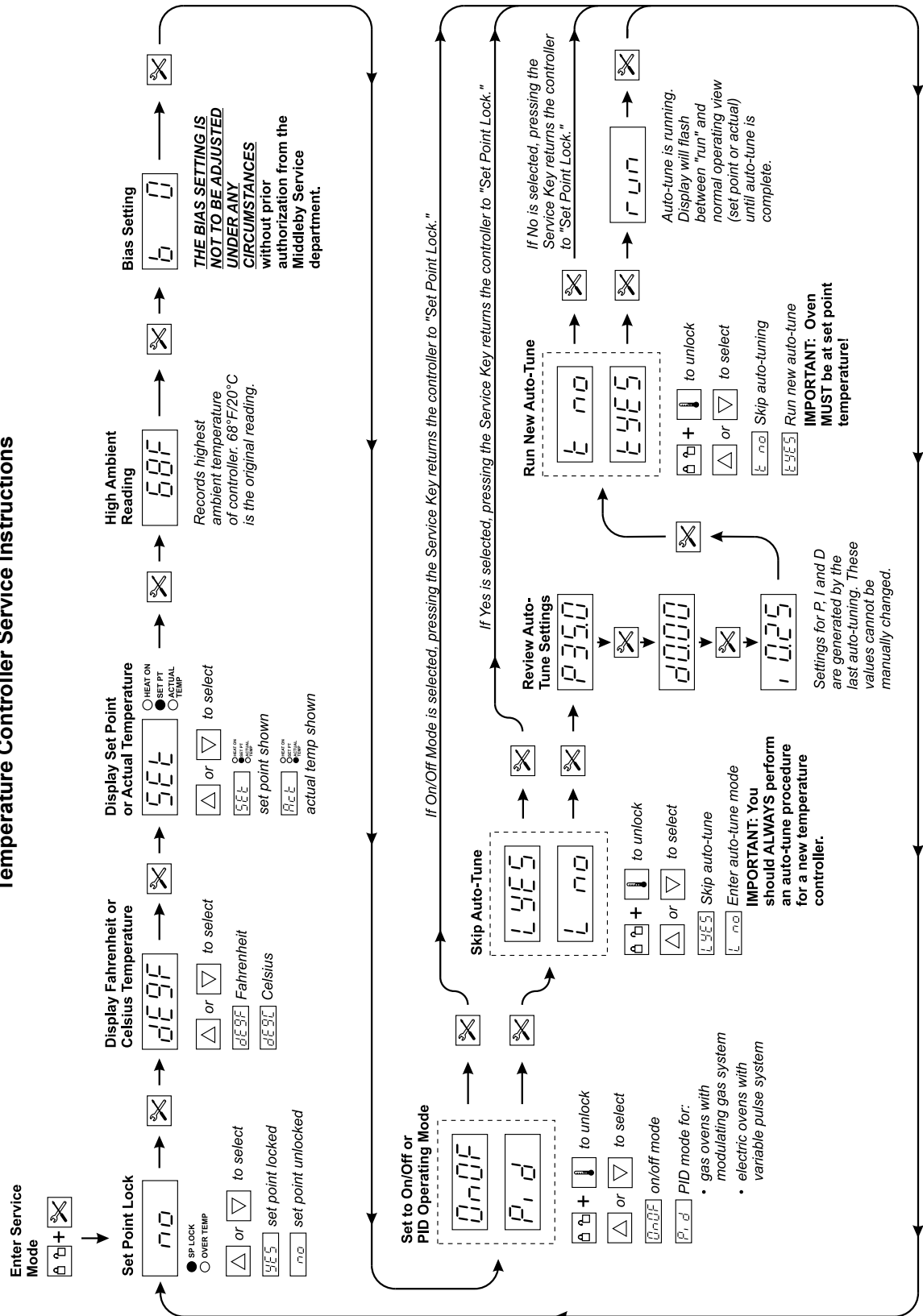


### Programming

1. Restore electrical power to the oven.
2. Refer to Figure 7. Set the following options, according to the customer's preferences:
  - Set Point locked or unlocked
  - Degrees Fahrenheit or Celsius
  - Set Point or Actual Temperature display
3. Set the controller to PID or On-Off operating mode. Choose the PID mode for BOTH gas ovens with the modulating system AND for electric ovens with the variable pulse system.
4. Adjust the Set Point according to the customer's specifications.
5. If the PID operating mode was chosen, perform an Auto-Tune calibration as per the instructions in Figure 7.
6. Check that the customer is familiar with the operation of the controller. The last page of these instructions includes an operating guide for the controller. Remove this page and leave it with the customer for future reference.

Appendix - Instructions for Service Kit 47321 - Digital Temperature Controller Kit, 2/02

Figure 7  
Temperature Controller Service Instructions





**Appendix - Instructions for Service Kit 47321 - Digital Temperature Controller Kit, 2/02****Diagnostic Error Messages**

The controller runs background tests during normal operation. If any problems occur during the tests, an error message flashes in the display. A listing of these diagnostic error messages is shown below.



Flashes on the display (alternating with the temperature) indicating that the internal diagnostic test has failed.

1. Turn the Blower Switch (HEAT Switch for PS536 ovens with the two-switch configuration) OFF for 2 minutes.
2. Turn the Blower Switch (or HEAT Switch, as per Step 1) ON.
3. If necessary, repeat Steps 1 and 2 up to two additional times.
4. If the problem does not clear after 3 attempts, replace the controller.



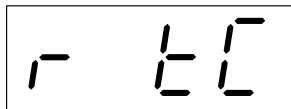
The oven temperature has not reached 200°F/93°C within 15 minutes of startup. On gas ovens, this is usually a result of the burner not lighting.

1. Turn the Blower Switch (HEAT Switch for PS536 ovens with the two-switch configuration) OFF for 2 minutes.
2. Turn the Blower Switch (or HEAT Switch, as per Step 1) ON.
3. If the problem does not clear, contact the Middleby Technical Service Department for assistance.



Caused by an open in the thermocouple circuit.

1. Check that the thermocouple leads are properly connected to Terminals 7 & 8 of the temperature controller.
2. Check the continuity of the thermocouple at room temperature. You should measure 9-20 Ohms of resistance.
3. If the reading was outside the correct range, the thermocouple has an open. Remove and replace the thermocouple.  
If the reading was inside the correct range, contact the Middleby Technical Service Department for assistance.



Polarity of the thermocouple leads is reversed.

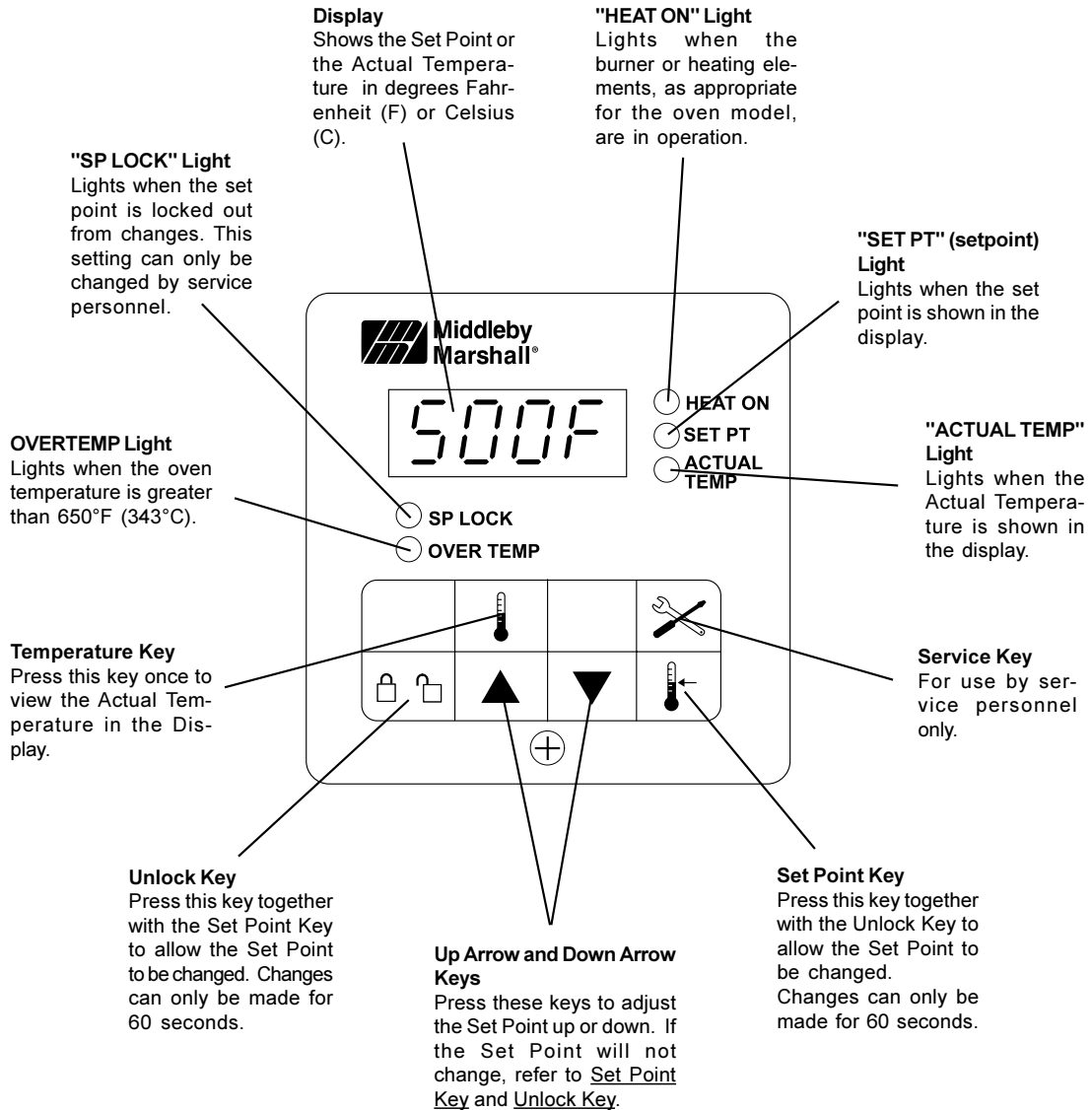
1. Check the polarity of the thermocouple leads. The red wire (-) should be attached to Terminal 7 on the temperature controller. The white wire (+) should be attached to Terminal 8.
2. If the polarity connections are incorrect, connect the thermocouple properly.  
If the polarity connections are correct, replace the thermocouple.

## Appendix - Instructions for Service Kit 47321 - Digital Temperature Controller Kit, 2/02

## Digital Temperature Controller

### P/N 46837

### Operating Instructions



**Appendix - Instructions for Service Kit 47321 - Digital Temperature Controller Kit, 2/02**



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## Appendix - Service Bulletin MM-136 - Electrical Noise Filter Capacitor Assembly on Temperature Controllers, 9/93



**Toastmaster**®

**Bus Boy**



Middleby Cooking Systems Group

Bulletin No. MM-136

Date 9/28/93

1400 Toastmaster Drive ■ Elgin, Illinois 60120  
(708) 741-3300 ■ Service & Parts (708) 741-4406

### Middleby Marshall® Service Bulletin

**SUBJECT:** Digital Temperature Controller PN28071-0027 (Blue) or 28071-0028 (Gray)

#### GENERAL

In some oven installations electrical noise/static have caused the Digital Temperature Controller not to function properly. Some common symptoms are:

1. The Controller Display changes and/or may flash frequently.
2. Temperature Set Point(s) may change without operator intervention.
3. Gas solenoid valve opens and closes erratically.

The electrical noise/static enters the Digital Temperature Controller circuitry through the thermocouple wires. The thermocouple wires are attached to terminals 7 and 8 on the rear of the controller. To correct this problem, the supplied Filter Capacitor Assembly (PN 27170-0283) should be connected from terminals 7 and 8 to Ground (G).

#### APPLICATION

Model PS200 Series, Model PS250, Model PS300 Series, and Model PS500 Series.

#### COMPATIBILITY

The Filter Capacitor Assembly is installed on the rear terminal strip of either Digital Temperature Controller PN28071-0027 (Blue) or 28071-0028 (Gray).

#### FEATURES

- Filters electrical noise/static.

#### AVAILABILITY

- Effective September 20, 1993 part orders for the Digital Temperature Controller include the Filter Capacitor Assembly installed on rear of unit.

### Appendix - Service Bulletin MM-136 - Electrical Noise Filter Capacitor Assembly on Temperature Controllers, 9/93

- Effective September 20, 1993 ovens shipped with the Digital Temperature Controller include the Filter Capacitor assembly (installed).
- Effective October 1, 1993 Middleby Marshall will fill all Orders for the Filter Capacitor Assembly.

#### DISPOSITION OF INVENTORY

All distributor inventory should be upgraded with the filter capacitor assembly.

#### INSTALLATION PROCEDURES

To Install the Filter Capacitor Assembly (PN 27170-0283), proceed as follows:

1. Turn "OFF" all power to the oven.
2. Open the Control Compartment.
3. Install the filter capacitor assembly on the terminals. Refer to Figure 1. The capacitors should be mounted across the back of the controller.
  - a. The joined leads of the two capacitor assembly are connected to Ground (G).
  - b. Either single capacitor lead is connected to Terminal 7, and the other single capacitor lead is connected to Terminal 8.
4. Close the Control Compartment.
5. Turn Oven "ON", check and/or set the set point(s), monitor for stable display(s) and operation. Refer to appropriate documentation covering the Digital Temperature Controller.

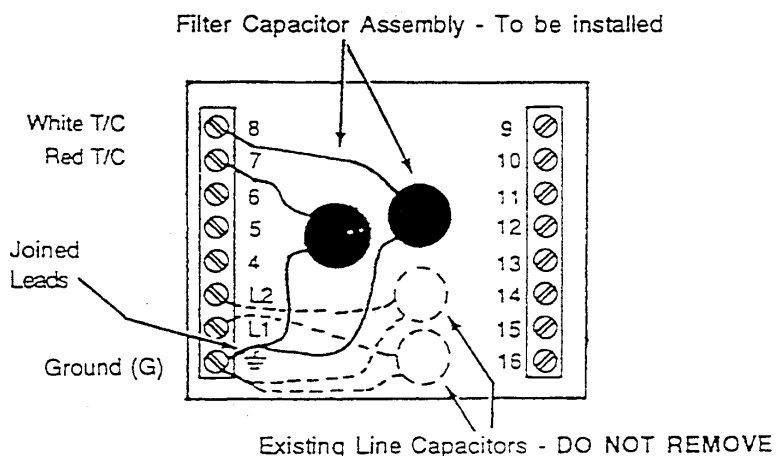


Figure 1 - Rear View of Digital Temperature Controller Showing the Filter Capacitor Assembly Connected to the Terminals

### III. HIGH LIMIT CONTROL MODULE

On most PS200-series and PS300-series gas ovens, the temperature controller monitors the high limit. All other oven models use a High Limit Control Module that is independent of the temperature controller.

Middleby ovens have used several different types of high limit control modules. See Figure 23.

- The United Electric Type 54 control was used for high limit functions only. Ovens equipped with this control did not have a cooldown feature. The control was used on early PS310 and PS360 electric ovens.
- The United Electric Type 55 control included both high limit and cooldown functions, and was used on PS310 and PS360 electric ovens.
- The Watlow high limit control module is the only version still in use by Middleby. The module includes high limit functions only. The cooldown function is controlled by the oven's temperature controller, except on PS200VL-series ovens, which do not include a cooldown feature.

The Watlow high limit control module is used on PS200-series, PS360-series, and PS555/570-series ovens.

Service information in this Manual is limited to the current Watlow high limit control module. The United Electric units are no longer available. Service Kit P/N 39733 can be used to upgrade either of the two previous controllers to the Watlow version.

#### A. Part Number Reference - High Limit Control Modules

P/N	Description
28071-0002	United Electric Type 54 high limit control module <i>No longer available - upgrade to current model 34982 using Service Kit 39733</i>
28071-0014	United Electric Type 55 high limit/cooldown control module <i>No longer available - upgrade to current model 34982 using Service Kit 39733</i>
34982	Watlow high limit control module, 115V <i>For use on ovens with 120V control circuits</i>
33983	Watlow high limit control module, 240V <i>For use on ovens with 208-240V control circuits</i>
30693	Illuminated reset button (green) for Watlow control (all voltages)
39733	High Limit Conversion Kit for PS300, PS310, PS350, and PS360 ovens <i>Replaces P/Ns 28071-0002 or 28071-0014 with P/N 34982</i>

#### B. Location

On ovens that include the separate high limit control module, it is located:

- PS200-series - Inside the machinery compartment.
- PS360-series - Inside the control compartment.
- Early PS555 ovens - Inside the left blower motor compartment.
- Current PS555 and all PS570 ovens - Inside the machinery compartment.

#### C. Operation and Troubleshooting

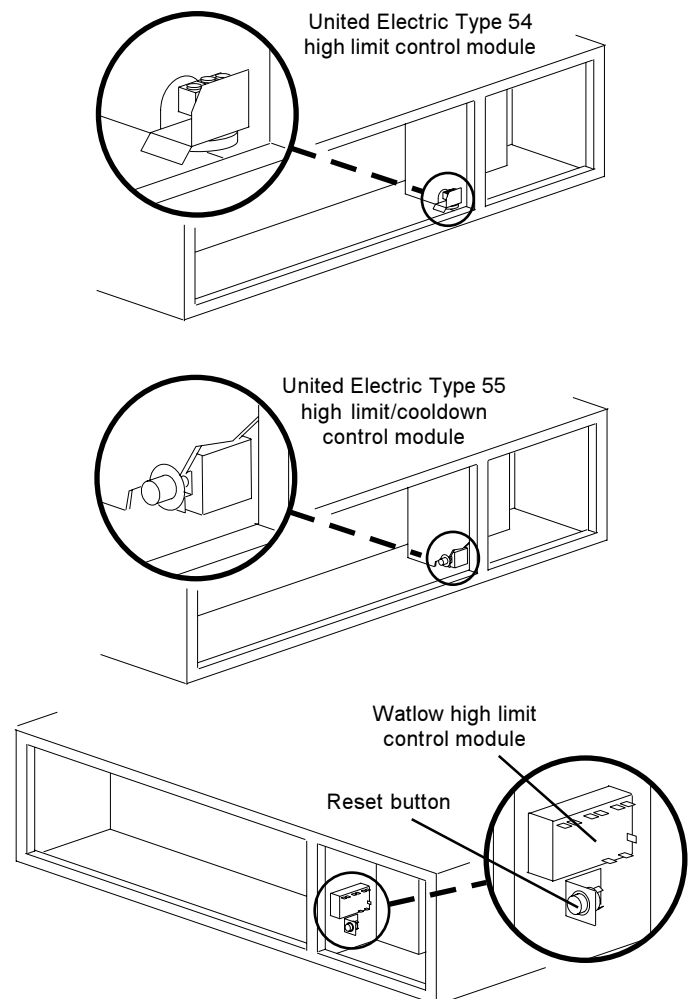
Refer to the wiring diagrams at the back of this manual for high limit wiring connections.

The Watlow high limit control module generally uses a dedicated high limit thermocouple. Some older ovens use a dual-function, four-lead thermocouple that sends a signal to both the temperature controller and the high limit control module. Refer to *Thermocouples* on Page 54 for details.

If the temperature sensed by the high limit thermocouple exceeds 650°F/343°C, the high limit control module will shut down the oven and illuminate the green reset button. The module will need to be reset (by pressing the reset button) before the oven can be operated. The reset button is located inside the machinery compartment to ensure that it is reset by an authorized service agent. The agent should determine and correct the cause of the high limit condition before returning the oven to service.

An open high limit thermocouple will trigger the high limit control module to shut down the burner. The high limit control will need to be reset after the open is corrected (as per the procedure described above) before the oven can return to operation.

**Figure 23 - High limit control modules (Shown in PS360-series oven)**



D. Appendices

**Appendix - Instructions for Service Kit 39733 -  
High Limit Conversion Kit for PS300, 310, 350 & 360 Ovens, 5/99**

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**Instructions for Service Kit 39733  
High Limit Conversion Kit for PS300, 310, 350, & 360 Ovens**

**KIT COMPONENTS** - Check that the kit includes ALL of these parts BEFORE you begin!

<i>Qty.</i>	<i>P/N</i>	<i>Description</i>	<i>Qty.</i>	<i>P/N</i>	<i>Description</i>
1	39732	Instructions	2 ft./610mm	27152-0050	Wire, #18 AWG, brown
1	34982	Watlow high limit control module	2 ft./610mm	27152-0053	Wire, #18 AWG, white
1	30693	Reset switch w/ lighted pushbutton	2 ft./610mm	27152-0054	Wire, #18 AWG, purple
1	35634	Mounting bracket, reset switch	8	1455A8750	Wire connector, 1/4"/6.4mm
1	35691	Wire set, reset switch (includes 4 wires and 3 1/4"/25mm connectors)	1	3002693	Wire tie, nylon
1	33812-1	Thermocouple, type J, 6"/152.4mm	2	2000076	Screw, 6-32 X 1-5/8"
1	39690	Mounting sleeve, thermocouple	2	1421B8803	Screw, 6-32 X 1/4"
			4	2001327	Nut, 6-32

**TOOLS REQUIRED**

- Drill with 3/16" drill bit
- Middleby Marshall Thermocouple Signal Source Generator (P/N 27170-0192)
- Wire cutters/strippers

**A. OVERVIEW**

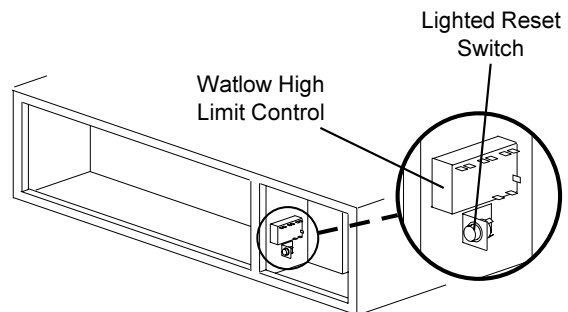
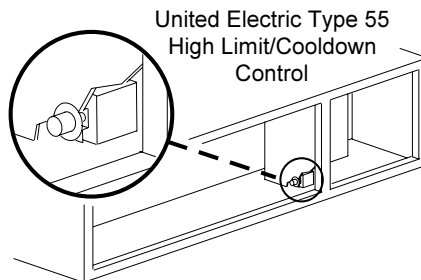
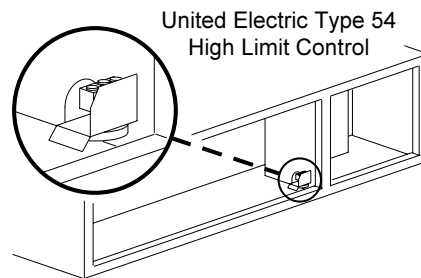
This Service Kit is used to replace two different types of United Electric high limit/cooldown controllers with a Watlow high limit controller for PS300, 310, 350, and 360 Ovens. See Figure 1.

- The early (Type 54) United Electric control was ONLY equipped with a high limit circuit. Ovens equipped with this control did NOT have a cooldown circuit. This control was used on the following models:
  - PS300/350 Gas (early)
  - PS300/310/350/360 Electric (early - all voltages)

For these ovens, the kit directly replaces the Type 54 high limit control with the Watlow high limit control.
- The later (Type 55) United Electric control was equipped with BOTH high limit and cooldown circuits, and was used on the following models:
  - PS300/310/350/360 Electric (late), 208/240V and 480V UL versions ONLY

For these ovens, the kit replaces the Type 55 control with the Watlow high limit control, and uses the oven's temperature controller to provide the cooldown circuit.

**Figure 1**



## Appendix - Instructions for Service Kit 39733 - High Limit Conversion Kit for PS300, 310, 350 & 360 Ovens, 5/99

### B. INSTALLATION



#### **WARNING**

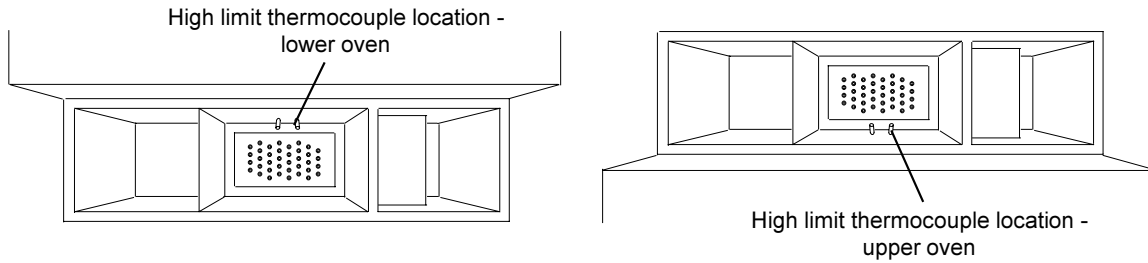
*BEFORE PERFORMING ANY SERVICE WORK, THE GAS SUPPLY (IF SO EQUIPPED) AND THE ELECTRICAL SUPPLY TO THE OVEN MUST BE TURNED OFF.*

1. Open the machinery compartment and control compartment access panels.
  2. Locate the high limit thermo bulb/capillary assembly. Its location is shown in Figure 2. Loosen the set screw that holds the assembly in place. Remove the thermo bulb/capillary assembly from the mounting tube.
  3. Disconnect the wires (2 for the Type 54 control, 4 for the Type 55 control) from the terminals of the United Electric control. Bundle the loose wires together, and allow them to hang loose for later reconnection.
  4. Remove the mounting screws that hold the United Electric high limit control in place. Then, remove and discard the high limit control and its mounting screws.
  5. Position the new high limit control in place on the left wall of the control compartment, as shown in Figure 3. When positioning the control:
    - Ensure that the control is positioned AT LEAST 1" (25mm) back into the compartment to allow the compartment door to close.
    - Ensure that additional space is left underneath the control for the reset switch.
- NOTE:** *Instead of holding the high limit control in place, you may use the dimensions provided in Figure 4 to determine the location of the control and its mounting holes.*
6. Mark the locations of the two mounting holes for the high limit control. Then, drill the holes using a 3/16" drill bit.
  7. Secure the high limit control in place using the kit-supplied 6-32 x 1-5/8" screws and 6-32 nuts.
  8. Position the bracket for the reset switch on the left wall of the control compartment, as shown in Figure 3. Note that the face of the bracket with the large, circular switch-mounting hole should face YOU. Also, the bracket should be positioned AT LEAST 3" (75mm) back into the compartment to allow the door to close.
  9. While holding the bracket in place, mark the locations of the two mounting holes. Then, remove the bracket and drill the holes using a 3/16" drill bit.
  10. Secure the bracket to the panel using the kit-supplied 6-32 x 1/4" screws and 6-32 nuts. **DO NOT INSTALL THE RESET SWITCH INTO THE BRACKET AT THIS TIME.**
  11. Insert the kit-supplied thermocouple into its mounting sleeve. Position the sleeve so that the mounting hole is at the base of the thermocouple, not the tip. See Figure 5.
  12. Insert the thermocouple and mounting sleeve into the original mounting tube. The set screw opening in the sleeve should align with the set screw hole on the side of the mounting tube.  
Push the thermocouple into the opening until its base seats firmly on the mount. See Figure 6.
  13. Insert the thermocouple's set screw into the hole on the side of the mounting tube. Tighten the set screw to hold the thermocouple and sleeve in place.
  14. Thread the thermocouple's shielded cable into the electrical compartment. Coil the free end of the cable and fasten it with the kit-supplied nylon wire tie. Be sure to leave enough free cable to reach the new high limit control.

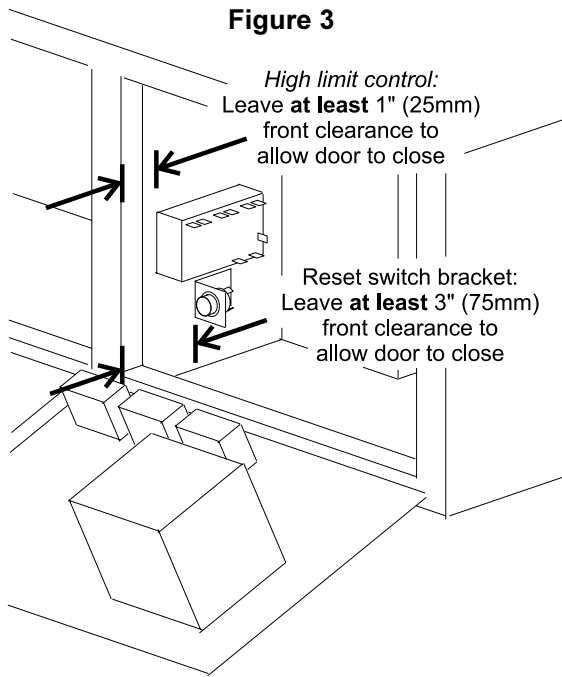


**Appendix - Instructions for Service Kit 39733 -  
High Limit Conversion Kit for PS300, 310, 350 & 360 Ovens, 5/99**

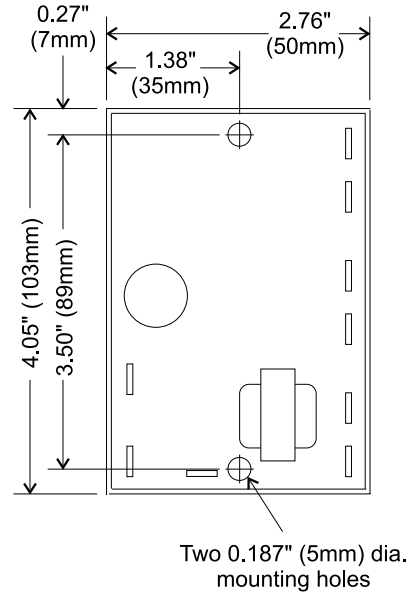
**Figure 2**



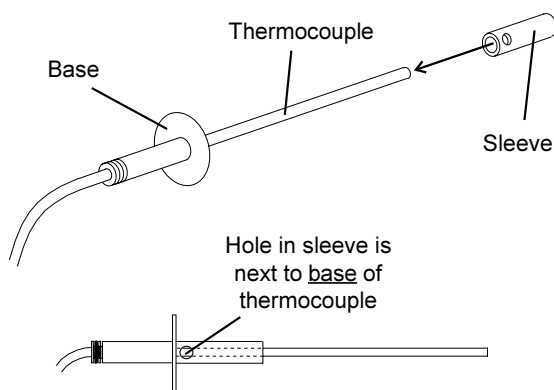
**Figure 3**



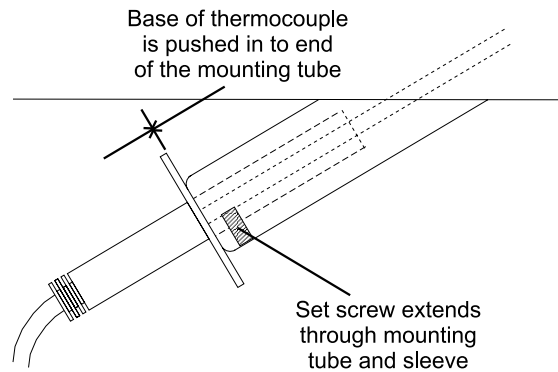
**Figure 4  
NOT TO SCALE**



**Figure 5**



**Figure 6**



## Appendix - Instructions for Service Kit 39733 - High Limit Conversion Kit for PS300, 310, 350 & 360 Ovens, 5/99

### C. WIRING

For the various wiring connections listed below, cut the kit-supplied #18 AWG wires to length. Refer to Figures 7 and 8 (on pages 6 and 7) for diagrams of the wiring connections.

#### **Lighted Reset Switch Wiring and Installation**

14. Using the kit-supplied 1/4" wire connectors, connect the following kit-supplied wires:
  - Red wires ..... connect one wire to each "RESET" terminal on the high limit control
  - Black wire ..... connect to terminal "NC" on the high limit control
  - White wire ..... connect to terminal "L2" on the oven's temperature controller
15. Slip the free ends of these four wires through the circular hole in the reset switch mounting bracket, so that they hang down in front of the control compartment.
16. Use the kit-supplied 1/4" wire connectors to connect these four wires to the terminals on the lighted reset switch.
  - Terminals 1 and 3 ..... Red wires (these connections are interchangeable)
  - Terminal 2 ..... Black wire
  - Terminal 4 ..... White wire (kit-supplied)
17. Push the lighted reset switch through the mounting hole in the center of the bracket until it snaps into place. Be sure to avoid pinching the wires against the sides of the mounting hole.

#### **Cooldown circuit wiring**

NOTE: Perform steps 18 and 19 ONLY if you are replacing a UE Type 55 controller. If you are replacing a UE Type 54 controller (which has no cooldown circuit), skip ahead to Step 20.

18. Attach the oven's existing cooldown wiring to the following terminals on the oven's Temperature Controller, as shown in Figures 7 and 8.

*For Ovens with a Digital Temperature Controller:*

- a. Terminal 9 ..... Black wire (from blower switch)
- b. Terminal 10 ..... Brown wire (from blower switch)

*For Ovens with an Analog Temperature Controller:*

- a. Terminal 13 ..... Black wire (from blower switch)
- b. Terminal 14 ..... Brown wire (from blower switch)

19. Attach a brown kit-supplied wire between the following terminals on the Temperature Controller:

Digital Controller ..... Terminals 10 and "L1"

Analog Controller ..... Terminals 13 and "L1"

#### **High Limit Control wiring**

20. Using the kit-supplied 1/4" wire connectors, wire the high limit control terminals as follows:
  - a. Terminal "NO" ..... Purple wire (originally to UE control)
  - c. Terminal "TC +" ..... White wire (to thermocouple) - DO NOT CUT THIS WIRE TO LENGTH.
  - d. Terminal "TC -" ..... Red wire (to thermocouple) - DO NOT CUT THIS WIRE TO LENGTH.
  - f. Terminal "L2" ..... White wire (kit-supplied; to neutral on the oven's terminal block)
  - h. Terminal "COM" ..... Orange wire (originally to UE control)
21. Using a 1/4" wire connector, attach a brown kit-supplied wire to the "L1" terminal on the high limit control. Attach the free end of the wire to the "L1" terminal on the temperature controller.

**Appendix - Instructions for Service Kit 39733 -  
High Limit Conversion Kit for PS300, 310, 350 & 360 Ovens, 5/99**

**D. TESTING THE INSTALLATION**

22. Remove the thermocouple wires from the "TC +" and "TC -" terminals on the high limit control.
23. Attach a Middleby Marshall Thermocouple Source (P/N 27170-0263) to the "TC +" and "TC -" terminals on the high limit control, in place of the thermocouple wires. Note that it may be necessary to attach a pair of terminal connectors to the leads of the Thermocouple Source to allow them to connect to the high limit control's terminals.
24. Restore the gas supply (if so equipped) and the electrical supply to the oven. Because the control compartment door is still open, pull the door safety switch out into the "service" position.
25. Test the operation of the high limit control as follows:
  - a. Set the Thermocouple Source to a normal operating temperature, between 200°-600°F (93°-315°C).
  - b. Turn the oven on, and allow it to heat to 600°F (315°C).
  - c. After the oven has reached the setpoint temperature, set the Thermocouple Source to 700°F (371°C).  
The high limit control is set to open at any temperature in excess of 650°F (343°C). This will shut down the oven's heat circuit and illuminate the Reset Switch lamp.
26. Set the Thermocouple Source to a temperature setting below 600°F (316°C), and depress the Reset Switch. This should turn off the Reset Switch lamp and restore heat circuit operation.
27. Turn the oven off.
28. If you replaced a UE type 55 controller (with a cooldown circuit), you must set the Thermocouple Source to a temperature setting below 200°F (93°C). Then, wait for the blowers to turn off.
29. Press the door safety switch in to reset it to normal.
30. Remove the Thermocouple Source from the oven.
31. Reattach the thermocouple wires to the high limit control's terminals as follows:  
White wire ..... "TC +"  
Red wire ..... "TC -"
32. Close the machinery compartment and control compartment access panels, and fasten them in place. The oven is now ready for normal operation.

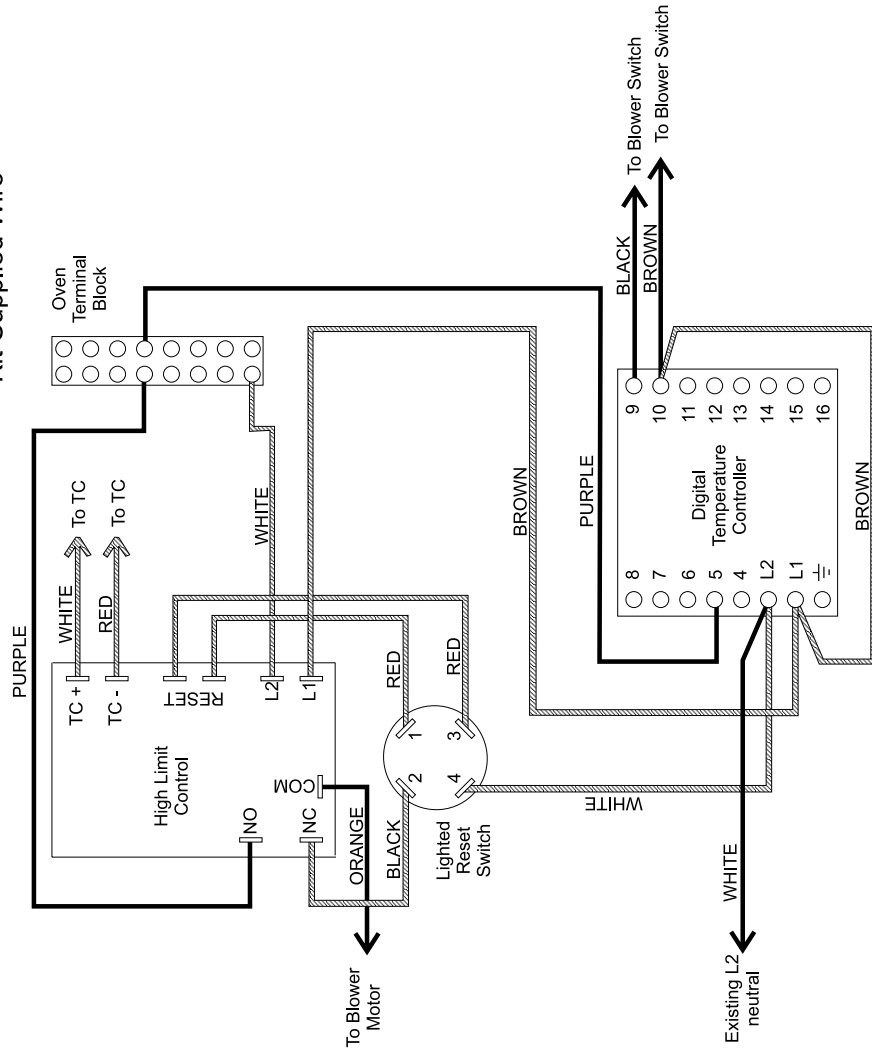
## Appendix - Instructions for Service Kit 39733 - High Limit Conversion Kit for PS300, 310, 350 & 360 Ovens, 5/99

Figure 7 - United Electric Model 55 replacement: ovens with a cooldown feature

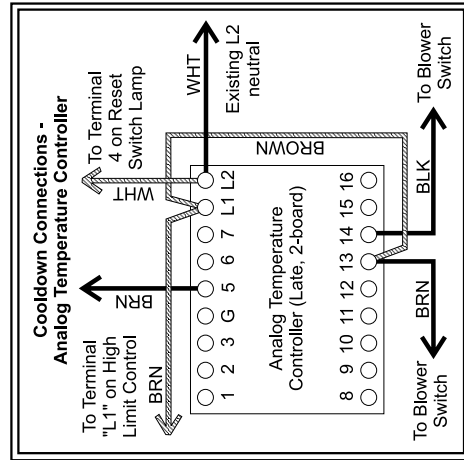
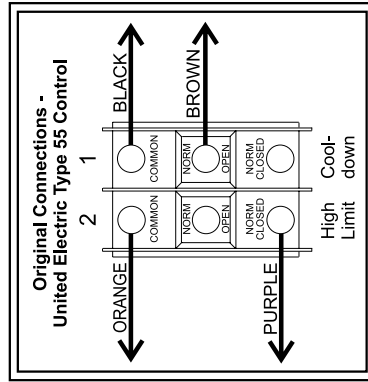
### KEY

Existing Wire in Oven

Kit-Supplied Wire



Page 6 of 8



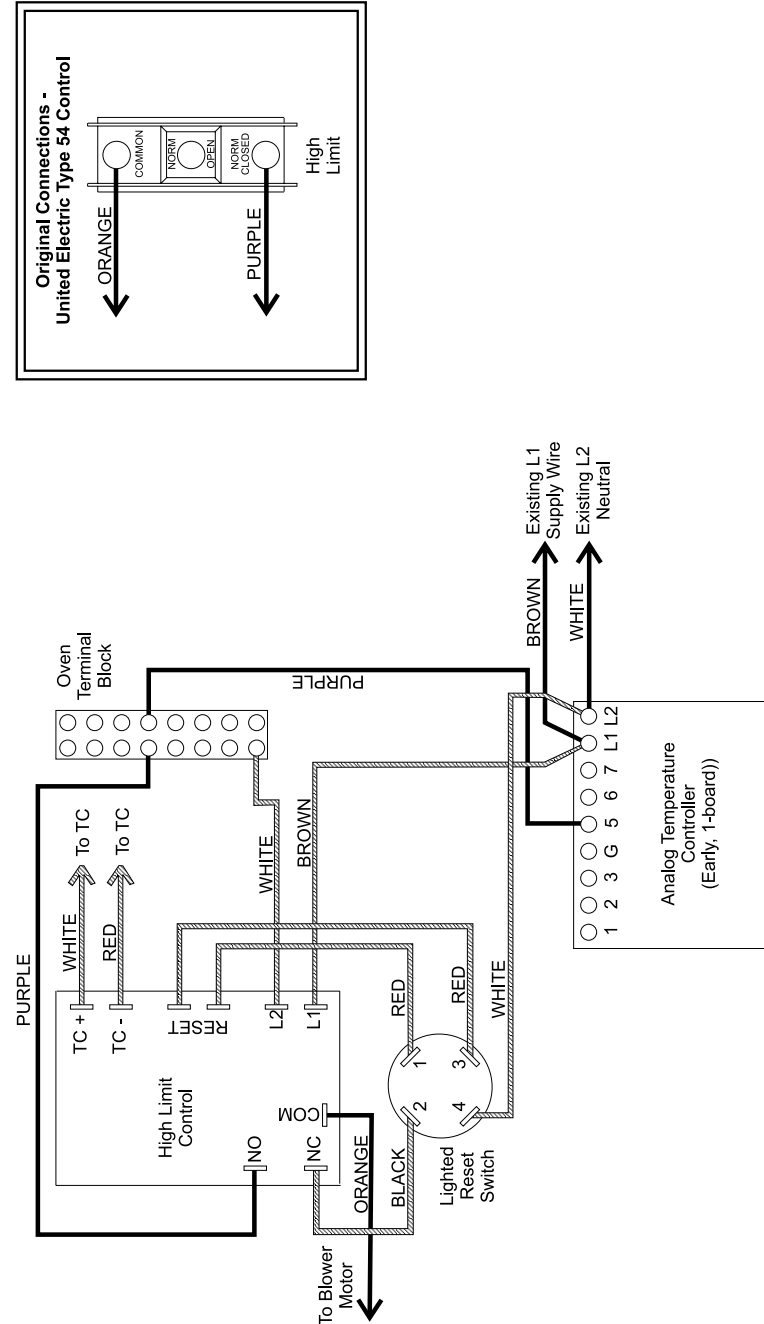
## Appendix - Instructions for Service Kit 39733 - High Limit Conversion Kit for PS300, 310, 350 & 360 Ovens, 5/99

**Figure 8 - United Electric Model 54 replacement: ovens without a cooldown feature**

### KEY

**Existing Wire in Oven**

**Kit-Supplied Wire**



**Appendix - Instructions for Service Kit 39733 -  
High Limit Conversion Kit for PS300, 310, 350 & 360 Ovens, 5/99**



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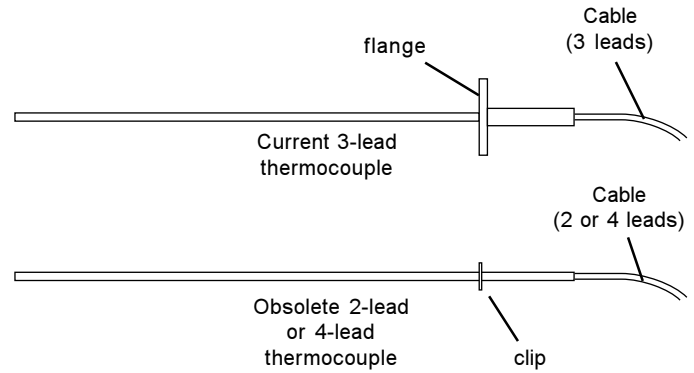
**IV. THERMOCOUPLES**

All temperature controller and high limit functions are based on input from thermocouples. When two wires composed of dissimilar metals are joined together and one of the ends is heated, a continuous current flow is generated. Middleby ovens use a Type J (iron constant) thermocouple. The iron wire increases the number of dissimilar metal junctions in the circuit.

Middleby has used several types of thermocouples. All can be replaced with the current version. Refer to Figure 24 for illustrations.

- A two-lead thermocouple with a small retaining clip. Used for EITHER temperature-sensing OR high-limit functions. This type is no longer available.
- A four-lead thermocouple with a small retaining clip. This is a dual-function unit that sends its signal to the temperature controller and to a separate high limit control module. This type is no longer available.
- A three-lead thermocouple with a separate ground lead, a shielded cable and a large mounting flange. This is the only type of thermocouple available from Middleby at this time. If it is used to replace a four-lead dual-function thermocouple, two complete and separate thermocouples will have to be installed.

**Figure 24 - Thermocouples**



**A. Part Number Reference - Thermocouples**

Part numbers are provided ONLY for the current, 3-lead thermocouple kits. These thermocouples include instructions for replacing all previous thermocouple designs, in all oven models.

<i><b>P/N</b></i>	<i><b>Description</b></i>
33984	Kit, thermocouple, PS360-series or PS555/570 series
33985	Kit, thermocouple, PS200-series or PS536

**B. Thermocouple Functions**

**1. Temperature-sensing thermocouple(s)**

All thermocouples monitor oven temperature. However, Middleby uses the term “temperature-sensing thermocouple” in reference to thermocouples that send their signal to the temperature controller instead of to a separate high limit control module.

On ovens that do NOT include a separate high-limit control module (this includes most PS200-series and PS360-series gas ovens), this thermocouple signal is used to monitor the oven temperature for regulating the gas flow/heater activation, AND to activate the high limit warning in case of an overtemp condition.

Middleby ovens use from one to three temperature-sensing thermocouples, depending on the oven model.

Temperature-sensing thermocouples are used on all oven models and are connected to Terminals 7 and 8 on the temperature controller. Based on the signal from this thermocouple, the temperature controller:

- Calls for heat from the burner/heating elements to maintain the set point (output from Terminals 4 & 5 for on-off electric and gas ovens; output from Terminals 15 & 16 for variable pulse electric and modulating gas ovens).
- Controls the cooldown feature if the HEAT switch is turned off while the oven is above the cooldown temperature (output from Terminals 9 & 10).
- On ovens without a separate high limit control module (most PS200-series and PS360-series gas and electric ovens), the oven temperature sensed by this thermocouple is also used to activate the high limit warning (output from Terminals 11 & 12).

**2. High limit thermocouple**

Middleby uses the term “high limit thermocouple” in reference to the thermocouple that sends its signal solely to the separate high limit control module.

If the oven does not have a separate high limit control module, there is no high limit thermocouple. On these ovens, the temperature-sensing thermocouple(s) control high limit activation.

**C. Troubleshooting**

**1. Open thermocouple**

An open in a thermocouple will cause the temperature controller to read the maximum temperature (usually 909°F/487°C). This causes the following:

- On ovens without a separate high limit control module, an open thermocouple triggers the high limit alarm. This shuts down the burner. After the open has been corrected, the high limit will need to be reset to allow the oven to resume operation.
- On ovens with a separate high limit control module, an open temperature-sensing thermocouple causes the temperature controller to stop calling for heat. This shuts down the burner.
- On ovens with a separate high limit control module, an open high limit thermocouple will trigger the high limit control module to shut down the burner. Note that the high limit control will need to be reset after the open is corrected before the oven can return to operation.

2. Checking the thermocouple with a DC millivolt meter  
It is possible to check that a thermocouple is reading accurately by using a multimeter set to read DC millivolts. At 32°F/0°C the thermocouple should read 0 mVDC. This can be checked by inserting the ther-

mocouple into an ice bath for several minutes. At 72°F/22°C the reading should be 1.134mVDC.

You can use the chart below by checking the temperature at the thermocouple's junction terminals. This is called the *Junction Temperature*.

**Figure 24 - Thermocouple millivolt readings at various operating and junction temperatures**

		OVEN TEMPERATURE										
		200°F 93°C	250°F 121°C	300°F 149°C	325°F 163°C	350°F 177°C	400°F 204°C	425°F 218°C	450°F 232°C	500°F 260°C	550°F 288°C	600°F 315°C
JUNCTION TEMPERATURE	90°F (32°C)	3.26	4.77	6.30	7.06	7.83	9.37	10.14	10.91	12.46	14.00	15.53
	88°F (31°C)	3.32	4.83	6.36	7.12	7.89	9.43	10.20	10.97	12.51	14.05	15.59
	86°F (25°C)	3.37	4.88	6.41	7.17	7.94	9.49	10.26	11.03	12.57	14.11	15.65
	84°F (29°C)	3.43	4.94	6.47	7.23	8.00	9.54	10.31	11.09	12.63	14.19	15.71
	82°F (28°C)	3.49	5.00	6.53	7.29	8.06	9.60	10.37	11.14	12.69	14.23	15.76
	80°F (27°C)	3.55	5.06	6.59	7.35	8.12	9.66	10.43	11.20	12.74	14.28	15.82
	78°F (26°C)	3.60	5.11	6.64	7.40	8.17	9.72	10.49	11.26	12.80	14.34	15.88
	76°F (24°C)	3.66	5.17	6.70	7.46	8.23	9.77	10.55	11.32	12.86	14.40	15.94
	75°F (24°C)	3.69	5.20	6.73	7.49	8.26	9.80	10.57	11.35	12.89	14.43	15.97
	74°F (23°C)	3.72	5.23	6.76	7.52	8.29	9.83	10.60	11.37	12.92	14.46	15.99
	72°F (22°C)	3.78	5.29	6.82	7.58	8.35	9.89	10.66	11.43	12.97	14.51	16.05
	70°F (21°C)	3.83	5.34	6.87	7.63	8.40	9.95	10.72	11.49	13.03	14.57	16.11
	68°F (20°C)	3.89	5.40	6.93	7.69	8.46	10.00	10.78	11.55	13.09	14.63	16.17
	66°F (19°C)	3.95	5.46	6.99	7.75	8.52	10.06	10.83	11.61	13.15	14.69	16.23
	64°F (18°C)	4.01	5.52	7.05	7.81	8.58	10.12	10.89	11.66	13.20	14.74	16.28
62°F (17°C)	4.06	5.57	7.10	7.86	8.63	10.18	10.95	11.72	13.26	14.80	16.34	
60°F (16°C)	4.12	5.63	7.16	7.92	8.69	10.24	11.01	11.78	13.32	14.86	16.40	



**D. Appendices      Appendix - Instructions for Service Kits 33984 and 33985 -  
Oven Thermocouple Kit, 11/01**

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**Instructions for Service Kits P/Ns 33984 and 33985  
Oven Thermocouple Kit**

This Service Kit provides the parts and instructions necessary to replace one temperature-sensing or high limit thermocouple in any of the following Middleby Marshall oven models:

- PS200 Series uses Kit P/N 33985      • PS536 uses Kit P/N 33985      • PS570 uses Kit P/N 33984
- PS360 Series uses Kit P/N 33984      • PS555 uses Kit P/N 33984

These instructions include replacement procedures for ovens built with the current flanged thermocouple, AND for ovens built with the obsolete thermocouple without a flange (P/N 28071-0001).

**KIT CONTENTS - KIT P/N 33984**

<i>P/N</i>	<i>Qty.</i>	<i>Description</i>
33812-1	1	Thermocouple, type J, 6" L
B301A8861	2	Screw, hex wshr hd #6 x 3/8"
21292-0001	3	Screw, hex wshr hd #10-16 x 3/4"
27276-0001	1	Cable clamp, nylon
41687	1	Attachment plate, PS360 rear thermocouple
34701	1	Instructions

**KIT CONTENTS - KIT P/N 33985**

<i>P/N</i>	<i>Qty.</i>	<i>Description</i>
33812-2	1	Thermocouple, type J, 13-3/8" L
B301A8861	1	Screw, hex wshr hd #6 x 3/8"
34701	1	Instructions

**IMPORTANT - READ THIS BEFORE YOU BEGIN!**

The thermocouple in your Kit has three leads:

- The red and white leads connect directly to the thermocouple terminals on the oven's temperature controller (or high limit control module, as appropriate), or to a local terminal block that in turn is connected to one of these units.
- The uninsulated lead is a ground wire for the thermocouple's protective sheath. The ground connection helps to drain any radio-frequency disturbances from the thermocouple before the signal enters the temperature controller or high limit control module. For a temperature-sensing thermocouple, the ground lead **MUST** be connected to the ground terminal on the temperature controller. For a high limit thermocouple, the ground lead should be connected to a chassis ground or to the mounting screw for the high limit control module.

Some early thermocouples may have either two or four leads:

- The two-lead thermocouple is simply an earlier version of the current model, without the ground lead. When replacing a two-lead thermocouple, it will be necessary to connect the new ground lead.
- The four-lead thermocouple is actually a dual-function unit which sends its signal to both the temperature controller and the high limit control module. Current ovens use separate thermocouples for these functions. When replacing a four-lead thermocouple, it will be necessary to use a **SECOND KIT** to install the high limit thermocouple. In addition, any oven equipped with these early thermocouples should have all of its thermocouples updated at the same time. For a PS570 or PS570S oven, this will require **THREE THERMOCOUPLE KITS** - two for the existing thermocouples, and one for the new, separate high limit.

<u><i>Oven Model</i></u>	<u><i>Page</i></u>
PS200 Series - before 2/96, serial numbers before ASH-0001 .....	2
PS200 Series - 2/96 or later, serial numbers after ASH-0001 .....	2
PS360 Series rear wall thermocouples - before 2/96, serial numbers before ASH-0001 .....	3
PS360 Series rear wall thermocouples - 2/96 or later, serial numbers after ASH-0001 .....	3
PS360 Series front-mounted thermocouples inside the machinery compartment .....	4
PS536 .....	5

<u><i>Oven Model</i></u>	<u><i>Page</i></u>
PS555 Gas - rear wall thermocouples with screw terminal connections (no terminal blocks) .....	8
PS555 Electric and PS555E .....	9
PS570 (X01-X05 name plate ID numbers) and PS570S (early) with side-mounted thermocouples inside or outside the blower motor compartments .....	10
PS570S (late) - rear wall thermocouples with left-side AND right-side terminal block connections .....	12
PS555G and PS570G - rear wall thermocouples with left-side terminal block connections .....	14

<b>WARNING</b> BEFORE PERFORMING ANY SERVICE WORK, THE ELECTRICAL POWER SUPPLY AND THE GAS SUPPLY <u>MUST</u> BE TURNED OFF.
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## Appendix - Instructions for Service Kits 33984 and 33985 - Oven Thermocouple Kit, 11/01

### PS200 Series - before 2/96, serial numbers before ASH-0001

Thermocouples on these ovens are located inside the machinery compartment. They are secured in place by a set screw in the mounting tube, inside the plenum chamber.

This Kit eliminates the set screw. The new thermocouple is held in place by the head of the screw that is already used to attach the mounting tube.

**NOTE FOR HIGH LIMIT THERMOCOUPLES:**

CE ovens and PS200VL models have two thermocouples, one mounted above the other. In these ovens, the upper thermocouple senses the oven temperature and is connected to the temperature controller. The lower thermocouple is connected to the high limit control module. Either thermocouple can be replaced using this Kit.

1. Remove the lower end plug from the control end of the oven. Then, remove 1 or 2 lower air fingers as necessary to access the thermocouple mounting tube.
2. Refer to Figure 1. REMOVE AND DISCARD the set screw and pull the thermocouple out of the mounting tube. Disconnect the thermocouple wiring from the temperature controller or high limit module, as appropriate.
3. Remove AND RETAIN the #10-16 screw that fastens the flange of the thermocouple mounting tube to the plenum wall. Leave the mounting tube in place.
4. Install the new thermocouple so that its flange fits firmly against the mounting tube flange.
5. Replace the #10-16 screw that you removed in Step 3. Check that the head of the screw holds the thermocouple flange securely in place, as shown in Figure 1.
6. Route the thermocouple leads away from the ignition cable. Connect the leads as shown in Figure 2.

### PS200 Series - 2/96 or later, serial numbers after ASH-0001

Thermocouples on these ovens are located in the same position as the earlier PS200 models described above. However, these ovens feature a flanged thermocouple identical to the new thermocouple provided in this Kit.

The thermocouple SHOULD be held in place by the screw that attaches the thermocouple mounting tube, as per the replacement procedure above. For these ovens, simply disconnect the thermocouple wiring from the temperature controller and follow Steps 3-6 of the procedure shown above to remove and replace the thermocouple.

On some of these ovens, the thermocouple flange rests ON TOP of the retaining screw for the mounting tube, as shown in the "INCORRECT" inset of Figure 1. These thermocouples are held in place by the set screw on the mounting tube, inside the plenum chamber. For these ovens, you should remove and replace the thermocouple by following Steps 1-6 of the preceding section.

Figure 1  
Thermocouple Installation - PS200 Series

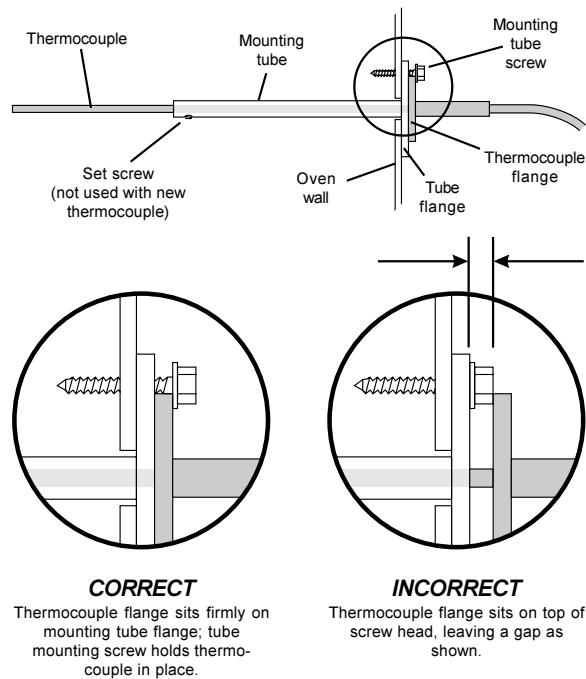
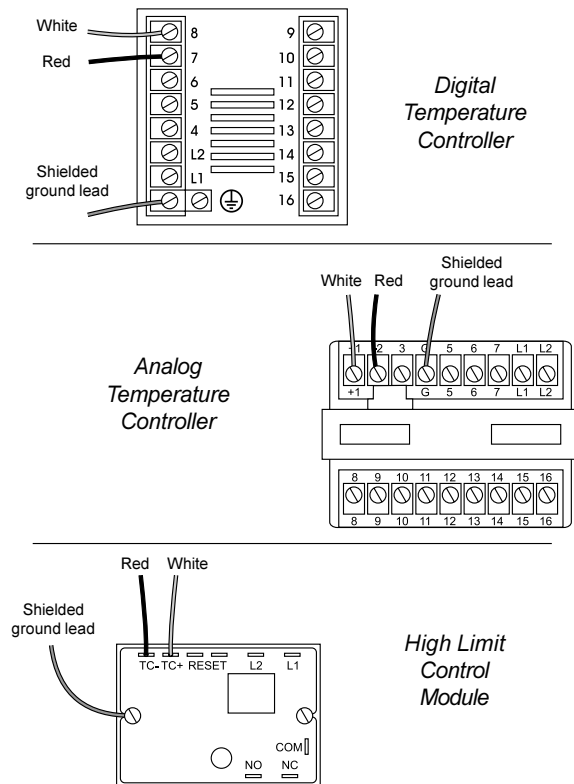


Figure 2  
Thermocouple Wiring - PS200 Series



## Appendix - Instructions for Service Kits 33984 and 33985 - Oven Thermocouple Kit, 11/01

### PS360 Series rear wall thermocouples - before 2/96, serial numbers before ASH-0001

Thermocouples on these ovens are located on the rear wall of the baking chamber. They are secured in place by a clamp on the outside of the oven.

This Kit eliminates the clamp. The flange of the new thermocouple is held to the back wall of the oven by a retaining plate, as shown in Figure 3.

1. Loosen the retaining clamp and pull the thermocouple straight out. Disconnect the thermocouple leads. Carefully thread the wiring out of the oven and discard the thermocouple.
2. Remove and discard the cable clamp.
3. Slide the new thermocouple into the mounting tube until the flange is seated firmly on the back wall of the oven.
4. Install the kit-supplied retaining plate (P/N 41687) as shown in Figure 3.
5. Fasten the attachment plate to the back wall of the oven using the two kit-supplied #10-16 x 3/4" self-tapping screws. Ensure that the thermocouple flange is securely trapped between the plate and the rear wall of the oven.
6. Route the wiring through the grommet hole and into the machinery compartment. Check that the leads are clear of all components, PARTICULARLY THE BLOWER MOTOR, by using the existing wiring bundles.
7. Connect the leads as shown in Figure 4.
8. Attach the kit-supplied nylon clamp and #10-16 x 3/4" screw to the rear of the oven. The clamp should be positioned to support the thermocouple leads away from the flue pipes and vent openings.

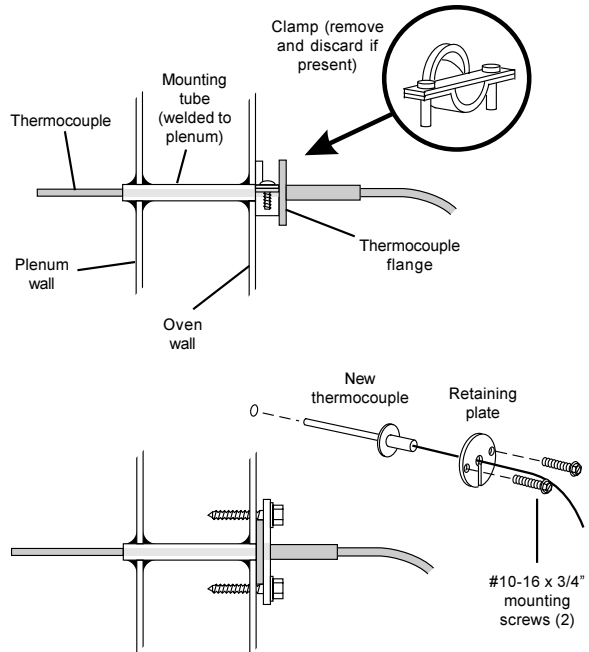
### PS360 Series rear-wall thermocouples - 2/96 or later, serial numbers after ASH-0001

Thermocouples on these ovens are mounted directly to the back wall of the oven using a single retaining screw. It should be possible to simply replace the existing thermocouple using the original mounting hardware.

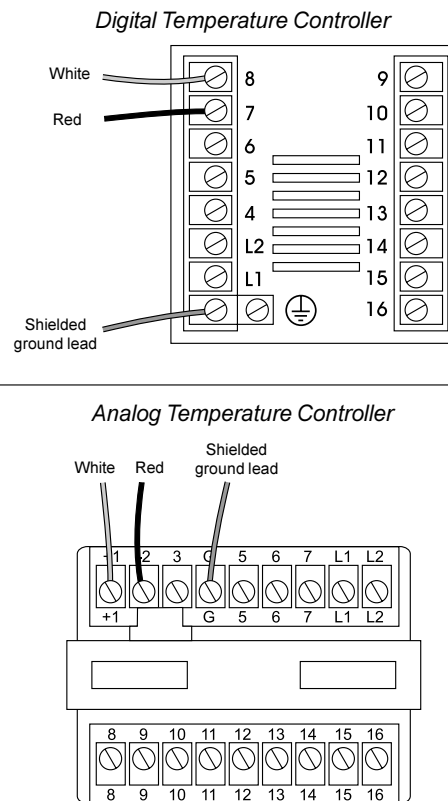
To replace the thermocouple:

1. Remove AND RETAIN the screw that holds the thermocouple in place on the rear wall.
2. Disconnect the thermocouple leads. Carefully thread the wiring out of the oven and discard the thermocouple.
3. Slide the new thermocouple into the mounting tube until the flange is seated firmly on the back wall of the oven.
4. Fasten the thermocouple to the back wall of the oven using the original mounting screw. Then, perform Steps 6-8 of the preceding section to wire the thermocouple.

**Figure 3**  
Thermocouple Installation - PS360 Series



**Figure 4**  
Thermocouple Wiring - PS360 Series



## Appendix - Instructions for Service Kits 33984 and 33985 - Oven Thermocouple Kit, 11/01

### PS360 Series front-mounted thermocouple inside the machinery compartment

These thermocouples are mounted in a tube that extends diagonally up and into the plenum chamber. They are secured in place by a set screw located on the mounting tube, and by a bead of high-temperature silicone around the end of the shaft.

The new thermocouple will be held in place in the same manner, except that the silicone should be applied so that it wraps around the edges of the thermocouple's mounting flange.

#### NOTE FOR HIGH LIMIT THERMOCOUPLES:

PS310/360 electric ovens have two thermocouples inside the machinery compartment. One thermocouple is connected to the temperature controller, while the other is connected to the high limit control module.

The thermocouple supplied in this Kit is incompatible with the early United Electric Type 54 and Type 55 high limit control modules used on these ovens. If the oven is equipped with one of these control modules, it will be necessary to upgrade the control unit to the current Watlow model (shown in Figure 6) before the thermocouple can be replaced. Service Kit 39733 includes all parts and instructions needed for the conversion. Refer to Service Bulletin MM-168 (5/7/99) for details.

