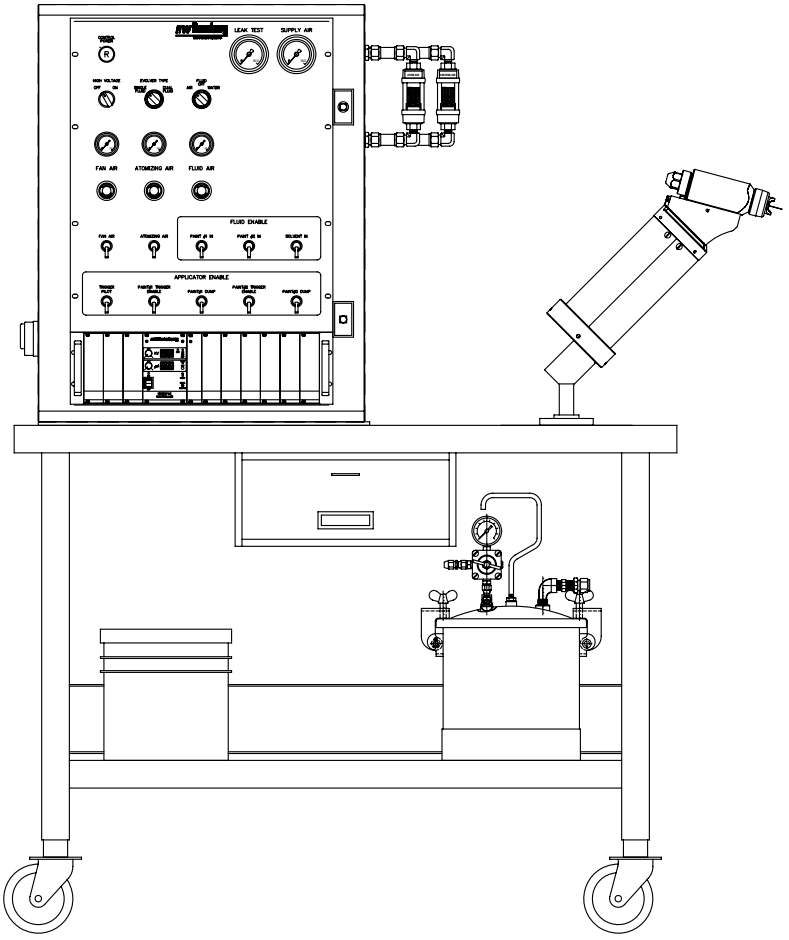
ITW Ransburg

SERVICE MANUAL
LN-9251-06

APT STATION FOR EVOLVER™



MODELS: 77918-09, 77918-10

IMPORTANT: Before using this equipment, carefully read SAFETY PRECAUTIONS, starting on page 1, and all instructions in this manual. Keep this Service Manual for future reference.

Service Manual Price: $30.00 (U.S.)

CONTENTS

SAFETY

SAFETY PRECAUTIONS

Before operating, maintaining or servicing any ITW Ransburg electrostatic coating system, read and understand all of the technical and safety literature for your ITW Ransburg products. This manual contains information that is important for you to know and understand. This information relates to USER SAFETY and PREVENTING EQUIPMENT PROBLEMS. To help you recognize this information, we use the following symbols. Please pay particular attention to these sections.

A **WARNING! states information to alert you to a situation that might cause serious injury if instructions are not followed.**

A CAUTION! states information that tells how to prevent damage to equipment or how to avoid a situation that might cause minor injury.

A NOTE is information relevant to the procedure in progress.

While this manual lists standard specifications and service procedures, some minor deviations may be found between this literature and your equipment. Differences in local codes and plant requirements, material delivery requirements, etc., make such variations inevitable. Compare this manual with your system installation drawings and appropriate ITW Ransburg equipment manuals to reconcile such differences.

Careful study and continued use of this manual will provide a better understanding of the equipment and process, resulting in more efficient operation, longer trouble-free service and faster, easier troubleshooting. If you do not have the manuals and safety literature for your Ransburg system, contact your local ITW Ransburg representative or ITW Ransburg.

⚠ WARNING

► The user **MUST** read and be familiar with the Safety Section in this manual and the ITW Ransburg safety literature therein identified.

► This manual **MUST** be read and thoroughly understood by **ALL** personnel who operate, clean, or maintain this equipment! Special care should be taken to ensure that the **WARNINGS** and safety requirements for operating and servicing the equipment are followed. The user should be aware of and adhere to **ALL** local building and fire codes and ordinances as well as NFPA-33 SAFETY STANDARD, prior to installing, operating, and/or servicing this equipment.

⚠ WARNING

► Never use solvent as a test fluid for this devise!

► Using any material **OTHER** than distilled water or de-ionized may cause fire during the test. Use only distilled water or de-ionized to test the applicator.

⚠ WARNING

► Insure **ALL** nongronded metallic objects in the test area are grounded properly.

⚠ WARNING

► Insure there are **NO OPEN** solvent containers in the test area. remove or properly store any solvents in the test area.

1. Wear the proper safety protection such as eye and ear protection.

2. Never wear loose clothing while working around the applicator.

NOTE

► When toggle switches are in the UP position they are considered to be “ON”.

NOTES

INTRODUCTION

GENERAL INFORMATION

The ITW Automotive Finishing ***Applicator Performance Test Station for Evolver™*** was developed to assist in determining the applicator performance in an off-line condition. This test station device helps to insure the applicator performs correctly when it is put into service.

The test stand was developed with the user and the safety of the user in mind. The user must become familiar with the overall function and operation of the unit.

