ServoWeld™ Plus
Spin Welder
User’s Manual
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St. Charles, IL  60174  USA

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Printed in the United States of America.

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Dukane ultrasonic equipment is manufactured under one or more of the following U.S. Patents:

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# Revision History

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<td>Index added &amp; other format corrections.</td>
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<tr>
<td></td>
<td>Added to Section 5 - Spin Tool Load Orientation.</td>
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<td>Repaginated as necessary.</td>
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<tr>
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<td>Added Fault Current notes to Pg 18 and 111.</td>
<td>June 17, 2020</td>
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<td>Added Alarms page 137.</td>
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Dukane ServoWeld™ Plus Spin Welder

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SECTION 1

Introduction

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Important User Information

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

Notes and Tips
Throughout this manual we use NOTES to provide information that is important for the successful application and understanding of the system. A NOTE block is shown to the right.

Cautions and Warnings
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. Different symbols also accompany the CAUTION and WARNING blocks to indicate whether the notice pertains to a general condition or practice, an electrical safety issue, a hand protection issue or other condition.

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.
The ServoWeld™ Plus Spin Welder excels at frictional welding of assemblies and parts which require accurate angular orientation and finished height. The parts can be any shape and only the weld joint must be circular. The welder uses two electric servos: a servo motor for spinning the tool, and a servo actuator for moving the machine head up and down. Both servos have high-resolution position feedback devices, enabling accurate process control.

Dukane offers three models: SSW800, SSW3000, and SSW4000. Model differences are in the maximum spin speed, maximum torque of the spin servo motor, maximum force of the vertical servo actuator, and maximum vertical speed.

Specifications for the models are provided in Table 1-I. The ServoWeld™ Plus Spin Welder was designed to provide a reliable, long, and economical service life and meet the applicable CE regulations.

<table>
<thead>
<tr>
<th>MODEL</th>
<th>SSW800</th>
<th>SSW3000</th>
<th>SSW4000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. Spin Speed</td>
<td>RPM</td>
<td>800</td>
<td>3000</td>
</tr>
<tr>
<td>Max. Spin Torque</td>
<td>ft.*lb. (Nm)</td>
<td>59 (80)</td>
<td>16 (21)</td>
</tr>
<tr>
<td>Max. Spin Power</td>
<td>HP (kW)</td>
<td>5.3 (4)</td>
<td></td>
</tr>
<tr>
<td>Spin Drive Type</td>
<td></td>
<td>Geared</td>
<td>Direct</td>
</tr>
<tr>
<td>Max. Vertical Speed</td>
<td>in./s (mm/s)</td>
<td>5.9 (150)</td>
<td>5.9 (150)</td>
</tr>
<tr>
<td>Max. Vertical Force</td>
<td>lb. (N)</td>
<td>600 (2600)</td>
<td>500 (2200)</td>
</tr>
<tr>
<td>Stroke</td>
<td>in. (mm)</td>
<td>5.0 (127)</td>
<td></td>
</tr>
<tr>
<td>Throat Depth</td>
<td>in. (mm)</td>
<td>8.5 (215)</td>
<td></td>
</tr>
<tr>
<td>Max. Vertical Clearance(1)</td>
<td>in. (mm)</td>
<td>16.9 (429)</td>
<td>20.2 (513)</td>
</tr>
<tr>
<td>Height Adjustment Range</td>
<td>in. (mm)</td>
<td>14 (355)</td>
<td></td>
</tr>
<tr>
<td>Power Requirements</td>
<td></td>
<td>200-240 VAC, 50/60 Hz, 20 A, single phase</td>
<td></td>
</tr>
<tr>
<td>Weight (complete system)</td>
<td>lb. (kg)</td>
<td>415 (189)</td>
<td>390 (177)</td>
</tr>
<tr>
<td>Weld Joint Diameters (guidelines only)</td>
<td>in. (mm)</td>
<td>4-7 (100-180)</td>
<td>0.5-4 (12-100)</td>
</tr>
</tbody>
</table>

Note:
(1) Vertical clearance is listed for standard support column. Column riser options are available to increase values listed.
Key ServoWeld™ Plus Spin Welder Features

- **Color touch-screen display** with 800 x 480 pixel resolution uses Color Active Matrix Thin-Film Transistors (TFT) for high contrast and wide viewing angle even under high ambient-lighting conditions. The resistive analog touch technology provides a high performance interface.

- **Ultra-rigid**, steel rectangular support column minimizes load deflection for precise and repeatable operation.

- **High-power spin servo motors** are used to achieve fast cycle times and rapid decelerations, preventing bond shearing and producing strong joints.

- **High-resolution position feedback devices** are built into the servo motors for maximum precision. The spin motor encoder accurately measures the final angular orientation to within 0.1° (1 part in 3600), and the vertical actuator resolver measures the distance to within .0004 inch (0.01 mm).

- **Trigger by Spin Torque, Vertical Position, or an External Signal** to precisely control the start of the weld phase.

- **Weld by Distance, Position, Energy, or Peak Spin Torque.** For each weld method, final spin Weld Orientation and Melt-Match® Mode can be independently enabled.

- **Parameter monitoring** with programmable upper and lower limits for 16 different cycle variables such as weld time, rotations, and angular orientation.

- **Weld process setups (recipes)** can quickly and easily be selected from among the 64 available setups.

- **Download cycle and graph data** to a storage device via the front mounted USB port.

- **Output of cycle data to external devices** using OPC UA, Modbus TCP, or FTP standard (RS-232 optional).

- **Fixture throat depth** is a generous 8.5 inches (215 mm).

- **Vertical servo actuator** with adjustable 5 inch (127 mm) stroke provides quiet operation and is environmentally safe.

- **Industry-standard servo controller/drive hardware** means replacement parts are readily available.

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

- **24-month domestic warranty** assures you of reliability and quality construction.
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## SECTION 2

### Safety Considerations

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<th>Section</th>
<th>Page</th>
</tr>
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<td>Plastics Health Notice</td>
<td>10</td>
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<tr>
<td>Operate Switches</td>
<td>10</td>
</tr>
<tr>
<td>General Safety</td>
<td>10</td>
</tr>
<tr>
<td><strong>Electrical Safety</strong></td>
<td>10</td>
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<td>AC Power Receptacle</td>
<td>10</td>
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<tr>
<td>Grounding</td>
<td>11</td>
</tr>
<tr>
<td><strong>Mechanical Safety</strong></td>
<td>11</td>
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</tbody>
</table>
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Health and Safety Tips

Please observe these health and safety recommendations for safe, efficient, and injury-free operation of your welder.

Proper Installation - Do not operate the ServoWeld™ Plus Spin Welder until after the electrical system is properly installed.

No Unauthorized Modifications - Do not modify your ServoWeld™ Plus Spin Welder in any way unless authorized to do so by Dukane. 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 welder covers. The servo motors and drives 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. Always press the Emergency-Stop (E-Stop) switch or turn welder power off when installing and removing tools. 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.
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.

Operate Switches

The dual finger operate switches comply with OSHA safety regulations. Using a foot switch in place of the dual finger run switches violates OSHA regulations.

General Safety

Before performing any maintenance or service on the ServoWeld™ Plus Spin Welder, locks and tags should be applied to all energy isolating switches. Anything that might restore energy to the 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.

Electrical Safety

AC Power Receptacle

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

FIGURE 2–1 240VAC–20A Receptacle Wiring

WARNING
Power line outlet MUST be grounded.
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 ServoWeld™ Plus 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 studs 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 2-3). The 200-1557 grounding cables supplied with the welder (or equivalent 14 AWG* wires) should be connected between these two studs and an effectively grounded metal pipe. This will minimize any external electrical interference from leaking into the ServoWeld™ Plus Spin Welder control circuitry. This will not compromise the safety of the power ground.

* 14 AWG wire has a diameter of .064 inch (1.63 mm)

Mechanical Safety

The ServoWeld™ Plus Spin Welder is capable of developing substantial torque, force, as well as high rotational and linear velocities. 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 welder during operation. Always press the Emergency-Stop (E-Stop) switch or turn welder power off when installing and removing tools. Spin tools must be properly designed and maintained to ensure parts loaded into the tool do not fall out during welder operation.

WARNING

Always turn off AC power at the power switch, unplug the power cord, and wait at least 5 minutes before removing covers or servicing the welder. Failure to remove AC power and to wait for the servo drives to discharge are unsafe practices and can result in injury or loss of life.
SECTION 3

Unpacking and Setup

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Unpacking Welder

The ServoWeld™ Plus Spin Welder is normally packed in a wood crate resting on a wooden shipping pallet. To unpack the welder follow these steps.

1. Bend back the clips along the top cover of the crate. Knock each clip out and carefully remove the top cover of the crate.

2. The side panels of the crate are removed in pairs by first bending back the clips along two edges of the crate. Knock each clip out and carefully remove both panel pairs.

3. Carefully remove any packing materials, loose cables and documentation.

4. The welder will be secured to the pallet by lag bolts. Remove these bolts to free the welder from the pallet.

5. Leave the power cable wrapped up until after the welder has been placed in its working area and the welder is ready to be powered. This will prevent accidental kinking or pinching of the power cable.

6. Inspect the assembly for any damage before placing it in position.

Packing List

After removing the shipping container, check that you have the items listed in Table 3-I. Inspect the welder for damage. Report any damage immediately to the carrier and to Dukane Customer Service at (630) 797–4900. Also see Section 14 for information on contacting Dukane. Save all shipping and packing materials so they can be inspected in processing any claims that may arise.

Work Area

Allow sufficient area on either side of the ServoWeld™ Plus 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.

<table>
<thead>
<tr>
<th>Description</th>
<th>Part Number</th>
<th>Quantity</th>
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<tr>
<td>ServoWeld™ Plus Spin Welder</td>
<td>SSWxxxx (welder, column, base) or SSWxxxx-LB (welder and column only) or SSWxxxx-T (welder only)</td>
<td>1</td>
</tr>
<tr>
<td>Base Interface Cable</td>
<td>200-1545-02M</td>
<td>1 (welders SSWxxxx) 0 (all other welders)</td>
</tr>
<tr>
<td>Grounding Cable</td>
<td>200-1557</td>
<td>2 (welders SSWxxxx) 1 (all other welders)</td>
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<tr>
<td>ServoWeld™ Plus Spin Welder Manual</td>
<td>403-602</td>
<td>1</td>
</tr>
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</table>

Table 3-I ServoWeld™ Plus Spin Welder Packing List
Securing to Work Bench

Bench Capacity
The ServoWeld™ Plus Spin Welder weighs approximately 415 lb. (189 kg) without tooling. It must be attached to a table or bench capable of supporting at least 650 lbs. (295 kg).

Use mechanical means such as a forklift or hoist to place the ServoWeld™ Plus Spin Welder on its work bench. There are two 3/4 inch (19 mm) lifting eyes located at the top of the column (see Figure 3–7) for a lifting ring or strap.