1. Remove the silicone seal around the end of the thermocouple. Loosen the set screw.
2. Pull the thermocouple out of its mounting tube. Carefully thread the wiring out of the oven and discard the thermocouple.
3. Check that the silicone has been removed completely from the end of the mounting tube. Any remaining silicone can interfere with the correct placement of the new thermocouple.
4. Insert the new thermocouple until its flange is seated on the end of the mounting tube. See Figure 5.
5. Tighten the set screw until the thermocouple is secure inside the tube. **AVOID OVERTIGHTENING THE SET SCREW TO PREVENT DAMAGE TO THE THERMOCOUPLE.**
6. Use high-temperature silicone to seal the flange to the mounting tube, as shown in Figure 5. Check that all holes and spaces are filled by the silicone. This not only helps to hold the thermocouple in place, but prevents heat from entering the machinery compartment.
7. Route the wiring for the new thermocouple through the hole in the side of the electrical control box by using the existing wiring bundle. Check that the leads are clear of the ignition cable and all components.
8. Connect the leads as shown in Figure 6.

Figure 5  
Thermocouple Installation - PS360 Series  
Machinery Compartment

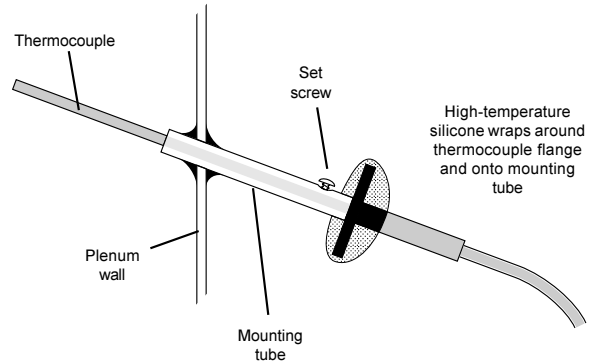
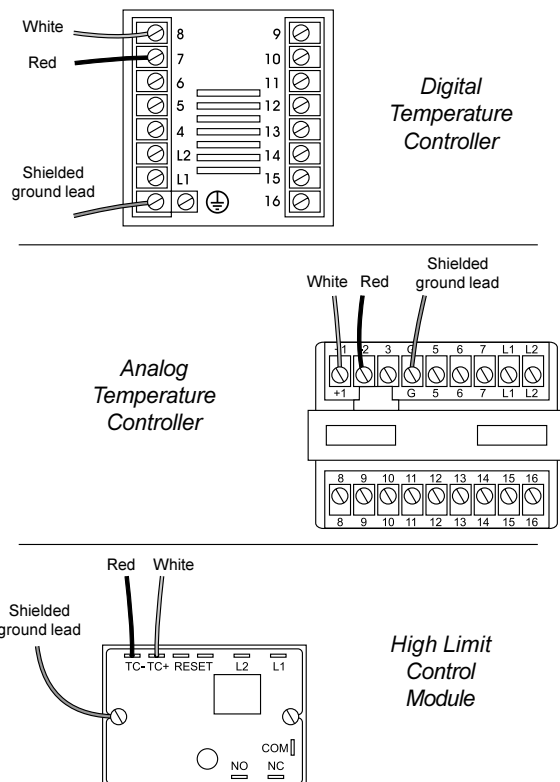


Figure 6  
Thermocouple Wiring - PS360 Series



## Appendix - Instructions for Service Kits 33984 and 33985 - Oven Thermocouple Kit, 11/01

### PS536

Thermocouples on these ovens are located inside the machinery compartment. They are secured in place by a sheet metal screw that traps the thermocouple flange against the wall of the compartment. See Figure 7.

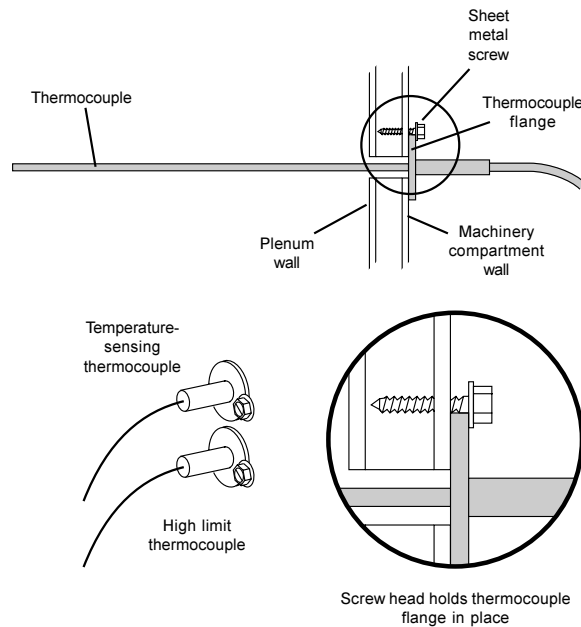
**NOTE FOR HIGH LIMIT THERMOCOUPLES:**  
PS536 ovens have two thermocouples, one mounted above the other. The upper thermocouple senses the oven temperature and is connected to the temperature controller. The lower thermocouple is connected to the high limit control module. Either thermocouple can be replaced using this Kit.

1. Loosen the sheet metal screw that holds the thermocouple flange to the wall of the machinery compartment.
2. Pull the thermocouple out of the machinery compartment. Disconnect the thermocouple leads.
3. Install the new thermocouple so that its flange fits firmly against the wall of the machinery compartment. Tighten the sheet metal screw so that its head holds the thermocouple flange securely in place.

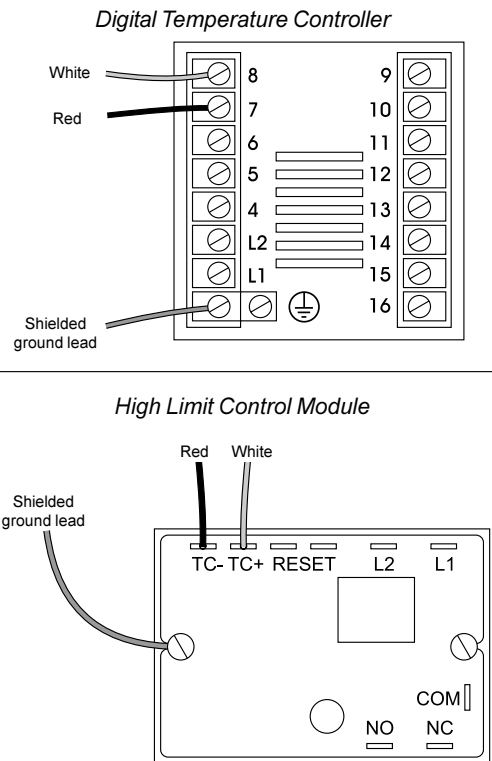
NOTE: PS536 ovens do not use a thermocouple mounting tube, so it is CRITICAL that the thermocouple flange is securely fastened to the wall of the machinery compartment.

4. Route the thermocouple leads away from the ignition cable. Connect the leads as shown in Figure 8.

**Figure 7**  
Thermocouple Installation - PS536



**Figure 8**  
Thermocouple Wiring - PS536



## Appendix - Instructions for Service Kits 33984 and 33985 - Oven Thermocouple Kit, 11/01

### PS555 Gas - thermocouples with screw terminal connections (no terminal blocks)

Thermocouples on these ovens are located on the rear wall. They are secured in place by two screws that are inserted through the holes in the thermocouple flange. These ovens are equipped with a three-lead, flanged thermocouple identical to the one in this Kit.

#### NOTE FOR HIGH LIMIT THERMOCOUPLES:

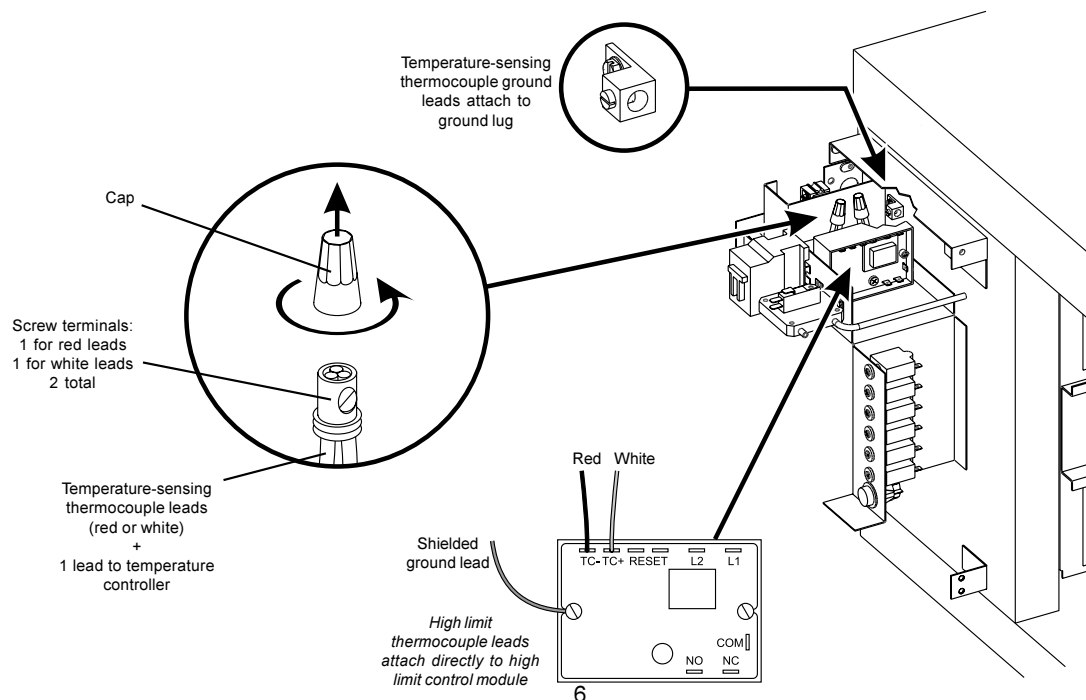
These ovens have a high limit thermocouple installed in the last mounting hole at the exit end of the oven.

The thermocouple supplied in this Kit can be used to replace ANY of the temperature-sensing or high limit thermocouples on the oven.

1. Remove the rear shrouds and blower motor covers. This allows access to the thermocouples (on the rear wall) and screw terminals (inside the blower motor compartments).
2. Remove the screws that hold the thermocouple to the wall. Slide the thermocouple out of its mounting hole.
3. Disconnect the thermocouple leads. Refer to Figure 9.
  - High limit thermocouples are wired directly to the high limit control module. The thermocouple's ground wire is connected to the mounting screw for the high limit control module.
  - The red and white leads from ALL temperature-sensing thermocouples are joined at capped screw terminals, located inside the left blower motor compartment. Leads from these screw terminals connect to the temperature controller at the front of the oven.

The ground leads for temperature-sensing thermocouples are connected to the chassis ground lug inside the left blower motor compartment.
4. Remove and discard the thermocouple.
5. Install the new thermocouple into the original mounting hole. Fasten it in place with the supplied #6 x 3/8" screws.
6. Wire the thermocouple as shown in Figure 9.
6. Use the kit-supplied nylon clamp and #10-16 x 3/4" screw to secure the thermocouple leads so that they will clear the shrouds, blower belts, and pulleys.
7. Close the machinery compartment door. Replace all shrouds onto the oven.

Figure 9  
Thermocouple Wiring - PS555



## Appendix - Instructions for Service Kits 33984 and 33985 - Oven Thermocouple Kit, 11/01

### PS555 Electric and PS555E

Temperature-sensing thermocouples on these ovens are located on the rear wall. High limit thermocouples are located inside the machinery compartment. All thermocouples are secured in place by two screws that are inserted through the holes in the thermocouple flange. These ovens are equipped with a three-lead, flanged thermocouple identical to the one in this Kit.

**NOTE FOR HIGH LIMIT THERMOCOUPLES:**

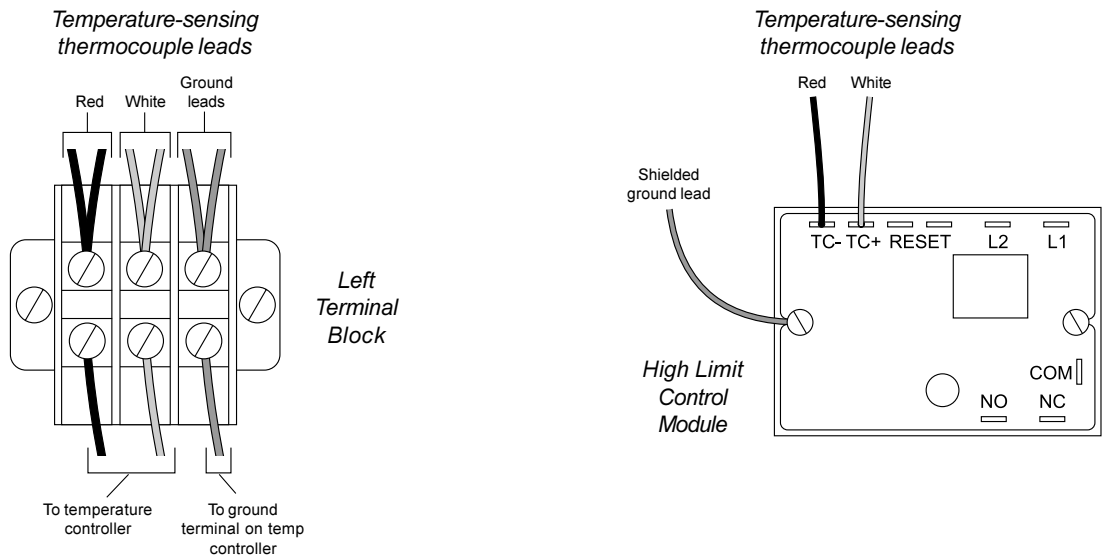
PS555E electric ovens are equipped with a high limit thermocouple at the front of the oven, inside the machinery compartment. All other PS555E, PS555G and PS570G ovens have a high limit thermocouple installed into the rear wall in the last mounting hole at the exit end of the oven.

The thermocouple supplied in this Kit can be used to replace ANY of the temperature-sensing or high limit thermocouples on the oven.

1. If you will be replacing the high limit thermocouple, open the machinery compartment door.  
To replace any other thermocouple, first remove the rear shrouds. Then, remove the cover over the left blower motor. This allows access to the thermocouples on the rear wall, and to the terminal block inside the blower motor compartment.

- Note that all of the rear wall thermocouples are connected to the terminal block inside the left blower motor compartment. It is not necessary to access the right blower motor compartment.
2. Remove the screws that hold the thermocouple to the wall. Slide the thermocouple out of its mounting hole.
  3. Disconnect the thermocouple leads. Rear wall thermocouples are connected to the terminal block inside the left blower motor compartment. High limit thermocouples are connected directly to the high limit control module.
  4. Remove and discard the thermocouple.
  5. Install the new thermocouple into its mounting hole. Fasten it in place with the supplied #6 x 3/8" screws.
  6. Wire the thermocouple as shown in Figure 10.
  7. If you replaced a rear wall thermocouple, use the kit-supplied nylon clamp and #10-16 x 3/4" screw to secure the thermocouple leads so that they will clear the shrouds, blower belts, and pulleys.
  8. Replace all shrouds onto the oven. Close the machinery compartment door.

**Figure 10**  
**Thermocouple Wiring - PS555 Electric and PS555E**



## Appendix - Instructions for Service Kits 33984 and 33985 - Oven Thermocouple Kit, 11/01

### PS570 (X01-X05 name plate ID numbers) and PS570S (early) with side-mounted thermocouples inside or outside the blower motor compartments

These ovens are equipped with two thermocouples, one on each end wall of the oven. The thermocouples may be mounted either inside or outside of the blower motor compartments.

- The thermocouple on the right side of the oven has two leads and sends its signal to the temperature controller.
- The thermocouple on the left side of the oven is a dual-function unit. It has FOUR LEADS and sends individual signals to the temperature controller and the high limit control module.

Installing this Kit will replace BOTH thermocouples with current three-lead versions located on the back wall of the oven. The Kit also requires the installation of a THIRD thermocouple to act as a high limit sensor. Because of this, **you will need three separate thermocouple kits for these ovens.**

If the oven has already been updated with the rear-wall thermocouple configuration, you can simply replace the affected thermocouple. Follow the instructions for PS570S (late) rear wall thermocouples on Page 10.

1. If the thermocouples are located outside the blower motor compartments, remove and retain the thermocouple covers.
2. Remove the end plugs from the oven. Then, remove 1 or 2 air fingers from each end of the oven as necessary to access the thermocouple mounting tubes.
3. Remove the rear shrouds. Open the blower motor compartment doors.
4. Remove the cooling fans from both blower motors. Then, remove the blower belts.
5. For each thermocouple:
  - Disconnect the thermocouple leads from the terminal block inside the blower motor compartment.
  - Remove and discard the screws that hold the thermocouple mounting tube to the plenum wall. Remove and discard the thermocouple and tube.
  - Plug the internal and external openings left by the tubes using a high-temperature silicone sealant.
6. If the thermocouples were located outside the blower motor compartments, replace the thermocouple covers.

7. Refer to Figure 11. Measure and scribe marks in the rear wall of the oven for drilling the thermocouple mounting holes. Make sure that your measurements begin at the edges of the rear panels, and NOT at the outer edges of the oven!

Note that there are two different thermocouple placement locations: one for Pizza Hut (and Pizza Hut International, or Tricon) ovens, and one for all other ovens.

8. Drill the new thermocouple mounting holes using an 11/32" (8.73mm) D x 8" (203mm) L bit. Make sure that you drill through all three walls of the oven.
9. Drill the two screw mounting holes for each thermocouple using a 7/64" (2.78mm) bit. Tap the holes using a #6-32 tap.
10. If necessary, remove air fingers from the oven to access the areas around the new thermocouple mounting holes.
11. Vacuum out ALL drill shavings. If the oven is equipped with a screen over the openings for the lower air fingers, use a flexible hose extension on the vacuum to reach the shavings through the upper air finger openings.
12. Reinstall the air fingers and end plugs onto the oven.
13. Install the three new thermocouples into the back wall of the oven. Check that the thermocouple flanges are flush with the back wall.
14. Secure each thermocouple in place with the two kit-supplied #6 x 3/8" screws.
15. Wire the thermocouples as shown in Figure 12. The thermocouples should be wired to the terminal block inside the blower motor compartment closest to the thermocouple.

#### IMPORTANT

As you wire the thermocouples, be sure to connect a single chassis ground wire to the mounting screw for the terminal block. See Figure 12.

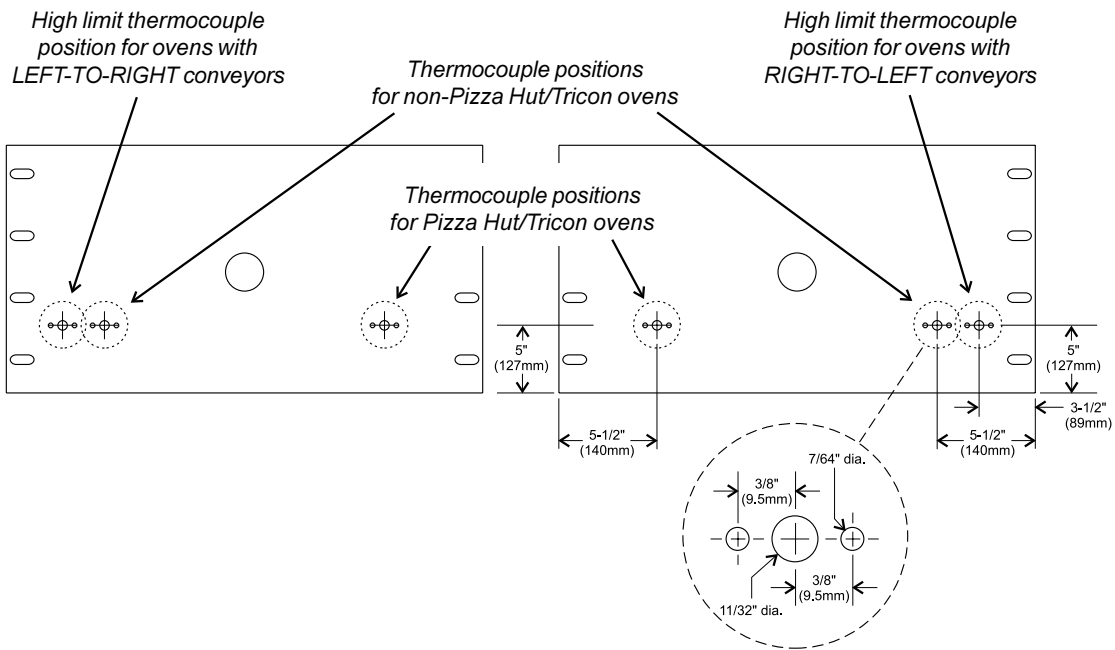
A good ground connection for the thermocouple's uninsulated lead is REQUIRED for proper operation!

16. If you will be replacing additional thermocouples, repeat Steps 7-15 as necessary.
17. Using the kit-supplied nylon clamps and #10-16 x 3/4" screws, secure the thermocouple leads to the back wall of the oven so that they will clear the shrouds, blower belts, and pulleys.
18. Replace the blower belts and cooling fans.
19. Close the blower motor compartment doors. Replace all shrouds onto the oven.

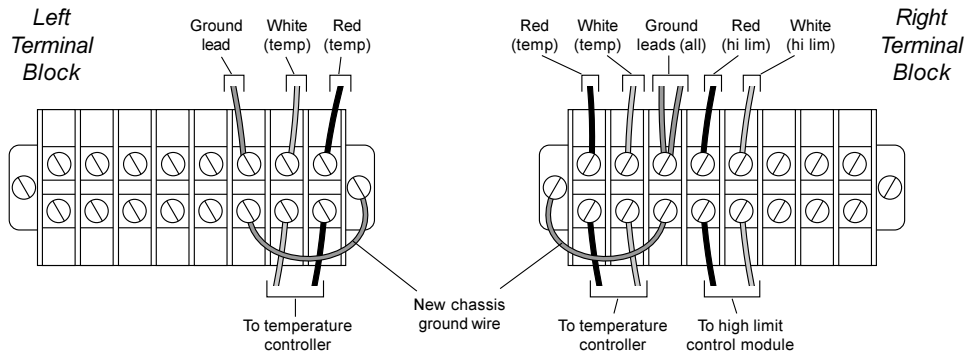


## Appendix - Instructions for Service Kits 33984 and 33985 - Oven Thermocouple Kit, 11/01

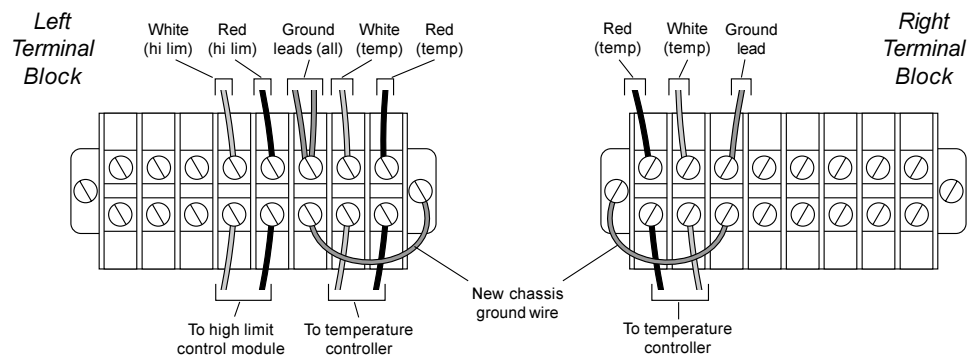
**Figure 11**  
Location of New Thermocouple Mounting Holes - PS570, PS570S



**Figure 12a**  
Thermocouple Wiring - PS570 and PS570S (early) after thermocouple update - Left to Right Conveyor



**Figure 12b**  
Thermocouple Wiring - PS570 and PS570S (early) after thermocouple update - Right to Left Conveyor



## Appendix - Instructions for Service Kits 33984 and 33985 - Oven Thermocouple Kit, 11/01

### PS570S (late) - rear wall thermocouples with left-side AND right-side terminal block connections

Thermocouples on these ovens are located on the rear wall and are secured in place by two screws that are inserted through the holes in the thermocouple flange.

Most of these ovens have either three or four thermocouples, all installed in the back wall of the oven. The thermocouple at the extreme exit end of the oven is the high limit thermocouple, while all other thermocouples send their signals to the digital temperature controller. The thermocouple supplied in this Kit can be used to replace ANY of the thermocouples on these ovens.

Some PS570S ovens are equipped with only two thermocouples. In these ovens:

- The thermocouple on the right side of the oven has two leads and sends its signal to the temperature controller.
- The thermocouple on the left side of the oven is a dual-function unit. It has FOUR LEADS and sends individual signals to the temperature controller and the high limit control module.
- Installing this Kit will replace BOTH thermocouples with current three-lead versions located on the back wall of the oven. The Kit also requires the installation of a THIRD thermocouple to act as a high limit sensor. Because of this, **you will need three separate thermocouple kits for these ovens.**

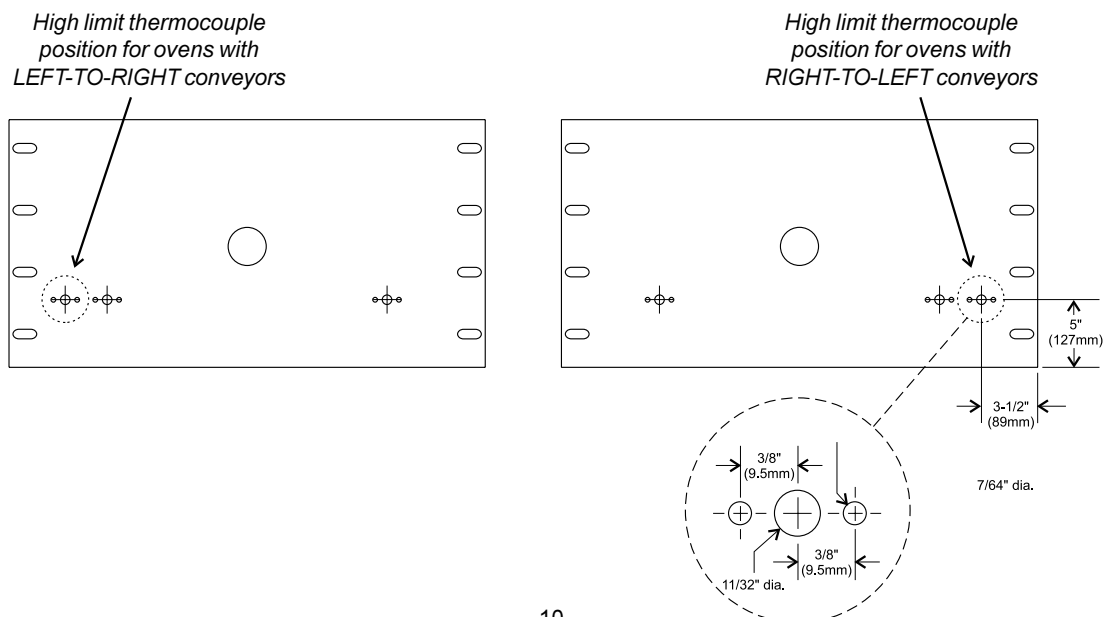
1. Remove the rear shrouds and open the blower motor compartment doors. This allows access to the thermocouples (on the rear wall) and terminal blocks (inside the blower motor compartments).

2. Remove the screws that hold the thermocouple to the wall. Slide the thermocouple out of its mounting hole.
3. Disconnect the thermocouple leads. Remove and discard the thermocouple.
4. **Perform Step 4 ONLY if you are installing a high limit thermocouple and no mounting hole is present. This would be the case if the oven formerly used a four-lead thermocouple to send a signal to the high limit control module.**

**Temperature-sensing thermocouples for these ovens should be installed in the two existing thermocouple mounting holes.**

- Refer to Figure 13. Measure and scribe marks in the rear wall of the oven for drilling the high limit thermocouple mounting hole. Make sure that your measurements begin at the edges of the rear panels, and NOT the outer edges of the oven!
- Drill the new high limit thermocouple mounting hole using an 11/32" (8.73mm) D x 8" (203mm) L bit. Be sure to drill through all three walls of the oven.
- Drill the two screw mounting holes for the high limit thermocouple using a 7/64" (2.78mm) bit. Tap the holes using a #6-32 tap.
- If necessary, remove the end plugs and air fingers from the oven to access the areas around the new high limit thermocouple mounting hole.
- Vacuum out ALL drill shavings. If the oven is equipped with a screen over the openings for the lower air fingers, use a flexible hose extension on the vacuum to reach the shavings through the upper air finger openings.
- Reinstall the air fingers and end plugs onto the oven.

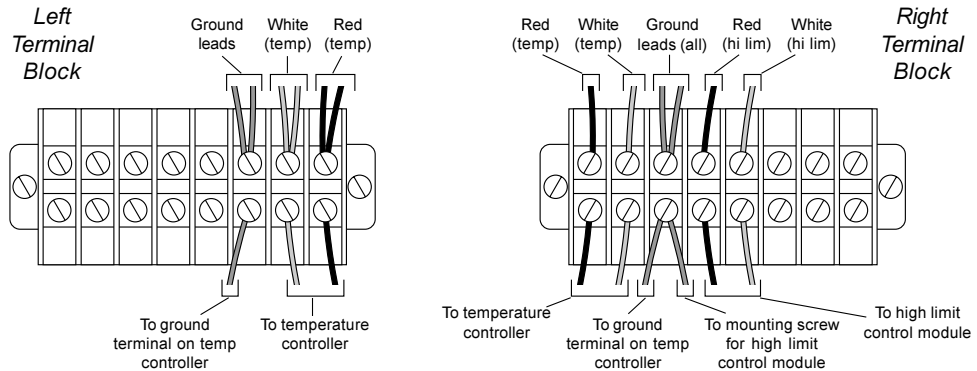
Figure 13  
Location of High Limit Thermocouple Mounting Hole - PS570S



10

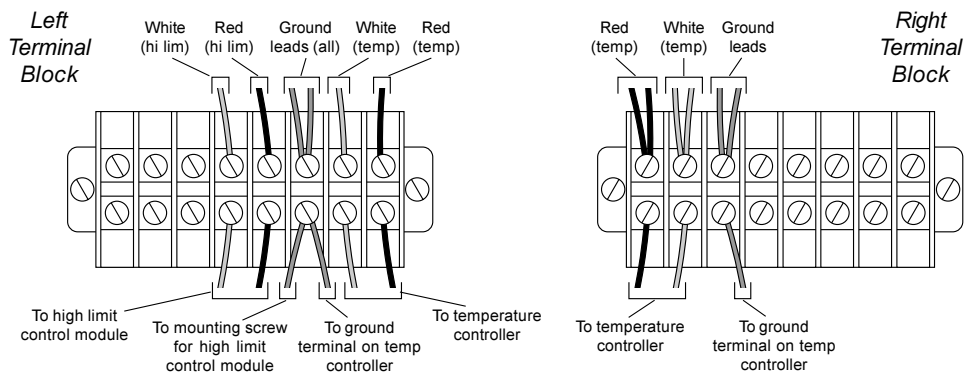
## Appendix - Instructions for Service Kits 33984 and 33985 - Oven Thermocouple Kit, 11/01

**Figure 14a**  
Thermocouple Wiring - PS570S (Late) - Left to Right Conveyor



NOTE: This configuration shows leads for three temperature-sensing thermocouples - two on the left side, and one on the right. Ovens with only two temperature-sensing thermocouples will have a single set of leads on the left terminal block, instead of the two sets that are shown.

**Figure 14b**  
Thermocouple Wiring - PS570S (Late) - Right to Left Conveyor



NOTE: This configuration shows leads for three temperature-sensing thermocouples - two on the right side, and one on the left. Ovens with only two temperature-sensing thermocouples will have a single set of leads on the right terminal block, instead of the two sets that are shown.

5. Install the new thermocouple into its mounting hole. Fasten it in place with the supplied #6 x 3/8" screws.
6. Wire the thermocouple as shown in Figure 14. The thermocouples should be wired to the terminal block inside the blower motor compartment closest to the thermocouple.
7. If you will be replacing additional thermocouples, repeat Steps 2-6 as necessary.
8. Use the kit-supplied nylon clamp and #10-16 x 3/4" screw to secure the thermocouple leads so that they will clear the shrouds, blower belts, and pulleys.
9. Close the machinery compartment and blower motor compartment doors. Replace all shrouds onto the oven.

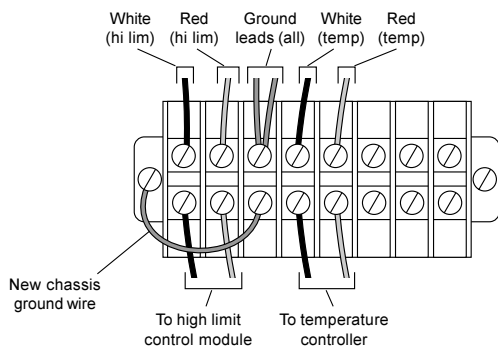
**IMPORTANT**

As you wire the thermocouples, check that ground leads run from the terminal blocks inside the blower motor compartments to BOTH the temperature controller AND the high limit control module, as shown in Figure 14.

If the ground leads to the front compartment of the oven are NOT present - for example, on an oven that previously used the older-style 2-lead or 4-lead thermocouples - it is acceptable to use a single chassis ground wire to the mounting screw for the terminal block. See Figure 15.

A good ground connection for the thermocouple's uninsulated lead is REQUIRED for proper operation!

**Figure 15**  
Alternate ground lead wiring  
Use ONLY if ground leads to front compartment are not present.



## Appendix - Instructions for Service Kits 33984 and 33985 - Oven Thermocouple Kit, 11/01

### PS555G and PS570G rear wall thermocouples with left-side terminal block connections

Thermocouples on these ovens are located on the rear wall. They are secured in place by two screws that are inserted through the holes in the thermocouple flange. The ovens are equipped with a three-lead, flanged thermocouple identical to the one in this Kit.

**NOTE FOR HIGH LIMIT THERMOCOUPLES:**

These ovens have a high limit thermocouple installed in the last mounting hole at the exit end of the oven.

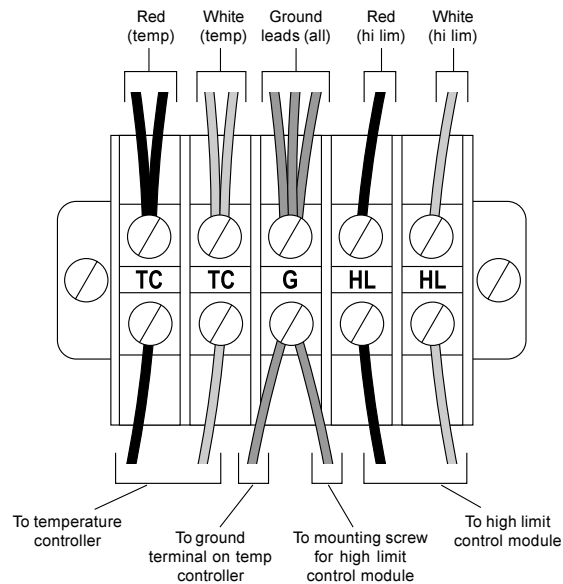
The thermocouple supplied in this Kit can be used to replace ANY of the temperature-sensing or high limit thermocouples on the oven.

1. Remove the rear shrouds. Then, remove the cover over the left blower motor. This allows access to the thermocouples on the rear wall, and to the terminal block inside the blower motor compartment.

Note that the thermocouples on these ovens are all connected to the terminal block inside the left blower motor compartment. It is not necessary to access the right blower motor compartment.

2. Remove the screws that hold the thermocouple to the wall. Slide the thermocouple out of its mounting hole.
3. Disconnect the thermocouple leads from the terminal block. Remove and discard the thermocouple.
4. Install the new thermocouple into its mounting hole. Fasten it in place with the supplied #6 x 3/8" screws.
5. Wire the thermocouple as shown in Figure 16. Note that the terminals are labeled - "TC" for temperature-sensing thermocouple leads, "G" for ground leads, and "HL" for high limit thermocouple leads.
6. Use the kit-supplied nylon clamp and #10-16 x 3/4" screw to secure the thermocouple leads so that they will clear the shrouds, blower belts, and pulleys.
7. Replace all shrouds onto the oven.

Figure 16  
Thermocouple Wiring - PS555G and PS570G



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SECTION 3 - SERVICING COMPONENTS

V. BLOWERS

A. PS200-series ovens

All PS200 ovens are equipped with one 1/3hp blower motor. The motor indirectly drives a pulley on the shaft of the blower fan with a fan belt.

Two main designs exist for the PS200 indirect fan drive assembly:

- Early design, used through 6/90. This design used 1/2" (12.7mm) bore flange mount bearings and a 1/2" (12.7mm) diameter blower fan shaft. See Figure 25.
- Current design, used 7/90 and later. This design uses 5/8" (15.9mm) pillow block bearings and a 5/8" (15.9mm) diameter blower fan shaft. See Figure 26.

Blower motors on both versions are rated for 208-240V, single-phase, and are protected by:

- A built-in thermal overload protection device.
- Two 9A fuses on the inside of the machinery compartment door. Fuse location is shown in Figure 27.

In addition, the blower fan is protected by an air pressure safety switch that prevents the burner/heating elements from activating if the fan is not rotating. See *Air Pressure Safety Switch* on Page 81.

1. Part number reference

*Early version components*

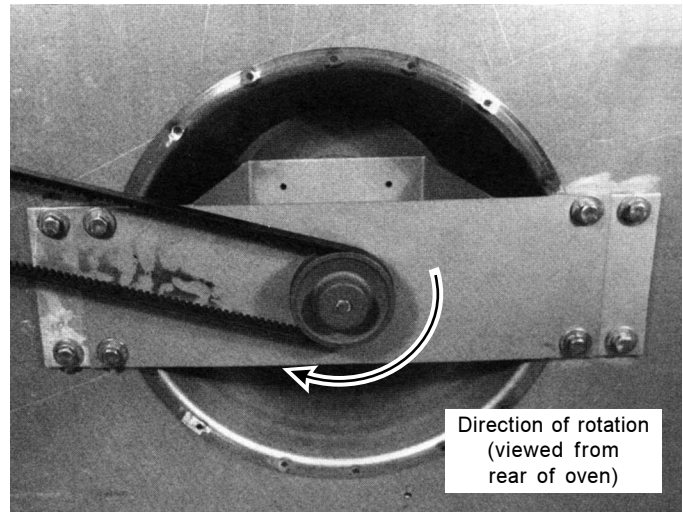
NOTE: If an early-version PS200-series oven has a failed fan shaft, upgrade the oven to the current drive assembly using Kit P/N 49810-0121.

Part Number	Description
22230-0072	Pulley, 1/2" / 12.7mm bore
22071-0019	Bearing, 1/2" / 12.7mm bore, flange mount
37900-0094	Fan shaft alignment tool (early)
27381-0066	Motor, 1/3 hp, 200-240V, 50/60Hz, 1 Ph
22181-0034	Fan belt

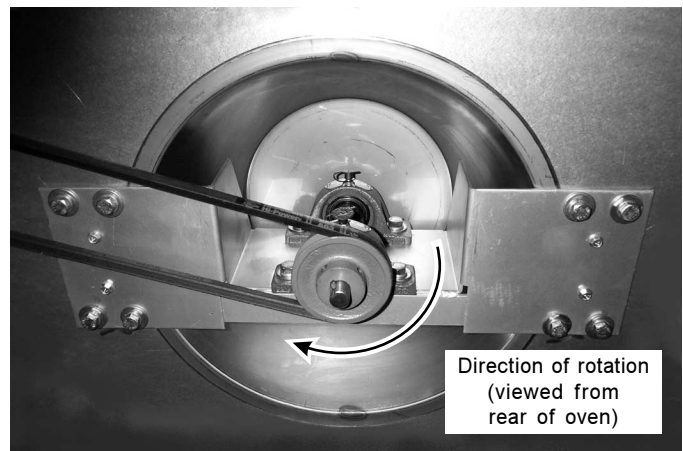
*Current version components*

Part Number	Description
35900-0232	Shaft, blower fan
22230-0073	Pulley, 5/8" / 15.9mm bore
22072-0025	Bearing, 5/8" / 15.9mm bore, pillow block mount
27399-0003	Blower fan, 16" / 0.4m diameter
37900-0106	Fan shaft alignment tool (current)
49810-0121	Indirect drive upgrade kit (upgrades early-style version to current version)
49810-0018	Fan shaft service kit (includes 2 bearings, 1 shaft, and alignment tool)
27381-0066	Motor, 1/3 hp, 200-240V, 50/60Hz, 1 Ph
22181-0034	Fan belt

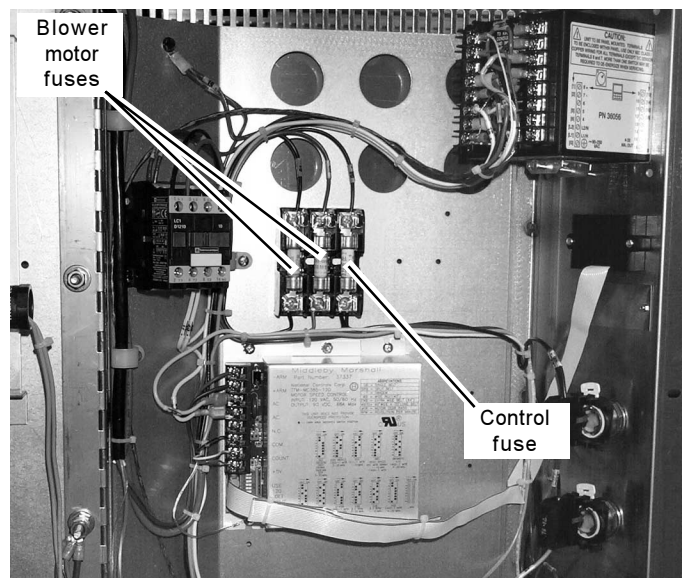
**Figure 25**  
Early-style PS200 indirect drive assembly



**Figure 26**  
Current PS200 indirect drive assembly



**Figure 27**  
Blower motor fuses



## 2. Blower balancing and direction of rotation

Proper blower rotation is extremely important. From the rear of the oven, the blower shaft pulley should turn in a clockwise direction. See Figures 25 and 26.

All blower fans are balanced at the factory. Any fan found to be out of balance should be replaced. Vibration from an out-of-balance fan can cause poor baking and premature bearing failure. Note that vibrations can also be caused by other sources, including defective motor or blower shaft bearings, loose bearings or motor mounting bolts, or an incorrectly tensioned fan belt.

## 3. Lubricating the blower fan shaft bearings

**IMPORTANT:** Middleby uses two different types of grease in blower shaft bearings:

- DuPont Krytox® grease is used in some PS536 ovens. Refer to Service Bulletin MM-192 (included in the *Appendices* section of this chapter) for details on identifying Krytox® bearings.
- All other ovens use the standard Middleby high-temperature grease, P/N 17110-0015.

Mixing grease types within the bearing will cause the bearing to seize. For all PS200 ovens, be sure to use **ONLY** the standard Middleby grease.

**NOTE:** Middleby recommends lubricating the blower fan shaft bearings every three months.

Use a grease gun to lubricate the main blower fan shaft bearings. See Figure 28. When lubricating the bearings:

- Use a high-quality NLGI #2, lithium soap grease with petroleum oil, such as Middleby P/N 17110-0015.
- Add the grease slowly until a small bead of grease is present at the seals. AVOID OVERGREASING. Excessive greasing may cause harm to the bearing.

Manually turn the blower shaft by pulling on the belt to purge the grease. Wipe off any excess grease. The oven cannot be operated until the rear shroud is replaced.

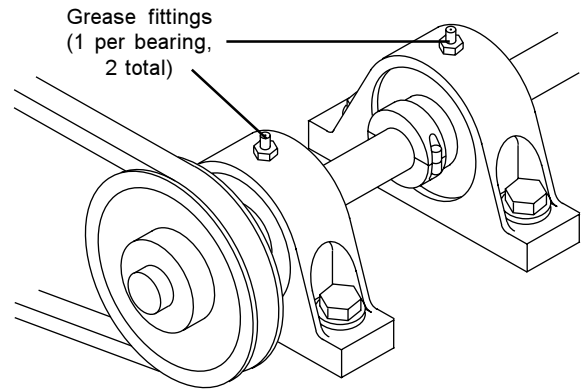
## 4. Blower belt tension

**NOTE:** Middleby recommends checking the blower belt condition and tension every three months.

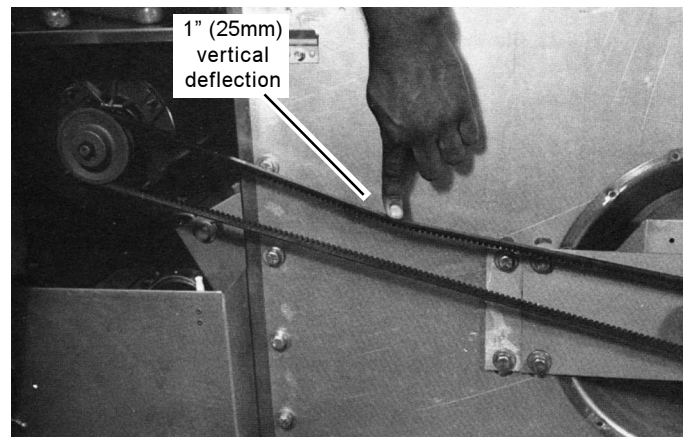
Check the blower belt for at least 1" (25mm) deflection at the center, and for cracking or excessive wear. Overtightening the belt will cause premature bearing failure and possible vibrations. See Figure 29.

If necessary, adjust the tension of the belt by loosening the two motor mounting bolts as shown in Figure 30. Reposition the motor as necessary until the correct deflection is reached, then tighten the bolts.

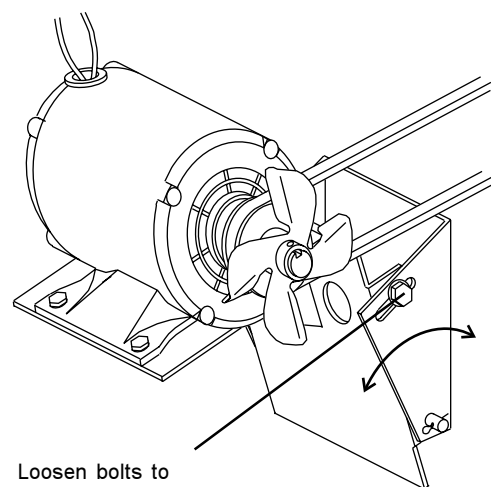
**Figure 28**  
**Bearing lubrication**



**Figure 29**  
**Blower belt tension**



**Figure 30**  
**Repositioning the blower motor**



Loosen bolts to reposition motor and adjust belt tension

## SECTION 3 - SERVICING COMPONENTS

### 5. Early-style PS200 bearing replacement and alignment

**NOTE:** This procedure is for early-style indirect fan shaft assemblies only, as shown in Figure 25. Bearing replacement procedures for the current-style indirect fan shaft assembly (Figure 26) are provided on Page 72.

**IMPORTANT:** Before attempting any repair on the early-style PS200 Indirect Fan Drive Assembly:

- If you need to perform any maintenance more involved than replacing and aligning the shaft bearings, you should upgrade the fan shaft assembly to the current version.
- Check the front and rear brackets (Item 6 in Figure 32). If the brackets ARE NOT welded together, you should upgrade the fan shaft assembly to the current version.

In either of these cases, you can upgrade the fan shaft assembly using Service Kit P/N 49810-0121. See *Part Number Reference* on Page 68 for details.

The following procedures are necessary to align the fan shaft whenever service to the fan shaft or replacement of the bearings is required. REFER TO FIGURE 32 FOR ILLUSTRATIONS OF THE COMPONENTS DESCRIBED HERE.

1. Remove the entire back wall (Item 1) of oven to service the fan assembly.
2. Remove the blower fan (Item 13) and pulley (Item 8).

**NOTE:** If parts are to be replaced, you should replace them now.

3. When installing the Drive Bracket Assembly (Item 5) insert one 3/8" flat washer (Item 4) at the 4 outer holes and one 3/8" special flat washer (Item 14) at the 4 inner holes between bracket and back wall at mounting locations. Use eight 3/8"-16 x 1" screws (Item 2) and assemble a 3/8" lockwasher (Item 3) and a 3/8" flat washer (Item 4) onto each screw. Insert a screw at all 8 locations, hand tighten only at this time.
4. Install front and rear fan shaft flange bearings (Item 10), if they were removed, to Indirect Drive Bracket (Item 6) using three 1/4-20 x 3/4" screws (Item 11) and three 1/4" lockwashers (Item 12) on each bearing.

**IMPORTANT:** The bearings (10) must be mounted so the grease fitting faces up when the bracket assembly (Item 5) is mounted on the rear wall.

**NOTE:** Do not tighten flange bearing block screws until Step 10 has been completed.

9. Install the fan shaft as shown in Figure 32. Align bearing set screws with flats on shaft but do not tighten set screws at this time.
10. Insert fan shaft alignment tool (Item 15) into back wall as shown in Figure 31.

**NOTE:** The bracket assembly is designed for slight up and down and right to left movement to attain free shaft rotation when the shaft alignment tool is in place. Once free shaft rotation is achieved, tighten all eight bracket screws (Item 2).

11. Tighten rear flange bearing block screws (Item 11) then front flange bearing block screws.
12. Remove shaft alignment tool, then recheck fan shaft for free rotation.
13. Install pulley (Item 8) on fan shaft and position fan shaft per the dimensions shown in Figure 32. Align the two flats per bearing which are machined on fan shaft for the bearing set screws. Use High Temperature Loctite, RC 620 on bearing set screws and then tighten set screws. Recheck fan shaft for free rotation.
14. Apply anti-seize compound on fan shaft before installing fan blade (Item 13). Position fan blade per dimension shown in Figure 32.
15. Apply High Temperature Loctite Type RC 620 to fan blade set screws.

**NOTE:** Tighten the two set screws on fan blade per the following sequence when viewing fan blade from front: first, the screw at the 12:00 position, then the screw at the 3:00 position.

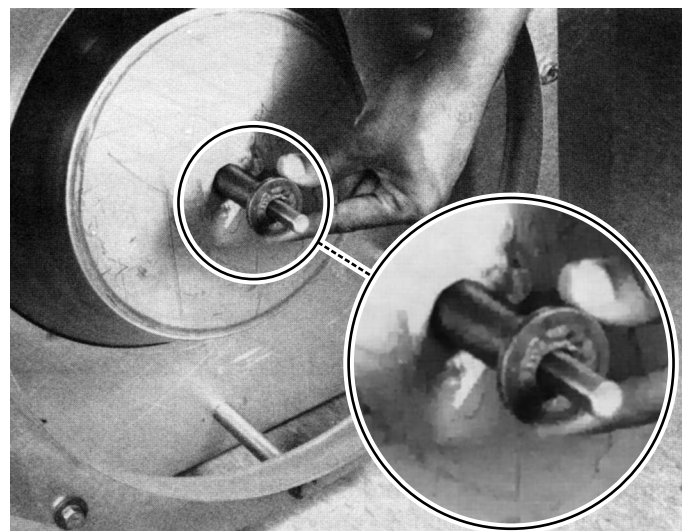
16. Recheck fan shaft rotation before installing back wall to oven cavity.

**NOTE:** Apply anti-seize compound (MM P/N 17110-0017) to all 12 bolts before installing back wall assembly to oven.

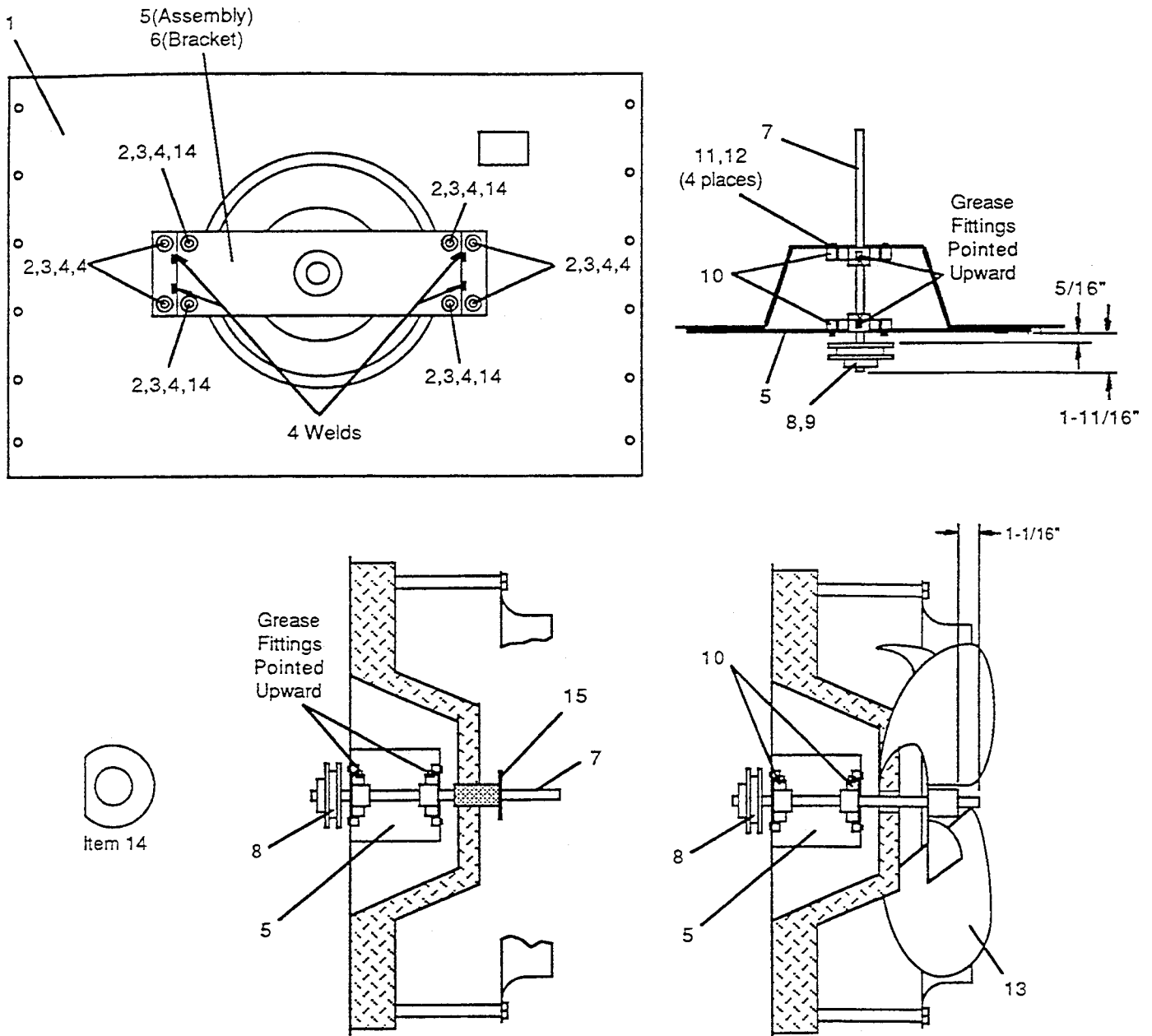
17. Install back wall on oven.
18. Install fan belt.

**NOTE:** Excessive fan belt tension will create overloading of rear bracket fan shaft bearing. Refer to *Blower Belt Tension* on Page 69.

**Figure 31**  
**Fan shaft alignment tool**



**Figure 32**  
**Bearing replacement and alignment - early-style PS200 fan shaft assembly**



Item	Qty.	Part Number	Description
1	1	Not available	Back Wall Assembly
2	8	21216-0001	Screw, Hex Cap SS 3/8-16x1"
3	16	21422-0001	Lock Washer, Split 3/8"
4	20	21416-0001	Flat Washer, SS 3/8"
5	1	Not available	Indirect Fan Drive Bracket Assembly
6	1	Not available	Bracket, Indirect Drive
7	1	Not available	Shaft, Fan Drive
8	1	22230-0072	Pulley, 1/2" Bore

Item	Qty.	Part Number	Description
9	1	21651-0008	Square Key 1/8"
10	2	22071-0010	Flange Bearing, 5/8" Bore
11	6	21211-0004	Screw, Hex Cap 1/4-20 x 3/4"
12	6	21421-0016	Lock Washer, Split 1/4"
13	1	Not available	Blower Fan, 16" Dia.
14	4	21419-0004	Flat Washer 3/8" SS Special
15	1	37900-0094	Fan Shaft Alignment Tool

**IMPORTANT:** If parts listed as "Not Available" require replacement, use Service Kit 49810-0121 to upgrade the fan shaft assembly to the current version.



## SECTION 3 - SERVICING COMPONENTS

### 6. Current-style PS200 bearing replacement and alignment

**NOTE:** This procedure is for current-style indirect fan shaft assemblies only, as shown in Figure 26. Bearing replacement procedures for the early-style indirect fan shaft assembly (Figure 25) are provided on Page 70.

The following procedures are necessary to align the fan shaft whenever service to the fan shaft or replacement of the bearings is required. REFER TO FIGURE 34 FOR ILLUSTRATIONS OF THE COMPONENTS DESCRIBED HERE.

1. Remove the entire back wall (Item 1) of oven to service the fan assembly.
2. Remove the blower fan (Item 11) and pulley (Item 7).
3. Remove the indirect drive bracket assembly (Item 5) by removing eight (8) screws (Item 2). If you are upgrading from the early-style assembly, save the hardware (Items 2, 3, 4, and 12) to be reused with the new style bracket (Item 5).

**NOTE:** If parts are to be replaced, you should replace them now.

4. Install front and rear fan shaft pillow block bearings (Item 9), if they were removed, to indirect drive bracket (Item 5) using two (2) 3/8-16 X 1" screws (Item 2) and two 3/8" lockwashers (Item 10) on each bearing.

**NOTE:** Do not tighten the pillow block bearings until Step 7 has been completed.

5. Install the fan shaft (Item 6) as illustrated in Figure 34. Align bearing set screws with flats on shaft but do not tighten set screws at this time.

**NOTE:** Before proceeding to Step 6, it is advisable to position the rear wall assembly in an upright, vertical position using a block of wood under the fan ring.

6. When installing the drive bracket (Item 5) insert one 3/8" flat washer (Item 4) at the four outer holes and one 3/8" special flat washer (Item 12) at the 4 inner holes between the bracket and back wall at the mounting locations. Use eight 3/8-16 X 1" screws (Item 2) and assemble a 3/8" lockwasher (Item 3) and a 3/8" flat washer (Item 4) into each screw. Insert a screw at all 8 locations. Hand tighten only at this time.

7. Insert fan shaft alignment tool (Item 13) as shown into back wall.

**NOTE:** The bracket assembly is designed for slight up and down and right to left movement to attain free shaft rotation when the shaft alignment tool is in place. Once free shaft rotation is achieved, tighten all eight bracket screws (Item 2).

8. Tighten rear pillow block bearing screws (Item 9) then front pillow block bearing screws.
9. Remove shaft alignment tool, then recheck fan shaft for free rotation.
10. Install pulley (Item 7) on fan shaft and position fan shaft per dimension shown in Figure 34. Align the flats machined on fan shaft with the bearing set screw holes. Apply High Temperature Loctite, type RC 620 on bearing set screws and then tighten set screws. Recheck fan shaft for free rotation.
11. Apply anti-seize compound on fan shaft before installing fan blade (Item 11). Position fan blade flush with 5/8" shoulder on shaft as called out in Figure 34.

**NOTE:** Fan blade hub has a 1/2" bore. The fan shaft is turned down from 5/8" to 1/2" to receive fan blade.

12. Apply High Temperature Loctite Type RC 620 to fan blade set screws.

**NOTE:** Tighten the two set screws on fan blade per the following sequence when viewing fan blade from front: first, the screw at the 12:00 position, then the screw at the 3:00 position.

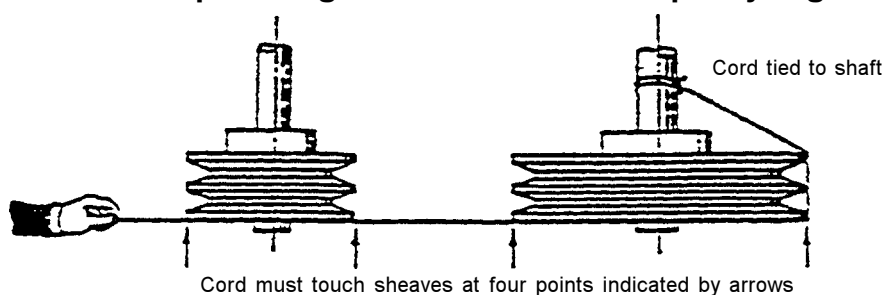
13. Recheck fan shaft rotation before installing back wall to oven cavity. Be sure fan assembly has adequate clearance inside orifice ring and is not rubbing.

**NOTE:** Apply anti-seize compound (MM P/N 17110-0017) to all 12 bolts before installing back wall assembly to oven.

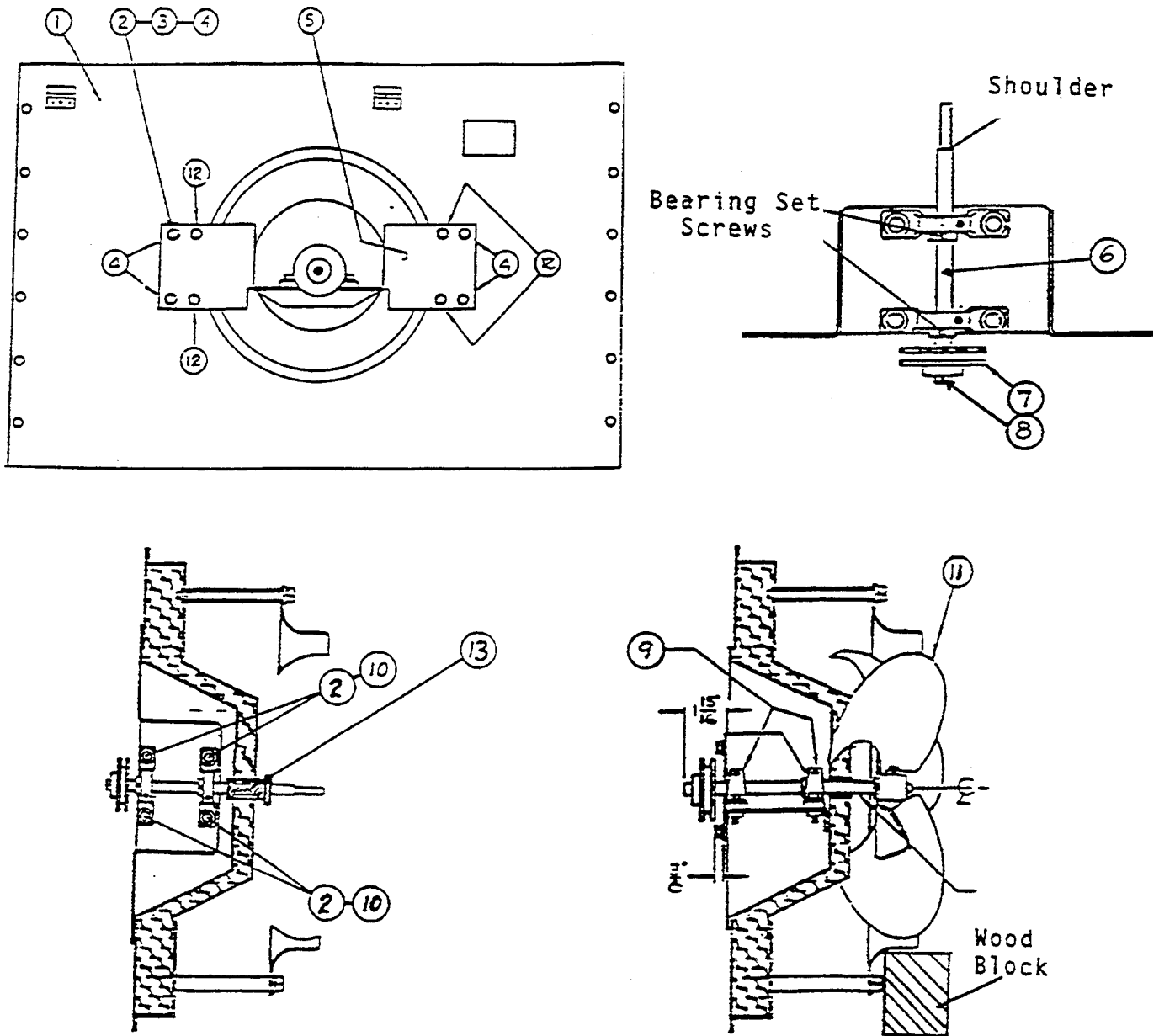
14. Install back wall on oven.
15. Check motor pulley and fan pulley alignment. See Figure 33.
16. Install fan belt.

**NOTE:** Excessive fan belt tension will create overloading of rear bracket fan shaft bearing. Refer to *Blower Belt Tension* on Page 69.

**Figure 33 - Four-point alignment test for correct pulley alignment**



**Figure 34**  
**Bearing replacement and alignment - current-style PS200 fan shaft assembly**



Item	Qty.	Part Number	Description
1	1	37900-0068	Back Wall Assembly
2	16	21216-0001	Screw, Hex Cap SS 3/8-16x1"
3	16	21422-0001	Lock Washer, Split 3/8"
4	12	21416-0001	Flat Washer, SS 3/8"
5	1	37900-0101	Bracket, Indirect Drive
6	1	35900-0232	Shaft, Fan Drive
7	1	22230-0073	Pulley, 5/8" Bore
8	1	21651-0008	Square Key 3/16"
9	2	22072-0025	Pillow Block Bearing, 5/8" Bore
10	4	21422-0001	Lock Washer, Split 1/4"

Item	Qty.	Part Number	Description
11	1	27399-0003	Blower Fan, 16" Dia.
12	4	21419-0004	Flat Washer 3/8" SS Special
13	1	37900-0106	Fan Shaft Alignment Tool

**Also available:**

--	--	49810-0018	Fan Shaft Service Kit Includes Qty. 2 of Item 9 and Qty. 1 ea. of Items 6 and 13.
--	--	49810-0021	Fan Shaft Upgrade Kit Includes parts and instructions to update early-style fan shaft assembly to the current version shown here.

SECTION 3 - SERVICING COMPONENTS

**B. PS360-series ovens**

All PS360-series ovens are equipped with two blower motors.