The test station will test the applicator for voltage, current draw, air flows, fluid flows, and triggering functions. Each of the individual functions of the applicator is broken out into 'individual' tests throughout this service manual. It is recommended to baseline voltage, air flows, and air cap pressures for this product. A Baseline Air Flow Meter Readings log sheet has been included within this service manual to record this information.

SPECIFICATIONS

Electrical / Physical

Power Requirements: 110/120 VAC

Air Requirements: 1 in. NPT (F) Inlet
3/4 in. ID Air Line to Stand
100 psi (6.4 bar) min.
0.3 to 0.6 Micron Filtration

Dimensions

Height:	67 in. (1702 cm)
Width:	30 in. (762 cm)
Length:	48 in. (1219 cm)

Fluids: Use water only for testing

Maximum Fluid Pressure: 80 psi (5.2 bar)

Test Pressures

Atomization Air (ATOM):	100 psi max. (6.9 bar)
Fan/Shaping Air (FAN):	100 psi max. (6.9 bar)
Fluid Trigger Pilot Air:	60 psi max.

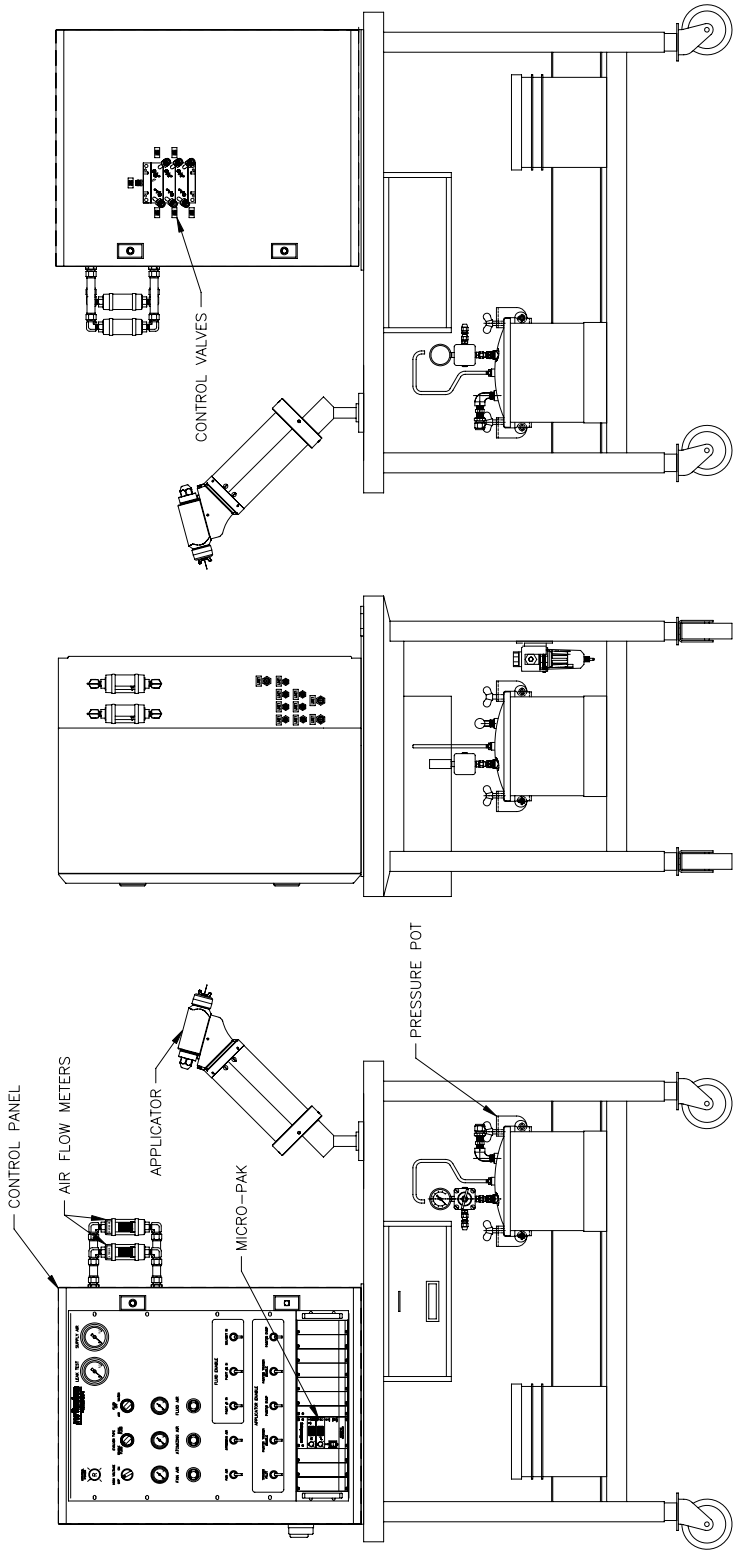


Figure 1: Evolver Test Parts Description

INSTALLATION

CONTROL PANEL FUNCTIONS

With this information, understanding which valve is actuated may assist in troubleshooting problems associated with the test itself.

