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2900 Dukane Drive
St. Charles, IL 60174  USA

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This user’s manual documents product features, hardware, and controls software available at the time this user's manual was published.

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<table>
<thead>
<tr>
<th>Revision Number</th>
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<th>Date</th>
</tr>
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<tbody>
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</tr>
</tbody>
</table>
This page intentionally left blank
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 – Introduction</td>
<td>1</td>
</tr>
<tr>
<td>2 – Health and Safety</td>
<td>7</td>
</tr>
<tr>
<td>3 – Unpacking and Setup</td>
<td>13</td>
</tr>
<tr>
<td>4 – Display and Controls</td>
<td>21</td>
</tr>
<tr>
<td>5 – Touch Screen Menus</td>
<td>29</td>
</tr>
<tr>
<td>6 – Machine Operation</td>
<td>43</td>
</tr>
<tr>
<td>7 – Optimizing Performance</td>
<td>55</td>
</tr>
<tr>
<td>8 – Dukane Servo Spin Welder Utility</td>
<td>65</td>
</tr>
<tr>
<td>9 – Troubleshooting</td>
<td>71</td>
</tr>
<tr>
<td>10 – Maintenance</td>
<td>79</td>
</tr>
<tr>
<td>11 – Contacting Dukane</td>
<td>83</td>
</tr>
<tr>
<td>12 – Specifications</td>
<td>87</td>
</tr>
<tr>
<td>13 – Appendices</td>
<td>93</td>
</tr>
<tr>
<td>Appendix A – Connector Pinouts</td>
<td>95</td>
</tr>
<tr>
<td>Appendix B – Tooling</td>
<td>99</td>
</tr>
<tr>
<td>Appendix C – Optional Features</td>
<td>101</td>
</tr>
<tr>
<td>Appendix D – Additional Machine Settings</td>
<td>103</td>
</tr>
<tr>
<td>Appendix E – Batteries and Software Retention</td>
<td>104</td>
</tr>
<tr>
<td>Appendix F – List of Figures</td>
<td>105</td>
</tr>
<tr>
<td>Appendix G – List of Tables</td>
<td>108</td>
</tr>
<tr>
<td>Index</td>
<td>109</td>
</tr>
</tbody>
</table>
This page intentionally left blank
SECTION 1

Introduction

General User Information .............................................. 3
  Read The Manual First ........................................... 3
  Notes, Cautions and Warnings .................................. 3
  Drawings and Tables ............................................... 3
Servo Spin Welder Overview ......................................... 4
Key Servo Spin Welder Features .................................... 5
General User Information

Read This Manual First
Before operating the Servo Spin Welder, read this User’s Manual to become familiar with the equipment. This will ensure correct and safe operation. The manual is organized to allow you to learn how to safely operate this equipment. The examples given are chosen for their simplicity to illustrate basic setup procedures.

Notes, Cautions and Warnings
Throughout this manual we use NOTES to provide information that is important for the successful application and understanding of the product. A NOTE block is shown to the right.
In addition, we use special notices to make you aware of safety considerations. These are the CAUTION and WARNING blocks as shown here. They represent increasing levels of important information. These statements help you to identify and avoid hazards and recognize the consequences. One of three different symbols also accompany the CAUTION and WARNING blocks to indicate whether the notice pertains to a condition or practice, an electrical safety issue or a operator protection issue.

Drawings and Tables
The figures and tables are identified by the section number followed by a sequence number. The sequence number begins with one in each section. The figures and tables are numbered separately. The figures use Arabic sequence numbers (e.g. –1, –2, –3) while the tables use Roman sequence numerals (e.g. –I, –II, –III). As an example, Figure 3–2 would be the second illustration in section three while Table 3–II would be the second table in section three.
Servo Spin Welder Overview

The servo spin welder excels at frictional welding of assemblies and parts which require an accurate orientation. The parts can be any shape, only the weld joint must be circular. This is Dukane’s second generation of spin welders. They have new features, a refined design concept and improved performance based on customer surveys and feedback.

Using servomotor drive technology provides very fast positioning, higher peak torque, wider speed ranges and controllability compared to other motor technologies. In practical terms, this means the servo motor of the same power rating offers peak torque 200 to 400 percent higher than continuous duty motors. Higher peak torque means the motor will accelerate and position the load faster, which results in higher productivity. Besides the performance benefits, servo motors offer excellent controllability, which means accurate parts with increased quality and reduced rejects. Servo motors also have a higher bandwidth which means they respond quicker to load disturbances and make corrections faster which improves the process reliability.

The SVT0X2R differences are in the maximum speed, power and torque of the servo motor. The specification for each model is:

SVT012R.......750 RPM, 4.2 HP, 47 ft-lb Torque Motor
SVT032R.......3,000 RPM, 4.2 HP, 16 ft-lb Torque Motor
SVT042R.......4,000 RPM, 2.5 HP, 10 ft-lb Torque Motor

All models have a 6-inch stroke and a fixture throat depth of 8-inches. Both SVT032R and SVT042R models have the same maximum vertical clearance of 21.3 inches (541 mm) between the bottom of the tooling hub and top of the mounting base. The SVT012R model has a clearance of 20.4 inches (518 mm).

The new and larger color operator interface is also a commercial unit containing field–tested and proven control software and interface. Every subassembly has been selected to provide the maximum reliability with a long and economical service life. The servo motor and control enclosure has been designed to permit easy access to components and minimize emissions to meet the applicable CE regulations.
Key Servo Spin Welder Features

- **Color Touch-Screen Display** uses Color Active Matrix Thin-Film Transistors (TFT) for high contrast and wide viewing angle even under high ambient-lighting conditions. The 192 touch-cells provides a high performance interface.

- **Commercial Subassemblies** are used ensure a longer and more economical service life than units built with proprietary components. These readily available items also lessen the need for expensive field service calls.

- **Ultra-Rigid** square support column minimizes load deflection for precise and repeatable operation.

- **Column-Mounted** direct drive 2.5 or 4.2 HP servo motor for faster cycle times and quick deceleration to prevent bond shearing and produce stronger joints.

- **Digital Rotary Encoder** is built into the servo motor for maximum reliability. The encoder accurately measures and controls the final angular orientation to within 0.1° (1 part in 3600). On a 6-inch diameter circle, that is just 0.005-inch measured at the circumference.

- **Weld By Time, Number of Rotations or Distance.** Built in sensors give you the choice of weld methods and triggering by position or by torque.

- **Parameter Monitoring** with programmable upper and lower limits of time, rotations, angular orientation, energy, peak RPM, peak torque and cycle time.

- **Torque Load Measurement** can be downloaded for review of torque profile.

- **Digital Timer** for Weld Time and Hold Time gives precise control of the spin welding process.

- **Fixture throat depth** is a generous 8”. The tool hub height can be adjusted from 7.4 to 21.3 inches. The hub can easily accommodate up to 15” diameter tooling.

- **Pneumatic Operation** with adjustable 6” stroke assures quiet operation and is environmentally safe.

- **Built-in** Air Pressure Gauge and Regulator means the Servo Spin Welder is ready to operate.

**Continued**
- **Lockable Panel** for Air Pressure Regulator, trigger, end-of-weld, hydraulic speed control, and mechanical stop adjustments prevents any accidental changes to the settings.

- **Industry Standard** Logic Controller and Motor Controller means replacement parts are readily available.

- **Proximity Motor Start and End–Of–Weld Switches** for trouble–free and reliable operation.

- **Several Menu Languages Available:** English, Czech, French, and German.

- **ISO 9001 Certification** means that the Spin Welder is manufactured to exacting quality standards.

- **24–Month** domestic warranty assures you of reliability and quality construction.
# Section 2 – Health and Safety

## Health and Safety

<table>
<thead>
<tr>
<th>Topic</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health and Safety Tips</td>
<td>9</td>
</tr>
<tr>
<td>Plastics Health Notice</td>
<td>10</td>
</tr>
<tr>
<td>Activation Switches</td>
<td>10</td>
</tr>
<tr>
<td>General Safety</td>
<td>10</td>
</tr>
<tr>
<td>Electrical Safety</td>
<td>11</td>
</tr>
<tr>
<td>AC Power Receptacle</td>
<td>11</td>
</tr>
<tr>
<td>Grounding</td>
<td>11</td>
</tr>
<tr>
<td>Mechanical Safety</td>
<td>11</td>
</tr>
<tr>
<td>Pneumatic Safety</td>
<td>12</td>
</tr>
</tbody>
</table>
This page intentionally left blank
Health and Safety Tips

Please observe these health and safety recommendations for safe, efficient, and injury-free operation of your welder. In this manual, the term welder and/or servo spin welder both refer to the Servo Spin Welder.

Proper Installation - Do not operate the Servo Spin Welder until after the pneumatic and electrical systems are properly installed.

No Unauthorized Modifications - Do not modify your Servo Spin Welder in any way unless authorized to do so by Dukane Corporation. Unauthorized modifications may cause injury to the operator and/or equipment damage. In addition, unauthorized modifications will void the equipment warranty.

Keep the Sheet Metal Intact - Do not remove any of the protective sheet metal enclosing the motor or controls. The servo motor and driver have exposed electrical terminals which could cause injury or death if touched.

Grounded Electrical Power - Operate this equipment only with a properly grounded electrical connection. Refer to the NEMA Type 6–20R wiring diagram in Figure 2–1 and receptacle photo in Figure 3–5. If there is any question about the grounding of your AC power, have it checked by a qualified electrician.

Comply with Regulations - You may be required to add accessories to bring the system into compliance with applicable OSHA (Occupational Safety and Health Administration) regulations for machine guarding and noise exposure.

Operate Safely – Keep your hands and body away from the tool head during operation. Always wear a face shield when operating the spin welder. Be extremely careful not to let long sleeves, necklaces or long hair become entangled in the spin welder during operation. Do not operate the welder if under the influence of alcohol or drugs. Read the warning labels on prescriptions to determine if your judgement or reflexes are impaired while taking drugs. If there is any doubt, do not operate the machine.

IMPORTANT
Always wear a face shield when operating the machine.

CAUTION
Welded parts may be hot.

IMPORTANT
Never operate the Servo Spin Welder with the protective sheet metal removed. This is an unsafe practice and can result in injury.
Safety Regulations
Plastics Health Notice
Before using any Dukane welding system, be sure you are familiar with OSHA regulations from the U.S. Department of Labor about the particular type of plastic(s) you are using.

When plastic materials are being processed, some of them may emit fumes and/or vapors that could be hazardous (e.g. PVC – Polyvinyl Chloride can emit chlorine gas under certain processing conditions). Make sure you use proper ventilation whenever these plastics are processed.

Activation Switches
The dual finger activation switches comply with OSHA safety regulations. Using a foot switch in place of the dual finger activation switches violates OSHA regulations.

General Safety
Before performing any maintenance or service on the Servo Spin Welder, locks and tags should be applied to all energy isolating switches. Anything that might restore energy to the Servo Spin Welder must be locked out.

You may be required to add accessories to bring the system into compliance with applicable regulations for operator safety. In the United States, these regulations are administered by OSHA.

Do not make any unauthorized modifications to the Spin Welder or base. Unauthorized modifications could cause equipment damage and injury to the operator. In addition, unauthorized modifications will void the equipment warranty.
Electrical Safety

AC Power Receptacle

The power cord used on the Servo Spin Welder has a two–blade, grounding type plug designed for 240 VAC at 20 Amps. It is designed to be plugged into a 240 VAC, 20 Amp NEMA type 6–20R receptacle as shown in Figure 2–1. Do not alter the plug or receptacle in any way.

Grounding

It is important for operator safety that the receptacle grounding wire be installed properly and securely attached to an effectively grounded rod. The function of the ground wire is to keep the Servo Spin Welder base and housing at earth potential. In the event of a short circuit from one of the AC lines to the case, the circuit breaker will open, protecting the equipment and operator. If there is any question about the grounding of your AC power, have it checked by a qualified electrician.

Grounding lugs are also provided, one on the back of the base (see Figure 2-2) and one on the back of the welder housing (see Figure 3-7). You should connect a separate 14 AWG* ground wire between these lugs and an effectively grounded metal pipe. This will minimize any external electrical interference from leaking into the Servo Spin Welder control circuitry. This will not compromise the safety of the power ground.

* 14 AWG wire has a diameter of 1.63mm or 0.064”

Mechanical Safety

The Servo Spin Welder is capable of developing substantial torque and high rotational velocity. Keep your hands and body away from the tool head during operation. The spinning head is capable of inflicting serious injury. Never attempt to retrieve a part from a spinning tool head. Always wear a face shield when operating the spin welder. Be extremely careful not to let long sleeves, ties, necklaces or long hair become entangled in the Servo Spin Welder during operation. Always turn machine power off when installing or removing tooling.

IMPORTANT

Always turn off the AC power at the power switch before servicing or working on the servo spin welder. Failure to turn off the AC power is an unsafe practice and can result in injury or death.
Pneumatic Safety
Always isolate and lockout the compressed air before performing any maintenance on the Servo Spin Welder. The lockout device is shown in Figure 2–3, and is installed in series with the compressed air filter. When activated, the lockout device will isolate the compressed air supply from the air filter and pneumatic actuator in the servo spin welder. This device complies with OSHA regulations. When the lockout device is isolating the compressed air from the welder, a hole in the slide bar is visible for inserting a lock or lockout tag.

Compressed air can develop a considerable amount of force. This force is large enough to inflict serious injury if one places their hand or other limb under the tool head. The Servo Spin Welder uses a 2.5-inch (63mm) diameter air cylinder which converts the air pressure to mechanical movement and has a force multiplication factor of 4.9. This means that at the full 100 psi (6.8 Atmospheres), the air cylinder is capable of exerting 490 pounds (222kg) of force. This much force can result in serious injury to the operator. 

**Figure 2–3** Compressed Air Lockout and Filter

**WARNING**

Never attempt to remove the filter housing while the compressed air is on. Turn off the compressed air using the pneumatic lockout device and make sure the pressure gauge reads zero.
# Section 3 – Unpacking and Setup

## Unpacking and Setup

<table>
<thead>
<tr>
<th>Topic</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unpacking Welder</td>
<td>15</td>
</tr>
<tr>
<td>Packing List</td>
<td>15</td>
</tr>
<tr>
<td>Work Area</td>
<td>16</td>
</tr>
<tr>
<td>Secure to Work Table</td>
<td>16</td>
</tr>
<tr>
<td>Bench Capacity</td>
<td>16</td>
</tr>
<tr>
<td>Leveling</td>
<td>16</td>
</tr>
<tr>
<td>Mounting Holes</td>
<td>16</td>
</tr>
<tr>
<td>Tooling Hub and Fixture</td>
<td>17</td>
</tr>
<tr>
<td>AC Power</td>
<td>18</td>
</tr>
<tr>
<td>Compressed Air</td>
<td>19</td>
</tr>
<tr>
<td>Height Adjustment</td>
<td>20</td>
</tr>
<tr>
<td>Control Connectors</td>
<td>20</td>
</tr>
<tr>
<td>Base Interface Connector</td>
<td>20</td>
</tr>
<tr>
<td>User I/O Connector</td>
<td>20</td>
</tr>
<tr>
<td>Slide Kit Connector</td>
<td>20</td>
</tr>
</tbody>
</table>
Unpacking Welder

The Servo Spin Welder is normally packed in a corrugated carton resting on a wooden shipping pallet. To unpack the Spin Welder follow these steps.

1. Remove the straps from the carton.
2. Open the top of the carton. Carefully remove any packing materials, cables and documentation.
3. Cut the tape at the bottom corners and unfold the flaps.
4. Remove the corrugated carton, but leave the Servo Spin Welder on the pallet.
5. Leave the power cable wrapped up until after the Servo Spin Welder has been placed in its working area and you are ready to begin hooking up power and air. This will prevent accidental kinking or pinching of the power cable.

Packing List

After removing the shipping container, check that you have the items listed in Table 3-I. Inspect the Servo Spin Welder for damage. Report any damage immediately to the carrier and to Dukane Ultrasonics Service at (630) 762-4090. Also see Section 11 for information on contacting Dukane. Save all shipping and packing materials so they can be inspected in processing any claims that may arise.

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<tbody>
<tr>
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<td>SVT012R</td>
</tr>
<tr>
<td></td>
<td>Servo Spin Welder</td>
<td>SVT032R</td>
</tr>
<tr>
<td></td>
<td>Servo Spin Welder</td>
<td>SVT042R</td>
</tr>
<tr>
<td>1</td>
<td>Base Interface Cable</td>
<td>200-1124-3 or 200-1545-01</td>
</tr>
<tr>
<td>1</td>
<td>Servo Welder Manual</td>
<td>403-568-XX</td>
</tr>
<tr>
<td>1</td>
<td>CD with Servo Spin Welder Utility</td>
<td></td>
</tr>
</tbody>
</table>

Table 3-I Servo Spin Welder Packing List
Work Area
Allow sufficient area on either side of the Servo Spin Welder for handling material, work pieces and fixtures. Provide ample room so that the movement of an operator or helper does not interfere with the work of another. Also be aware that under extreme conditions, small droplets of molten plastic may be spun off from the upper part.

Securing to Work Bench
Bench Capacity
The Servo Spin Welder weighs approximately 400 lbs. (182 kg). It should be attached to a table or bench capable of supporting 650 lbs. (295 kg) to accommodate the additional force imposed by the vertical movement of the motor and slide during the spin welding operation.