- All gas ovens have motors rated at 230V, single-phase.
- All electric ovens built before 8/02 have three-phase motors.
- All electric ovens built 8/02 or later that operate on a supply voltage of 208-240V have single-phase motors.
- All electric ovens built 8/02 or later that operate on supply voltages above 240V have three-phase motors.

Blower motors are protected by:

- A built-in thermal overload protection device.
- For ovens with single-phase blower motors: Two 9A fuses. Fuse location is shown in Figure 35.
- For ovens with three-phase blower motors: Three 5A fuses. Fuse location is shown in Figure 36.

In addition, each motor contains a centrifugal safety switch that prevents the burner/heating elements from activating if either motor is not operating. See *Blower Motor Centrifugal Safety Switch* on Page 80.

The blower wheel is directly connected to the motor shaft. A heat slinger, also mounted on the motor shaft, helps to keep heat away from the motor bearings. If the motor is stopped when the temperature in the compartment is over 180°F/82°C, the bearings can be damaged.

1. Part number reference

**Blower motors**

Part Number	Description
27381-0023	1 Ph, 1/3 hp (PS310, -314, -360, -360S)
27381-0024	3 Ph, 1/3 hp (PS310, -314, -360)
27381-0054	1 Ph, 1/4 hp (PS360Q)
27381-0075	1 Ph, 1/2 hp (PS360WB)
31432	1 Ph, 1 hp (PS360EWB, -WB70)

**Blower wheels**

Part Number (clockwise)	Part Number (counter-clockwise)	Description
22523-0002	22523-0003	9-3/16" / 233mm dia. (PS310, -314, -360, -360Q, -360S, -360WB)
35603	35604	9-1/8" / 232mm dia. (PS360EWB)
36014	36015	8-1/4" / 210mm dia. (PS360EWBQ)
31599	31600	9-7/8" dia. / 251mm (PS360WB70)

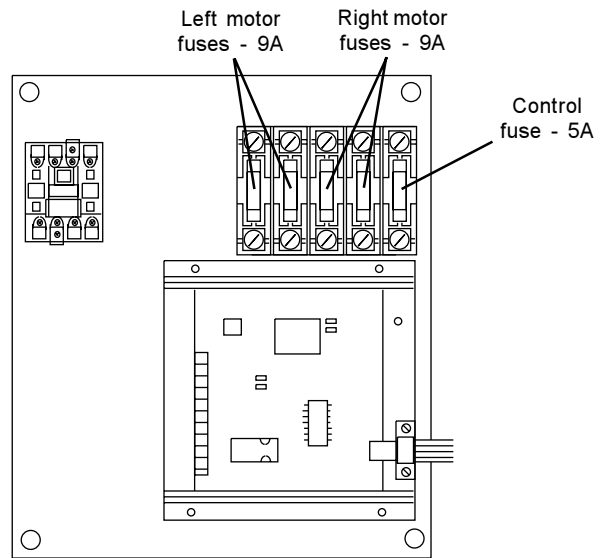
**Other components**

Part Number	Description
27396-0005	Heat slinger
42400-0101	Blower wheel puller tool

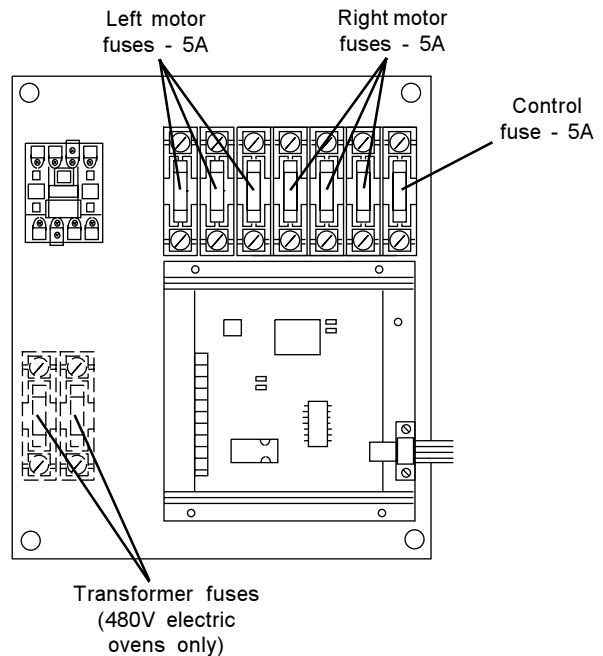
2. Blower balancing

All blower wheels are balanced at the factory. Any blower wheel found to be out of balance should be replaced. Vibration from an out-of-balance wheel can cause poor baking and premature motor bearing failure. Note that vibrations can also be caused by other sources, including defective motor bearings and loose motor mounting bolts.

**Figure 35**  
**Blower motor fuses - single-phase motors**



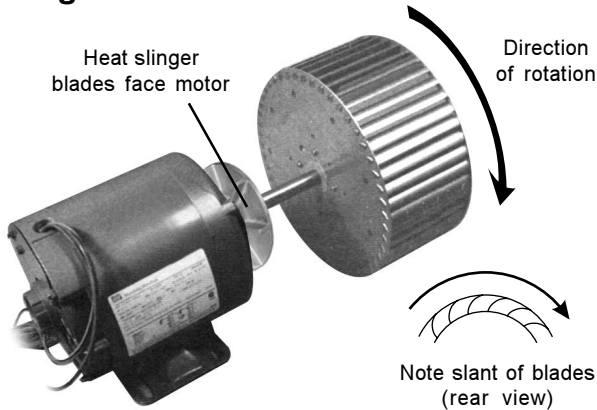
**Figure 36**  
**Blower motor fuses - three-phase motors**



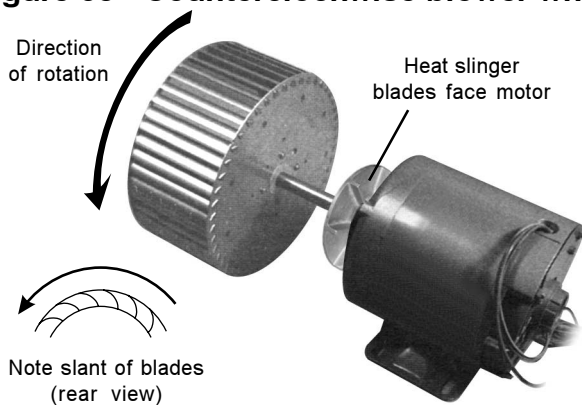
3. Direction of blower rotation

Proper blower rotation is extremely important. Blower rotation is determined by viewing the motor and wheel from the REAR of the motor (or from the open end of the oven). See Figures 37-39.

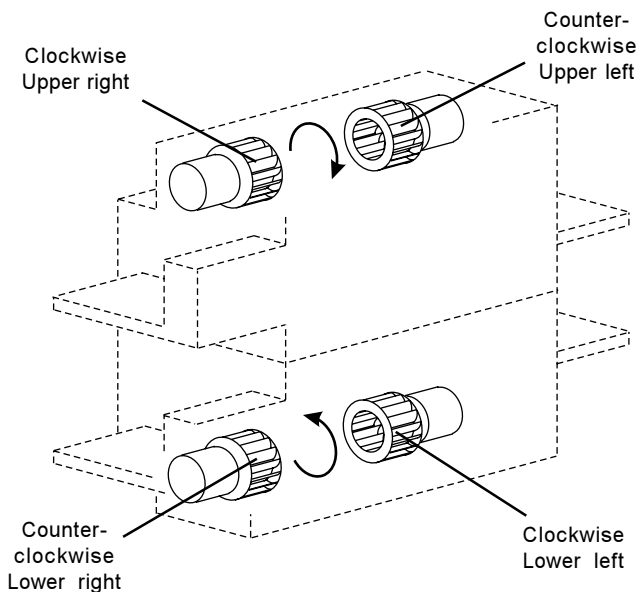
**Figure 37 - Clockwise blower wheel**



**Figure 38 - Counterclockwise blower wheel**



**Figure 39 - Blower wheel placement  
Shown from rear of oven**



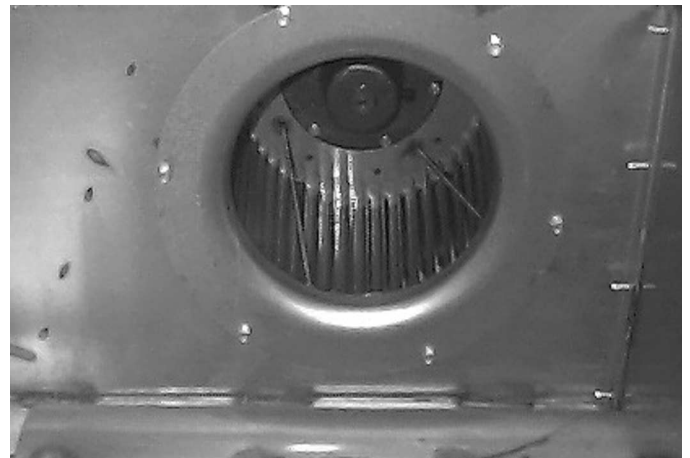
4. Removing the blower wheels

To change a motor or blower wheel, the wheel must first be removed from inside the oven as follows:

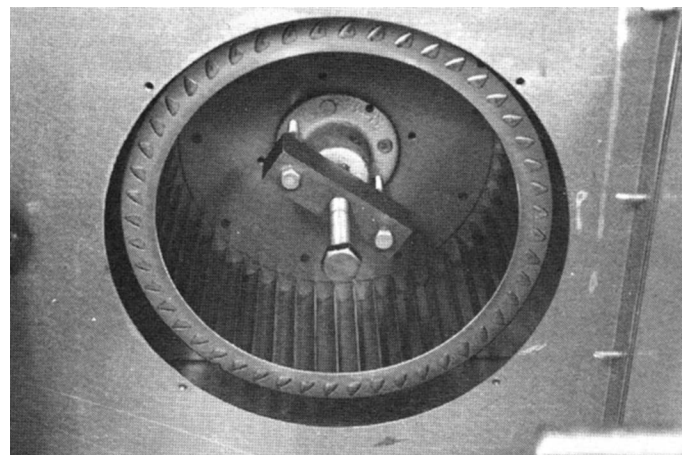
- Remove the end plugs and conveyor assembly.
- From inside the oven cavity, reach into the blower recess and remove the inlet rings. See Figure 40.
- Loosen the set screw on the blower wheel hub and remove the blower wheel. A special wheel puller tool (P/N 42400-0101) is available for this purpose. See Figure 41.

**IMPORTANT:** Before installing the new wheel, apply an anti-seize lubricant (Middleby P/N 17110-0017) to the motor shaft and the inside of the blower wheel hub.

**Figure 40  
Inlet ring**



**Figure 41  
Blower wheel puller tool**



## SECTION 3 - SERVICING COMPONENTS

### A. PS555/570-series ovens

All PS555/570-series ovens are equipped with two 1hp blower motors. Each motor indirectly drives a pulley on the shaft of a blower wheel with a fan belt.

Two main designs exist for the PS555/570 blower fan system:

- PS570/570S design. In this version, the pillow block bearings for the blower wheel shaft were mounted upright, on brackets that were parallel to the fan belts. See Figure 42.
- PS555/570G design. In this version, the pillow block bearings are mounted with the grease fittings pointing in towards the center of the oven. See Figure 43.

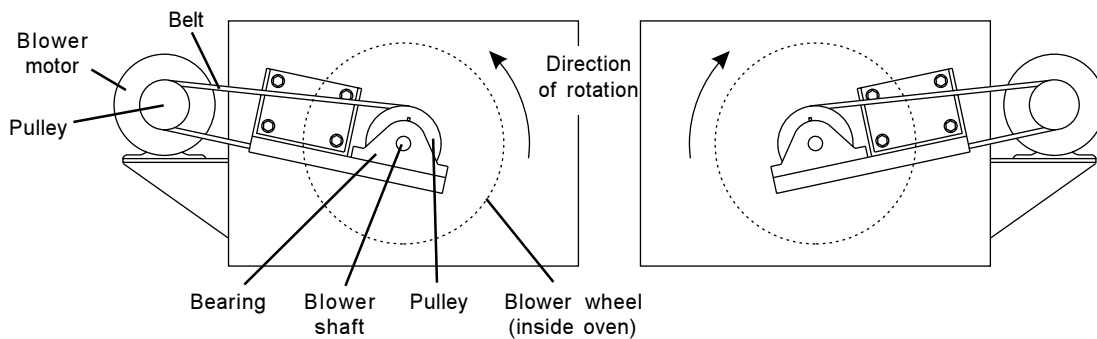
The two designs share many common parts, including blower wheels, motors, and bearings. From a service standpoint, the major difference is the size of the pulleys and the length of the belts.

Blower motors on all PS555/570-series ovens are rated for 208-240V, single-phase, and are protected by:

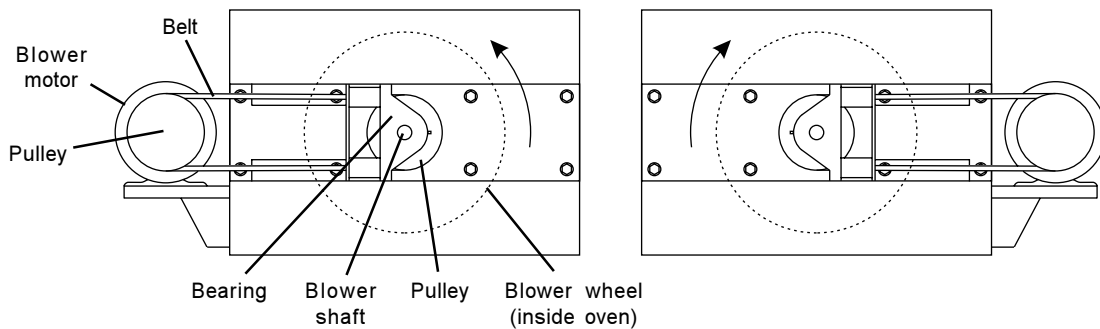
- A built-in thermal overload protection device.
- Two 15A fuses or 15A circuit breakers. Refer to Figure 44 for the location of the fuses/breakers.

In addition, each blower fan is protected by an air pressure safety switch that prevents the burner/heating elements from activating if the fan is not rotating. See *Air Pressure Safety Switch* on Page 81.

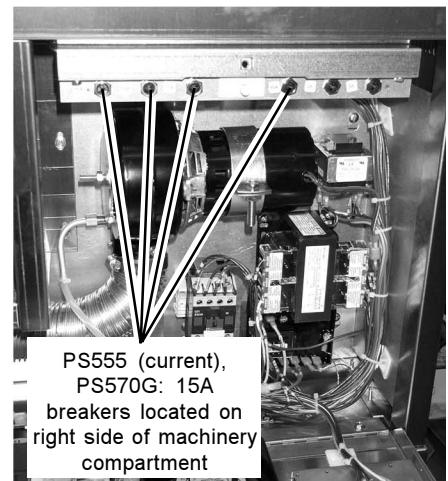
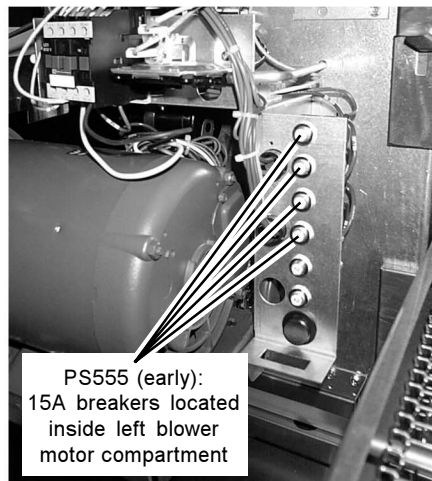
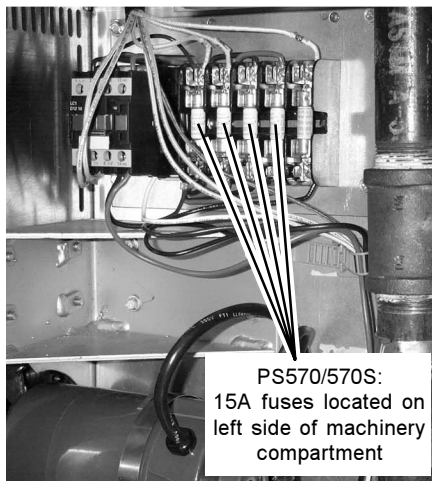
**Figure 42 - PS570/570S blower configuration**



**Figure 43 - PS555/570G blower configuration**



**Figure 44 - Fuse/circuit breaker locations**



## SECTION 3 - SERVICING COMPONENTS

## 1. Part number reference

<i>Part Number</i>	<i>Description</i>
27381-0069	Motor, 1 hp, 208-240V, 50/60 Hz, 1 Ph
22521-0005	Blower wheel, clockwise (right end of PS570; left end of PS555, PS570S, PS570G)
22521-0006	Blower wheel, counterclockwise (left end of PS570; right end of PS555, PS570S, PS570G)

<i>Part Number</i>	<i>Description</i>
22072-0026	Bearing, pillow block, 1" / 25.4mm bore (PS570)
22072-0017	Bearing, pillow block, 1-7/16" / 36.5mm bore (PS570S)
35210-0251	Blower shaft, 1" dia. (PS570)
35210-0506	Blower shaft, 1-7/16" dia. (PS570S)
41899	Blower shaft, 1-7/16" dia. (PS555 or PS570G)

<i>Application</i>	<i>Oven model</i>	<i>Hz</i>	<i>Blower Pulley</i>		<i>Motor Pulley</i>		<i>Belt</i>		<i>Blower RPM</i>
			<i>Part No.</i>	<i>Desc.</i>	<i>Part No.</i>	<i>Desc.</i>	<i>Part No.</i>	<i>Desc.</i>	
<b>Standard</b>	PS570	60	22230-0084	BK52	30476	BK47	22181-0037	-	-
	PS570S	60	22230-0087	BK47H	30476	BK47	46744	BX55	1780 RPM
	PS570S	50	22230-0087	BK47H	22230-0086	BK55	46745	BX56	1733 RPM
	PS570G	60	39587	BK70	44977	BK70	46452	BX67	1780 RPM
	PS555/ 555G/555E	60	39587	BK70	39586	BK80	44946	BX61	2080 RPM
<b>Pizza Hut USA</b>	PS570S	60	22230-0087	BK47H	22230-0086	BK55	46745	BX56	1733 RPM
	PS570S High Altitude	60	22230-0087	BK47H	39910	BK62	44963	BX58	2300 RPM
	PS570G	60	39587	BK70	39586	BK80	46453	BX68	2057 RPM
	PS570G High Altitude	60	39587	BK70	46455	BK90	46454	BX70	2300 RPM
<b>Pizza Hut Intl. (Tricon)</b>	PS570S	60	22230-0087	BK47H	22230-0086	BK55	46745	BX56	1733 RPM
	PS570G	60	39587	BK70	39586	BK80	46453	BX68	2057 RPM
	PS555G	50	39587	BK70	42984	BK95H	47044	BX62	2020 RPM
	PS555E	50	39587	BK70	22031-0001 bushing	39586	BK80	44946	BX61
<b>Domino's "Q"</b>	PS570S	60	22230-0087	BK47H	45796	BK45	46744	BX55	1692 RPM
	PS570G	60	39587	BK70	47267	BK65	46452	BX67	1692 RPM
	PS555G	60	39587	BK70	39910	BK62	44963	BX58	1580 RPM
<b>Papa John's</b>	PS555G	60	39587	BK70	39910	BK62	44963	BX58	1580 RPM

**NOTE:** If a particular customer/oven model combination is not listed (for example, Pizza Hut PS555G), use the "Standard" information.

SECTION 3 - SERVICING COMPONENTS

2. Blower balancing and direction of rotation

Proper blower rotation is extremely important. Proper blower rotation is shown in Figure 45.

Early PS570 blower wheels were positioned so that the open end of the wheel faced into the baking chamber. This was changed on the PS570S (and all later models) to improve airflow. Note that this also means that on early PS570 ovens the counterclockwise wheel is moved to the left side of the oven, and the clockwise wheel moved to the right side, so that the wheel blades point in the same direction. This is reflected in the *Part Number Reference* information on Page 77.

All blower wheels are balanced at the factory. Any blower wheel found to be out of balance should be replaced. Vibration from an out-of-balance wheel can cause poor baking and premature bearing failure. Note that vibrations can also be caused by other sources, including defective motor or blower shaft bearings, loose bearings or motor mounting bolts, or an incorrectly tensioned fan belt.

3. Lubricating the blower shaft bearings

**IMPORTANT:** Middleby uses two different types of grease in blower shaft bearings:

- DuPont Krytox® grease is used in some PS536 ovens. Refer to Service Bulletin MM-192 (included in the *Appendices* section of this chapter) for details on identifying Krytox® bearings.
- All other ovens use the standard Middleby high-temperature grease, P/N 17110-0015.

Mixing grease types within the bearing will cause the bearing to seize. For all PS555/570-series ovens, be sure to use **ONLY** the standard Middleby grease.

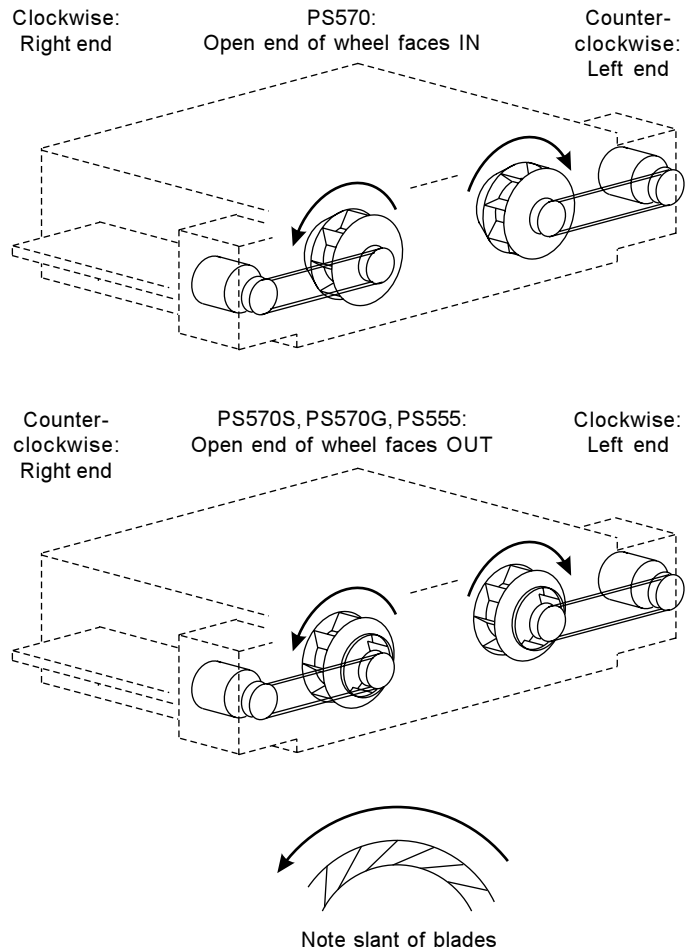
**NOTE:** Middleby recommends lubricating the blower fan shaft bearings every three months.

Use a grease gun to lubricate the main blower fan shaft bearings. See Figure 46. When lubricating the bearings:

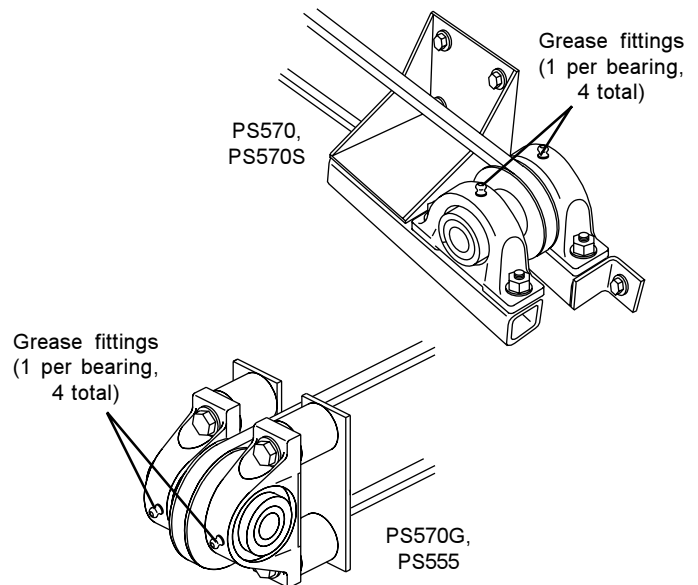
- Use a high-quality NLGI #2, lithium soap grease with petroleum oil, such as Middleby P/N 17110-0015.
- Add the grease slowly until a small bead of grease is present at the seals. **AVOID OVERGREASING.** Excessive greasing may cause harm to the bearing.

Manually turn the blower shaft by pulling on the belt to purge the grease. Wipe off any excess grease. The oven cannot be operated until the rear shroud is replaced.

**Figure 45**  
**PS500-series blower wheel orientation**



**Figure 46**  
**Bearing lubrication**



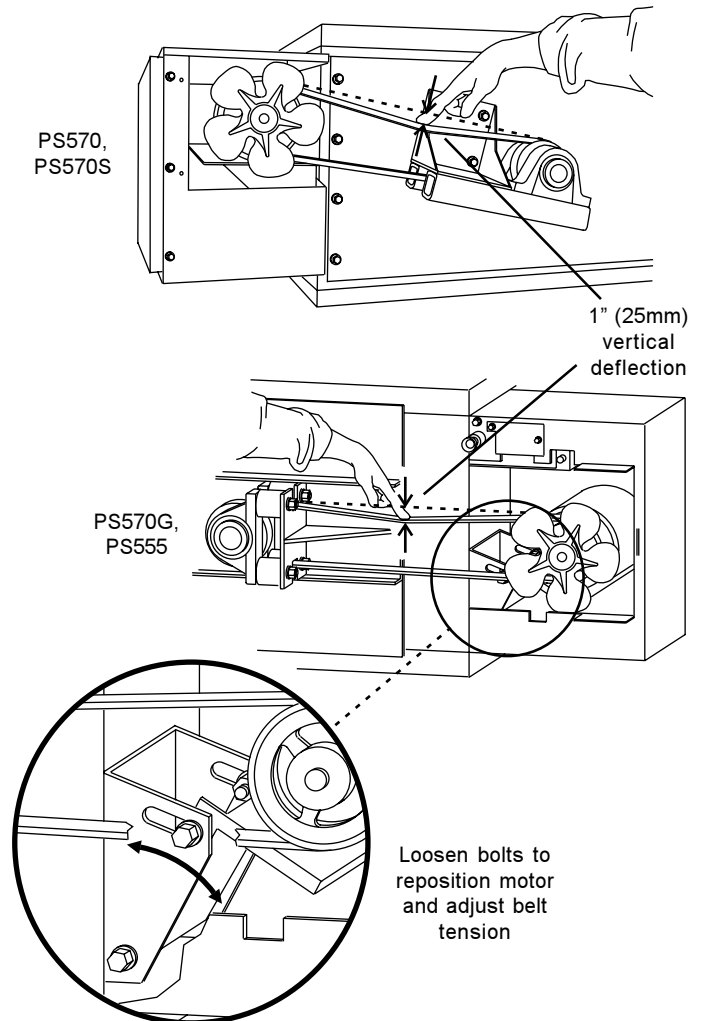
## 4. Blower belt tension

**NOTE:** Middleby recommends checking the blower belt condition and tension every three months.

Check the blower belt for at least 1" / 25mm deflection at the center, and for cracking or excessive wear. Overtightening the belt will cause premature bearing failure and possible vibrations. See Figure 47.

If necessary, adjust the tension of the belt by loosening the two motor mounting bolts as shown in Figure 47. Reposition the motor as necessary until the correct deflection is reached, then tighten the bolts.

**Figure 47**  
**Blower belt tension and repositioning the blower motor**



## 5. Bearing replacement and alignment

Whenever service to the blower shaft or replacement of the bearings is required, the shaft will need to be aligned.

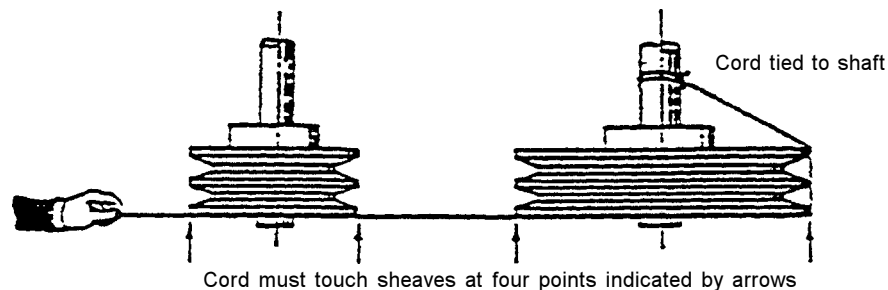
**NOTE:** Apply anti-seize compound (MM P/N 17110-0017) to all bolts before installing back wall assembly to oven.

First, reassemble the back wall components, but **DO NOT TIGHTEN THE HEX BOLTS** that hold the bearings to their mounting brackets. Leaving the bearings loose allows the pulleys to be aligned.

Next, check the alignment of the pulleys using a cord as shown in Figure 48. Reposition the bearings as required to align the blower shaft, then tighten the hex bolts to hold the shaft in place.

Replace the belts and rear shrouds after the pulleys are properly aligned.

**Figure 48 - Four-point alignment test for correct pulley alignment**





## SECTION 3 - SERVICING COMPONENTS

### VI. BLOWER MOTOR CENTRIFUGAL SAFETY SWITCH (PS360-SERIES)

Middleby ovens have a safety feature that prevents the burner/heating elements from activating if the blower(s) are not in operation. On PS360-series ovens, this feature is controlled by a centrifugal switch mounted inside each blower motor. If either motor is not operating, the burner/heating elements cannot activate.

The centrifugal switch is a normally-closed (NC) limit switch mounted inside the rear of each blower motor. See Figure 49. When the motor is not running, the centrifugal switch weight holds the switch open. As the motor reaches full speed, the weight moves away from the switch permitting the contacts to close. When the switch contacts of BOTH blower motors are closed, the heat circuit is completed, allowing the burner/heating elements to activate.

If a blower motor is not operating, the switch will not close and the circuit remains open, preventing burner/heating element activation.

#### A. Part Number Reference - Blower Centrifugal Switch

On all PS360-series blower motors, the centrifugal switch can be replaced with switch P/N 27270-0144.

#### B. Troubleshooting

1. To access the switch, remove the rear motor wiring cover plates. See Figure 49.
2. When the switch is operating properly, both sides of the brown wires coming from the switch should be "hot" when the motor is at full RPM.
3. No adjustment can be made to the switch. If it is not operating properly, it must be replaced.

### VII. BURNER BLOWER MOTOR CENTRIFUGAL SAFETY SWITCH (PS200-SERIES GAS, PS310, PS314, PS360, PS360WB, PS570S)

Middleby gas ovens with a 120V burner blower motor have a centrifugal safety switch that prevents burner activation if the burner blower motor is not in operation. This includes:

- Most PS360-series ovens (except PS360WB70 and PS360EWB);
- PS200-series gas ovens (except units produced with the modulating gas system);
- All Model PS570S ovens.

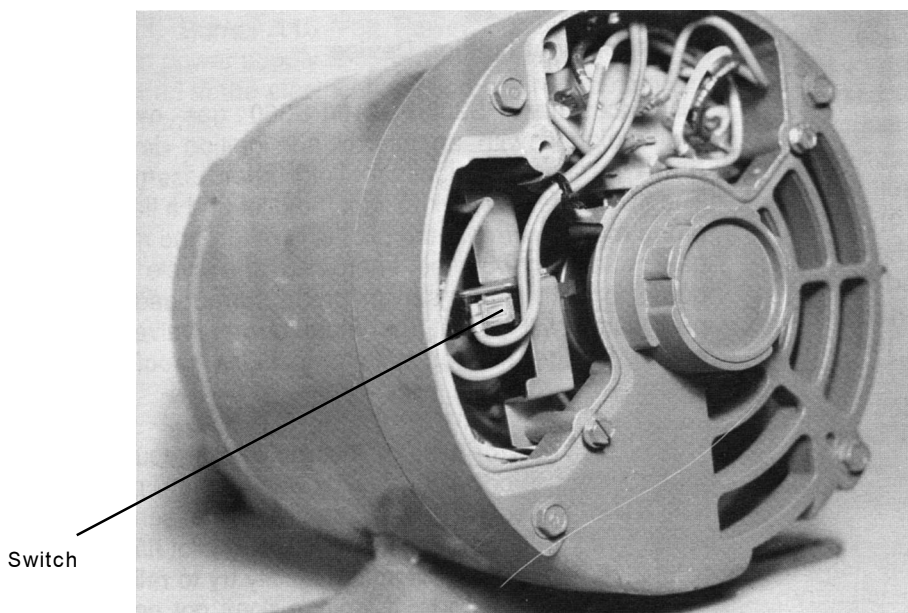
Ovens with a 208/240V burner blower motor use a separate air pressure safety switch to prove motor operation. See *Air Pressure Safety Switch* on Page 81.

The centrifugal switch is a normally-closed (NC) limit switch mounted inside each blower motor. When the motor is not running, the centrifugal switch weight holds the switch open. As the motor reaches full speed, the weight moves away from the switch permitting the contacts to close. This completes the heat circuit, allowing the burner to light.

If the burner blower motor is not operating, the switch will not close and the circuit remains open, preventing burner activation.

No adjustment can be made to the switch. If it is not operating properly, the burner blower motor must be replaced.

**Figure 49 - PS360-series blower motor centrifugal safety switch**



**VIII. AIR PRESSURE SAFETY SWITCH (PS200-SERIES, PS555/570-SERIES, PS360EWB, PS360WB70)**

Middleby ovens have a safety feature that prevents the burner/heating elements from activating if the blower(s) are not in operation. On PS200-series ovens and PS555/570-series ovens, this feature is controlled by a separate air pressure switch that reads air flow from the blower. One switch is used for each blower (1 for the PS200-series, 2 for the PS555/570 series).

These ovens cannot use a centrifugal switch on the motor because they use an indirect, belted drive system. If a belt fails, it is possible for the motor to operate normally while the blower itself is stopped.

In addition, gas ovens with a line-voltage burner blower motor use an identical air switch to check that the burner blower motor is operating before burner activation. These ovens include the PS360EWB, PS360WB70, PS555, PS555G, and PS570G, as well as PS200-series ovens equipped with the modulating gas system. This additional air switch is not necessary on ovens with a 120V burner blower motor

because of the presence of a centrifugal air switch inside the motor housing (see Section VII, *Burner Blower Motor Centrifugal Safety Switch*, on the previous page).

The switch is an assembly that includes a normally-open microswitch and a diaphragm. When the blower is at speed, pressure is applied to the diaphragm which in turn closes the microswitch. This completes the heat circuit, allowing the burner/heating elements to activate.

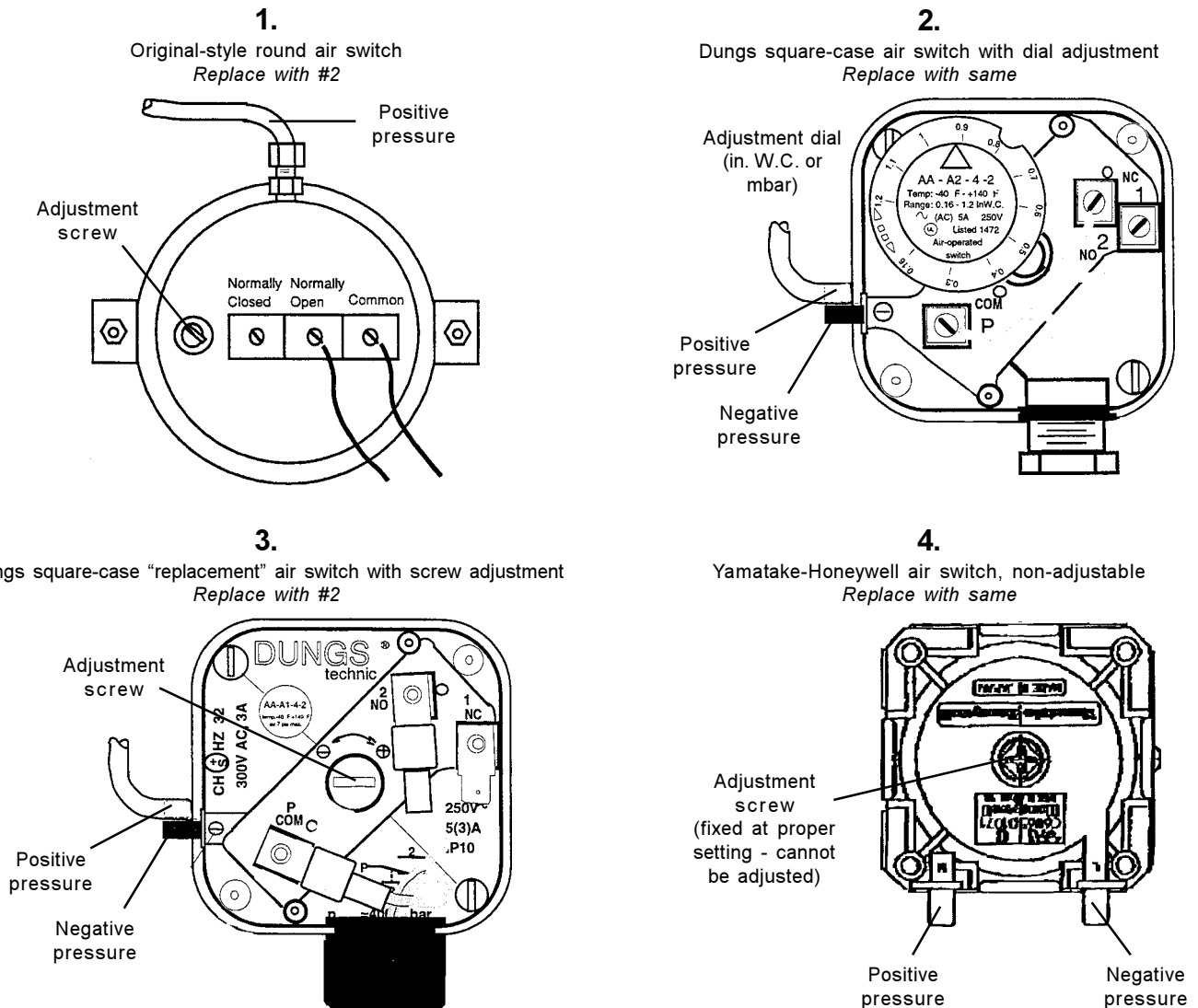
If a blower is not operating, the microswitch receives no signal from the diaphragm and cannot close, preventing burner/heating element activation.

**A. Part Number Reference - Air Switches**

Middleby has used four different types of air switches for these applications. See Figure 50.

When replacing one of these switches, note that the "current" Yamatake-Honeywell air switch (#4 below) cannot be used as an upgrade for an older switch. If you are replacing Switches #1, #2 or #3 as shown in Figure 50, you should use the Service Kits described for Switch #2.

**Figure 50 - Air pressure safety switch models**



## SECTION 3 - SERVICING COMPONENTS

1. Original-style round air switch with screw adjustment (P/N 28023-0005)

This was the standard switch used through 9/96 and is no longer available. If it must be replaced, use Kit P/N 35624 (for use in the USA) or 35625 (for export use). See #2 below for a description of these kits.

2. Dungs square-case air switch with dial adjustment

This was the standard switch used from 9/96 through 1/02. It cannot be upgraded to the current Yamatake-Honeywell octagonal switch, and so should still be used as a service replacement. EXCEPTION: PS570G and all PS555 ovens have used the Yamatake-Honeywell switch throughout their production run (see #4 below).

Two different models were used; one for domestic ovens, and another for export ovens. The switches are identical except for the markings on the dial. The domestic unit measures pressure in water column inches (in. W.C.), while the export unit measures pressure in millibars (mbar).

- Domestic switch: Kit P/N 35624
- Export switch: Kit P/N 35625.

3. Dungs square-case "alternate" air switch with threaded screw-type adjustment (P/N 36194)

This switch was used on a limited number of domestic production ovens in early 1997 to cover an availability problem with the standard switch (see #2 above). Markings were in water column inches (in. W.C.). An export version of this switch was never used.

This switch was never available as a service part. If it must be replaced, use Kit P/N 35624 (see #2 above).

4. Yamatake-Honeywell air switch, non-adjustable

This switch is the current standard for all new-production Middleby ovens. You may NOT use this switch as an upgrade on an oven equipped with an older switch.

Two different models are used; one for domestic and standard export ovens, and another for CE-approved ovens.

- Domestic switch: P/N 39530
- CE-version switch: P/N 37498

If this switch must be replaced, use an identical switch. Note that this is the **ONLY** time that you may use P/Ns 39530 and 37498 as service replacement parts.

### B. Troubleshooting

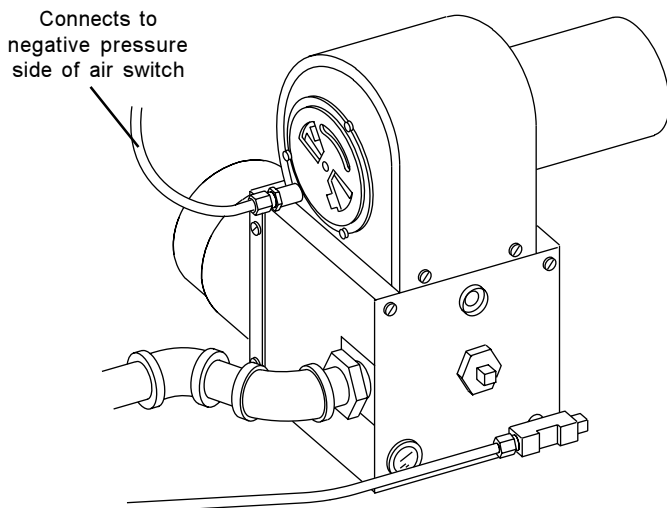
1. Positive pressure vs. negative pressure

All air switches except the original round version can sense either positive air pressure or negative air pressure. The connection that is actually made to the switch depends on the application.

- If the switch is used to detect blower operation, the tip of the pitot tube is located outside of the blower wheel. This means that the pressure applied to the end of the tube is positive. Because of this, the tube should be connected to the positive side of the switch.
- If the switch is used to detect burner blower operation, check the type of burner used on the oven.
  - The Midco burner, used **ONLY** on some PS360EWB and PS360WB70 ovens, has its pitot tube mounted inside the blower wheel. For correct operation, you should attach the tube to the **NEGATIVE** side of the switch. Refer to Figure 51 for an illustration of the Midco burner.
  - For ovens with the standard Wayne burner, the pitot tube is mounted outside the blower wheel. For correct operation, you should attach the tube to the **POSITIVE** side of the switch. Note that some PS360EWB and PS360WB70 ovens use the Wayne burner. You should always check the type of burner installed into the oven before connecting the air tube. Refer to Figure 52 for an illustration of a typical PS360WB70/EWB gas train with the Wayne burner.

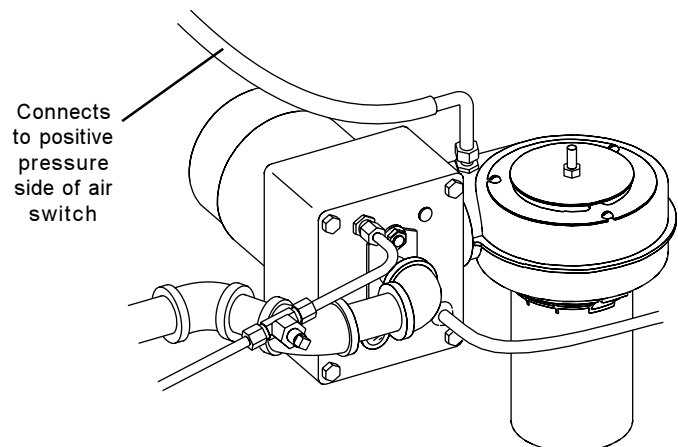
**Figure 51**

**PS360WB70/EWB with Midco burner**



**Figure 52**

**PS360WB70/EWB with Wayne burner**



C. Appendices **Appendix - Instructions for Service Kits 35624 and 35625 -  
Air Pressure Switch Replacement Kits, 1/97**

p/n 35623, Sheet 1 of 2,  
R: 0197

**SERVICE KIT INSTALLATION INSTRUCTIONS  
Air Pressure Switch Replacement Kit**

**Air Pressure Switch Replacement Kit Parts List**

Part Name	Qty	Kit p/n	Kit p/n
		35624	35625
		Part Number	
Air Pressure Switch	1	32102 (In. per WC)	31462 (mbars)
Flexible Plastic Tubing	15"	22450-0297	22450-0297
Mounting Bracket	1	35900-0523	35900-0523
#8-32 x 3/4" Screw	2	21278-0002	21278-0002
#10-32 x 5/8" Screw	4	2000227	2000227
#10-32 Hex Nut	4	21126-0007	21126-0007
Kit Instruction Sheet	1	35623	35623

- Switch all oven controls to OFF. Switch OFF the electrical power supply to the oven at its main disconnect switch or circuit breaker. Turn off the main gas supply valve on the gas pipe line.
- Label each wire on the old Air Switch, identifying it with its terminal name. (The replacement Air Pressure Switch has the same terminal names, with the same functions.) Figure 1 shows the terminal names and locations for the old Air Switch.
- Detach the old Air Switch from its mounting by removing its mounting hardware, but do not remove any wires until you have labeled them as instructed in step 2.
- Observe whether the aluminum tubing from the oven connects to the front or rear fitting of the old Air Switch. Loosen the nut that fastens the aluminum tubing to the old Air Switch; disconnect the tubing.
- Disconnect the wire; complete the removal of the old Air Switch.
- Using a tubing cutter (or similar tool), cut the aluminum tubing near the bend where it connected to the old Air Switch (see Figure 1); remove and discard the cutoff section. Smooth the end of the tubing and make sure that the tubing interior is clean (not preventing air flow).
- Insert the end of the aluminum tubing about 1/2- to 3/4-inch (13 to 19 mm) into the kit's flexible plastic tubing, as shown in Figure 2.
- Position the kit's Mounting Bracket (used mainly in PS 200 ovens) so that the replacement Air Pressure Switch, when mounted, is near the location of the old Air Switch. Mark the locations of the holes for mounting the bracket. Drill each hole using a 11/64" (4.5mm) drill bit. Fasten the Mounting Bracket to the oven, using the four #10-32 screws and nuts, tightening them securely.
- Partially unscrew both screws fastening the clear plastic cover of the Air Pressure Switch, to allow removal of this cover. (The cover is removed in Figure 3.)
- Insert one #8-32 x 3/4" (19mm) screw into the lower right mounting hole (near the threaded coupling). Screw it partially into the lower-right threaded hole of the Mounting Bracket.

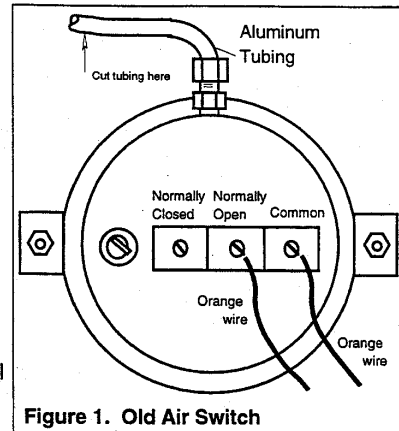


Figure 1. Old Air Switch

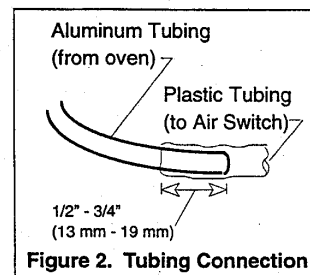


Figure 2. Tubing Connection

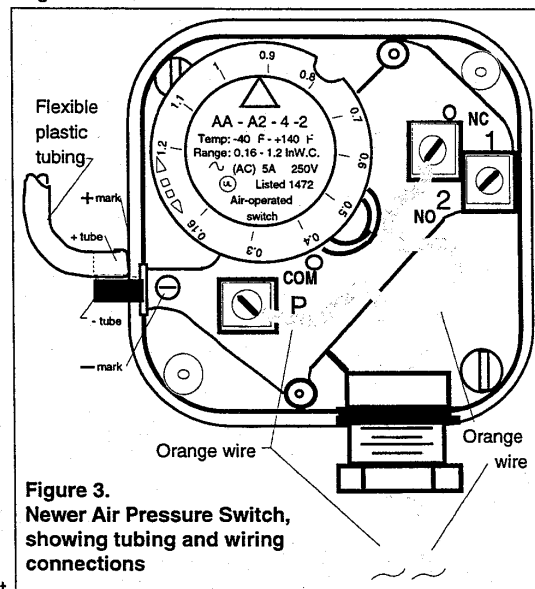


Figure 3.  
Newer Air Pressure Switch,  
showing tubing and wiring  
connections

(Continued on Sheet 2)

## Appendix - Instructions for Service Kits 35624 and 35625 - Air Pressure Switch Replacement Kits, 1/97

### Air Pressure Switch Replacment SERVICE KIT INSTALLATION INSTRUCTIONS (Continued)

p/n 35623, Sheet 2 of 2  
R: 0197

11. Insert the other #8-32 x 3/4" (19mm) screw into the upper left mounting hole (near the blue knob). Tighten both screws to fasten the Air Pressure Switch securely to the Mounting Bracket. (To allow screw-driver access to the screw head, turn the blue-labeled knob until its notch aligns with the mounting hole.)
12. Unscrew the Coupling Nut on the Air Pressure Switch. Remove the rubber washer and the metal washer inside the Threaded Coupling. Insert each of the two wires through the Coupling Nut, the rubber washer, the metal washer, and finally, through the Threaded Coupling of the Air Pressure Switch. Pull enough wire into the Air Pressure Switch for the electrical connections, as shown in Figure 3.
13. Connect the orange wire labeled "Common" to the switch terminal marked 'COM' (Common) and 'P' (Figure 3) by loosening the terminal screw and wrapping the wire around the threaded portion of the screw. Tighten the screw for a good electrical connection. Connect the wire labeled "Normally Open" to the switch terminal marked 'NO' (Normally Open) and '2', **OR**, if the wire is labeled "Normally Closed", connect that orange wire to the switch terminal marked 'NC' (Normally Closed) and '1', wrapping the wire around the threaded portion of the screw. Tighten the screw for a good electrical connection.
14. Bend the wires only enough to avoid sharp kinks or other interference as they exit the Air Pressure Switch. Slide the metal washer, rubber washer, and Coupling Nut up the wires and into the coupling hole on the Air Pressure Switch; screw the Coupling Nut finger-tight to hold the wires.
15. Adjust the setting of the dark rim around the blue center knob so that the white triangle is touching:
  - A. On an Air Pressure Switch with a UL symbol on the blue label, the 0.16 value; **OR**
  - B. On an Air Pressure Switch with a DIN symbol on the blue label, the 0.4 value.
16. Reinstall the clear plastic cover on the Air Pressure Switch; tighten both screws to fasten the cover to the body of the Air Pressure Switch.
17. Insert the free end of the plastic tubing onto one of the short tubes protruding from the side of the Air Pressure Switch (just below the blue knob), as follows:
  - A. The upper tube (*extending from the baseplate* of the Air Pressure Switch) is marked with a plus (+) sign on the baseplate. Connect the plastic tubing here (on the + tube) when the Air Pressure Switch is being activated by positive air pressure. In CE ovens, for example, the pressure inside the burner blower is positive. Figure 3 shows the tubing connection to the '+ tube.'
  - B. Connect the plastic tubing to the upper (+ mark) tube whenever the Air Pressure Switch is being activated by positive air pressure; for example, the pressure of an oven's plenum.

**NOTE:** Step C applies **ONLY** to **PS360WB70** and **PS360EWB** Ovens using Midco burners.

  - C. The lower tube (*extending out through a notch* in the Air Pressure Switch's clear plastic cover) is marked with a ⊖ (minus (-) sign inside a circle), inside the cover. Connect the plastic tubing here (- tube) when an Air Pressure Switch is activated by negative pressure; for instance, the pressure inside the burner blower on these ovens.
18. Close the compartment door (or panel) housing the Air Pressure Switch. Confirm that the oven is ready for operation.
19. Switch ON the main disconnect switch or the circuit breaker to apply electrical power to the oven. Turn on the main gas valve on the gas pipeline. Perform a normal oven startup procedure to confirm satisfactory operation.

## Appendix - Instructions to Replace an "Alternate" Air Switch P/N 36194 with Service Kit P/N 35624, 3/97

p/n 36226, Sheet 1 of 2,  
P: 0397

### ALTERNATE AIR PRESSURE SWITCH ADJUSTMENT INSTRUCTIONS

For about two weeks in early 1997, our supplier, Eclipse-Dungs Controls, was unable to supply Middleby Marshall with the 'Blue dial' Air Pressure Switch, p/n 32102. As an alternate to the 'blue-dial' Air Switch, they sent us the Air Pressure Switch, p/n 36194 (shown in Figure 1 with its clear plastic cover removed). The pressure setting adjustment mechanism for this alternate Air Pressure Switch is a threaded, white, plastic cap, with a slotted top for screwdriver adjustment.

When servicing an oven that has one (or more) of these alternate Air Pressure Switches, operate the oven in the following manner to determine whether the oven has a pressure-sensing problem:

1. Using the normal oven startup procedure (BLOWER switch turned ON; HEAT switch turned ON), adjust the temperature setpoint value on the Temperature Controller to 600°F(315°C). If the oven shuts down before reaching 600°F(315°C), remove the clear plastic cover of the Air Pressure Switch (by loosening the two Phillips-head screws attaching it).

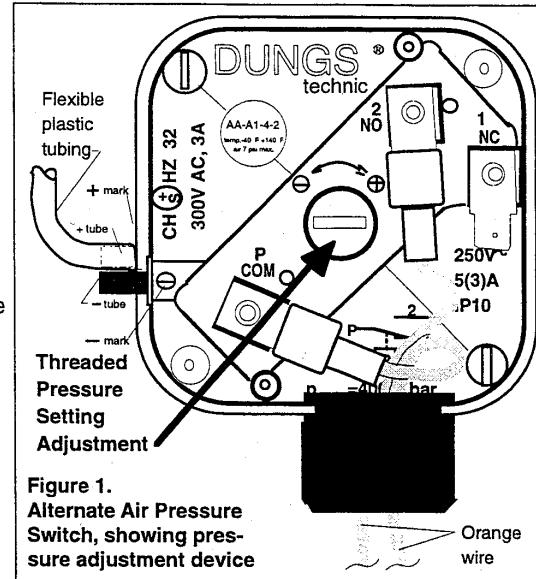


Figure 1.  
Alternate Air Pressure  
Switch, showing pres-  
sure adjustment device

**CAUTION:** Excessive or rapid turning of the Threaded Pressure Setting Adjustment may damage the switch or cause it to lose its calibration. **ALWAYS** adjust the Threaded Pressure Setting Adjustment **very slowly** and **carefully**. Do **NOT** turn the Threaded Pressure Setting Adjustment so that it is more than 1/16" (1.5mm) above or below the rim of its threaded housing.

Adjust the Threaded Pressure Setting Adjustment (Figure 1) *slowly counterclockwise* (in the direction of the arrow pointing to the ⊖ symbol) to keep the burner/heater operating until it reaches the 600°F(315°C) temperature set point.

2. Upon completing this adjustment process, reinstall the clear, plastic cover to the Alternate Air Pressure Switch.

NOTE: Instructions for replacing an inoperative Alternate Air Pressure Switch with a 'blue dial' Air Switch appear on sheet 2.

## Appendix - Instructions to Replace an "Alternate" Air Switch P/N 36194 with Service Kit P/N 35624, 3/97

p/n 36226, Sheet 2 of 2  
P: 0397

### ALTERNATE AIR PRESSURE SWITCH REPLACEMENT INSTRUCTIONS

Because the mounting of an Alternate Air Pressure Switch is identical to the 'blue dial' Air Pressure Switch, replacing an Alternate Air Pressure Switch with a 'blue dial' Air Pressure Switch (part of Service Kit, p/n 35624) requires removing the mounting hardware of the inoperative alternate Air Pressure Switch and, using this mounting hardware in the same holes of the bracket/panel, installing a 'blue dial' Air Switch in the same location. Observe the tube on the inoperative Air Switch to which the flexible plastic tubing is attached and install this tubing on the matching short tube of the new Air Switch.

Electrically, however, slight differences affect this replacement. A different type of termination on the Alternate Air Pressure Switch requires a change in the termination of the orange wires leading to a replacement 'blue dial' Air Pressure Switch. Install the replacement Air Pressure Switch as follows:

1. Remove the cover of the inoperative Air Pressure Switch.
2. Label each orange wire with the terminal number or symbol ("P" / "COM"; "2" / "NO") identifying its terminal on the old Air Switch. The new Air Switch uses an identical set of identifying symbols and numbers.
3. Pull the spade lug ('easy-on') termination free of the terminal. Remove the orange wires from the inoperative Air Switch.
4. Clip the wire at each spade lug ('easy-on') termination, where the wire enters the spade lug.
5. Insert the orange wires through the coupling hardware of the replacement Air Switch.
6. If U-blade, spade-lug terminals are available, strip each orange wire properly for that terminal; then, crimp a U-blade terminal on each wire. Other wise, skip to step 7.
7. Strip the insulation on each wire about 3/8" to 1/2" back from the clipped end of the wire.
8. Unscrew the terminal connections on the 'blue dial' Air Pressure Switch. Under the rectangular washer of the terminal, insert the U-blade spade lug, if used, or wrap the bare wire around the threaded portion of the terminal corresponding to a terminal on the alternate Air Pressure Switch.
9. Tighten the screw of each terminal to ensure a good electrical connection.
10. Arrange the wires within the switch body to ensure adequate clearance and to remain connected when the coupling hardware is positioned for switch cover reinstallation.
11. Install and tighten the coupling hardware. Avoid any strain on the orange wires.
12. Adjust the rim around the blue dial so that the 0.16 value on the rim is aligned with the ▲ symbol on the blue dial.
13. Reinstall the switch cover.
14. Close the panel or door and restore the oven to normal operating condition. Test the new Air Pressure Switch's operation, as outlined in the procedure on sheet 1 of these instructions.

## IX. PS570/570S FLAME GATE

All PS570/570S ovens produced for Pizza Hut USA through 8/00 were equipped with an adjustable flame gate at the end of the burner tube. The purpose of the flame gate was to direct heat towards the entrance end of the oven to better suit the customer's cooking needs.

PS570S ovens produced 9/00 or later, as well as all PS570G ovens, are not equipped with the flame gate. The introduction of the modulating gas system to these ovens, as well as improvements to the customer's air finger configuration and baking specs, make the flame gate unnecessary on these ovens.

### A. Part Number Reference - Flame Gate

Part No.	Description
35210-0555	Flame gate
35210-0511	Adjustment rod
35210-0510	Clamp

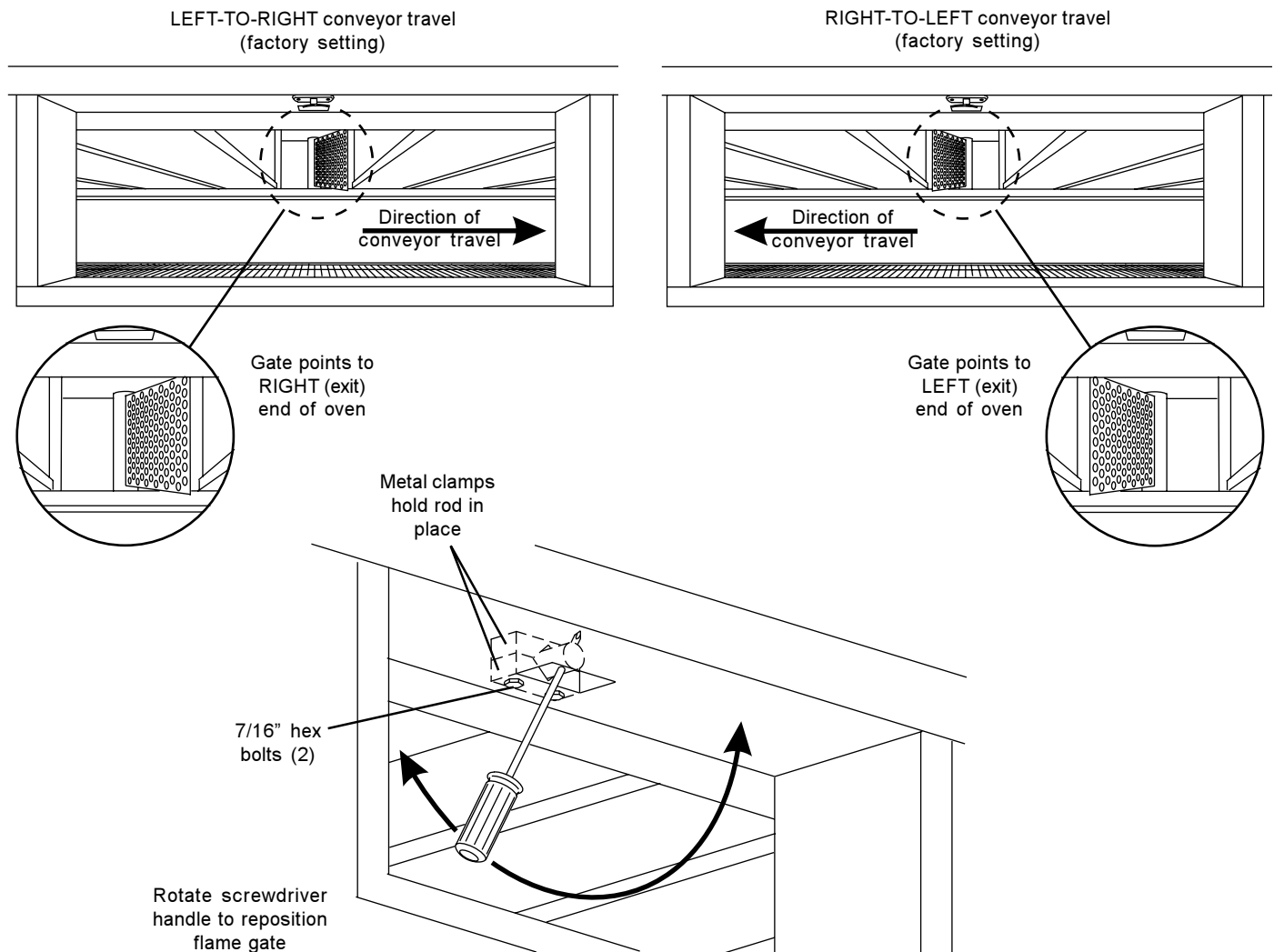
### B. Flame Gate Orientation

To check the position of the flame gate, view it through the oven's window. See Figure 53. The gate must point towards the EXIT end of the oven. Note that this directs the flame from the burner tube towards the ENTRANCE end of the oven, as described above.

All ovens were originally shipped from Middleby Marshall with the gate pointing to the right. This is because all ovens were shipped with left-to-right conveyors. If the conveyor direction of one of these ovens is reversed in the field, the flame gate should be repositioned as follows:

- Loosen (do not remove) the two 7/16" hex bolts on the clamps that hold the adjustment rod in place.
- Insert a #2 Phillips-head screwdriver into the hole in the rod as shown in Figure 53. Swing the handle of the screwdriver to rotate the rod and move the flame gate. You should position the gate as far as possible towards the EXIT end of the conveyor as shown.
- Remove the screwdriver. Tighten the two screws to hold the clamps in place.