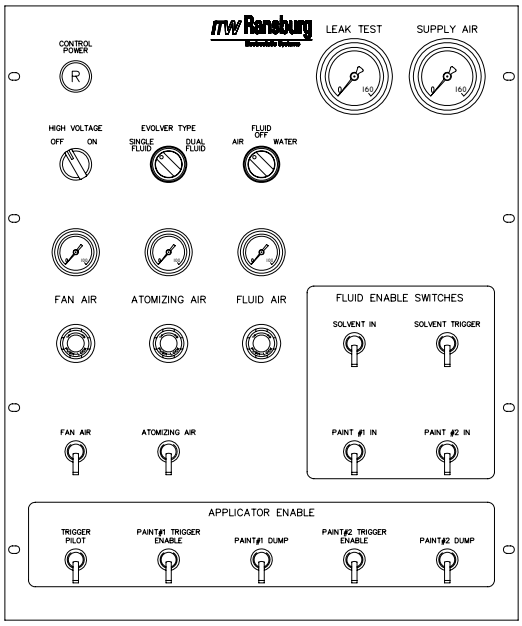


Figure 2: Control Panel

Trigger / Selector Descriptions

- **High Voltage Selector Switch**
  Turns high voltage "On" or "Off" depending upon position

- **Evolver Type Switch**
  Selects single or dual head guns

- **Fluid Selector Switch**
  Selects fluid media depending upon position

- **Atomizing air Switch**
  Toggles ATOM Air "On" or "Off" depending upon position

- **Fan / Shaping Air Switch**
  Toggles FAN air "On" or "Off' depending upon position

Applicator Enable

- **Trigger Pilot**
  Actuates piston to pull back needle

- **Paint 1 and 2 Triggers**
  Actuates paint valves

- **Dump 1 and 2 Triggers**
  Actuates dump valves for Paint 1 and 2

- **Solvent In**
  Activates solvent in pressure

- **Solvent Trigger**
  Actuates solvent valve

- **Paint 1 and 2 In**
  Activates Paint In pressures

SETUP PROCEDURE

1. Insure that ground connections, cart ground, and applicator ground are made to a true earth ground.

⚠ WARNING

► If true earth ground is not made, injury to personnel or serious damage to the equipment may occur.

⚠ CAUTION

► Insure **ALL** items are connected properly before applying air to the unit.

2. Provide air filtration to the manifold that has the capability of passing 136 scfm with particulate removal of .3 to .6 micron particle size.

3. Provide a minimum 3/4 inch ID air line to the filter at the manifold inlet. A minimum of 100 psig pressure is required at the manifold inlet.

4. Install pressure pot air and fluid lines. Install the line with the ferrule and nut to the fluid exit of

Figure 3: Fluid and Air Line Connections

the pot and install the push to lock at the air inlet.
5. Plug the line cord into 110/120 VAC outlet.

6. Turn air pressure "On" to the inlet manifold. 100 psig supply air minimum pressure is required.

HIGH VOLTAGE TEST

The purpose of the high voltage test is to insure all voltage generating components are set or installed properly.

NOTE

► When toggle switches are in the "UP" positon, they are considered to be "On".

1. Insure pilot trigger switch is in the "DOWN" or "Off" position (refer to Figure 4).

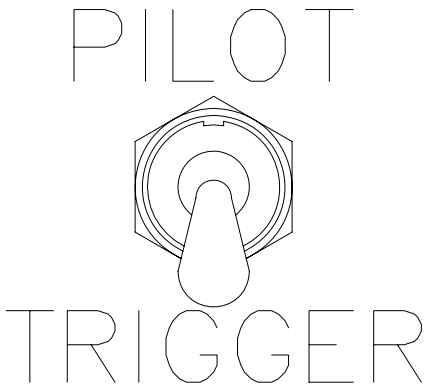


Figure 4: Pilot Trigger Switch In "Off" Position

2. Insure the main power switch is in the "Off" position. Remove the shroud from the applicator and install applicator on to the manifold mounting plate as shown in Figure 5.

Figure 5: Applicator (Shroud Removed)

EFM gun assembly shown, same procedure for Evolver Assembly.

3. With control panel power “Off”, cover the end of the applicator with a plastic bag to contain the electrostatic voltage and prevent current from being drawn off to the atmosphere. Insure that the bag fits tight around the applicator (see Figure 6). A non-metallic external elastic band may be used if required.

⚠ WARNING

► Insure **ALL** ungrounded, metallic objects are **GROUNDED** and no solvents exist in the test area.

Figure 6: Containment of Electrostatic Current

EFM gun assembly shown, same procedure for Evolver Assembly.

4. Turn the main control power switch to the “On” position. The red illuminated indicator should now be seen.

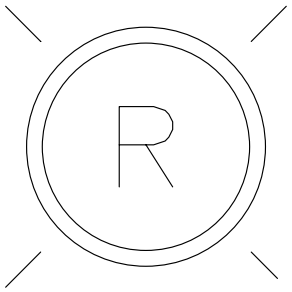


Figure 7: Main Power Supply Indicators

5. Turn the MicroPak Power Supply “On”. Switch the unit to the “Local” setting. Adjust the voltage adjustment potentiometer fully clockwise. Also insure current adjustment is fully adjusted clockwise.

6. Turn the high voltage “ON” switch (on the test panel) to the “On” position.

NOTE

► High voltage and trigger functions are interlocked. When high voltage is “On”, trigger function is locked-out.

7. Read the kV and µA current reading from the appropriate display of the MicroPak (refer to Figure 8). The reading of voltage should be between 90 to 100 kV. The current draw should be 6 to 20 µA. Turn voltage switch to the “Off” position. If readings taken are inside this range, remove voltage containment bag from end of applicator and proceed to the “Test Triggers” in the “Installation” section of this manual. If the readings are outside the listed range, go to the “Troubleshooting High Voltage Test” in the “Installation” section of this manual.

Figure 8: MicroPak Controller Panel

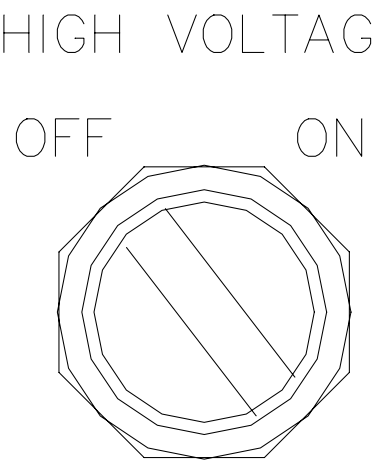


Figure 9: High Voltage "ON/OFF" Switch

8. Actual voltage output may be verified using ITW Ransburg High Voltage Test Probe 76652-04. (Consult current "Paint, HV & SCI Test Equipment" manual for test procedure.)