Leveling
We recommend that the ServoWeld™ Plus 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 ServoWeld™ Plus Spin Welder has two mounting holes in the front as shown in Figures 3-1 and 3-3. The two holes will accept either 7/16 inch or 12 mm diameter bolts. The welder base must be secured to the work table using these mounting holes.
Tooling Hub & Base

The upper tooling attaches to the tooling hub. The size of the hub depends on the welder model.

For models SSW3000 and SSW4000, the hub is shown in Figure 3-2a. To attach the tooling to this hub, at least four 5/16 inch (M8) diameter bolts or machine screws should be used, along with one spring lock washer and one flat washer per fastener. Each fastener should be tightened to 90 in.*lb. (10 Nm). This hub has an intergral precision slot to accomplishate a 1/4” (6.35 mm) indexing pin on the tool so that the tool can be mounted in a consistent orientation relative to the hub.

For model SSW800, the hub is shown in Figure 3-2b. To attach the tooling to this hub, four 3/8 inch (M10) diameter bolts or machine screws should be used, along with one spring lock washer and one flat washer per fastener. Each fastener should be tightened to 160 in.*lb. (18 Nm). The precision slot on this hub is designed to accomodate a 3/8” (9.53 mm) indexing pin on the tool.

The lower tooling fixture attaches to the base plate using M10–1.5 cap screws for all welder models. See Figure 3–3 for the detailed layout of the mounting holes in the base platen.
AC Power

The ServoWeld™ Plus Spin Welder requires a 200-240 VAC 1–phase outlet rated at 20 Amps. All machine models use the same power cord and plug. The AC power cord is permanently attached to the 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 switch/breaker is identical on all models and is shown in Figure 3–6.

NOTE
The rated fault current (or leakage current) is equal to or less than 100 mA.
Head Height Adjustment

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 3–7 and covered in detail in Section 6. The thruster position on the column is indicated by the COLUMN POSITION pointer line on the thruster against the reference scale on the column. When adjusting the height of the thruster head, do not remove the nuts but only loosen them. Once the desired height is achieved, ensure all three lock nuts are fully tightened before operating the welder.

Figure 3–7  Height Adjustment and Lock Nuts
Welder/Base Cable Connection

For welders with a Dukane base (models SSW800, SSW3000, and SSW4000), the base interface cable supplied with the welder (part number 200-1545-02M) must be connected between the J6 BASE/ABORT connector located on the back of the welder shown in Figure 3-8 and the J35 BASE INTERFACE connector located on the back of the base shown in Figure 3-9. This cable carries the operate and emergency stop signals from the optical operate switches and abort switch on the base.

For welders without a Dukane base (models ending in -LB or -T), operate and emergency stop signals must be wired to the welder J6 BASE/ABORT connector. Refer to Section 8 for details.
SECTION 4

Display and Controls

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Touch Screen Display

The display is a 6 inch (15 cm) wide by 3.6 inch (9 cm) tall color LCD screen with an integrated touch control shown in Figure 4-1.

Setup parameters and mode selections are programmed through the touch screen. A close-up view of the screen layout is shown in Figure 4–2. There are multiple features of this screen that remain visible for most of the selected functions. These are covered in detail in Section 5.

Above the screen is an LED light. This light indicates the status of the welder. Green indicates that the welder is powered on, E-Stop is not engaged, and no alarms are active. Orange indicates that there are active alarms that require attention. Red indicates that the E-Stop is engaged.

The function of the USB Port is described in the External Connectors section below.

Figure 4–1 ServoWeld™ Plus Spin Welder Touch Screen Panel

Figure 4–2 Startup Screen
Operational Switches and E-Stop

Emergency Stop Switch

A red Emergency–Stop (E-Stop) switch is located in the center of the base as shown in Figure 4–3. The emergency stop switch must be in its reset position before the operate switches will function. To reset the E-Stop, twist the large red button about 45 degrees clockwise, which will cause the button to spring out. This is depicted in Figure 4–4. Activation of the E-Stop (pushing button in) will cause rapid deceleration of both motors if they were in motion, then removal of power from the motors and the actuation of the vertical actuator holding brake.
Operate Switches

Located on either side of the base are two optical operate switches as shown in Figure 4–3. These switches use Infrared (IR) sensors, and comply with OSHA and CE safety standards. These switches are identical.

Each optical switch has a small green LED, labeled POWER, which is illuminated whenever the power is on, as shown in Figure 4–5. When the operator places their finger in the tray, a second green LED, labeled OUTPUT, is illuminated to indicate the switch has been activated as shown in Figure 4–6. Both switches must be activated simultaneously to initiate homing, jogging, or weld cycle motion.
External Connectors

USB Port
A USB port is provided on the front of the welder just below the screen (see Figure 4-7). This USB port is intended for use with a USB storage device (i.e. thumb drive). With this port multiple import and export functions can be executed.

Via the welder’s touch screen, a user can export graph data, part history data, setup files, an application snapshot, and a system snapshot. To locate each of these options within the touch screen, see Section 5. In all cases the export options will only be enabled when a USB storage device is plugged in.

Via the welder’s touch screen, a user can also import setup files and custom welder configuration files. To locate these options within the touch screen, see Section 5. In all cases the import options will only be enabled when a USB storage device is plugged in. In addition, the USB port can be used to update welder software.

Rear Connectors
Several connectors are located on the rear of the welder as shown in Figure 4-8. The function of each connector is described below.

J2 INPUTS
The J2 INPUTS connector is used for activating dedicated digital inputs on the welder, such as signals from optional part presence and fixture clamp sensors, as well as other signals used in controlling the welder via external automation. The connector pinout and additional details are provided in Section 8.

J3 OUTPUTS
The J3 OUTPUTS connector provides welder status outputs for operation via external automation and signals for driving optional fixture clamps. The connector pinout and additional details are provided in Section 8.
J6 BASE/ABORT
The J6 BASE/ABORT connector is used to interface operating and E-Stop signals from the base or external automation. It is a required connection for operating the welder as described in Section 3. The connector pinout and additional details are provided in Section 8.

J9 ETHERNET
The J9 ETHERNET connector (RJ45, female) is used to export cycle data and provide access to welder diagnostic functions.

Cycle data (i.e., weld process results shown on the HMI RUN screen) are available for retrieval on this connector after the completion of each cycle using one of the following protocols: OPC UA, Modbus TCP, or FTP. Refer to Section 8 for details.

For diagnostic purposes, this connector provides access to the System Diagnostics Manager (SDM) via a computer.

J21 VACUUM/PRESSURE
The J21 VACUUM/PRESSURE connector is used to interface with the optional upper (spin) tool vacuum system when it is installed on the welder. Refer to Section 9 for additional information.

J22 COMM
The J22 COMM port is populated when the optional RS-232 cycle data output kit is installed. Refer to Section 9 for details.

Figure 4–8  Rear Connectors

NOTE
See Section 8 for details on interfacing the welder with external automation.
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Touch Screen Menus

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Section 5 - Touch Screen Menus

Screen Layout

When the welder is first powered on and no alarms are active, the **RUN Mode** screen is displayed as shown in Figure 5–1. The touchscreen has basic layout elements that remain constant for all modes and mode views:

In the top left corner is the **STATUS box**. This box indicates the state of the machine. It can have a variety of different messages displayed but the background color indicates its state. A red background indicates that an alarm is active. A yellow background, when the operate switches are not activated, indicates that operator action is required, such as homing the welder or loading parts. A green background indicates that the welder is ready to run a weld cycle. A white or gray background indicates that the RUN Mode is not selected.

To the right of the status box is the **SETUP field**. It contains the number and name of the active setup.

To the right of the setup field is the **Date and Time field**. It shows the current date and time information that the welder has been set to.

Below the setup field is the **Message Box**. It provides instructions on required actions and alarm messages.

Below the status box and along the left side of the screen are the **Mode buttons**. These buttons activate one of three modes: RUN (for running weld cycles), SETUP (for setting weld process parameters), and SYSTEM (for setting system-level parameters).

Below the message box are the **View buttons**. These buttons bring up the different views (or screens) for each mode.

Below the view buttons is the **View Window**. This area displays the user interface for each view button.
RUN Mode

The RUN screen, shown in Figure 5-2, is the default startup screen. It contains several view buttons, which determine the type of information displayed as described below. The RUN button must be active in order to home the welder and initiate weld cycles.

Homing Process

Once the RUN screen appears after start up, the welder must be homed before weld cycles can be initiated. The message near the top of the HMI directs the operator to Activate both operate switches to home welder (see Figure 5-2). Activate the switches simultaneously and maintain activation to perform the homing sequence. When the sequence is initiated, the above message will disappear and the status box will change from “NOT HOMED” in yellow to “HOMING” in blue (see Figure 5-3). After approximately 30 seconds, the homing process will complete and the status will change to “HOMED” in yellow. At this point, the switches can be deactivated, which will cause the status to change to “HOMED” in green. The message will now be Activate both operate switches to start weld cycle (see Figure 5-4). The welder is now ready to run a weld cycle.
CYCLE DATA

The CYCLE DATA view is the default screen in RUN mode (see Figure 5-4). It contains weld process result data for the last weld cycle. The following is a description of each field.

**Part Number** – The part number for the last cycle. This number increments sequentially for each cycle if the same setup remains active. When a different setup number is selected, the first cycle is automatically assigned the number 1. It is possible to manually assign this value for the next cycle to be run (refer to screen SYSTEM > UTILITIES).

**Part Analysis** – Generic indicator of the overall process result for the last cycle. This field can state “GOOD” or “BAD” (will be blank at start up). “GOOD” is displayed when all weld result measures were within the defined process limits, or when no limits are defined. “BAD” is displayed when at least one of the weld result measures was outside of the defined limits, or when an alarm occurred during the weld cycle (regardless of any limit violations).

Below the Part Number field is a set of parameters displayed in green. This set generally represents data for the vertical axis as follows:

- **Position At Trigger** - Vertical position at trigger event (mm).
- **Weld Time** - Total time of weld phase (seconds).
- **Weld Peak Force** - Peak vertical thrust during weld phase (% of maximum thrust).
- **Weld Collapse** - Collapse distance during weld phase (mm).
- **Weld End Position** - Vertical position when weld phase completed (mm).
- **Hold Collapse** - Collapse distance during hold phase (mm).
- **Total Stroke Distance** – Farthest vertical position reached during entire weld cycle (mm).
- **Total Collapse** - Overall part collapse during entire cycle (mm).
Below the Part Analysis field is a set of parameters displayed in blue. This set generally represents data for the spin axis as follows:

**Torque At Trigger** - Spin motor torque at trigger event (% of maximum torque).

**Weld Orientation** - Part angular orientation at end of hold phase (degrees).

**Weld Rotations** - Total spin motor rotations during weld phase (revolutions).

**Weld Peak Spin Speed** - Peak spin motor speed during weld phase (RPM).

**Weld Energy** - Energy output by spin servo drive during weld phase (Joules).

**Weld Peak Motor Torque** - Peak spin motor torque during weld phase (% of maximum torque).

**Weld Peak Part Torque** – Peak net torque on parts being welded during weld phase (% of maximum torque). The data for this parameter is populated only when the Idle Spin Torque Compensation option is enabled (refer to screen SETUP > GENERAL > OPTIONS).