**Figure 53**  
**PS570/570S flame gate adjustment**



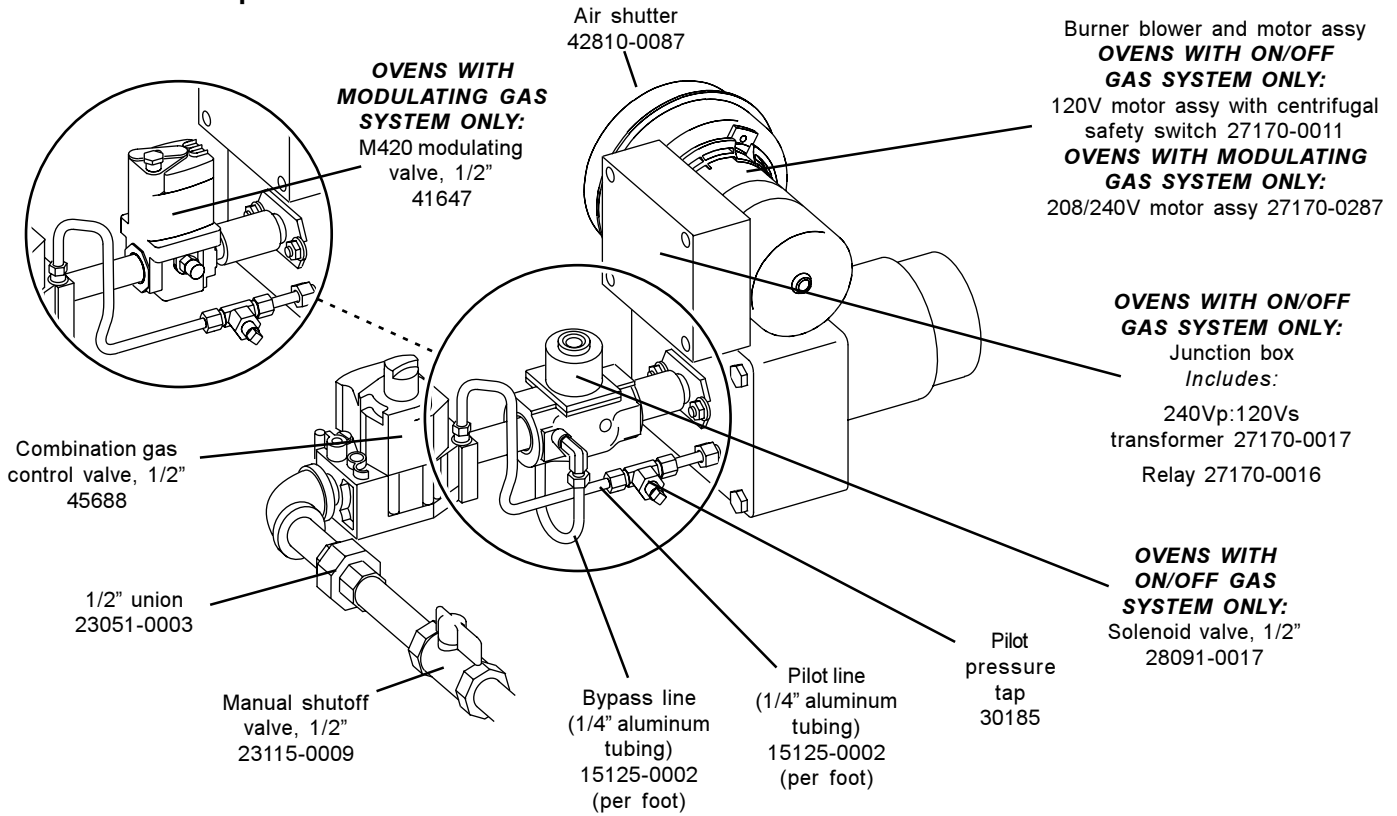


SECTION 3 - SERVICING COMPONENTS

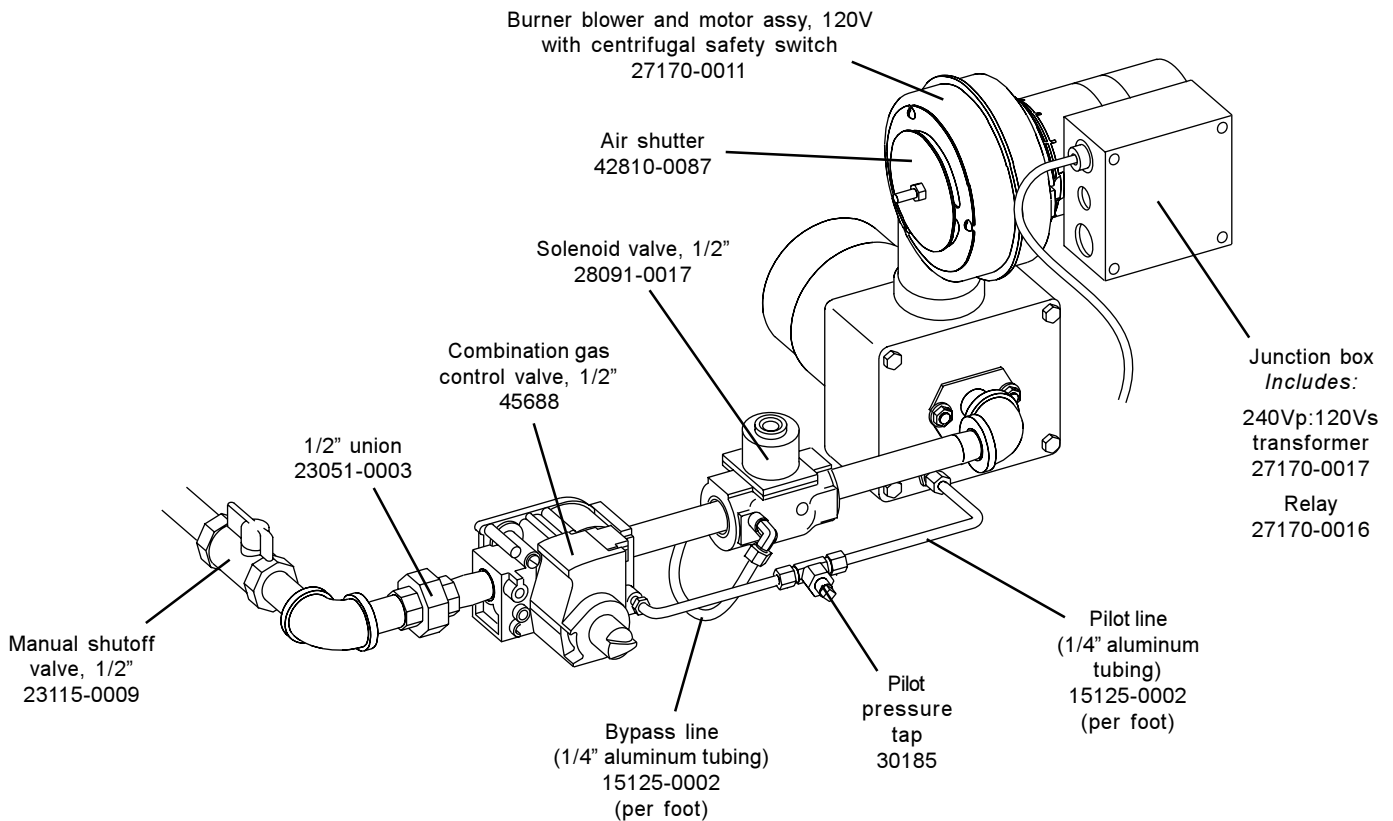
X. GAS TRAIN AND BURNER SYSTEM

A. Part Number Reference - Gas Train Components

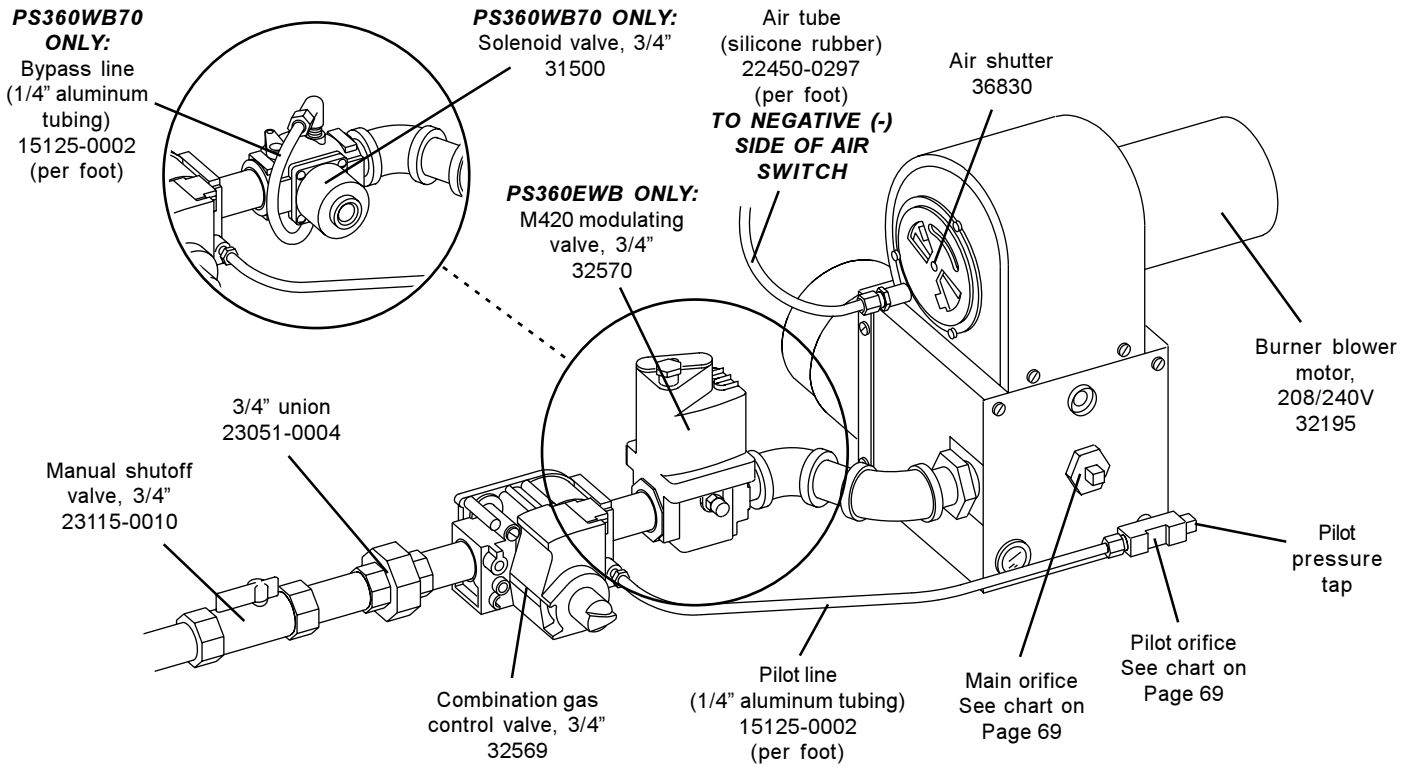
**Figure 54**  
**PS200-series gas train**



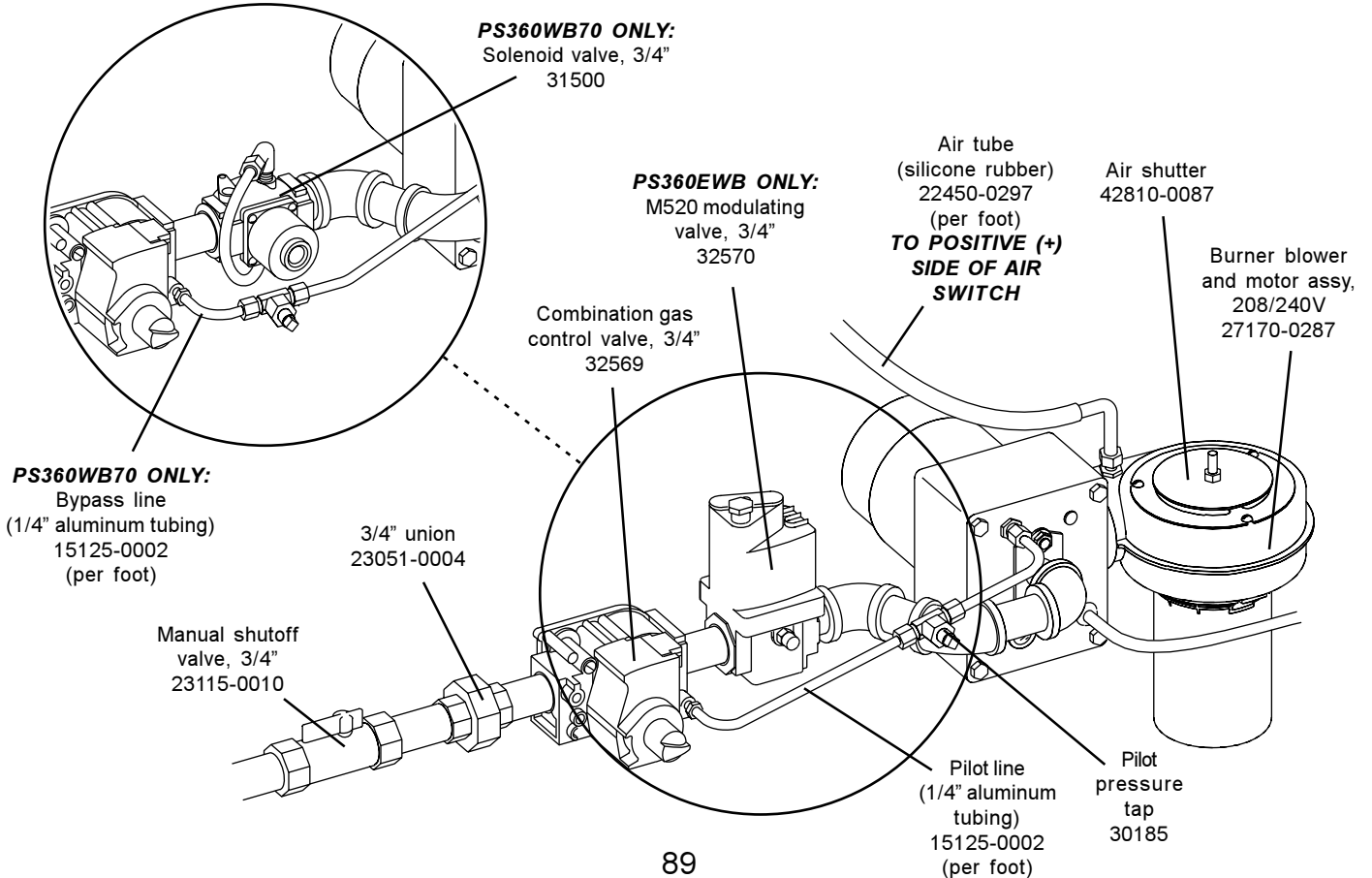
**Figure 55**  
**PS310, PS314, PS360 or PS360WB gas train**



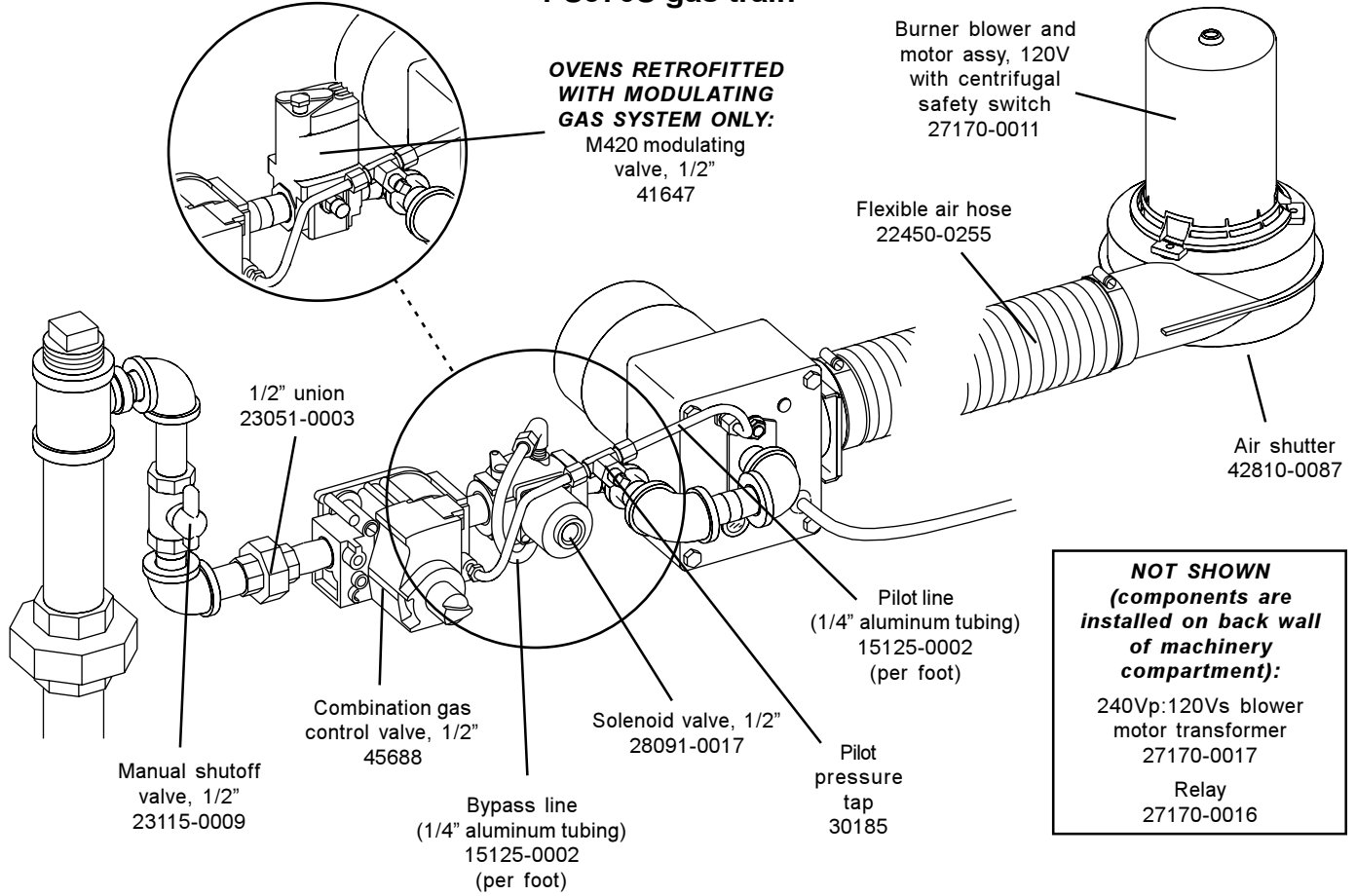
**Figure 56**  
**PS360EWB or PS360WB70 gas train with Midco burner**



**Figure 57**  
**PS360EWB or PS360WB70 gas train with Wayne burner**



**Figure 58  
PS570S gas train**



**Figure 59  
PS570G or PS555 gas train**

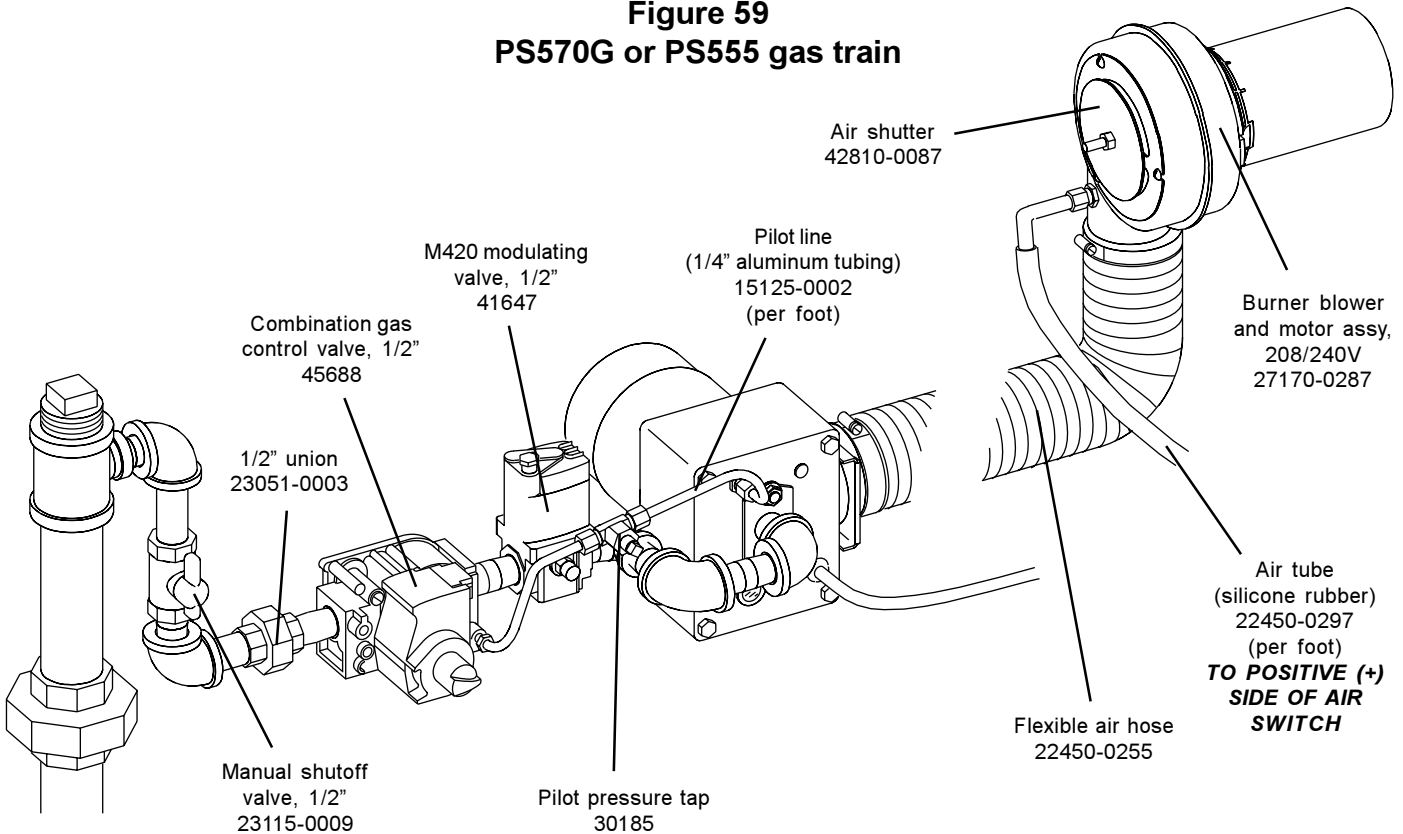
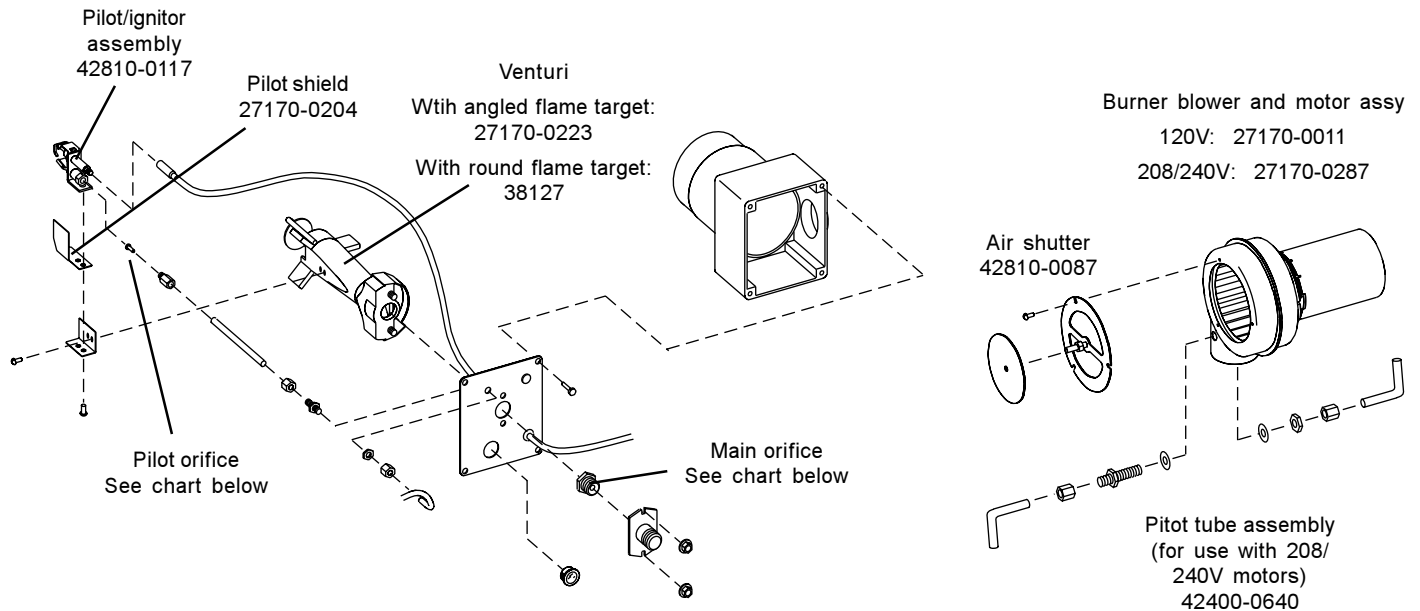


Figure 60 - Wayne burner - exploded view



## B. Part Number Reference - Gas Orifices and Gas Conversion Kits

PS200	PS220/224	PS310/314/360	PS360WB	PS360WB70/EWB Midco burner	PS360WB70/EWB Wayne burner	PS555	PS570S/PS570G	Description
42810-0125	42810-0126	42810-0120	42810-0127	36863	44664	43061	42810-0127	GAS CONVERSION KIT, PROPANE TO NATURAL
22176-0010 0.204"/5.18mm	22176-0016 0.182"/4.62mm	22176-0004 0.219"/5.56mm	22176-0014 0.250"/6.35mm	31821 0.234"/5.94mm	22176-0014 0.250"/6.35mm	43059 0.228"/5.79mm	22176-0014 0.250"/6.35mm	MAIN ORIFICE, NATURAL GAS
22174-0011 0.028"/0.71mm	22174-0011 0.028"/0.71mm	22174-0011 0.028"/0.71mm	22174-0011 0.028"/0.71mm	31818 0.032"/0.81mm	22174-0011 0.028"/0.71mm	22174-0011 0.028"/0.71mm	22174-0011 0.028"/0.71mm	PILOT ORIFICE, NATURAL GAS
22174-0006* 0.060"/1.52mm/ #53 drill	22174-0006* 0.060"/1.52mm/ #53 drill	22174-0006 0.060"/1.52mm/ #53 drill	22174-0006 0.060"/1.52mm/ #53 drill	22174-0006* 0.060"/1.52mm/ #53 drill	22174-0006* 0.060"/1.52mm/ #53 drill	NONE*	22174-0006* 0.060"/1.52mm/ #53 drill	BYPASS ORIFICE, NATURAL GAS
28092-0019	28092-0019	28092-0019	28092-0019	28092-0019	28092-0019	28092-0019	28092-0019	GAS VALVE SPRING KIT, NATURAL GAS
42810-0122	42810-0123	42810-0119	42810-0124	36856	44665	43062	42810-0124	GAS CONVERSION KIT, NATURAL TO PROPANE
22176-0007 0.1285"/3.26mm	22176-0017 0.113"/2.87mm	22176-0003 0.134"/3.40mm	22176-0015 0.152"/3.86mm	31822 0.185"/4.70mm	31980 0.165"/4.19mm	43060 0.141"/3.58mm	22176-0015 0.152"/3.86mm	MAIN ORIFICE, PROPANE
22174-0010 0.018"/0.45mm	22174-0010 0.018"/0.45mm	22174-0010 0.018"/0.45mm	22174-0010 0.018"/0.45mm	31819 0.025"/0.64mm	22174-0010 0.018"/0.45mm	22174-0010 0.018"/0.45mm	22174-0010 0.018"/0.45mm	PILOT ORIFICE, PROPANE
22174-0009* 0.038"/0.97mm/ #62 drill	22174-0009* 0.038"/0.97mm/ #62 drill	22174-0009 0.038"/0.97mm/ #62 drill	22174-0009 0.038"/0.97mm/ #62 drill	22174-0009* 0.038"/0.97mm/ #62 drill	22174-0009* 0.038"/0.97mm/ #62 drill	NONE*	22174-0009* 0.038"/0.97mm/ #62 drill	BYPASS ORIFICE, PROPANE
28092-0018	28092-0018	28092-0018	28092-0018	28092-0019 (same as natural gas)	28092-0018	28092-0018	28092-0018	GAS VALVE SPRING KIT, PROPANE

## \* NOTE

Bypass orifices are used ONLY on ovens equipped with an on-off gas regulation system (with a solenoid valve). These ovens include:

- PS200-series (through 3/02)
- PS310
- PS360
- PS360WB70
- PS314
- PS360WB
- PS570S (through 8/00)

Ovens equipped with a PID modulated gas system (with a modulating valve) do not use a bypass orifice. These ovens include:

- PS200-series (4/02 or later)
- PS360EWB
- PS570S (9/00 or later)
- PS555
- PS570G

**NOTE:** Installations at higher altitudes have a lower ambient air pressure that disrupts the air-fuel mixture. To correct this problem, smaller gas orifices are required. A general rule is a 4% reduction for each 1000 ft. (305m) above sea level. Refer to the chart in the *Appendices* section (page 135) for a listing of orifice sizes showing this reduction.

## SECTION 3 - SERVICING COMPONENTS

### C. Component Identification

#### 1. Burner type

Middleby ovens are equipped with one of two main burner designs. Details of these burners are provided below.

1. Midco burner - see Figure 61. This burner was used on PS360WB70 and PS360EWB ovens only.

Late-production PS360EWB and PS360WB70 ovens used the Wayne burner shown in Figure 62. In addition, many PS360EWB ovens were retrofitted during 1998 to use the Wayne burner.

Servicing the Midco burner is beyond the scope of this manual. However, note that most gas train components EXCEPT FOR THE BURNER ITSELF are identical to the components used with the Wayne burner. If necessary, contact Middleby Technical Service for assistance.

2. Wayne burner - see Figure 62. Wayne burners are used on all Middleby oven models except early-production PS360WB70 and PS360EWB models.

The Wayne burner configuration varies slightly between oven models and so may be slightly different from that shown in Figure 62. Refer to the drawings in *Part Number Reference - Burner Components* (pages 88-90) for illustrations of the burner configuration used on each oven model. Common variants include:

- Flexible air tube between the burner blower and plenum. Used on all PS555/570 series ovens.
- 120V burner blower motor. Used on PS200-series (through 3/02), PS310, PS314, PS360, PS360WB and PS570S ovens.
- 208/240V line voltage blower motor. Used on PS200-series (4/02 or later), PS360WB70, PS360EWB, PS555, and PS570G ovens.

#### 1. Solenoid valve vs. Modulating valve

Middleby ovens use one of the following systems for gas flow regulation:

- **On-Off gas flow regulation.** These ovens are equipped with a high flame solenoid valve. The solenoid valve can only be positioned fully open (100% gas flow) or fully closed (0% gas flow) as necessary to maintain the set point. A bypass line supplies gas to maintain the flame when the valve is closed. On/off gas systems have a temperature "swing" of several degrees on either side of the set point.

On-Off gas flow regulation is used on the following Middleby oven models:

- |                               |                |
|-------------------------------|----------------|
| - PS200-series (through 3/02) | - PS360WB      |
| - PS310                       | - PS360WB70    |
| - PS314                       | - PS570S       |
| - PS360                       | (through 8/00) |

Additional information on the solenoid valve is provided in *Solenoid Valve* on Page 96.

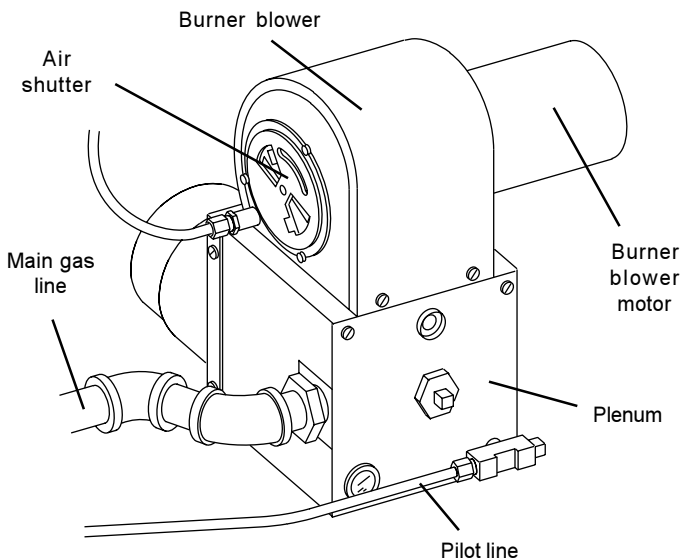
- **Modulated gas regulation.** These ovens are equipped with a modulating gas valve. The modulating valve can open or close at any setting from 0-100% gas flow in response to the need for heat to maintain the set point. Because of this flexibility, the temperature "swing" is eliminated.

The modulated gas system is used on the following Middleby oven models:

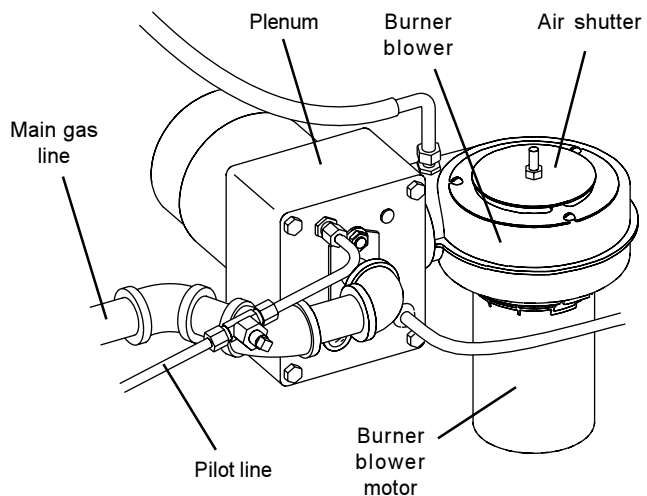
- |                                |                          |
|--------------------------------|--------------------------|
| - PS200-series (4/02 or later) | - PS570S (9/00 or later) |
| - PS360EWB                     | - PS570G                 |
| - PS555                        |                          |

Additional information on the modulating valve is provided in *Modulating Valve* on Page 97.

**Figure 61 - Midco burner**



**Figure 62 - Wayne burner**  
PS360EWB shown. For different oven models, refer to the drawings on pages 88-90.



## D. Pilot/Ignitor Assembly

The pilot assembly is attached to the end of the pilot line. It consists of an ignitor electrode/flame sensor, a pilot shield and the pilot burner. See Figure 63.

The pilot assembly includes a safety circuit. An electrical current is sent to the flame sensor probe to prove the presence of the pilot flame. When the spark ignites the pilot, a circuit is completed THROUGH THE FLAME from the flame sensor probe to the pilot burner, which is grounded. This safety circuit must be completed before the pilot will light.

### 1. Pilot Shield

The pilot shield is a plate located on the bottom of the pilot. It prevents drafts, etc. from blowing the pilot flame away from the sensing probe. See Figure 64.

### 2. Flame target

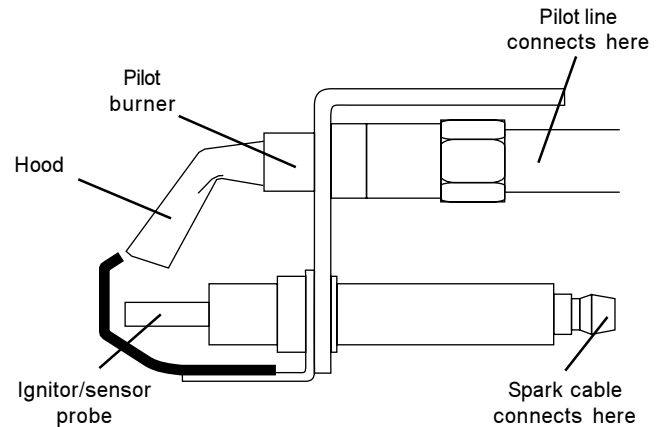
The flame target aids in distributing the flame from the end of the venturi. See Figure 65.

- PS310/360-series ovens built prior to 6/87 are not equipped with a flame target. The burner on these ovens resembles the one shown in Figure 64.
- The angled flame target is used on:
  - PS200-series ovens built through 3/02.
  - PS310, PS314, PS360 and PS360WB ovens built 6/87 or later.
  - PS570S ovens.
- The round flame target is used on:
  - PS200-series ovens built 4/02 or later.
  - PS360EWB and PS360WB70 ovens equipped with the Wayne burner system.
  - PS555 and PS570G ovens.

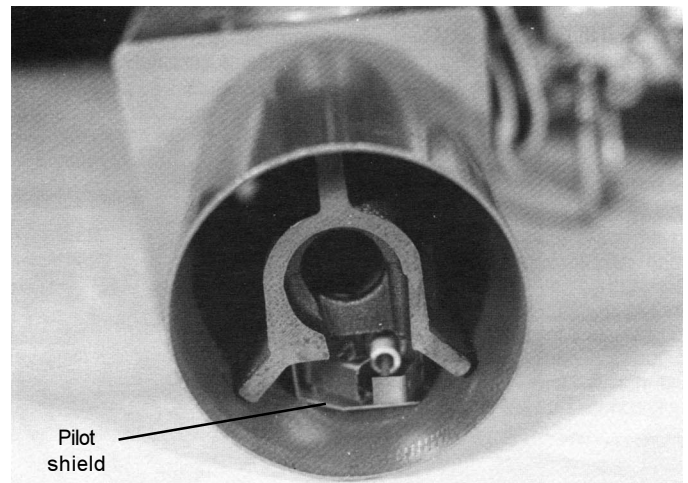
All of these ovens use a 120V burner blower motor. Most units equipped with the 120V burner blower motor also use the angled flame target.

All of these ovens use a 208/240V burner blower motor. All ovens equipped with the line voltage burner blower motor use the round flame target.

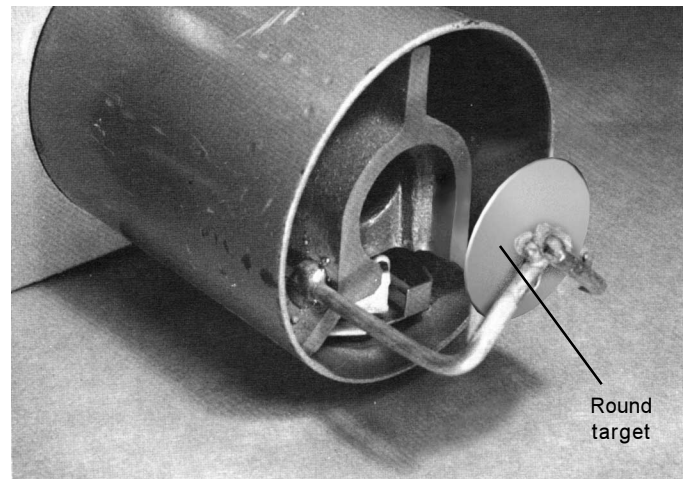
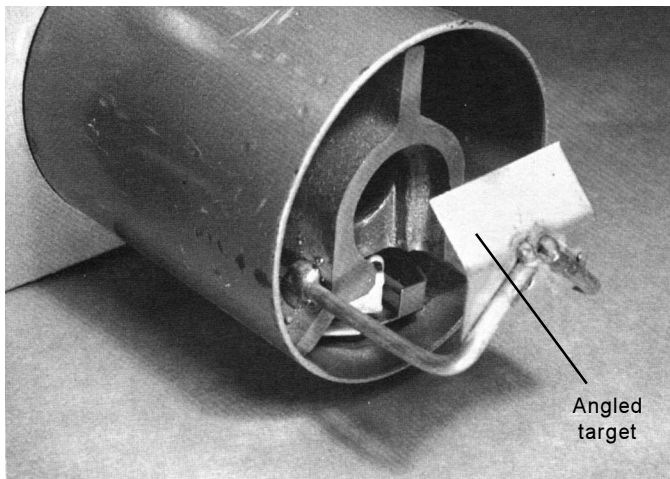
## Figure 63 - Pilot/ignitor assembly



## Figure 64 End of burner without flame target showing pilot shield



## Figure 65 Flame targets

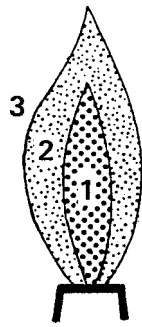


SECTION 3 - SERVICING COMPONENTS

3. Pilot and Proof of Pilot Flame Rectification

With standing pilots, heat is a necessary ingredient for proper thermocouple operation. But this is not the case with IIDS (Intermittent Ignition Device Systems) when flame conduction or rectification is used. To better understand the principles of flame conduction and rectification, we must first understand the structure of a gas flame. See Figure 66.

**Figure 66**  
**Flame structure**



With the proper air-gas ratio to give a blue pilot flame, three zones exist.

**Zone 1:** An inner, fuel-rich cone that will not burn because excess fuel is present.

**Zone 2:** Around the inner, fuel-rich cone is a blue envelope. In this area is a mixture of vapor from the fuel-rich inner cone and the secondary, or surrounding, air. This is where combustion occurs.

**Zone 3:** Outside the blue envelope is a third zone that contains an excessive quantity of air and will not burn.

Of concern is the second, or combustion area. This is where the burning occurs and is the area that is of prime importance for good flame sensor location.

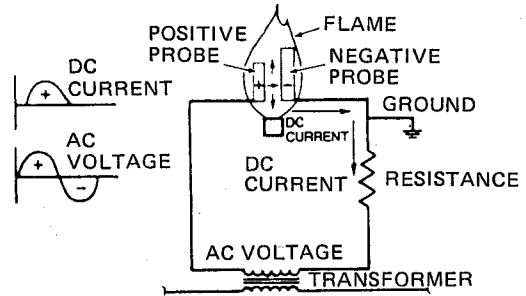
**Flame Rectification**

With flame rectification, two probes with different surface areas are exposed to a flame - in this case, the pilot flame. The probe with the larger surface area attracts more free electrons and, as a result, becomes the negative probe. Therefore, current is conducted through the flame from the positive probe to the negative probe. See Figure 67.

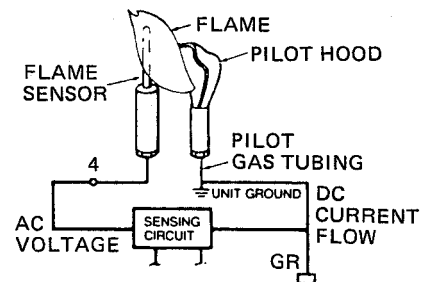
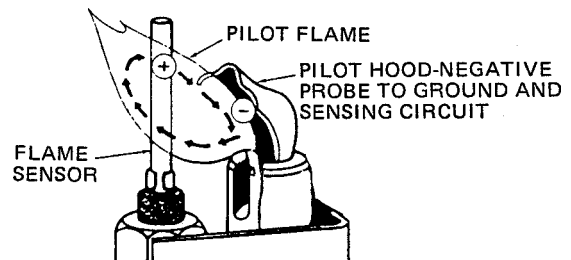
Note also that the AC voltage sine wave has not changed, but the negative portion of the current sine wave has been chopped off. This positive portion now represents a DC current. This is the phenomenon of flame rectification.

To apply this principle to an IID (Intermittent Ignition Device) - in this case, the pilot/ignitor assembly, a pilot and flame sensor have been substituted for the two probes (See Figure 68). After the pilot is ignited, a DC current flow of 2.0µA (microamps) or more is conducted through the flame, from the flame sensor (the positive probe) to the pilot tip (the negative probe). The pilot tip, acting as the negative probe, completes the circuit to ground. The IID sensing circuit uses this DC current flow to energize a relay and open the main burner gas valve.

**Figure 67 - Flame rectification**



**Figure 68 - Pilot and probe**



THE FOLLOWING CONDITIONS WILL HAVE A DIRECT BEARING ON EVERY IID APPLICATION:

**Voltage**

The supply voltage to the ignition controls should be within the following ranges:

- 120VAC controls – 102 to 132VAC
- 24VAC controls – 21 to 26.5VAC

24VAC systems should use transformers that will provide adequate power under maximum load conditions.

**Gas Pressure**

**Inlet gas pressures**

- Natural gas, Wayne burner - 6-12" W.C. (14.9-29.9 mbar)
- Propane, Wayne burner - 11½-12" W.C. (28.7-29.9 mbar)
- Midco burner (all gases) - 6-14" W.C. (14.9-34.9 mbar)

**Regulated gas pressures**

- Natural gas, Wayne burner - 3.5" W.C. (8.7 mbar)
- Propane, Wayne burner - 10" W.C. (24.9 mbar)
- Midco burner (all gases) - 3-5" W.C. (7.5-12.5 mbar)

**Pilot gas pressures**

- Natural gas, Wayne burner - 3½-4" W.C. (8.71-9.95 mbar)
- Propane, Wayne burner - 8-10" W.C. (19.9-24.9 mbar)
- Midco burner (all gases) - 5-6" W.C. (12.5-14.9 mbar)

### Temperature

Ignition controls should not be exposed to temperatures exceeding 140°F (60°C) or less than -40°F (-40°C).

### Pilot Application

The pilot and flame sensor application is the most critical aspect of the IID application.

The pilot flame must make contact with the pilot tip and surround the flame sensor probe. A multimeter or ampmeter set to read microamps (mA) is necessary to verify that the proper amount of current is being maintained through the pilot flame. **The minimum value required is 2.0 mA.** Rectification-based ignition systems respond in less than 0.8 of a second to a loss of flame. If the minimum signal is not being maintained at all times, OR if the pilot flame is briefly directed away from the flame sensor or pilot tip, the main gas valve may cycle rapidly (“chattering”) or the burner may be prevented from activating.

Other conditions that can cause the failure of the main burner to activate, OR chattering of the burner, are:

1. Pilot flame is too small.
2. Gas pressure is too low for proper pilot flame impingement on the flame sensor.

In these cases, the pilot may ignite, but the main burner gas valve will not be energized. It is also possible for drafts or unusual air currents to deflect the pilot flame away from the flame sensor. Deflection of the pilot flame may also be caused by main burner ignition concussion or roll-out of the main burner flame.

An additional point to be considered is the condition of the pilot flame. If the pilot flame is hard and blowing, the grounding area of the pilot is reduced to a point where the necessary current is not being maintained, and a shutdown of the system will result.

The positioning of the flame sensor is also critical in the pilot application. Positioning of the flame sensor should be such that it will be in contact with the second, or combustion area of the pilot flame. Passing the flame sensor through the inner cone of the pilot flame is not a recommended procedure. For this reason, a short flame sensor may provide a superior signal over a longer one. The final determination of the sensor location (length) is best determined by the use of a multimeter set to read microamps (μA).

## E. Burner Blower Motor

The burner blower motor is located on the side or top of the burner housing. Some blowers use a flexible tube to connect the blower to the burner, depending on the available space inside the machinery compartment. The burner blower motor drives a blower wheel located in a housing attached to the end of the motor that is the primary air supply for combustion. The motor requires no lubrication.

Depending on the oven model, the burner motor operates on either 120V or 208/240V (line voltage). 120V motors have an internal centrifugal switch that controls the 24V power supply to the gas valve (see *Burner Blower Motor Centrifugal Safety Switch* on Page 80). 208/240V motors use a separate air pressure safety switch to sense blower operation (see *Air Pressure Safety Switch* on Page 81). This safety feature prevents burner operation in case of motor failure.

## F. Air Shutter

The air shutter is a round metal plate located on the open end of the burner blower wheel. Adjusting the position of the shutter will increase or decrease the amount of air that is permitted into the plenum for combustion. Rotate the plate in a counterclockwise direction to increase the air supply, or in a clockwise direction to reduce the air supply. You can insert a drill bit into the shutter gap to check the size of the opening. Refer to Figure 69 for the recommended opening sizes.

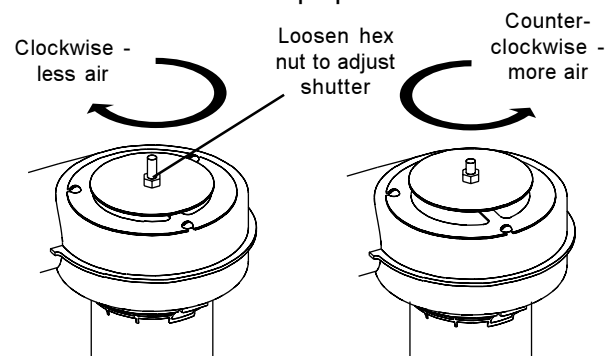
Early Midco burners use an adjustment screw on the front wall of the plenum to adjust the airflow. If it is not possible to adjust the air supply properly using the screw, a retrofit kit is available (P/N 36829) to install the external air shutter shown in Figure 69.

**Figure 69**  
**Air shutter adjustment**

### Wayne burner

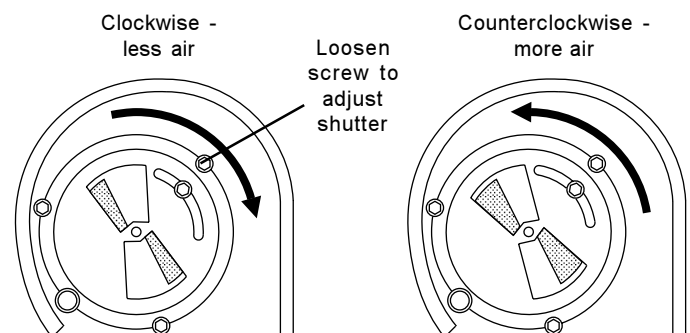
Standard openings:

- 1/4"/6.4mm for natural gas ovens
- 3/8"/9.5mm for propane ovens



### Midco burner

Standard opening 5/16"/7.9mm (all gases)





## SECTION 3 - SERVICING COMPONENTS

### G. Burner Transformer

120V burner blower motors feature a transformer located in the electrical junction box on the burner. In PS570S ovens, AND all ovens with 208/240V burner blower motors, the transformer is located inside the machinery compartment.

The transformer supplies 24V to the burner motor relay (if present) and also to the 24V gas valve through the motor's centrifugal switch (or air pressure safety switch).

### H. Burner Motor Relay

120V burner blower motors feature a 24V time delay relay located in the electrical junction box on the burner. In PS570S ovens, the relay is located on the back wall of the machinery compartment.

Approximately 25 seconds after power is applied to the coil of the relay, the contacts will close and complete a circuit to the burner blower, allowing the motor to operate. This 15-30 second delay is a prepurge for a cold start. When the coil of the relay is warm, the delay is bypassed.

Ovens with 208/240V burner blower motors are not equipped with the burner motor relay, and do not have a prepurge for a cold start.

### I. High Flame Solenoid Valve (if so equipped)

Ovens that use an on-off gas regulation system are equipped with a high flame solenoid valve. The valve is located between the combination gas control valve and the burner. The valve operates on 110-120V.

The valve opens when the oven's temperature falls 2 degrees Fahrenheit below the set point, and closes when the temperature rises to 2 degrees above the set point. Because of residual heat within the oven, however, the temperature swing after preheating is about 5 degrees Fahrenheit above and below the set point.

The solenoid valve can only be positioned fully open (100% gas flow) or fully closed (0% gas flow). While the valve is closed, gas is still supplied to the burner through the by-

pass line that goes around the solenoid valve. This allows the burner to operate in low flame mode while awaiting re-activation.

When the oven has been fully preheated and has maintained the set point for about an hour with a moderate product load, the low flame to high flame ratio should be approximately 1 to 1. That is, the oven will be calling for heat approximately half the time. To check this ratio, refer to the HEAT indicator on the temperature controller, which will only be active when the burner is on high flame.

EXCEPTION: Older PS310/314/360 ovens have a temperature-sensing thermocouple mounted at the front of the oven, inside the machinery compartment. On these ovens, the low flame to high flame ratio should be approximately 2 or 3 to 1 (oven calls for heat 1/3 or 1/4 of the time).

**IMPORTANT: For proper functioning of the solenoid valve, the temperature controller *MUST* be set to the on-off operating mode. Refer to *Temperature Controller* on Page 31.**

### J. Bypass (Low Flame) Orifice (ovens with a high flame solenoid valve only)

All ovens that use an on-off gas regulation system are equipped with an orifice in the low flame bypass line. See Figure 70.

When the oven is not calling for heat, the solenoid valve is closed, but gas is still supplied to the burner through the bypass line. This allows the burner to operate in low flame mode while awaiting re-activation.

The low flame orifice regulates the gas flow through the bypass line. If the orifice size is too large, the low flame will be too high. In some cases, this will prevent the oven from being able to maintain the set point.

Refer to the chart on Page 91 to determine the proper size for the bypass orifice.

**Figure 70**  
**Low Flame (Bypass) Orifice**

*Bypass line configuration varies depending on the oven model. Refer to the drawings on pages 88-90.*



**K. Modulating Gas Valve (if so equipped)**

Ovens that use a PID (modulated) gas regulation system are equipped with a modulating gas valve instead of a solenoid valve. The valve is located between the combination gas control valve and the burner.

In response to the millivolt signal from the thermocouple, the Digital Temperature Controller sends a 4-20mA signal to an amplifier board. The board, in turn, passes on a 0-20VDC signal to the modulating valve itself. The valve opens or closes proportionally to the signal from the amplifier board, allowing any setting from 0-100% gas flow.

When the oven is switched on, gas demand is at its peak and the valve is fully open, permitting 100% gas flow. As the oven's temperature approaches the set point, the valve slowly begins to close, restricting gas flow to the 35-60% range. After the oven is fully preheated, the gas flow usually stabilizes at about 30%. The actual oven temperature can remain constant, with NO temperature swing, because the valve is adjusted constantly according to the demand.

Modulating valves are used on all PS360EWB, PS555, and PS570G gas ovens. They are also used on PS200 ovens produced 4/02 or later and PS570S ovens produced 9/00 or later.

The Model PS360EWB oven uses a Maxitrol M520 modulating valve with a 3/4" gas line, P/N 32570. All other Middleby oven models equipped with a modulating valve use the Maxitrol M420 valve with a 1/2" gas line, P/N 41647.

The modulating valve features a bypass adjustment screw, shown in Figure 71. For all ovens except the PS536, the screw should ALWAYS remain fully closed; no adjustment is necessary. The screw is pre-set to the fully-closed position from the factory. If the screw is adjusted to any setting other than fully-closed, the oven may not be able to maintain the set point temperature.

**IMPORTANT:** For proper functioning of the modulating valve, the temperature controller **MUST** be set to the PID operating mode. Refer to *Temperature Controller* on Page 31.

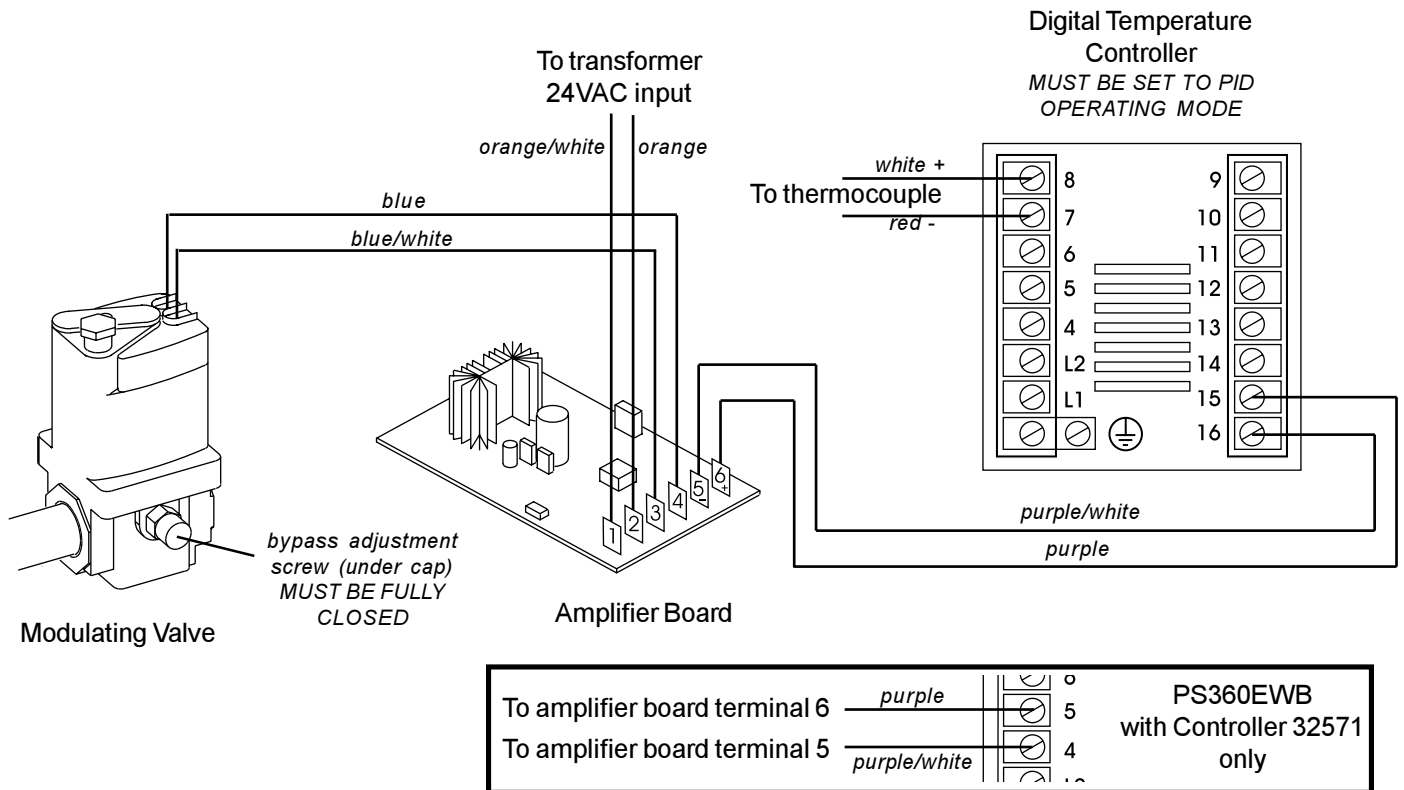
**L. Amplifier Board (ovens with a modulating gas valve only)**

Ovens equipped with a modulating gas valve have an amplifier board mounted inside the machinery compartment.

In response to the millivolt signal from the thermocouple, the Digital Temperature Controller sends a 4-20mA signal to the amplifier board. The board, in turn, passes on a 0-20VDC signal to the modulating valve. The valve opens or closes proportionally to the signal from the amplifier board, allowing any setting from 0-100% gas flow.

All Middleby oven models equipped with a modulating valve use amplifier board P/N 31651.

**Figure 71 - Modulating Gas System**



## SECTION 3 - SERVICING COMPONENTS

### M. Combination Gas Control Valve

#### 1. Part Number Reference - Combination Gas Valve

- PS360WB70 and PS360EWB ovens are equipped with a 3/4" (19.05mm) gas line. This requires the use of Combination Gas Valve P/N 32569. The valve has a tan plastic cover with a blue On/Off knob.
- All other oven models are equipped with a 1/2" (12.7mm) gas line.
  - Through 10/01 - these ovens used Valve P/N 28092-0017. The valve operated on a 60 Hz supply, had a tan plastic cover and a blue On/Off knob.
  - 11/01 and later - these ovens use Valve P/N 45688. The valve operates on a 50 or 60 Hz supply, has a grey plastic cover and a black On/Off knob. It is otherwise identical to the previous version, and may be used to replace it in all cases.

#### 2. Valve Operation

When the ON-OFF knob on the valve is in the ON position, gas is allowed to enter the valve. Once 24VAC is supplied to the valve, gas is supplied to the pilot line.

When the pilot flame has been proved (see *Pilot and Proof of Flame Rectification* on Page 94), 24VAC is supplied to the combination valve by the ignition module, opening the main valve. Gas pressure from the inlet side of the valve is passed through the Pressure Regulator. The regulated pressure is supplied to a cavity below the main valve diaphragm. This pressure overcomes the spring force and moves the main valve to its open position. During operation, the main valve is opened and closed by the pressure regulator to keep a constant pressure at the outlet of the valve.

When power to the valve is cut, the cavity below the main valve diaphragm is depressurized and the valve spring closes the main valve rapidly to shut off the main burner.

When the 24VAC supply to the valve is cut, the valve stops gas flow to both the pilot and the main burner.

The combination valve includes taps to measure both the inlet pressure and the regulated pressure. To ensure accuracy, the regulated pressure should be measured when the oven is on low flame.

#### 3. Servicing the Combination Valve

##### • Pilot pressure

One of the more common service issues with the combination valve occurs on ovens with the on/off gas regulating system (with a solenoid valve), when the oven is on low flame. During low flame, the servo can "bounce" inside the valve as it searches for the proper level. The bouncing line pressure can also cause surges in the pilot pressure. A properly adjusted pilot will tend to smooth out the surges.

The best way to check for a properly adjusted pilot is to check the pilot line pressure. This requires a pilot pressure tap in the pilot line. Ovens built 3/94 or later should have the tap installed in the line. The tap is also available as Service Kit P/N 30185 which includes installation instructions.

Recommended pilot gas pressures are:

- Wayne burner, natural gas - 3½-4" W.C. (8.71-9.95 mbar)
  - Wayne burner, propane - 8-10" W.C. (19.9-24.9 mbar)
  - Midco burner (all gases) - 5-6" W.C. (12.5-14.9 mbar)
- *Burrs in pilot adjustment portal*

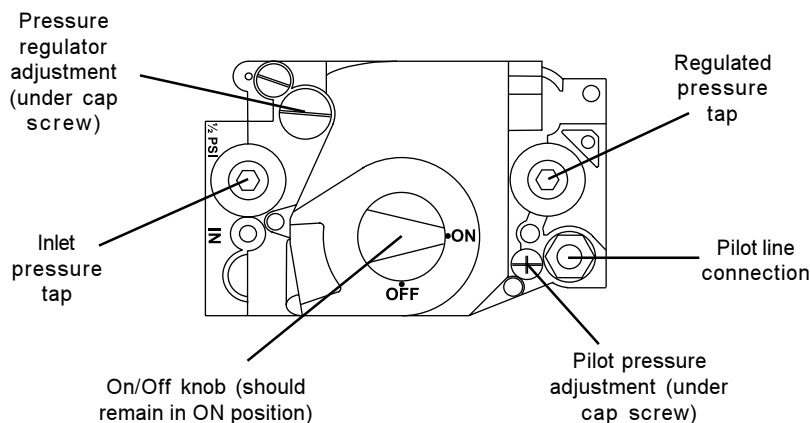
Some combination valves have been shown to have shipped with small burrs in the pilot adjustment portal. Although this will not interfere with proper operation of the valve in any way, it does make it difficult to adjust the pilot pressure until the burr is removed.

Check for a burr by attaching a manometer to the pilot pressure tap. If the manometer does not detect any change in pilot pressure when the screw is tightened all the way down, there is probably a burr in the portal.

To remove a burr, perform the following procedure:

- Turn the adjustment screw all the way down.
- Apply more pressure to break through the burr.
- Back the screw out until the top of the screw is level with the top of the access hole.
- Turn the adjustment screw back down to adjust the pressure.
- Repeat these steps until the burr is cleared.

**Figure 72 - Combination Gas Control Valve**



## N. Ignition Module

- Part Number Reference - Ignition Module
  - PS360WB70 and PS360EWB ovens equipped with the Midco burner use Ignition Module P/N 31501.
  - For all other oven models:
    - Through 10/90 - these ovens used Ignition Module P/N 27161-0004. Some versions of this module included a separate, replaceable fuse. This module shared a common ground with the 24V transformer and the relay coil. See Figure 73.
    - 11/90 or later - these ovens use Ignition Module P/N 27161-0005, included in Service Kit 42810-0114. The module is internally grounded and the common ground with the transformer and relay coil has been eliminated. See Figure 74.

If you are replacing the obsolete module (P/N 27161-0004) with the current version (P/N 27161-0005), **BE SURE TO DISCONNECT THE MODULE FROM THE COMMON GROUND WITH THE TRANSFORMER AND RELAY.** Double-grounding of the module creates a feedback voltage circuit that allows the module to operate without a signal from the burner/blower assembly. This procedure is explained in greater detail in the instructions for Kit 42810-0114, included in the *Appendices* section.

### 2. Module Operation

The ignition module delivers 24V to the pilot ignitor when the blower motor centrifugal switch (or air pressure safety switch) is closed.

When the module detects a current flow of at least 2.0  $\mu$ A through the pilot flame, it supplies 24V to the combination gas control valve, allowing the valve to operate.

Figure 73

### Wiring diagram of ignition and gas valve system (obsolete ignition module 27161-0004)

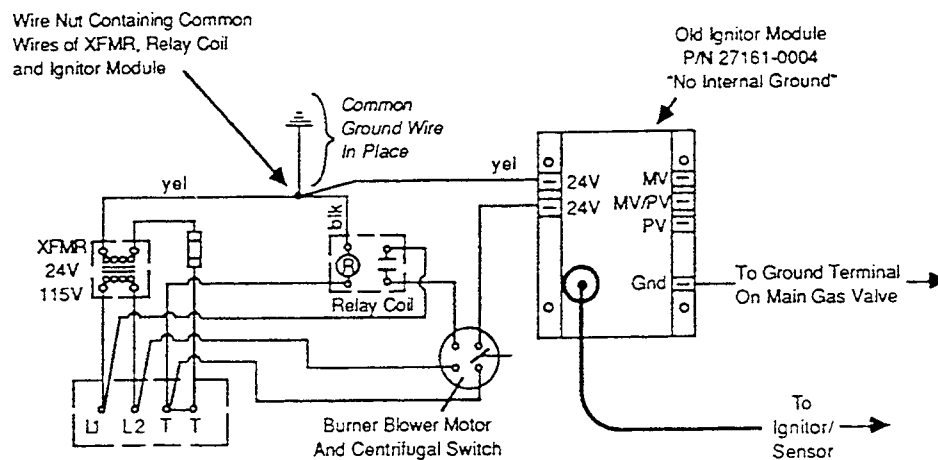


Figure 2

Figure 74

### Wiring diagram of ignition and gas valve system (current ignition module 27161-0005)

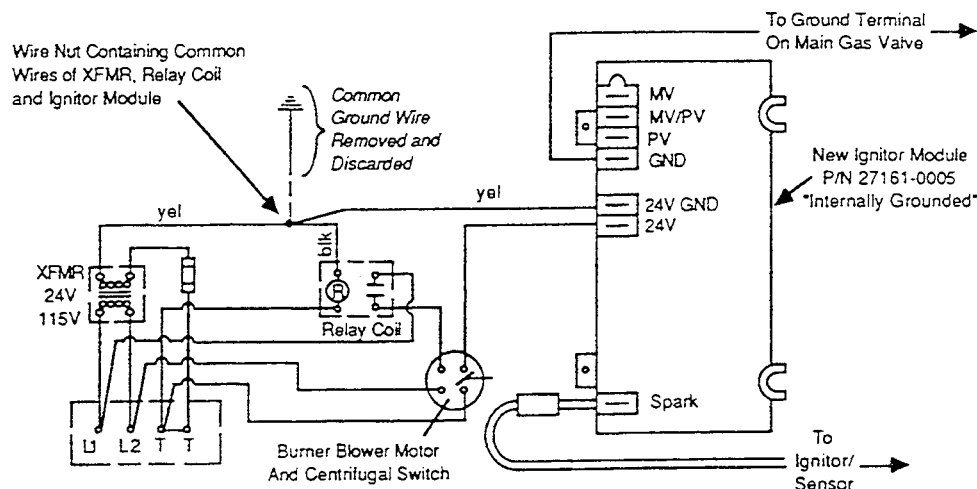


Figure 1  
99

## SECTION 3 - SERVICING COMPONENTS

### O. Gas Conversion Kits

Ovens can be converted from natural gas to propane operation, or from propane to natural gas operation, by the installation of the appropriate Gas Conversion Kit. Refer to *Part Number Reference - Gas Orifices and Gas Conversion Kits* on Page 91 for a listing of kit part numbers.

Converting the oven to operate on a different gas type generally requires:

- Replacement of the regulator spring on the combination gas control valve. The spring is located underneath the pressure regulator screw. Note that on PS360EWB and PS360WB70 ovens equipped with the Midco burner, replacement of the regulator spring is not necessary.
- Replacement of the main orifice, pilot orifice, and bypass orifice. Note that ovens equipped with the modulating gas system do not use a bypass orifice.
- Adjustment of the main and pilot gas pressures.
- Documenting the gas conversion using the labels and tags supplied in the kit.

Instructions for the gas conversion kits are provided in the *Appendices* section.

### P. Burner and Gas Train Troubleshooting

#### 1. Burner Blower Motor

If there is 110V (or 208/240V, as appropriate) to the motor terminals, it should be running. If the motor is not running, replace it.

#### 2. Burner Blower Motor Centrifugal Switch (or air pressure safety switch)

If the burner blower motor is running at top speed, and you cannot measure 24V across the supply terminals of the ignition module, the centrifugal switch is not closing properly and is either loose or defective.

For 120V burner blower motors with an internal centrifugal switch, tighten the switch. If this fails to correct the problem, replace the motor.