TROUBLESHOOTING

High Voltage Test

If the voltage display of the MicroPak reads less than 90 kV or the current draw is above 20 µA potentiometer adjusted fully clockwise, the fluid lines may need to be purged or the voltage test bag is leaking current and voltage to the air. If you have no voltage reading at all, proceed to "High Voltage Troubleshooting" in the "Installation" section. If you have voltage, check to make sure the voltage test bag is secured tight to the applicator. If it is, follow the procedure "Blow the Fluid Lines Out" in the "Installation" section.

Blow The Fluid Lines Out

1. Turn the MicroPak voltage "Off" at the switch.

NOTE

► High voltage and trigger functions are interlocked. When high voltage is "On", trigger function is locked-out.

2. Remove the voltage containment bag from the end of the applicator.

3. Turn the fluid selector switch to the "Air" position (see Figure 10).

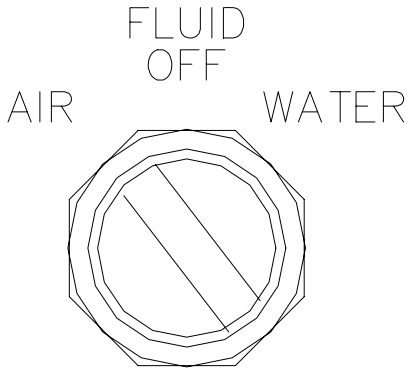


Figure 10: Fluid Selection Switch

4. Turn pilot trigger to “On” or “UP” position (see Figure 11).

Figure 11: Pilot Trigger Switch In “On” Position

5. Turn the fluid enable switche to the “On” or “UP” position (see Figure 12).

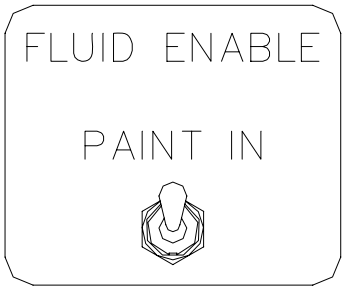


Figure 12: Fluid Enable Paint In “On” Position

6. Adjust the fluid air regulator to 60 psig (see Figure 13).

NOTE

► **DO NOT** exceed 60 psig or possible damage to the gun regulator may occur.

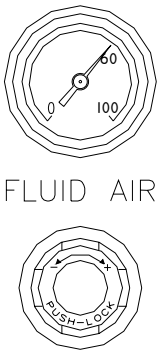


Figure 13: Fluid Air Regulator Location In “On” Position

7. Turn the dump toggle switches to the “On” or “UP” position. Air will begin to blow through the system (see Figure 14).

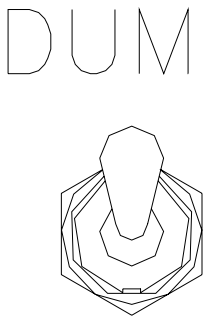


Figure 14: Dump Toggle Switch In “On” Position

8. Turn the trigger switch to the “On” or “UP” position (see Figure 15).

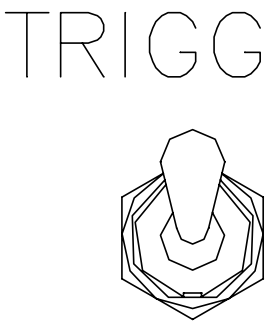


Figure 15: Trigger Toggle Switch in “On” Position

9. Switch all actuated switches to their "Off" positions.

10. Reinstall the voltage containment bag.

11. Restart voltage test, sections 4 through 6. All current and voltage readings should meet the listed specifications for the applicator to deliver the performance that is expected from it.

High Voltage Troubleshooting

If there is zero kV reading at the MicroPak display with the voltage adjust potentiometer turned fully clockwise, there could be several different causes. Some of the most likely causes of the problem are:

1. The cascade connector is loose or was not properly connected at the wiring harness. Verify the connection.

2. Low voltage cable 79008 or A11353 may not be connected into the manifold properly. The timing marks must match up perfectly between the cable and wiring harness located in the manifold plate (this requires removal of applicator to allow visual inspection of timing mark).

3. Recheck that BOTH grounds of the stand are at true earth ground potential.

4. 79010 cascade assembly may be bad. Install a known good cascade in the applicator and check for improved results. When reinstalling the cascade, use LSCH0009 dielectric grease around the circle labyrinth at the spring connection end of the 79010 cascade assembly.

5. Air passages (or the outside of the gun) have material deposits on (or in) them which are drawing current back to ground. Clean with appropriate solvent as required.

TEST TRIGGERS

The purpose of the trigger test section is to guarantee all the triggers on the applicator have been properly hooked up and when they receive an air signal, they properly cycle.

Verify Trigger Functions With Air

Air is used in the initial test to reduce the mess associated with water if the trigger valves or dump valves have not been properly plumbed or rebuilt. The following procedure describes the test of each of the following valves in the applicator.

1. Insure that the MicroPak main power control is in the "Off" position.

2. Turn the fluid selector switch to the "Air" position (see Figure 10).

3. Turn pilot trigger to "On" or "UP" position (see Figure 11).

4. Turn the "Solvent IN", "Paint #1 and #2 "On" or "UP" position.

5. Adjust the fluid air regulator to 60 psig (see Figure 13).

NOTE

► **DO NOT** exceed 60 psig or possible damage to the gun regulator may occur.