Use mechanical means such as a forklift or hoist to place the servo spin welder on its work bench. There are two 3/4 inch lifting eyes located at the top of the column (see Figure 3–8) for a lifting ring or strap. Remove any remaining plastic wrap after the welder is in its final position.

Leveling
We recommend that the Servo Spin Welder be leveled to within one degree. This can be accomplished using a carpenter’s level. One degree corresponds to approximately one-quarter of an inch (6 mm) deviation across the 16 inch (406 mm) width of the platen.

Mounting Holes
The base of the Servo Spin Welder has two mounting holes in the front as shown in Figure 3–1. The two holes will accept either 12mm or 7/16” diameter bolts. We recommend that you securely attach the Servo Spin Welder base to the work table using these mounting holes.
Tooling Hub & Fixture

The upper tooling attaches to a hub using four 5/16”-18 screws, spring lock washers, and flat washers. Figure 3–2(a & b) gives the dimensions of the tooling hubs. The hubs have precision slots to accommodate an indexing pin on the tool so that the tool can be mounted in a consistent orientation relative to the hub.

The lower tooling fixture attaches to the base platen using M10–1.5 cap screws. See Figure 3–3 for the detailed measurements of the mounting holes in the base platen.
AC Power
The Servo Spin Welder requires a 240 VAC 1–phase outlet rated at 20 Amps. Both the 2.5 HP and 4.2 HP model use the same power cord and plug. The AC power cord is permanently attached to the Servo Spin Welder. The other end of the cable has a 240 VAC, 1–phase plug shown in Figure 3–4. This is designed for a NEMA 6–20R configuration wall receptacle shown in Figure 3–5.

Directly below the AC cord strain relief is the AC power switch. The switch combines the functions of a power switch and a 20 Amp circuit breaker. The breaker/switch is identical on both the 2.5 HP and 4.2 HP models and is shown in Figure 3–6.
Compressed Air

The Servo Spin Welder requires a supply of clean, dry, compressed air at 100 psi (6.9 bar) nominal. The air supply should be capable of delivering 1 SCFM and at least 80 psi (5.5 bar) and not greater than 110 psi (7.6 bar). The connection is made using 5/16” O.D. tubing at the input to the pneumatic lockout device shown in Figure 2–3 and 3–7. A separate air line connects the filter output to the thruster pneumatic cylinder inlet fitting. Make sure all the connections are secure before applying the compressed air to the machine. A detailed startup procedure is given at the beginning of Section 6 – Machine Operation.

**WARNING**

Tighten all compressed air connections securely. A loose connection can cause injury if it detaches from the compressed air fitting and whips around.
Head Height Adjustment

The rear of the support column features a threaded shaft for adjusting the overall height of the thruster head. The adjustment is secured by three lock nuts which prevent the thruster from moving once the overall height has been established. This is shown in Figure 3–8 and covered in detail in Section 6. A reference scale and index pointer are located next to the column to indicate the head height.

Control Connectors

Base Interface Connector

On the rear of the housing is the base control input connector. The Base Interface cable (Part No. 200-1124-3 or 200-1545-01) is a supplied part and is included with the Servo Spin Welder (see Table 3-I). Connect one end of the cable to the rear thruster connector and the other end to the Base Interface connector (J35) as shown in Figure 3–7. The control cable carries the operate and emergency stop signals from the optical operate switches and abort switches on the base. If you are using custom automation, you may have separate operate and abort switches, but these still connect to the press control input on the Servo Spin Welder. Both the base and thruster connectors are the same DB–9 type. The rear thruster connector is identified in Figure 3–9. The pinout for this connector is given in Appendix A.

User I/O Connector

Directly above the DB–9 base interface connector is a HD–15 User I/O connector for custom automation applications. This is shown in Figure 3–9. The pinout for this connector is given in Appendix A.

Slide Kit Connector

To the right of the DB–9 base interface connector is a round 16-pin connector for controlling the optional Slide Kits. This is shown in Figure 3–9. The pinout for this connector is given in Appendix A.
Touch Screen Display
The display is a 4.6 inch (12 cm) wide by 3.5 inch (9 cm) tall color LCD screen. It contains an integrated touch screen with 192 touch-sensitive cells arranged as 16 rows of 12 columns.

Setup parameters and mode selections are programmed through the touch screen. A closeup view of the controls is shown in Figure 4–2. The left side of the display remains visible for most of the selected functions.

The icon in the upper left corner indicates machine status. Below that are three touch cells for Run mode (RUN), Weld and Post–Weld Setup (SETUP), and Setup Utilities (TOOLS). The function of these buttons is covered in Section 5. The touch cell on the right labeled View Stored Part Data displays part data for the previously welded assemblies.

Figure 4–1 Servo Spin Welder Touch Screen Panel

Figure 4–2 Startup Screen
Mechanical Settings
A lockable panel is located on the right side of the servo spin welder head. Opening the panel reveals four mechanical adjustments and two pneumatic controls as shown in Figure 4–3. Directly below each mechanical adjustment is a vertical scale with the control function label at the top of the scale. The threads are metric with a pitch of 1mm which results in 1.0 mm movement per turn. The scale at the far left is the stroke indicator and indicates the vertical stroke position during machine operation.

Hydraulic Speed Control
This adjusts the engagement position of the Hydraulic Speed Control (HSC) damper. Normally the engagement position is set about 8mm higher than the point where the upper part contacts the lower part.

Mechanical Stop
This adjusts the bottom limit stop. The downward stroke stops when this mechanical limit is reached. The thruster head cannot move past this point.
Pretrigger Adjustment
This adjusts the position during the downward stroke at which the upper tool begins to spin.

End–Of–Weld Adjustment
This adjusts the position of the down stroke at which the welding stops (the head stops rotating). It should be set slightly above the mechanical stop setting. This setting is used in the Weld–By–End–Switch mode to control the depth of weld. In other modes, activation of the End-of-Weld switch causes a fault.

HSC Adjustment
This adjusts the damping of the Hydraulic Speed Control so the downward head velocity during welding matches the rate at which the plastic is melting. The lower wide slot is for adjusting the amount of hydraulic damping applied. Above the adjustment slot is a narrower dial reading slot. The HSC damper is covered in more detail in Section 6.

Pneumatic Adjustments
Figure 4–4 shows the location of the two pneumatic controls inside the access panel. The Air Pressure Regulator Adjustment is at the upper right. Directly below it is the Air Pressure Gauge. At the left side of the panel is the Downspeed Adjustment (pneumatic flow control).

Air Pressure Regulator
The regulator controls air pressure applied to the air cylinder which in turn determines the force applied to the weld joint. The gauge is calibrated in psi (pounds per square inch) on the outside of the dial, and kg/cm² on the inside of the dial. This is shown in Figure 4–5. One technical atmosphere (At) is approximately 14.7 psi = 1kg/cm² at 45°N latitude, sea level and 0°C.

FYI
1 Bar is the pressure of 10 Newtons (Nt) per square centimeter. It is approximately equal to 1 Atmosphere (At).
1 Bar = 10 Nt/cm² = 1.0197 kg/cm²= 1.0197 At
1.0 kg/cm² = 14.4 psi and 14.7 psi = 1.02 kg/cm²
Downspeed Adjustment

The downspeed adjustment controls the flow of air leaving the air cylinder during the downward stroke only. The restoring pressure during the upward stroke is not affected. The knob has numeric graduations ranging from 0 to 9 engraved on its front and controls a ten–turn flow valve with a one–way bypass. There are two small windows on either side of the knob to view a color–coded internal shaft. Pull the external red ring to the right to unlock the knob before adjusting it. The difference between the locked and unlocked position is about 0.08 inches (2mm). Once the final speed setting has been determined, push the locking ring back to lock the setting in place.

Operational Switches

Emergency Stop Switch

A red Emergency–Stop (E–STOP) switch is located in the center of the base as shown in Figure 4–6. The emergency stop switch must be in its reset position before the operate switches will function. To reset the Emergency Stop, twist the large red button about 45 degrees to the right, which will cause the button to spring out. This is depicted in Figure 4–7.
Opti–Touch Run Switches

Located on either side of the base are two optical RUN switches. These are shown in Figure 4–6. These switches use Infrared (IR) sensors. They comply with OSHA and CE safety standards. Both switches are identical.

Each optical–touch switch has a small red LED which is dimly illuminated whenever the power is on, as shown in Figure 4–8. When the operator places their finger in the tray, the LED brightens and a second LED in the opposite corner of the tray illuminates to indicate the switch has been activated as shown in Figure 4–9. Both switches must be activated simultaneously to initiate a weld cycle.

Data I/O Connector

A connector for the output data is provided at the top of the control compartment and is identified in Figure 4–4. This connector is a female type DB-9 as shown in Figure 4–10. It provides a computer connection to export part data, export part torque profiles and to import the servo driver parameter database. A pinout of the Data I/O connector is provided in Appendix A.
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STARTUP Screen

When the welder is first turned on, the STARTUP mode screen is displayed as shown in Figure 5–1. The message area is red and indicates the E-Stop switch is pushed in. After the E-Stop is cleared (refer to Figure 4–7), the message directs the operator to Press both RUN SWITCHES to reset machine as shown in Figure 5–2. Press both operate switches simultaneously and hold until a beep sounds (the bar under the smiley face will become green at the same time). This takes several seconds. The error message is now clear and the STATUS icon in the upper left has changed to a smiley face with a green band below it as shown in Figure 5–3.

Screen Layout

The screen has the same basic layout for most of the selected operations. The STATUS icon indicates the ready state of the machine. To the right of the icon is the name of the currently loaded Setup File. Below the file name is the Message Area. The three mode select buttons on the left side below the status icon select either a Run mode (RUN), a Weld Setup and Post–Weld Setup screen (SETUP), or the Setup Utilities screen (TOOLS). The selected mode is indicated by a darkened button. The center of the screen displays the parameters from the last weld cycle. The View Stored Part Data button on the right displays a report of previously welded parts.

RUN Mode

The screen shots on this page all show the RUN mode. The RUN screen is the default startup screen. This screen needs to be selected in order to initiate a weld cycle. After each weld cycle, the measured values are displayed here. Just below the PROCESS DATA label, there are a number of fields containing part data. The first field identifies the current sequential part number. Next is the Limits field. It displays "-" for a good part, "S" for suspect part, "B" for a bad part, or "E" for an error. A suspect or bad part means one or more of the measured parameters was not within the limits set for the weld cycle. The next two fields indicate the time and date the part was welded.

Just below the WELD label, there are a number of fields with weld data for the last cycle. The displayed data lists the:
• Weld time (seconds)
• Number of motor turns during weld
• Peak motor speed (RPM)
• Peak motor torque (% of maximum motor torque)
• Weld energy (Joules)
• Welded part orientation (degrees)
• Stroke time (seconds)
• Total cycle time (seconds)

VIEW PARTS
The VIEW STORED PART DATA button on the right side of the screen displays seven part reports at a time. Each report occupies two lines and displays the same information reported on the RUN screen. The report starts with the last cycle at the bottom and works backwards toward the top. This is shown in Figure 5–5. Two buttons at the bottom of the screen permit you to page up (backwards) and down (forward). Press one of the three menu buttons on the left side of the screen to return.

SETUP Menu
TRIGGER Setup
The TRIGGER setup is the first tab in the SETUP menu and is shown in Figure 5–6. The Security Code screen will appear first for entering the numerical password. If no password has been set, press the ENTER key. The two upper fields specify the TIMEOUT (sec) to wait for a trigger and the Spin Delay (sec) after trigger before initiating spin. Pressing the numerical value cell displays a new data entry window that also specifies the maximum and minimum values. The TIMEOUT (sec) data entry window is shown in Figure 5–7. Use the keypad to specify a value and press the ENTER key.

The RPM button displays the desired welding RPM. Pressing the numerical value cell displays a new data entry window. The arrow cell below the numerical value toggles to select either clockwise or counterclockwise rotation.

The button labeled Part Pickup toggles from Off to On (shown). When enabled, the PICKUP TIME (s) field appears. Pressing the cell displays a data entry window. The Part Pickup option is designed to work in conjunction with a rotary table or slide kit to automatically feed parts.
It first lowers the upper tooling head to pickup a part, then raises the head. The head then descends to execute the welding cycle. Part Pickup can work in conjunction with the Pre-Spin Orientation setup.

The last two buttons in TRIGGER setup are PreSpin Orient and Torque which each cause a new window to be displayed for configuring the parameters.

**Pre-Spin Orientation Setup**

This option enables the servo spin welder to rotationally align the upper tooling head with a keyed part. The drive head will rotate before descending to the specified angular position. The Pre-Spin Orientation screen is shown in Figure 5–8. The Enable button is shown in the On position. Pressing the button toggles it between On and Off. When the Enable button is Off, the Pre-Spin data entry field below the button and the left arrows are not displayed. The button must be in the On state to setup a pre-weld rotational alignment. To the right is a Jog Speed radio button set, two buttons for selecting jog direction (JOG+/JOG-) and HEAD DOWN button.

Press the HEAD DOWN button to enable the thruster pneumatic cylinder and then press the operate switches to lower the head. As soon as the operate switches are released, the head will automatically retract upwards.

To set the pre-weld rotational alignment, the value can be manually entered or determined visually by rotating the motor shaft.

1. To manually specify a value, press the Pre-Spin data entry field on the left and enter an angular value.

2. To visually determine the alignment angle, use the JOG+ and JOG- buttons along with a selected Jog Speed (Lo, Med or Hi) to adjust the rotational alignment. Activate both RUN switches on the base simultaneously to rotate the tool. Once aligned, press the left arrow to transfer the value displayed in the Jog (Deg.) display cell on the right to the Pre-Spin data field on the left. Note that the Jog Deg. display takes about a second to update after motion stops.

Pressing the left arrow transfers the value from the Jog (Deg.) display cell to the Pre-Spin data entry field. Figure 5–8 shows a visual alignment setup with the angular...
orientation value displayed in the Jog (Deg.) cell. The Pre-Spin field displays 12.3 indicating the alignment value has not been transferred yet. The value in the Pre-Spin data field determines the pre-spin orientation. If alignment is done visually and the transfer icon is not pushed, the value currently in the Pre-Spin field will be used as a pre-spin orientation. In this case, a value of 12.3 degrees will be used if the screen is exited at this point. However, if the alignment is done manually by entering a value into the Pre-Spin data field, the Jog (Deg.) display cell would normally display 0. In this case, pressing the transfer icon would overwrite the manually entered value with zero. Only use the transfer icon button when visually aligning the pre-spin orientation. Press the DONE button to return to the Trigger setup screen.

**Torque Setup**

This option specifies a torque level to sense when the upper and lower parts make contact. Prior to contact, the motor is running under a no-load condition. At contact, there is an increase in the torque required to maintain the angular velocity, at which point the weld is considered to start (i.e. the weld timer and counter are started). The setup window is shown in Figure 5–9. The Enable button is shown in the On position. Pressing the button toggles it between On and Off. When the Enable button is Off, the Torque (% of max.) and Timeout (sec.) data fields are not displayed.

The Torque (% of max.) data field specifies the torque required to indicate contact in terms of the percentage of peak motor torque. The Timeout (sec.) data field specifies the time window for the torque threshold to be crossed, beginning with the operate switch activation. Press the DONE button to return to the TRIGGER setup screen.

When using the Torque Trigger feature, it is important to ensure that the torque setting is above the idle torque (i.e. torque required to spin the tool in the no-load condition) to prevent false triggering, and that the motor is spinning at the programmed weld RPM when part contact occurs. To determine the idle torque, follow these steps:

a) Ensure that the mechanical stop is properly adjusted to prevent contact between the spin tool and fixture.
b) Program the desired motor RPM for the application (NOTE: Idle torque is dependent on the RPM).

c) Disable the Torque Trigger feature.

d) Without parts in place, run a “dry” weld cycle.

e) Read the “Peak Tq. (%))” value displayed on the RUN screen. This value represents the idle torque.

f) Repeat Steps (d) and (e) several times to determine the largest idle torque value.

To determine if the motor is spinning at the programmed RPM when part contact occurs, follow these steps:

a) Program the welder with all the desired parameters for the application, but disable the Torque Trigger feature.

b) Load a set of parts to be welded.

c) Initiate a weld cycle, and observe when the TRIGGER LED below the touch screen turns ON relative to the point at which the parts come in contact.

If the LED turns ON before part contact, the motor has properly come up to weld RPM – no setup changes are necessary.

If the LED does not turn on before part contact, the motor is not at weld speed when expected, and the setup will need to be modified until this condition is resolved.

The following suggestions will increase the likelihood of the motor reaching weld RPM (NOTE: These adjustments may affect the weld process and require that other parameters be modified to compensate for their effects):

1. Increase the distance between the top-of-stroke position and part contact by raising the thruster on the column.

2. Engage hydraulic speed control (HSC) if it is not being used.

3. Raise the vertical position of the HSC.

4. Increase the resistance of the HSC.
5. Lower downspeed flow control setting (but not less than 1 full turn open).
6. Reduce air pressure.
7. Reduce weld RPM.

**WELD Setup**

The WELD setup is the middle tab in the SETUP menu and is shown in Figure 5–10. The screen contains four buttons and 3 data fields. Three of the buttons are mode selection for Weld–by–Time, Weld–by–Rotations and run until End–of–Weld Switch trigger. The fourth button on the right labeled ORIENTATION specifies the final angular orientation of the part.