For 208/240V burner blower motors with a separate air pressure safety switch, refer to *Air Pressure Safety Switch* on Page 82 to troubleshoot the switch.

#### 3. Relay

- Connect a voltmeter across the supply terminals on the relay. The reading should be 24V. If you do not get a 24V reading, the transformer should be replaced.
- If 24V is present at the relay, and if after 15 to 45 seconds you do not get 110V (or 208/240V, as appropriate) on terminal 3 of the relay, replace the relay.

#### 4. Main Gas Valve and Ignition Module

If 24V can be measured across the ignition module supply terminals, there should also be 24V between terminals PV and MV/PV on the gas control module.

If you have a 24V reading, the pilot valve should be open and the spark should be on to ignite the pilot gas. When the pilot gas has ignited, the main burner should ignite. If not, check MV terminal to ground and see if 24V is present. If no voltage is present, replace the ignition module.

It is possible to have a pilot on, but have the spark continue to try to light the pilot. If this continues for more than 30 seconds, then it should be assumed that the flame sensor is not working properly. This can be easily checked. Refer to *Control Module Flame Sensor Test* on the next page.

A reading of 2.0  $\mu$ A or greater should be obtained. If a poor reading is obtained, the pilot flame and sensor are probably not making good contact. This will keep the main valve from opening. Refer to the section on flame rectification. If the microamp reading is good and 24V cannot be obtained at terminal MV then the ignition module should be replaced.

5. *Burner Operation*

- a. Shut off the manual gas valve for oven. Turn the Burner and Heat switches ON. The spark should begin at the pilot burner within 30 seconds.

With the manual gas valve turned off, no gas will be present; so, the spark will continue for the lockout timing period of 90 seconds.

- b. Turn the Heat switch OFF, then turn on the gas supply. Set the temperature controller set point above the actual oven temperature.
- c. Turn the Heat switch ON. The system should start as follows:
- Spark turns on and pilot gas valve opens at once. Pilot burner ignites after gas reaches the pilot burner.
  - Spark cuts off when pilot flame is established.
  - Main gas valve opens and main burner lights after gas reaches the burner ports.

NOTE: Main burner flame may not be satisfactory until the gas input and combustion air have been adjusted.

6. *Check Grounding*

Electrical ground connections must be clean and tight. If the lead wire is damaged or deteriorated, use only No. 14 to 18 gauge, moisture-resistant thermoplastic insulated wire with a 221°F (105°C) minimum rating as a replacement.

Excessive temperature at the ceramic flame rod insulator can also permit electrical leakage to ground. Examine the flame rod and mounting bracket, and correct if it is bent out of position. Replace the ignitor/sensor if the insulator is cracked.

7. *Ignition Module Flame Sensor Circuit Test*

The ignition module provides AC power to the ignitor/sensor which the pilot burner flame rectifies to direct current (DC). If the flame signal back to the control module is not at least 2.0  $\mu\text{A}$  DC, the system will lock out.

The output of the flame sensing circuit cannot be checked directly, so check the flame sensing circuit indirectly by checking the flame sensing current from the ignitor/sensor to the control module as follows.

- a. Connect a ampmeter or multimeter set to read DC microamps ( $\mu\text{A}$ ) in series with the flame signal ground wire. Disconnect the ground wire at the control module. Connect the red (positive) lead of the meter to the free end of the ground wire. Connect the black (negative) meter lead to the ground terminal on the ignition module.

- b. Restart the system and read the meter. The flame sensor current must be at least 2.0  $\mu\text{A}$ , and the reading must be steady. If the reading is below 2.0  $\mu\text{A}$  or if the reading is unsteady, check the pilot flame and electrical connections as described above. Also, replace the ignitor/sensor if the ceramic insulator is cracked.

If the reading still is unsteady, it may be necessary to adjust the pilot pressure. Refer to *Pilot Pressure* under *Servicing the Combination Valve* on Page 98.

8. *System Troubleshooting.*

Start the system by setting the temperature controller above room temperature, and observe the system response.

Establish the type of system malfunction or deviation from normal operation by using the *Intermittent Pilot System Troubleshooting Table* on Page 103.

Use the table by following the questions in the boxes. If the condition is true (answers yes), go down to the next box. If the condition is not true (answers no), go to the box alongside.

Continue checking and answering conditions in each box until a problem and/or the repair is explained. Use the *Component Checks* section as necessary to perform system checks.

After any maintenance or repair, the troubleshooting sequence should be repeated until the procedure ends with normal system operation.

**Figure 75**  
**Voltage Checks for Ignition Module and Combination Gas Valve**

Ignition Module		
Test Points Marked	Voltage	
	Fused	Nonfused
MV/PV to PV	3 VAC	24 VAC
MV/PV to MV	12 VAC	24 VAC
Combination Gas Valve		
TR to TH	12 VAC	24 VAC
TH/TR to TR	3 VAC	24 VAC

NOTE: Information on the fused ignition module is provided for reference only. All ovens produced 1988 or later use the nonfused module. The fused module is no longer available.

## SECTION 3 - SERVICING COMPONENTS

### 9. *Component Checks Reset System After Lockout*

If the oven enters safety lockout, the system must be reset before attempting further operation or checkout. The system will remain in safety lockout until it is reset. Shut system OFF. (Turn Heat switch OFF.) Wait at least five minutes, then turn Heat switch ON.

### 10. *Check Spark Ignition Circuit*

The electronic module and step-up transformer in the ignition module provide spark ignition at 15,000V (open circuit). This circuit can be checked at the ignition module as follows:

- Turn OFF the gas flow at the manual shutoff valve.
- Disconnect the ignition cable at the ignition module terminal to isolate the circuit from the pilot burner/ignitor sensor, and prepare a short jumper lead using heavily insulated wire, such as a spare ignition cable.
- Energize the ignition module and touch one end of the jumper firmly to the control board ground terminal (GND). Do not disconnect the existing ground lead. Move the free end slowly toward the stud terminal to establish a spark and then pull the lead wire slowly away from the stud. Note the length of the gap at which arcing stops.
- An arc length of 1/8" (3.2mm) or more indicates satisfactory voltage output. Replace the ignition module if no arc can be established or if the maximum gap is less than 1/8" (3.2mm), and power to the ignition module input terminals was correct.

## WARNING

**Do Not touch either stripped end of jumper or stud terminal. This is a very high voltage circuit and electrical shock can result. Perform the test immediately upon energizing the system, before the ignition module enters safety lockout and interrupts the spark circuit.**

### 11. *Check Spark Ignitor*

If the troubleshooting procedure indicates a problem with the ignitor/sensor, check the spark ignitor and the ignition cable connections and continuity as follows:

#### Check Ignitor/Sensor

- Check the ignitor spark gap to make certain it is correct, 1/8" (3.2mm). If necessary, use a needlenose pliers and carefully bend the tip of the outer electrode to the correct gap.
- Check that the pilot flame is properly adjusted.

#### Check Igniton Cable

- The ignition cable must not touch metal surfaces or current-carrying wires. Use ceramic standoff insulators, if necessary.
- Check the length of the ignition cable. It must not exceed 3 ft. (0.9 m).

- Check the connections to the ignitor and ignition module terminals. All connections must be clean and tight. Loose connections may not conduct a flame current even though the ignition spark is satisfactory. Check the electrical continuity of the cable. Replace the cable if it is damaged or deteriorated.
- If no spark or a weak spark occurs, but the spark ignition circuit checked normally, disconnect the ignition cable at the ignitor/sensor and measure the arc from the cable end to the ignitor stud. Follow the same general procedures and observe the same cautions as in Step 10, *Check Spark Ignition Circuit*, above.

If the arc is correct, replace the ignitor/sensor.

If the arc is less than it should be, disconnect the ignition cable and use a jumper wire from the ignition module stud terminal. If the spark is normal, replace the ignition cable. If the arc is still smaller than normal, replace the ignition module.

## Q. Checking the Gas Pressures

All gas pressures should be checked using a manometer at the supplied pressure taps, as follows:

- Inlet pressure* can be checked at the inlet pressure tap on the combination gas valve. See Figure 72 (on Page 98).
- Regulated pressure* can be checked at the outlet pressure tap on the combination gas valve. See Figure 72 (on Page 98).

Current PS555/570-series ovens provide an additional regulated pressure tap in the main gas line, just before the line enters the burner. This allows you to connect a SECOND manometer downstream of the modulating valve to check that the valve is functioning properly. We encourage you to use this tap to diagnose problems with the modulating valve whenever possible.

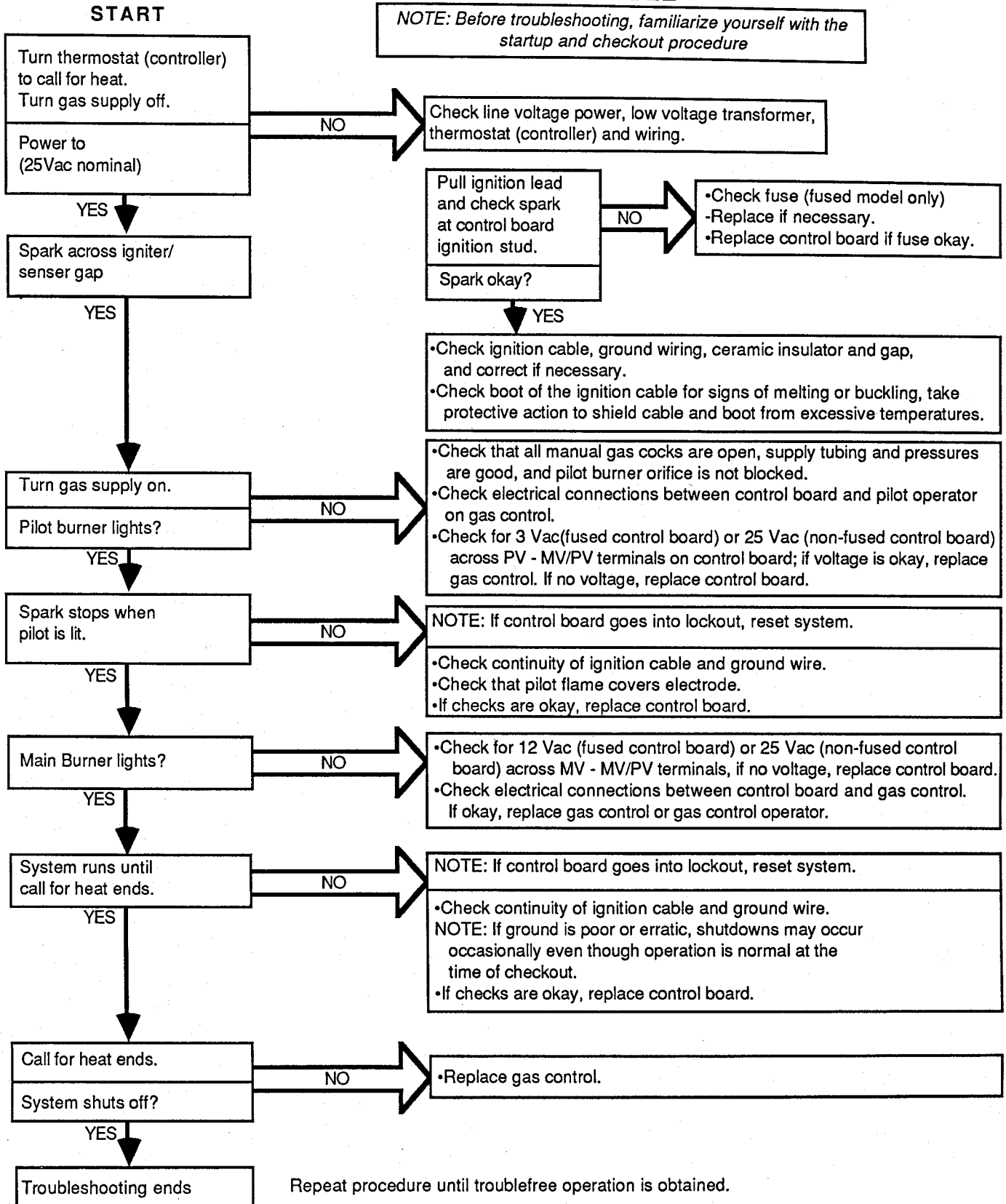
- Pilot gas pressure* can be checked at the pilot pressure tap. For ovens with a Wayne burner, the tap is located on the pilot line. For PS360EWB/WB70 ovens with a Midco burner, the tap is located on the end of the pilot orifice fitting. Refer to the illustrations on Pages 88-90.

Some older ovens (pre-1994) with Wayne burners may not be equipped with a pilot pressure tap. If you encounter problems with an erratic pilot (see *Servicing the Combination Valve* on Page 98), it may be necessary to install a tap. Middleby offers Service Kit P/N 30185 which includes the pilot pressure tap and instructions. A copy of the instructions are also provided in the *Appendices* section.

**IMPORTANT:** Any older oven that has a pilot pressure tap installed should have the combination gas valve replaced with a current version at the same time. Combination valves used prior to 1994 are beyond the scope of this Manual and may not be compatible with the tap.

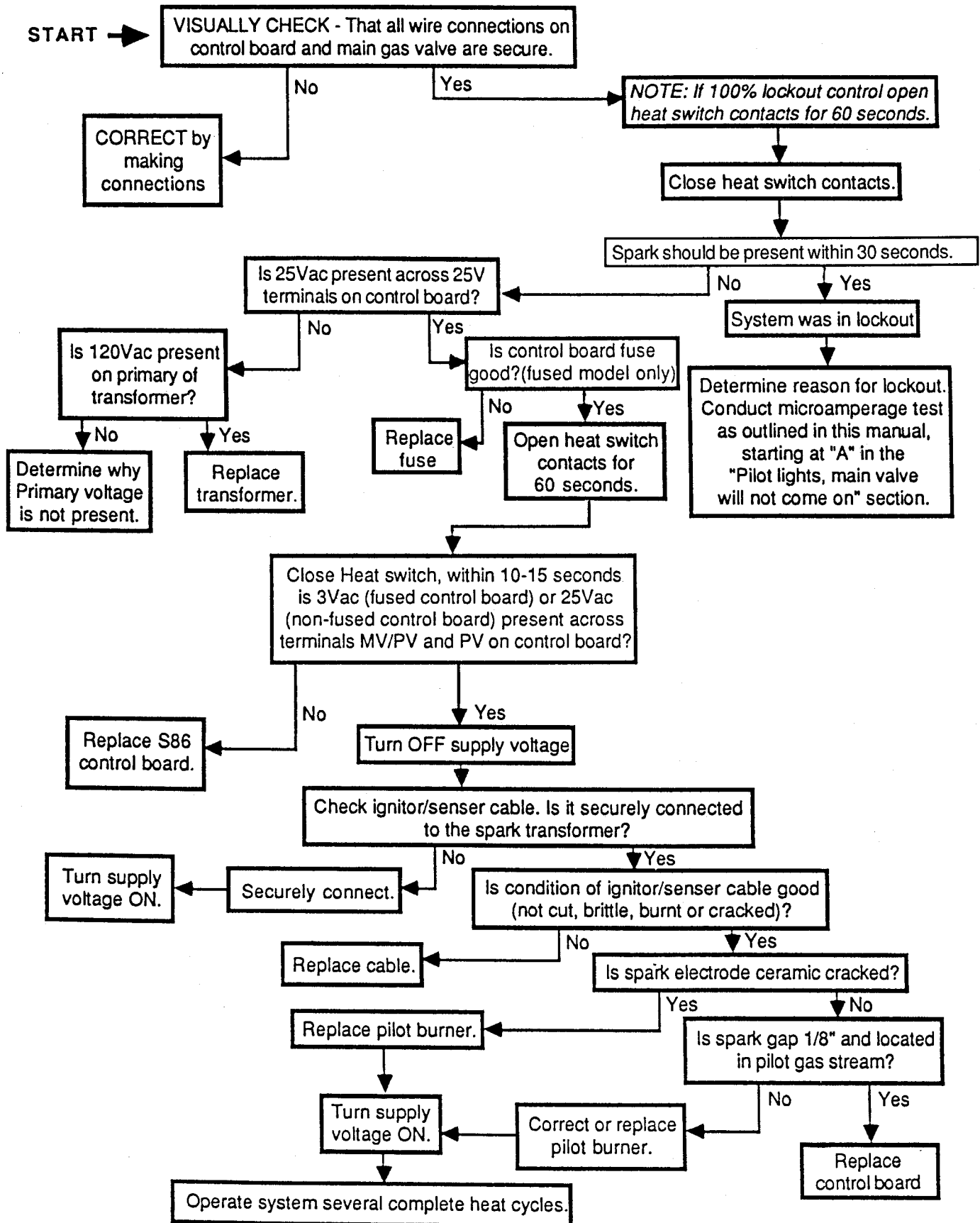
R. Troubleshooting Flowcharts

**INTERMITTENT PILOT SYSTEM  
TROUBLESHOOTING TABLE**

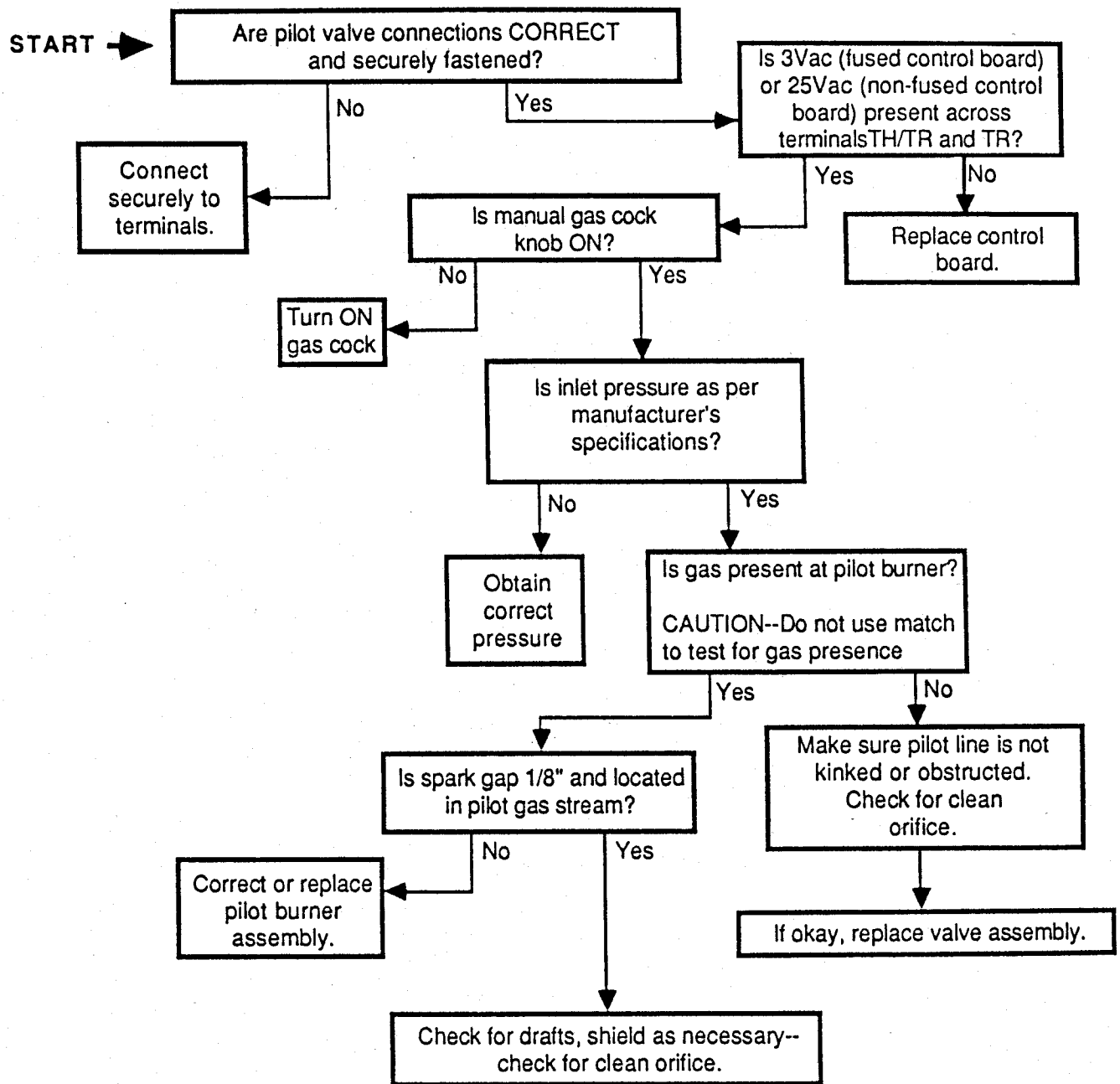




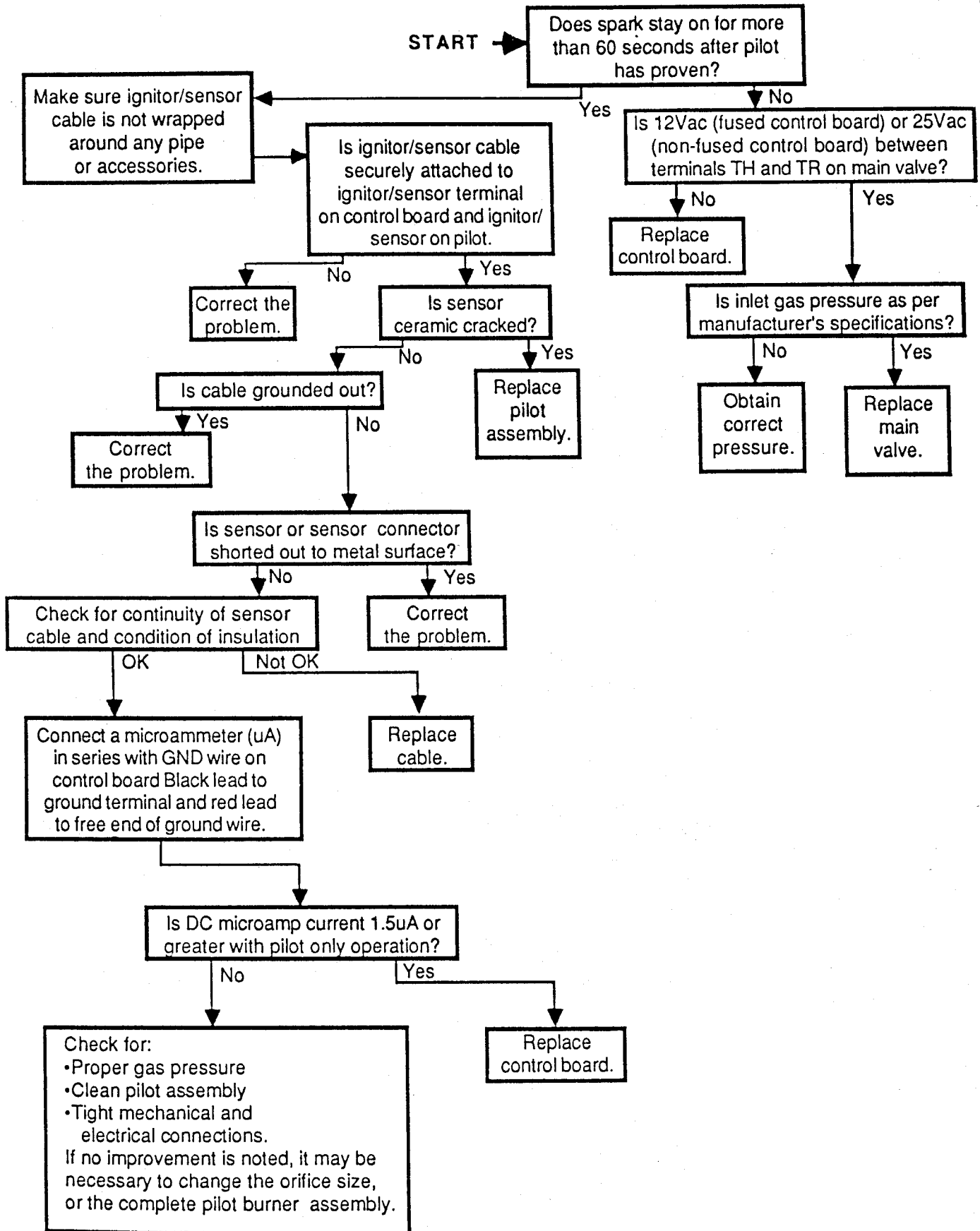
## NO SPARK, SYSTEM DOES NOT WORK



## SPARK IS PRESENT, PILOT WILL NOT LIGHT



## PILOT LIGHTS, MAIN VALVE WILL NOT COME ON



## S. Appendices

## Appendix - Instructions for Service Kit 42810-0117 - Pilot/Ignitor Kit, 7/91

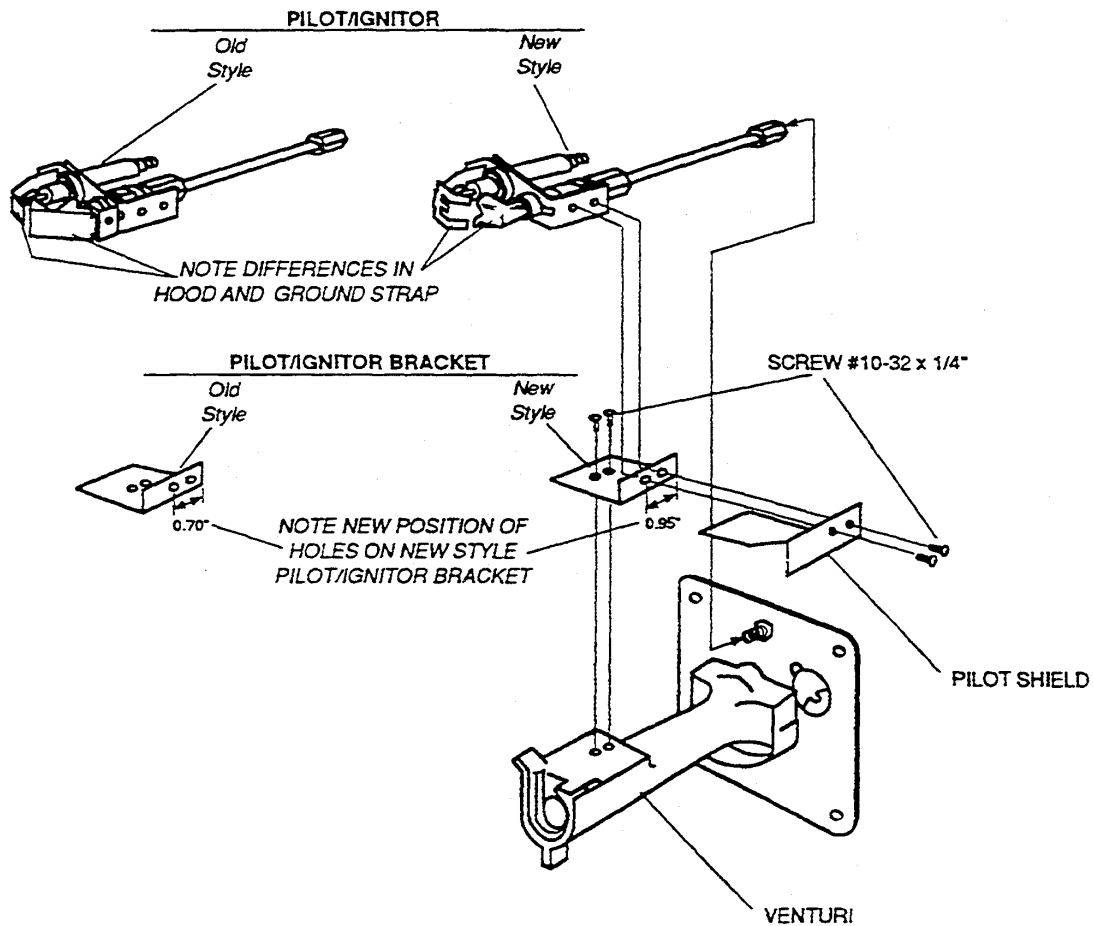
### PILOT/IGNITOR REPLACEMENT INSTRUCTIONS

USING KIT #42810-0117

**IMPORTANT:** When using Kit #42810-0117 the old style pilot/ignitor bracket must be replaced with the new style bracket contained in the kit or the burner will not light.

## KIT CONTENTS:

ITEM	QTY	MM P/N	DESCRIPTION
1	1	27363-0002	PILOT IGNITOR
2	1	27170-0264	PILOT IGNITOR BRACKET
3	1	88210-0067	PILOT/IGNITOR REPLACEMENT INSTRUCTIONS



MM P/N 88210-0067  
P 7/91

**Appendix - Instructions for Service Kit 30185 - Pilot Tee, 3/94**



**INSTALLATION INSTRUCTIONS**

**PILOT TEE  
ON PACESETTER OVENS**

**KIT P/N 30185**

**Kit Contains:**

Branch Tee..... P/N 30001  
Branch Plug..... P/N 30002  
Installation Instructions ..... P/N 30184

**Tools Required:**

Middleby Marshall Technical Manual (PN 88210-0019)  
DC Micro-amp Meter  
Water Column Gauge (do not use a dial type meter)  
Aluminum Tube Cutter  
Soap Solution For Gas Leak Test  
Standard Tools of the Trade (open end wrench set, screw driver set, etc.)

Middleby Marshall Inc. • 1400 Toastmaster Drive • Elgin, IL 60120 • (708) 741-3300 • FAX (708)741-4406  
***Middleby Corporation Service Hotline 1-800-238-8444***

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Part # 30184  
P3/94

**Appendix - Instructions for Service Kit 30185 - Pilot Tee, 3/94****INSTALLATION INSTRUCTION  
PILOT TEE  
KIT P/N 30185****A. INSTALLATION OF TEE AND PLUG KIT P/N 30185**

**IMPORTANT:** BEFORE ATTEMPTING TO INSTALL THIS KIT, READ THESE INSTRUCTIONS THOROUGHLY. TURN OFF GAS AND MAIN POWER TO OVEN BEFORE INSTALLING THIS KIT.

1. Remove pilot line tubing from between the combination gas valve and the burner plate. Refer to Figure 1.
2. Cut the tubing for installation of the tee as shown in Figure 1. Cut a 3/4" piece out of the pilot line tubing to insert the tee as shown in Figure 1. **NOTE:** *The tubing will insert 1/4" into the tee at both ends.*
3. Replace the pilot tube and tee and tighten all connections. Check that there are no kinks in the pilot line.
4. Fire the oven and check all connections for gas leaks by painting them with a rich soap and water solution. Bubbles indicate a gas leak.
5. If a gas leak is detected, tighten the pipe connection and recheck for leaks. Replace the part(s) if gas leak cannot be stopped.

**B. PILOT PRESSURE REGULATION - Using Combination Gas Valve Pilot Adjustment**

1. Unscrew the plug from the pilot tee and install a water column gauge. To avoid calibration problems **do not** use a dial face mechanical W.C. gauge. Refer to Figure 1, PS300 Lower Oven for an example of water gauge connection.
2. Wait until oven is running on low flame in order to adjust pilot pressure. Turn the temperature control set point down well below the actual temperature in the oven to maintain low flame.
3. Gain access to the pilot adjustment screw under the screw on combination gas valve as shown in Figure 1.
4. Read the water column gauge connected at the tee while turning the pilot screw adjustment. Turning clockwise decreases pressure and turning counterclockwise increases pressure.

**NOTE:** *Some combination gas valves may have burrs in the pilot adjustment portal. The pilot of these valves is difficult to adjust unless you break through the burr. If the water column gauge does not register any change after the adjustment screw has been turned all the way down, then apply more torque to break through the burr, back the screw out until the top of the screw is flush with the top of the access hole, and turn the screw down again. This must be repeated several times.*

Adjust the pilot line pressure as follows:

If oven is running on NATURAL GAS adjust pilot pressure to 3.5" - 4.0" WC.

If oven is running on PROPANE GAS adjust pilot pressure to 8.0" - 10.0" WC.

5. Replace screw over pilot adjustment screw.

### Appendix - Instructions for Service Kit 30185 - Pilot Tee, 3/94

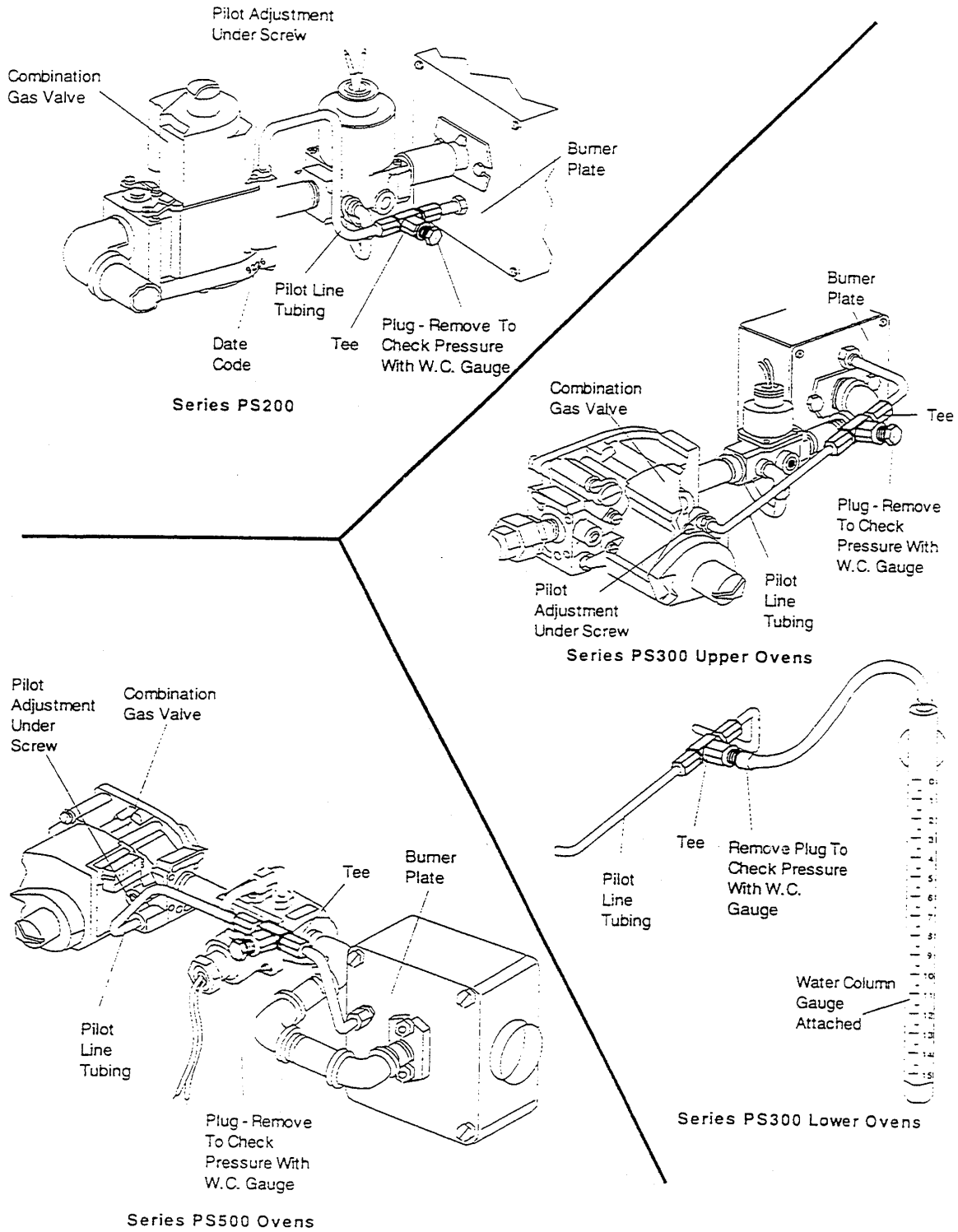


Figure 1

**Appendix - Instructions for Service Kit 30185 - Pilot Tee, 3/94****C. PILOT LIGHT CHECK**

1. Cycle oven back onto high flame and check burner flame for proper color. Natural gas appears soft blue with orange tips and propane gas appears orange. The shutter plate on the burner blower motor is typically set at:

PS200 Series = 1/16" to 3/32"

PS300 Series = 1/8" to 3/16"

PS500 Series = 1/8" to 1/4"

Each installation can vary. Adjust the shutter plate until the flame color is correct. Also check for proper microamp readings. Refer to Technical Manual (P/N 88210-0019), Section 2.

2. Turn burner off by cycling the burner heat switch momentarily two or three times to check for proper reignition. If difficult lighting or burner outage occurs, go to Step 3. If reignition is satisfactory then skip to Step 4.
3. If burner is difficult to light or goes out intermittently, check for proper microamp adjustment of pilot using Technical Manual (P/N 88210-0019), Section 2. Recheck pilot pressure on low flame to be sure it is adjusted within the correct parameters listed in Step B-4 of these instructions.
4. Turn off the gas flow to burner by turning heat switch to the OFF position.
5. Remove water column gauge and install tee plug and check for leaks.

**For further assistance with any portion of these instructions call the  
Technical Service Hotline at 1-800-238-8444.**



Appendix - Instructions for Service Kit 42810-0121 -  
Combination Gas Valve, 1/92



Middleby Marshall Inc. • 8300 Austin Ave. • Morton Grove, IL 60053 • (708)968-8300 • TWX910 223 0211 • FAX(708)968-8701

**Intermittent Pilot Combination Gas Control Kit  
(Kit Number 42810-0121)  
Installation Instructions**

**WARNING**

**FIRE OR EXPLOSION HAZARD  
CAN CAUSE PROPERTY DAMAGE,  
SEVERE INJURY OR DEATH.**

Do Not attempt to use a gas control set for natural gas on propane gas or a gas control set for propane gas on natural gas.

**IMPORTANT**

These gas controls are shipped with protective seals over inlet and outlet teppings. Do Not remove seals until ready to connect piping.

**WARNING**

**FIRE OR EXPLOSION HAZARD  
CAN CAUSE PROPERTY DAMAGE,  
SEVERE INJURY OR DEATH**

Do Not disassemble the gas control; it contains no replaceable components. Attempted disassembly or repair may damage the gas control.

The following instructions describe the installation of the Middleby Marshall gas control kit, MMP/N 42810-0121, which is the replacement for the discontinued gas control MMP/N 28092-0013. The new gas control kit consists of four (4) parts:

- 1 28092-0017 Gas Control
- 2 33300-0225 Pilot Tube
- 3 23070-0055 Compression Nut w/Sleeve
- 4 88210-0068 Instruction Sheet

The new control will fit in all existing applications of the discontinued control, however, due to the new pilot outlet location it is necessary to install the longer pilot tube supplied in the kit.

## Appendix - Instructions for Service Kit 42810-0121 - Combination Gas Valve, 1/92

1. Mount the gas control 0°-90° in any direction, from the upright position of the gas control knob.

2. Mount the gas control so gas flows in the direction of arrow on the bottom of the gas control.

3. Apply a moderate amount of good quality pipe compound (do not use teflon tape) to pipe only, leaving the last two end threads bare. On propane installations use compound resistant to propane gas.

4. Remove seals over gas control inlet and outlet.

5. Connect pipe to gas control inlet and outlet. Use wrench on the square ends of the gas control. Insert pipe a maximum of 1/2" into control valve. Distortion or malfunction may result if the pipe is inserted too deeply into the gas control.

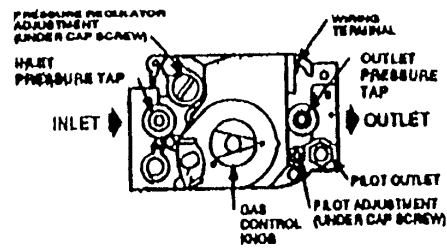


Figure 1 - Top View Of Gas Control

### PILOT GAS TUBING INSTALLATION

1. Cut tube to desired length. Square off and remove burrs from end of tubing both inside and outside.

2. Bend tube as necessary for routing to pilot burner. Do not make sharp bends or deform the tubing. Do not bend tubing at gas control or pilot burner after compression fitting has been tightened, as this may result in gas leakage at the connection.

3. Unscrew compression fitting from the pilot outlet of the gas control. Slip the compression fitting over the tubing and slide out of the way.

4. Push tubing into the pilot outlet until it bottoms. While holding tubing all the way in, slide compression fitting into place and engage threads, turn until finger tight. Then tighten one more turn with wrench. Do not overtighten.

5. Slide the compression fitting supplied with the kit over the other end of the tube. Push tubing into the pilot fitting located on the burner plate until it bottoms. While holding tubing all the way in, slide compression fitting into place and engage threads. Turn until finger tight. Then tighten one more turn with wrench. Do not overtighten.

### WARNING

Do Not apply a jumper across or short the valve coil terminals. Doing so may burn out the heat anticipator in the thermostat or damage the electronic module.

### WIRING

Disconnect power supply before making wiring connection to prevent electrical shock or equipment damage.

Connect wiring from the Ignition module to the gas valve. Refer to Figure 2.

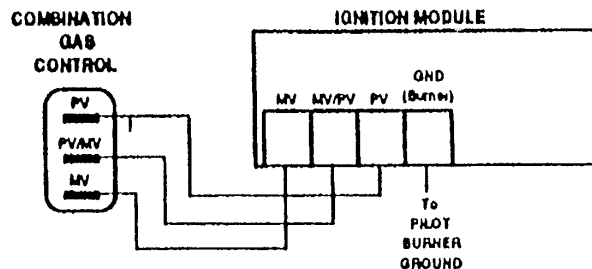


Figure 2 - Wiring

## Appendix - Instructions for Service Kit 42810-0121 - Combination Gas Valve, 1/92

**FIRE OR EXPLOSION HAZARD  
CAN CAUSE PROPERTY DAMAGE,  
SEVERE INJURY OR DEATH.**  
Check for gas leaks with rich soap and water  
solution any time work is done on a gas control.

### GAS LEAK TEST

1. Paint all pipe connections upstream of the gas control with a rich soap and water solution. Bubbles indicate a gas leak.
2. If a gas leak is detected, tighten the pipe connection.
3. Stand clear while lighting main burner to prevent injury caused from hidden gas leaks which could cause flashback in the machinery compartment. Light the main burner.
4. With the main burner in operation, paint all pipe joints and gas control inlet and outlet with rich soap and water solution.
5. If another gas leak is detected, tighten joints and pipe connections.
6. Replace the part if gas leak cannot be stopped.

### ADJUST THE PILOT BURNER FLAME

The pilot flame should envelop  $3/8$  to  $1/2$  inch (10 to 13 millimeters) of the ignitor-sensor tip. Refer to Figure 3. To adjust the pilot flame;

1. Remove the pilot adjustment cover screw. Refer to Figure 1.
2. Turn the inner adjustment screw clockwise to decrease or counterclockwise to increase the pilot flame.
3. Always replace the cover screw after adjustment and tighten firmly to ensure proper operation.

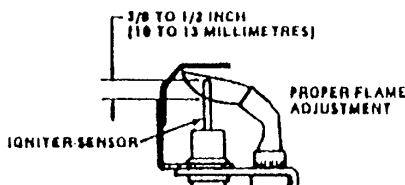


Figure 3 - Proper Flame Adjustment

### CAUTION

Shut off the gas supply at the service valve behind the oven before removing the outlet pressure tap plug or before disconnecting the manometer.

### ADJUST MANIFOLD PRESSURE

1. The gas control outlet pressure should be 3.5" w.c. for natural gas and 10.5" w.c. for propane gas.
2. With the main burner operating, check the gas pressure using a manometer connected to the gas control outlet pressure tap. Refer to Figure 1.
3. If necessary, adjust the pressure regulator.
  - a. Remove the pressure regulator adjustment cap.
  - b. Using a screwdriver, turn the inner adjustment screw clockwise to increase or counterclockwise to decrease the main burner gas pressure.
  - c. Always replace the cap screw and tighten firmly to ensure proper operation.
4. If the desired outlet gas pressure cannot be achieved by adjusting the gas control, check the gas control inlet pressure using a manometer at the inlet pressure tap. If the inlet pressure is at least 6" w.c. for natural gas or 11" w.c. for propane, replace the gas control. Otherwise, take the necessary steps to provide proper gas pressure to the gas control.
5. Be sure the main burner primary air supply is properly adjusted for complete combustion (approximately  $1/4$ " to  $3/8$ " open)
6. Perform gas leak test at the pressure tap plugs.

**Appendix - Instructions for Service Kit 42810-0121 -  
Combination Gas Valve, 1/92**



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**Appendix - Instructions for Service Kit 42810-0114 -  
Ignition Module, 11/90**

INSTALLATION INFORMATION (P/N 88210-0058)  
NEW HONEYWELL IGNITION MODULE (P/N 27161-0005)  
OLD HONEYWELL IGNITION MODULE (P/N 27161-0004)

REPLACING OLD MODULE WITH NEW

1. **WHEN REPLACING AN OLD MODULE WITH A NEW MODULE IT IS MANDATORY TO REMOVE AND DISCARD THE BURNER TRANSFORMER GROUND WIRE. SEE FIGURE 1.**

This ground wire is located inside the burner/blower motor electrical box containing the 24 volt transformer and prepurge relay. The green ground wire is secured by a ring terminal at the base of the transformer and runs from a wire nut which ties the yellow ground lead from the ignitor module with the yellow wire from the transformer and the black wire from the prepurge relay coil. It is the green wire only that is to be removed.

2. When reconnecting the module wires, be sure that the yellow wire which is actually the ground wire is connected to the top terminal marked 24v (GND) on the new module.
3. If using existing ignitor/sense lead from old module, reconnect to new module using adapter. See Figures 3 and 4.
4. When new ignitor/sense lead becomes available, the adapter will no longer be needed and the ignitor/sensor lead will connect to the new module as called out in Figure 5.

REPLACING NEW MODULE WITH OLD

1. **WHEN REPLACING A NEW MODULE WITH AN OLD MODULE IT IS MANDATORY TO INSTALL A BURNER TRANSFORMER GROUND WIRE. SEE FIGURE 2.**

Use a green 18 AWG, 105 degree C, U.L. listed wire and terminal ring. This ground wire should be located inside the burner/blower motor electrical box containing the 24 volt transformer and prepurge relay. The green ground wire should be secured by a ring terminal at the base of the transformer and run into the wire nut which ties the yellow ground lead from the ignitor module with the yellow wire from the transformer and the black wire from the prepurge relay coil.

2. When reconnecting the module wires be sure the yellow wire which is actually the ground wire, is connected to the top terminal marked 24v on the old module.
3. Reconnect the ignitor/sense lead to spark terminal of old module. The adapter in Figure 4 of the new module is not used.

NOTE: The new style ignitor/sense lead as shown in Figure 5 will not be compatible with the old module. Either a new module must be used or the ignitor/sense lead must also be replaced with an old style.

### Appendix - Instructions for Service Kit 42810-0114 - Ignition Module, 11/90

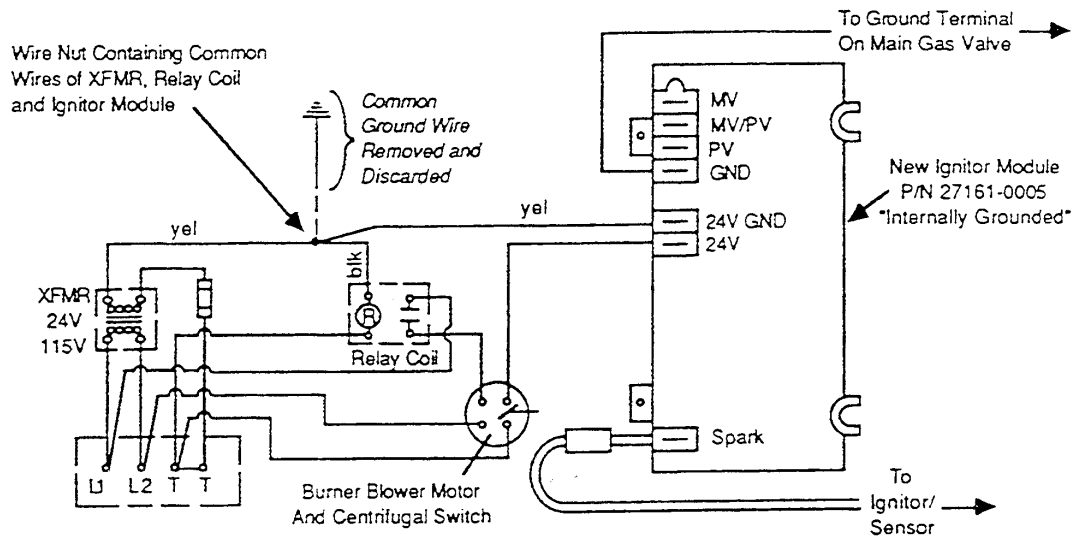


Figure 1

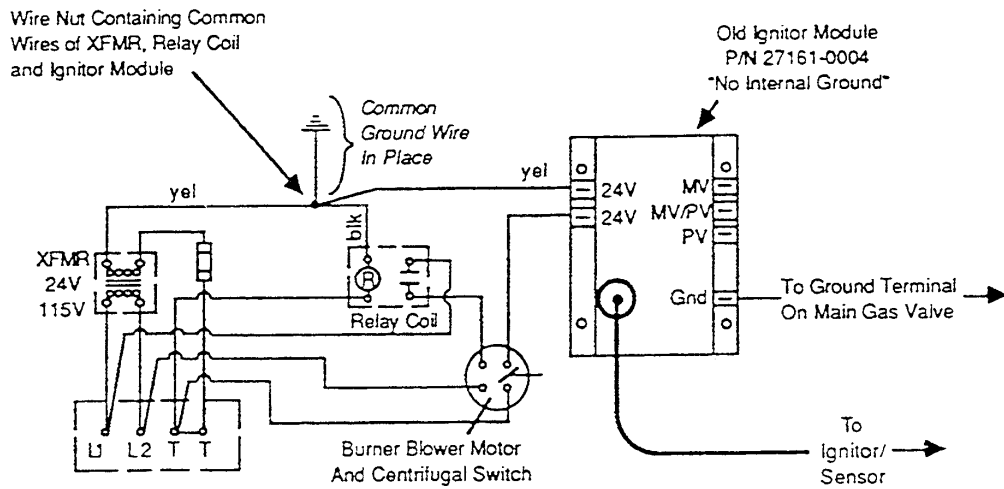
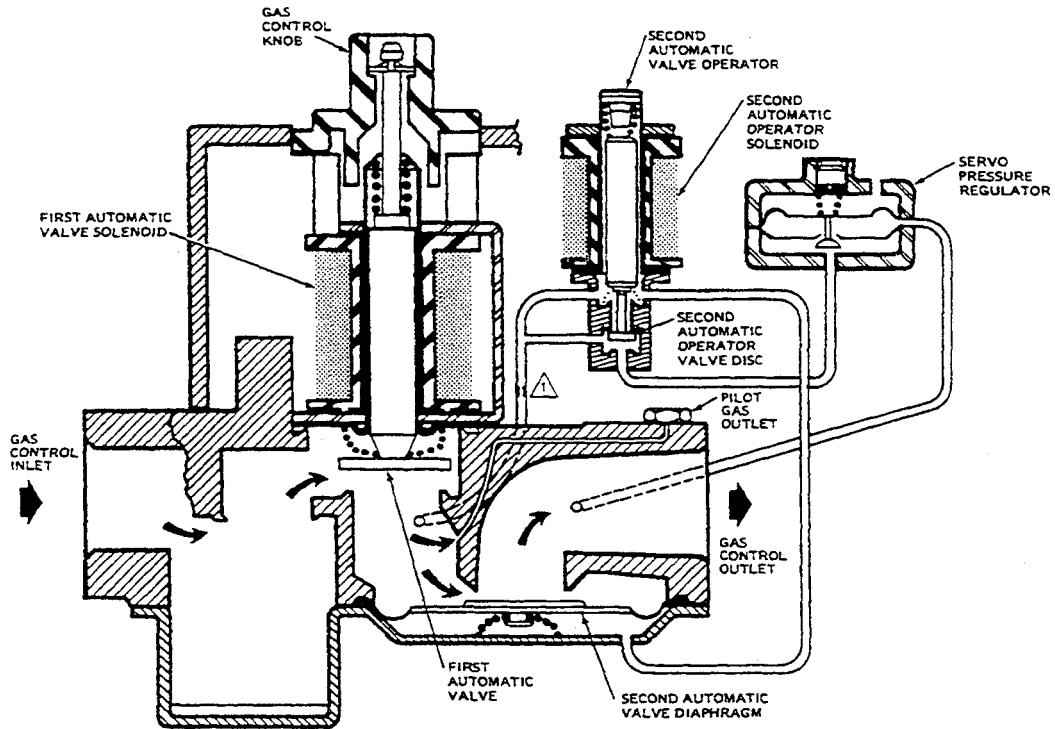


Figure 2

### Appendix - Position of Combination Gas Valve Components during Burner Operation, 4/02



NOTE: SECOND AUTOMATIC VALVE OPERATOR AND SERVO PRESSURE REGULATOR SHOWN OUTSIDE GAS CONTROL FOR EASE IN TRACING GAS FLOW.

 SLOW-OPENING GAS CONTROL HAS A GAS FLOW RESTRICTOR IN THIS PASSAGE.

## Appendix - Instructions for All Gas Conversion Kits for Ovens with Wayne Burner, Natural Gas to Propane, 8/00

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Instructions for Service Kits 42810-0119, 42810-0122, 42810-0123, 42810-0124, 43062, 44665

### Gas Conversion Kit for Middleby Marshall Ovens Natural Gas to Propane Operation


#### KIT COMPONENTS:

Qty.	PS200	PS220/224	PS310/360	PS360WB	PS360WB70/EWB	PS555	PS570S	Description
1	42810-0122	42810-0123	42810-0119	42810-0124	44665	43062	42810-0124	KIT, GAS CONVERSION, NATURAL TO PROPANE
1	22176-0007 0.1285"/3.26mm	22176-0017 0.1137"/2.87mm	22176-0003 0.134"/3.40mm	22176-0015 0.152"/3.86mm	31980 0.165"/4.19mm	43060 0.141"/3.58mm	22176-0015 0.152"/3.86mm	ORIFICE, MAIN
1	<-----				22174-0010 0.018"/0.45mm	----->		ORIFICE, PILOT
1	22174-0009 0.038"/0.97mm/ #62 drill	22174-0009 0.038"/0.97mm/ #62 drill	22174-0009 0.038"/0.97mm/ #62 drill	22174-0009 0.038"/0.97mm/ #62 drill	22174-0009 * 0.038"/0.97mm/ #62 drill	NONE *	22174-0009 * 0.038"/0.97mm/ #62 drill	ORIFICE, BYPASS (HIGH-FLAME)
1	<-----				28092-0018	----->		KIT, GAS CONTROL VALVE SPRING -PROPANE
1	<-----				22500-0065	----->		LABEL, PROPANE (RED)
1	<-----				22500-0123	----->		LABEL, GAS CONVERSION
1	<-----				22501-0007	----->		TAG, GAS CONTROL CONVERSION
1	<-----				88210-0069	----->		INSTRUCTIONS

\* NOTE: The bypass orifice is not used if the oven is equipped with a modulating gas valve. These ovens include:


- PS360EWB (all)
- PS555 (all)
- PS570S (units produced 4/00 or later)


For additional information, refer to Part III of these instructions (*Bypass Orifice Conversion*).




**IMPORTANT**


THIS CONVERSION KIT IS INTENDED FOR AGA-, CGA-, AND CSA-APPROVED MIDDLEBY MARSHALL GAS-FIRED OVENS OPERATING AT ALTITUDES UP TO 5000 FT. (1524m). FOR OVENS INSTALLED AT ALTITUDES ABOVE 5000 FT. (1524m), CONSULT THE FACTORY BEFORE INSTALLING THIS KIT.






THIS KIT MAY NOT BE USED WITH CE-APPROVED MIDDLEBY MARSHALL OVENS. FOR THESE OVENS, FOLLOW THE GAS CONVERSION INSTRUCTIONS IN THE *INSTALLATION* SECTION OF THE OVEN'S *OWNER'S OPERATING AND INSTALLATION MANUAL*.





**WARNING**

THIS CONVERSION KIT IS TO BE INSTALLED BY A MIDDLEBY MARSHALL AUTHORIZED SERVICE AGENT IN ACCORDANCE WITH THE MANUFACTURER'S INSTRUCTIONS AND ALL CODES AND REQUIREMENTS OF THE AUTHORITY HAVING JURISDICTION. FAILURE TO FOLLOW INSTRUCTIONS COULD RESULT IN SERIOUS INJURY OR PROPERTY DAMAGE. THE AUTHORIZED SERVICE AGENT PERFORMING THIS WORK ASSUMES RESPONSIBILITY FOR THIS CONVERSION.



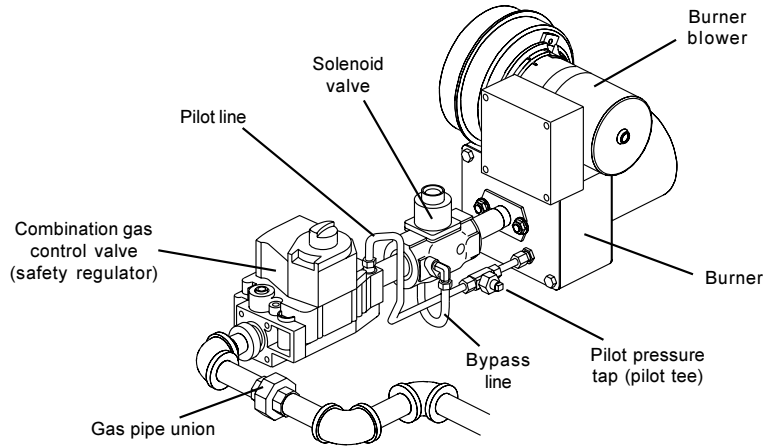
**WARNING**

BEFORE PERFORMING ANY SERVICE WORK, THE ELECTRICAL POWER SUPPLY AND THE GAS SUPPLY MUST BE TURNED OFF.

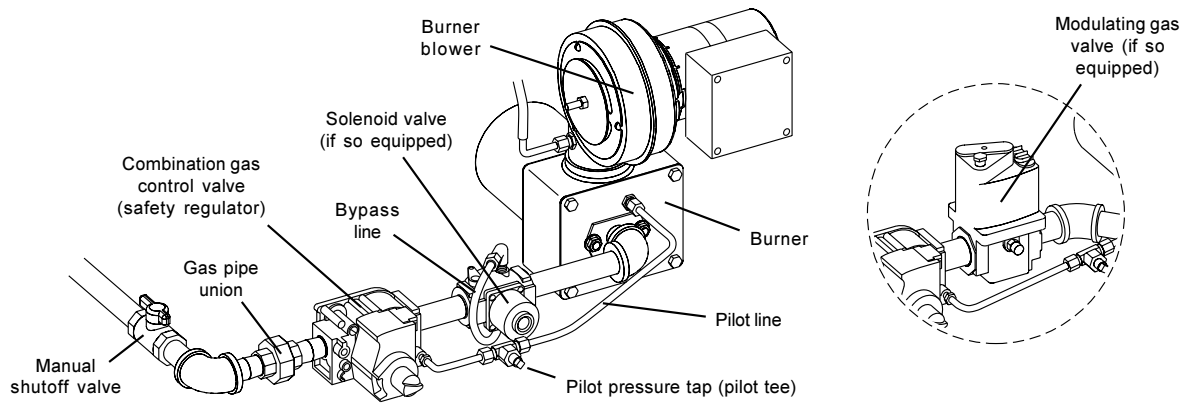


## Appendix - Instructions for All Gas Conversion Kits for Ovens with Wayne Burner, Natural Gas to Propane, 8/00

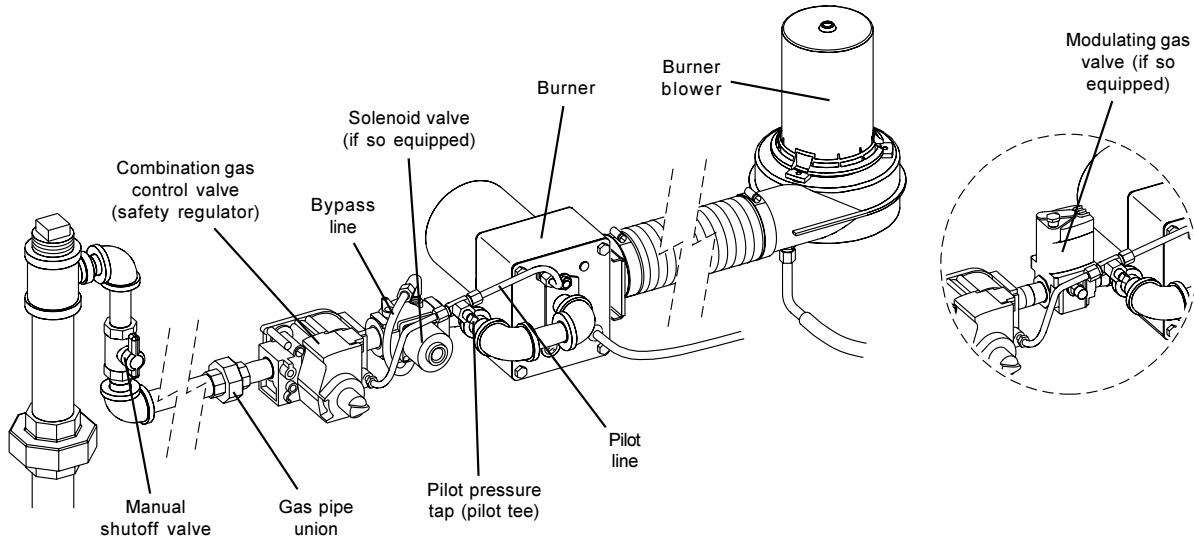
**Typical PS200-series gas train configuration**



**Typical PS300-series gas train configuration**



**Typical PS555 or PS570S gas train configuration**

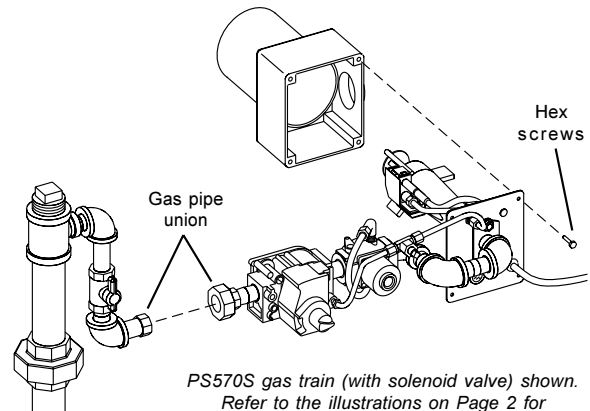


## Appendix - Instructions for All Gas Conversion Kits for Ovens with Wayne Burner, Natural Gas to Propane, 8/00

### I. PREPARATION AND DISASSEMBLY

1. Turn off the electric power supply to the oven.
2. Turn off the gas supply at the service valve behind the oven.
3. Open the machinery compartment door.
4. Open the union in the gas supply line. The union is located on the inlet side of the combination gas control valve. See Figure 1.
5. Unscrew the four hex screws that hold the venturi mounting plate to the front of the burner. Remove the gas train/venturi assembly from the oven.

Figure 1

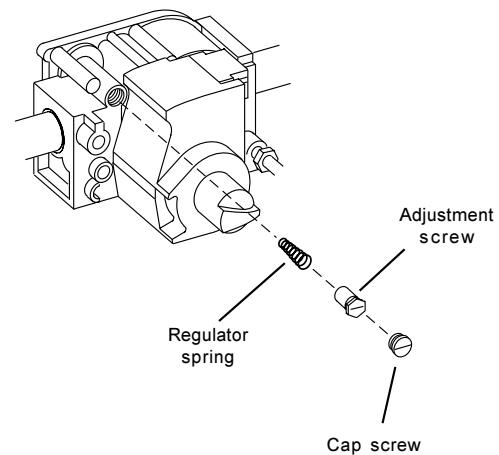


*PS570S gas train (with solenoid valve) shown.  
Refer to the illustrations on Page 2 for  
component placement for other oven models.*

### II. COMBINATION GAS CONTROL VALVE (SAFETY REGULATOR) CONVERSION

1. Remove and discard the following components from the combination gas control valve, as shown in Figure 2:
  - Regulator cap screw
  - Regulator adjustment screw
  - Regulator spring
2. Install the red kit-supplied regulator spring, with the tapered end facing into the valve, as shown in Figure 2.
3. Install the white kit-supplied regulator adjustment screw. Carefully adjust the screw until its top is flush with the top of the regulator.
4. Turn the adjustment screw six complete turns in a clockwise direction. This preliminary pressure setting is approximately 10-1/2" W.C. (26.1mbar).
5. Install the black kit-supplied cap screw.