Trigger the trigger pilot to the "On" or "UP" position. This allows air to flow through the gun inlet fluid passages.

6. Turn the trigger toggle switches to the "On" or "UP" position. Paint #1 "Trigger Enable", Paint #2 "Trigger Enable", and solvent "Trigger Enable".

7. Listen for any audible leaks. Correct as required.

8. Turn the trigger switch to the "Off" or "DOWN" position.

9. Turn the dump line trigger switch to the "On" or "UP" position. Listen for air purge.

10. Open dump ball valve.

11. Turn “Off” dump trigger.

12. Turn all switches “Off”.

Trigger Troubleshooting

1. If any audible leaks exist, tighten or check to make sure seal o-ring is in place.

2. If the gun does not trigger or trigger is sluggish, check the following:

- Trigger pilot regulator has not been set to a minimum of 70 psig.
- Tubing leading from the source to the gun mounting plate is pinched or broken.
- Piston seal 7723-06 within the gun spray head is not in place or there is an extremely tight fit between the seal and the cylinder wall.

3. If atomization and fan air do not respond, check for the following:

- Low trigger pilot air pressure (80 psi minimum required).
- Air tubes 79134-00 are not installed properly.
- Black or natural 3/8 inch OD tube is cut or pinched.

FAN AND ATOMIZATION AIR TESTS

1. Insure the fluid air, trigger, and dump switches are in the “Off” position.

2. Using the air cap test gauge to set (ITW Ransburg Test Gauge EMF-430-1 - not supplied) the air cap pressures to match the spray pressures used in production (see Figure 16).

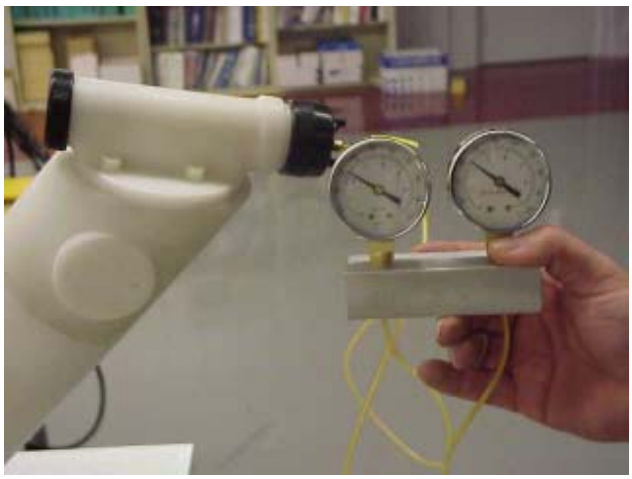


Figure 16: Fan and Atomization Air Test

EFM gun assembly shown, same procedure for Evolver Assembly.

3. Turn “Off” fan and atomization air trigger switches.

4. Remove the test cap and install the air cap being tested. Turn atomization and fan air “On”. Record air flow rates using the supplied “Baseline Air Flow Meter Readings” Log Sheet

BASELINE AIR FLOW METER READINGS							
	Flow Rate		Pressure				
Gun SN#	FAN	ATOM	FAN	ATOM	kV	µA	DATE

Figure 17: Atomization Air Flow Meter Readings

NOTE

► Before using the gun in production the baseline air flows should be recorded.

PRESSURIZED WATER TEST
(Static)

The purpose of this section of the test is to verify that each of the valves in the applicator will pass fluid. Also, this test verifies all seals along the fluid passages have been properly located to prevent any fluid leakage.

1. Insure all trigger select switches are set to the "Off" position.

2. Position the applicator where any water sprayed out of the gun may be collected and properly disposed of.

3. Verify there is no residual pressure in the pressure pot included with the test station. Pull the bleed-off valve to release the pressure if any.

4. Loosen the pressure pot clamps until the lid may be removed from the pot itself. Fill the pressure pot with either de-ionized or distilled water.

5. Close the lid. Tighten the lid clamps so that the lid is secure and no air pressure may escape.

6. Turn the pilot trigger to the "On" or "UP" position.

7. Turn the fluid actuation switch to water (see Figure 18).

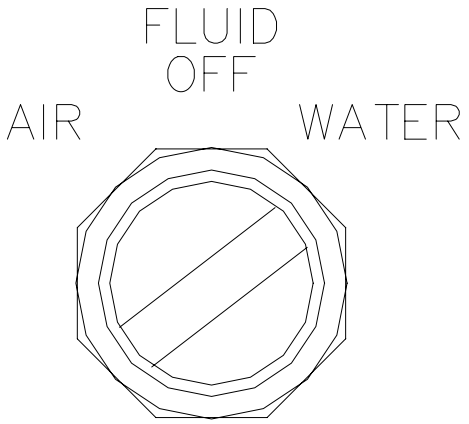


Figure 18: Fluid Selection Switch for Water Tests

8. Manually turn up the water pressure to 75 psig by adjusting the pressure regulator on the pressure pot. Verify by looking at the pressure gauge for fluid pressure.

9. Turn on all triggers except for "Trigger Pilot, Paint #1 Dump, and Paint #2 Dump" to the "Water" position.

10. Visually inspect the coiled fluid tubes to verify there is fluid in them and no leaks at the connections exist.

11. Visually inspect around the applicator to insure there are no visible water leakages.

12. Turn the fluid selector switch to the "Off" positon as shown in Figure 19.

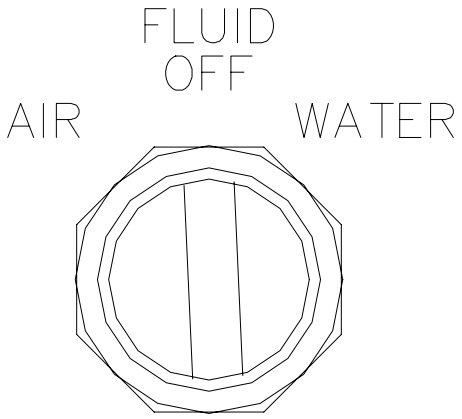


Figure 19: Fluid Selector Switch "Off" Position

13. Record the pressure from the leak test gauge after 1 minute. The leak pressure should stay constant over this period. If it does not, locate the source of the leak, repair it, and retest the applicator.