**Time Mode**

The Time button selects a Weld–by–Time mode. The data field to the right labelled Weld Time (sec.) specifies a value in seconds for the weld time. The button below it labeled Orientation... displays an Orientation Setup screen which is shown in Figure 5–11. It is similar to the Pre–Spin Orientation screen (see Figure 5–8). In order to Weld–by–Time, the TIME button must be selected and a value for the WELD TIME (sec.) greater than zero must be entered. The weld time includes the time it takes the motor to decelerate to a stop from the programmed speed. As a result, the weld time must be above a minimum value. If the entered value is too low, a warning message will be displayed on the RUN screen when the weld cycle is initiated.

**Rotation Mode**

The Rotation button selects a Weld–by–Rotation mode. The data field to the right labeled Weld Rotations specifies the number of complete rotations the upper head will make during a weld cycle. This screen is shown in Figure 5–12. The button below labeled Orientation displays an Orientation screen which is shown in Figure 5–11. It operation was covered on the previous page. To Weld–by–Rotation, the Rotations button must be selected and a value for the number of weld rotations must be entered. This can be an non–integer value (e.g. 10.5). The number of rotations specified is only for the welding
cycle. The final number of rotations will always be equal to or greater than the number specified and depends on the deceleration and whether final angular orientation is enabled or disabled.

**End Switch Mode**

This mode ends a weld when the End-Of-Weld trigger switch is activated. The adjustment and indicator flags are shown in Figures 4–3 and 4–4. The Timeout (Sec.) value ends the welding process if the End–Of–Weld switch has not been triggered within the specified time. This screen is shown in Figure 5-13.

Since Time, Rotation and End Switch are all welding modes, only one can be selected. The label above the data field changes to reflect the correct description, but the data value does not change when another weld mode is selected. You must enter a value each time you change weld modes to change its setting.

**Orientation**

Angular orientation is an option. If a final rotational alignment is desired, the value can be entered manually or determined visually by rotating the motor shaft. Press the Orientation ... button and then the Enable button until it displays On as shown in Figure 5–11.

1. To manually specify a value, press the WELD data entry field on the left and enter an angular value. A data entry screen like Figure 5–7 appears. Use the keypad to specify a value and press the ENTER key. Then Press the DONE button to return to the TRIGGER setup screen.

2. To visually determine the final alignment angle, use the JOG+ and JOG– buttons along with a selected Jog Speed (Lo, Med or Hi) to adjust the angular orientation. The Jog+ will display CW when pushed. Press both operate switches simultaneously to rotate the motor. Once aligned, press the arrow icon to transfer the value displayed in the right side Jog (Deg.) display cell to the Weld data field on the left. Press the DONE button to return to the Trigger setup screen.

Pressing the arrow icon transfers the value from the Jog (Deg.) display cell to the Weld data entry field.

Figure 5–11 shows an alignment setup with the angular orientation value displayed in the Jog (Deg.) cell. The Weld field displays 12.3 indicating the alignment value has not been transferred yet. The value in the Weld data field determines the final orientation. If alignment is done visually and the transfer icon is not pushed, the value currently in the Weld field will be used as the final orientation. In this case, a value of 12.3 degrees will be used if the screen is exited at this point. However, if the alignment is done manually by entering a value into the WELD data field, the Jog Deg display cell would normally display 0. In this case, pressing the transfer icon would overwrite the manually entered value with zero. Only use the transfer icon button when visually...
aligning the final orientation. Always press the DONE button to return to the TRIGGER setup screen.

The Decel. \((\text{rev/s}^2)\) data entry field sets the deceleration rate of the upper tooling. The units of measurement are revolutions/sec\(^2\). Typical starting values for deceleration are 50 to 100 revolutions/sec\(^2\). A high deceleration value is preferable because it stops the rotation as quickly as possible. This allows the joint to solidify during the hold phase without subjecting it to any shear forces which would weaken the joint.

The Tool Inrt. \((\text{kg} \cdot \text{cm}^2)\) data entry field is the moment of inertia of the upper tooling in kilogram–cm\(^2\). The tool inertia is a parameter for the servo tuning. A lookup table contains the Proportional, Integral and Derivative gains for the servo feedback control loop for various ranges of tooling inertia. Calculating the Moment of Inertia is covered in Appendix C.

**POST WELD Setup**

The POST–WELD setup is the third tab in the SETUP menu and is shown in Figure 5–14. It contains a Hold Time (Sec.) data entry field, a Process Limits screen access button, a Suspect part mode button and a Latch mode button.

To set the hold time press the Hold Time (sec.) button to display the data entry field. A screen similar to Figure 5–7 is displayed. Use the keypad to specify a value and press the ENTER key. The Process Limits button displays a new window for specifying which parameters to monitor along with the minimum and maximum values. The values set for the lower and upper limits determine whether a part is considered good or bad/suspect. If all the monitored parameters are within specified limits, the part is considered good and a dash (–) is displayed on the RUN screen. If one or more of the parameters fall outside the limits, the part is considered suspect (S) or bad (B). The first Limits screen is shown in Figure 5–15. This screen contains the limits for:

1. Weld Time (Seconds)
2. Weld Rotations
3. Orientation (Degrees)
4. Weld Energy (Joules)
The Time Method Limits label at the top displays the selected weld mode (see Figures 5–10, 5–12 and 5–13). The More Limits button at the bottom displays the second screen of limit parameters with a DONE button to return to the POST-WELD screen.

The second screen has the limits for:

5. Peak RPM
6. Peak Torque % of motor max.
7. Downstroke (Seconds)
8. Cycle Time (Seconds)

The right side of the POST-WELD setup screen is labeled Part Test Failure and contains two buttons for setting the action when an out-of-limit condition occurs. The orange Suspect button toggles to red Bad (Abort) when pressed. This means the cycle will abort when an out-of-limit condition occurs. There are three different combinations that can be set.

1. Suspect with Latch Off will display a red dash (–) for a good part or S for a Suspect part on the RUN screen after a weld cycle.
2. Suspect with Latch On (pressing the Latch button toggles it between On and Off) will display an Acknowledge Part Test Fail button on the RUN screen when an out-of-limit condition occurs. This is illustrated in Figure 5–16. Press the message button to clear the machine and continue welding.
3&4 Bad (Abort) with Latch On or Latch Off will display an error message in a red banner at the top of the Run screen. The message reads Error: Weld Ended at (error condition that caused fault). This is shown in Figure 5–17. To reset the welder, press the RESET FAULT button on screen (see Figure 5–1). The RUN screen now instructs you to Press both RUN SWITCHES to reset machine as shown in Figure 5–2. This will home the upper drive head and clear the error message. Also note that the limits column of data now displays a red E instead of an S.
TOOLS Menu

SELECT SETUP Tab

Pressing the TOOLS button displays the first tab labeled SELECT SETUP. This contains eight buttons for selecting a setup file as shown in Figure 5–18. The Machine Cycle Count in the lower right corner is the total number of weld cycles that have occurred in the machine’s lifetime.

UTILITIES Tab

The middle tab named Utilities and shown in Figure 5–19, contains buttons for renaming, copying, saving and erasing the setup files. There are also buttons for accessing a screen to record the manual settings and one for exporting the torque profile data.

The Manual Machine Settings button displays the screen shown in Figure 5–20. This screen offers a convenient place to record and store the ten manual settings related to the current setup file. The data field label descriptions are:

1. Pre–Trigger Height Setting (3rd Flag)
2. End–Of–Weld Height Setting (4th Flag)
3. Mechanical Stop Height Setting (2nd Flag)
4. Column Height (use silkscreened scale)
5. Compressed Air Regulator Pressure Setting
   Inner Dial Reading 0.00 – 7.00 (kg/cm^2=Bar)
6. Flow Control Setting (Number of Turns)
7. Upper Tool Number ID – Alphanumeric
8. Lower Tool Number ID – Alphanumeric
9. Hydraulic Speed Control Height (1st Flag)
10. Hydraulic Speed Control Speed Setting

Items 1, 2, 3 and 9 refer to the flag position indicators shown in Figure 4–3. Item 10 is the HSC (Hydraulic Speed Control) resistance setting which is visible through a slot in the side of the access panel shown in Figure 5–21. The Upper Tool Nr. and Lower Tool Nr. buttons display a text entry keypad. The other eight data fields display a numerical keypad. After entering the data, press the DONE button. Then press the Save Manual Settings button to store the manual settings with the current setup file.

The Export Torque button transmits the torque profile record for the last part to a computer via the Data I/O port. Instructions on how to capture this data is provided in Section 8 and a pinout of the Data I/O connector is provided in Appendix A.
Rename Setup allows a name up to 26 characters. The keypad has the letters a through z and a caps key for A through Z, plus the numbers 0 through 9 and a space key. To rename a setup, enter a new name and then press the RENAME button under the new name. Press the DONE button when finished.

Copy Setup copies the values of the currently loaded setup file to the setup file specified. To copy a setup, press the Destination Setup ID button, enter the desired number, then press the COPY button. Press the DONE button when finished.

After entering or changing the Manual Machine Settings, the SAVE Manual Settings button will be displayed. Pressing this button will store the manual settings with the current setup file. All other data values are automatically saved in the current setup as soon as the RUN button is pressed.

Erase Setup clears all the parameter values and the Manual Settings from the currently loaded setup file. To erase a setup, press the ERASE button, and then the DONE button. The active setup is now restored to factory defaults.

The SYSTEM I/O button (available on HMI’s with software version 2.10.x or later) provides access to screens which indicate the status of all welder PLC digital inputs and outputs. This information is typically used for diagnostic purposes. When the SYSTEM I/O button is pressed, the Input Status screen is displayed as shown in Figure 5-22. Active input states are indicated by a value of 1 with a green background; inactive states are indicated by a value of 0. When the OUTPUTS button is pressed, the Output Status screen is displayed as shown in Figure 5-23. Active outputs are indicated by a value of 1 with a green background; inactive states are indicated by a value of 0.

The BATTERY button (available on HMI’s with software version 2.9.x or later) displays the date at which a battery replacement warning message will start to appear, as well as an additional screen for setting a new date if the battery is replaced. This date applies only if the PLC software version is 1.8 or earlier. For PLC software versions 1.9 or later, the battery replacement warning message is displayed when the actual battery voltage (monitored internally by the PLC) falls below a fixed threshold. Contact Dukane service for assistance with battery replacement.
SYSTEM SETUP Tab
The third tab is labeled SYSTEM SETUP and is shown in Figure 5–24.

The Set Password button is used to set the password which must subsequently be entered to change programmed machine settings. The default password is 0 (zero) so that password–protected screens are easily accessed by just pressing the Enter key on the Enter Password Code screen. The password is a numerical value with a maximum 10–digit value of 4 294 967 295 (or 2<sup>32</sup> – 1). The password–protected screens and menus are shown in Figure 5–25.

The Clear Data on Power Up button zeroes out the records for the parts report shown in Figure 5–5. Pressing this button will toggle it On. Recyling the power will clear the parts data at restart.

The Data Export button enables the transmission of weld data for each part to a computer via the Data I/O connector shown in Figures 4–4 and 4–9. A pinout of the Data I/O connector is provided in Appendix A.

The Start Type button toggles from Manual to Automatic each time it is pressed. Manual is used for most operations. Automatic is used in an automated system and requires a switch closure contact on the User I/O HD-15 connector (see Figure 3–9). A pinout of the User I/O connector and automation wiring information are provided in Appendix A.

The Home Offset (Deg.) box specifies the home orientation of the motor relative to the factory 0 position. During the homing sequence, the motor will first find the factory 0 position, then rotate to the value specified in this field.

The buttons English, French, Czech, and German set the active language on the welder. When one of these buttons is pressed, the menu language changes to the selected language and remains in effect while the welder is powered up. To preserve the language selection between power cycles, press the Save Language Select button.

The Import Servo DB button reloads the servo tuning parameter table. This table contains the gains for the Proportional, Integral and Derivative portions of the servo feedback control loop. Loading the table requires a computer with the SpinWelder Utility program installed and a cable attached to the Data I/O connector. Pressing this button brings up the screen shown in Figure 5-26. To import the tuning database, follow the instructions for the SpinWelder Utility program in Section 8. If this button is pressed and a communication link has not been established, the servo spin welder will import a blank list of parameters which overwrites the existing values. This will result in a non–functioning servo drive. It will also generate an error message stating that Servo Database Import Failed.

The Software Rev. button displays a screen with software revisions of the welder components as shown in Figure 5-27.

Parameter Value Range
The minimum and maximum values of the welding parameters are listed in Table 5—I.

<table>
<thead>
<tr>
<th>Screen</th>
<th>Parameter Name</th>
<th>Min. Value</th>
<th>Max. Value</th>
<th>Resolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trigger</td>
<td>Timeout (sec.)</td>
<td>1</td>
<td>6000</td>
<td>1 second</td>
</tr>
<tr>
<td></td>
<td>Spin Delay (sec.)</td>
<td>0.0</td>
<td>60.0</td>
<td>0.1 second</td>
</tr>
<tr>
<td></td>
<td>RPM</td>
<td>5</td>
<td>750 (SVT012R) 3000 (SVT032R) 4000 (SVT042R)</td>
<td>1 RPM</td>
</tr>
<tr>
<td></td>
<td>Pickup Time (s)</td>
<td>0.0</td>
<td>30.0</td>
<td>0.1 second</td>
</tr>
<tr>
<td></td>
<td>Pre–Spin (degrees)</td>
<td>0.0</td>
<td>359.9</td>
<td>0.1 Degrees</td>
</tr>
<tr>
<td></td>
<td>Torque (% of max.)</td>
<td>0.1</td>
<td>100.0</td>
<td>0.1 %</td>
</tr>
<tr>
<td></td>
<td>Torque Timeout (sec.)</td>
<td>0.1</td>
<td>60.0</td>
<td>0.1 second</td>
</tr>
<tr>
<td>Weld</td>
<td>Weld Time (sec.)</td>
<td>0.00</td>
<td>1000.00</td>
<td>0.01 second</td>
</tr>
<tr>
<td></td>
<td>Weld Rotations</td>
<td>0.00</td>
<td>1000.00</td>
<td>0.01 Rotn.</td>
</tr>
<tr>
<td></td>
<td>Timeout (sec.)</td>
<td>0.00</td>
<td>1000.00</td>
<td>0.01 second</td>
</tr>
<tr>
<td></td>
<td>Orientation</td>
<td>0.0</td>
<td>359.9</td>
<td>0.1 Degrees</td>
</tr>
<tr>
<td></td>
<td>Deceleration Rev/S&lt;sup&gt;2&lt;/sup&gt;</td>
<td>1.0</td>
<td>500.0</td>
<td>0.1 rev/s&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>Tool kg*cm&lt;sup&gt;2&lt;/sup&gt;</td>
<td>0</td>
<td>3000 (SVT012R) 780 (SVT032R) 160 (SVT042R)</td>
<td>1 kg*cm&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
<tr>
<td>Post–Weld</td>
<td>Hold Time (sec.)</td>
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<td>10000.00</td>
<td>0.01 second</td>
</tr>
<tr>
<td>System Setup</td>
<td>Password</td>
<td>0</td>
<td>4294967295</td>
<td></td>
</tr>
</tbody>
</table>

Table 5—I Parameter Minimum and Maximum Values
SECTION 6

Machine Operation

Machine Setup ............................................. 45
Mechanical Stop ............................................. 46
End of Weld ................................................... 47
Hydraulic Speed Control ................................. 47
Pre Trigger .................................................... 48
Trigger Light .................................................. 48
Air Pressure Regulator ..................................... 48
Downspeed Control ........................................ 48
Stroke Indicator .............................................. 49
Modifying a Setup .......................................... 49
Starting the Weld Cycle ................................... 51
Stopping the Weld Cycle ................................. 52
Setup Sheet ................................................... 52
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Machine Setup
The startup procedure given here is for a new machine that has just been installed.

1. Disable System by Pressing E-Stop
Push the E-Stop switch in as shown in Figure 6–1.

2. Base Interface Cable
Attach the base interface cable from the rear of base to the back of the thruster housing as shown in Figures 3–7 and 3–9.

3. AC Power
Insert the AC power plug (refer to Figure 3–4) into a 240 VAC, 1–Phase NEMA type 6–20R receptacle rated at 20 Amps. The correct style outlet is shown in Figure 3–5. Do not alter the plug or receptacle in any way. Refer to the section on Electrical Safety in Section 2 if you have any questions.

4. Compressed Air
First push the lockout slide bar to the locked position as shown in Figure 2–3. The locked position has the hole for a lock visible in the slide bar. Connect a supply of clean, dry, compressed air at 80 to 100 psi to the Servo Spin Welder. The location of the compressed air fitting is shown in Figure 3–7. Now push the lockout valve slide bar to the operate position to open the valve. The thruster will rise up into the head assembly. Adjust the compressed air regulator to about 40 psi.

5. Turn Power ON
Turn on the AC power switch. The power switch is located just above the power cord strain relief and is shown in Figure 3–6.

6. Reset E-Stop
Reset the emergency stop button by turning clockwise and pulling out (or up). Refer to Figure 6–1. The status display on the base will change from ABORT in red to POWER in green.

7. HOME Procedure
The touch screen will now instruct you to Press both RUN SWITCHES to reset the machine. This is illustrated in Figure 6–2. Once the switches are activated, the servo head will rotate until the internal zero reference pulse is read, then position the head to the value specified in the Weld field (Figure 5–11) and stop. If the Home
Offset (Deg.) field is non-zero, the head will first rotate to this position before moving to the Weld orientation. The switches can be deactivated once a beep sounds or when the indicator directly below the yellow face icon becomes green.