At the bottom of the screen, the parameters displayed in black are:

**Date & Time** – Date and time of beginning of last cycle (YYYY-MM-DD, hh:mm:ss).

**Total Cycle Time** - Elapsed time from the start of the cycle until the welder is ready to run the next cycle if no alarms occur, or until the occurrence of an alarm (seconds).
GRAPH

To the right of the CYCLE DATA button is the GRAPH button. Pressing this button brings up the Graph view (see Figure 5-5), which allows the user to easily review a pair of data sets (Y-axes) from the previous part run over a selectable amount of time (X-axis). The graph can only be viewed on the screen for the last cycle run, and will be cleared once the following cycle is initiated. However, the last 1,000 graph data files are recorded to welder non-volatile memory, which can be exported using the EXPORT DATA button to an external USB storage device when plugged into the welder.

To modify the time interval (X axis) change the values selected in the two upper right hand drop down boxes. The left box, Startpoint, can be set to the following values:

- Start of Cycle
- Sensing Start Position
- Start of Weld

The right box, Endpoint, can be set to the following values:

- End of Weld
- End of Hold
- End of Cycle

To change the pair of data sets displayed on the graph (Y axes) select values from the two lower drop down boxes. These boxes are located directly beneath the graph at the left and right hand corners. They are labeled Left axis and Right axis accordingly.

Once the X axis and Y axes are set, a pair of Cursors can be used to review specific values along the X axis. Set the cursors using the left and right arrow keys beneath the Cursor 1 and Cursor 2 labels. The text boxes beneath the cursor arrows will identify the time the cursor is set at, and the value of both left and right Y axes. Below the two cursor values is the Differences box. This box shows the differences in the time values, left axis values, and right axis values between the two cursors (see Figure 5-6).

To leave the Graph view, press the CYCLE DATA button located above the top left corner of the graph.
LIVE DATA

In Run mode, to the right of the GRAPH button is the LIVE DATA button. The Live Data view allows active monitoring of motor, hardware, and I/O status parameters. The default Live Data view is the Motors view. Select different Live Data views by using the three buttons below the Run mode view buttons.

MOTORS

The Motors view (see Figure 5-7) contains the same Part Number and Part Analysis values from the Cycle Data view. Below those fields are two groups of boxes containing live values for the Vertical and Spin motors.

Vertical:

- Motor On - Status of power being supplied to the vertical motor by the servo drive (On/Off)
- Position - Vertical position, where zero is the home (topmost) position (mm)
- Position Error - Difference between actual press position and commanded position (mm)
- Force - Net force output by vertical actuator (% of maximum force; positive value indicates downward direction)
- Speed - Vertical movement speed (mm/s)

Spin:

- Motor On - Status of power being supplied to the spin motor by the servo drive (On/Off)
- Orientation - Rotational position, where zero is defined as the orientation of the tooling hub when the slot in the hub faces the operator (degrees)
- Position Error - Difference between actual orientation and commanded orientation (degrees)
- Motor Torque - Torque output by spin motor (% of maximum torque)
- Speed - Spin speed (RPM)

![Figure 5–7  Run Mode, Live Data, Motors View](image)
HARDWARE

The Hardware view (see Figure 5-8) provides basic status information of various hardware components. On the left of the screen each piece of hardware is listed with a status indicating if the hardware is detected, and the current firmware ID number. The last three hardware components have an added status for error detections.

Below the hardware list are the CPU conditions and Limit Switches fields, which provide temperature readings for the CPU, and the statuses of the top and bottom vertical travel limit sensors.

On the right side of the screen are the Vertical drive, and Spin drive statuses. These provide information related to the state, power, and thermal conditions of the motor drives.

INPUTS/OUTPUTS

The Inputs/Outputs view (see Figure 5-9) provides state information for all digital I/O modules in the welder and the status of the safety program running within the safe modules. This screen is useful in diagnosing connection problems (such as with the machine base) and verifying that signals from external automation equipment are interfaced properly. Note that the numbers next to the signal names represent internal welder module numbers, not the pinouts of the external “J” connectors on the back of the welder.

Figure 5–8  Run Mode, Live Data, Hardware View

Figure 5–9  Run Mode, Live Data, Input/Output View
HISTORY

To the right of the LIVE DATA button is the HISTORY button. The History view (see Figure 5-10) allows a user to review cycle data for previous part runs. The data available for display on the screen is limited to the last 225 cycles. However, cycle data is continuously recorded to welder non-volatile memory, which has a storage capacity of nearly 1 GB. This capacity is sufficient to store data for many millions of cycles. The data can be exported to a USB device on demand as described below.

Parts are listed in rows with five parts displayed per page. To scroll through the parts list use the up and down arrow buttons located in the lower left corner of the view.

There are multiple columns of data that can be reviewed per part. Cycle through these different sets of data using the slider located to the right of the up and down arrows. There are five different tabs of data, with each tab containing 4 different variables. The part number will always appear in the left most column.

It is possible to jump through the parts list to the next set that contains a “Bad” result by using the FIND BAD button. This button is located to the right of the EXPORT TO USB button. It allows for quick navigation through the parts lists to find bad parts, which will have a red highlighted part number and a red X in the Part Analysis column.

To erase the values displayed on the History view, press the ERASE ALL button, then OK on the confirmation window. All fields on this screen will be cleared; however, the cycle data recorded to welder non-volatile memory will not be affected and can be exported as described below.

When a USB storage device is attached, this data can be exported to it using the EXPORT TO USB button, which is located to the right of the slider. After pressing the button, a new screen will appear, providing selections for the number of days of data to export. To export the data for the last number of days, enter the appropriate value in the Days to Export field, then press the SELECTED HISTORY button. To export all data stored on the welder, press the ALL HISTORY button.
SETUP Mode

The SETUP mode is accessed by pressing the SETUP button directly below the RUN button on the left hand side of the screen. The SETUP mode contains all of the options for creating, updating, switching, importing, and exporting weld setups. The default first view, MANAGE, contains a list of all the stored weld setups. The proceeding 5 views (GENERAL, TRIGGER, WELD, HOLD, and LIMITS) are for setting the different parameters within the active weld setup.

MANAGE

The Manage view (see Figure 5-11) contains a Select Setup list on the left hand side of the view. This list represents all possible weld setup storage spots.

In the middle of the screen there is a button which indicates if the selected setup is active or inactive. If the selected setup is active, this button will have a green border with the words Setup Active displayed in it, and the button will be disabled as shown in Figure 5-11. If the selected setup is inactive, this button will have a red border with Load Setup displayed in it, and the button will be enabled as shown in Figure 5-12. Pressing this button while an inactive setup is selected will cause the inactive setup to be loaded. The Setup Field will now display this setup’s number and name, and the welder will function using this setup’s configuration.

On the right side of the screen is a column of six buttons. These buttons are only active when the currently loaded setup is selected from the list on the left.

- SUMMARY - Use to quickly review an uneditable list of all the settings for the active setup.
- RENAME - Use to rename the currently active setup.
- COPY - Use to copy the currently active setup to any of the other setup storage spots. The name of the copied setup is automatically set to “NO NAME”.
- ERASE - Use to erase the currently active setup. This will set the name back to “DEFAULT” and set all of the values back to default.
• **EXPORT USB** - Use to export the currently active weld setup to an external storage device. A USB device must be plugged in for this button to be enabled.

• **IMPORT USB** - Use to load a previously exported weld setup into the currently selected setup location from an external storage device. A USB device must be plugged in for this button to be enabled.

**GENERAL**

To the right of the MANAGE button is the GENERAL button. This button brings up the **General view** (see Figure 5-13), which is used to specify basic parameters related to the tooling installed on the welder and welder operation.

The first field, **Tool Inertia**, is where the moment of inertia of the spin tool about the axis of rotation is entered in units of kg*cm². (Refer to Section 10 for details on determining tool inertia.) To the right of that is a check box for **Advanced Servo Tuning**. Checking this box causes the **Servo Tuning button** to appear to the right of the check box. The purpose of this function is to adjust servo tuning in rare cases and should only be used with guidance from Dukane.

Below the Tool Inertia field is the **Top of Stroke Position** field. This value indicates the vertical press position from which the tool starts a cycle and to which it retracts at the end of the cycle. This value can be manually entered into the field or taught by jogging using the TEACH button to the right of the field (see page 54).

To the right of the Top of Stroke Position field is the **Vertical Travel Limit** field. This value indicates how far the tool can travel before an alarm is triggered, which will cause motion on both axis to stop rapidly and the weld cycle to be terminated. This feature is intended to protect the spin tool from contacting the lower fixture or over-compressing the parts in case of errors in the setting of other setup parameters. This value can be manually entered into the field or taught by jogging using the TEACH button to the right of the field (see page 54).
Below the Top of Stroke Position field is the **Initiate Mode** field. This drop down box offers two options: Manual and Automation. Manual Mode is for manual machine operation using the standard operate switches on the base, and Automation Mode is for automated operation via external controls or when light curtains are integrated with the welder. If light curtains are not integrated with the welder, Automation Mode must not be used if the welder is to be operated manually (i.e., by a human operator). It is the responsibility of the end user to ensure safety when the welder is configured in this manner.

**OPTIONS**

Below the Initiate Mode drop down is the **OPTIONS** button. This button opens a new view (see Figure 5-14) containing multiple features that can be enabled as described below.

- **Idle Spin Torque Compensation** - This feature is used to compensate spin torque measurements by excluding the non-productive torque required to keep the spin motor running at the programmed RPM without any load from the parts. Enabling this option maximizes the sensitivity of the Spin Torque Trigger Method (see TRIGGER section below), which is especially useful when welding parts with small joint diameters or when the optional upper (spin) tool vacuum system is installed. When enabled, the Weld Peak Part Torque cycle data parameter is recorded and displayed on the RUN screen, which represents the net peak torque applied to the parts (i.e., excludes internal motor and vacuum seal friction torque).

- **Tool Vacuum** – This option enables monitoring of the vacuum switch included with the optional upper (spin) tool vacuum system kit (see Section 9). It must be checked if the kit is installed on the welder. When enabled, a weld cycle can be started only after vacuum is detected in the spin tool.