Figure 2

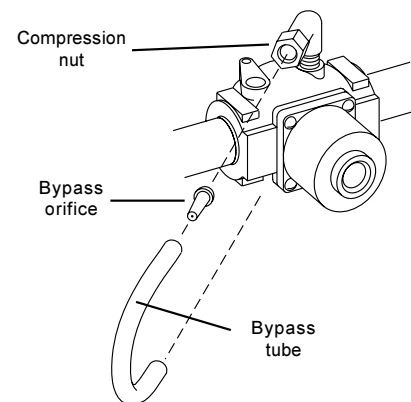


### III. BYPASS ORIFICE CONVERSION

*NOTE: Ovens are equipped with EITHER an on-off solenoid valve with a separate bypass line, OR with a modulating gas valve. Refer to the illustrations on Page 2. When installing this Kit, the bypass orifice will only be changed if the oven is equipped with a solenoid valve.*

- If the oven is equipped with a modulating gas valve, skip ahead to Section IV, *Pilot Orifice Conversion*.
  - If the oven is equipped with a solenoid valve, continue on to Step 1, below.
1. Unscrew the compression nuts at both ends of the bypass tube, and slide them back and out of the way. Then, remove and retain the tubing. See Figure 3.
  2. Remove and discard the existing bypass orifice.
  3. Slip the kit-supplied bypass orifice into the discharge end of the bypass tube, as shown in Figure 3.
  4. With the orifice in place, push the tube back into the compression fittings until it bottoms.
  5. While holding the tube in place, slide the compression nuts into place. Tighten them to a snug fit with your fingers.
  6. Gently tighten the nuts one complete turn with a wrench. **DONOT OVERTIGHTEN THE COMPRESSION NUTS.**

Figure 3

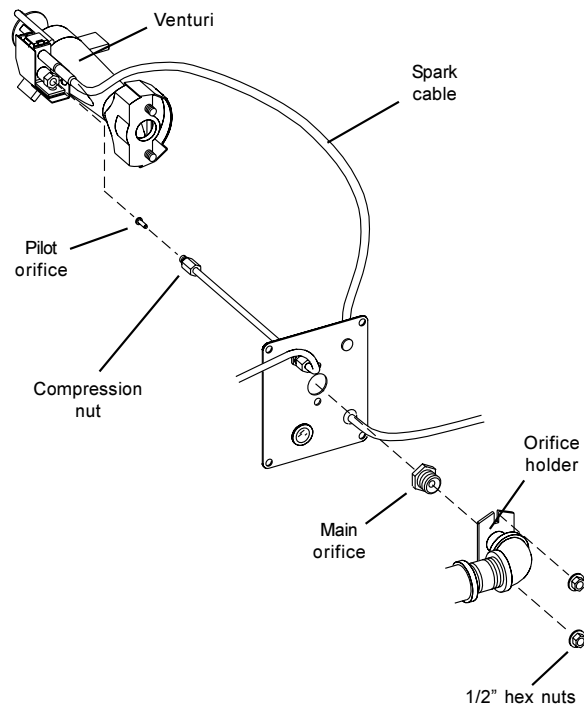


## Appendix - Instructions for All Gas Conversion Kits for Ovens with Wayne Burner, Natural Gas to Propane, 8/00

### IV. PILOT ORIFICE CONVERSION

1. Unscrew the two 1/2" nuts that secure the gas train to the venturi mounting plate. See Figure 4.
2. Unscrew the pilot tube compression nut, and slide it out of the way. Then, pull the tube from the fitting to expose the pilot orifice. See Figure 4.
3. Separate the venturi, mounting plate, and gas train assembly. Leave the main orifice holder attached to the gas train piping assembly.
4. Remove and discard the existing pilot orifice.
5. Slip the kit-supplied pilot orifice into the pilot tube.
6. With the orifice in place, push the tube back into the compression fitting until it bottoms.
7. While holding the tube in place, slide the compression nut into place. Tighten the nut to a snug fit with your fingers.
8. Gently tighten the nut one complete turn with a wrench. **DO NOT OVERTIGHTEN THE COMPRESSION NUT.**
9. To allow the main orifice to be replaced, do not reassemble the gas train to the venturi and mounting plate at this time.

Figure 4



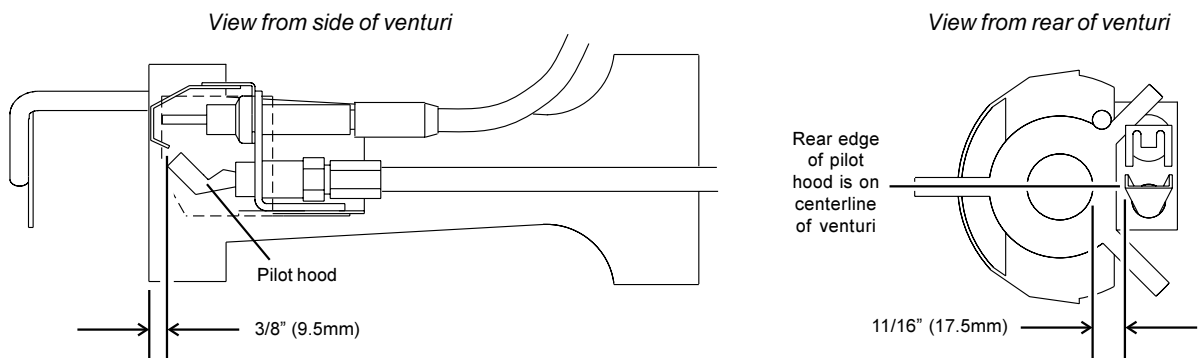
### V. MAIN ORIFICE CONVERSION

1. Unscrew the existing main orifice from its holder using an 11/16" wrench. See Figure 4.
2. Install the kit-supplied main orifice into the holder.

### VI. REASSEMBLY

1. Check that the pilot assembly is correctly aligned with the venturi, as shown in Figure 5. If necessary, reposition the pilot assembly.
2. Reassemble the venturi and mounting plate to the gas train assembly. Replace the two 1/2" hex nuts to hold the assembly together.
3. Replace the assembled gas train into the oven. Tighten the gas pipe union (on the inlet side of the combination gas valve) to hold the gas train in place.

Figure 5



4

## Appendix - Instructions for All Gas Conversion Kits for Ovens with Wayne Burner, Natural Gas to Propane, 8/00

### VII. GAS LEAK TEST

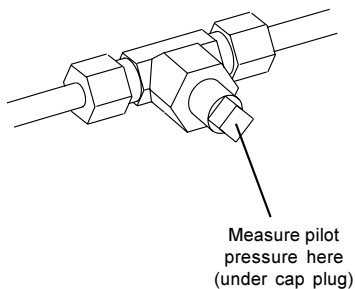
1. Restore the electrical and gas utility connections to the oven.
2. Paint all gas pipe connections from the union to the venturi mounting plate, as well as the pilot tubing, bypass tubing, and pressure tap plug, with a rich solution of soap and water (2/3 soap, 1/3 water is recommended). Any visible bubbles indicate a gas leak.
3. If a gas leak is detected, tighten the affected joints and connections. If tightening the connection(s) fails to stop the leak:
  - Turn off the electric power supply to the oven.
  - Turn off the gas supply at the service valve behind the oven.
  - Replace the affected component(s).
  - Repeat the gas leak test.



#### **WARNING - FIRE/EXPLOSION HAZARD**

*HIDDEN GAS LEAKS CAN CAUSE A FLASHBACK IN THE MACHINERY COMPARTMENT. THIS CAN CAUSE SEVERE INJURY OR DEATH. STAND WELL CLEAR WHEN SWITCHING ON THE HEATING CIRCUIT.*

4. If no leaks are detected by the test, depress the safety switch(es) and switch on the oven. Then, switch on the heating circuit to ignite the burner.
5. With the burner in operation, paint all gas pipe joints with the solution of soap and water.
6. If any further gas leaks are detected, shut down the oven. Reseal and tighten the affected joints and connections. If tightening the connection(s) fails to stop the leak:
  - Turn off the electric power supply to the oven.
  - Turn off the gas supply at the service valve behind the oven.
  - Replace the affected component(s).
  - Repeat the gas leak test.



### VIII. INLET PRESSURE CHECK

1. Using a manometer, check the inlet pressure at the inlet pressure tap. See Figure 6. An inlet pressure of 11-14" W.C. (27.4-34.9mbar) is recommended for propane operation.
2. If the inlet pressure is:
  - HIGHER THAN 14" W.C. (34.9mbar) - This pressure may damage the combination gas control valve (safety regulator). The gas supply pressure should be decreased.
  - LOWER THAN 11" W.C. (27.4mbar) - It may be necessary to increase the supplied gas pressure.

#### **CAUTION**

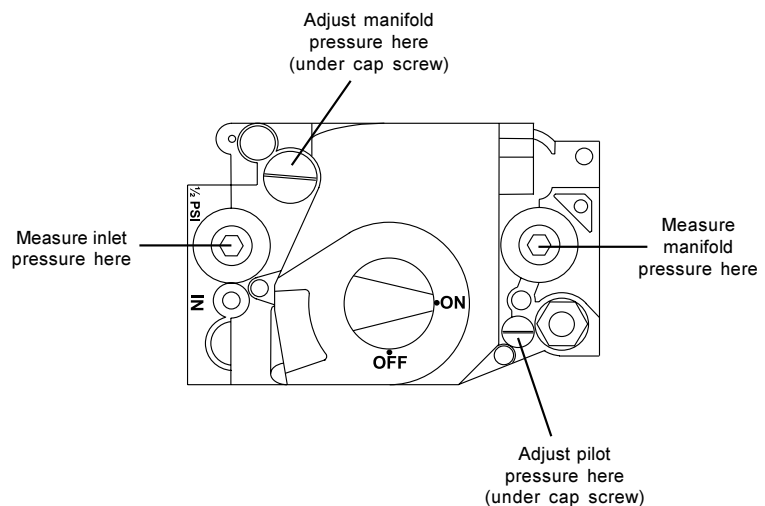
**IF IT IS NECESSARY TO ADJUST THE GAS LINE PRESSURE, HAVE THE CUSTOMER CONTACT THE GAS UTILITY SUPPLIER.**

### IX. PILOT PRESSURE ADJUSTMENT

1. Unscrew the cap plug from the pilot pressure tap (pilot tee), and attach a manometer to the tap. See Figure 6.
2. Remove the pilot adjustment cap screw from the combination gas control valve.
3. Turn the oven on, and allow it to heat to temperature. Make a note of the customer's set point temperature.
4. After the oven has heated, adjust the set point of the oven far lower than its current (operating) temperature. This ensures that the pilot flame will be at its lowest level for some time.

*Continued...*

**Figure 6**



5



## Appendix - Instructions for All Gas Conversion Kits for Ovens with Wayne Burner, Propane to Natural Gas, 8/00

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Instructions for Service Kits 42810-0120, 42810-0125, 42810-0126, 42810-0127, 43061, 44664

### Gas Conversion Kit for Middleby Marshall Ovens Propane to Natural Gas Operation


#### KIT COMPONENTS:

Qty.	PS200	PS220/224	PS310/360	PS360WB	PS360WB70/EWB	PS555	PS570S	Description
1	42810-0125	42810-0126	42810-0120	42810-0127	44664	43061	42810-0127	KIT, GAS CONVERSION, PROPANE TO NATURAL
1	22176-0010 0.204"/5.18mm	22176-0016 0.182"/4.62mm	22176-0004 0.219"/5.56mm	22176-0014 0.250"/6.35mm	22176-0014 0.250"/6.35mm	43059 0.228"/5.79mm	22176-0014 0.250"/6.35mm	ORIFICE, MAIN
1	< -----			22174-0011 0.028"/0.71mm	> -----			ORIFICE, PILOT
1	22174-0006 0.060"/1.52mm/ #53 drill	22174-0006 0.060"/1.52mm/ #53 drill	22174-0006 0.060"/1.52mm/ #53 drill	22174-0006 0.060"/1.52mm/ #53 drill	22174-0006 * 0.060"/1.52mm/ #53 drill	NONE *	22174-0006 * 0.060"/1.52mm/ #53 drill	ORIFICE, BYPASS (HIGH-FLAME)
1	< -----			28092-0019	> -----			KIT, GAS CONTROL VALVE SPRING - NATURAL GAS
1	< -----			22500-0064	> -----			LABEL, NATURAL GAS (YELLOW/GREEN)
1	< -----			22500-0123	> -----			LABEL, GAS CONVERSION
1	< -----			22501-0007	> -----			TAG, GAS CONTROL CONVERSION
1	< -----			88210-0070	> -----			INSTRUCTIONS

\* NOTE: The bypass orifice is not used if the oven is equipped with a modulating gas valve. These ovens include:


- PS360EWB (all)
- PS555 (all)
- PS570S (units produced 4/00 or later)


For additional information, refer to Part III of these instructions (*Bypass Orifice Conversion*).




**IMPORTANT**


THIS CONVERSION KIT IS INTENDED FOR AGA-, CGA-, AND CSA-APPROVED MIDDLEBY MARSHALL GAS-FIRED OVENS OPERATING AT ALTITUDES UP TO 5000 FT. (1524m). FOR OVENS INSTALLED AT ALTITUDES ABOVE 5000 FT. (1524m), CONSULT THE FACTORY BEFORE INSTALLING THIS KIT.






THIS KIT **MAY NOT** BE USED WITH CE-APPROVED MIDDLEBY MARSHALL OVENS. FOR THESE OVENS, FOLLOW THE GAS CONVERSION INSTRUCTIONS IN THE *INSTALLATION* SECTION OF THE OVEN'S *OWNER'S OPERATING AND INSTALLATION MANUAL*.





**WARNING**

THIS CONVERSION KIT IS TO BE INSTALLED BY A MIDDLEBY MARSHALL AUTHORIZED SERVICE AGENT IN ACCORDANCE WITH THE MANUFACTURER'S INSTRUCTIONS AND ALL CODES AND REQUIREMENTS OF THE AUTHORITY HAVING JURISDICTION. FAILURE TO FOLLOW INSTRUCTIONS COULD RESULT IN SERIOUS INJURY OR PROPERTY DAMAGE. THE AUTHORIZED SERVICE AGENT PERFORMING THIS WORK ASSUMES RESPONSIBILITY FOR THIS CONVERSION.

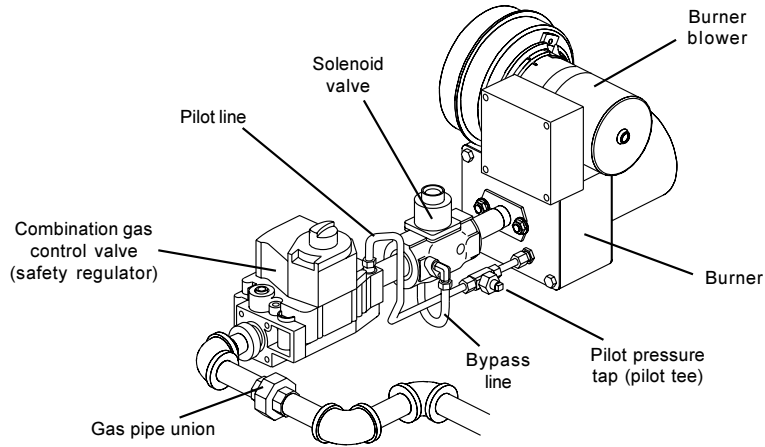


**WARNING**

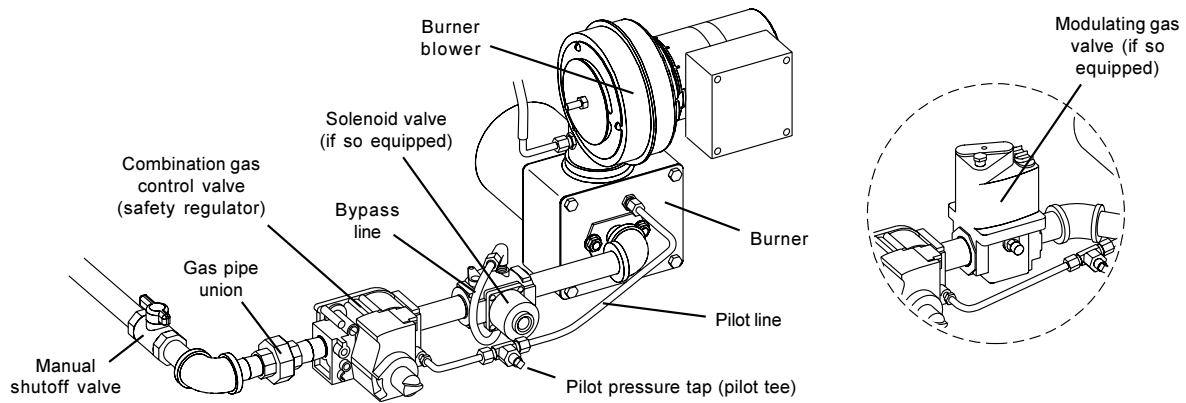
BEFORE PERFORMING ANY SERVICE WORK, THE ELECTRICAL POWER SUPPLY AND THE GAS SUPPLY MUST BE TURNED OFF.

## Appendix - Instructions for All Gas Conversion Kits for Ovens with Wayne Burner, Propane to Natural Gas, 8/00

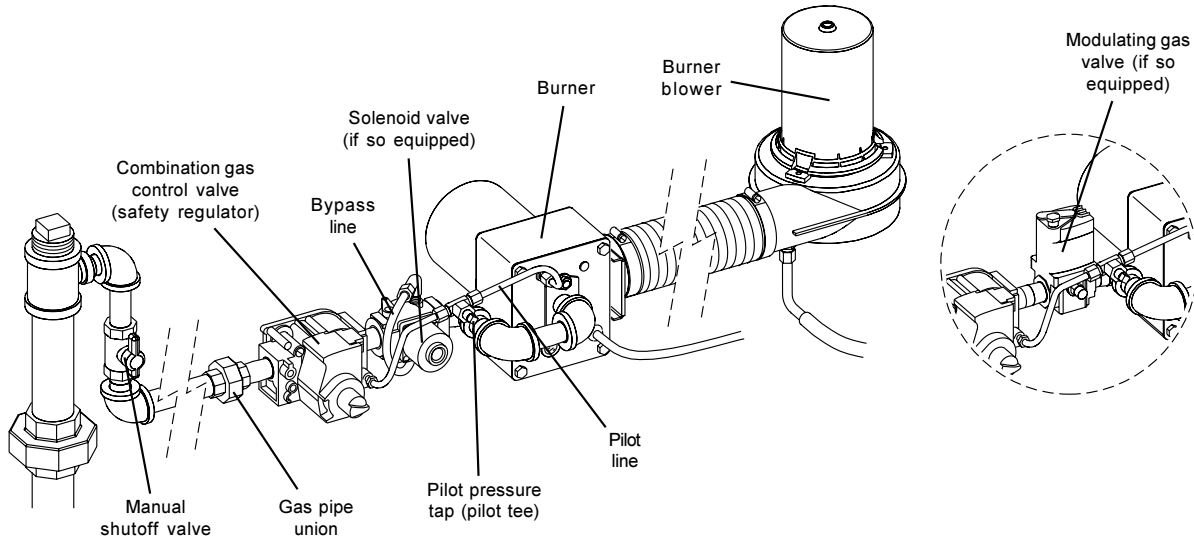
**Typical PS200-series gas train configuration**



**Typical PS300-series gas train configuration**



**Typical PS555 or PS570S gas train configuration**

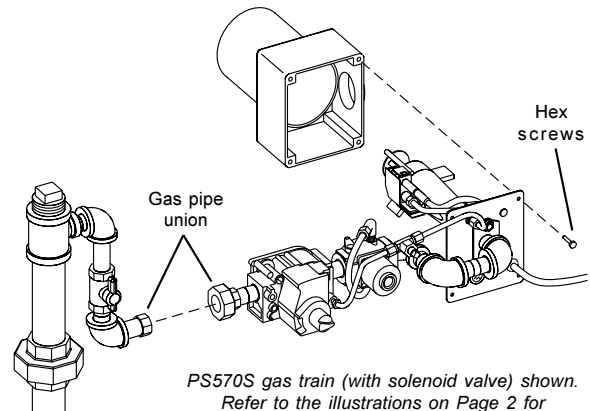


## Appendix - Instructions for All Gas Conversion Kits for Ovens with Wayne Burner, Propane to Natural Gas, 8/00

### I. PREPARATION AND DISASSEMBLY

1. Turn off the electric power supply to the oven.
2. Turn off the gas supply at the service valve behind the oven.
3. Open the machinery compartment door.
4. Open the union in the gas supply line. The union is located on the inlet side of the combination gas control valve. See Figure 1.
5. Unscrew the four hex screws that hold the venturi mounting plate to the front of the burner. Remove the gas train/venturi assembly from the oven.

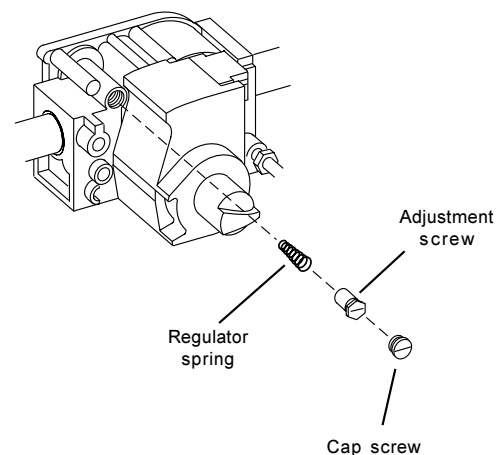
Figure 1



### II. COMBINATION GAS CONTROL VALVE (SAFETY REGULATOR) CONVERSION

1. Remove and discard the following components from the combination gas control valve, as shown in Figure 2:
  - Regulator cap screw
  - Regulator adjustment screw
  - Regulator spring
2. Install the stainless steel kit-supplied regulator spring, with the tapered end facing into the valve, as shown in Figure 2.
3. Install the kit-supplied regulator adjustment screw. Carefully adjust the screw until its top is flush with the top of the regulator.
4. Turn the adjustment screw six complete turns in a clockwise direction. This preliminary pressure setting is approximately 3-1/2" W.C. (8.7mbar).
5. Install the silver kit-supplied cap screw.

Figure 2

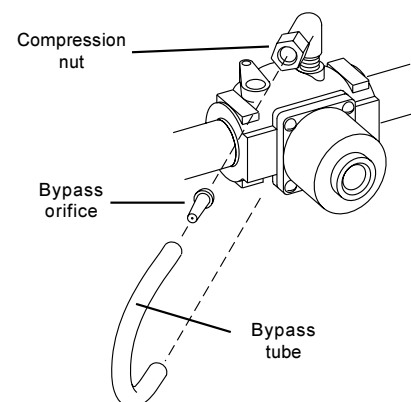


### III. BYPASS ORIFICE CONVERSION

*NOTE: Ovens are equipped with EITHER an on-off solenoid valve with a separate bypass line, OR with a modulating gas valve. Refer to the illustrations on Page 2. When installing this Kit, the bypass orifice will only be changed if the oven is equipped with a solenoid valve.*

- If the oven is equipped with a modulating gas valve, skip ahead to Section IV, *Pilot Orifice Conversion*.
  - If the oven is equipped with a solenoid valve, continue on to Step 1, below.
1. Unscrew the compression nuts at both ends of the bypass tube, and slide them back and out of the way. Then, remove and retain the tubing. See Figure 3.
  2. Remove and discard the existing bypass orifice.
  3. Slip the kit-supplied bypass orifice into the discharge end of the bypass tube, as shown in Figure 3.
  4. With the orifice in place, push the tube back into the compression fittings until it bottoms.
  5. While holding the tube in place, slide the compression nuts into place. Tighten them to a snug fit with your fingers.
  6. Gently tighten the nuts one complete turn with a wrench. **DO NOT OVERTIGHTEN THE COMPRESSION NUTS.**

Figure 3



3

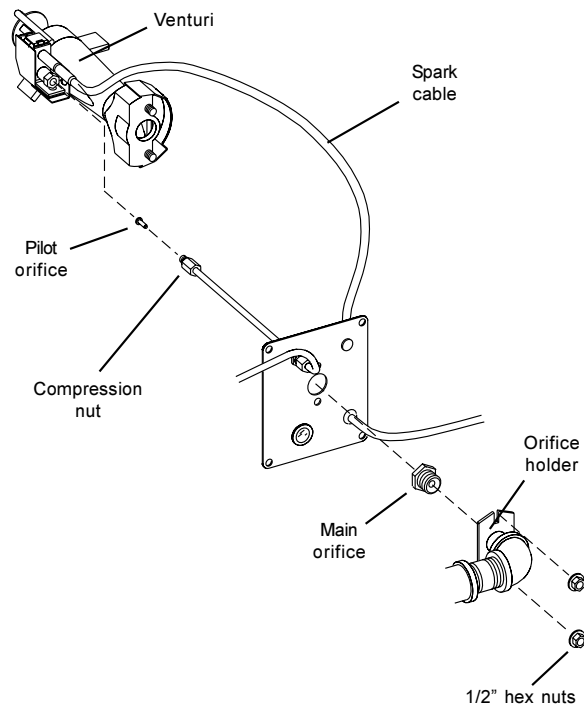


## Appendix - Instructions for All Gas Conversion Kits for Ovens with Wayne Burner, Propane to Natural Gas, 8/00

### IV. PILOT ORIFICE CONVERSION

1. Unscrew the two 1/2" nuts that secure the gas train to the venturi mounting plate. See Figure 4.
2. Unscrew the pilot tube compression nut, and slide it out of the way. Then, pull the tube from the fitting to expose the pilot orifice. See Figure 4.
3. Separate the venturi, mounting plate, and gas train assembly. Leave the main orifice holder attached to the gas train piping assembly.
4. Remove and discard the existing pilot orifice.
5. Slip the kit-supplied pilot orifice into the pilot tube.
6. With the orifice in place, push the tube back into the compression fitting until it bottoms.
7. While holding the tube in place, slide the compression nut into place. Tighten the nut to a snug fit with your fingers.
8. Gently tighten the nut one complete turn with a wrench. **DO NOT OVERTIGHTEN THE COMPRESSION NUT.**
9. To allow the main orifice to be replaced, do not reassemble the gas train to the venturi and mounting plate at this time.

Figure 4



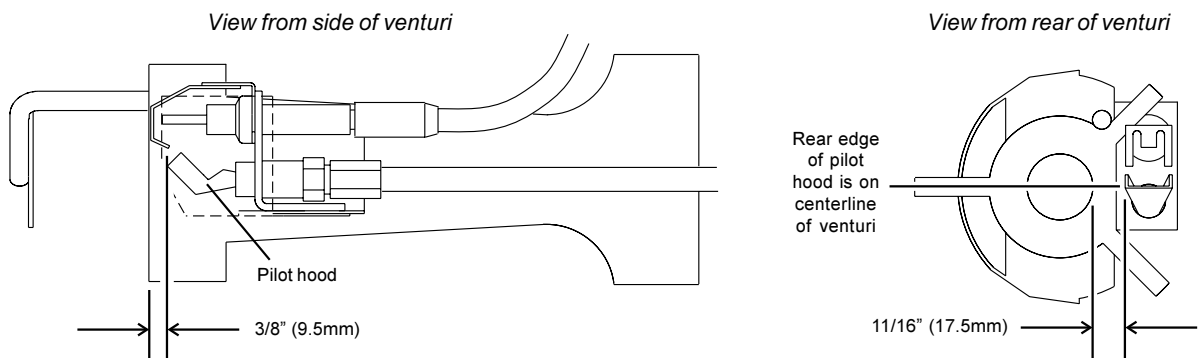
### V. MAIN ORIFICE CONVERSION

1. Unscrew the existing main orifice from its holder using an 11/16" wrench. See Figure 4.
2. Install the kit-supplied main orifice into the holder.

### VI. REASSEMBLY

1. Check that the pilot assembly is correctly aligned with the venturi, as shown in Figure 5. If necessary, reposition the pilot assembly.
2. Reassemble the venturi and mounting plate to the gas train assembly. Replace the two 1/2" hex nuts to hold the assembly together.
3. Replace the assembled gas train into the oven. Tighten the gas pipe union (on the inlet side of the combination gas valve) to hold the gas train in place.

Figure 5



## Appendix - Instructions for All Gas Conversion Kits for Ovens with Wayne Burner, Propane to Natural Gas, 8/00

### VII. GAS LEAK TEST

1. Restore the electrical and gas utility connections to the oven.
2. Paint all gas pipe connections from the union to the venturi mounting plate, as well as the pilot tubing, bypass tubing, and pressure tap plug, with a rich solution of soap and water (2/3 soap, 1/3 water is recommended). Any visible bubbles indicate a gas leak.
3. If a gas leak is detected, tighten the affected joints and connections. If tightening the connection(s) fails to stop the leak:
  - Turn off the electric power supply to the oven.
  - Turn off the gas supply at the service valve behind the oven.
  - Replace the affected component(s).
  - Repeat the gas leak test.



#### **WARNING - FIRE/EXPLOSION HAZARD**

*HIDDEN GAS LEAKS CAN CAUSE A FLASHBACK IN THE MACHINERY COMPARTMENT. THIS CAN CAUSE SEVERE INJURY OR DEATH. STAND WELL CLEAR WHEN SWITCHING ON THE HEATING CIRCUIT.*

4. If no leaks are detected by the test, depress the safety switch(es) and switch on the oven. Then, switch on the heating circuit to ignite the burner.
5. With the burner in operation, paint all gas pipe joints with the solution of soap and water.
6. If any further gas leaks are detected, shut down the oven. Reseal and tighten the affected joints and connections. If tightening the connection(s) fails to stop the leak:
  - Turn off the electric power supply to the oven.
  - Turn off the gas supply at the service valve behind the oven.
  - Replace the affected component(s).
  - Repeat the gas leak test.

### VIII. INLET PRESSURE CHECK

1. Using a manometer, check the inlet pressure at the inlet pressure tap. See Figure 6. An inlet pressure of 6-12" W.C. (14.9-29.9mbar) is recommended for natural gas operation.
2. If the inlet pressure is:
  - HIGHER THAN 14" W.C. (34.9mbar) - This pressure may damage the combination gas control valve (safety regulator). The gas supply pressure should be decreased.
  - LOWER THAN 6" W.C. (14.9mbar) - It may be necessary to increase the supplied gas pressure.

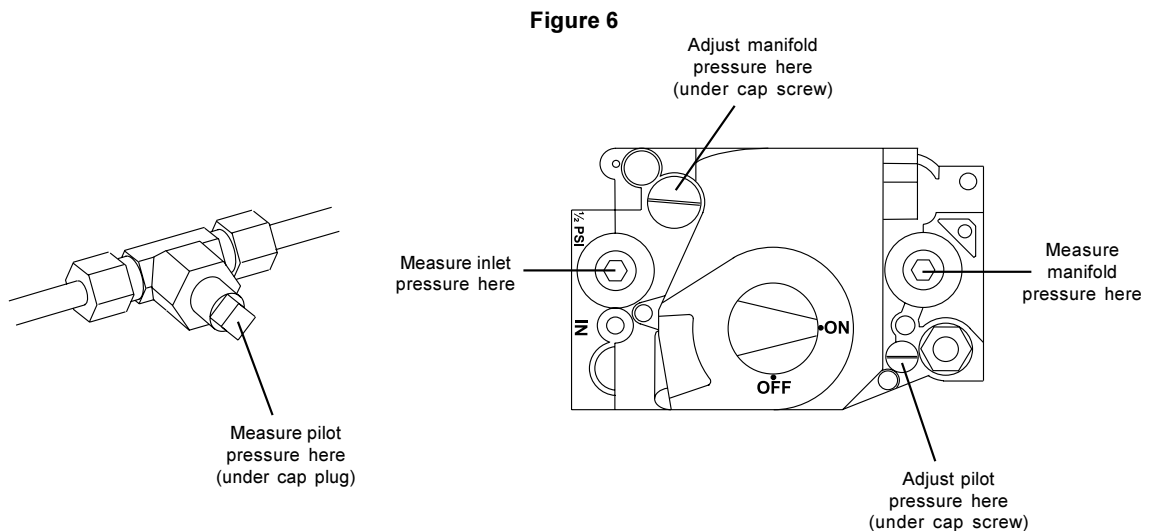
#### **CAUTION**

**IF IT IS NECESSARY TO ADJUST THE GAS LINE PRESSURE, HAVE THE CUSTOMER CONTACT THE GAS UTILITY SUPPLIER.**

### IX. PILOT PRESSURE ADJUSTMENT

1. Unscrew the cap plug from the pilot pressure tap (pilot tee), and attach a manometer to the tap. See Figure 6.
2. Remove the pilot adjustment cap screw from the combination gas control valve.
3. Turn the oven on, and allow it to heat to temperature. Make a note of the customer's set point temperature.
4. After the oven has heated, adjust the set point of the oven far lower than its current (operating) temperature. This ensures that the pilot flame will be at its lowest level for some time.

*Continued...*



## Appendix - Instructions for All Gas Conversion Kits for Ovens with Wayne Burner, Propane to Natural Gas, 8/00

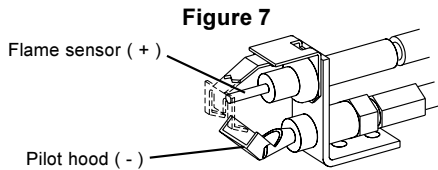
5. The pilot pressure should be adjusted as follows:
  - The current flow between the pilot hood and the flame sensor, when measured with a microamp meter or multimeter, holds constant at a minimum of 2.0  $\mu$ A. See Figure 7.
  - The pilot pressure as shown on the manometer is in the range of 3-1/2" - 4" W.C. (8.7-10.0 mbar).

Adjust the pilot pressure as necessary by turning the pilot adjustment screw on the combination gas control valve. Turning the screw clockwise decreases the pilot pressure. Turning the screw counter-clockwise increases the pressure.

Some valves may have a burr in the pilot adjustment portal. If you have fully tightened the adjustment screw, and the manometer still does not register a change in pressure, continue to tighten the screw to break through the burr. Back the screw out until its top is flush with the top of its hole, then tighten the screw again as necessary to adjust the pressure. Repeat this procedure as necessary to properly adjust the pilot pressure.

If the pilot pressure cannot be properly adjusted, switch the oven off and allow it to cool; then, replace the combination gas control valve. Repeat Section VII (*Gas Leak Test*) before attempting to adjust the pilot pressure again.

7. After the pilot pressure has been properly adjusted, replace the cap screw.
8. Reset the oven's set point temperature to the customer's original settings. Leave the oven in operation to allow the manifold pressure to be checked in the next Section of these instructions.



**Figure 7**

### X. MANIFOLD PRESSURE ADJUSTMENT

1. Remove the regulator cap screw from the combination gas control valve.
2. Using a manometer, check the pressure at the manifold pressure tap, as shown in Figure 6. A manifold pressure of 3-1/2" W.C. (8.7mbar) is recommended for natural gas operation.
3. Adjust the pressure as necessary by turning the adjustment screw on the combination gas control valve. Turning the screw clockwise decreases the pressure. Turning the screw counter-clockwise increases the pressure.

If the manifold pressure cannot be properly adjusted, switch the oven off and allow it to cool; then, replace the combination gas control valve. Repeat Section VII (*Gas Leak Test*) before attempting to adjust the manifold pressure again.

4. After the manifold pressure has been properly adjusted, replace the cap screw. Record the final value on the Gas Conversion Label, as shown in Figure 8.
5. Switch the oven off, and allow it to cool.

### XI. MARKING AND LABELING

1. Print the word "NATURAL" in the space provided on the Gas Control Conversion Tag, P/N 22501-0007. See Figure 8. Fasten the tag onto the gas piping next to the combination gas control valve.
2. Locate the round "LPG" label (red) on the burner or burner motor. Attach the kit-supplied yellow/green "NAT" label, P/N 22500-0064, on top of the "LPG" label. The new label should completely cover the "LPG" label. See Figure 8.
3. Complete the information on the Gas Conversion Label as shown in Figure 8.
4. Attach the Gas Conversion Label in plain view on the outside of the oven, as close as possible to the oven's serial plate.

**Figure 8**

THIS CONTROL HAS BEEN CONVERTED FOR USE WITH NATURAL GAS  
22501-0007

Attach to gas piping next to combination gas valve

Attach on top of existing "LPG" label (on burner or burner motor)

New label completely covers "LPG" label

THIS APPLIANCE HAS BEEN CONVERTED ON \_\_\_\_\_ TO NATURAL GAS WITH KIT NO. \_\_\_\_\_ BY \_\_\_\_\_, WHO ACCEPTS THE RESPONSIBILITY FOR THE CORRECTNESS OF THIS CONVERSION.

Name of technician \_\_\_\_\_ Date of conversion \_\_\_\_\_

Part no. of this Kit - see chart on Page 1

MODEL NO. \_\_\_\_\_ MAIN BURNER ORIFICE SIZE \_\_\_\_\_ MANIFOLD PRESSURE \_\_\_\_\_  
INPUT RATING \_\_\_\_\_ MAXIMUM INLET PRESSURES \_\_\_\_\_ 14" W.C. / 34.9mbar

Measured value from Section X

Stated on the oven's serial plate

See chart on Page 1

Attach completed label in plain view near serial plate

## Appendix - Instructions for Service Kit 36856 - Gas Conversion Kit for PS360EWB/WB70 with Midco Burner, Natural Gas to Propane, 1/98

Middleby Cooking Systems Group • 1400 Toastmaster Drive • Elgin, IL 60120 • (847)741-3300 • FAX (847)741-4406



### Oven Gas Conversion Kit p/n 36856 PS360EWB and PS360WB70 Natural Gas to Propane Installation Instructions



#### WARNING

This conversion kit is to be installed by a Middleby Marshall Authorized Service Organization in accordance with the manufacturer's instructions and all codes and requirements of the authority having jurisdiction. Failure to follow instructions could result in serious injury or property damage. The authorized service organization performing this work assumes responsibility for this conversion.

This kit consists of the following parts:

Qty.	Units	p/n	Description
1	ea.	36857	Instructions for Conversion of Natural Gas Operation to Propane Operation, PS360EWB and PS360WB70
1	ea.	31819	Orifice, Pilot Assembly - Propane, 0.025" (0.64mm)
1	ea.	31822	Orifice, Main - Propane, 0.185" (4.70mm)
1	ea.	22174-0009	Orifice, Low Flame - Propane, 0.034" (0.86mm, #62 drill) - used for converting PS360WB70 only
1	ea.	22500-0065	Label, LPG, Red
1	ea.	22500-0123	Label, Conversion - Gas



#### IMPORTANT

When converting any oven that is installed at an altitude above 5000 ft. (1524m), consult Middleby before installing this Kit.

### 1. PREPARATION

- 1.1 Turn off the electric power supply to the oven.
- 1.2 Turn off the gas supply at the service valve behind the oven.



#### WARNING

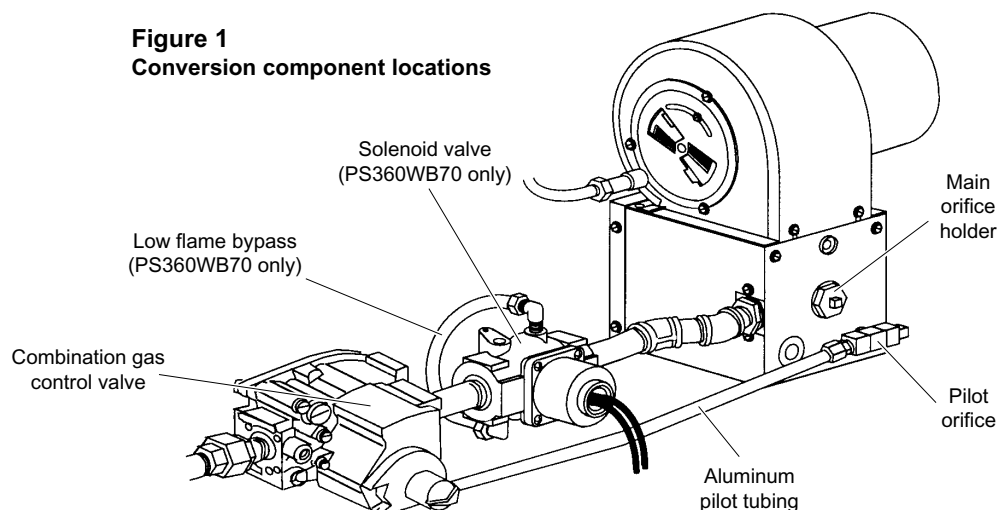
Before performing any service or conversion work, the electrical power supply AND the gas supply **MUST** be turned off.

- 1.3 Open the machinery compartment access door.

### 2. PILOT ORIFICE REPLACEMENT

- 2.1 Unscrew the brass fittings at both ends of the aluminum pilot tubing that connects the pilot orifice to the combination gas control valve. This allows the tubing to be removed. See **Figure 1**.

**Figure 1**  
Conversion component locations



## Appendix - Instructions for Service Kit 36856 - Gas Conversion Kit for PS360EWB/WB70 with Midco Burner, Natural Gas to Propane, 1/98

- 2.2 Remove and retain the aluminum pilot tubing from the burner assembly. The end of the tubing that enters the combination gas control valve should be removed first.
- 2.3 Remove and retain the pilot orifice by unscrewing it (counterclockwise) from the burner plenum wall.
- 2.4 Unscrew and retain the pilot tubing connector and the pilot tap plug from the ends of the pilot orifice, as shown in **Figure 2**. When these attachments have been removed, discard the pilot orifice.
- 2.5 Screw the pilot tubing connector and the pilot tap plug into place in the new propane pilot orifice (p/n 31819). Tighten them to a snug fit.
- 2.6 Screw the new propane pilot orifice into its opening in the plenum wall. Tighten it to a snug fit. Ensure that the end of the orifice holding the pilot tubing mount points towards the piping assembly.
- 2.7 Replace the aluminum pilot tubing that was removed in **Step 2.2**, above.
- 2.8 Screw in the brass fittings at both ends of the aluminum pilot tubing. Tighten them to a snug fit. **DO NOT OVERTIGHTEN THE FITTINGS.**

### 3. MAIN ORIFICE REPLACEMENT

- 3.1 Remove and retain the main orifice holder by unscrewing it (counterclockwise) from the burner plenum wall.
- 3.2 Unscrew and discard the main orifice from the inner end of the holder, as shown in **Figure 3**.
- 3.3 Screw the new propane main orifice (p/n 31822) into the orifice holder. Tighten it to a snug fit.
- 3.4 Replace the main orifice holder into its opening in the burner plenum. Tighten it to a snug fit.

### 4. LOW FLAME ORIFICE REPLACEMENT (PS360WB70 only)

- 4.1 Unscrew the brass fittings at both ends of the aluminum low flame tubing. This allows the tubing to be removed. See **Figure 4**.
- 4.2 Remove and retain the tubing from the solenoid valve.
- 4.3 Remove and discard the low flame orifice from the end of the low flame tubing.
- 4.4 Insert the new propane low flame orifice (p/n 22174-0009) into the discharge end of the low flame tubing, as shown in **Figure 4**.
- 4.5 Replace the low flame tubing into the fittings on the solenoid valve.
- 4.6 Screw in the brass fittings at both ends of the aluminum low flame tubing. Tighten them to a snug fit.

### 5. GAS LEAK TEST

- 5.1 Paint all pipe connections from the gas union to the burner plenum, and the aluminum pilot and low flame orifice tubing connections, with a solution of soap and water (2/3 soap, 1/3 water is recommended). Any bubbles that are visible indicate a gas leak.
- 5.2 If a gas leak is detected, tighten the affected joints and connections. If tightening the connections fails to stop the leak, replace the affected component and repeat the gas leak test.

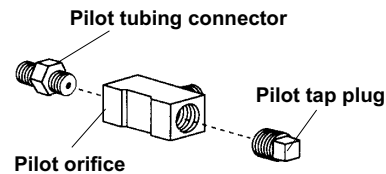


#### **WARNING - FIRE / EXPLOSION HAZARD**

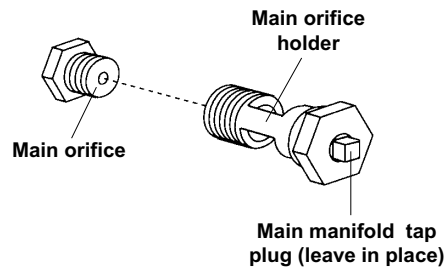
Hidden gas leaks can cause a flashback in the machinery compartment. **THIS CAN CAUSE SEVERE INJURY OR DEATH. Stand well clear when switching on the heating circuit.**

- 5.3 If no leaks are detected by the test, switch on the oven. Switch on the heating circuit to ignite the main burner.
- 5.4 With the burner in operation, paint all gas pipe joints with the solution of soap and water.
- 5.5 If any further gas leaks are detected, shut down the oven. Reseal and tighten the affected joints and connections. If tightening the connections fails to stop the leak, replace the affected component(s) and repeat the gas leak test.

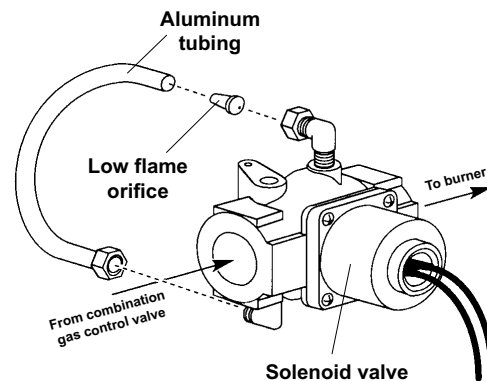
**Figure 2**  
Pilot orifice assembly



**Figure 3**  
Main orifice and holder



**Figure 4**  
Low flame orifice replacement



## Appendix - Instructions for Service Kit 36856 - Gas Conversion Kit for PS360EWB/WB70 with Midco Burner, Natural Gas to Propane, 1/98

### 6. INLET PRESSURE CHECK

6.1 Check the gas control inlet pressure at the inlet pressure tap. See **Figure 6**. An inlet pressure of 6-14" (14.9-34.9mbar) is recommended for propane operation.

6.2 If the inlet pressure is:

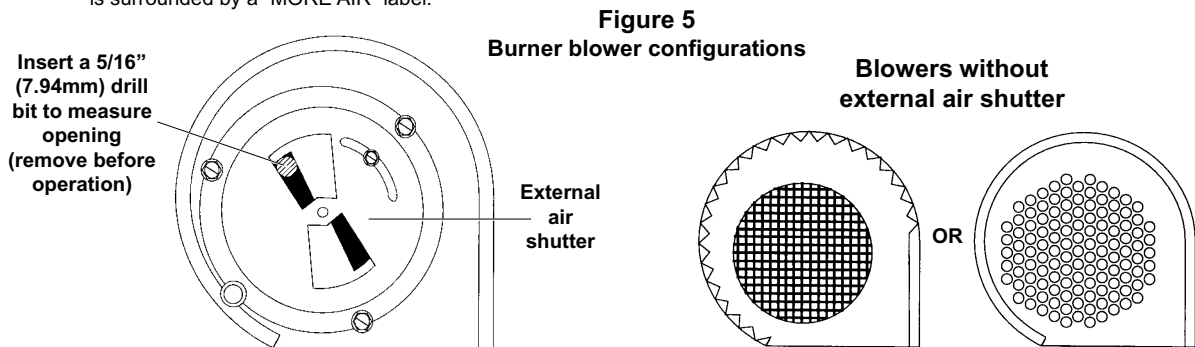
- HIGHER THAN 14" W. C. (34.9mbar) - This pressure may damage the combination gas control valve. Decrease the supplied gas pressure.
- LOWER THAN 3" W. C. (7.46mbar) - It may be necessary to increase the supplied gas pressure.

If it is necessary to adjust the gas line pressure, have the customer contact the gas utility supplier.

### 7. PILOT PRESSURE ADJUSTMENT

7.1 Ensure that the air supply is properly adjusted for propane operation.

- Units with a burner blower air shutter (see **Figure 5**) should have the shutter opening (at its outside edge) set to 5/16" (7.94mm). A drill bit can be used to check the adjustment of this opening.
- Units without the air shutter (see **Figure 5**) should have the burner air supply adjustment screw turned 11-17 full revolutions clockwise from the fully closed (counterclockwise) position. The screw is located on the front wall of the burner plenum, and is surrounded by a "MORE AIR" label.



7.2 Before proceeding:

- For a PS360EWB oven, the set point should be reduced below the room temperature.
- For a PS360WB70 oven, set the oven to low flame.

7.3 Measure the pilot pressure at the pilot pressure tap, as shown in **Figure 6**. The gas pressure should be 5-6" W. C. (12.5-14.9mbar) for proper operation.

7.4 If necessary, adjust the pilot pressure as follows:

- Remove the pilot adjustment cap screw.
- Using a screwdriver, turn the inner adjustment screw counterclockwise to increase, or clockwise to decrease, the pilot gas pressure.
- Replace the cap screw and tighten it firmly.

7.5 Measure the current across the pilot flame sensor. The current must measure **at least 2.0  $\mu$ A**. If the current reading is too low, recheck the pilot pressure as per **Step 7.3**. If the pressure reading is correct, consult the factory; otherwise, repeat **Steps 7.4** and **7.5**.

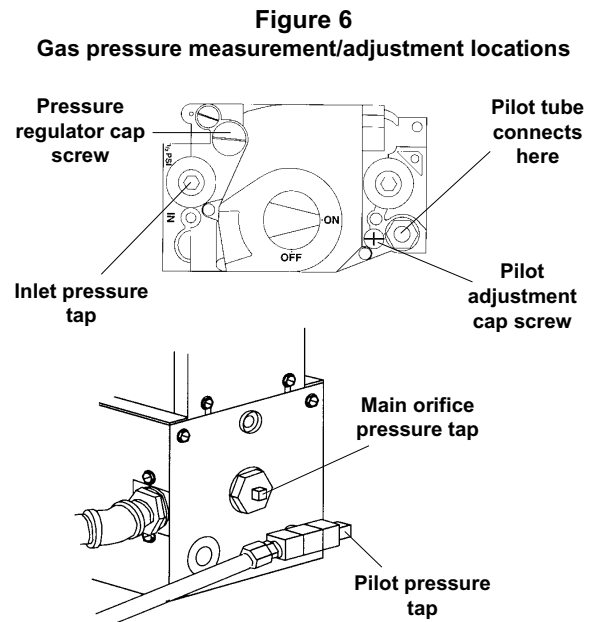
### 8. MAIN MANIFOLD PRESSURE ADJUSTMENT

8.1 With the oven set to high flame, measure the regulated gas pressure to the burner. The outlet pressure should be checked at the main orifice pressure tap. See **Figure 6**. The gas pressure should be 3" W. C. (7.46mbar) for proper operation.

8.2 If necessary, adjust the pressure regulator as follows:

- Remove the pressure regulator cap screw.
- Using a screwdriver, turn the inner adjustment screw clockwise to increase, or counterclockwise to decrease, the main burner gas pressure.
- Replace the cap screw and tighten it firmly.

8.3 Record the final measured regulated gas pressure on the silver conversion information label (included in the kit).

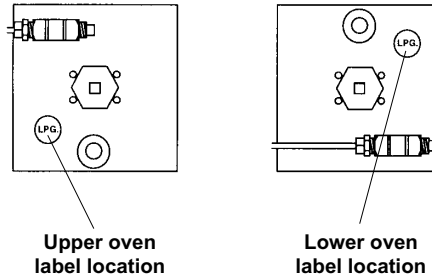


## Appendix - Instructions for Service Kit 36856 - Gas Conversion Kit for PS360EWB/WB70 with Midco Burner, Natural Gas to Propane, 1/98

### 9. CONVERSION LABELING

- 9.1 Remove and discard the round, green "NAT." label from the front face of the burner plenum.
- 9.2 Apply the round, red "LPG." label (p/n 22500-0065) to the front face of the burner housing as shown in **Figure 7**.
- 9.3 Close the machinery compartment access door.
- 9.4 Record the information requested on the silver conversion information label. **Figure 8** shows a representation of this label.
- 9.5 Apply the conversion information label to the front of the machinery compartment access door, next to the control panel. See **Figure 9**.

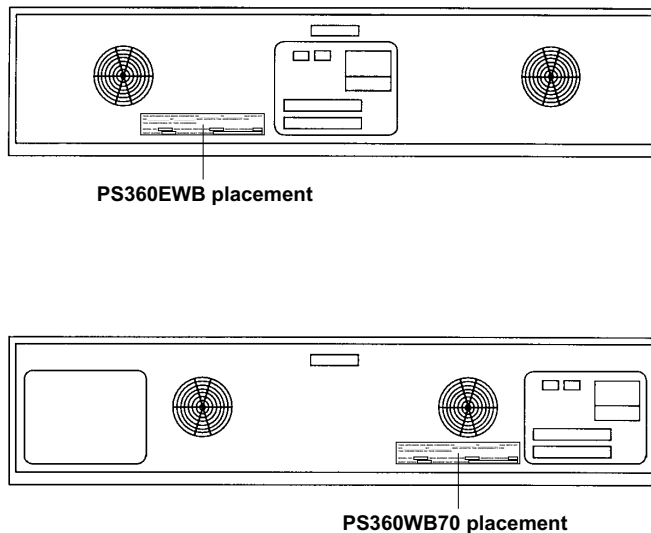
**Figure 7**  
Red "LPG." label placement  
(on burner housing)



**Figure 8**  
Conversion information label

Signature of technician performing conversion	Date of conversion
<p>THIS APPLIANCE HAS BEEN CONVERTED ON _____ TO <u>PROPANE</u> GAS WITH KIT NO. <u>36856</u> BY _____, WHO ACCEPTS THE RESPONSIBILITY FOR THE CORRECTNESS OF THIS CONVERSION.</p>	
<p>MODEL NO. <input type="text"/> MAIN BURNER ORIFICE SIZE <u>185"/4.70mm</u> MANIFOLD PRESSURE <input type="text"/></p>	<p>INPUT RATING <u>175,000 BTU</u> MAXIMUM INLET PRESSURES <u>14" W.C./34.9mbar</u></p>
<p>Stated on the oven's data plate</p>	<p>Measured value recorded in Step 8.3</p>

**Figure 9**  
Conversion information label placement



## Appendix - Instructions for Service Kit 36863 - Gas Conversion Kit for PS360EWB/WB70 with Midco Burner, Propane to Natural Gas, 1/98

Middleby Cooking Systems Group • 1400 Toastmaster Drive • Elgin, IL 60120 • (847)741-3300 • FAX (847)741-4406



### Oven Gas Conversion Kit p/n 36863 PS360EWB and PS360WB70 Propane to Natural Gas Installation Instructions



#### WARNING

This conversion kit is to be installed by a Middleby Marshall Authorized Service Organization in accordance with the manufacturer's instructions and all codes and requirements of the authority having jurisdiction. Failure to follow instructions could result in serious injury or property damage. The authorized service organization performing this work assumes responsibility for this conversion.

This kit consists of the following parts:

Qty.	Units	p/n	Description
1	ea.	36862	Instructions for Conversion of Propane Operation to Natural Gas Operation, PS360EWB and PS360WB70
1	ea.	31818	Orifice, Pilot Assembly - Natural Gas, 0.032" (0.81mm)
1	ea.	31821	Orifice, Main - Natural Gas, 0.234" (5.94mm)
1	ea.	22174-0006	Orifice, Low Flame - Nat. Gas, 0.065" (1.65mm, #53 drill) - used for converting PS360WB70 only
1	ea.	22500-0064	Label, NAT, Green
1	ea.	22500-0123	Label, Conversion - Gas



#### IMPORTANT

When converting any oven that is installed at an altitude above 5000 ft. (1524m), consult Middleby before installing this Kit.

### 1. PREPARATION

- 1.1 Turn off the electric power supply to the oven.
- 1.2 Turn off the gas supply at the service valve behind the oven.



#### WARNING

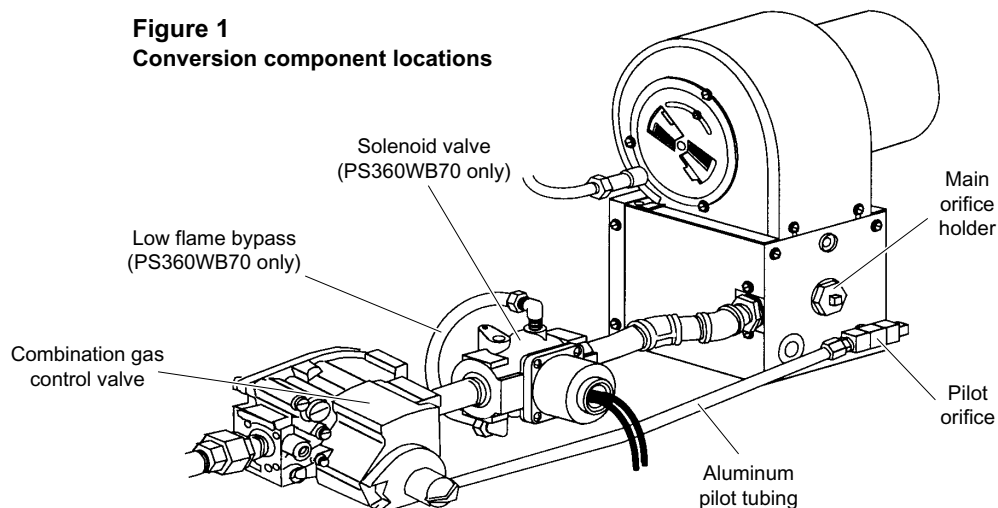
Before performing any service or conversion work, the electrical power supply AND the gas supply **MUST** be turned off.

- 1.3 Open the machinery compartment access door.

### 2. PILOT ORIFICE REPLACEMENT

- 2.1 Unscrew the brass fittings at both ends of the aluminum pilot tubing that connects the pilot orifice to the combination gas control valve. This allows the tubing to be removed. See **Figure 1**.

**Figure 1**  
Conversion component locations





## Appendix - Instructions for Service Kit 36863 - Gas Conversion Kit for PS360EWB/WB70 with Midco Burner, Propane to Natural Gas, 1/98

- 2.2 Remove and retain the aluminum pilot tubing from the burner assembly. The end of the tubing that enters the combination gas control valve should be removed first.
- 2.3 Remove and retain the pilot orifice by unscrewing it (counterclockwise) from the burner plenum wall.
- 2.4 Unscrew and retain the pilot tubing connector and the pilot tap plug from the ends of the pilot orifice, as shown in **Figure 2**. When these attachments have been removed, discard the pilot orifice.
- 2.5 Screw the pilot tubing connector and the pilot tap plug into place in the new propane pilot orifice (p/n 31819). Tighten them to a snug fit.
- 2.6 Screw the new propane pilot orifice into its opening in the plenum wall. Tighten it to a snug fit. Ensure that the end of the orifice holding the pilot tubing mount points towards the piping assembly.
- 2.7 Replace the aluminum pilot tubing that was removed in **Step 2.2**, above.
- 2.8 Screw in the brass fittings at both ends of the aluminum pilot tubing. Tighten them to a snug fit. **DO NOT OVERTIGHTEN THE FITTINGS.**

### 3. MAIN ORIFICE REPLACEMENT

- 3.1 Remove and retain the main orifice holder by unscrewing it (counterclockwise) from the burner plenum wall.
- 3.2 Unscrew and discard the main orifice from the inner end of the holder, as shown in **Figure 3**.
- 3.3 Screw the new natural gas main orifice (p/n 31821) into the orifice holder. Tighten it to a snug fit.
- 3.4 Replace the main orifice holder into its opening in the burner plenum. Tighten it to a snug fit.

### 4. LOW FLAME ORIFICE REPLACEMENT (PS360WB70 only)

- 4.1 Unscrew the brass fittings at both ends of the aluminum low flame tubing. This allows the tubing to be removed. See **Figure 4**.
- 4.2 Remove and retain the tubing from the solenoid valve.
- 4.3 Remove and discard the low flame orifice from the end of the low flame tubing.
- 4.4 Insert the new natural gas low flame orifice (p/n 22174-0006) into the discharge end of the low flame tubing, as shown in **Figure 4**.
- 4.5 Replace the low flame tubing into the fittings on the solenoid valve.
- 4.6 Screw in the brass fittings at both ends of the aluminum low flame tubing. Tighten them to a snug fit.

### 5. GAS LEAK TEST

- 5.1 Paint all pipe connections from the gas union to the burner plenum, and the aluminum pilot and low flame orifice tubing connections, with a solution of soap and water (2/3 soap, 1/3 water is recommended). Any bubbles that are visible indicate a gas leak.
- 5.2 If a gas leak is detected, tighten the affected joints and connections. If tightening the connections fails to stop the leak, replace the affected component and repeat the gas leak test.

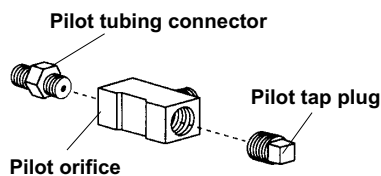


#### WARNING - FIRE / EXPLOSION HAZARD

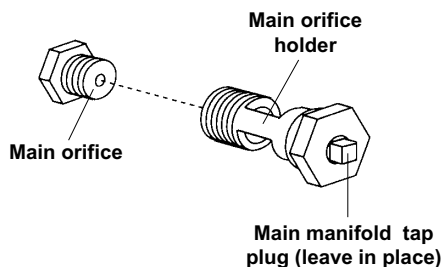
Hidden gas leaks can cause a flashback in the machinery compartment. THIS CAN CAUSE SEVERE INJURY OR DEATH. Stand well clear when switching on the heating circuit.

- 5.3 If no leaks are detected by the test, switch on the oven. Switch on the heating circuit to ignite the main burner.
- 5.4 With the burner in operation, paint all gas pipe joints with the solution of soap and water.
- 5.5 If any further gas leaks are detected, shut down the oven. Reseal and tighten the affected joints and connections. If tightening the connections fails to stop the leak, replace the affected component(s) and repeat the gas leak test.

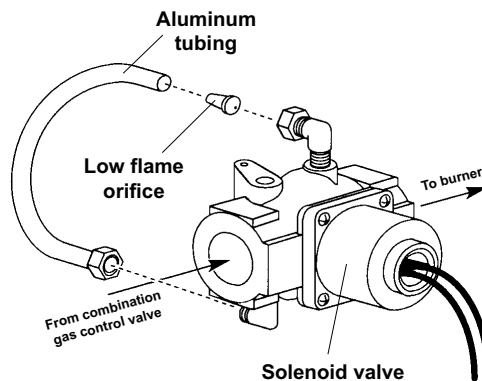
**Figure 2**  
Pilot orifice assembly



**Figure 3**  
Main orifice and holder



**Figure 4**  
Low flame orifice replacement



## Appendix - Instructions for Service Kit 36863 - Gas Conversion Kit for PS360EWB/WB70 with Midco Burner, Propane to Natural Gas, 1/98

### 6. INLET PRESSURE CHECK

6.1 Check the gas control inlet pressure at the inlet pressure tap. See **Figure 6**. An inlet pressure of 6-14" (14.9-34.9mbar) is recommended for natural gas operation.

6.2 If the inlet pressure is:

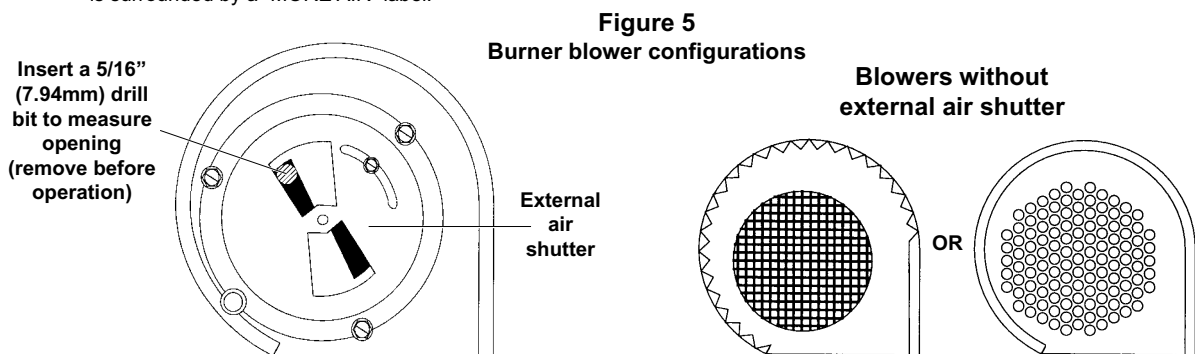
- HIGHER THAN 14" W. C. (34.9mbar) - This pressure may damage the combination gas control valve. Decrease the supplied gas pressure.
- LOWER THAN 3" W. C. (7.46mbar) - It may be necessary to increase the supplied gas pressure.

If it is necessary to adjust the gas line pressure, have the customer contact the gas utility supplier.

### 7. PILOT PRESSURE ADJUSTMENT

7.1 Ensure that the main burner primary air supply is properly adjusted for natural gas operation.

- Units with a burner blower air shutter (see **Figure 5**) should have the shutter opening (at its outside edge) set to 5/16" (7.94mm). A drill bit can be used to check the adjustment of this opening.
- Units without the air shutter (see **Figure 5**) should have the burner air supply adjustment screw turned 11-17 full revolutions clockwise from the fully closed (counterclockwise) position. The screw is located on the front wall of the burner plenum, and is surrounded by a "MORE AIR" label.



7.2 Before proceeding:

- For a PS360EWB oven, the set point should be reduced below the room temperature.
- For a PS360WB70 oven, set the oven to low flame.

7.3 Measure the pilot pressure as shown in **Figure 6**. The gas pressure should be 5-6" W. C. (12.5-14.9mbar) for proper operation.

7.4 If necessary, adjust the pilot pressure as follows:

- Remove the pilot adjustment cap screw.
- Using a screwdriver, turn the inner adjustment screw counterclockwise to increase, or clockwise to decrease, the pilot gas pressure.
- Replace the cap screw and tighten it firmly.

7.5 Measure the current across the pilot flame sensor. The current must measure **at least 2.0  $\mu$ A**. If the current reading is too low, recheck the pilot pressure as per **Step 7.3**. If the pressure reading is correct, consult the factory; otherwise, repeat **Steps 7.4** and **7.5**.

### 8. MAIN MANIFOLD PRESSURE ADJUSTMENT

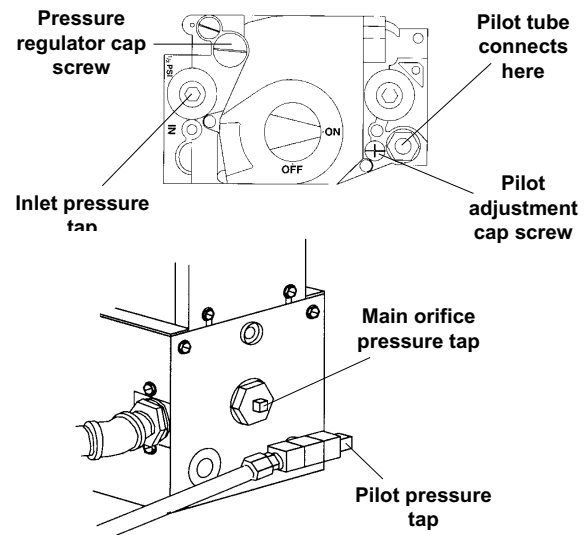
8.1 With the oven set to high flame, measure the regulated gas pressure to the burner. The outlet pressure should be checked at the main orifice pressure tap. See **Figure 6**. The gas pressure should be 3" W. C. (7.46mbar) for proper operation.

8.2 If necessary, adjust the pressure regulator as follows:

- Remove the pressure regulator cap screw.
- Using a screwdriver, turn the inner adjustment screw clockwise to increase, or counterclockwise to decrease, the main burner gas pressure.
- Replace the cap screw and tighten it firmly.