8. Attach Tooling
The head is now fully retracted and the servo hub is set to zero degrees. Before attaching the tool, TURN OFF the AC power switch. Attach your upper tooling to the hub and torque tightly. The upper tooling hub dimensions are given in Figure 3-2. Align and securely attach the lower fixture to the press base. Turn on the AC power switch, and navigate to setup, WELD tab. Enter the tool inertia into the Tool Inert. (kg*cm²) box. Now press the RUN button and perform the home procedure described in step 7 above. You can use the Pre-Spin Orientation Setup screen shown in Figure 5–8 to lower and raise the head. By reducing the regulator air pressure, you can slow the movement. The lower base mounting dimensions are given in Figure 3–3.

9. Adjust Overall Height
The rear support column of the Servo Spin Welder features a threaded shaft for adjusting the overall height of the thruster head. The adjustments are shown in Figure 6–3. Loosen the three rear nuts (which lock the head assembly in place). The nuts are 22mm (0.866 inch) but a 7/8-inch socket will also fit. Then raise or lower the head by turning the adjustment lead screw. The lead screw has 8 threads per inch, so 1 turn moves the head 0.125 inch (3.175 mm). Tighten the rear locking nuts.

Mechanical Stop
The Mechanical Stop sets the lower limit of the downward stroke. The thruster head cannot move past this point. The stop is set with the knob labeled Mechanical Stop as shown in Figure 6–4. Set the mechanical stop so that the upper tooling does not come any closer than about 1/16 inch or 1mm of the lower tooling when the head is completely lowered. This will allow you to make dry runs without parts and also prevent tooling damage when the compressed air is turned off. The adjustment screw has a pitch of 1mm per turn. This means that one turn of the knob moves the stop vertically 1.0mm or 0.039 inch. Counterclockwise rotation lowers the stop and clockwise rotation raises the stop.

Final adjustment may require you to readjust the overall height (Step 9 above) if you do not have sufficient stroke. The maximum stroke of the Servo Spin Welder is 6-inches (152mm).
End–Of–Weld

The End–Of–Weld adjustment sets the position where the welding stops (the head stops rotating) when using the Weld–By–End–Switch weld mode. Figure 5–13 shows the End–Switch mode selected. The End–Of–Weld should be set above the bottom mechanical stop. The adjustment is shown in Figure 6–5. The exact setting depends upon the thickness and other dimensions of the parts you are welding.

If you are welding by Time or Rotations, the End–Of–Weld switch must be set a little lower to about the same position as the bottom stop. If the End Switch is triggered during a Weld–By–Time or Weld–By Rotations cycle, an error will be generated and the weld cycle will abort. The system will have to be reset. Figure 5–17 shows a typical error screen. In this case the error message would display Error: Weld Ended by Switch. A complete list of the error messages is provided in Section 9.

Hydraulic Speed Control

The Hydraulic Speed Control (HSC) is a hydraulic damper that lets you accurately control the downward velocity of the servo head by providing an adjustable resistance to the pneumatic cylinder lowering the servo head. The damper has a total stroke of 1 inch (25.4 mm); however, the first .25 inch (6.4 mm) of travel is used for load deceleration and should not be used to control the weld process. The yellow flag for the HSC is set to the position when the damper begins to compress. The HSC engagement point is typically 5/16 inch (8 mm) above the point where the parts make contact. This will ensure that about 1/16 inch (1.5 mm) of travel will be in the controlled velocity range. The setting is shown in Figure 6–6. If the engagement point is set higher, the cycle time increases without any benefit to the weld quality. The maximum stroke of the hydraulic damper is one inch.

The HSC damping should be set to provide a downward velocity that matches the rate at which the plastic is melting. This allows the molten plastic to flow together instead of being forced. This in turn provides greater heat penetration which increases the bond line thickness and creates a stronger weld joint.

Figure 6–7 shows the two slots for adjusting the damper and reading the indicator dial. The lower wide slot is for adjusting the amount of hydraulic damping applied. Above the adjustment slot is a narrower slot for reading the dial. Higher numbers on the dial correspond to a larger hydraulic resistance and provide more damping (i.e. slower descent speed).
Pre Trigger
The Pre Trigger setting, shown in Figure 6–8, initiates rotation of the motor. This is normally set about 2 inches or 50 mm above the contact point to allow the motor to reach the desired RPM. Once the motor has reached the specified RPM, the Trigger light will illuminate.

When the head is completely retracted, an internal Top–Of–Stroke switch is activated. If more than one switch (Top–Of–Stroke, Pretrigger or End–Of–Weld) is activated at the same time, the Servo Spin Welder will generate an error. Therefore, it is important the Pretrigger switch not be positioned at the top of stroke.

Trigger Light
The front panel Trigger light, shown in Figure 6–9, should illuminate shortly after the head lowers past the Pre trigger point. The Trigger light indicates when the motor has reached the target RPM if Torque triggering is not used. With Torque trigger enabled, the light turns on when the torque threshold is crossed. The Servo Spin Welder considers this to be the start of the weld cycle and begins the weld timer or rotation counter.

Air Pressure Regulator
The regulator controls air pressure applied to the air cylinder which in turn determines the force applied to the weld joint. The gauge is calibrated in psi (pounds per square inch) on the outside of the dial, and kg/cm\(^2\) on the inside of the dial. The regulator can be seen in Figure 6–4. A closeup of the regulator is shown in Figure 4–5.

The boost factor of the pneumatic air cylinder is calculated by the ratio of cylinder area to the area for standard atmospheric pressure measurements. The standard 2.5 inch diameter cylinder has an area of 4.91 sq. inches so its boost is 4.9 times the applied pressure in pounds per sq. inch (psi). A setting of 40 psi results in a downward force of 196 lbs (40 lbs/inch\(^2\) x 4.91 inch\(^2\)).

Downspeed Control
The down speed adjustment controls the flow of air leaving the pneumatic cylinder during the down stroke only. The restoring pressure during the up stroke is not affected. The knob has numeric graduations ranging from 0 to 9 engraved on its front and controls a ten–turn
flow valve with a one-way bypass. There are two small windows on either side of the knob (see Figure 6–10) to view a color-coded internal shaft. The shaft has eight colored bands. Reading from left to right they are Green, Yellow, Blue, White, Red, Blue, Gray and Brown. The lowest setting has the Green band visible and the highest setting is the Brown band. Pull the external red ring to the right to unlock the knob before adjusting it. The difference between the locked and unlocked position is about 0.08 inches (2mm). Once the final speed setting has been determined, push the locking ring back to lock the setting in place.

The down speed setting is a flow control device, so the amount of air released from the air cylinder during down stroke is dependent upon the pressure set by the air pressure regulator. Higher air pressure gives a faster down speed. The initial setting should be approximately 1-1/2 to 2-1/4 turns open at a pressure regulator setting of 40 psi. The closed, or 0 position is where the knob is turned clockwise as far as possible. Opening the downspeed more results in a faster stroke, and closing the valve slows the downstroke.

Stroke Indicator
The yellow stroke indicator can be seen in Figure 6–4. The flag indicates the current position of the thruster head. When the flag is at the top position, the Top–Of–Stroke switch is activated.

Modifying a Setup
Once the mechanical settings are adjusted, you can load a setup file. If you do not have a file with the correct parameters, select a file that is blank or not needed. Press the TOOLS button and choose a setup file as shown in Figure 6–11. You can either Erase the selected setup file, or overwrite the existing settings. The data is saved automatically each time the RUN button is pressed. Select the UTILITIES tab and assign the file a meaningful name by pressing the New Name button as shown in Figure 6–12. An alphanumeric keypad appears. After entering a name, press the ENT key on the keypad to return to the Rename screen. Then press the RENAME button. The legend at the top will change to display the new setup file name.
A disk icon will also briefly appear during the rename and save operation. Press the DONE button to exit. Pressing the DONE button without pressing the Rename button will discard any changes.

Press the SETUP button to begin entering data values for the Setup file. The setup file you selected and its name should appear at the top of the screen. Decide which method will be used to trigger the welding process and begin to enter the parameters in the TRIGGER screen. Select whether any Part Pickup and Pre-Spin Orientation is required. These screens are covered in Section 5. Next, determine the welding method best suited for your application. Press the Weld tab and select either

1. Weld by Time
2. Weld by Number of Rotations or
3. Weld by End Switch

and then enter the appropriate data. These screens are covered in Section 5 and shown in Figures 5–10 through 5–13. Also select whether you require Angular Orientation on the finished assembly.

Next, press the POST-WELD tab and enter the hold time (seconds) in the Hold Time (sec.) box (see Figure 5–14). This is the amount of time the machine will wait after motion of the head stops to let the plastic solidify. The next step is to select whether you require Bad part or Suspect part notification, with or without the Latch function. Refer to Figure 5–14 and the description given for Part Test Failure. Then set any Limits in the POST-WELD screen (see Figure 5–15). Make sure that if a limit is turned on, that a nonzero value is entered for the upper threshold value.

At this point, you can record the known mechanical parameters by selecting TOOLS > UTILITIES (shown in Figure 6–13) and pressing the Manual Machine Settings button. The Record Manual Setup screen shown in Figure 6–14, acts like an electronic note pad to record the information. You can update the information later after the final values are confirmed. Press the DONE button to exit, and then press the Save Manual Settings button to save the manual settings with the file parameters. Again the disk icon will appear briefly in the upper left–hand corner.
Starting a Weld Cycle

To start a weld cycle, press the RUN button on the touch screen if the screen is not already in the run mode (see Figure 6–2). All weld cycles must be initiated from the RUN screen. If you had powered down the Servo Spin Welder or pressed the Abort button, the screen may instruct you to execute a RESET procedure – Press both RUN SWITCHES to reset the machine. The servo spin welder will perform the homing sequence. The machine is now ready to weld.

The first tests should be performed without parts. Press both base switches simultaneously to initiate a cycle. The head will begin to descend. The motor starts spinning at the pretrigger point and the trigger light turns on when the desired RPM has been reached. The descent slows when the hydraulic damper is engaged. The weld cycle continues until the selected welding parameter (time, number of rotations or end switch) has been reached. The motor stops and remains in the lowered position for the specified hold time, then returns to the top. The screen then displays the data for that cycle. The base switches must remain actuated until the end of hold time; otherwise, an error will be generated and no weld data will be displayed.

During the test, the upper tooling should not have come in contact with anything. Check that the motor RPM reached the specified value. Refer to Figure 5–4 for the identification of the data values.
Stopping a Weld Cycle

Several conditions can stop a weld cycle. Normally, the cycle will stop when the desired weld motion, such as the specified amount of spin time, and hold time are complete. The machine head will automatically retract to the top of stroke after the cycle completes.

If the base switches are released at any point prior to the end of hold time, the weld cycle will terminate, and the press head will retract to the top. An error message will be displayed on the touch screen and the machine will need to be reset before running the next cycle. The machine behavior will be the same if the abort switch is activated. The machine will then also have to be reset after the abort switch is reset.

A weld cycle will also be terminated if certain programmed process limit are outside the specified window. The applicable process limits are Cycle Time, number of Rotations, motor RPM, and motor Torque. For all other process limits, the cycle will not stop, but an error message will be displayed on the touch screen if the weld data is outside the limits.

Setup Sheet

On the following page is a table containing all the machine settings for the servo spin welder. An electronic version is provided on the CD included with the machine.
# SERVO SPIN WELDER - SETUP SHEET

**Application** | **Machine Model** | **SVT0____2R**
---|---|---
**Date** | **Machine Setup Number** |  

## MANUAL SETTINGS

<table>
<thead>
<tr>
<th>SETTING</th>
<th>VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Flag Positions</strong></td>
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</tr>
<tr>
<td>Hydraulic Speed Control (mm)</td>
<td></td>
</tr>
<tr>
<td>Mechanical Stop (mm)</td>
<td></td>
</tr>
<tr>
<td>Pre-Trigger (mm)</td>
<td></td>
</tr>
<tr>
<td>End of Weld (mm)</td>
<td></td>
</tr>
<tr>
<td><strong>Air Pressure (psi)</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Hydraulic Speed Control Resistance</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Flow Control (# of turns open OR band color)</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Thruster Position on Column (mm)</strong></td>
<td></td>
</tr>
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</table>

## TOUCH SCREEN SETTINGS

<table>
<thead>
<tr>
<th>SETTING</th>
<th>VALUE</th>
</tr>
</thead>
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<td><strong>SETUP -&gt; TRIGGER</strong></td>
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<td>RPM</td>
<td></td>
</tr>
<tr>
<td>Dir.</td>
<td></td>
</tr>
<tr>
<td>Spin Delay (sec)</td>
<td></td>
</tr>
<tr>
<td>Timeout (sec)</td>
<td></td>
</tr>
<tr>
<td>Part Pickup</td>
<td>Pickup Time (s)</td>
</tr>
<tr>
<td>Pre-Spin Orient</td>
<td>Pre-Spin</td>
</tr>
<tr>
<td>Torque</td>
<td>Torque (% of max.)</td>
</tr>
<tr>
<td><strong>SETUP -&gt; WELD</strong></td>
<td></td>
</tr>
<tr>
<td>Method (Time, Rotation, or End Switch)</td>
<td>TIME</td>
</tr>
<tr>
<td>Weld Time (sec.) / Weld Rotations / End Switch Timeout (sec.)</td>
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</tr>
<tr>
<td>Tool Inert. (kg*cm^2)</td>
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</tr>
<tr>
<td>Decel. (rev/s^2)</td>
<td></td>
</tr>
<tr>
<td>Orientation...</td>
<td>Weld</td>
</tr>
<tr>
<td><strong>SETUP -&gt; POST-WELD</strong></td>
<td></td>
</tr>
<tr>
<td>Hold Time (sec.)</td>
<td></td>
</tr>
<tr>
<td>Part Test Failure</td>
<td>SUSPECT</td>
</tr>
<tr>
<td>Latch</td>
<td>ON</td>
</tr>
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<td><strong>TOOLS -&gt; SYSTEM SETUP</strong></td>
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</tr>
<tr>
<td>Process Limits...</td>
<td></td>
</tr>
<tr>
<td>Weld Time (sec.)</td>
<td></td>
</tr>
<tr>
<td>Weld Rotations</td>
<td></td>
</tr>
<tr>
<td>Orientation (Deg.)</td>
<td></td>
</tr>
<tr>
<td>Weld Energy (J)</td>
<td></td>
</tr>
<tr>
<td>Peak RPM</td>
<td></td>
</tr>
<tr>
<td>Peak Torque (% of max.)</td>
<td></td>
</tr>
<tr>
<td>Downstroke Time (sec.)</td>
<td></td>
</tr>
<tr>
<td>Cycle Time (sec.)</td>
<td></td>
</tr>
<tr>
<td><strong>Home Offset (Deg.)</strong></td>
<td></td>
</tr>
</tbody>
</table>

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*dukane Manual Part No. 403–568–04* Page 53
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Spin Welding Process ............................................ 57
Material Considerations ........................................ 58
Control Parameters ............................................. 58
   Axial Pressure ............................................. 58
   Surface Velocity (RPM) ................................. 59
   Weld Time ................................................. 59
   Hold Time ............................................... 59
Initial Settings ............................................... 60
   Axial Pressure .......................................... 60
   RPM (Surface Velocity) ............................... 60
   Weld Time ............................................. 62
   Hold Time ............................................ 63
   Part Size ............................................. 63
Spin Welding Process

The formal definition of spin welding is “An assembly process in which thermoplastic parts with rotationally-symmetric mating surfaces are joined together under pressure using unidirectional circular motion. The heat generated during the rotational contact melts the plastic in the heat-affected zone forming a weld upon cooling.” Note that the parts themselves can be any shape, only the mating surfaces to be welded need to be circular.

The spin welding process is divided into five distinct phases as shown in Figure 7–1. In Phase I, the rotational friction generates heat. Frictional heating is intensified with both axial pressure and joint surface velocity. In Phase II, the friction results in abrasive forces which strip off surface roughness, generating wear particles causing the surfaces of the polymer to begin to melt. As the polymer reaches its crystalline melting point or glass transition temperature, it enters Phase III. This is an unsteady state in which the temperature quickly increases and viscous flow is initiated resulting in a large increase in melt thickness. This is accompanied by a sharp rise in the melt (weld) penetration velocity. Once the melting process is initiated, heat is then generated by internal friction within the molten region. This continues in Phase IV until a steady state equilibrium is reached and the penetration velocity stalls. In Phase IV, the heat loss through the wall and flash expelled approaches the heat being generated. Here the temperature of the molten layer remains relatively constant. Because plastics are poor conductors of heat, the surface heat is transferred slowly to the interior and much of it remains localized. At this point, the rotation is stopped and we enter Phase V where the molten material is allowed to cool under pressure for a short period called the Hold Time.

![Figure 7-1 Penetration Depth and Velocity as a Function of Time During the Five Phases of Spin Welding](image-url)
Material Considerations

Materials that can be friction (i.e. vibration) welded can also be joined with by spin welding. The semicrystalline thermoplastics are more readily joined using spin welding than ultrasonics. Using compatible polymers, spin welding is capable of making reliable hermetic seals. Far-field welding is easier with spin welding than with ultrasonic welding. Additional parts can be entrapped between the upper and lower pieces during spin welding.

Joining of dissimilar polymers is possible using the spin weld process although it generally produces lower strength weld joints. By designing the weld joint with an undercut, the polymer with the lower melting temperature will flow into the undercut, creating a mechanical union.

Material filler and surface contaminants (e.g. mold release agent) are two factors that will affect consistency and weld repeatability. Spin welding is more tolerant of contaminants than ultrasonic welding. Spin welding is also less affected by hygroscopic polymers, although they may still require special handling for critical applications. The moisture content can lead to bubble formation in the joint resulting in decreased weld strength.