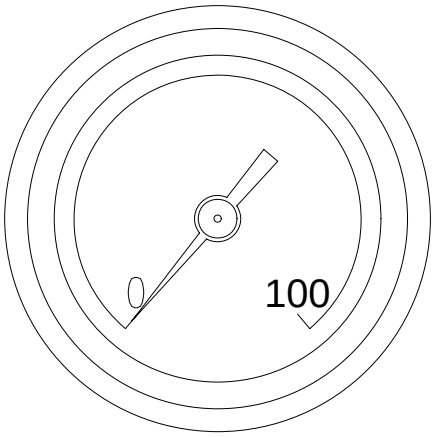


Figure 20: Leak Test Gauge

14. Turn on the dump triggers.

15. Turn the fluid selector switch back to "Air". Depressurize the pressure pot.

16. Actuate the dump triggers and blow out the lines per the procedure outlined in "High Voltage Troubleshooting" in the "Installation" section.

PREPARE FOR ON-LINE PLACEMENT

1. Turn all pressures and switches off.

2. Turn pilot trigger to “Off” or “DOWN” postion.

3. Remove applicator from station.

NOTES

MAINTENANCE

There should be no maintenance required. If any maintenance is required, consult factory for spare parts availability.

NOTES

NOTES

WARRANTY POLICIES

LIMITED WARRANTY

ITW Ransburg will replace or repair without charge any part and/or equipment that fails within the specified time (see below) because of faulty workmanship or material, provided that the equipment has been used and maintained in accordance with ITW Ransburg's written safety and operating instructions, and has been used under normal operating conditions. Normal wear items are excluded.

THE USE OF OTHER THAN ITW RANSBURG APPROVED PARTS VOIDS ALL WARRANTIES.

SPARE PARTS: One hundred and eighty (180) days from date of purchase, except for rebuilt parts (any part number ending in "R") for which the warranty period is ninety (90) days.

EQUIPMENT: When purchased as a complete unit, (example: guns, power supplies, control units, etc.), is one (1) year from date of purchase. **WRAPPING THE APPLICATOR IN PLASTIC, SHRINK-WRAP, ETC., WILL VOID THIS WARRANTY.**

ITW RANSBURG'S ONLY OBLIGATION UNDER THIS WARRANTY IS TO REPLACE PARTS THAT HAVE FAILED BECAUSE OF FAULTY WORKMANSHIP OR MATERIALS. THERE ARE NO IMPLIED WARRANTIES NOR WARRANTIES OF EITHER MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. ITW RANSBURG ASSUMES NO LIABILITY FOR INJURY, DAMAGE TO PROPERTY OR FOR CONSEQUENTIAL DAMAGES FOR LOSS OF GOODWILL OR PRODUCTION OR INCOME, WHICH RESULT FROM USE OR MISUSE OF THE EQUIPMENT BY PURCHASER OR OTHERS.

EXCLUSIONS:

If, in ITW Ransburg's opinion the warranty item in question, or other items damaged by this part was improperly installed, operated or maintained, ITW Ransburg will assume no responsibility for repair or replacement of the item or items. The purchaser, therefore will assume all responsibility for any cost of repair or replacement and service related costs if applicable.

APPENDIX

PAINT AND SOLVENT SPECIFICATIONS

	REA™ VECTOR™ EFM™ EVOLVER™	REM™ / M90™	NO. 2 HAND GUN	TURBODISK™	AEROBELL® II*** AEROBELL® AEROBELL® 33 RMA™-101
RECOMMENDED VISCOSITY USING A ZAHN NO. 2	18 TO 30 SEC	18 TO 30 SEC	20 TO 60 SEC	20 TO 60 SEC	20 TO 60 SEC
PAINT ELECTRICAL RESISTANCE**	.1 MΩ TO ∞	.1 MΩ TO ∞	.1 TO 1 MΩ	.1 MΩ TO ∞	.1 MΩ TO ∞
RECOMMENDED DELIVERY (UP TO)	1000 cc/min	1500 cc/min	180 cc/min	1000 cc/min	500 cc/min