8.3 Record the final measured regulated gas pressure on the silver conversion information label (included in the kit).

**Figure 6**  
Gas pressure measurement/adjustment locations

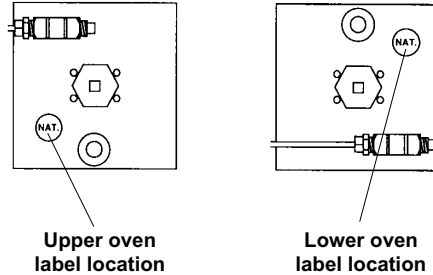


## Appendix - Instructions for Service Kit 36863 - Gas Conversion Kit for PS360EWB/WB70 with Midco Burner, Propane to Natural Gas, 1/98

### 9. CONVERSION LABELING

- 9.1 Remove and discard the round, red "LPG." label from the front face of the burner plenum.
- 9.2 Apply the round, green "NAT." label (p/n 22500-0064) to the front face of the burner housing as shown in **Figure 7**.
- 9.3 Close the machinery compartment access door.
- 9.4 Record the information requested on the silver conversion information label. **Figure 8** shows a representation of this label.
- 9.5 Apply the conversion information label to the front of the machinery compartment access door, next to the control panel. See **Figure 9**.

**Figure 7**  
Yellow "NAT." label placement  
(on burner housing)



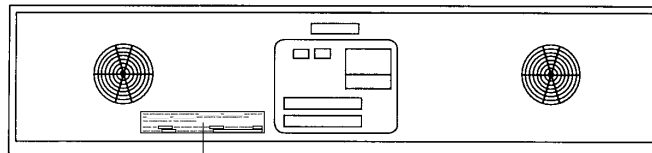
**Figure 8**

Conversion information label

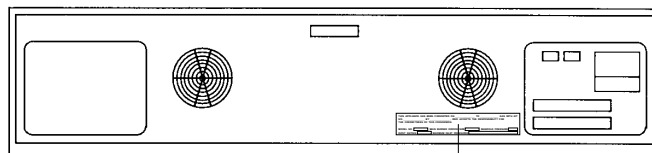
Signature of technician performing conversion	Date of conversion
THIS APPLIANCE HAS BEEN CONVERTED ON _____ TO <u>NATURAL</u> GAS WITH KIT NO. <u>36863</u> BY _____, WHO ACCEPTS THE RESPONSIBILITY FOR THE CORRECTNESS OF THIS CONVERSION.	
MODEL NO. <input type="text"/> MAIN BURNER ORIFICE SIZE <input type="text" value="234"/> " / <input type="text" value="5.94"/> mm	MANIFOLD PRESSURE <input type="text"/>
INPUT RATING <input type="text" value="175,000"/> BTU	MAXIMUM INLET PRESSURES <input type="text" value="14"/> " W.C. / <input type="text" value="34.9"/> mbar
Stated on the oven's data plate	Measured value recorded in Step 8.3

**Figure 9**

Conversion information label placement



PS360EWB placement



PS360WB70 placement

**Appendix - Equivalent Orifice Sizes at High Altitudes  
(Includes 4% reduction for each 1000 ft. above sea level), 4/02**

Orifice Size at Sea Level	Orifice Size Required at Other Elevations										Orifice Size at Sea Level	Orifice Size Required at Other Elevations									
	2000	3000	4000	5000	6000	7000	8000	9000	10000	2000		3000	4000	5000	6000	7000	8000	9000	10000		
1	2	2	3	3	4	5	7	8	10	47	48	48	49	49	49	50	50	51	51		
2	3	3	4	5	6	7	9	10	12	48	49	49	49	50	50	50	51	51	52		
3	4	5	7	8	9	10	12	13	15	49	50	50	50	51	51	51	52	52	52		
4	6	7	8	9	11	12	13	14	16	50	51	51	51	51	52	52	52	53	53		
5	7	8	9	10	12	13	14	15	17	51	51	52	52	52	52	53	53	53	54		
6	8	9	10	11	12	13	14	16	17	52	52	53	53	53	53	53	54	54	54		
7	9	10	11	12	13	14	15	16	18	53	54	54	54	54	54	54	55	55	55		
8	10	11	12	13	13	15	16	17	18	54	54	55	55	55	55	55	56	56	56		
9	11	12	12	13	14	16	17	18	19	55	55	55	55	56	56	56	56	56	57		
10	12	13	13	14	15	16	17	18	19	56	56	56	57	57	57	58	59	59	60		
11	13	13	14	15	16	17	18	19	20	57	58	59	59	60	60	61	62	63	63		
12	13	14	15	16	17	17	18	19	20	58	59	60	60	61	62	62	63	63	64		
13	15	15	16	17	18	18	19	20	22	59	60	61	61	62	62	63	64	64	65		
14	16	16	17	18	18	19	20	21	23	60	61	61	62	63	63	64	64	65	65		
15	16	17	17	18	19	20	20	22	24	61	62	62	63	63	64	65	65	66	66		
16	17	18	18	19	19	20	22	23	25	62	63	63	64	64	65	65	66	66	67		
17	18	19	19	20	21	22	23	24	26	63	64	64	65	65	65	66	66	67	68		
18	19	19	20	21	22	23	24	26	27	64	65	65	65	66	66	66	67	67	68		
19	20	20	21	22	23	25	26	27	28	65	65	66	66	66	67	67	68	68	69		
20	22	22	23	24	25	26	27	28	29	66	67	67	68	68	68	69	69	69	70		
21	23	23	24	25	26	27	28	28	29	67	68	68	68	69	69	69	70	70	70		
22	23	24	25	26	27	27	28	29	29	68	68	69	69	69	70	70	70	71	71		
23	25	25	26	27	27	28	29	29	30	69	70	70	70	70	71	71	71	72	72		
24	25	26	27	27	28	28	29	29	30	70	70	71	71	71	71	72	72	73	73		
25	26	27	27	28	28	29	29	30	30	71	72	72	72	73	73	73	74	74	74		
26	27	28	28	28	29	29	30	30	30	72	73	73	73	73	74	74	74	74	75		
27	28	28	29	29	29	30	30	30	31	73	73	74	74	74	74	75	75	75	76		
28	29	29	29	30	30	30	30	31	31	74	74	75	75	75	75	76	76	76	76		
29	29	30	30	30	30	31	31	31	32	75	75	76	76	76	76	77	77	77	77		
30	30	31	31	31	31	32	32	33	35	76	76	76	77	77	77	77	77	77	77		
31	32	32	32	33	34	35	36	37	38	77	77	77	77	78	78	78	78	78	78		
32	33	34	35	35	36	36	37	38	40	78	78	78	78	79	79	79	79	80	80		
33	35	35	36	36	37	38	38	40	41	79	79	80	80	80	80	.013	.012	.012	.012		
34	35	36	36	37	37	38	39	40	42	80	80	.013	.013	.013	.012	.012	.012	.012	.011		
35	36	36	37	37	38	39	40	41	42												
36	37	38	38	39	40	41	41	42	43												
37	38	39	39	40	41	42	42	43	43												
38	39	40	41	41	42	42	43	43	44												
39	40	41	41	42	42	43	43	44	44												
40	41	42	42	42	43	43	44	44	45												
41	42	42	42	43	43	44	44	45	46												
42	42	43	43	43	44	44	45	46	47												
43	44	44	44	45	45	46	47	47	48												
44	45	45	45	46	47	47	48	48	49												
45	46	47	47	47	48	48	49	49	50												
46	47	47	47	48	48	49	49	50	50												

SECTION 3 - SERVICING COMPONENTS

XI. ELECTRIC OVEN HEATING SYSTEM

A. PS200-series ovens

1. Description of heating system

All PS200-series electric ovens use an on-off system for heater activation. When the oven demands heat, the temperature controller activates contactors that in turn activate the heaters at 100% power. The contactors open when the temperature rises to 2 degrees above the set point, and close when the oven's temperature falls 2 degrees Fahrenheit below the set point. Because of residual heat within the oven, however, the temperature swing after preheating is about 5 degrees Fahrenheit above and below the set point.

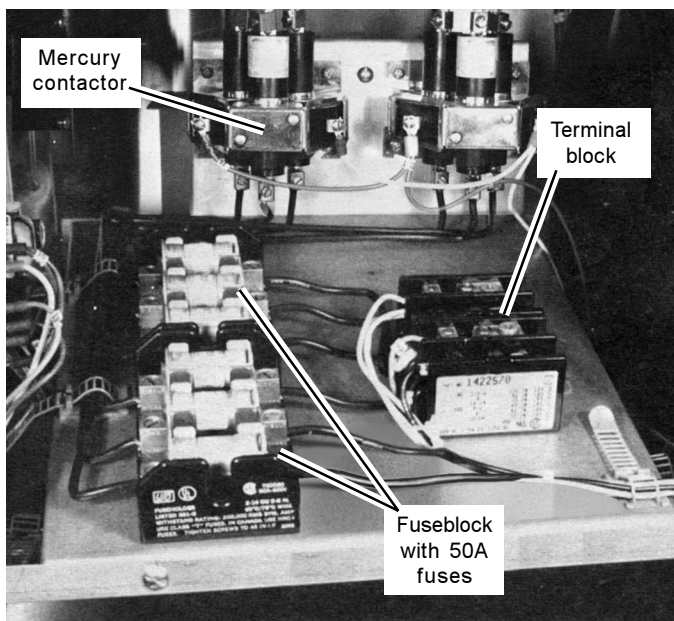
**IMPORTANT:** Because the PS200-series electric oven uses an on-off system for heater activation, the temperature controller ***MUST*** be set to the on-off operating mode. Refer to *Temperature Controller* on Page 30.

Early PS200-series ovens used mercury contactors. 208-380V ovens used two 3-pole contactors. 416-480V ovens used a single 3-pole contactor. Six 50A fuses (one per element) protect the heating circuit. See Figure 76.

Current PS200-series ovens replace the mercury contactors with solid state relays mounted on heat sinks. Six relays are used on 208-380V ovens. 416-480V ovens use three relays. Ovens that use the solid state relays also use 50A circuit breaker blocks in place of the fuses. See Figure 77.

**NOTE:** All control wire used on these ovens is rated at 221°F/105°C. DO NOT replace with lower rated wire.

**Figure 76**  
PS200 electric (early) with mercury contactors and fuses



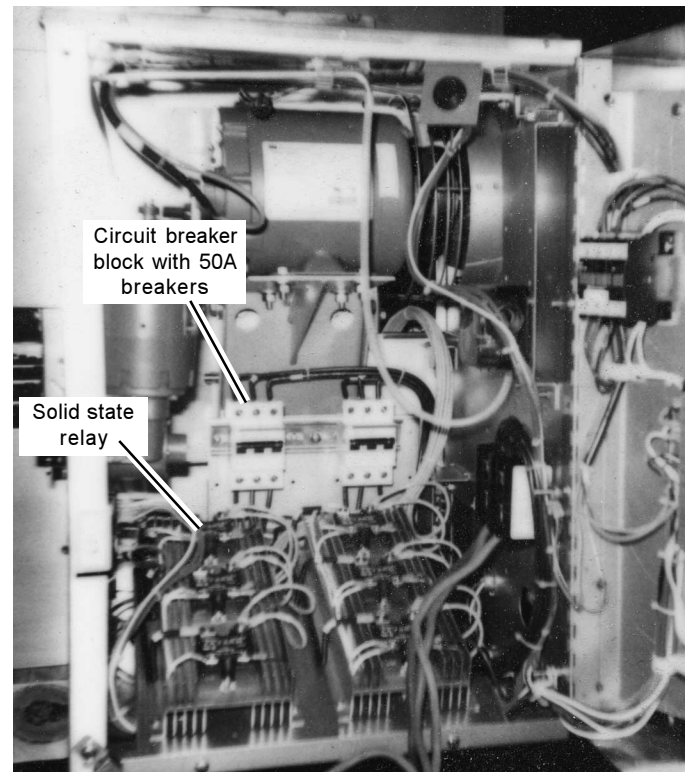
2. Part number reference

Part No.	Description
27375-0001	Heating element, 208V
27375-0002	Heating element, 240V
27375-0003	Heating element, 380V
28041-0015	Mercury contactor, 3 pole, 50A
42810-0091	Contactor tube replacement kit (inc. qty. 1 retainer clip P/N 27170-0248)
42810-0090	Coil replacement kit (inc. qty. 3 retainer clip P/N 27170-0248)
28150-0130	Fuse, 50A, class T
31463	Relay, solid state, 75A
35018	Circuit breaker block, 50A, 3 pole

3. Supply

Ovens have a 208V, 220-240V, 380V, 416V or 480VAC electrical supply. The control current of the oven operates at 110V, single phase. If the oven was specified for a 3 wire system, it was supplied with an optional control transformer to step the 3 phase current down for the control circuit. If the oven was specified for a 4 wire system, the 4th (neutral) wire is utilized to split 2 of the 3 incoming 3 phase legs and obtain a separate 110V circuit. Most export ovens are supplied with a stepdown transformer for the 110V control voltage.

**Figure 77**  
PS200 electric (current) with solid state relays and circuit breaker blocks



## 4. Heater specifications

- PS200-series electric ovens use six individual heating elements.
- 208V elements are used for ovens with a 208V supply.
- 240 volt elements are used for ovens with a 220, 230 or 240V supply. 240V elements are also used on ovens with a 416V or 480V supply (connected in series).
- 380V elements are used for ovens with a 380V supply.
- All heaters are connected in Delta.
- Each heating element is stainless clad and has a 3"/76mm cold (unheated) end next to the connecting leg.
- *Individual element electrical data*

Volts	Watts	Ohms	Connection
208V	4500W	9.6Ω	Parallel
220V	3781W	12.8Ω	Parallel
230V	4133W	12.8Ω	Parallel
240V	4500W	12.8Ω	Parallel
380V	4500W	32.2Ω	Parallel
416V	3380W	12.8Ω	Series
480V	4500W	12.8Ω	Series

## 5. Checking the Heating Elements

The most common problems encountered with electric heaters are:

- Open or bad connections.
- Open, shorted or grounded heating elements.

To troubleshoot the heating elements, disconnect all leads at the back wall and check each element with a digital multimeter set to Ohms ( $\Omega$ ). Correct ratings are shown in the table in the preceding section. Zero reading on the ohm scale indicates an open or shorted element.

**Figure 78**  
Fan shroud removed



It is also possible to check for an open element using an ampmeter. Any current through the element indicates that the element is not open.

## 6. Changing Heating Elements

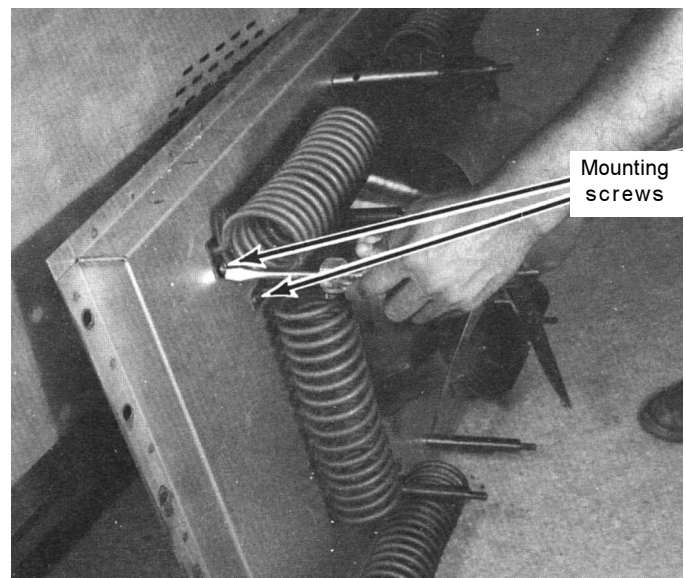
**NOTE:** Wires going from the mercury contactor (or solid state relays, as appropriate) to the heating elements are rated at #12 gauge TAGT, 482°F/250°C. DO NOT, under any circumstances, use a wire of lesser rating or quality.

**NOTE:** All lugs and connections are rated at 600°F/316°C. All heating element connections are double-nutted.

To remove the element:

- Remove the blower belt.
- Remove the 12 electrical lead connections to the heaters at the back wall.
- Remove the 12 bolts that hold the rear oven panel to the body. Once removed, DO NOT lay the panel on either its front or back side. This can damage the heating elements and blower fan. The panel should be kept upright as shown in Figure 78.
- Remove the fan shroud.
- Remove the screws at both ends of the element and pull the element straight out. See Figure 79.
- When replacing the rear oven panel, be sure to use a high-temperature never-seize lubricant on the 12 bolts that hold the panel in place.

**Figure 79**  
Removing elements



SECTION 3 - SERVICING COMPONENTS

**B. PS310/360-series ovens**

1. Description of heating system

All PS310/360-series electric ovens use an on-off system for heater activation. When the oven demands heat, the temperature controller activates mercury contactors that in turn activate the heaters at 100% power. The contactors open when the temperature rises to 2 degrees above the set point, and close when the oven's temperature falls 2 degrees Fahrenheit below the set point. Because of residual heat within the oven, however, the temperature swing after preheating is about 5 degrees Fahrenheit above and below the set point.

**IMPORTANT:** Because the PS310/360-series electric oven uses an on-off system for heater activation, the temperature controller ***MUST*** be set to the on-off operating mode. Refer to *Temperature Controller* on Page 30.

Each bank of heaters (3 total) uses one mercury contactor and three fuses. 30A fuses were used through 1/91. Heat inside the machinery compartment can de-rate these fuses, causing the fuse to blow prematurely. To correct this situation, 40A fuses were used 2/91 and later.

NOTE: All control wire used on this oven is AWM rated at 221°F/105°C. DO NOT replace with lower rated wire.

2. Part number reference

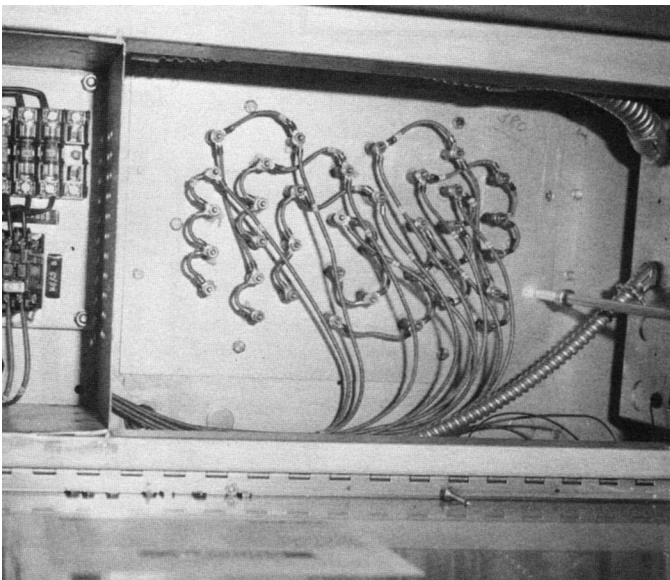
<i>Part No.</i>	<i>Description</i>
27374-0001	Heating element, 208V
27374-0002	Heating element, 240V
27374-0003	Heating element, 380V
28041-0016	Mercury contactor, 3 pole, 30A
27170-0251	Contactor tube replacement kit
27170-0250	Coil replacement kit
28154-0002	Fuse, 30A, class M (early)
28150-0134	Fuse, 40A, class T (current)
27021-0016	Fuse block, 40A (used when upgrading from 30A to 40A fuse - qty. 3 reqd.)

3. Supply

Ovens have a 208V, 220-240V, 380V, 416V or 480VAC electrical supply. The control current of the oven operates at 110V, single phase. If the oven was specified for a 3 wire system, it was supplied with an optional control transformer to step the 3 phase current down for the control circuit. If the oven was specified for a 4 wire system, the 4th (neutral) wire is utilized to split 2 of the 3 incoming 3 phase legs and obtain a separate 110V circuit.

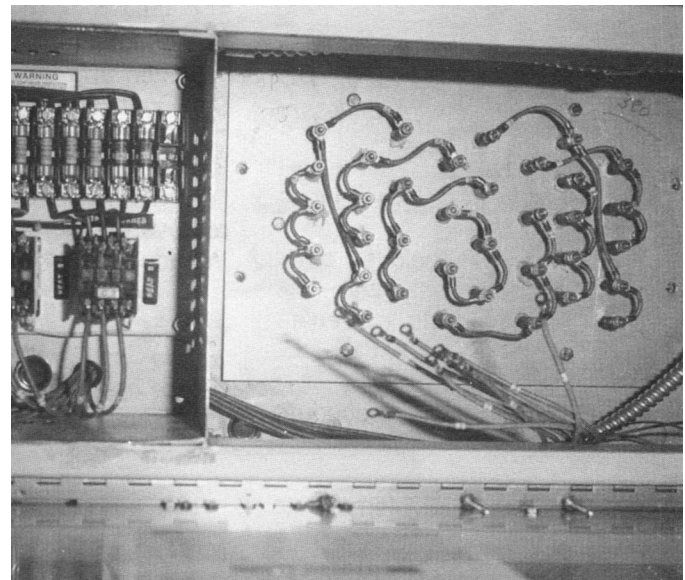
**Figure 80**

**Removing the element bank mounting bolts**



**Figure 81**

**Electrical leads disconnected**



## 4. Heater specifications

- PS310/360-series electric ovens use 18 heating elements in 3 banks (6 elements per bank).
- 208V elements are used for ovens with a 208V supply.
- 240 volt elements are used for ovens with a 220, 230 or 240V supply. 240V elements are also used on ovens with a 416V or 480V supply (connected in series).
- 380V elements are used for ovens with a 380V supply.
- All heaters are connected in Delta.
- Each element is stainless-clad and has a 4-7/8"/124mm cold (unheated) end next to the connecting leg.
- *Individual element electrical data*

Volts	Watts	Ohms	Connection
208V	1350W	32 $\Omega$	Parallel
220V	1134W	42.7 $\Omega$	Parallel
230V	1239W	42.7 $\Omega$	Parallel
240V	1350W	42.7 $\Omega$	Parallel
380V	1350W	107 $\Omega$	Parallel
416V	1013W	42.7 $\Omega$	Series
480V	1350W	42.7 $\Omega$	Series

## 5. Checking the Heating Elements

The most common problems encountered with electric heaters are:

- Open or bad connections.
- Open, shorted or grounded heating elements.

To troubleshoot the heating elements, disconnect all leads from ALL of the elements in the bank. Then, check each element with a digital multimeter set to

Ohms ( $\Omega$ ). Correct ratings are shown in the table in the preceding section. Zero reading on the ohm scale indicates an open or shorted element.

It is also possible to check for an open element using an ammeter. Any current through the element indicates that the element is not open.

## 6. Changing Heating Elements

**NOTE:** Wires going from the mercury contactors to the heating elements are rated at #12 gauge TAGT, 482°F/250°C. DO NOT, under any circumstances, use a wire of lesser rating or quality.

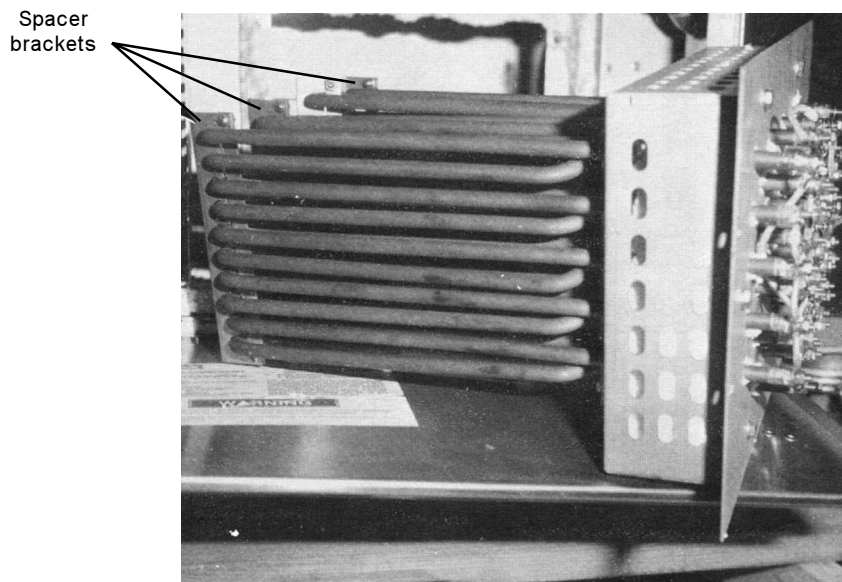
**NOTE:** All lugs and connections are rated at 600°F/316°C. All heating elements are double-nutted. The rear of each heating element is held to other elements by a spacer bracket. The only way the element can be changed is by removing the entire bank from the oven.

To remove the element bank:

1. Remove the 4 bolts holding the bank of element to the oven. See Figure 80.
2. Remove the 9 electrical leads going to the element bank. See Figure 81.
3. Gently work the bank of elements out of the oven. Be careful not to pinch the wires between the frame of the oven and the side plate of the heating elements. See Figure 82.
4. Remove the bank of elements and place them on the floor. The entire bank may now be serviced.
5. Remove the element jumper wires and element cover if individual elements need replacement.

**NOTE:** The spacer brackets MUST be reinstalled before assembling the element bank back into the oven. These brackets keep the elements from touching each other during use. See Figure 82.

**Figure 82**  
**Element bank removed - spacer bracket visible**





SECTION 3 - SERVICING COMPONENTS

C. PS555 ovens

1. Description of heating system

All PS555 electric ovens use a variable pulse system for heater activation.

In response to the millivolt signal from the thermocouple, the temperature controller sends a 4-20mA signal to a controller module. This module contains an amplifier board and two solid state relays. The amplifier board receives the 4-20mA signal and in turn activates the relays. The relays then activate the heating elements.

The relays operate on a fixed cycle time. Within each cycle, the relays activate the heating elements at 100% for a length of time that is proportional to the signal from the amplifier board.

When the oven is switched on, heat demand is at its peak and the elements are activated for 100% of each cycle. As the oven's temperature approaches the set point, the relays reduce the length of time that the heaters are activated within each cycle. After the oven is fully preheated, the heaters are usually activated for about 30% of each cycle. This system allows the actual oven temperature can remain constant, with NO temperature swing.

**IMPORTANT:** The PS555 electric oven uses a variable pulse system that is designed to emulate the PID gas operating mode. Because of this, the temperature controller **MUST** be set to the PID operating mode.

Temperature controller P/N 46837 (inc. with Service Kit 47321) includes a dedicated variable pulse mode intended for the PS536 electric oven. This mode is NOT used on the PS555 electric oven. If you are using controller P/N 46837, be sure to set the controller for the PID operating mode.

Refer to *Temperature Controller* on Page 30.

Heaters are arranged into four assemblies, each of which contains three elements. Each pair of assemblies (left and right) share a controller and a 50A circuit breaker block.

NOTE: All control wire used on this oven is AWM rated at 221°F/105°C. DO NOT replace with lower rated wire.

2. Part number reference

Part No.	Description
43337	Heating element assembly, 208V
44525	Heating element assembly, 230V
44526	Heating element assembly, 380V
44527	Heating element assembly, 480V
44914	Controller module, 208/230/240V ovens
44568	Controller module, 380/480V ovens
35018	Circuit breaker block, 50A, 3 pole

3. Supply

Ovens have a 208V, 220-240V, 380V or 480VAC electrical supply. The control current of the oven operates at 208/240V.

208V and 240V ovens use a 3-wire system (4-wire including the ground connection). The control circuit operates at line voltage.

380V and 480V ovens use a 4-wire system (5-wire including the ground connection). The 4th (neutral) wire is utilized to split the incoming 3 phase legs and obtain a separate control circuit at 208/240V.

4. Heater specifications

- PS555 electric ovens use 12 heating elements in 4 assemblies (3 elements per assembly). Elements CANNOT be removed from the assembly. If one element is not functioning properly, the entire assembly should be replaced.
- 208V elements are used for ovens with a 208V supply.
- 240 volt elements are used for ovens with a 220V, 230V or 240V supply.
- 380V elements are used for ovens with a 380V supply.
- 480V elements are used for ovens with a 416V or 480V supply.
- All heaters are connected in Delta.
- Heaters are grouped into four assemblies, each of which contains three elements. Elements CANNOT be removed from the assembly.
- Each element has a cold (unheated) end next to the connecting leg. 12"/0.3m leads are connected to the cold ends for easy connection to the terminal blocks on the back wall of the oven.
- *Individual element electrical data*

Volts	Watts	Ohms	Connection
208V	2667W	16.2Ω	Parallel
220V	2241W	21.6Ω	Parallel
230V	2449W	21.6Ω	Parallel
240V	2667W	21.6Ω	Parallel
380V	2667W	54.1Ω	Parallel
416V	2003W	86.4Ω	Parallel
480V	2667W	86.4Ω	Parallel

5. Checking the Heating Elements

The most common problems encountered with electric heaters are:

- Open or bad connections.
- Open, shorted or grounded heating elements.

To troubleshoot the heating elements, disconnect all leads at the terminal blocks on the back wall. Then, check each element with a digital multimeter set to Ohms (Ω). Correct ratings are shown in the table in the preceding section. Zero reading on the ohm scale indicates an open or shorted element.

It is also possible to check for an open element using an ammeter. Any current through the element indicates that the element is not open.

#### 6. Changing Heating Elements

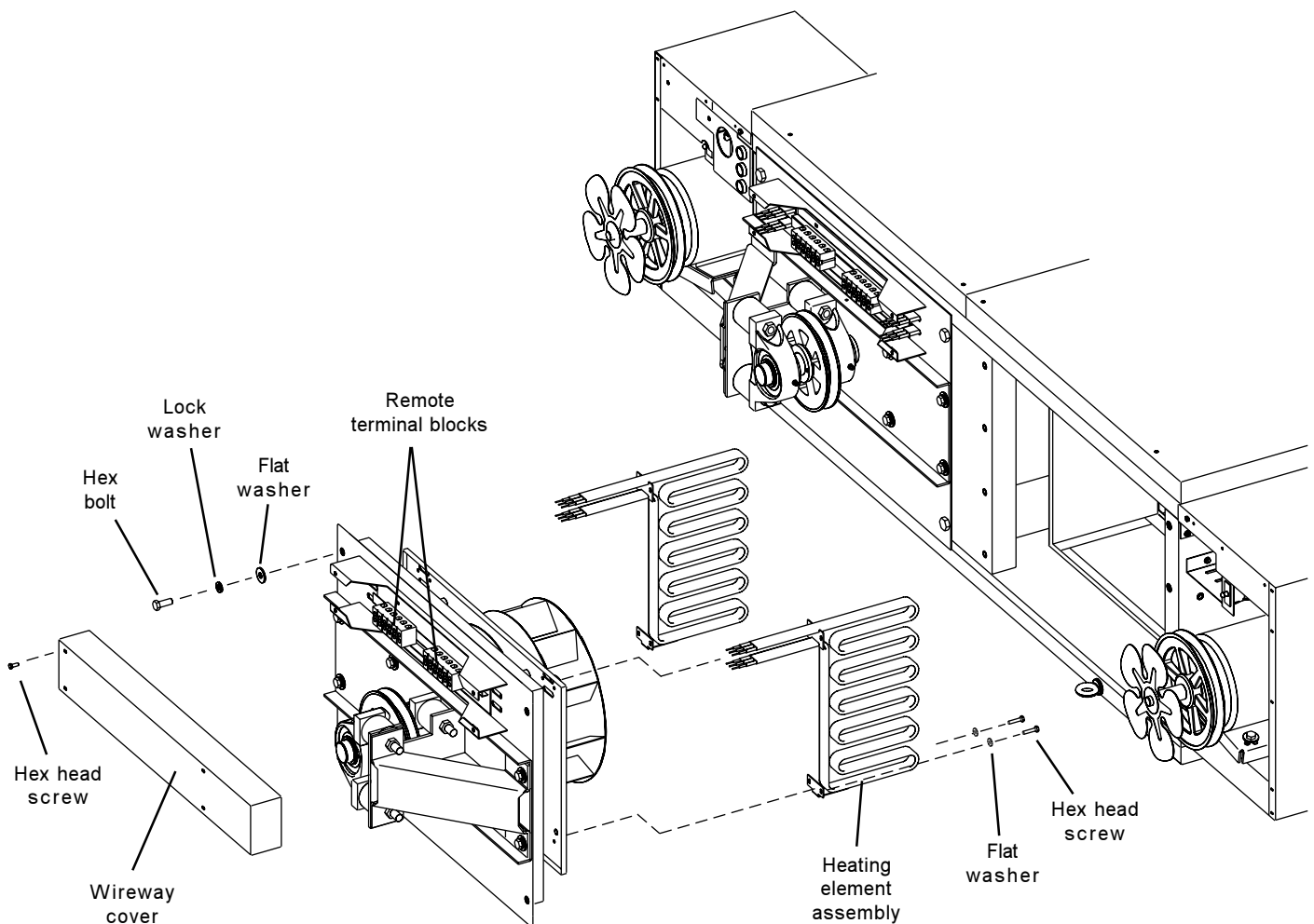
**NOTE:** Wires going from the controller assembly contactor to the heating elements are rated at 392°F/ 200°C. DO NOT, under any circumstances, use a wire of lesser rating or quality.

To remove the element:

- Remove the blower belt on the affected side of the oven.
- Remove the wireway cover.

- Disconnect the electrical lead connections from the front of the oven to the remote terminal blocks on the back wall. Then, disconnect the leads from the remote terminal blocks to the elements.
- Remove the 8 hex bolts that hold the rear wall panel to the body of the oven. Once removed, DO NOT lay the panel on either its front or back side. This can damage the heating elements, blower fan and bearings. The panel should be kept upright.
- Remove the two hex head screws that hold the element assembly to the back wall.
- When replacing the rear oven panel, be sure to use a high-temperature never-seize lubricant on the 8 hex bolts that hold the panel in place.

**Figure 83**  
**PS555 electric oven heating element removal**



## SECTION 3 - SERVICING COMPONENTS

### D. Mercury Contactor Replacement

Early PS200-series electric ovens and all PS310/360-series electric ovens use mercury contactors to activate the heating elements. Each pole in the contactor is a separate mercury-filled tube that is individually replaceable. This feature ensures that the entire contactor should never have to be replaced.

Individual part numbers for the mercury contactor components are listed in the *Part Number Reference* sections on Pages 140 and 142, respectively.

#### 1. PS200-series mercury contactor replacement

- Remove the complete contactor from the oven. Then, remove the terminal clamps from the contactor tube(s) to be replaced.

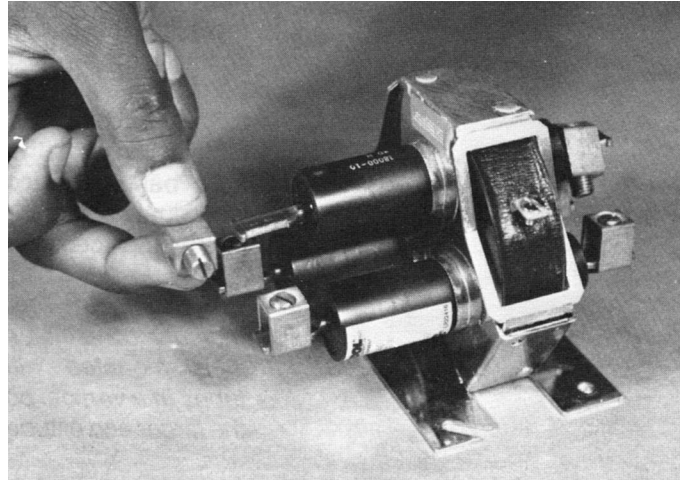


Figure 84

- Locate the Tinnerman clips on the bottom side of the contactor that hold each individual contact tube in place.
- Find the break in the tube bracket located in the center. Then, using a diagonal cutter, cut the Tinnerman clip so that it may be removed.

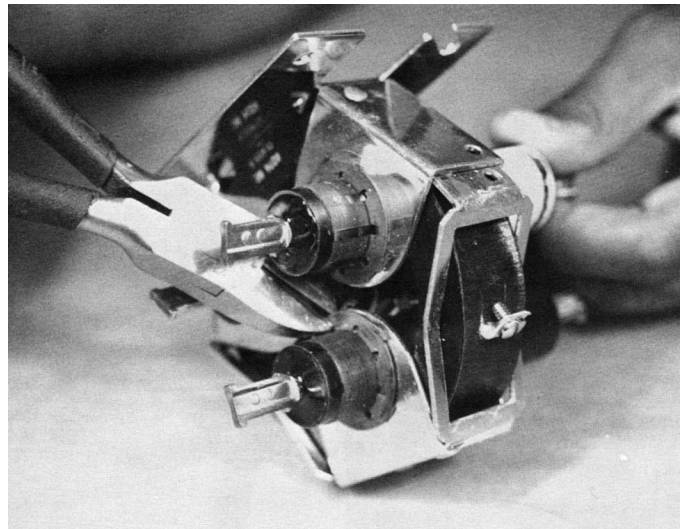


Figure 85

- Remove the contact tube. If the coil must be replaced, all three contactor tubes must first be removed.
- To replace the contactor tube(s), slide the thin end of the tube into the contactor bracket.

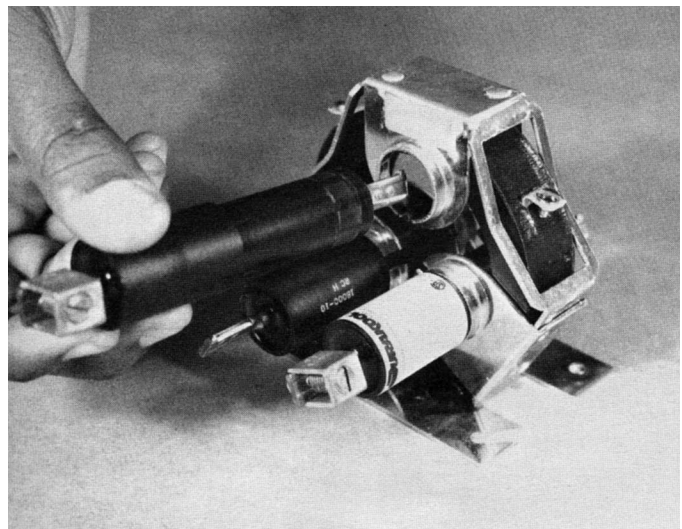
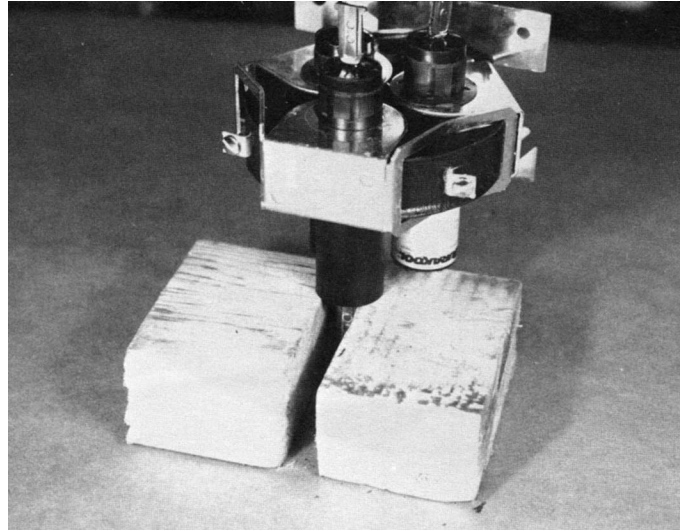


Figure 86

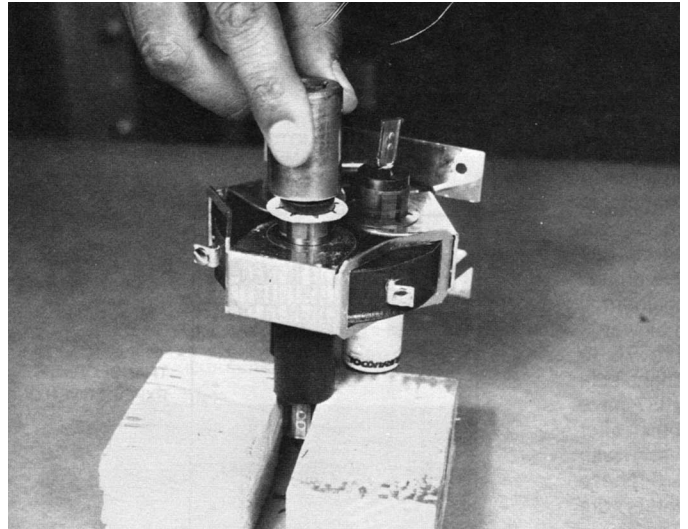
- Support the wide end of the tube between two pieces of wood so that the terminal end will not be damaged.

**Figure 87**



- Place a deep well socket over the new Tinnerman clip.

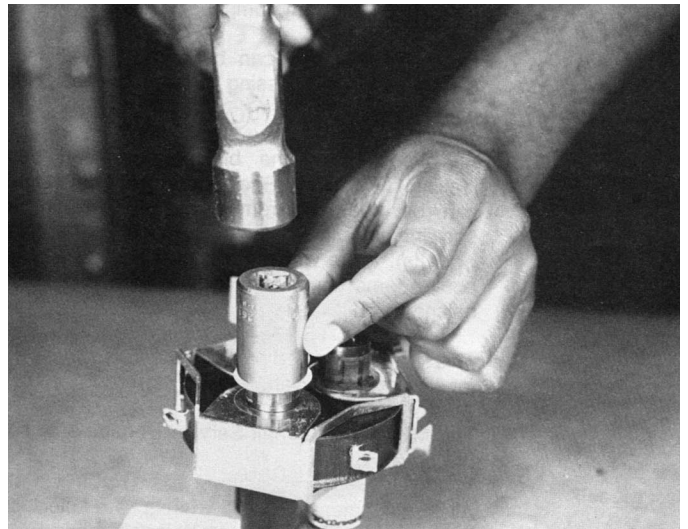
**Figure 88**



- Gently tap the socket with a hammer to push the clip down and into place.

**NOTE:** When replacing the mercury contactor into the oven, the wider tube ends must be pointing UP. The tubes must ALWAYS be mounted in a vertical position.

**Figure 89**

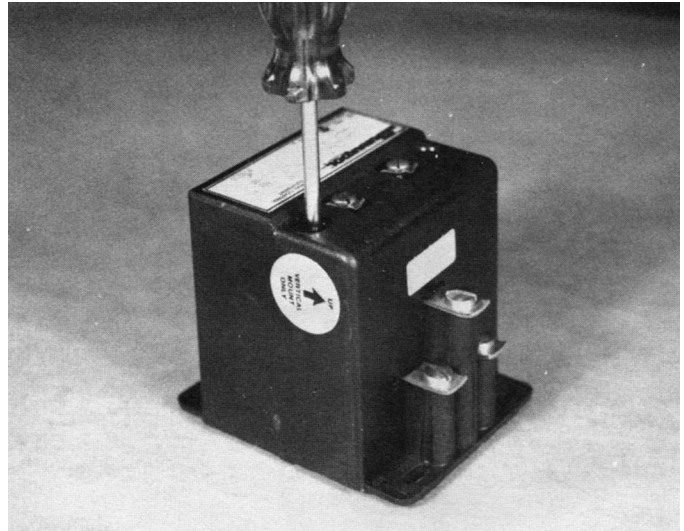


## SECTION 3 - SERVICING COMPONENTS

### 2. PS310/360-series contactor replacement

- Remove the two Phillips-head screws holding the cover in place. Then, remove the cover.

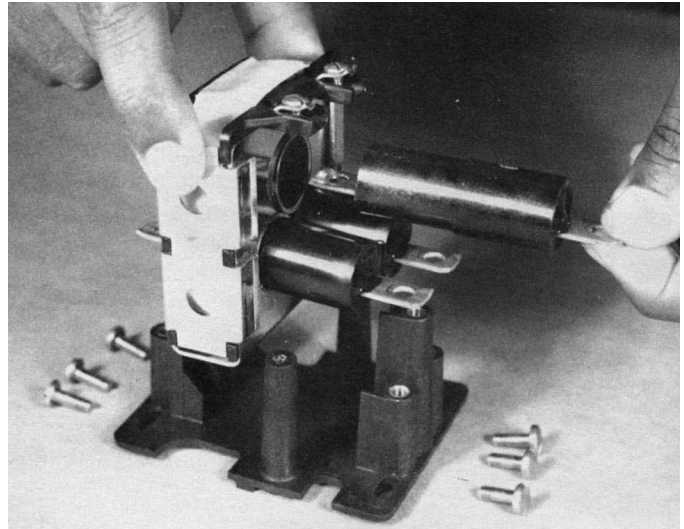
**Figure 90**



- Remove the six terminal lug screws. This procedure must be followed when replacing the coil or any one contact tube.
- The coil and contact tubes will now pull straight out from the base. The coil or any individual contact tube can now be replaced.

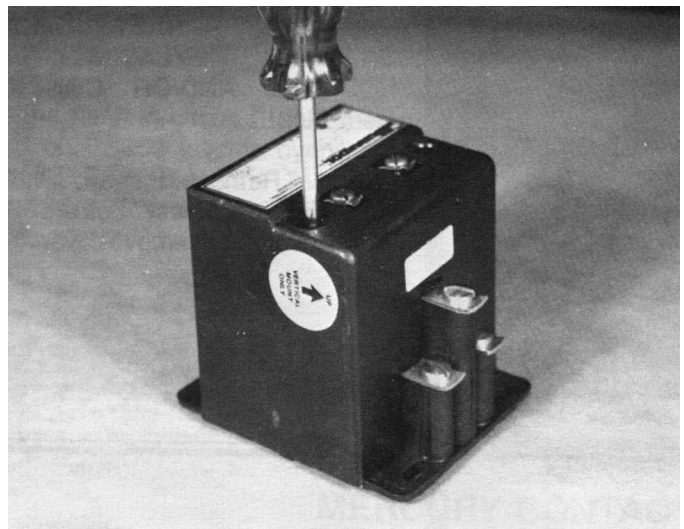
**NOTE:** When replacing the mercury contactor into the oven, the wider tube ends must be pointing UP. The tubes must ALWAYS be mounted in a vertical position.

**Figure 91**



- Replace the cover and attach it with the two Phillips-head screws. Note that the cover and base are marked to show correct orientation.

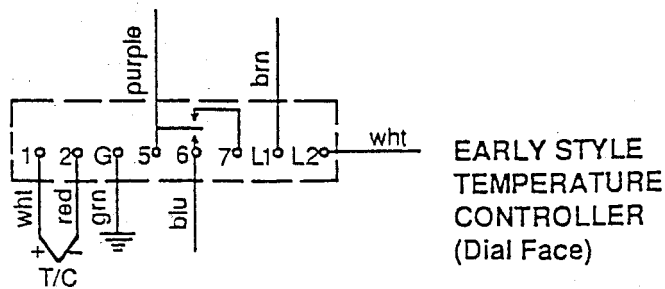
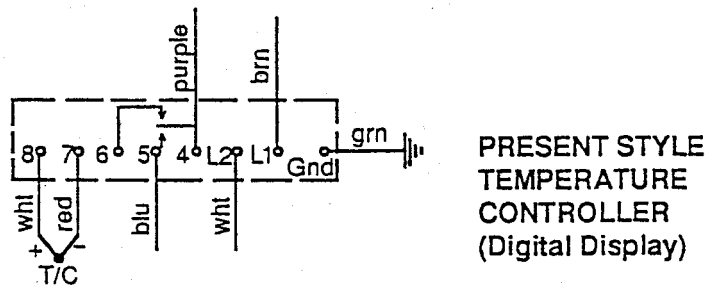
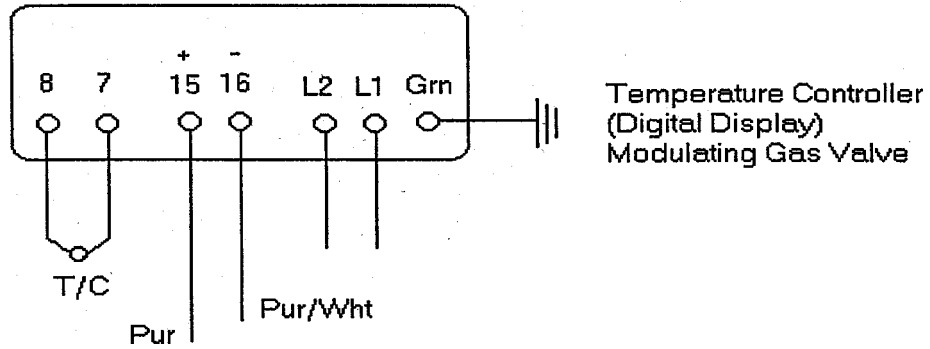
**Figure 92**



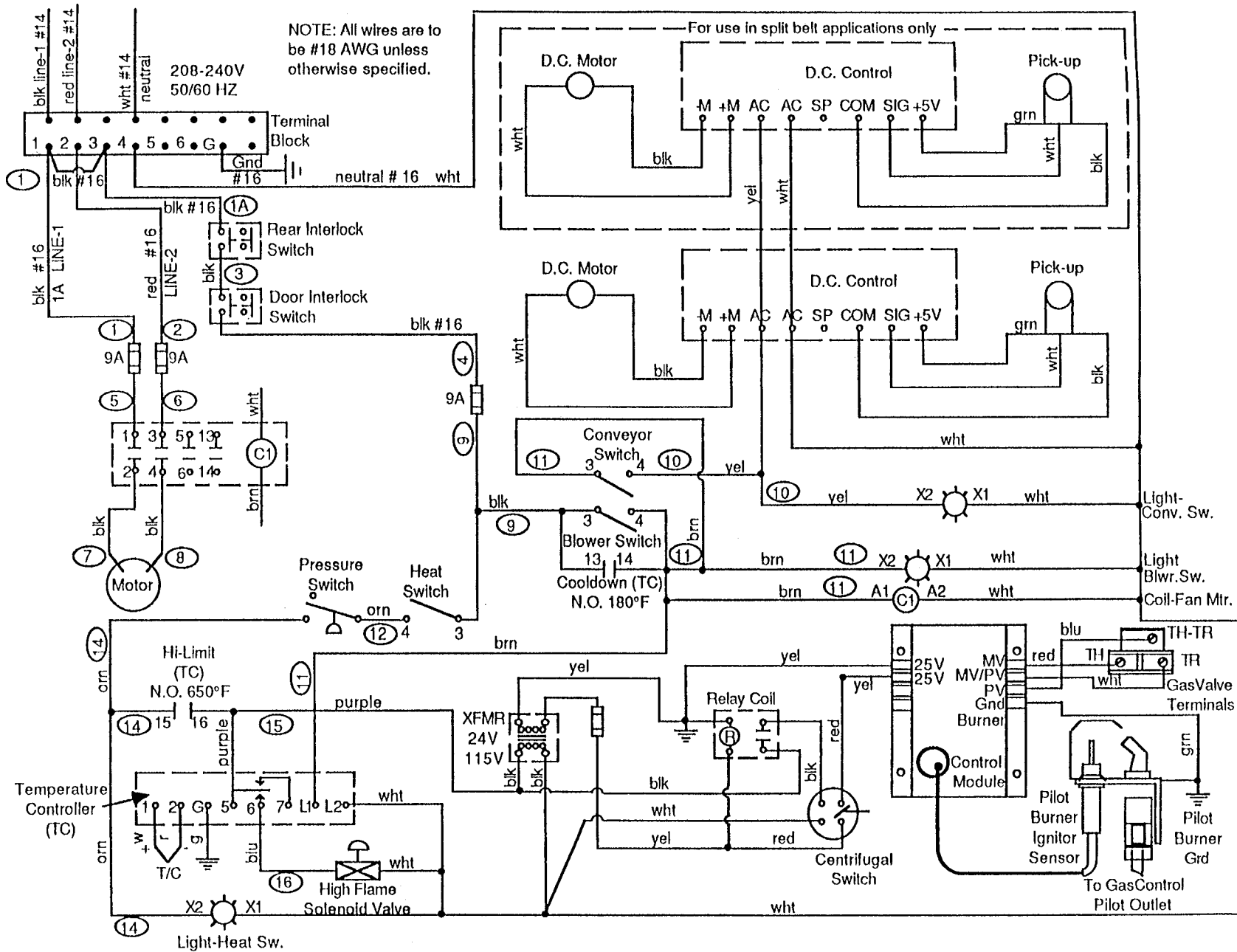
# SECTION 4 ELECTRICAL WIRING DIAGRAMS

## I. COMPONENT WIRING

### A. Temperature Controllers





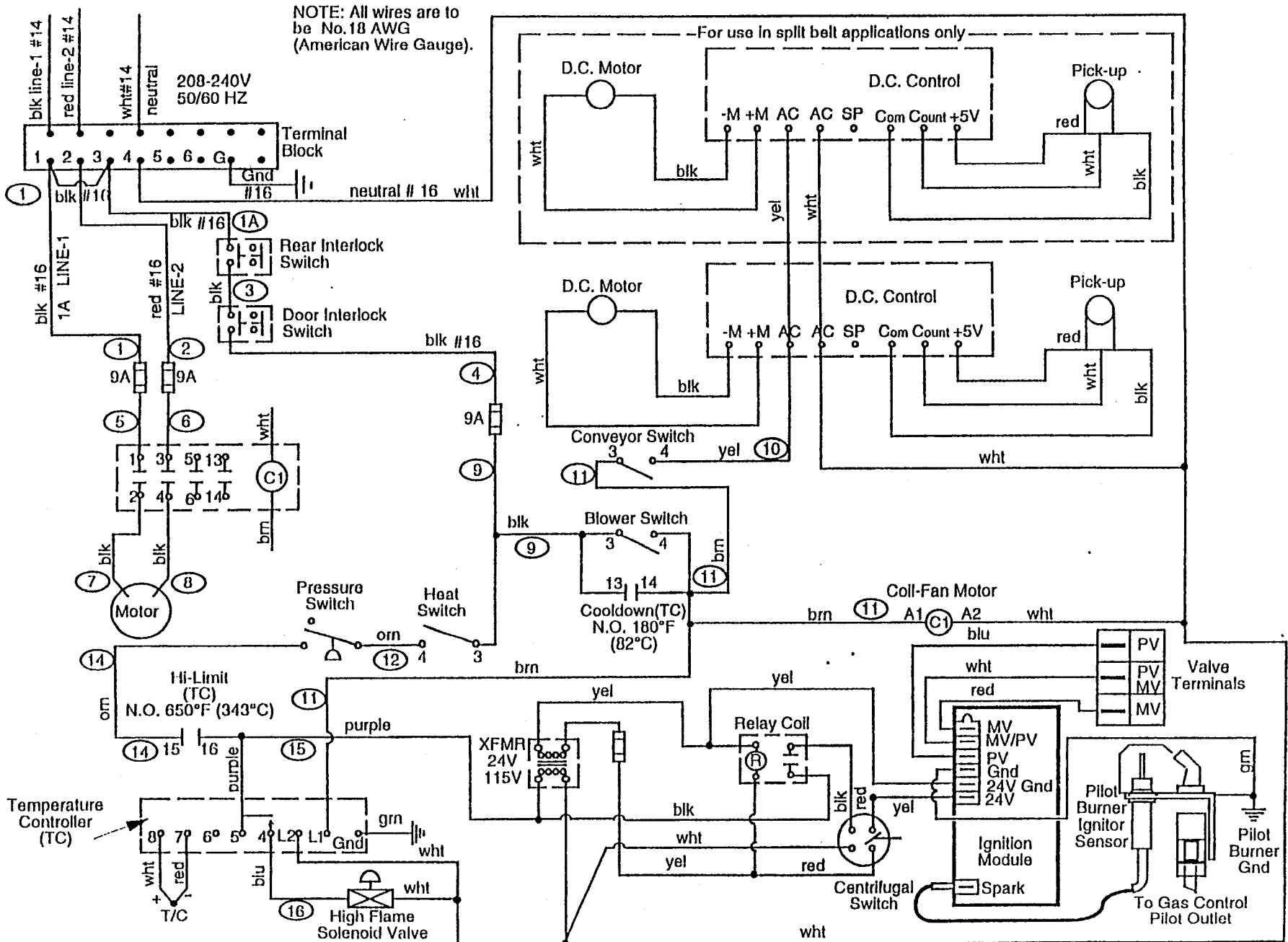


151

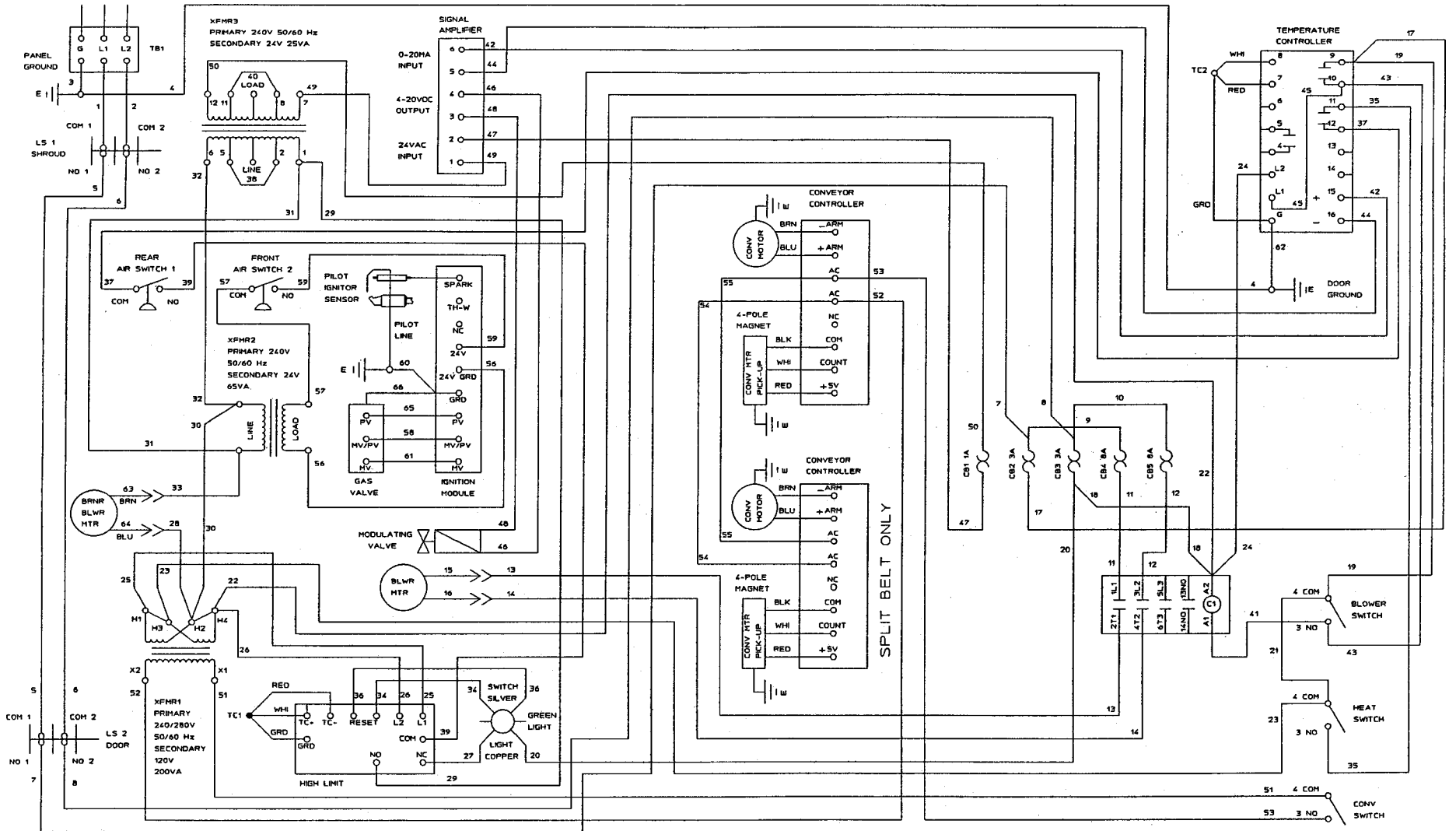
PS200-series gas oven (with solenoid valve and analog temp control), 208/240V main blower motor, 120V control circuit 208/240V, 50/60 Hz, 1 Ph, 3 pole, 4 wire supply (2 hot, 1 neutral, 1 ground)



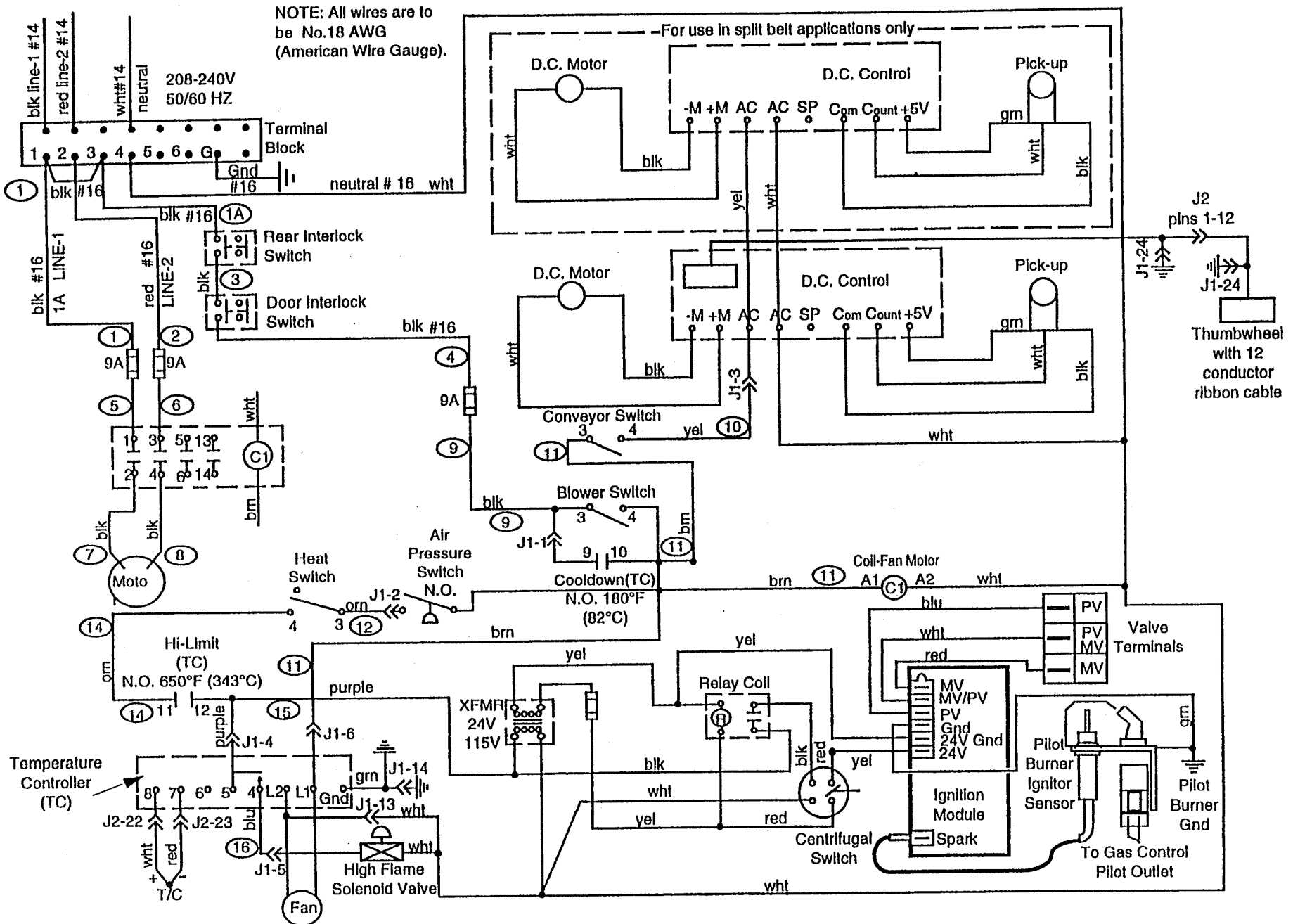
152



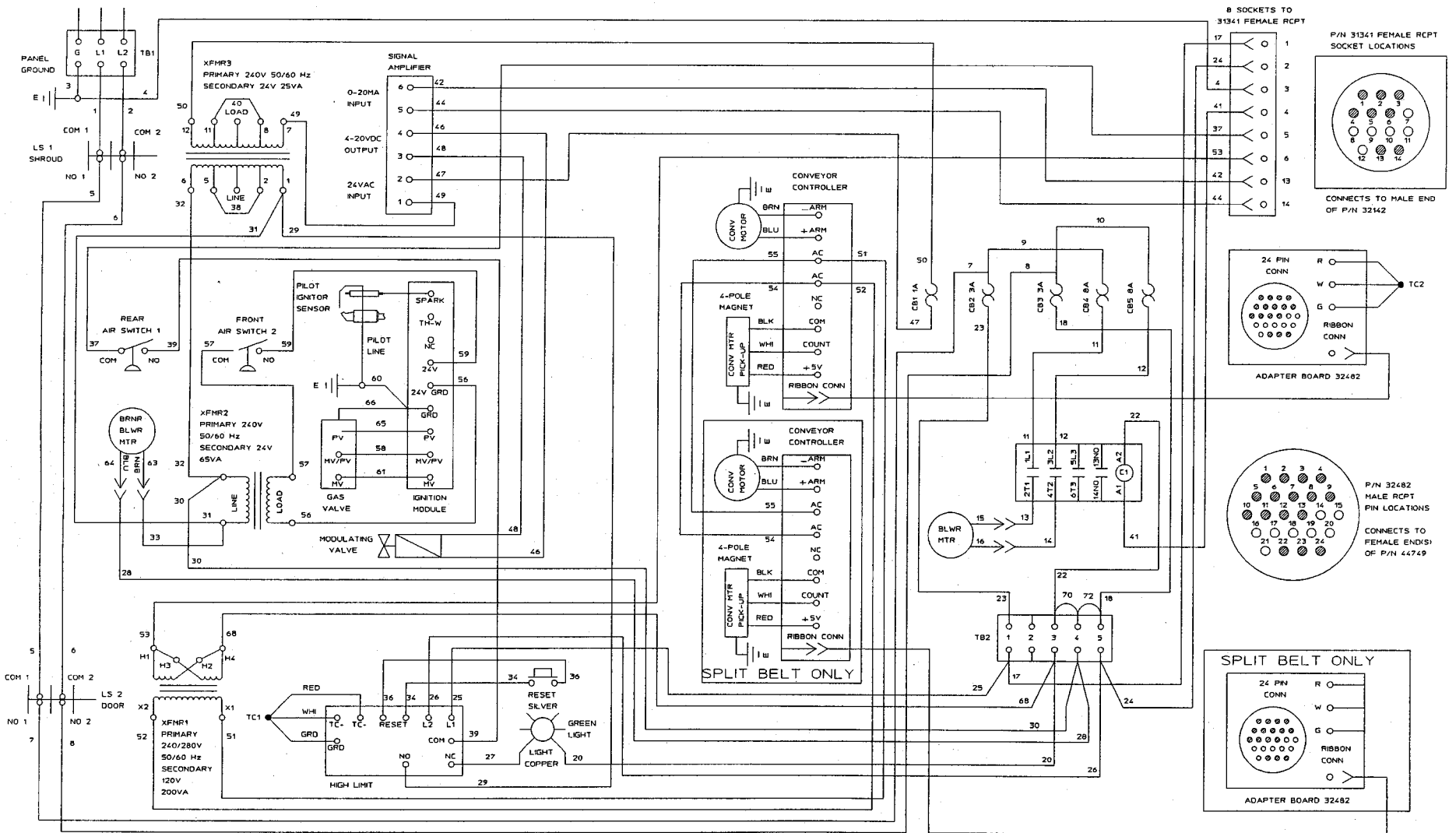
PS200-series gas oven (with solenoid valve and digital temp control), 208/240V main blower motor, 120V control circuit 208/240V, 50/60 Hz, 1 Ph, 3 pole, 4 wire supply (2 hot, 1 neutral, 1 ground)