Control Parameters

Axial Pressure

There are three primary process control variables that determine the weld penetration. They are the axial pressure on the weld joint, the surface velocity of the weld joint and the weld time. An increase in each yields an increase in weld penetration. The effects of pressure and velocity are also highly nonlinear. The axial pressure required is determined by the material strength and wall thickness (how much pressure the part can safely sustain), surface weld joint area and partially by the surface velocity. Larger joint areas require more pressure. Higher pressure not only increases the weld penetration depth, it also increases the penetration velocity. Mass reduction (i.e. a measure of the amount of wear particles and flash) is not significantly affected by increased pressure, especially at high rotation speeds. A slower surface velocity (i.e. small diameter weld joints) requires higher pressure.

NOTE

Common hygroscopic thermoplastics:
 ABS/Polycarbonate (Cycoloy)
 Polyoxyethylene (Acetal, Delrin)
 Polyamides (Nylon, Zytel)
 Polycarbonate (Lexan)
 Polycarbonate/Polyester (Xenoy)
 Polysulfone (Udel)
Higher axial pressure may also be required to force any contaminants or bubbles out of the weld joint. The combination of speed and pressure must be controlled but be high enough to cause melting at the interface as opposed to grinding.

**Surface Velocity (RPM)**

For a fixed rotational speed, surface velocity increases with weld joint diameter. For a fixed weld joint diameter, surface velocity increases with motor RPM. Smaller diameter parts therefore usually require more RPM than larger parts and typically cannot tolerate as much axial pressure. However, the same percentage change in axial pressure has a larger effect than the same percentage change in RPM in determining the time required to initiate weld formation and the depth to which the weld penetrates. The previous statement is a generalization, and is meant to imply that axial pressure has a greater effect than motor RPM. Mass reduction shows an almost exponential increase with rotational velocity.

**Weld Time**

Welding time is the third process variable. It is the time the axial pressure and surface velocity are applied to achieve the desired uniform weld penetration depth. Increasing the weld time results in an almost linear increase in weld penetration. Weld penetration beyond the critical threshold does not significantly increase weld strength. The total welding time is dependent upon loading pressure, rotational velocity and desired weld penetration depth. Once the desired weld penetration has been achieved, we want to stop the rotation as quickly as possible. Too long of a deceleration time will allow the polymer to solidify and subsequently shear, reducing the weld strength. Higher axial pressure may help stop the rotation sooner on large diameter parts.

**Hold Time**

During Phase V, a holding time allows the plastic to solidify before removing pressure from the joint. Larger weld joints take longer for the plastic to solidify due to the larger mass and poor thermal conductivity of plastic.
Initial Settings
The following sections are presented for informational purposes only and is in no way meant to serve as a rule or formula. The information is collected from publicly available books and papers. It is presented here to provide you with a general guideline for setting the initial parameters.

Axial Pressure
This is the most difficult parameter to estimate. You will require less pressure with an electric motor spin welder than with an inertial welder due to the inertial welder’s loss of kinetic energy. A rough estimate can be derived from a specific pressure of $1.7 \text{ MPa (1.7x10}^6 \text{ Nt–m}^{-2})$ of projected joint area. This translates to roughly 250 pounds per inch$^2$ of weld surface area (total wetted surface area). The servo spin welder uses a 2.5–inch diameter air cylinder to supply pressure and it has a boost factor of 4.9, so a pressure reading on the regulator of 50 psi translates to approximately 250 pounds of force. Again remember that the 250 pounds per square inch of weld surface area is only a starting estimate and differs from values used in inertial spin welders. Depending upon the joint design, your application may require 2x more or 0.5x less pressure. Axial pressure typically also has a larger effect on the weld initiation process than the RPM setting.

RPM (Surface Velocity)
Maximum weld strength occurs at an optimum pressure and speed. Higher rotation speeds decrease the weld initiation time, but to a lesser extent than axial pressure. This means that you will typically need to make larger percentage changes in motor speed to see a noticeable difference in the weld properties than you would in axial pressure. The basic expression commonly seen is:

\[
\pi \frac{D}{2} \times RPM = \frac{\pi D}{2} \times RPM
\]

where \( v \) is surface velocity (inch/sec)
\( \pi = 3.14 \)
\( D = \text{average diameter of the joint (inch)} \)
\( RPM = \text{motor rotation per minute} \)

The initial target for \( v \) is in the 360 to 600 inch/sec range. This corresponds to the common quoted values of 30 to
50 ft/sec. Surface velocities as low as 120 inch/sec (3 m/sec) have been used for parts with thin wall sections. Figure 7–2 is a plot of surface velocity (v) as a function of weld joint diameter (D) for five different RPM settings. You can use this graph to estimate the surface velocity (vertical axis), that various RPM settings will yield for a given part diameter (horizontal axis).

Note that we have converted all units to inches/second for consistency. Some graphs mix part diameter in inches with a surface velocity in feet/second. Be careful to compare graphs in the same units. Solving the previous expression for RPM gives us:

\[
RPM = \frac{60 \, v}{\pi \, D}
\]

![Figure 7–2](image-url)  
**Figure 7–2** Dependence of the Surface Velocity on the Weld Diameter at various RPMs
A plot of this expression is shown in Figure 7–3. Now we have $RPM$ plotted as a function of weld joint diameter ($D$) for eight different values of $v$ ranging from 120 to 960 inch/sec.

The generalization of RPM being a noncritical parameter applies only to motor drives. An inertial drive utilizes a flywheel’s kinetic energy which is a function of the square of its rotational velocity. Inertial drive units adjust the energy delivered by adjusting the flywheel’s speed and are therefore more sensitive to a change in rotational velocity.

**Weld Time**

Weld times are very application dependent but typically less than 2 seconds. Filler content may reduce the coefficient of friction. Softer plastics (except fluropolymers)
generally have higher coefficients of friction. This influences the weld initiation time. If you require a short weld time, it may be necessary to allocate part of the weld time to the deceleration time in order to achieve the desired weld penetration. Once the polymers reach Phase III, an increase in welding time does not significantly yield an increase in weld strength. Excessively long weld times may draw out reinforcing filler and realign the interchain bonds in the weld plane resulting in a weak axial weld joint. It may also lead to part distortion in extreme cases.

**Hold Time**

The hold time typically ranges from 1.0 to 3.0 seconds. Amorphous plastics will normally take longer to solidify than semicrystalline plastics. It is during the hold time that the axial pressure forces the parts together until the plastic solidifies. For large parts, it may be upwards of 5 seconds.

**Part Size**

Machine model selection will mostly depend on the weld diameter of the parts. See the table below for approximate guidelines.

<table>
<thead>
<tr>
<th>Weld Diameter Range (in)</th>
<th>Machine Model</th>
<th>Peak RPM</th>
</tr>
</thead>
<tbody>
<tr>
<td>up to 1.5</td>
<td>SVT042R</td>
<td>4000</td>
</tr>
<tr>
<td>.5 to 4</td>
<td>SVT032R</td>
<td>3000</td>
</tr>
<tr>
<td>4 to 7</td>
<td>SVT012R</td>
<td>750</td>
</tr>
</tbody>
</table>

*Table 7–I  Machine Selection Based on Parts Weld Diameter*

For diameters under 4 inches, the SVT032R model is recommended due to its torque capacity. The SVT042R model is used where high RPM is required.

Please contact the Dukane Applications Laboratory (see Section 11) for a recommendation concerning your specific application.
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SECTION 8

Dukane Servo Spin Welder Utility

Introduction .................................................. 67
Hardware and Software Requirements .............. 67
Installation, Start-up and Cable Connections ........ 67
Parts Data ...................................................... 68
Torque Data ...................................................... 69
Servo Tuning Database ..................................... 70
Machine Debugging Messages ......................... 70
Introduction

The DUKANE Servo Spin Welder Utility is a Windows application designed for use with the Servo Welder. It contains features for obtaining data from the welder, importing the servo tuning database, and obtaining messages from the machine that may be useful in troubleshooting.

Hardware and Software Requirements

The utility requires a PC or laptop running a Windows XP or Windows 2000 operating system. A straight DB-9 cable is needed to interface to the Servo Welder. The cable must be terminated with a male connector where it connects to the welder.

Installation, Startup, and Cable Connections

To install the program, run the setup.exe located in the Dukane Servo Spin Utility Installer folder on the CD supplied with the welder and follow the prompts on the screen. Once installed, run the program. It can be accessed through:

Start Menu -> All Programs -> Dukane -> Spin Welder Utility

(located above the pressure regulator) and a serial port or a USB-to-serial converter. If a converter is to be used, the serial communications settings should be set as follows:

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baud Rate</td>
<td>57600</td>
</tr>
<tr>
<td>Data Bits</td>
<td>8</td>
</tr>
<tr>
<td>Parity</td>
<td>NONE</td>
</tr>
<tr>
<td>Stop Bits</td>
<td>1</td>
</tr>
<tr>
<td>Flow Control</td>
<td>Xon / Xoff</td>
</tr>
</tbody>
</table>

Table 8–1 Serial Communications Settings

The Utility software uses the COM1 port on the PC. Ensure that the serial cable is connected to COM1, or that the USB-to-serial converter is assigned to COM1 (for USB adapters, the assigned COM port can be checked/modified using Windows Device Manager).

Parts Data

Upon startup, the screen will appear as shown in Figure 8–1, with the Parts tab selected by default. The following is a description of the items on the Parts tab:
Part Data
This area contains a series of lines of part data, one line per part. This data is displayed after each cycle if the Data Export option in the System Setup screen on the welder is selected (see Figure 5-22). The data is comma delimited with the fields given in the order as follows:

1. Part number
2. Test result number
3. Test result symbol
4. Date
5. Time
6. Weld time (sec.)
7. Number of weld revolutions
8. Weld energy (Joules)
9. Peak motor RPM
10. Peak motor torque (% of motor max.)
11. Weld orientation (degrees)
12. Stroke time (sec.)
13. Cycle time (sec.)

CLEAR
Clears parts data from screen.

WRITE
Writes parts data from the screen to a file on the computer. After pressing this button, enter the name of the file where to store the data. Add a .txt or .csv extension to the end of the file name as the generated file is in text format. Saving the file with a .csv extension will allow it to be opened directly with Microsoft Excel.

File Write
Sets the write behavior for an existing file. Write Over overwrites an existing file, while Add On appends data to the end of the file.

EXIT
Exits program.

Torque Data
The torque data is obtained by activating the Torque tab.
**Torque Plot**
After a weld cycle, pressing the Export Torque button located in the TOOLS -> UTILITIES menu on the welder sends the motor torque data to the computer. Please note that this data is in percent of the peak motor torque. The maximum motor torques for the welders are:

<table>
<thead>
<tr>
<th>Model</th>
<th>Maximum Torque (lb *ft (Nm))</th>
</tr>
</thead>
<tbody>
<tr>
<td>SVT012R</td>
<td>47 (64)</td>
</tr>
<tr>
<td>SVT032R</td>
<td>16 (21)</td>
</tr>
<tr>
<td>SVT042R</td>
<td>10 (14)</td>
</tr>
</tbody>
</table>

**Table 8–II**  Maximum Motor Torque

**Torque Data**
The torque data values are displayed in the box. The first line of this data is a header row, containing the number of points collected, the time interval between the points in milliseconds, and the torque trigger value.

**Setpoint %**
If torque triggering is activated, the Torque Trigger value is displayed in this box.

**WRITE**
Writes the torque data to a file. Add a `.txt` or `.csv` extension to the end of the file name as the generated file is in text format.
Servo Tuning Database

The servo motor tuning database contains data necessary for proper operation of the machine for different upper tool sizes. It can be imported into the welder by using the Servo tab.

The procedure for importing the database is as follows:
1. Click on the **SEND** button.
2. Find, but do not hit **OK** yet, the database file (this is a .txt file provided by DUKANE).
3. On welder, navigate to TOOLS -> SYSTEM SETUP.
4. Press the Import Servo DB button.
5. Be prepared to press the Start Import button on the welder, and then the **OK** button on the computer within 8 seconds.
6. Perform the action in step 5.

While the database is being transferred, the Sending indicator will be illuminated (bright green), and the Sent box will be filled with the data being transferred to the welder. When the transfer completes successfully, the Sending indicator will return to a dark green color.

The Param File box shows the name of the file being transferred, and the Bytes box shows how many bytes of data have been transferred.

Machine Debugging Messages

The Info box on the Debug Tab displays debugging information useful in troubleshooting the welder. This data is displayed if the machine is put in Debug mode. This is done by going to the TOOLS -> SYSTEM SETUP screen on the welder and actuating the right side optical switch only – the characters DB will appear on the display screen. To turn off the Debug mode, go to the TOOLS -> SYSTEM SETUP screen and actuate the left side optical switch only. The DB indicator will disappear.

**CLEAR**
Clears the debugging information from the computer screen.

**WRITE**
Writes the debugging information to a file. Add a .txt or .csv extension to the end of the file name as the generated file is in text format.
SECTION 9

Troubleshooting

Welding Process ............................... 73
Material Choice ................................. 73
Parameter Effects .............................. 73
Welder Troubleshooting ...................... 74
  Pneumatics ................................. 74
  Mechanical ................................. 74
  Electrical Power ............................ 74
  Base Interface Cable ....................... 74
  Troubleshooting Table ..................... 75
  Machine Display Messages ............... 76-77
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Welding Process

Material Choices
A family of thermoplastics is usually compatible with its own type and sometimes with other types. Characteristics to consider are the melting point and coefficient of linear expansion. Even members of the same family may cause problems due to differences in the manufacturing process. For example, an extruded Polyethylene (PE) piece may not weld as well to an injection molded PE piece as it would to another extruded PE piece.

Parameter Effects

Surface Velocity
Insufficient surface velocity may not allow the plastic to reach its melting temperature. Instead, it may simply erode away part of the material and stick by a clawing effect. The surface velocity is determined by both the weld joint diameter and the motor speed.

Axial Pressure
In conjunction with surface velocity, axial pressure determines whether the plastic reaches the melting temperature. Both speed and pressure are needed to produce sufficient frictional heating. Excessive pressure may cause one part to scrape away part of the surface and produce a lot of flash but insufficient melt volume.

Weld Time
Insufficient welding time may not allow the melt to propagate far enough into the plastic to achieve the necessary melt volume and the required weld strength.

Hold Time
Insufficient holding time may not allow the plastic enough time to solidify and form a strong permanent bond.

Weld Process Troubleshooting
Table 9-I lists some potential problems with the weld process and suggested solutions.
Welder Troubleshooting

Pneumatics
The air cylinder requires a clean, dry supply of compressed air at 100 psi (6.9 At). Make sure the air lockout device is passing air. The slide bar should be in a position so that the hole is not visible. When the hole for a lockout is visible, the device is isolating the compressed air from the welder. If you have a pre-filter, make sure it is clean and functioning properly.

Mechanical
The part fixture should be securely mounted perpendicular to, and centered under the spin axis.

Electrical Power
Make sure the AC power cord is plugged in to a 240 VAC, 1–phase electrical outlet with a 20 Ampere capacity. Check that the circuit is live. Also refer to Electrical Safety in Section 2.

Base Interface Cable
The cable must be plugged in to the base and the back of the press. If the cable is not plugged in, or has a fault, the base switches will not initiate any action. Also the ABORT and POWER indicators on the base status display will not function.

Machine Display
Messages
A list of all machine messages, their meaning, and possible solutions to problems are given in Table 9-II.
### Problem | Symptom | Possible Cause | Recommended Solution
--- | --- | --- | ---
**Overwelding** | Excessive Weld Flash | Weld Time Too Long | Reduce Weld Time.
 | Final Dimensions Of Component Are Too Small | Weld Distance Too Large | Reduce Weld Distance.
 | Incorrect Flash Trap Design | Evaluate and Correct Flash Trap Design.
**Underwelding** | Low Weld Strength | Weld Time Too Short | Increase Weld Time.
 | Final Dimensions Of Component Are Too Large | Weld Distance Too Small | Increase Weld Distance.
 | Material Difficult To Weld Due To Low Friction Coefficient | Degrease Joint Interface To Remove Mold Release Agent. Consider Changing Material (i.e. avoid PTFE).
**Nonuniform Or Inconsistent Weld Joints** | Excessive Weld Flash | Warped Parts | Check Part Dimensions.
 | Low Weld Strength | Uneven Weld Interface | Check Molding Process Conditions.
 | Failure When Leak Tested | Fixture and Part Are Not Parallel | Shim Fixture Where Necessary. Check That Tooling Is True To Table.
 | Part Failure In Service | Poor Part Alignment Of Parts In Fixture | Redimension Parts. Improve Part Tolerance Caused By Cavity Variations In Multiple Cavity Molds.
 | Insufficient Fixture Support | Insufficient Fixture Support | Check For Parts Shifting During Welding. Provide Provisions For Alignment In Mating Parts.
 | Walls Are Flexing During Welding | Excessive Filler or Uneven Distribution | Redesign Parts With Reinforcing Ribs and/or Tongue–And–Groove Joints.
 | Moisture in Parts | Moisture in Parts | Prevent Moisture Absorption After Molding Prior to Welding. Dry Parts Before Welding.
**Final Part Orientation Different from Programmed Orientation** | Parts Not Aligned Properly | Low Deceleration | Increase Deceleration As High As Possible. (If Deceleration Is Set Too High, Machine will Fault With Spin Tracking Errors.)
 | Excessive Cylinder Pressure | Reduce Pressure as Low as Possible Without Affecting Weld Quality
 | Insufficient Hydraulic Speed Control Damping | Increase Hydraulic Speed Control Resistance
 | Poor Tuning | Enter Tool Inertia Correctly into Setup. Verify Tool Inertia is Correct. Contact DUKANE for Special Tuning Requirements
 | Parts Not Held Properly by Tool or Fixture | Ensure Tooling Does Not Allow Excessive Part Play and Is Not Worn Out.