GUIDE TO USABLE SOLVENT SELECTION

Chemical Name	Common Name	Category	Flash Point†† (TCC)	*CAS Number	Evap. Rate†		Elec. Res.**
DICHLOROMETHANE	Methylene Chloride	Chlorinated Solvents		75-09-2	**14.5**	⇑	HIGH
VM & P NAPHTHA	Naptha	Aliphatic Hydrocarbons	65°F	8030-30-6	**10**		HIGH
ACETONE		Ketones	-18°F	67-64-1	**5.6**		LOW
METHYL ACETATE		Esters	90°F	79-20-9	**5.3**	F	LOW
BENZENE		Aromatic Hydrocarbons	12°F	71-43-2	**5.1**		HIGH
ETHYL ACETATE		Esters	24°F	141-78-6	**3.9**		MEDIUM
2-BUTANONE	MEK	Ketones	16°F	78-93-3	**3.8**	A	MEDIUM
ISO-PROPYL ACETATE		Esters	35°F	108-21-4	**3.4**		LOW
ISOPROPYL ALCOHOL	IPA	Alcohols	53°F	67-63-0	**2.5**	S	LOW
2-PENTANONE	MPK	Ketones	104°F	107-87-9	**2.5**		MEDIUM
METHANOL	Methyl Alcohol	Alcohols	50°F	67-56-1	**2.1**	T	LOW
PROPYL ACETATE	n-Propyl Acetate	Esters	55°F	109-60-4	**2.1**		LOW
TOLUOL	Toluene	Aromatic Hydrocarbons	48°F	108-88-3	**1.9**	E	HIGH
METHYL ISOBUTYL KETONE	MIBK	Ketones	60°F	108-10-1	**1.6**		MEDIUM
ISOBUTYL ACETATE		Esters	69°F	110-19-0	**1.5**	R	LOW
ETHANOL	Ethyl Alcohol	Alcohols		64-17-5	**1.4**		LOW
BUTYL ACETATE		***Esters***	**78°F**	***123-86-4***	***1.0***		***LOW***
ETHYLBENZENE		Aromatic Hydrocarbons	64°F	100-41-4	**.89**		HIGH
1-PROPANOL	n-Propyl Alcohol	Alcohols	74°F	71-23-8	**.86**		LOW
2-BUTANOL	sec.-Butyl Alcohol	Alcohols	72°F	78-92-2	**.81**		LOW
XYLOL	Xylene	Aromatic Hydrocarbons	79°F	1330-02-07	**.80**		HIGH
AMYL ACETATE		Esters	106°F	628-63-7	**.67**		MEDIUM
2-METHYLPROPANOL	iso-Butyl Alcohol	Alcohols	82°F	78-83-1	**.62**		LOW
METHYL AMYL ACETATE		Esters	96°F	108-84-9	**.50**	S	LOW
5-METHYL-2-HEXANONE	MIAK	Ketones	96°F	110-12-3	**.50**		MEDIUM
1-BUTANOL	n-Butyl Alcohol	Alcohols	95°F	71-36-3	**.43**	L	LOW
2-ETHOXYETHANOL		Glycol Ethers	164°F	110-80-5	**.38**		LOW
2-HEPTANONE	MAK	Ketones	102°F	110-43-0	**.40**	O	MEDIUM
CYCLOHEXANONE		Ketones	111°F	108-94-1	**.29**		MEDIUM
AROMATIC-100	SC#100	Aromatic Hydrocarbons	111°F		**.20**	W	HIGH
DIISOBUTYL KETONE	DIBK	Ketones	120°F	108-83-8	**.19**		MEDIUM
1-PENTANOL	Amyl Alcohol	Alcohols		71-41-0	**.15**	E	LOW
DIACETONE ALCOHOL		Ketones	133°F	123-42-2	**.12**		LOW
2-BUTOXYETHANOL	Butyl Cellosolve	Glycol Ethers	154°F	111-76-2	**.07**	R	LOW
CYCLOHEXANOL		Alcohols	111°F	108-93-0	**.05**		LOW
AROMATIC-150	SC#150	Aromatic Hydrocarbons	149°F		**.004**	⇓	HIGH
AROMATIC-200		Aromatic Hydrocarbons	203°F		**.003**		HIGH

***** CAS Number: Chemical Abstract Service Number.
****** Electrical Resistance using the ITW Ransburg Meter.
******* Solvent Base Configuration Only.
† Information Obtained From: http://solvdb.ncms.org
†† The lowest temperature at which a volatile fluid will ignite.
Evaporation Rate is Based Upon Butyl Acetate Having a Rate of 1.0

NOTE: Chart provides resistance and control information that we feel is necessary when using ITW Ransburg equipment.

VISCOSITY CONVERSION CHART

Poise	Centipoise	DuPont Parlin 7	DuPont Parlin 10	Fisher 1	Fisher 2	Ford Cup 3	Ford Cup 4	Gardner - Holdt Bubble	Gardner - Lithographic	Krebs Unit KU	Saybolt Universal SSU	Zahn 1	Zahn 2	Zahn 3	Zahn 4	Zahn 5	Sears Craftsman Cup	Din Cup 4
.1	10	27	11	20			5	A-4			60	30	16					10
.15	15	30	12	25			8	A-3			80	34	17					11
.2	20	32	13	30	15	12	10				100	37	18					12
.25	25	37	14	35	17	15	12	A-2			130	41	19					13
.3	30	43	15	39	18	19	14	A-1			160	44	20					14
.4	40	50	16	50	21	25	18	A			210	52	22				19	15
.5	50	57	17		24	29	22			30	260	60	24				20	16
.6	60	64	18		29	33	25	B		33	320	68	27				21	18
.7	70		20		33	36	28			35	370		30				23	21
.8	80		22		39	41	31	C		37	430		34				24	23
.9	90		23		44	45	32			38	480		37	10			26	25
1.0	100		25		50	50	34	D		40	530		41	12	10		27	27
1.2	120		30		62	58	41	E		43	580		49	14	11		31	31
1.4	140		32			66	45	F		46	690		58	16	13		34	34
1.6	160		37				50	G		48	790		66	18	14		38	38
1.8	180		41				54		000	50	900		74	20	16		40	43
2.0	200		45				58	H		52	1000		82	23	17	10	44	46
2.2	220						62	I		54	1100			25	18	11		51
2.4	240						65	J		56	1200			27	20	12		55
2.6	260						68			58	1280			30	21	13		58
2.8	280						70	K		59	1380			32	22	14		63
3.0	300						74	L		60	1475			34	24	15		68
3.2	320							M			1530			36	25	16		72
3.4	340							N			1630			39	26	17		76
3.6	360							O		62	1730			41	28	18		82
3.8	380										1850			43	29	19		86
4.0	400							P		64	1950			46	30	20		90
4.2	420										2050			48	32	21		95
4.4	440							Q			2160			50	33	22		100
4.6	460							R		66	2270			52	34	23		104
4.8	480								00	67	2380			54	36	24		109
5.0	500							S		68	2480			57	37	25		112
5.5	550							T		69	2660			63	40	27		124
6.0	600							U		71	2900			68	44	30		135
7.0	700									74	3375				51	35		160
8.0	800								0	77	3380				58	40		172
9.0	900							V		81	4300				64	45		195
10.0	1000							W		85	4600					49		218
11.0	1100									88	5200					55		
12.0	1200									92	5620					59		