- **Part Presence Sense 1 & 2** – These options enable monitoring of the part presence sensor input(s) and can be independently enabled. When part presence sensor(s) are used and configured to activate the welder inputs on the J2 INPUTS connector (see...
Section 8), the corresponding option box must be checked. When enabled, a weld cycle can be started only after part presence is detected. Once started, the cycle will continue even if the part presence sensor(s) become inactive.

- **Fixture Clamp 1 & 2** – These options enable the control and monitoring of optional fixture clamp(s) used to secure the parts being welded. If only one fixture clamp is used, the Fixture Clamp 1 box must be checked. When at least one box is checked, the Clamp Timeout field is displayed, which defines the amount of time allowed for the clamps to close and open before an alarm is triggered. When enabled, the corresponding fixture clamp outputs on the J3 OUTPUTS connector are activated to close and open the clamps, and the corresponding fixture clamp inputs on the J2 INPUTS connector are monitored to determine the state of the clamp(s) (see Section 8 for wiring details).

The sequence of clamp operation during welder homing or after clearing alarms is as follows:

1. Operate signals are activated to start the homing process.
2. Welder executes normal motion on spin and vertical axes.
3. Clamp open outputs are activated.
4. Welder waits until the clamp open sensor inputs are activated.

The sequence of clamp operation during a weld cycle is as follows:

1. Operate signals are activated to start the cycle.
2. Clamp close outputs are activated.
3. Welder waits until the clamp close sensor inputs are activated.
4. Welder executes the cycle per the programmed setup.
5. Welder head retracts to the Top of Stroke Position.
6. Clamp open outputs are activated.
7. Welder waits until the clamp open sensor inputs are activated. (Note that when the Initiate Mode is set to Manual, the operator must maintain activation of the operate switches until the
clamps are completely open at the end of this step.)

To test operation of fixture clamps, enter any TEACH screen, activate the OPEN or CLOSE button at the bottom of the screen, then activate the operate switches.

- **Part Pickup** – This option enables part pickup mode, in which the tool performs a part pickup step (without spinning) to engage the part to be spun into the spin tool before proceeding with the weld process. When enabled, a SETTINGS button appears next to this option. Pressing it opens the Part Pickup Setup window for setting pickup parameters as described below.

- **Reposition Spin Tool After Upstroke** – This option enables the precise repositioning of the spin tool to the programmed Weld Orientation after the press retracts to the Top of Stroke Position following the completion of the weld process. This feature is intended to provide a consistent tool orientation for upper part loading and should only be enabled when parts are loaded automatically (i.e. not by human operator).

- **Spin Tool Load Orientation** - This option enables the spin tool to be positioned at a specific orientation for convenience of loading unwelded parts into the tool by the operator. When enabled, the orientation field appears next to the option. Use of this feature requires sensing the presence of parts in the spin tool and bottom fixture by enabling one of the following combination of options and connecting the corresponding sensors to the welder:
  A) Part Presence Sense 1 and Part Presence Sense 2. Part Presence Sense 1 must sense the presence of the part in the fixture, and Part Presence Sense 2 must sense the presence of the part in the spin tool.
  B) Part Presence Sense 1 and Tool Vacuum. Part Presence Sense 1 must sense the presence of the part in the fixture, and the vacuum switch (included with the optional upper tool vacuum system kit) must sense the presence of the part.
in the spin tool. When this option is enabled, the spin tool will automatically rotate to the programmed Spin Tool Load Orientation position after the head retracts to the Top of Stroke position at the end of a cycle if the welder senses that: 1) a part/welded assembly is present in the fixture and 2) a part is not present in the spin tool. If either condition is not satisfied, the spin motion is aborted and an alarm is displayed. If this option is enabled, the option Reposition Spin Tool After Upstroke is automatically disabled.

### Part Pickup Setup

The Part Pickup Setup view (see Figure 5-15) contains a Method drop down in the top left corner of the view. There are three methods to select from:

- **Method 1) Vacuum Sense** - This method uses vacuum in the spin tool (if this optional kit is installed) to determine when part pickup is achieved. It requires setting the following parameters (see Figure 5-15):
  - **Sensing Start Position** (mm) - This value specifies the vertical press position at which the welder will start monitoring the vacuum sensor input to detect that the part is loaded into the spin tool. At the start of the cycle, the press will initially travel down rapidly, then slow down before reaching this position. The value should be defined such that there is always a gap between the tool and the upper part, regardless of unwelded part height variation. This value can be manually entered into the field or taught by jogging using the TEACH button to the right of the field (see page 54).
  - **Sensing Speed** (mm/s) - This value specifies the vertical speed at which the tool approaches the part to be picked up (after reaching Sensing Start Position) while the welder monitors the vacuum sensor. Once the part is detected, the vertical motor decelerates and stops. Typical values are 1-3 mm/s.

- **Method 2) Force Sense** - This method uses measurement of the vertical force to determine when part pickup is
achieved. It requires setting the following parameters (see Figure 5-16):

- **Sensing Start Position** (mm) - This value specifies the vertical press position at which the welder will start monitoring the vertical force to detect that the part is loaded into the spin tool. At the start of the cycle, the press will initially travel down rapidly, then slow down before reaching this position. The value should be defined such that there is always a gap between the tool and the upper part, regardless of unwelded part height variation. This value can be manually entered into the field or taught by jogging using the TEACH button to the right of the field (see page 54).

- **Sensing Speed** (mm/s) - This value specifies the vertical speed at which the tool approaches the part to be picked up (after reaching Sensing Start Position) while the welder monitors the vertical force. Once the part is detected, the vertical motor decelerates and stops. Typical values are 1-3 mm/s.

- **Force** (% of maximum force) – This value specifies the level of vertical force to be reached to designate that the upper part is engaged in the spin tool.

**Method 3) Position** - This method involves the press travelling to a specific vertical position to perform the part pickup. It requires setting the following parameter (see Figure 5-17):

- **Position** (mm) – This value is the position to which the press moves to pick up the part. Once this position is reached, the part is considered to be engaged in the spin tool.

All three methods also require a **Timeout** value (seconds). This is the time allowed for the pickup phase to complete before an alarm is triggered.

At the bottom of the Part Pickup Setup view is the **Pre-Spin Orientation** option (see Figure 5-17). When this option is enabled, the spin tool will rotate to the orientation specified in the field to the right of the option before the press moves down to pick up the part. This feature is useful if the orientation of the upper part...
before welding is different than the orientation after welding. This option can be enabled for any of the methods above. The orientation value can be manually entered into the field or taught by jogging using the TEACH button to the right of the field (see page 54).

OTHER SETTINGS
Below the Initiate drop down and to the right of the OPTIONS button is the OTHER SETTINGS button. The Other Settings view is intended for entering information to provide additional details about the setup. It includes text fields for Column Position, Spin Tool ID, Fixture ID, and Notes.

TRIGGER
The button to the right of the GENERAL button is the TRIGGER button. This button brings up the Trigger view (see Figure 5-18). The settings in this view specify the trigger event, which defines the start of the weld phase. The Method drop down box in the top left corner of the Trigger view offers three options. The required parameter fields are displayed once the method is selected. Regardless of the selected method, the spin tool must always be spinning at the programmed weld speed (RPM) at the time of the trigger event.

Method 1) Spin Torque - This method specifies that the weld phase will begin when the torque of the spin motor reaches a predetermined level. It is used to detect when contact occurs between the two parts being welded, which is beneficial in producing consistent weld results when the heights of unwelded parts vary. This method requires setting the following parameters (see Figure 5-18):

- Spin Torque (% of maximum torque) - This value specifies the level of spin torque which is to be reached for the weld phase to start. If the Idle Spin Torque Compensation option is disabled, this value represents the total torque required to keep the motor spinning at the programmed weld speed, which is the sum of the internal motor friction torque and the torque applied to the parts. If the Idle Spin Torque Compensation option is enabled (on screen SETUP
> GENERAL > OPTIONS), this value represents the torque applied to the parts only. The proper value is dependent on the application, but a typical starting point is 10%.

- **Sensing Start Position (mm)** – This value specifies the vertical position at which the welder will start monitoring the spin motor torque to detect when it reaches the level specified above. At the start of the cycle, the press will initially travel down rapidly, then slow down before reaching this position. It is critical that this value is set such that when the press is in this position, there is always a gap between the parts to be welded (i.e. parts are not in contact), regardless of unwelded part height variation. Failure to do so may cause inaccurate triggering and result in inconsistent or over-welded assemblies. The minimum recommended gap is .020 inch (0.5 mm). The Sensing Start Position value can be manually entered into the field or taught by jogging using the TEACH button to the right of the field (see page 54).

- **Timeout (seconds)** – This value specifies the allotted amount of time from the start of the cycle until Spin Torque trigger is detected. If the trigger event does not occur within this time, an alarm is triggered and the weld cycle is aborted.

**Method 2) Position** - This method specifies that the weld phase will begin when the vertical press position reaches a prescribed (absolute) position. It requires setting the following parameters (see Figure 5-19):  

- **Position (mm)** – This value specifies the vertical position at which the weld phase will start. At the start of the cycle, the press will initially travel down rapidly, then slow down to the programmed vertical weld speed by the time it reaches this position.

- **Timeout (seconds)** - This value specifies the allotted amount of time from the start of the cycle until Position trigger is detected. If the trigger event does not occur within this time, an alarm is triggered and the weld cycle is aborted.

**Method 3) External Signal** - This method specifies that the weld phase will begin when an external digital input signal is detected by the welder. This method functions in the same manner as the Spin Torque method described.
above, except instead of the welder monitoring spin motor torque and detecting when it reaches a specific level, it monitors an external input and detects when the input is activated. The external signal must be wired to the J2 INPUTS connector (pin 13) on the back of the welder (see Section 8 for wiring details). This feature requires a sensor or switch to be integrated with the tooling, which activates a digital output when the desired condition (such as reaching a specific force on the fixture) are met. It is useful in unique applications, such as small parts, where the sensitivity of the Spin Torque method is not sufficient. This method requires setting the following parameters (see Figure 5-20):

- **Sensing Start Position** (mm) - This value specifies the vertical position at which the welder will start monitoring the external signal to detect when it becomes active. At the start of the cycle, the press will initially travel down rapidly, then slow down before reaching this position. It is recommended that this value is set such that when the press is in this position, there is a gap between the parts to be welded (i.e. parts are not in contact), regardless of unwelded part height variation. The minimum recommended gap is .020 inch (0.5 mm). If the signal is active before the press reaches this position, an alarm is triggered. The Sensing Start Position value can be manually entered into the field or taught by jogging using the TEACH button to the right of the field (see page 54).

- **Timeout** (seconds) - This value specifies the allotted amount of time from the start of the cycle until External Signal trigger is detected. If the trigger event does not occur within this time, an alarm is triggered and the weld cycle is aborted.
WELD

The button to the right of the TRIGGER button is the WELD button. This button brings up the Weld view (see Figure 5-21). The settings in this view are used to define the weld phase, which immediately follows the trigger event. The Method drop down box in the top left corner of the Weld view offers four options, which determine how the weld phase ends. The required parameter fields are displayed once the method is selected.