Table 9–I  Welding Process Troubleshooting
### INSTRUCTIONS

Press both RUN SWITCHES to reset machine.

Resetting of machine at startup or recovery requires the activation of both optical switches on base.

### MACHINE FAULTS

<table>
<thead>
<tr>
<th>MESSAGE</th>
<th>DESCRIPTION</th>
<th>CAUSE</th>
<th>POSSIBLE SOLUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Press both RUN SWITCHES to reset machine.</td>
<td>Resetting of machine at startup or recovery requires the activation of both optical switches on base.</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

### MACHINE FAULTS

<table>
<thead>
<tr>
<th>MESSAGE</th>
<th>DESCRIPTION</th>
<th>CAUSE</th>
<th>POSSIBLE SOLUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Home index edge not found.</td>
<td>Servo motor internal index pulse not detected</td>
<td>Possible servo hardware failure</td>
<td>Restart machine; if fault persists, contact DUKANE service</td>
</tr>
<tr>
<td>Lower part not detected.</td>
<td>Part presence sensor did not detect part</td>
<td>1. Part not present 2. Problem with sensor</td>
<td>1. Ensure part is present 2. Troubleshoot sensing components</td>
</tr>
<tr>
<td>More than one of TopOfStroke, Trigger, or EndWeld ON</td>
<td>Control system has detected that more than one of these switches is turned ON at the same time</td>
<td>Switches are not set properly</td>
<td>1. Lower Pre Trigger switch if it is close to the Top of Stroke 2. Adjust switch positions so that no more than one of the switches is ON at the same time</td>
</tr>
<tr>
<td>Operator E-Stop</td>
<td>E-stop activated</td>
<td>Operator pressed E-stop switch</td>
<td>Reset E-stop switch then reset machine</td>
</tr>
<tr>
<td>Part pickup not detected</td>
<td>Sensor for upper tool vacuum not activated when expected</td>
<td>1. Loss of vacuum between part and tool 2. No part present to pick up</td>
<td>1. Ensure part is present 2. Troubleshoot sensing components</td>
</tr>
<tr>
<td>RUN SWITCH(ES) not held for process</td>
<td>Weld cycle aborted since the optical base switches were released during the process</td>
<td>The optical base switches were released before the motor stopped spinning</td>
<td>Once weld cycle is started, ensure switches remain activated until the end of Hold Time</td>
</tr>
<tr>
<td>Servo CPU no Idle before Run</td>
<td>Motor controller error</td>
<td>Internal machine error</td>
<td>Contact DUKANE service</td>
</tr>
<tr>
<td>Servo CPU program error</td>
<td>Motor controller error</td>
<td>Internal machine error</td>
<td>Contact DUKANE service</td>
</tr>
<tr>
<td>Servo database import failed</td>
<td>Servo motor tuning database import failed</td>
<td>1. Cable problem 2. Import procedure problem</td>
<td>1. Check that the correct cable is used and that it is securely connected. 2. Follow procedure described in this manual</td>
</tr>
<tr>
<td>Servo param select by inertia failed</td>
<td>Servo tuning data not found for the tooling inertia entered</td>
<td>1. Tooling inertia entered is outside allowable range 2. Servo tuning database is missing</td>
<td>1. Enter tooling inertia within limits stated on the machine screen 2. Import servo tuning database</td>
</tr>
<tr>
<td>Slide In timeout</td>
<td>Slide did not move to the commanded position within the allowable time</td>
<td>1. Air pressure to slide too low 2. Slide limit switch improperly positioned 3. Slide jammed</td>
<td>1. Increase air pressure 2. Adjust slide switch position 3. Ensure slide can move freely</td>
</tr>
<tr>
<td>Slide Out timeout</td>
<td>see Slide In timeout fault</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Spin aborted</td>
<td>Weld cycle was aborted</td>
<td>Internal machine error</td>
<td>Contact DUKANE service</td>
</tr>
<tr>
<td>Spin amplifier faulted</td>
<td>There is a problem with the servo amplifier</td>
<td>1. Excessive air pressure 2. Improper tuning 3. Amplifier too hot</td>
<td>1. Reduce air pressure 2. Ensure correct tool inertia is entered in touch screen 3. a) Reduce duty cycle of machine b) Ensure temperature around machine is within operational limits</td>
</tr>
<tr>
<td>Spin at travel limit</td>
<td>Number of servo motor rotations has exceeded controller counting capability</td>
<td>Weld time or number of rotations too large, or position of End of Weld switch too low</td>
<td>Reduce weld time or number of rotations, or move End of Weld switch up to reduce number of weld rotations</td>
</tr>
<tr>
<td>Spin motor not on</td>
<td>Servo amplifier does not power up</td>
<td>Possible sevo hardware failure</td>
<td>Restart machine; if fault persists, contact DUKANE service</td>
</tr>
<tr>
<td>Spin tracking error</td>
<td>The servo motor was not able to execute the spinning motion generated by the setup parameters</td>
<td>1. Excessive deceleration 2. Excessive air pressure 3. Inadequate Hydraulic Speed Control resistance 4. Improper tuning</td>
<td>1. Reduce deceleration 2. Reduce air pressure 3. Increase Hydraulic Speed Control resistance 4. Ensure correct tool inertia is entered in touch screen</td>
</tr>
<tr>
<td>Timeout on servo CPU Thread 1(thrd1)</td>
<td>Motor controller error</td>
<td>Internal machine error</td>
<td>Contact DUKANE service</td>
</tr>
<tr>
<td>Timeout on servo response to command start</td>
<td>Servo system communication error</td>
<td>Internal machine error</td>
<td>Contact DUKANE service</td>
</tr>
</tbody>
</table>

Table continued on next page.
### Machine Display Messages

<table>
<thead>
<tr>
<th>MESSAGE</th>
<th>DESCRIPTION</th>
<th>CAUSE</th>
<th>POSSIBLE SOLUTION</th>
</tr>
</thead>
</table>
| Tool Extend timeout to Trigger   | Machine head did not leave Top of Stroke position at start of cycle within timeout | 1. Air pressure too low  
2. Head movement obstructed | 1. Increase air pressure  
2. Remove pressure from machine and inspect that the head is able to move up and down freely |
| Tool Retract timeout            | Machine head did not return to Top of Stroke position within timeout        | 1. Loss of air pressure  
2. Head movement obstructed | 1. Ensure air pressure is not lost  
2. Remove pressure from machine and inspect that the head is able to move up and down freely |
| Unknown Servo operation command | Motor controller error                                                      | Internal machine error                                                | Contact DUKANE service                                                              |

#### PROCESS ERRORS

- **Spin stop before spin start**
  - Machine was commanded to stop cycle before motor reached full speed
    - 1. End of Weld switch higher than Pre Trigger switch
    - 2. End of Weld switch too close to Pre Trigger switch
    - 3. Inadequate Hydraulic Speed Control resistance
    - 4. Air pressure too high
    - 5. Flow Control open too far
    - 1 & 2 Lower End of Weld switch to be below Pre Trigger switch by an amount that will give motor enough time to reach the programmed RPM
    - 3. Increase Hydraulic Speed Control resistance
    - 4. Decrease air pressure
    - 5. Restrict Flow Control
- **Timeout starting spin**
  - The Pre Trigger switch was not activated within the allowable timeout
    - 1. Air pressure too low
    - 2. Pre Trigger position too low
    - 1. Increase air pressure  
2. Raise position of Pre Trigger switch
- **Timeout torque sense**
  - The torque trigger was not detected within the allowable time
    - 1. Torque trigger value set too high
    - 2. Motor did not reach full speed
    - 1. Reduce torque trigger value.  
2. Ensure that the motor has enough time to reach full speed (programmed RPM) before there is contact between the parts to be welded
- **Weld aborted by CycleTime limit**
  - Weld cycle stopped because cycle time exceeded programmed limit
    - 1. Weld process problem
    - 2. Limits too narrow for weld process
    - 1. Check parts to be welded, fixturing, etc.  
2. If practical, widen process limit window
- **Weld aborted by Rotate limit**
  - Weld cycle stopped because number of revolutions exceeded programmed limit
    - 1. Weld process problem
    - 2. Limits too narrow for weld process
    - 1. Check parts to be welded, fixturing, etc.  
2. If practical, widen process limit window
- **Weld aborted by RPM limit**
  - Weld cycle stopped because motor speed was outside programmed limits
    - 1. Weld process problem
    - 2. Limits too narrow for weld process
    - 1. Check parts to be welded, fixturing, etc.  
2. If practical, widen process limit window
- **Weld aborted by Torque limit**
  - Weld cycle stopped because motor torque was outside programmed limits
    - 1. Weld process problem
    - 2. Limits too narrow for weld process
    - 1. Check parts to be welded, fixturing, etc.  
2. If practical, widen process limit window
- **Weld ended at time limit**
  - Weld did not complete within the specified time limit when welding in the End Switch mode
    - 1. Timeout too low
    - 2. Setup problem
    - 1. Increase timeout value
    - 2. Check process parameters
- **Weld ended by switch**
  - The End of Weld switch was turned ON when welding in the Time or Rotations mode
    - End of Weld switch positioned too high
    - Lower switch position
- **Weld duration too short**
  - Weld duration generated by programmed parameters is too short
    - 1. Weld Time too short
    - 2. Number of Weld Rotations too low
    - 3. Deceleration too low
    - NOTE: the time for deceleration is counted as part of the total weld time or number of rotations
    - 1. Increase Weld Time  
2. Increase number of Weld Rotations  
3. Increase Deceleration

#### WARNINGS

- **Battery life limit, press Continue**
  - The batteries in the PLC and touch screen need to be replaced
    - Batteries have not been replaced in approximately 5 years.
    - Replace both the PLC battery (Dukane Part #136-26) and touch screen (HMI) battery (Dukane Part #136-28): Contact DUKANE service for information on battery replacement
- **Enable Run by retracting to Top Of Stroke**
  - Machine head is not at Top of Stroke
    - 1. No air pressure
    - 2. Head slide motion obstructed
    - 1. ensure proper air supply  
2. remove pressure from machine and inspect that the slide is able to move up and down freely
- **Lower limit is greater than upper limit**
  - Lower process limit is greater than Upper process limit
    - Improper process limit values entered
    - Re-enter values
- **Weld duration set too short**
  - Weld duration generated by programmed parameters is too short
    - 4. Weld Time too short
    - 5. Number of Weld Rotations too low
    - 6. Deceleration too low
    - NOTE: the time for deceleration is counted as part of the total weld time or number of rotations
    - 1. Increase Weld Time  
2. Increase number of Weld Rotations  
3. Increase Deceleration
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SECTION 10

Maintenance

Touch Screen Display
Cleaning
Display
AC Power Cord
Weekly Maintenance
Compressed Air Filter
Visual Inspection
Lubricate Slide
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Touch Screen Display Cleaning

Do not use any solvents or abrasive cleaners on the display window. Apply a small amount of computer cleaner to a soft towel first. Clean the panel with the moistened towel. Do not spray or apply a cleaner directly to the interface panel.

Remove grease by rubbing lightly with isopropyl alcohol. Afterward, provide a final cleaning using a mild detergent and rinse with clean water.

Display

Do not use any sharp objects on the display. It should not be touched unnecessarily. It is lit by a long-life LED backlight and should not require any maintenance other than occasional cleaning.

AC Power Cord

The AC power cord should be kept in good condition and free from any cuts and abrasions. The AC plug should be straight with no bent prongs.

CAUTION

Never use anything sharp on the touch screen. Only use your finger. The screen is intended for industrial use, but can be damaged by scratching or puncturing.

Use only a damp (not wet), soft cloth to clean the display. Never spray any liquid directly on the screen. Do not attempt to clean the screen with any solvents.
Weekly Maintenance
Compressed Air Filter

The air filter is shown in Figure 10–1. The clear bubble window at the top normally shows a green indicator when the filter (5 micron element) is functioning properly. When the filter element needs replacement, the indicator turns red. Under normal operating conditions, the filter should not need to be changed for one to two years. Replacement filters are available from Norgren (Part No. 5925–03). Before attempting to change the filter, turn off the compressed air supply, and engage the pneumatic lockout so the locking hole is visible. To change the filter, twist the clear filter housing one-quarter turn to the left, then pull down. Remove the old filter and install the new one. Replace the filter housing by pushing up until the housing is fully seated, and then twist one-quarter turn to the right.

The filter has an external valve at the bottom of the housing to drain any water that may accumulate. There is a fitting at the bottom of the housing (1/8” NPT Male thread) to attach a drain hose to direct the water away from the press base.

Visual Inspection

Visually inspect the cables and air lines once a week. Replace or repair any damaged cables, air lines or fittings.

Lubricate Slide

Lubricate the unpainted area on the front of the support column as needed with conventional grease.

WARNING

Never attempt to remove the filter housing while the compressed air is on. Turn off the compressed air supply, and disconnect the air line from the filter inlet either physically or by using the air lockout device.
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Contacting Dukane

Identify Equipment

When contacting Dukane about a service–related problem, be prepared to give the following information:

- Model number, line voltage and serial number
- Fault/error indicators from the LCD display
- Software version (Press INFO. With pointer at System Information, press ENTER to get this data.)
- Problem description and steps taken to resolve it

Many problems can be solved over the telephone, so it is best to call from a telephone located near the equipment.

Intelligent Assembly Solutions

Mailing Address: Dukane Ultrasonics
2900 Dukane Drive
St. Charles, IL 60174 USA

Phone: (630) 797–4900
E-mail: ussales@dukane.com
Fax:
  Main (630) 797–4949
  Service & Parts (630) 584–0796

Website

The website has information about our products, processes, solutions, and technical data. Downloads are available for many kinds of literature.

Here is the address for the main website:
www.dukane.com/us/

You can locate your local representative at:
www.dukane.com/us/sales/intsales.htm
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SECTION 12

Specifications

Tooling Specifications ......................................... .89
Weight ............................................................... .89
Power Requirements .............................................. .89
   AC Power ........................................................ .89
   Compressed Air ............................................... .89
Operating Environment .......................................... .89
Dimensions & 5-View Drawing ............................... .90
Identification Number ............................................ .91
Regulatory Agency Compliance ............................... .91
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Tooling Specifications

Tooling Size
Refer to Table 5-I for maximum tooling sizes.

Machine Weight
The Servo Spin Welder weighs approximately 400 lbs. (182 kg). It should be mounted on a table or bench capable of supporting 650 lbs. (295 kg) to accommodate the additional force imposed by the vertical movement of the motor and slide during the spin welding operation.

Use mechanical means such as a forklift or hoist to place the servo spin welder on its work bench. There are two 3/4 inch lifting eyes located at the top of the column (see Figure 3–8) for a lifting ring or strap.

Power Requirements

AC Power
The Servo Spin Welder requires a 240 VAC 1–phase outlet rated at 20 Amps. All welder models use the same power cord and plug. The AC power cord has a 240 VAC, single phase plug which is designed for a NEMA 6–20R configuration wall receptacle shown in Figure 12–1.

Compressed Air
The Servo Spin Welder requires a supply of clean, dry, compressed air at 75 to 100 psi (4.9 to 7.0 kg/cm²).

Operating Environment
Operate the Servo Spin Welder within these guidelines:
Temperature: 40°F to 95°F (+5°C to +35°C)
Altitude: 4570 m (15,000 ft)
Air Particulates: Keep the Servo Spin Welder dry. Minimize exposure to moisture, dust, dirt, smoke and mold.
Humidity: 5% to 95% Non-condensing @ +5°C to +30°C
Figure 12–2  Servo Spin Welder Dimensions
NOTE: All specifications are subject to change without notice. The specifications listed are current at the time of publication.
Identification Number
Welder Model & Serial Number
The serial number and model number tag for the Servo Spin Welder are located either on the covers on the back of the machine or on the underside of the motor mounting plate just above the tooling hub.

Regulatory Agency Compliance

FCC
The equipment complies with the following Federal Communications Commission regulations.


CE Marking
This mark on your equipment certifies that it meets the requirements of the EU (European Union) concerning interference causing equipment regulations. CE stands for Conformité Européenne (European Conformity). The equipment complies with the following CE requirements.

- The EMC Directive 2004/108/EC for Heavy Industrial —
  EN 61000-6-4: 2001
  EN 55011: 2003
  EN 61000-6-2: 2001
  EN61000-4-2
  EN61000-4-3
  EN61000-4-4
  EN61000-4-5
  EN61000-4-6
  EN61000-4-8
  EN61000-4-11

- The Low Voltage Directive 2006/95/EC.

- The Machinery Directive 2006/42/EC.
  EN 60204: 2006

CAUTION
DO NOT make any modifications to the Servo Spin Welder. The changes may result in violating one or more regulations under which this equipment is manufactured.

IP Rating
The iQ generator has an IP (International Protection) rating from the IEC (International Electrotechnical Commission).