VISCOSITY CONVERSION CHART (Continued)

Poise	Centipoise	DuPont Parlin 7	DuPont Parlin 10	Fisher 1	Fisher 2	Ford Cup 3	Ford Cup 4	Gardner - Holdt Bubble	Gardner - Lithographic	Krebs Unit KU	Saybolt Universal SSU	Zahn 1	Zahn 2	Zahn 3	Zahn 4	Zahn 5	Sears Craftsman Cup	Din Cup 4
13.0	1300							X		95	6100					64		
14.0	1400								1	96	6480							
15.0	1500									98	7000							
16.0	1600									100	7500							
17.0	1700									101	8000							
18.0	1800							Y			8500							
19.0	1900										9000							
20.0	2000									103	9400							
21.0	2100										9850							
22.0	2200										10300							
23.0	2300							Z	2	105	10750							
24.0	2400									109	11200							
25.0	2500							Z-1		114	11600							
30.0	3000									121	14500							
35.0	3500							Z-2	3	129	16500							
40.0	4000									133	18500							
45.0	4500							Z-3		136	21000							
50.0	5000										23500							
55.0	5500										26000							
60.0	6000							Z-4	4		2800							
65.0	6500										30000							
70.0	7000										32500							
75.0	7500										35000							
80.0	8000										37000							
85.0	8500										39500							
90.0	9000										41000							
95.0	9500										43000							
100.0	10000							Z-5	5		46500							
110.0	11000										51000							
120.0	12000										55005							
130.0	13000										60000							
140.0	14000										65000							
150.0	15000							Z-6			67500							
160.0	16000										74000							
170.0	17000										83500							
180.0	18000										83500							
190.0	19000										88000							
200.0	20000										93000							
300.0	30000										140000							

Note: All viscosity comparisons are as accurate as possible with existing information. Comparisons are made with a material having a specific gravity of 1.0.

VOLUMETRIC CONTENT OF HOSE OR TUBE (English Units)

I.D. (inches)	cc/ft.	Cross Section ($in.^2$)	Length				
			5ft. (60")	10ft. (120")	15ft. (180")	25ft. (300")	50ft. (600")
1/8	2.4	.012	.003 gal. .4 fl. oz.	.006 gal. .8 fl. oz.	.010 gal. 1.2 fl. oz.	.016 gal. 2.0 fl. oz.	.032 gal. 4.1 fl. oz.
3/16	5.4	.028	.007 gal. .9 fl. oz.	.014 gal. 1.8 fl. oz.	.022 gal. 2.8 fl. oz.	.036 gal. 4.6 fl. oz.	.072 gal. 9.2 fl. oz.
1/4	9.7	.049	.013 gal. 1.6 fl. oz.	.025 gal. 3.3 fl. oz.	.038 gal. 4.9 fl. oz.	.064 gal. 8.2 fl. oz.	.127 gal. 16.3 fl. oz.
5/16	15.1	.077	.020 gal. 2.5 fl. oz.	.040 gal. 5.1 fl. oz.	.060 gal. 7.6 fl. oz.	.100 gal. 12.7 fl. oz.	.199 gal. 25.5 fl. oz.
3/8	21.7	.110	.029 gal. 3.7 fl. oz.	.057 gal. 7.3 fl. oz.	.086 gal. 11.0 fl. oz.	.143 gal. 18.4 fl. oz.	.287 gal. 36.7 fl. oz.
1/2	38.6	.196	.051 gal. 6.5 fl. oz.	.102 gal. 13.1 fl. oz.	.153 gal. 19.6 fl. oz.	.255 gal. 32.6 fl. oz.	.510 gal. 65.3 fl. oz.

VOLUMETRIC CONTENT OF HOSE OR TUBE (Metric Units)

I.D. (mm)	cc/m	Cross Section (mm^2)	Length				
			1.5m	3.0m	4.5m	6.0m	7.5m
3.6	10.2	10.2	15.3 cc	30.5 cc	45.8 cc	61.1 cc	76.3 cc
5.6	24.6	24.6	36.9 cc	73.9 cc	110.8 cc	147.8 cc	184.7 cc
6.8	36.3	36.3	54.5 cc	109.0 cc	163.4 cc	217.9 cc	272.4 cc
8.8	60.8	60.8	91.2 cc	182.5 cc	273.7 cc	364.9 cc	456.2 cc

Service Manual Price: $30.00 (U.S.)

Manufacturing
1910 North Wayne Street
Angola, Indiana 46703-9100
Telephone: 260/665-8800
Fax: 260/665-8516

Technical/Service Assistance

Automotive Assembly and Tier I	Telephone: 800/ 626-3565	Fax: 419/ 470-2040
Industrial Systems	Telephone: 800/ 233-3366	Fax: 419/ 470-2071
Ransburg Guns	Telephone: 800/ 233-3366	Fax: 419/ 470-2071

Technical Support Representative will direct you to the appropriate telephone number for ordering Spare Parts.

Form No. LN-9251-06
Litho in U.S.A.
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