**Method 1) Distance** - This method specifies that the weld phase will be controlled by the vertical distance traveled after the trigger event. It requires setting of the Distance (mm) field (see Figure 5-21), which indicates the amount of relative vertical travel (i.e., collapse distance) during the weld phase. While the press is traveling down, the spin tool rotates at a constant weld speed (RPM) and automatically decelerates to a stop by the time the Distance is reached.

**Method 2) Position** - This method specifies that the weld phase will be controlled by the vertical position. It requires setting of the Position (mm) field (see Figure 5-22), which indicates the vertical (absolute) position at which the weld phase will end. While the press is traveling down, the spin tool rotates at a constant weld speed (RPM) and automatically decelerates to a stop by the time the Position is reached. The Position value can be manually entered into the field or taught by jogging using the TEACH button to the right of the field (see page 54).

**Method 3) Energy** - This method specifies that the weld phase will be controlled by the amount of energy output by the spin servo drive after the trigger event. It requires setting of the Energy (J) field (see Figure 5-23), which indicates the amount of energy output at which the spin tool will start to decelerate to a stop. Once the spin tool stops, the weld phase ends.

**Method 4) Peak Spin Torque** - This method specifies that the weld phase will be controlled by the level of torque of the spin motor. It requires setting of the Peak Spin Torque (% of maximum torque) field (see Figure 5-24), which indicates the level of spin torque at which the spin tool will start to decelerate to a stop. Once the spin tool stops, the weld phase ends.
Idle Spin Torque Compensation option is enabled (on screen SETUP > GENERAL > OPTIONS), this value represents the peak torque applied to the parts only.

For each of the four methods listed the following five fields must be set:

- **Vertical Speed** (mm/s) - This value specifies the vertical speed during the weld phase. Typical values are 0.5-3 mm/s.
- **Spin Speed** (RPM) - This value specifies the rotational speed of the spin tool.
- **Spin Deceleration** (% of nominal) - This value specifies the rate of spin tool deceleration at the end of the weld phase.
- **Spin Direction** (CW/CCW) - This value specifies the direction of spin tool rotation, which can be clockwise (CW) or counter-clockwise (CCW).
- **Timeout** (seconds) - This value specifies the allotted amount of time from the trigger event until the end of the weld phase. If this time is exceeded, an alarm is triggered and the weld cycle is aborted.

For each of the weld methods listed above, the following two options are available:

- **Weld Orientation** - When this option is enabled, the spin tool will stop at a specific angular orientation at the end of the weld phase. It requires setting of the Weld Orientation (deg.) field, which appears to the right of the option (see Figure 5-21). The value can be manually entered into the field or taught by jogging using the TEACH button to the right of the field (see page 54).
- **Melt-Match® Mode** - When this option is enabled, the vertical speed is automatically varied during the weld phase to match the rate of plastic melt of the parts being joined. In this mode, the torque of the spin motor is continuously sampled and the vertical speed is continuously adjusted (on-the-fly) based on the spin torque measurements. The goal of the vertical speed adjustments is to maintain the spin torque at a nearly constant level. If the measured spin torque falls below the programmed target, the vertical speed will automatically increase. Conversely, if the torque rises above the target,
the vertical speed will automatically decrease. The underlying implementation of this feature is a closed-loop proportional/integral (PI) control algorithm, where spin torque is the process variable being controlled.

When the Melt-Match® Mode box is checked, a SETTINGS button appears to the right of the option (see Figure 5-25). Pressing it causes the Melt-Match® Setup view to be activated, where the required parameter fields are displayed (see Figure 5-26):

- **Spin Torque** (% of maximum torque) - This value specifies the target level of spin torque to maintain during the weld phase. If the Idle Spin Torque Compensation option is enabled (on screen SETUP > GENERAL > OPTIONS), this value represents the torque applied to the parts only.

- **Max. Vertical Speed** (mm/s) - This value specifies the maximum vertical speed of the press while attempting to reach the spin torque target.

- **Proportional Gain & Integral Gain** - These parameters specify the proportional and integral gains of the control algorithm, which determine the amount and response time of the changes in vertical speed in response to the measured spin torque. Proportional gain affects the amount of speed change, where higher values will cause larger speed changes. Integral gain affects the response time of the speed change, where higher values will cause the changes to occur faster.

When the Melt-Match® Mode box is checked, the **Initial Vertical Speed** (mm/s) field shown in Figure 5-25 must also be specified. This value is the vertical speed upon entering Melt-Match® Mode. Shortly after the mode is initiated, however, the vertical speed will change based on the automatic control algorithm.

Note: Depending on the selected Weld Method and state of the Weld Orientation option, automatic adjustment of the vertical speed may be terminated shortly before the end of the weld phase. In these cases, the vertical
speed will automatically change to and be maintained at a constant level equal to the average speed during the weld up to this point of transition.

**HOLD**

To the right of the WELD button is the HOLD button. This button brings up the Hold view (see Figure 5-27). The settings in this view are used to define the hold phase, which immediately follows the weld phase. During this phase, the molten plastic cools and solidifies, beginning when the spin tool stops at the end of the weld phase. Two hold segments are available: dynamic and static. During dynamic hold, the press travels for a specified distance at a constant speed to compress the parts being welded while the material is still in the molten state. During static hold, which follows dynamic hold, the vertical position is maintained (i.e. press is stationary) for a specified time duration to allow the plastic to solidify. The Method drop down box in the top left corner of the Hold view offers four options, which determine the hold segment combination to be utilized. The required parameter fields are displayed once the method is selected.

**Method 1) Dynamic and Static** - This method specifies that both dynamic and static hold segments are performed. After the static hold segment is completed, the press head retracts to the Top of Stroke Position. This method requires setting the following parameters (see Figure 5-27):
• **Dynamic Hold Distance** (mm) - This value specifies the amount of relative vertical travel during dynamic hold. The zero reference for this distance is the vertical position at the end of the weld phase. Typical values are 5-10% of the weld collapse distance.

• **Vertical Speed** (mm/s) - This value specifies the vertical speed during the dynamic hold segment. This speed is in effect from the start of dynamic hold until the press automatically decelerates and stops at the prescribed Dynamic Hold Distance. Typical values are 0.5-5 mm/s.

• **Timeout** (seconds) - This value specifies the allotted amount of time for the dynamic hold segment to complete. If this time is exceeded, an alarm is triggered and the weld cycle is aborted.

• **Static Hold Time** (seconds) - This value specifies the amount of time during which the press position will be maintained.

*Method 2)* **Dynamic Only** - This method specifies that only the dynamic hold segment is performed. After this segment is completed, the press head retracts to the Top of Stroke Position. It requires setting of the Dynamic Hold Distance, Vertical Speed, and Timeout fields (see Figure 5-28) described above for Method 1.

*Method 3)* **Static Only** - This method specifies that only the static hold segment is performed. After this segment is completed, the press head retracts to the Top of Stroke Position. It requires setting only Static Hold Time field (see Figure 5-29) described above for Method 1.

*Method 4)* **None** - This method disables both hold segments. When selected, the press head retracts to the Top of Stroke Position immediately following the weld phase.

Note: Regardless of the Hold Method selection, while the press head is retracting to the Top of Stroke Position, power to the spin motor is removed to reduce the possibility of the welded parts being damaged as the upper part disengages from the spin tool. Power is restored once the press reaches the Top of Stroke Position. As a result, the spin tool orientation after retraction may be different than the Weld Orientation.
LIMITS

To the right of the HOLD button is the LIMITS button. This button brings up the Limits view (see Figure 5-30). The settings in this view define which process limits are enabled and their corresponding lower and upper ranges. The Limits view spans four screens, which are accessed by pressing the MORE LIMITS button (see Figures 5-30, 5-31, 5-32, and 5-33). The available limit parameters are the same as the weld process parameters shown on the RUN > CYCLE DATA screen.

A limit is enabled by checking the box next to the corresponding parameter, then entering the LOWER and UPPER values as shown in Figure 5-30 for limit Position At Trigger. The lower value must be less than the upper value for all limits except Weld Orientation. Any number and combination of limits may be active. If at least one limit is violated during the weld cycle, the Part Analysis field on the RUN > CYCLE DATA screen will indicate BAD. In addition, all parameters for which violations occurred will be highlighted by a red background on the RUN > HISTORY screen.

At the bottom of each Limits view screen is the Abort Cycle and Latch on Bad Part option. When enabled, the weld cycle will be stopped as soon as a process limit violation is detected. In addition, the limit violation must be acknowledged before the next cycle can be initiated, either by pressing the CLEAR ALARMS button on the HMI or, in automated environments, activating the SYSTEM LATCH RESET input on the J2 connector (see Section 8). If a supervisor password has been set, this password must be entered to acknowledge the limit violation via the HMI.

In some manufacturing environments, it may be desirable to prevent a welded assembly from being removed by the operator from the fixture if a process limit has been violated. This behavior is achieved for most process limits when the Abort Cycle and Latch on Bad Part option is enabled and a supervisor password is set since the welder head will remain in place when a limit violation is detected, trapping the parts between the
spin tool and fixture.

**Position TEACH Feature**

The position TEACH feature is used to facilitate setting specific vertical and spin motor positions by jogging the press head or spin tool. Access to this feature is provided via the TEACH button, which appears on setup screens next to all parameters that can be taught. When this button is pressed, the Teach view is displayed. If the TEACH feature was invoked for a vertical parameter, this view appears as in Figure 5-34. If invoked for a spin parameter, the view appears as in Figure 5-35.

Near the top of the Teach view screen is a label indicating which parameter is being taught. This label starts with “TEACH..." and is followed by the parameter name. Directly below the label is the Current Value field, which shows the value of this parameter currently stored in the setup. Below the Current Value field is the SET NEW VALUE button. Once the desired motor position is reached by jogging, pressing this button causes the Current Value field to be overwritten with the present motor position. If the SET NEW VALUE button is not pressed, the Current Value field remains unchanged regardless of the motor position.

Depending on what parameter is being taught, either the JOG VERTICAL or JOG SPIN group box will be visible. These boxes are used to set and monitor motor motion while manually jogging the motor. The JOG VERTICAL box appears on the left side of the SET NEW VALUE button. The JOG SPIN box appears on the right side of the SET NEW VALUE button. The SET NEW VALUE button is only enabled when the correct JOG box is selected, but either axis can be jogged while this screen is active. For example, when teaching a spin orientation position as shown in Figure 5-35, the press head can be jogged by pressing the Jog Vertical button.
Both group boxes contain buttons in their first row to set travel direction for the corresponding motor. For the JOG VERTICAL box these are Up and Down buttons. For the Jog Spin box these are Clockwise and Counter-Clockwise buttons. In the second row are buttons for setting the travel speed of the selected motor: HIGH, MED (medium), and LOW.