The rating is IP2X, in compliance with finger-safe industry standards.
Appendices

Appendix A - Connector Pinouts ................. 95
Appendix B - Tooling ................................ 99
Appendix C - Optional Features ................. 101
Appendix D - Additional Machine Settings .... 103
Appendix E - Batteries and Software Retention ... 104
Appendix F - List of Figures ...................... 105
Appendix G - List of Tables ...................... 108
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Appendix A

Connector Pinouts

Base Interface
The base interface connector is a DB 9–socket connector. The cable connection is shown in Figure 3–7. A closeup of the base connector is shown in Figure 2–2, and a closeup of the rear thruster connector is shown in Figure 3–9. The pin numbers for the connector are shown in Figure A–1. The pin assignments and signal descriptions are given in Table A–I.

A schematic of the Operate and Abort switches connected through the base Interface Connector is shown in Figure A–5.

User I/O Connector
The User I/O connector is a HD–15 connector located directly above the base interface connector on the rear of the thruster. The connector is shown in Figure 3–9. This connector provides access to signals for interfacing to custom automation equipment. The pin numbers for the connector are shown in Figure A–2. The pin assignments and signal descriptions are given in Table A–II.

Input signals, such as Vacuum On Sense, can be configured as sourcing or sinking using 24 VDC and Input Common. Outputs, such as Ready Status, are provided through relays rated at 1A@24VDC.
Table A-II Pin Assignments and Signal Description for the User I/O Connector

<table>
<thead>
<tr>
<th>Pin</th>
<th>Signal Description</th>
<th>Functionality</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Top-of-Stroke Status Output</td>
<td>ON when press is at Top-of Stroke position</td>
</tr>
<tr>
<td>2</td>
<td>Vacuum On Output, Part Pickup</td>
<td>ON when welder calls for vacuum to be turned ON with Part Pickup mode enabled</td>
</tr>
<tr>
<td>3</td>
<td>Bad Part Status Output</td>
<td>ON when weld process is outside defined limits with Bad option enabled</td>
</tr>
<tr>
<td>4</td>
<td>Suspect Part Status Output</td>
<td>ON when weld process is outside defined limits with Suspect option enabled</td>
</tr>
<tr>
<td>5</td>
<td>Vacuum On Output, No Part Pickup</td>
<td>ON when welder calls for vacuum to be turned ON with Part Pickup mode disabled (signal is deactivated if idle time between cycles is more than 5 minutes; one of the RUN SWITCHES must be turned on to reactivate signal)</td>
</tr>
<tr>
<td>6</td>
<td>Ready Status Output</td>
<td>ON when welder is ready to initiate a weld cycle</td>
</tr>
<tr>
<td>7</td>
<td>Output Common</td>
<td>Output Common connection</td>
</tr>
<tr>
<td>8</td>
<td>Fixture Clamp 1 (Right) Output</td>
<td>Function depends on configuration:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Without slide or In/Out slide: ON at start of cycle; OFF at end of cycle.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>With Left/Right slide: ON at start of cycle when slide is command-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ed to move to In (right) position; OFF at the end of cycle.</td>
</tr>
<tr>
<td>9</td>
<td>Fixture Clamp 2 (Left Output)</td>
<td>Function depends on configuration:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Without slide or In/Out slide: not used.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>With Left/Right slide: ON at start of cycle when slide is command-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ed to move to Out (left) position; OFF at the end of cycle.</td>
</tr>
<tr>
<td>10</td>
<td>Spare Output 2</td>
<td>Not Used</td>
</tr>
<tr>
<td>11</td>
<td>Spare Output 1</td>
<td>Not Used</td>
</tr>
<tr>
<td>12</td>
<td>Vacuum On Sense Input</td>
<td>Activate when sufficient vacuum in upper tool has been detected</td>
</tr>
<tr>
<td>13</td>
<td>Automation Start Input</td>
<td>Activate to initiate a weld cycle (500 ms min.) with Start Type set to</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Automation</td>
</tr>
<tr>
<td>14</td>
<td>Input Common</td>
<td>Input Common Connection</td>
</tr>
<tr>
<td>15</td>
<td>(No Connection)</td>
<td>------</td>
</tr>
</tbody>
</table>

**Slide Kit Connector**

The Slide kit interface is a round 16-pin connector located directly to the right of the base interface connector on the rear of the thruster. The servo spin welder is prewired to accept a slide kit without any modification or reprogramming of the press. The connector is shown in Figure 3–9. The connector will interface to a Left/Right or an In/Out slide kit, and provides activation signals to extend and retract the slide table as well as readouts of the table position switches. It also provides an input for a signal from a part presence sensor. The pin numbers for the connector are shown in Figure A–3. The pin assignments and signal descriptions are given in Table A-III.
Appendix A
Connector Pinouts

<table>
<thead>
<tr>
<th>Pin</th>
<th>Signal Description</th>
<th>Functionality</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ground</td>
<td>Ground connection</td>
</tr>
<tr>
<td>2</td>
<td>(No Connection)</td>
<td>-----</td>
</tr>
<tr>
<td>3</td>
<td>Slide Out Sense (Left) Input</td>
<td>Activate when slide is in Out (Left) position by connecting to Ground (direct connection to PLC)</td>
</tr>
<tr>
<td>4</td>
<td>Output Common</td>
<td>Output common connection</td>
</tr>
<tr>
<td>5</td>
<td>Top-of-Stroke Output (Closed at TOS)</td>
<td>ON when press is at Top-of Stroke position (uses Output Common)</td>
</tr>
<tr>
<td>6</td>
<td>Slide In Sense (Right) Input</td>
<td>Activate when slide is in In (Right) position by connecting to Ground (direct connection to PLC)</td>
</tr>
<tr>
<td>7</td>
<td>In/Out Slide Identification Input</td>
<td>Activate to designate connected slide as In/Out type (ensure Pin 8 is disconnected) by connecting to Ground (direct connection to PLC)</td>
</tr>
<tr>
<td>8</td>
<td>Left/Right Slide Identification Input</td>
<td>Activate to designate connected slide as Left/Right type (ensure Pin 7 is disconnected) by connecting to Ground (direct connection to PLC)</td>
</tr>
<tr>
<td>9</td>
<td>Part Presence Sensor Input</td>
<td>Activate when part presence is sensed by connecting to Ground (direct connection to PLC)</td>
</tr>
<tr>
<td>10</td>
<td>Ground</td>
<td>Ground connection</td>
</tr>
<tr>
<td>11</td>
<td>Slide In (Right) Output</td>
<td>ON when welder calls for slide to move to the In (Right) position (connected to Ground when ON; direct connection to PLC)</td>
</tr>
<tr>
<td>12</td>
<td>Slide Home Status Output</td>
<td>ON when slide is in Home position (connected to Ground when ON; direct connection to PLC) NOTE: home slide position is Out (left)</td>
</tr>
<tr>
<td>13</td>
<td>Ready Status Output</td>
<td>ON when welder is ready to initiate a weld cycle (uses Output Common)</td>
</tr>
<tr>
<td>14</td>
<td>Slide Out (Left) Output</td>
<td>ON when welder calls for slide to move to the Out (Left) Position (connected to Ground when ON; direct connection to PLC)</td>
</tr>
<tr>
<td>15</td>
<td>Ground</td>
<td>Ground connection</td>
</tr>
<tr>
<td>16</td>
<td>+24V DC Switched (Power OFF when Abort switch pushed)</td>
<td>+24V DC switched connection</td>
</tr>
</tbody>
</table>

Table A-III  Pin Assignments and Signal Description for the Slide Kit Connector

Data I/O Connector

The computer interface connector is identified in Figure 4–4 and 5–21. It provides a computer connection to export part data, export part torque profiles and to import the servo driver parameter database. The pin numbers for the connector are shown in Figure A–4.

Automation Wiring

If the Servo Spin Welder will be used in Automation mode, the signals normally generated by the optical switches and abort switch have to be reproduced. Figure A-6 shows a wiring diagram and a description of the required signals.
Appendix A  Connector Pinouts

**Figure A–5** Schematic of Operate and Abort Switches

**Figure A–6** Wiring for Automation

<table>
<thead>
<tr>
<th>PIN #</th>
<th>SIGNAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>OPTO SWITCH 1</td>
</tr>
<tr>
<td>2</td>
<td>OPTO SWITCH 2</td>
</tr>
<tr>
<td>3</td>
<td>+24VDC SWITCHED</td>
</tr>
<tr>
<td>4</td>
<td>ABORT INPUT</td>
</tr>
<tr>
<td>5</td>
<td>GND</td>
</tr>
<tr>
<td>6</td>
<td>GND</td>
</tr>
<tr>
<td>7</td>
<td>GND</td>
</tr>
<tr>
<td>8</td>
<td>AUTOMATION INPUT</td>
</tr>
<tr>
<td>9</td>
<td>+24VDC</td>
</tr>
</tbody>
</table>

**SWITCH DESIGNATIONS**

<table>
<thead>
<tr>
<th>SWITCH</th>
<th>FUNCTION</th>
<th>USE</th>
<th>SWITCH CURRENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>SW1</td>
<td>MACHINE HOMING</td>
<td>CLOSE FOR MINIMUM OF 10 SECONDS TO HOME MACHINE AT STARTUP OR AFTER FAULT RESET (NOTE: ABORT SWITCH (SW2) MUST BE IN POSITION SHOWN TO HOME MACHINE)</td>
<td>&lt; 20 mA</td>
</tr>
<tr>
<td>SW2</td>
<td>ABORT</td>
<td>AS SHOWN. SYSTEM IS UNABORTED. “TOGGLE TO ABORT”</td>
<td>500 mA</td>
</tr>
<tr>
<td>SW3</td>
<td>AUTOMATION</td>
<td>MOMENTARY CLOSURE (MIN. 0.5 SEC.) STARTS WELD CYCLE</td>
<td>&lt; 20 mA</td>
</tr>
</tbody>
</table>
Moment of Inertia

Explanation of Inertia

The moment of inertia is a measure of the mass and the mass distribution of the tool. It is defined mathematically as the product of the mass times the distance of that mass from the axis of rotation squared. For a cylinder spinning around its axis, the formula for the moment of inertia is:

\[
\text{Inertia} = \frac{1}{8} M D^2,
\]

where

- \( \text{Inertia} \) is in \( \text{kg-cm}^2 \)
- \( M \) is the mass in \( \text{kg} \)
- \( D \) is the cylinder diameter in \( \text{cm} \)

Taking into account material density, the formula can be rewritten as:

\[
\text{Inertia} = 0.098 \times \beta \times L \times D^4,
\]

where

- \( \beta \) is the density in \( \text{kg/cm}^3 \)
- \( L \) is the cylinder length in \( \text{cm} \)

Calculating the Moment of Inertia

For spin welder applications, most tools will have a geometry close to a cylinder with internal cutouts for the parts. To estimate the inertia of such a tool, first calculate the inertia of a solid cylinder, then the inertia of the void created for the part using the density of the tool material, and then subtract the two values.

Example:

Aluminum tool with outside dimensions:

- \( D = 4 \text{ in.} = 10.1 \text{ cm} \)
- \( L = 2.5 \text{ in.} = 6.4 \text{ cm} \)
- \( \beta = 0.1 \text{ lb/in.}^3 \) (density of Aluminum) = 0.0028 \( \text{kg/cm}^3 \)

Part void:

- \( D = 3 \text{ inches} = 7.6 \text{ cm} \)
- \( L = 1 \text{ inch} = 2.5 \text{ cm} \)

The inertia would be calculated as follows:

\[
\text{Inertia}_{\text{cylinder}} = 0.098 \times 0.0028 \times 6.4 \times (10.1)^4 = 18.1 \text{ kg-cm}^2
\]

\[
\text{Inertia}_{\text{void}} = 0.098 \times 0.0028 \times 2.5 \times (7.6)^4 = 2.3 \text{ kg-cm}^2
\]

\[
\text{Inertia}_{\text{tool}} = \text{Inertia}_{\text{cylinder}} - \text{Inertia}_{\text{void}} = 16 \text{ kg-cm}^2
\]
Tool and Fixture Design

The most important aspect of tool and fixture design is that it is safe. Please note that using tools not provided by Dukane may result in voiding of the warranty — consult Dukane for details.

Several aspects should be considered when tooling is not purchased from Dukane:

• tool nest should be designed such that part being held is firmly retained in the tool so that it does not fall out before being welded
• tool should surround part being captured where possible – the exterior of the tool should be a continuous cylindrical surface (i.e. avoid protruding parts)
• rotational play between tool and part should be minimized – this will affect the angular orientation accuracy and repeatability
• tool should be as light as possible to allow for rapid deceleration and keep machine energy consumption to a minimum
• tool should be balanced as accurately as possible to avoid excessive machine vibration and bearing wear
• bottom fixture should grip the part firmly to maintain accurate weld orientation and prevent undesirable vibrations during welding
Upper Tool Vacuum

As an aid in holding the spinning part, the welder can optionally be equipped with vacuum in the upper tool by installing a vacuum system kit (#438-963 for models SVT032R & SVT042R; and #438-964 for model SVT012R).

This kit includes all components needed to generate, control, and transfer the vacuum to the tool. It mounts to the welder as shown in Figure C-1.

The spin tool must be designed to interface with the kit. In addition, the welder must be configured to work with certain features of the kit. Please refer to DUKANE document 403-580 (Servo Spin Welder Vacuum System User Guide) for further details.

Figure C-1  Upper Tool Vacuum System
Remote Touch Screen

In situations where it is desirable to provide access to the touch screen some distance away from the welder, the remote touch screen kit (#438-965) can be used. The touch screen is mounted in a separate enclosure as shown in Figure C-2, which can be up to 15 ft. (4.5 m) away from the welder. Two cables (power and communications) are needed to connect the touch screen with the welder. The enclosure includes mounting brackets for attachment to an external support (refer to Dukane drawing #400-2283 for dimensions). This kit can be used with any Servo Spin Welder model.

Figure C-2  Remote Touch Screen Components
The time and date displayed on the touch screen is preset at the factory for US Central Standard Time. It can be changed using the following procedure:

1. Press the upper left-hand corner (marked by 1 in Figure D-1) and lower left-hand corner (marked by 2) at the same time. The screen shown in Figure D-2 should appear.

2. Press the “Clock” button. The screen shown in Figure D-3 should appear.

3. To change the date and time, first enter a numeric value. Then press the corresponding button associated with that value. For example, to set the month to May, press 5 and then the “Mon” button.

4. After setting the time and date, press the “Exit” button on this screen and on the next screen.

5. Wait several seconds for the touch screen to return to normal operation before welding.

**NOTE**: If the touch screen does not retain the programmed time and date after the welder is powered off, then back on, the touch screen battery has expired and must be replaced (Dukane Part #136-28). Contact DUKANE service for information on battery replacement.

**Vacuum and Part Presence Sensing**

External vacuum and part presence sensors may be used to interface with the welder. The vacuum sensor provides a signal that causes the welder to delay cycle execution until sufficient vacuum is present in the upper tool. The part presence sensor provides a signal which causes the welder to delay starting a weld cycle until a part presence is detected. For both sensing options (with the part pickup feature disabled), if the corresponding signal is not provided, the welder will not be ready to run a cycle and a “frowning” face will be shown on the touch screen. Once the signal is provided, the welder will be ready as indicated by a “smiley” face. The vacuum and part presence signals are enabled and disabled with jumpers located on an internal welder circuit board. Please contact DUKANE for instructions on setting the jumpers.
The welder contains two batteries: one in the PLC, and one in the touch screen (HMI). Dukane battery part numbers are:

<table>
<thead>
<tr>
<th>Battery</th>
<th>Dukane Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLC</td>
<td>136-26</td>
</tr>
<tr>
<td>Touch screen (HMI)</td>
<td>136-28</td>
</tr>
</tbody>
</table>

Table E-1  Batteries - Dukane Part Numbers

The PLC battery retains the PLC program when the welder is powered off. If the welder is in the powered off state when this battery expires, the PLC program (including all setup parameters) will be lost and the welder will be inoperable. The battery must be replaced and the program uploaded using a PC to restore welder functionality. Warning messages on the welder are displayed when the battery needs to be replaced. The timing of these messages depends on the version of welder PLC software. For version 1.8 or earlier, the messages start to appear on the date set in the TOOLS > UTILITIES tab > BATTERY screen. For version 1.9 or later, the messages appear when the actual battery voltage (monitored internally by the PLC) falls below a fixed threshold.

The touch screen battery retains the touch screen program as well as the current time and date when the welder is powered off. If the welder is in the powered off state when this battery expires, the current time and date settings will be lost. If the touch screen is equipped with a compact flash card, the touch screen program will be retained. If it is not, the program will also be lost and the touch screen will display the message NO USER PROGRAM; the welder will continue to function, but no user interface is displayed and setup parameters cannot be changed. (The presence of a flash card is indicated by a non-zero entry in the “Flash” field shown in Figure D-2.) Once a new battery is installed, the time and date can be set as outlined in Appendix D. If the program was lost, it must be uploaded using a PC, or a compact flash card programmed at the Dukane factory with a suitable version of the software be installed (blank flash card is Dukane part #409-487).