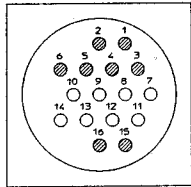
PS200-series gas oven (with modulating valve), 208/240V main blower motor and control circuit  
208/240V, 50/60 Hz, 1 Ph, 2 pole, 3 wire supply (2 hot, 1 ground)



PS200R68-series gas oven (with solenoid valve), 208/240V main blower motor, 120V control circuit  
208/240V, 50/60 Hz, 1 Ph, 3 pole, 4 wire supply (2 hot, 1 neutral, 1 ground)

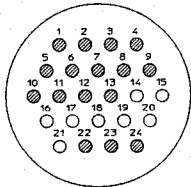


P/N 31279  
MALE RCPT  
PIN LOCATIONS



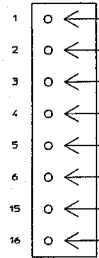
CONNECTS TO  
FEMALE END  
OF P/N 32142

P/N 32482  
MALE RCPT  
PIN LOCATIONS

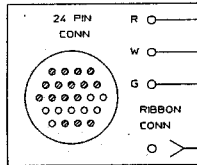


CONNECTS TO  
FEMALE END(S)  
OF P/N 44749

8 PINS TO  
P/N 31279  
MALE RCPT

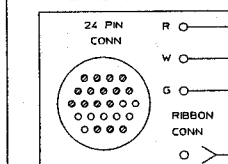


ADAPTER BOARD 32482



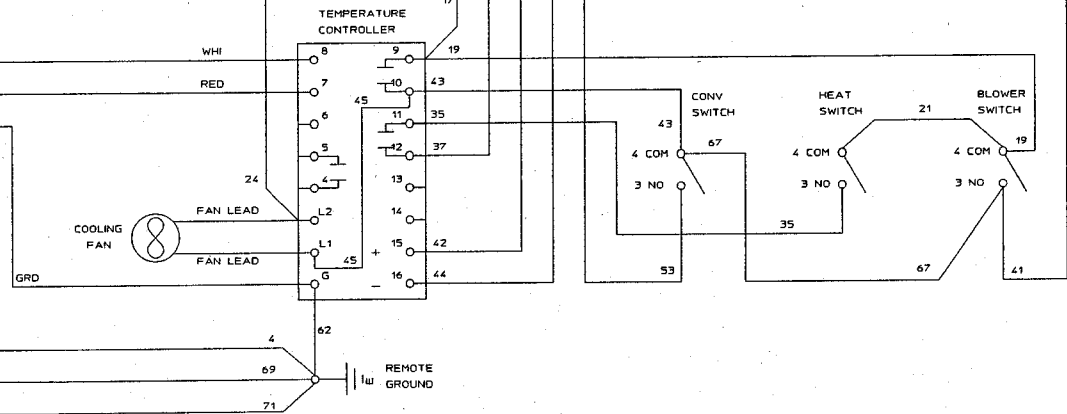
CONVEYOR  
SPEED  
DISPLAY

ADAPTER BOARD 32482



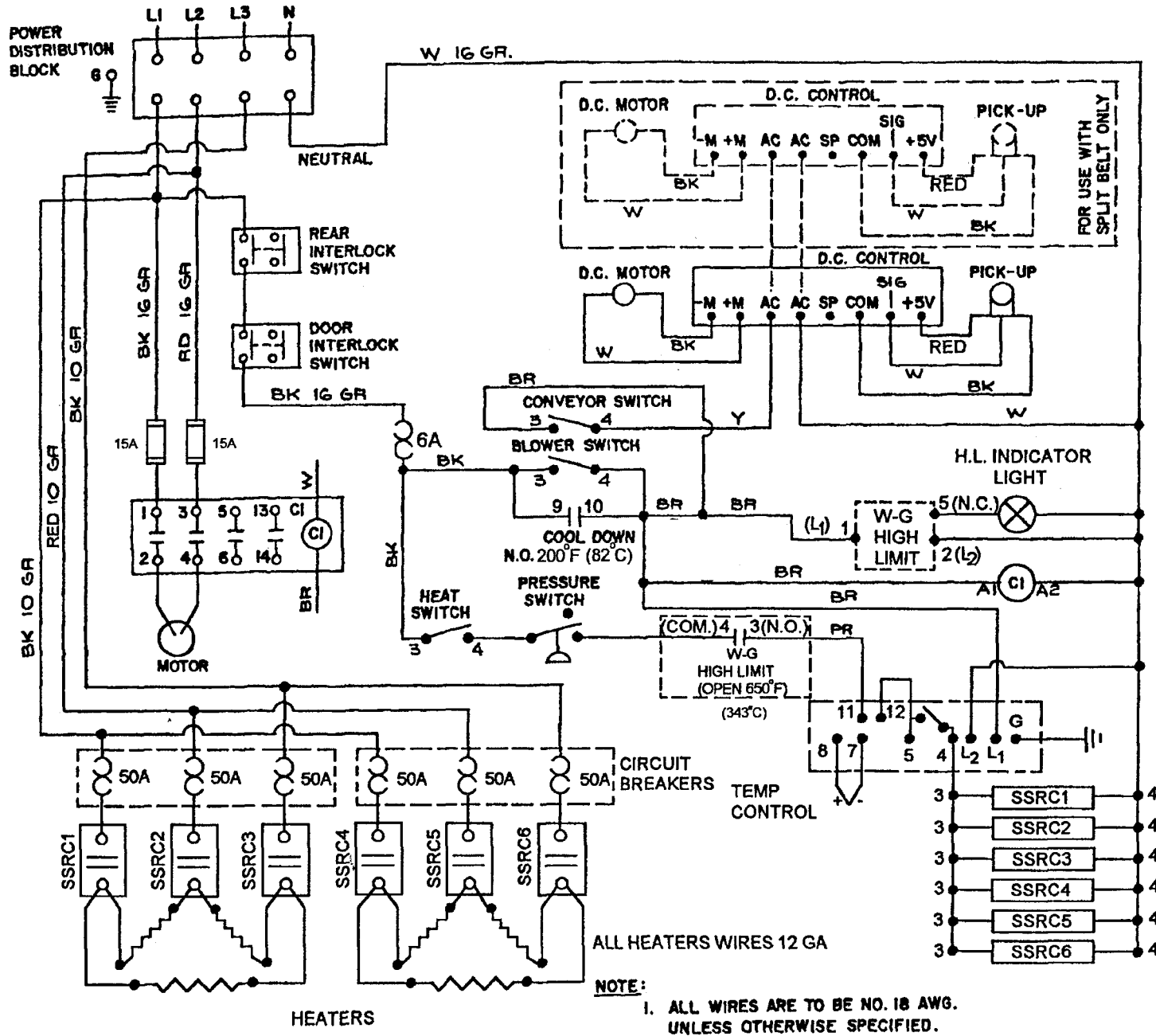
SPLIT BELT ONLY

CONVEYOR  
SPEED  
DISPLAY



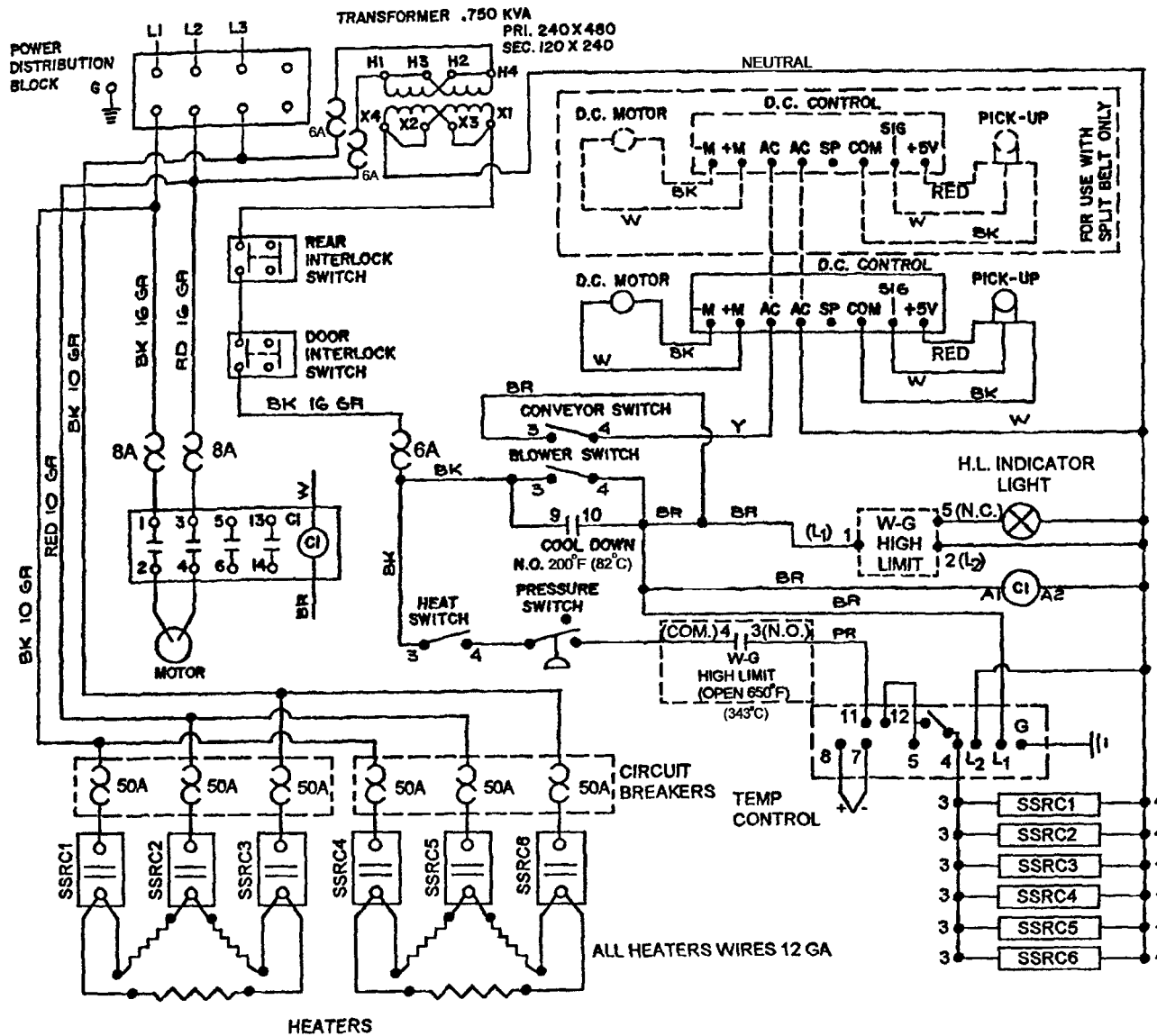
156





158

PS200-series electric oven (USA version), 208/240V main blower motor and heating elements, 120V control circuit 208/240V, 50/60 Hz, 3 Ph, 4 pole, 5 wire supply (3 hot, 1 neutral, 1 ground)



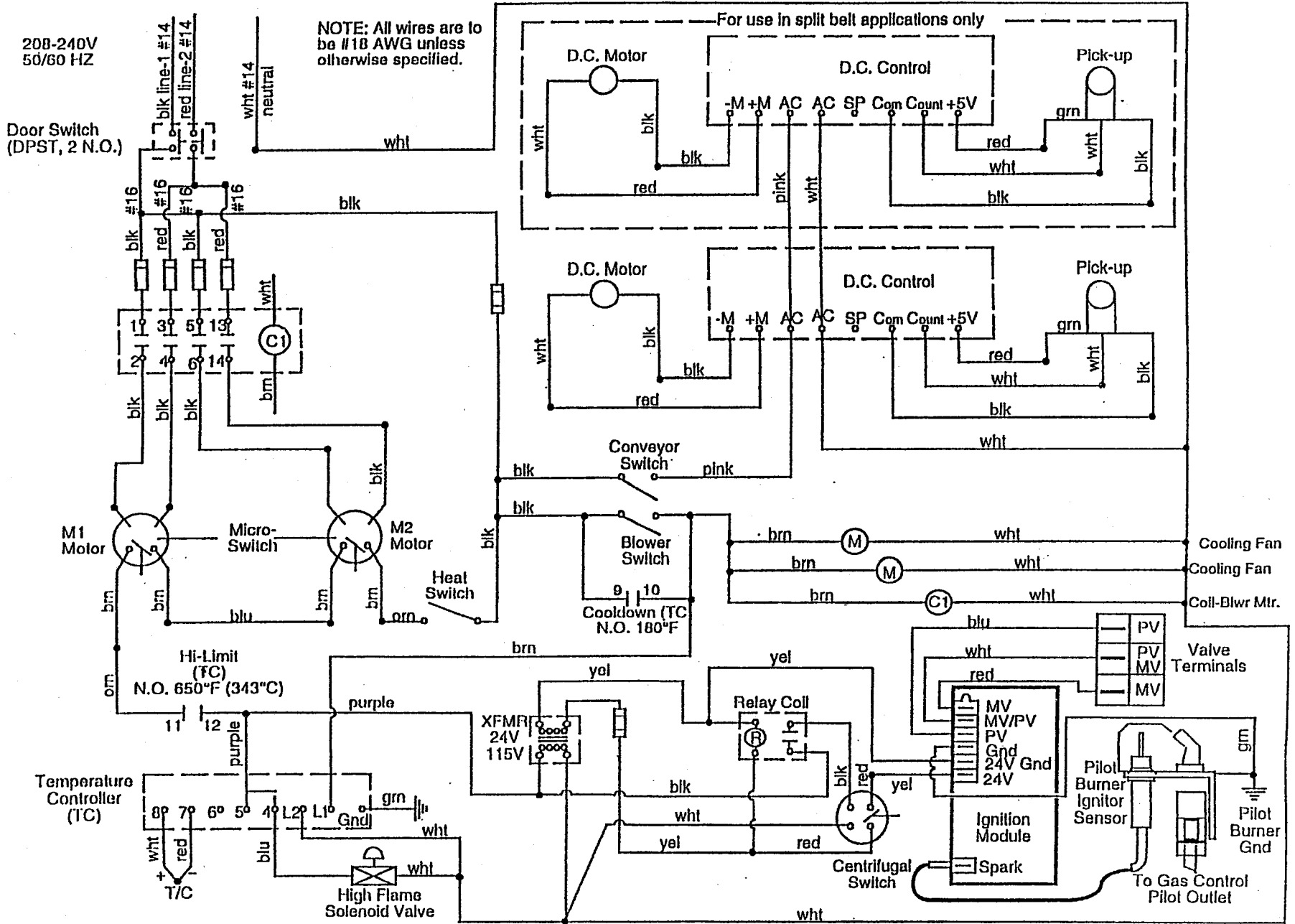
**NOTE:**

1. ALL WIRES ARE TO BE NO. 18 AWG. UNLESS OTHERWISE SPECIFIED.
2. WD LABEL P/N 37855.

PS200-series electric oven (export version), 208/240V main blower motor and heating elements, 120V control circuit 220-240V, 50/60 Hz, 3 Ph, 3 pole, 4 wire supply (3 hot, 1 ground)

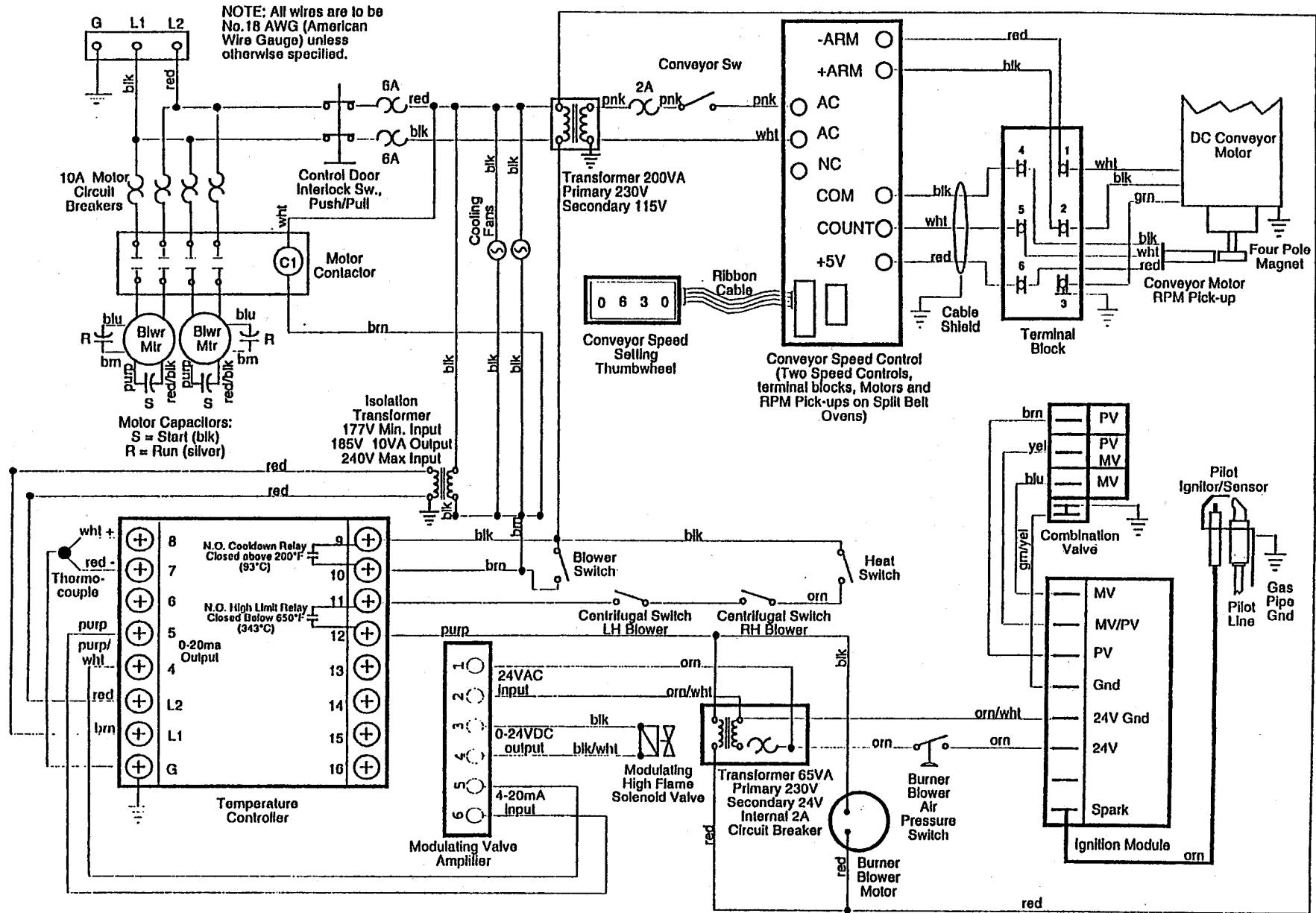






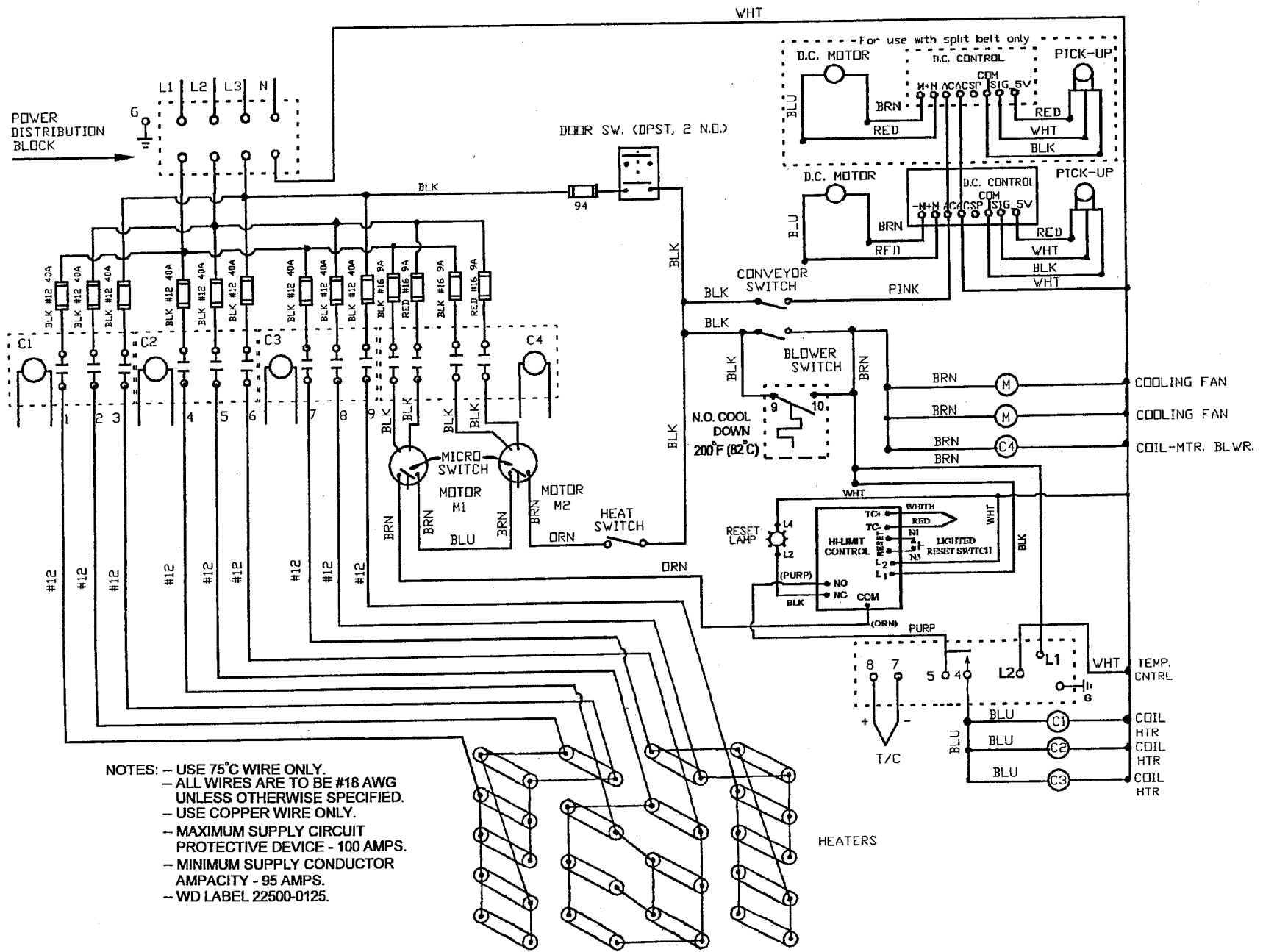
PS310/314/360/360WB gas oven (with digital temp control), 208/240V main blower motor, 120V control circuit  
208/240V, 50/60 Hz, 1 Ph, 3 pole, 4 wire supply (2 hot, 1 neutral, 1 ground)





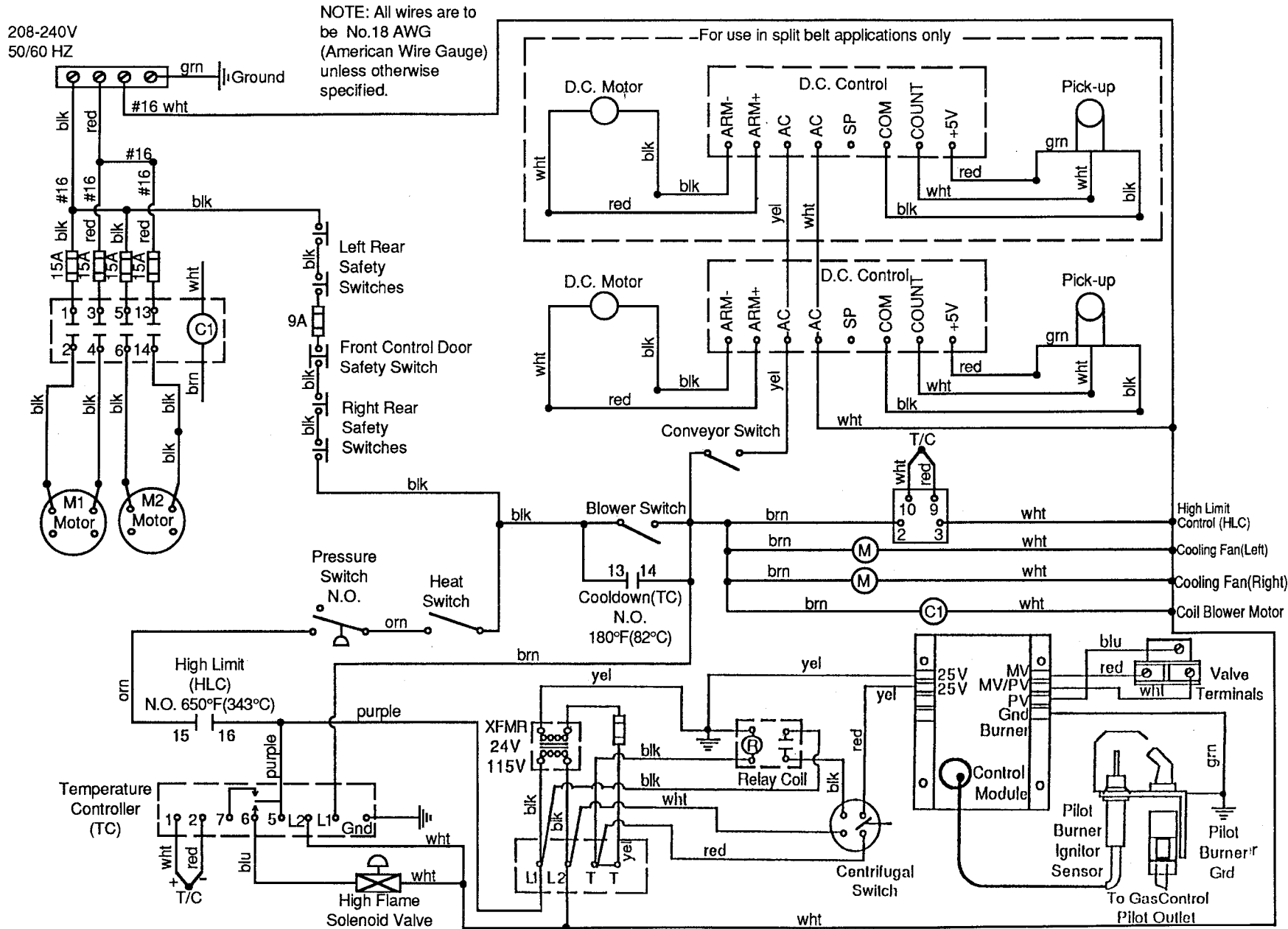
PS360EWB gas oven (with Midco burner and early temp control 32571), 208/240V main blower motor and control circuit 208/240V, 50/60 Hz, 1 Ph, 2 pole, 3 wire supply (2 hot, 1 ground)





- NOTES: - USE 75°C WIRE ONLY.  
 - ALL WIRES ARE TO BE #18 AWG UNLESS OTHERWISE SPECIFIED.  
 - USE COPPER WIRE ONLY.  
 - MAXIMUM SUPPLY CIRCUIT PROTECTIVE DEVICE - 100 AMPS.  
 - MINIMUM SUPPLY CONDUCTOR AMPACITY - 95 AMPS.  
 - WD LABEL 22500-0125.

PS360-series electric oven, 208/240V main blower motor and heating elements, 120V control circuit 208/240V, 50/60 Hz, 3 Ph, 4 pole, 5 wire supply (3 hot, 1 neutral, 1 ground)

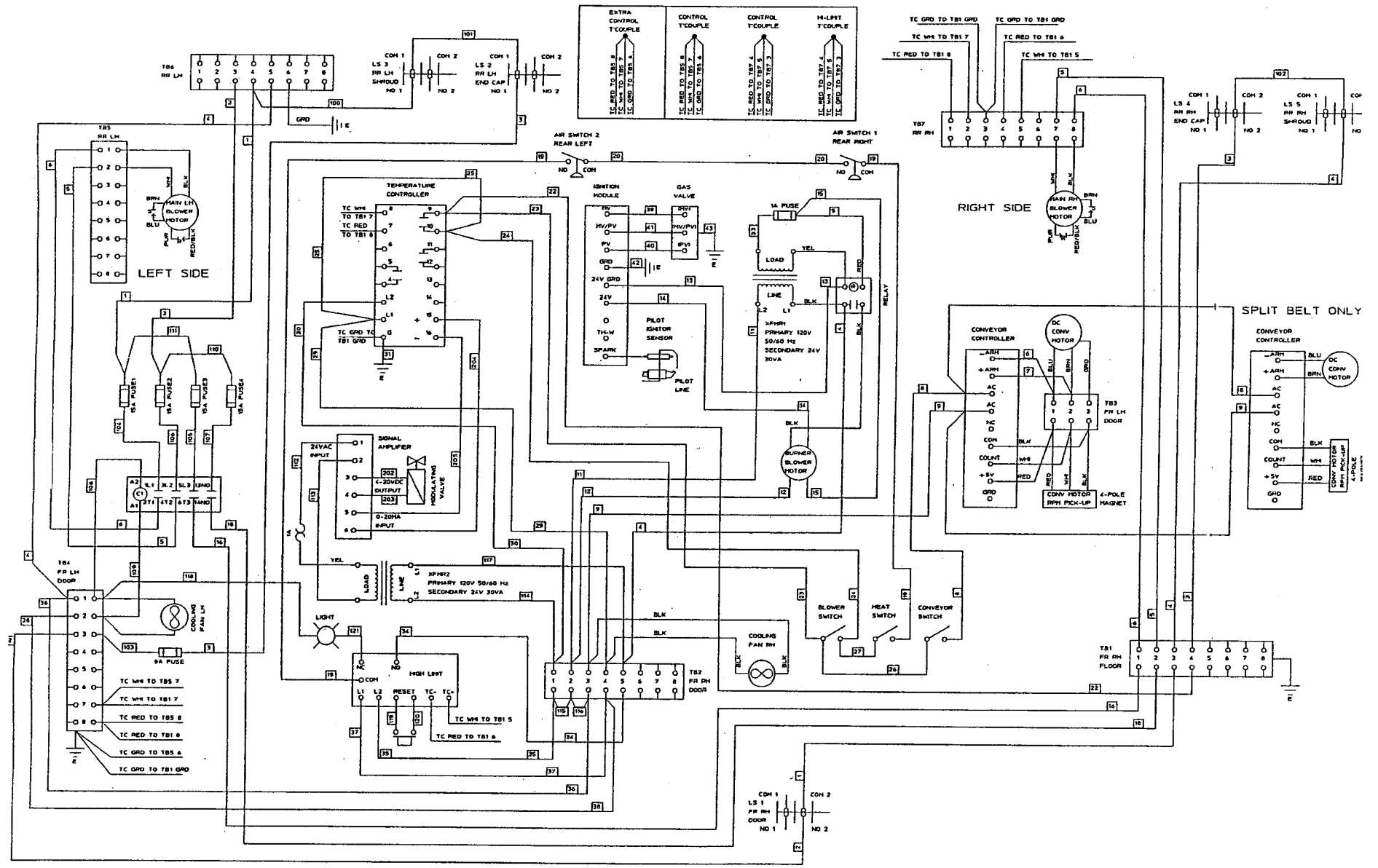


166

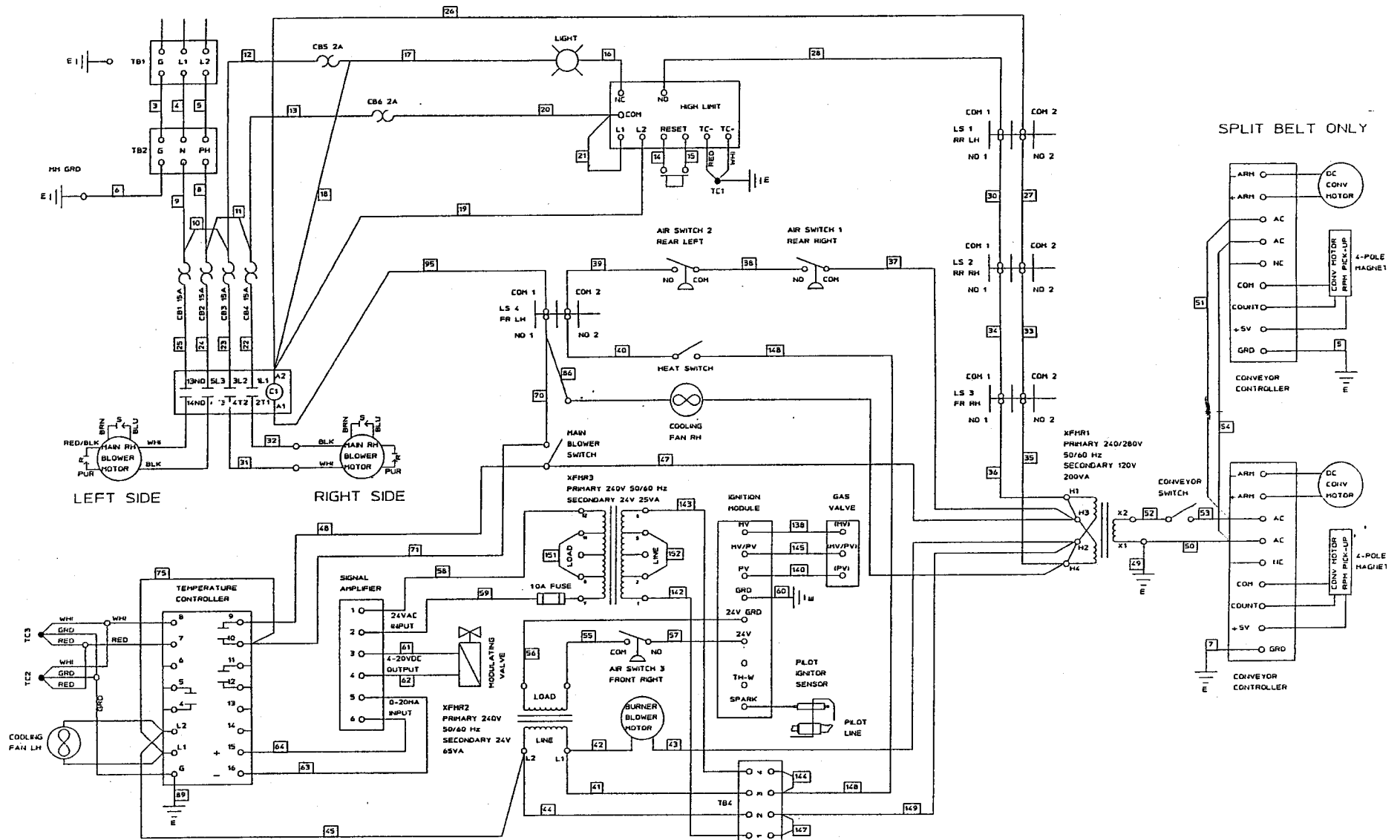
PS570 or PS570S gas oven (with solenoid valve and analog temp control), 208/240V main blower motor, 120V control circuit 208/240V, 50/60 Hz, 1 Ph, 3 pole, 4 wire supply (2 hot, 1 neutral, 1 ground)



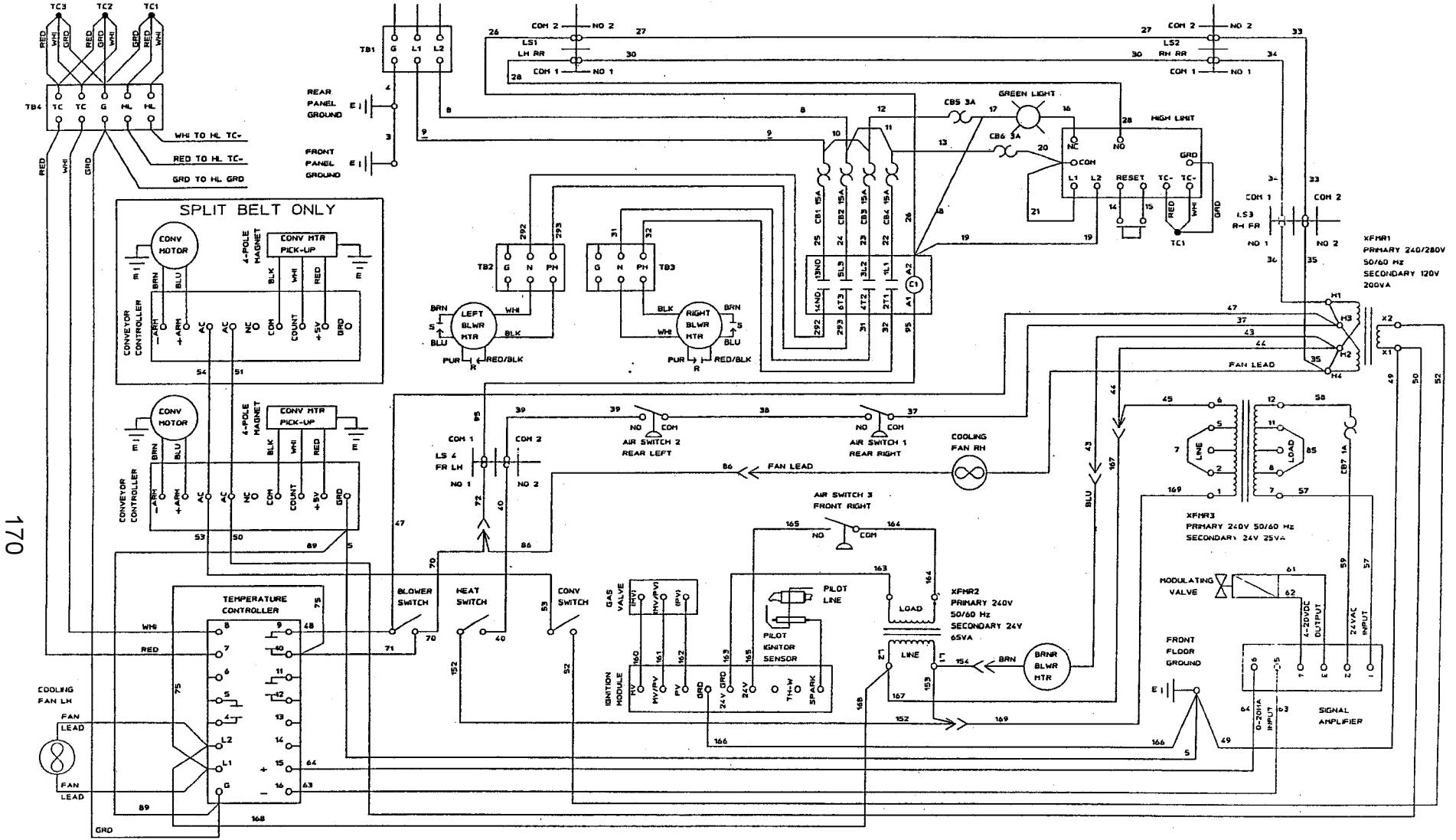




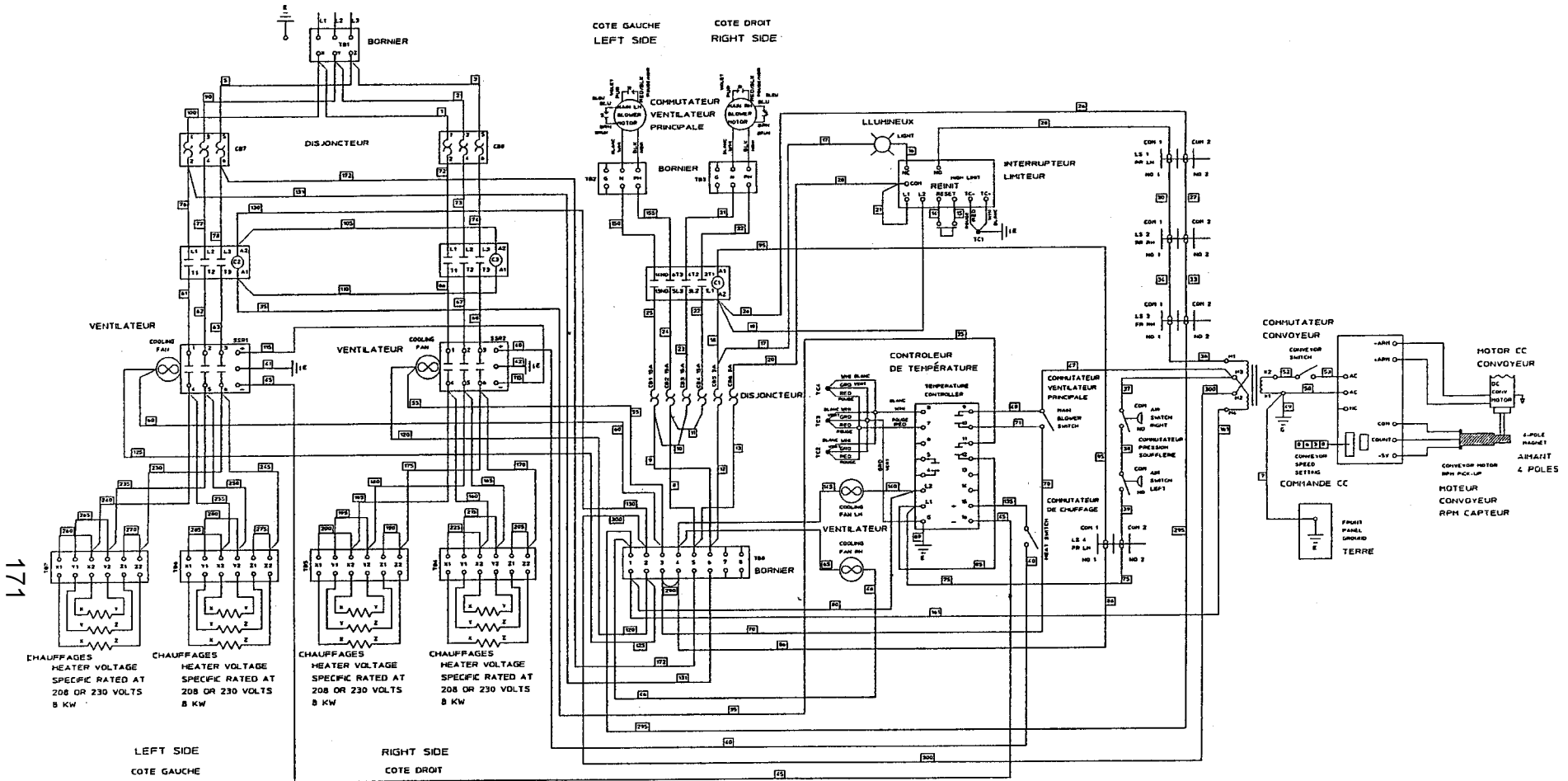
PS570S gas oven (with modulating valve), 208/240V main blower motor, 120V control circuit  
 208/240V, 50/60 Hz, 1 Ph, 3 pole, 4 wire supply (2 hot, 1 neutral, 1 ground)



PS55 gas oven (early), 208/240V main blower motor and control circuit  
 208/240V, 50/60 Hz, 1 Ph, 2 pole, 3 wire supply (2 hot, 1 ground)



PS555G or PS570G gas oven, 208/240V main blower motor and control circuit  
 208/240V, 50/60 Hz, 1 Ph, 2 pole, 3 wire supply (2 hot, 1 ground)



171

PS55 electric oven, 208/240V main blower motor, heating elements and control circuit  
 208/240V, 50/60 Hz, 3 Ph, 3 pole, 4 wire supply (3 hot, 1 ground)

## SECTION 5 REFERENCE

### ***25-point preventative maintenance checklist***

- [ ] 1. Check and clean (blow out) machinery/control compartment.
- [ ] 2. Check and clean (blow out) main blower motors.
- [ ] 3. Check and clean (blow out and brush) axial fans.
- [ ] 4. Check burner blower motor and fan operation.
- [ ] 5. Check and clean igniter assembly.
- [ ] 6. Check and clean all orifices.
- [ ] 7. Install pilot tee if oven is not so equipped.
- [ ] 8. Check gas pressures; adjust as necessary.
- [ ] 9. Check air-fuel mixture; adjust as necessary.
- [ ] 10. Check ignition cable for signs of deterioration.
- [ ] 11. Check and tighten all electrical connections.
- [ ] 12. Inspect conveyor belt for damage; repair as necessary.
- [ ] 13. Inspect conveyor frame pivot plates.
- [ ] 14. Inspect conveyor shaft bushings - Replace drive side bushing.
- [ ] 15. Check conveyor drive chain tension; adjust as necessary.
- [ ] 16. Verify proper air finger arrangement; correct as required.
- [ ] 17. Inspect and clean (vacuum) conveyor motor and motor brushes.
- [ ] 18. Inspect conveyor motor sensor and magnet; verify correct spacing; adjust as necessary.
- [ ] 19. Check conveyor speed control; verify belt speed to be within 10 seconds of set point.
- [ ] 20. Verify that proper number of thermocouples are installed.
- [ ] 21. Check temperature control with thermocouple source to verify accuracy.
- [ ] 22. Check high limit safety circuit with thermocouple source to verify correct operation.
- [ ] 23. Check cool down feature with thermocouple source to verify correct operation.
- [ ] 24. Using the "read" function of the temperature controller, verify and record the high ambient reading.
- [ ] 25. Verify positive ignition on cold start.

**Fractional inches to decimal and millimeter equivalents**

INCH FRACTION	DECIMAL EQUIVALENT	METRIC EQUIVALENT	INCH FRACTION	DECIMAL EQUIVALENT	METRIC EQUIVALENT	
	1/64	.015625	0.397	33/64	.515625	13.097
1/32	.03125	0.794	17/32	.53125	13.494	
	3/64	.046875	1.191	35/64	.546875	13.891
1/16	.0625	1.588	9/16	.5625	14.287	
	5/64	.078125	1.985	37/64	.578125	14.684
3/32	.09375	2.381	19/32	.59375	15.081	
	7/64	.109375	2.778	39/64	.609375	15.478
1/8	.125	3.175	5/8	.625	15.875	
	9/64	.140625	3.572	41/64	.640625	16.272
5/32	.15625	3.969	21/32	.65625	16.669	
	11/64	.171875	4.366	43/64	.671875	17.067
3/16	.1875	4.762	11/16	.6875	17.463	
	13/64	.203125	5.159	45/64	.703125	17.860
7/32	.21875	5.556	23/32	.71875	18.238	
	15/64	.234375	5.953	47/64	.734375	18.635
1/4	.25	6.350	3/4	.75	19.049	
	17/64	.265625	6.747	49/64	.765625	19.446
9/32	.28125	7.144	25/32	.78125	19.842	
	19/64	.296875	7.541	51/64	.796875	20.239
5/16	.3125	7.937	13/16	.8125	20.636	
	21/64	.328125	8.334	53/64	.828125	21.033
11/32	.34375	8.731	27/32	.84375	21.430	
	23/64	.359375	9.128	55/64	.859375	21.827
3/8	.375	9.525	7/8	.875	22.224	
	25/64	.390625	9.922	57/64	.890625	22.621
13/32	.40625	10.319	29/32	.90625	23.018	
	27/64	.421875	10.716	59/64	.921875	23.415
7/16	.4375	11.112	15/16	.9375	23.812	
	29/64	.453125	11.509	61/64	.953125	24.209
15/32	.46875	11.906	31/32	.96875	24.606	
	31/64	.484375	12.303	63/64	.984375	25.004
1/2	.5	12.700	1	1.000	25.400	

**Decimal equivalents of drill sizes**

SIZE	DRILL DIAMETER	SIZE	DRILL DIAMETER	SIZE	DRILL DIAMETER	SIZE	DRILL DIAMETER	SIZE	DRILL DIAMETER
1	.2280	17	.1730	33	.1130	49	.0730	65	.0350
2	.2210	18	.1695	34	.1110	50	.0700	66	.0330
3	.2130	19	.1660	35	.1100	51	.0670	67	.0320
4	.2090	20	.1610	36	.1065	52	.0635	68	.0310
5	.2055	21	.1590	37	.1040	53	.0595	69	.0292
6	.2040	22	.1570	38	.1015	54	.0550	70	.0280
7	.2010	23	.1540	39	.0995	55	.0520	71	.0260
8	.1990	24	.1520	40	.0980	56	.0465	72	.0250
9	.1960	25	.1495	41	.0960	57	.0430	73	.0240
10	.1935	26	.1470	42	.0935	58	.0420	74	.0225
11	.1910	27	.1440	43	.0890	59	.0410	75	.0210
12	.1890	28	.1405	44	.0860	60	.0400	76	.0200
13	.1850	29	.1360	45	.0820	61	.0390	77	.0180
14	.1820	30	.1285	46	.0810	62	.0380	78	.0160
15	.1800	31	.1200	47	.0785	63	.0370	79	.0145
16	.1770	32	.1160	48	.0760	64	.0360	80	.0135
LETTER SIZES									
A	.234	G	.261	L	.290	Q	.332	V	.377
B	.238	H	.266	M	.295	R	.339	W	.386
C	.242	I	.272	N	.302	S	.348	X	.397
D	.246	J	.277	O	.316	T	.358	Y	.404
E	.250	K	.281	P	.323	U	.368	Z	.413
F	.257								

All dimensions are given in inches. See decimal equivalents.

Drills designated in fractions are available in diameters 1/8" to 4" in increments of 1/64".

SECTION 5 - REFERENCE

**General conversion factors**

MULTIPLY	BY	TO OBTAIN
atmospheres (std. - 760mm of mercury at 32°F/0°C)	14.696	lbs./sq. inch
atmospheres	76.0	cm of mercury
atmospheres	29.92	in. of mercury
atmospheres	33.90	ft. of water
atmospheres	1.0333	kg/sq. cm
atmospheres	14.70	lbs./sq. inch
atmospheres	1.058	tons/sq. ft.
BTU (British Thermal Units)	0.2520	kilogram-calories
BTU	777.5	ft.-lbs.
BTU	0.000393	horsepower-hrs.
BTU	0.293	Watt-hrs.
BTU/min	12.96	ft.-lbs.-sec.
BTU/min	0.02356	horsepower
BTU/min	0.01757	kilowatts
BTU/min	17.57	Watts
calories	0.003968	BTU
centimeters	0.3937	inches
centimeters	0.03280	feet
centimeters	0.01	meters
centimeters	10	millimeters
cm of mercury	0.01316	atmospheres
cm of mercury	0.4461	ft. of water
cm of mercury	136.0	kg/sq. meter
cm of mercury	27.85	lbs./sq. ft.
cm of mercury	0.1934	lbs./sq. in. (psi)
cubic feet	2.832x10 <sup>4</sup>	cubic cm
cubic feet	1728	cubic inches
cubic feet	0.02832	cubic meters
cubic feet	0.03704	cubic yards
cubic feet	7.48052	gallons (U.S.)
cubic ft./min.	472	cubic cm/sec.
cubic ft./min.	0.1247	gallons/sec.
cubic ft./water	62.4	lb. @ 60°F/16°C
feet	30.48	centimeters
feet	12	inches
feet	0.3048	meters
feet	1/3	yards
feet of water	0.02950	atmospheres
feet of water	0.8826	in. of mercury
feet of water	0.03048	kg/sq. cm
feet of water	62.43	lbs./sq. ft.
feet of water	0.4335	lbs./sq. in. (psi)

MULTIPLY	BY	TO OBTAIN
feet/min	0.5080	cm/sec.
feet/min	0.01667	ft./sec.
feet/min	0.01829	km/hr.
feet/min	0.3048	meters/min.
feet/min	0.01136	miles/hr. (mph)
foot-pounds	0.001286	BTU
gallons (imp.)	1.201	gallons (U.S.)
gallons (U.S.)	0.833	gallons (imp.)
gallons (U.S.)	3785	cubic cm
gallons (U.S.)	0.1337	cubic feet
gallons (U.S.)	231	cubic inches
gallons (U.S.)	128	fluid ounces
gallons (U.S.)	3.785	liters
gallons (U.S.) water	8.35	lbs. H <sub>2</sub> O@60°F/16°C
horsepower	42.44	BTU/min.
horsepower	33,000	foot-lbs./min.
horsepower	550	foot-lbs./sec.
horsepower	0.7457	kilowatts
horsepower	745.7	Watts
horsepower (boiler)	33,479	BTU/hr.
horsepower (boiler)	9,803	kilowatts
horsepower-hours	2547	BTU
horsepower-hours	0.7457	kilowatt-hours
inches	2.54	centimeters
inches	25.4	millimeters
inches	0.0254	meters
inches	0.0833	feet
inches of mercury	0.03342	atmospheres
inches of mercury	1.133	feet of water
inches of mercury	13.57	inches of water
inches of mercury	70.73	lbs./sq. ft.
inches of mercury	0.4912	lbs./sq. in. (psi)
inches of water	0.002458	atmospheres
inches of water	0.07355	in. of mercury
inches of water	0.5781	oz./sq. inch
inches of water	5.202	lbs./sq. ft.
inches of water	0.03613	lbs./sq. in. (psi)
kilowatts	56.92	BTU/min.
kilowatts	1.341	horsepower
kilowatts	1000	Watts
kilowatt-hours	3415	BTU
liters	0.2642	gallons
liters	2.113	pints (liquid)
liters	1.057	quarts (liquid)

MULTIPLY	BY	TO OBTAIN
meters	100	centimeters
meters	1000	millimeters
meters	3.281	feet
meters	39.37	inches
meters	1.094	yards
ounces (fluid)	1.805	cubic inches
ounces (fluid)	0.02957	liters
ounces/sq. in.	0.0625	lbs./sq. in. (psi)
ounces/sq. in.	1.73	inches of water
pints	0.4732	liter
pounds	16	ounces
pounds of water	0.01602	cubic ft.
pounds of water	27.68	cubic in.
pounds of water	0.1198	gallons
pounds/sq. ft.	0.01602	feet of water
pounds/sq. ft.	0.006945	lbs./sq. in. (psi)
pounds/sq. in.	0.06804	atmospheres
pounds/sq. in.	2.307	feet of water
pounds/sq. in.	2.036	in. of mercury
pounds/sq. in.	27.68	inches of water
temp. (°C)+273	1	absolute temp (°K)
temp. (°C)+17.78	1.8	temperature (°F)
temp. (°F)+460	1	absolute temp.
temp. (°F)-32	59	temperature (°C)
therm	100,000	BTU
ton, refrigeration	12,000	BTU/hr.
tons (long)	2240	pounds
tons (short)	2000	pounds
watts	3.415	BTU
watts	0.05692	BTU/min.
watts	44.26	foot-pounds/min.
watts	0.7376	foot-pounds/sec.
watts	0.001341	horsepower
watts	0.001	kilowatts
watt-hours	3.415	BTU/hr.
watt-hours	2655	foot-pounds
watt-hours	0.001341	horsepower hrs.
watt-hours	0.001	kilowatt-hours

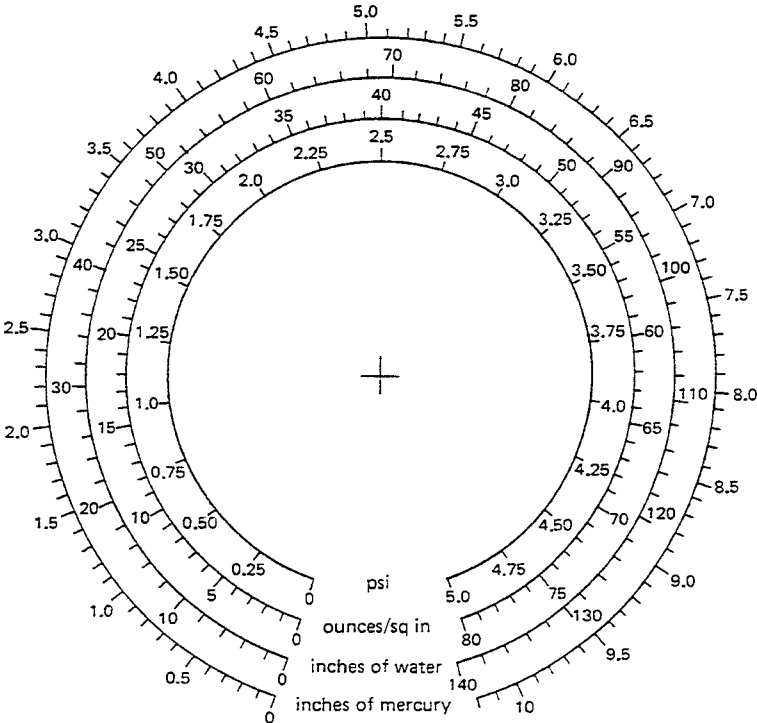
**Pressure conversions**

in. H <sub>2</sub> O	in. Hg	mbar	psi	oz./sq. in.
0.10	0.007	0.20	0.0036	0.0577
0.20	0.015	0.50	0.0072	0.115
0.30	0.022	0.75	0.0108	0.173
0.40	0.029	0.98	0.0145	0.231
0.50	0.037	1.25	0.0181	0.289
0.60	0.044	1.50	0.0217	0.346
0.70	0.051	1.72	0.0253	0.404
0.80	0.059	1.98	0.0289	0.462
0.90	0.066	2.23	0.325	0.520
1.00	0.074	2.50	0.036	0.577
1.36	0.100	3.38	0.049	0.785
1.74	0.128	4.33	0.067	1.00
2.00	0.147	4.97	0.072	1.15
2.77	0.203	6.87	0.100	1.60
3.00	0.221	7.48	0.109	1.73
4.00	0.294	9.95	0.144	2.31
5.00	0.368	12.4	0.181	2.89
6.00	0.442	14.9	0.217	3.46
7.00	0.515	17.4	0.253	4.04

in. H <sub>2</sub> O	in. Hg	mbar	psi	oz./sq. in.
8.00	0.588	20.0	0.289	4.62
9.00	0.662	22.4	0.325	5.20
10.00	0.74	25.0	0.361	5.77
11.00	0.81	27.4	0.397	6.34
12.00	0.88	29.8	0.433	6.92
13.00	0.96	32.5	0.469	7.50
13.60	1.00	33.8	0.491	7.80
13.90	1.02	34.5	0.500	6.00
14.00	1.06	35.8	0.505	8.08
15.00	1.10	37.2	0.542	8.7
16.00	1.18	40.0	0.578	9.2
17.00	1.25	42.3	0.614	9.8
18.00	1.33	45.0	0.650	10.4
19.00	1.40	47.4	0.686	10.9
20.00	1.47	49.7	0.722	11.5
25.00	1.84	62.3	0.903	14.4
27.20	2.00	67.7	0.975	15.7
27.70	2.03	68.7	1.00	16.0

**Pressure conversion chart**

To use this chart, simply place a straightedge so that it intersects the known value and lies across the center of the bullseye. Readings on all scales will then be equivalent.

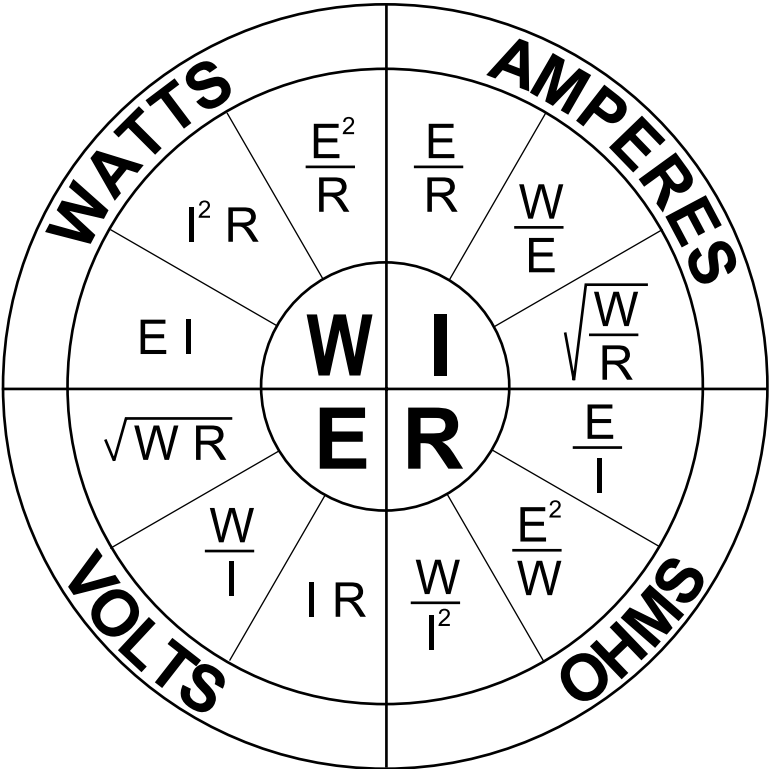


**Ohm's Law equation wheel**

Using this wheel, you can calculate any one of the following four basic factors of electricity, as long as two of the others are known:

- Power - Watts (W), shown as "W"
- Current - Amperes (A), shown as "A"
- Voltage - Volts (V), shown as "E"
- Resistance - Ohms ( $\Omega$ ), shown as "R"

Choose an equation that will give you the value that you need based on what values are already known.





**Common electrical wiring diagram symbols**

SWITCHES									
DISCONNECT		CIRCUIT INTERRUPTER		CIRCUIT BREAKER		LIMIT			
						NORMALLY OPEN	NORMALLY CLOSED	NEUTRAL POSITION	
									ACTUATED
LIMIT (CONTINUED)		LIQUID LEVEL		VACUUM & PRESSURE		TEMPERATURE			
MAINTAINED POSITION	PROXIMITY SWITCH		NORMALLY OPEN	NORMALLY CLOSED	NORMALLY OPEN	NORMALLY CLOSED	NORMALLY OPEN	NORMALLY CLOSED	
	CLOSED	OPEN							
FLOW(AIR, WATER ETC.)		FOOT		TOGGLE	CABLE OPERATED (EMERG.) SWITCH	PLUGGING		NON-PLUG	
NORMALLY OPEN	NORMALLY CLOSED	NORMALLY OPEN	NORMALLY CLOSED			F	F	F	
	SELECTOR			ROTARY SELECTOR					
	2-POSITION		3-POSITION		† NON-BRIDGING CONTACTS		† BRIDGING CONTACTS		
							OR		
						OR			
				† TOTAL CONTACTS TO SUIT NEEDS					
THERMOCOUPLE SWITCH		PUSHBUTTONS				CONNECTIONS, ETC.			
		SINGLE CIRCUIT	DOUBLE CIRCUIT		MAINTAINED CONTACT		CONDUCTORS		
		NORMALLY OPEN		MUSHROOM HEAD			NOT CONNECTED	CONNECTED	
		NORMALLY CLOSED							

**Common electrical wiring diagram symbols (continued)**

CONNECTIONS, ETC. (CONT'D)			CONTACTS						
GROUND	CHASSIS OR FRAME NOT NECESSARILY GROUNDED	PLUG AND RECP.	TIME DELAY AFTER COIL				RELAY, ETC.		THERMAL OVERLOAD
			ENERGIZED		DE-ENERGIZED		NORMALLY OPEN	NORMALLY CLOSED	
			NORMALLY OPEN	NORMALLY CLOSED	NORMALLY OPEN	NORMALLY CLOSED			
COILS									
RELAYS, TIMERS, ETC.	SOLENOIDS, BRAKES, ETC.				THERMAL OVERLOAD ELEMENT	CONTROL CIRCUIT TRANSFORMER			
	GENERAL	2-POSITION HYDRAULIC	3-POSITION PNEUMATIC	2-POSITION LUBRICATION					
COILS (CONTINUED)									
AUTO TRANSFORMER			LINEAR VARIABLE DIFFERENTIAL TRANSFORMER			VARIABLE AUTO-TRANSFORMER			
MOTORS									
3 PHASE MOTOR			DC MOTOR ARMATURE		DC MOTOR FIELD				
RESISTORS, CAPACITORS, ETC.									
RESISTOR	HEATING ELEMENT	TAPPED RESISTOR	RHEOSTAT		POTENTIOMETER				

**Common electrical wiring diagram symbols (continued)**

RESISTORS, CAPACITORS, ETC. (CONTINUED)						
CAPACITORS			METERS		METER SHUNT	FUSES (ALL TYPES)
FIXED	ADJUSTABLE	POLARIZED ELECTROLYTIC	VOLT	AMP		
RESISTORS, CAPACITORS, ETC. (CONTINUED)						
PILOT LIGHTS		HORN, SIREN ETC.	BUZZER	BELL	THERMOC'PLE	BATTERY
LETTER DENOTES COLOR						
ELECTRONIC TUBES						
COLD CATHODE VOLT. REGULATOR	DIODE	TRIODE	TETRODE	PENTODE		
● DOT IN ANY TUBE ENVELOPE DENOTES GAS						
NEON LIGHT						
AC	DC	AC W/INT. RES.				
SEMICONDUCTORS						
RECTIFIER DIODE	RECTIFIER BRIDGE	ARC SUPPRESSORS				
		AC	DC	AC AND DC		
					LIST VALUES OF RES. AND CAP.	

**Common electrical wiring diagram symbols (continued)**

MISCELLANEOUS								
TERMINAL BLOCK	LOCATION OF RELAY CONTACTS							
<table border="1"><tr><td>10</td></tr><tr><td>11</td></tr><tr><td>12</td></tr><tr><td>15</td></tr><tr><td> </td></tr><tr><td> </td></tr><tr><td> </td></tr></table>	10	11	12	15				<p>NUMBERS IN PARENTHESES DESIGNATE THE LOCATION OF RELAY CONTACTS. A LINE BENEATH A NUMBER SIGNIFIES A NORMALLY CLOSED CONTACT.</p>
10								
11								
12								
15								



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