Below the travel speed buttons are live readouts of Position/Orientation and Torque. Once the direction and speed are set, both operate switches must be activated to start motor movement as indicated by the message at the top of the screen.

If the motor is at a position different than what is shown in the Current Value field, it can be returned easily to the current value by using the MOVE TO CURRENT VALUE button in the top right corner. After pressing this button, activating the operate switches will cause the motor to move until it reaches the position shown in the Current Value field. Once motion stops, the operating switches can be deactivated.

To exit the TEACH feature, press the DONE button. The screen will revert to the view from which the TEACH feature was invoked.
SYSTEM Mode

The SYSTEM mode is accessed by pressing the SYSTEM button directly below the SETUP button on the left hand side of the screen. The SYSTEM mode contains information specific to the welder as well as access to various configuration settings and diagnostic features. The default first view for System mode is INFO.

INFO

The INFO view (see Figure 5-36) contains information about the pedigree of the welder. This includes: model number, serial number, software version, tuning database version, motor configuration version, IP address, and total number of weld cycles.

CONFIGURATION

To the right of the INFO button is the CONFIGURATION button. This button brings up the Configuration view (see Figure 5-37). In this view, general system configuration parameters can be set. These parameters apply to the welder as a whole (i.e., not setup-specific).

In the first row are the date and time fields. These can be set by entering the values for each year and date field, then pressing the SET DATE/TIME button on the far right. Current date and time values can be viewed in the upper right hand corner of the screen.

In the second row is the IP address fields. The first field shows the Current IP address. The second field is for entering a New IP address. This can be done by first entering the new address, then pressing the APPLY NEW IP button. It is recommended that the default IP address be retained in most cases to facilitate diagnostics.

In the third row is the SUPERVISOR PASSWORD field. When this field is blank, password protection is disabled. When the field is populated, protection is automatically enabled. Enabling password protection causes access to all HMI screens containing setup and welder configuration parameters to be restricted as shown in Figure 5-38. However, access to the following screens is not restricted to allow the welder to be operated: RUN (CYCLE DATA, GRAPH, LIVE DATA,
and HISTORY), SETUP > MANAGE (Select Setup and SUMMARY only), SYSTEM > INFO.

To the right of the SUPERVISOR PASSWORD field is the LOGOUT button. When a password is set, it must be entered to gain access to any password-protected screen. Once accessed, navigation to all other password-protected screens is permitted without having to re-enter the password each time for a duration of 1 minute. Pressing the LOGOUT button causes password protection to be re-applied immediately.

In the fourth row is the LANGUAGE SELECTION field. The desired language is activated by selecting it in the drop down list.

In the fifth row is the Home Spin Offset field. This value will set an offset to the spin motor’s predefined zero point. For example, if this value is set to 5 degrees, the spin motor will initially home to its encoder reference, then rotate an additional 5 degrees. This position will be designated as the 0 degree reference for all spin orientation parameters programmed in all setups. This feature is useful in correcting for any offsets in spin hub orientation if service is performed on the spin axis, especially if a large number of setups is utilized.

To the right of the Home Spin Offset field is the Remote Setup Switch field. When this option is enabled, the active setup is selected by remote digital input signals instead of manually on the HMI Setup Mode, Manage view. Additional details on remote setup switching are provided in Section 8.

In the last row is the Screen Brightness slider. Slide left to lower the screen brightness and slide right to increase the screen brightness. To extend the life of the HMI backlight, screen brightness is automatically reduced from the level specified on the slider if no welder activity is detected for a period of 75 minutes. The backlight is turned off completely if no welder activity is detected for 90 minutes, but the welder remains in an operational state. After either condition occurs, touching any part of the screen causes the set brightness to be restored.

Figure 5–38 Password-Protected Screen Example
UTILITIES

To the right of the CONFIGURATION button is the UTILITIES button. This button brings up the Utilities view (see Figure 5-39), which contains several groups of functions. The Set Next Cycle Part Number button and Part Number field are used to set the part number of the next cycle, which is displayed in the cycle data on the RUN screen. To set the number, enter it in the field, then press the button.

Below the part number fields are four buttons related to the welder safety component configuration. Buttons Safety with Light Curtains and Safety without Light Curtains are used to commission the welder after the software is initially installed, depending on whether light curtains are being integrated with the welder. Buttons Enable Light Curtains and Disable Light Curtains are used to reconfigure the safety components to work with or without light curtains, respectively. Do not use these buttons unless changing the welder configuration to add or remove light curtains, or being instructed by Dukane to do so.

At the bottom of the view are the Import Tuning Database From USB and Import Motor Configuration From USB buttons. These allow for the loading of custom tuning databases and motor configuration files. They should only be used with guidance from Dukane.

DIAGNOSTICS

To the right of the UTILITIES button is the DIAGNOSTICS button. This button brings up the Diagnostics view (see Figure 5-40). This view provides access to screens for the review of alarms, diagnostics data, and the export of snapshot data.

At the top left corner of the Diagnostics view is the ALARMS button. Access the Alarms view by pressing the ALARMS button (see the following section).

To the right of the Alarms button is the Systems Diagnostics Manager (SDM) button. Pressing this button will bring up the SDM view. This view is intended for advanced diagnostics purposes. It should only be used with guidance from Dukane.

Below the ALARMS button are two “snapshot” buttons,
which are used to export useful archiving and diagnostic information from the welder to an external USB storage device. Both buttons are enabled when a USB storage device is plugged into the welder USB port.

When the APPLICATION SNAPSHOT TO USB button is pressed, a folder is created on the storage device named “ApplicationSnapshot_SN_DATE_TIME” (where SN is welder serial number, DATE and TIME are date and time of the snapshot), containing data in the following folders:

**Screenshots** – Screen captures of the active welder setup shown on the SETUP SUMMARY screens and welder information shown on the SYSTEM > INFO screen.

**Setup** – A copy of the setup file in native format.

**Weld Data** – Cycle data file (.csv format) containing weld process results for all cycles executed on the day of the snapshot.

**Graphs** – Graph data files (.csv format) for the last 10 weld cycles.

**Alarms** – Alarm history file (.csv format)

The APPLICATION SNAPSHOT TO USB feature is especially useful in capturing the active setup and weld results for documentation purposes. Using this feature and storing the exported data in a secure location is recommended after a successful setup recipe is developed. Providing application snapshot files to Dukane personnel will likely facilitate troubleshooting of various problems.

When the SYSTEM SNAPSHOT TO USB button is pressed, a folder is created on the storage device named “Snapshot_SN_DATE_TIME” (where SN is welder serial number, DATE and TIME are date and time of the snapshot), containing data organized in folders similarly to the application snapshot described above. The system snapshot contains a more extensive set of data compared to the application snapshot, including all historical cycle data and graph data residing in welder memory. The purpose of the system snapshot is for both data archiving and diagnostic purposes. Note that it may take several minutes for the data to be written to the USB storage device.
Alarms View

The Alarms view (see Figure 5-41) will appear when an alarm is triggered (for most alarms). It can also be accessed from the System Mode > Diagnostics view > ALARMS button.

The Alarms view consists of a **Current Alarms list** in the center of the screen. This list contains only alarms that have not been cleared. The list can be navigated using the four **arrow buttons** to the right of the list.

Below the arrow buttons is a large **Reset All Alarms button**. Pressing this clears the current alarm list.

Below the Reset All Alarms button is the **History button**. Pressing this button brings up the **Alarm History list** (see Figure 5-42). This list shows all previous alarms. It can also be navigated using the arrows on the right side of the screen.

While viewing the Alarm History list, the **EXPORT ALL TO USB button** is available below the arrow keys on the right side of the screen. This will transfer the Alarm History list to a USB storage device if one is plugged in.

Below the export button is the **BACK button**, which causes the screen to change back to the Current Alarm list.

Alarms appear on the Current Alarm and Alarm History list from the most recent to the oldest. Each alarm is listed with the date, time, internal error code, external “Sxxx” error code, and description.


Parameter Value Range

The minimum and maximum values of the welding parameters are listed in Table 5-1.

<table>
<thead>
<tr>
<th>Screen</th>
<th>Parameter Name</th>
<th>Min. Value</th>
<th>Max. Value</th>
<th>Resolution</th>
<th>Units</th>
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<td>Tool Inertia</td>
<td>0.0</td>
<td>3000.0 (SSW800) 700.0 (SSW3000) 160.0 (SSW4000)</td>
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<td>kg* cm²</td>
</tr>
<tr>
<td></td>
<td>Top of Stroke Position</td>
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<td>127.00</td>
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<td>mm</td>
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<td></td>
<td>Vertical Travel Limit</td>
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<td>0.01</td>
<td>mm</td>
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<td>100</td>
<td>1</td>
<td>sec</td>
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<tr>
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<td>127.00</td>
<td>0.01</td>
<td>mm</td>
</tr>
<tr>
<td></td>
<td>Sensing Speed</td>
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<td>100.00</td>
<td>0.01</td>
<td>mm/s</td>
</tr>
<tr>
<td></td>
<td>Force</td>
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<td>100.00</td>
<td>0.1</td>
<td>%</td>
</tr>
<tr>
<td></td>
<td>Position</td>
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<td>127.00</td>
<td>0.01</td>
<td>mm</td>
</tr>
<tr>
<td></td>
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<td>99.00</td>
<td>0.01</td>
<td>sec</td>
</tr>
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<td>100.00</td>
<td>0.1</td>
<td>%</td>
</tr>
<tr>
<td></td>
<td>Position</td>
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<td>127.00</td>
<td>0.01</td>
<td>mm</td>
</tr>
<tr>
<td></td>
<td>Sensing Start Position</td>
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<td>127.00</td>
<td>0.01</td>
<td>mm</td>
</tr>
<tr>
<td></td>
<td>Timeout</td>
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<td>0.01</td>
<td>sec</td>
</tr>
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<td>0.01</td>
<td>mm</td>
</tr>
<tr>
<td></td>
<td>Position</td>
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<td>127.00</td>
<td>0.01</td>
<td>mm</td>
</tr>
<tr>
<td></td>
<td>Energy</td>
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<td>999,999.0</td>
<td>0.1</td>
<td>Joules</td>
</tr>
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<td></td>
<td>Peak Spin Torque</td>
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<td>100.00</td>
<td>0.1</td>
<td>%</td>
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<tr>
<td></td>
<td>Vertical Speed</td>
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<td>100.00</td>
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<td>mm/s</td>
</tr>
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<td></td>
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<td>RPM</td>
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<td>Spin Deceleration</td>
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<td>%</td>
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<td>Weld Orientation</td>
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<td>0.1</td>
<td>deg</td>
</tr>
<tr>
<td></td>
<td>Timeout</td>
<td>0.01</td>
<td>99.00</td>
<td>0.01</td>
<td>sec</td>
</tr>
<tr>
<td>SETUP &gt; WELD &gt; Melt-Match® Mode</td>
<td>Spin Torque</td>
<td>1.0</td>
<td>100.00</td>
<td>0.1</td>
<td>%</td>
</tr>
<tr>
<td></td>
<td>Max Vertical Speed</td>
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<td>100.00</td>
<td>0.01</td>
<td>mm/s</td>
</tr>
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<td>Proportional Gain</td>
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<td>5000</td>
<td>0.1</td>
<td>-</td>
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<tr>
<td></td>
<td>Integral Gain</td>
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<td>5000</td>
<td>0.1</td>
<td>-</td>
</tr>
<tr>
<td>SETUP &gt; HOLD</td>
<td>Dynamic Hold Distance</td>
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<td>0.01</td>
<td>mm</td>
</tr>
<tr>
<td></td>
<td>Vertical Speed</td>
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<td>100.00</td>
<td>0.01</td>
<td>mm/s</td>
</tr>
<tr>
<td></td>
<td>Static Hold Time</td>
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<td>0.01</td>
<td>sec</td>
</tr>
<tr>
<td></td>
<td>Timeout</td>
<td>0.01</td>
<td>99.00</td>
<td>0.01</td>
<td>sec</td>
</tr>
<tr>
<td>SYSTEM &gt; CONFIGURATION</td>
<td>Home Spin Offset</td>
<td>0.0</td>
<td>359.9</td>
<td>0.1</td>
<td>deg</td>
</tr>
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</table>