Contact DUKANE service for additional information about battery replacement.
## List of Figures

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-1</td>
<td>240VAC–20A Receptacle Wiring</td>
<td>11</td>
</tr>
<tr>
<td>2-2</td>
<td>Grounding Lug on Base of Servo Spin</td>
<td>11</td>
</tr>
<tr>
<td>2-3</td>
<td>Compressed Air Lockout and Filter</td>
<td>12</td>
</tr>
<tr>
<td>3-1</td>
<td>Mounting Hole Locations on Base</td>
<td>16</td>
</tr>
<tr>
<td>3-2a</td>
<td>Upper Tooling Hub Dimensions for SVT032R and SVT042R</td>
<td>17</td>
</tr>
<tr>
<td>3-2b</td>
<td>Upper Tooling Hub Dimensions for SVT012R</td>
<td>17</td>
</tr>
<tr>
<td>3-3</td>
<td>Lower Base Fixture Mounting</td>
<td>17</td>
</tr>
<tr>
<td>3-4</td>
<td>20-Amp 240V Plug</td>
<td>18</td>
</tr>
<tr>
<td>3-5</td>
<td>20-Amp 240V Receptacle</td>
<td>18</td>
</tr>
<tr>
<td>3-6</td>
<td>AC Power Switch and Power Cord</td>
<td>18</td>
</tr>
<tr>
<td>3-7</td>
<td>Compressed Air Hookup</td>
<td>19</td>
</tr>
<tr>
<td>3-8</td>
<td>Height Adjustment and Lock Nuts</td>
<td>20</td>
</tr>
<tr>
<td>3-9</td>
<td>Electrical Control Connectors</td>
<td>20</td>
</tr>
<tr>
<td>4-1</td>
<td>Servo Spin Welder Touch Screen Panel</td>
<td>23</td>
</tr>
<tr>
<td>4-2</td>
<td>Startup Screen</td>
<td>23</td>
</tr>
<tr>
<td>4-3</td>
<td>Control Panel and Indicator Scales</td>
<td>24</td>
</tr>
<tr>
<td>4-4</td>
<td>Mechanical and Pneumatic Controls</td>
<td>24</td>
</tr>
<tr>
<td>4-5</td>
<td>Air Pressure Regulator and Gauge</td>
<td>25</td>
</tr>
<tr>
<td>4-6</td>
<td>Operate Switches and E–Stop</td>
<td>26</td>
</tr>
<tr>
<td>4-7</td>
<td>Setting and Reseting the E–Stop</td>
<td>26</td>
</tr>
<tr>
<td>4-8</td>
<td>Right Operate Switch in Standby Mode, One LED Dimly Lit</td>
<td>27</td>
</tr>
<tr>
<td>4-9</td>
<td>Right Switch in Operate Mode, Both LEDs Brightly Lit</td>
<td>27</td>
</tr>
<tr>
<td>4-10</td>
<td>DB–9 Data I/O connector</td>
<td>27</td>
</tr>
<tr>
<td>5-1</td>
<td>Startup Screen With E-Stop Pushed</td>
<td>31</td>
</tr>
<tr>
<td>5-2</td>
<td>Startup Screen With E-Stop Cleared</td>
<td>31</td>
</tr>
<tr>
<td>5-3</td>
<td>Run Mode Screen With Welder Reset</td>
<td>31</td>
</tr>
<tr>
<td>5-4</td>
<td>RUN Screen With Data Fields Indicated</td>
<td>32</td>
</tr>
<tr>
<td>5-5</td>
<td>VIEW PARTS Screen</td>
<td>32</td>
</tr>
</tbody>
</table>

Continued
Appendix F

List of Figures

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-6</td>
<td>Trigger Setup Screen For SETUP Menu</td>
<td>32</td>
</tr>
<tr>
<td>5-7</td>
<td>Data Entry Screen</td>
<td>33</td>
</tr>
<tr>
<td>5-8</td>
<td>Pre–Spin Setup Screen For Trigger Setup</td>
<td>33</td>
</tr>
<tr>
<td>5-9</td>
<td>Torque Setup Screen For Trigger Setup</td>
<td>34</td>
</tr>
<tr>
<td>5-10</td>
<td>Weld–by–Time Screen For Weld Setup</td>
<td>35</td>
</tr>
<tr>
<td>5-11</td>
<td>Weld Orientation Setup Screen</td>
<td>35</td>
</tr>
<tr>
<td>5-12</td>
<td>Weld–by–Rotations Screen For Weld Setup</td>
<td>36</td>
</tr>
<tr>
<td>5-13</td>
<td>Weld–by–End–Switch Screen For Weld Setup</td>
<td>36</td>
</tr>
<tr>
<td>5-14</td>
<td>Post Weld Setup Screen</td>
<td>37</td>
</tr>
<tr>
<td>5-15</td>
<td>Post Weld Limits Setup Screen</td>
<td>37</td>
</tr>
<tr>
<td>5-16</td>
<td>Run Screen in Suspect Part/Latch On Mode</td>
<td>38</td>
</tr>
<tr>
<td>5-17</td>
<td>Run Screen in Bad (Abort) Mode</td>
<td>38</td>
</tr>
<tr>
<td>5-18</td>
<td>Select Setup Screen in Setup Mode</td>
<td>38</td>
</tr>
<tr>
<td>5-19</td>
<td>Utilities Screen in Setup Tools</td>
<td>39</td>
</tr>
<tr>
<td>5-20</td>
<td>Record Manual Setup Screen in Utilities Tab</td>
<td>39</td>
</tr>
<tr>
<td>5-21</td>
<td>HSC Adjustment and Speed Setting</td>
<td>39</td>
</tr>
<tr>
<td>5-22</td>
<td>System I/O Input Status Screen in Utilities Tab</td>
<td>40</td>
</tr>
<tr>
<td>5-23</td>
<td>System I/O Output Status Screen in Utilities Tab</td>
<td>40</td>
</tr>
<tr>
<td>5-24</td>
<td>System Setup Screen in Setup Tools</td>
<td>40</td>
</tr>
<tr>
<td>5-25</td>
<td>Password–Protected Screens and Menus</td>
<td>42</td>
</tr>
<tr>
<td>5-26</td>
<td>Import Servo Database Screen</td>
<td>42</td>
</tr>
<tr>
<td>5-27</td>
<td>Software Revision Levels Screen</td>
<td>42</td>
</tr>
<tr>
<td>6-1</td>
<td>Setting and Reseting the E–Stop</td>
<td>45</td>
</tr>
<tr>
<td>6-2</td>
<td>Startup Screen For Home Procedure</td>
<td>45</td>
</tr>
<tr>
<td>6-3</td>
<td>Servo Spin Welder Height Adjustment</td>
<td>46</td>
</tr>
<tr>
<td>6-4</td>
<td>Adjusting the Mechanical Stop</td>
<td>46</td>
</tr>
<tr>
<td>6-5</td>
<td>Adjusting the End Of Weld Switch</td>
<td>47</td>
</tr>
<tr>
<td>6-6</td>
<td>Adjusting the Hydraulic Speed Control</td>
<td>47</td>
</tr>
<tr>
<td>6-7</td>
<td>HSC Damping Adjustment and Indicator</td>
<td>48</td>
</tr>
<tr>
<td>6-8</td>
<td>Adjusting the Pre Trigger Switch</td>
<td>48</td>
</tr>
<tr>
<td>6-9</td>
<td>Trigger Light for Start of Weld Cycle</td>
<td>48</td>
</tr>
<tr>
<td>6-10</td>
<td>Downsopd Control Settings</td>
<td>49</td>
</tr>
<tr>
<td>6-11</td>
<td>Selecting a Setup File</td>
<td>50</td>
</tr>
</tbody>
</table>

Continued
## Appendix F

### List of Figures

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>6-12</td>
<td>Renaming the Selected Setup File</td>
<td>50</td>
</tr>
<tr>
<td>6-13</td>
<td>Manual Settings Button in Utilities Screen</td>
<td>51</td>
</tr>
<tr>
<td>6-14</td>
<td>Record Manual Settings Screen</td>
<td>51</td>
</tr>
<tr>
<td>7-1</td>
<td>Penetration Depth and Velocity as a Function...of Spin Welding</td>
<td>57</td>
</tr>
<tr>
<td>7-2</td>
<td>Dependence of the Surface Velocity on the Weld Diameter at various RPMs</td>
<td>61</td>
</tr>
<tr>
<td>7-3</td>
<td>Dependence of Motor RPM on the Weld Diameter for Selected Surface Speeds</td>
<td>62</td>
</tr>
<tr>
<td>8-1</td>
<td>Utility Startup Parts Screen</td>
<td>67</td>
</tr>
<tr>
<td>10-1</td>
<td>Replacing Air Filter Element</td>
<td>82</td>
</tr>
<tr>
<td>12-1</td>
<td>240V AC Single–Phase AC Receptacle</td>
<td>89</td>
</tr>
<tr>
<td>12-2</td>
<td>Servo Spin Welder Dimensions</td>
<td>90</td>
</tr>
<tr>
<td>A-1</td>
<td>Base Interface Connector</td>
<td>95</td>
</tr>
<tr>
<td>A-2</td>
<td>User I/O connector</td>
<td>95</td>
</tr>
<tr>
<td>A-3</td>
<td>Slide Kit Connector</td>
<td>96</td>
</tr>
<tr>
<td>A-4</td>
<td>Data I/O Connector</td>
<td>97</td>
</tr>
<tr>
<td>A-5</td>
<td>Schematic of Operate and Abort</td>
<td>98</td>
</tr>
<tr>
<td>A-6</td>
<td>Wiring for Automation</td>
<td>98</td>
</tr>
<tr>
<td>C-1</td>
<td>Upper Tool Vacuum System</td>
<td>101</td>
</tr>
<tr>
<td>C-2</td>
<td>Remote Touch Screen Components</td>
<td>102</td>
</tr>
<tr>
<td>D-1</td>
<td>Touch Screen - Time and Date 1</td>
<td>103</td>
</tr>
<tr>
<td>D-2</td>
<td>Touch Screen - Time and Date 2</td>
<td>103</td>
</tr>
<tr>
<td>D-3</td>
<td>Touch Screen - Time and Date 3</td>
<td>103</td>
</tr>
</tbody>
</table>
### List of Tables

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-I</td>
<td>Servo Spin Welder Packing List</td>
<td>15</td>
</tr>
<tr>
<td>5-I</td>
<td>Parameter Minimum and Maximum Values</td>
<td>42</td>
</tr>
<tr>
<td>7-I</td>
<td>Machine Selection Based on Parts Weld Diameter</td>
<td>63</td>
</tr>
<tr>
<td>8-I</td>
<td>Serial Communications Settings</td>
<td>64</td>
</tr>
<tr>
<td>8-II</td>
<td>Maximum Motor Torque</td>
<td>69</td>
</tr>
<tr>
<td>9-I</td>
<td>Welding Process Troubleshooting</td>
<td>75</td>
</tr>
<tr>
<td>9-II</td>
<td>Machine Display Messages</td>
<td>75-76</td>
</tr>
<tr>
<td>A-I</td>
<td>Pin Assignments and Signal Description for the Base Interface Connector</td>
<td>95</td>
</tr>
<tr>
<td>A-II</td>
<td>Pin Assignments and Signal Description for the User I/O Connector</td>
<td>96</td>
</tr>
<tr>
<td>A-III</td>
<td>Pin Assignments and Signal Description for the Slide Kit Connector</td>
<td>97</td>
</tr>
<tr>
<td>E-I</td>
<td>Batteries - Dukane Part Numbers</td>
<td>104</td>
</tr>
</tbody>
</table>
This page intentionally left blank
Index

A
AC Power 18
Agency Compliance
   IP (International Protection) Rating 91
Air Pressure Regulator 25
Appendices 93

B
Batteries and Software Retention 104

C
Compressed Air 19
Connector Pinouts
   Automation Wiring 97
   Base Interface 95
   Data I/O Connector 97
   Slide Kit Connector 96
   User I/O Connector 95
Contacting Dukane 85
   Intelligent Assembly Solutions 85
Control Connectors 20
Control Parameters 58
   Axial Pressure 58
   Hold Time 59
   Surface Velocity (RPM) 59
   Weld Time 59
Controls
   Air Pressure Regulator 25
   Data I/O Connector 27
   Downspeed Adjustment 26
   End-Of-Weld Adjustment 25
   HSC Adjustment 25
   Hydraulic Speed Control 24
   Mechanical Settings 24
   Mechanical Stop 24
   Operational Switches 26
   Pneumatic Adjustments 25
   Pretrigger Adjustment 25

D
Data I/O Connector 27
Downspeed Adjustment 26
Drawings and Tables 3
Dukane
   E-mail 85
   Website 85

Dukane Servo Spin Weld Utility 67
   CLEAR 68
   EXIT 68
   Machine Debugging Messages 70
   Part Data 68
   Parts Data 67
   Servo Tuning Database 70
   Torque Data 69
   Torque Plot 69
   WRITE 68
Dukane Website
   www.dukane.com/us/ 85

E
Emergency Stop Switch 26
End–Of–Weld 47
End-Of-Weld Adjustment 25
End–Of–Weld Adjustment 25

F
FCC 91

G
General User Information 3
   Drawings and Tables 3
   Notes, Cautions and Warnings 3
   Read This Manual First 3
Grounding 11

H
Head Height Adjustment 20
Health and Safety
   Activation Switches 10
   Electrical Safety 11
   General Safety 10
   Grounding 11
   Mechanical Safety 11
   Plastics Health Notice 10
   Pneumatic Safety 12
   Tips 9
   HSC Adjustment 25
   Hydraulic Speed Control 24
I

Initial Settings 60
   Axial Pressure 60
   Hold Time 63
   Part Size 63
   RPM (Surface Velocity) 60
   Weld Time 62
Intelligent Assembly Solutions 85
Introduction
   Drawings and Tables 3
   Key Servo Spin Welder Features 5
   Notes, Cautions and Warnings 3
   Read This Manual First 3
   Servo Spin Welder Overview 4
   IP (International Protection) Rating 91

L

List of Figures 105
List of Tables 108

M

Machine Operation
   Air Pressure Regulator 48
   Downspeed Control 48
   End-Of-Weld 47
   Hydraulic Speed Control 47
   Mechanical Stop 46
   Modifying A Setup 49
   Pre Trigger 48
   Setup Sheet 52
   Starting a Weld Cycle 51
   Stopping a Weld Cycle 52
   Stroke Indicator 49
   Trigger Light 48
Machine Settings, Additional
   Setting Time and Date On Touch Screen 103
   Vacuum and Part Presence Sensing 103
Machine Setup 45
Maintenance
   AC Power Cord 81
   Compressed Air Filter 82
   Lubricate Slide 82
   Touch Screen Display 81
   Visual Inspection 82
   Mechanical Safety 11
   Mechanical Stop 24,46
   Moment of Inertia 99

N

Notes, Cautions and Warnings 3

O

Operational Switches
   Emergency Stop Switch 26
   Opti-Touch Run Switches 27
Optimizing Performance
   Control Parameters 58
   Initial Settings 60
   Material Considerations 58
Optional Features
   Remote Touch Screen 102
   Upper Tool Vacuum 101

P

Packing List 15
Parameter Value Range 42
Pneumatic Adjustments 25
Pneumatic Safety 12
Pretrigger Adjustment 25

R

Regulatory Agency Compliance 91
   CE Marking 91
   FCC 91
   IP Rating 91

S

Setting Time and Date On Touch Screen 103
Setup Sheet 52
Specifications
   Identification Number 91
   Machine Weight 89
   Operating Environment 89
   Power Requirements 89
   Servo Spin Welder Dimensions 90
   Tooling Specifications 89
   Spin Welding Process 57
   Starting a Weld Cycle 51
   Stopping a Weld Cycle 52
T

Tool and Fixture Design  100
Tooling
  Moment of Inertia  99
  Calculating the Moment
  of Inertia  99
  Tool and Fixture Design  100
  Tooling Hub & Fixture  17
  Touch Screen Display  23
  Touch Screen Menus
  POST WELD Setup  38
  RUN Mode  31
Screen Layout  31
SETUP Menu  32
  TRIGGER Setup  32
  Pre-Spin Orientation Setup  33
Torque Setup  34
STARTUP Screen  31
TOOLS Menu  40
  SELECT SETUP Tab  40
  SYSTEM SETUP Tab  42
  UTILITIES Tab  40
VIEW PARTS  32
WELD Setup  36
  End Switch Mode  37
  Orientation  37
  Rotation Mode  36
  Time Mode  36
Troubleshooting
  Machine Display Messages  74
  Welder Troubleshooting  74
  Welding Process  73

U

Unpacking and Setup
  AC Power  18
  Compressed Air  19
  Control Connectors  20
  Head Height Adjustment  20
  Packing List  15
  Tooling Hub & Fixture  17
  Unpacking Welder  15
  Work Area  16
  Securing to Work Bench  16
Dukane ISO

ISO CERTIFICATION

Dukane chose to become ISO 9001 certified in order to demonstrate to our customers our continuing commitment to being a quality vendor. By passing its audit, Dukane can assure you that we have in place a well-defined and systematic approach to quality design, manufacturing, delivery and service. This certificate reinforces Dukane’s status as a quality vendor of technology and products.

To achieve ISO 9001 certification, you must prove to one of the quality system registrar groups that you meet three requirements:

1. Leadership
2. Involvement

The ISO 9001 standard establishes a minimum requirement for these requirements and starts transitioning the company from a traditional inspection-oriented quality system to one based on partnership for continuous improvement. This concept is key in that Dukane no longer focuses on inspection, but on individual processes.

Dukane’s quality management system is based on the following three objectives:

1. Customer oriented quality. The aim is to improve customer satisfaction.
2. Quality is determined by people. The aim is to improve the internal organization and cooperation between staff members.
3. Quality is a continuous improvement. The aim is to continuously improve the internal organization and the competitive position.

Dukane products are manufactured in ISO registered facilities.

Please refer to our website at:

www.dukane.com/us/sales/intsales.htm

to locate your local representative.