Table 5-1  Welding Parameter Ranges
SECTION 6

Machine Operation

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Stopping a Weld Cycle......................................... 69
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Machine Setup

This section is intended for the first time set up of a new machine configured for stand-alone manual operation with a Dukane base, and only includes basic instructions. Contact Dukane for detailed set up assistance.

1. Base Interface Cable

Attach the base interface cable, supplied with the welder, from the rear of the base to the back of the thruster housing as shown in Figures 3–8 and 3–9.

2. AC Power Cord

Ensure the AC Power Switch, on the back of the welder, is in the OFF position. Insert the AC power cord plug into a 200-240 VAC, 1–Phase NEMA type 6–20R receptacle rated at 20 Amps. The correct style outlet is shown in Figure 3–5. Refer to the section on Electrical Safety in Section 2 if there are any questions.

3. Install Tooling & Fixture

Attach the upper (spin) tooling to the hub and tighten to the values specified in Section 3 under the heading Tooling Hub & Base, depending on welder model. Place the lower fixture on the base and attach it loosely with the M10 x 1.5 screws provided with the base. Leave the hardware loose so the fixture can be aligned later.

4. Adjust Thruster Position on Column

The rear support column features a threaded shaft for adjusting the position of the thruster head (see Figure 3–7). The thruster height should be adjusted properly to ensure that the weld head has enough travel to perform the weld (within the 5-inch (127 mm) stroke limit), and that the welded assembly can be readily removed from the tooling:

a) Using a 7/8 inch or 22 mm wrench, loosen the three Height Adjustment Lock Nuts that lock the head assembly in place (do not remove nuts).

b) Raise or lower the head by turning the Height Adjustment Knob on top of the column using the same wrench as in step a). One turn moves the head 1/8-inch (3.18 mm).

c) Once the desired thruster position is reached, retighten the three rear nuts that lock the head assembly in place.
5. Reset E-Stop
If the E-Stop button is pushed in, reset it by turning clockwise (see Figure 6-1).

6. Turn Power ON
Turn on the AC power switch. Wait until the welder completes its startup sequence (approximately 2 minutes), which is indicated by the appearance of the RUN screen (see Figure 5-2).

7. Set Tool Inertia
On the HMI (touch screen), press the SETUP button, then the GENERAL button. Enter the Tool Inertia value (kg*cm^2). (Refer to Section 10 for details on how to determine the inertia of the tool.)

8. Home the Welder
Press the RUN button and follow the instructions near the top of the HMI to perform the homing sequence (for details, refer to Homing Process in Section 5).

9. Level and Align Lower Fixture
Place the upper part to be welded into the spin tool, and the lower part into the fixture on the base. Using the Vertical Travel Limit teach mode (on screen SETUP > GENERAL > Vertical Travel Limit TEACH), jog the press head down to a position where the parts are nearly in contact at the weld joint (for details on jogging, refer to the Position TEACH Function in Section 5). Make the necessary adjustments to the leveling features of the fixture such that the part surfaces that will engage during the weld are parallel to each other. Once the fixture is level, slide it on the base such that the parts are concentric at the weld joint. The press head may need to be jogged up and down several times during this process.

The welder’s vertical force is limited in jog mode. An alarm will be triggered if excessive force is detected. If this happens, clear the alarm, follow the HMI instructions to home the welder, then navigate again to the Vertical Travel Limit teach screen.
Once the lower fixture is leveled and aligned, secure all lower fixture mounting hardware. Press the RUN button, then follow the HMI instructions to move the motors to start position(s).

10. Set Vertical Travel Limit Position
To protect the spin tool from contacting the lower fixture or over-compressing the parts, teach the Vertical Travel Limit by navigating to the same screen as in step 9 (SETUP > GENERAL > Vertical Travel Limit TEACH) after removing parts from the spin tool and fixture. Dukane recommends setting this limit such that there is at least .080 inch (2 mm) clearance between the spin tool and lower fixture when the press head is in this position.

11. Set Weld Process Parameters
With the basic tooling parameters set, step through each Setup view and set all necessary parameters. These views consist of TRIGGER, WELD, HOLD, and LIMITS. Each view is described in detail in Section 5. Frequently, the appropriate setup parameters are determined by Dukane applications engineers during application evaluation and development.

12. Put Welder in Ready State
Press the RUN button. If the STATUS area of the HMI does not show READY, follow the HMI instructions. Once STATUS shows READY, the welder is ready to run a weld cycle.
Running a Weld Cycle

All weld cycles must be initiated from the RUN screen. If not already on this screen, press the RUN button (see Figure 5-2). Before a cycle is allowed to start, the STATUS area in the upper left corner must indicate, “READY”. If it does not, the HMI will display a message with instructions on how to proceed or an alarm that must be cleared.

To run a cycle, ensure that parts are loaded into the welder tooling and, if present, all manually operated fixture clamps are secured. Next, activate both operate switches simultaneously and maintain activation. At this point, the press will start to move down and the spin tool will begin to rotate. The STATUS area will indicate “IN CYCLE” in blue. The weld cycle will then continue per the programmed setup parameters. The phase of the cycle will be indicated on the HMI just below the STATUS area, typically progressing through the sequence DOWNSTROKE, WELD, DYNAMIC HOLD, STATIC HOLD, and UPSTROKE. Figure 6-2 shows the RUN screen during a cycle, when the WELD phase is active. Once the STATIC HOLD phase begins, the operate switches can be deactivated without causing an alarm. To complete the cycle, the press retracts to the Top of Stroke Position.

If a weld cycle completes successfully, the STATUS will immediately return to “READY”, indicating that the machine is ready to run another cycle. If a cycle terminates abnormally, an alarm message will be displayed on the screen describing the error condition. The alarm must be cleared and the welder motors returned to their start positions before another cycle can be initiated.

Figure 6–2  RUN Screen During Weld Cycle
Stopping a Weld Cycle

During normal operation, the cycle stops automatically when the press returns to the Top of Stroke Position. To stop a cycle before it completes, release the operate switches and press the E-Stop switch. Releasing either of the operate switches between the start of the cycle and the start of the STATIC HOLD phase, or pressing the E-Stop at any time, causes rapid deceleration of both motors, then removal of power from the motors and the actuation of the vertical actuator holding brake.

The cycle will also stop automatically if any fault conditions are detected, including violations of the timeouts defined for various phases of the cycle (in SETUP mode > TRIGGER / WELD / HOLD views). The cycle can also stop on a process limit violation if the Abort Cycle and Latch on Bad Part option is enabled in the LIMITS view (see Section 5 for more details). In all cases, an alarm message will appear on the HMI indicating the reason for the cycle stop.

When the welder is integrated with external automation and the Initiate Mode is set to Automation (on SETUP > GENERAL screen), the weld cycle can be stopped using the E-Stop signals on the J6 BASE/ABORT connector and the CYCLE STOP input on the J2 INPUTS connector (refer to Section 8 for details).
SECTION 7

Optimizing Performance

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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. In Phase I, the rotational friction generates heat. Frictional heating is intensified with both axial (press vertical) and joint surface velocities. 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, where heat starts to be generated by internal friction within the molten region. This continues in Phase IV, where 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.

Material Considerations

Materials that can be friction (i.e. vibration) welded can also be joined by spin welding. Semicrystalline thermoplastics are more readily joined using spin welding than by ultrasonic welding. 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
Control Parameters

There are several primary process control parameters that affect weld quality. They are the surface speed at the weld joint, press (vertical) speed, weld depth, and hold distance and time.

The following sections are presented for informational purposes only and are 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 a general guideline for setting the initial parameters.

Surface Speed

For a fixed rotational spin speed (RPM), linear surface speed increases with weld joint diameter. For a fixed weld joint diameter, surface speed increases with motor RPM. Smaller diameter parts therefore usually require more RPM than larger parts of the same material. If the surface speed is too low, an adequate amount of heat will not be generated to cause sufficient melting. If the speed is too high, excessive heat in the joint could result in material degradation or reduction in viscosity leading to material flow away from the joint.

The selection of the proper surface speed depends to a large degree on the material and joint geometry of the parts being welded. Some materials, such as PVC, can be readily welded for a wide range of values, while others require a narrow range. Commonly quoted values in the literature recommend using surface speeds between 360 and 600 in./sec. However, speeds of 120 in./sec. and lower have been used with good results. The mathematical relationship between surface speed and spin speed (RPM) is given by the equation:

**NOTE**

Common hygroscopic thermoplastics:
- ABS/Polycarbonate (Cycoloy)
- Polyoxymethylene (Acetal, Delrin)
- Polyamides (Nylon, Zytel)
- Polycarbonate (Lexan)
- Polycarbonate/Polyester (Xenoy)
- Polysulfone (Udel)
RPM = \( \frac{60v}{\pi D} \)

where

- \( v \) is the surface velocity
- \( D \) is the average weld diameter

A plot of the spin speed and average weld diameter for a number of surface speed values is shown in Figure 7-1.

**Figure 7–1** Dependence of Spin Speed on the Weld Diameter for Selected Surface Speeds
Press (Vertical) Speed
The press speed affects the amount of contact pressure between the parts being welded, which is required to generate frictional heat. The larger the speed, the larger the rate of heat rise. In combination with the surface speed, press speed must be high enough to cause melting at the interface as opposed to grinding, but not too high as to damage the parts. Excessive press speed can also lead to stalling of the spin motor as more torque is required to maintain constant spin speed.

The ServoWeld™ Plus Spin Welder is capable of operating in two different press speed modes. With the Melt-Match® Mode option (in SETUP > WELD view) disabled, the press speed is constant during the weld. With this option enabled, the press speed is variable so as to keep the spin torque constant (see Section 5). The latter case resembles the operation of a pneumatically driven press, where the press speed is the result of the melt rate under given air pressure and spin speed conditions.

Selection of the optimum press speed depends on the material and joint geometry of the parts, as well as the surface speed. A range for initial experimentation is 0.5 to 2.0 mm/s.

Weld Depth
The determination of the proper weld depth is highly dependent on the application. The weld joint is typically designed for a specific weld penetration. Ideally, the weld is sufficiently deep to produce a strong, hermetically sealed assembly. An excessive depth may lead to the formation of flash (material that is ejected from the joint area during the weld and adheres to the assembly), the drawing out of reinforcing filler material and realignment of the interchain bonds in the weld plane resulting in a weak axial weld joint, and possibly part distortion.

Since weld depth affects the joint strength and the amount of flash generated, it is important to design the weld joint properly to meet both requirements simultaneously. The incorporation of flash trap features is recommended to produce acceptable appearance without compromising strength.
**Hold**

During the hold phase, vertical press travel initially brings the molten parts closer together (dynamic hold) and then allows the molten material to solidify (static hold). Amorphous plastics will normally take longer to solidify than semicrystalline plastics. The dynamic hold distance is typically a small value compared to the weld distance. An approximate starting point for initial application setup is 10% of weld distance. The static hold time can vary depending on the size of the part, but is usually in the 1-3 second range.

---

**Part Size**

Machine model selection will mostly depend on the weld diameter of the parts. Refer to Table 7-I for approximate guidelines.

For diameters greater than 4 inches, the SSW800 model is recommended due to its torque capacity. For diameters under 4 inches, the SSW3000 model is recommended due to its balance of torque capacity and speed. The SSW4000 model is used where high RPM (>3000) is required.

Please contact the Dukane Applications Department (see Section 14) for a recommendation concerning your specific application.

<table>
<thead>
<tr>
<th>Weld Diameter Range (in. [mm])</th>
<th>Machine Model</th>
<th>Peak RPM</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;2 [&lt;50]</td>
<td>SSW4000</td>
<td>4000</td>
</tr>
<tr>
<td>0.5-4 [12-100]</td>
<td>SSW3000</td>
<td>3000</td>
</tr>
<tr>
<td>4-7 [100-180]</td>
<td>SSW800</td>
<td>800</td>
</tr>
</tbody>
</table>

**Table 7-I**
Approximate Guidelines for Machine Model Selection Based on Weld Joint Diameter
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SECTION 8
Operation in Automation

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The Servo Weld™ Plus Spin Welder can be configured for stand-alone manual operation or automated operation, ranging from simple workcells to fully automated environments.

The sections below describe how to interface with the welder for operation in automation.

**Cable Connections**

Welder control and monitoring via external control devices requires cable connections to be made to the following connectors located on the back of the welder (refer to Figure 4-8): J6 BASE/ABORT, J2 INPUTS, and J3 OUTPUTS. Dukane offers the following cables with flying leads on one end which mate with these connectors to facilitate wiring (XX in the part number designates cable length in meters: 03, 05, 07, 09, 11, or 13):

for J6, 200-1546-XXM
for J2, 200-1381-XXM
for J3, 200-2071-XXM

Details on these connectors, including pin assignments and function descriptions, are listed below. The convention for indicating pin numbers is JX-Y, where X is the connector number and Y is the pin number (for example, J6-1 corresponds to pin 1 on connector J6). Detailed instructions on operating the welder are provided under the heading **Automated Operation** further below.
J6 BASE/ABORT Connector

The BASE/ABORT connector is the interface for the E-stop circuit and operating signals (for initiating welder motion). It is a DB-9 socket (female) connector. The pin numbers for the connector are shown in Figure 8–1. The pin assignments, wire colors, signal descriptions, and functions are given in Table 8-I. The wire colors correspond to the Dukane cables listed above.

Figure 8-2 shows the proper wiring of the Automation E-Stop Switch or Safety Circuit.

Figure 8-3 shows wiring of the operate signals. The welder has four anti-tie-down switch inputs, where two are normally open (N.O.), and two are normally closed (N.C.). The normally open inputs must always be in an opposite state to the normally closed inputs. All inputs must be simultaneously switched to activate and deactivate the operating signals.

<table>
<thead>
<tr>
<th>Pin</th>
<th>Wire Color (cable 200-1546-XXM)</th>
<th>Signal</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Black</td>
<td>OPERATE SIGNAL 1 INPUT, N.O.</td>
<td>Connect to pin 7 to operate. Open when not operating.</td>
</tr>
<tr>
<td>2</td>
<td>Red</td>
<td>OPERATE SIGNAL 2 INPUT, N.O.</td>
<td>Connect to pin 7 to operate. Open when not operating.</td>
</tr>
<tr>
<td>3</td>
<td>Green</td>
<td>E-STOP INPUT, N.C.</td>
<td>Connect to pin 9 when E-Stop is not engaged. Open when E-Stop is engaged.</td>
</tr>
<tr>
<td>4</td>
<td>White</td>
<td>E-STOP INPUT, N.O.</td>
<td>Open when E-Stop is not engaged. Connect to pin 5 when E-Stop is engaged.</td>
</tr>
<tr>
<td>5</td>
<td>Brown</td>
<td>GND</td>
<td>Chassis Ground</td>
</tr>
<tr>
<td>6</td>
<td>Blue</td>
<td>OPERATE SIGNAL 1 INPUT, N.C.</td>
<td>Open to operate. Connect to pin 7 when not operating.</td>
</tr>
<tr>
<td>7</td>
<td>Orange</td>
<td>+22 VDC OPERATE SIGNAL SUPPLY</td>
<td>+22 VDC supply for operate signals</td>
</tr>
<tr>
<td>8</td>
<td>Yellow</td>
<td>OPERATE SIGNAL 2 INPUT, N.C.</td>
<td>Open to operate. Connect to pin 7 when not operating.</td>
</tr>
<tr>
<td>9</td>
<td>Violet</td>
<td>+22 VDC E-STOP SUPPLY</td>
<td>+22 VDC supply for E-Stop signal</td>
</tr>
</tbody>
</table>

Table 8-I Pin Assignments and Signal Descriptions for the J6 BASE/ABORT Connector
Figure 8-2  Wiring of E-Stop Switch or Safety Circuit

Figure 8-3  Wiring of Operate Signals
J2 INPUTS Connector
The INPUTS connector is the interface for activating welder inputs. It is a DB-25 socket (female) connector. The pin numbers for the connector are shown in Figure 8–4. The pin assignments, wire colors, signal descriptions, and functions are given in Table 8-II. The wire colors correspond to the Dukane cables listed above.

All inputs are optically isolated from the internal circuits and can be connected to sinking or sourcing PLC output cards. The inputs will draw approximately 10 mA with a 24 VDC supply. The inputs can also be configured for a contact closure if necessary. Wiring examples are provided in Figure 8-5 (PLC Sourcing Output Card), Figure 8-6 (PLC Sinking Output Card), and Figure 8-7 (Relay Contact Closure).
### Table 8-II  Pin Assignments and Signal Description for the J2 INPUTS Connector

<table>
<thead>
<tr>
<th>Pin</th>
<th>Wire Color (cable 200-1381-XXM)</th>
<th>Signal</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Black</td>
<td>+22 VDC</td>
<td>+22 VDC supply from welder (500 mA max.)</td>
</tr>
<tr>
<td>2</td>
<td>White</td>
<td>GND</td>
<td>Chassis ground</td>
</tr>
<tr>
<td>3</td>
<td>Red</td>
<td>GND</td>
<td>Chassis ground</td>
</tr>
<tr>
<td>4</td>
<td>Green</td>
<td>ISOLATED INPUT COMMON</td>
<td>ISOLATED INPUT COMMON connection shared by all INPUTS (pins 5-25).</td>
</tr>
<tr>
<td>5</td>
<td>Orange</td>
<td>SPARE INPUT 1</td>
<td>Not used</td>
</tr>
<tr>
<td>6</td>
<td>Blue</td>
<td>SPARE INPUT 2</td>
<td>Not used</td>
</tr>
<tr>
<td>7</td>
<td>White/Black</td>
<td>REMOTE SETUP BIT 5</td>
<td>Set bit states to activate a specific setup from the 64 available onboard setups. (See section REMOTE SETUP SWITCHING for details.)</td>
</tr>
<tr>
<td>8</td>
<td>Red/Black</td>
<td>REMOTE SETUP BIT 4</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Green/Black</td>
<td>REMOTE SETUP BIT 3</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Orange/Black</td>
<td>REMOTE SETUP BIT 2</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Blue/Black</td>
<td>REMOTE SETUP BIT 1</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Black/White</td>
<td>REMOTE SETUP BIT 0</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Red/White</td>
<td>EXTERNAL TRIGGER</td>
<td>Activate when trigger condition has been detected by external sensor. (Used only when Trigger Method is set to External Signal.)</td>
</tr>
<tr>
<td>14</td>
<td>Green/White</td>
<td>PART PRESENCE SENSOR 2</td>
<td>Activate when sensor indicates part is present. (Used only when Part Presence Sense 2 option is enabled.)</td>
</tr>
<tr>
<td>15</td>
<td>Blue/White</td>
<td>PART PRESENCE SENSOR 1</td>
<td>Activate when sensor indicates part is present. (Used only when Part Presence Sense 1 option is enabled.)</td>
</tr>
<tr>
<td>16</td>
<td>Black/Red</td>
<td>LIGHT CURTAIN STATUS 2</td>
<td>Activate when light curtain is not obstructed. Deactivate when light curtain is obstructed. (Used only when Light Curtains are enabled.)</td>
</tr>
<tr>
<td>17</td>
<td>White/Red</td>
<td>LIGHT CURTAIN STATUS 1</td>
<td>Activate when light curtain is not obstructed. Deactivate when light curtain is obstructed. (Used only when Light Curtains are enabled.)</td>
</tr>
<tr>
<td>18</td>
<td>Orange/Red</td>
<td>FIXTURE CLAMP 2 OPEN SENSOR</td>
<td>Activate when fixture clamp 2 is fully open. (Used only when Fixture Clamp 2 option is enabled.)</td>
</tr>
<tr>
<td>19</td>
<td>Blue/Red</td>
<td>FIXTURE CLAMP 1 OPEN SENSOR</td>
<td>Activate when fixture clamp 1 is fully open. (Used only when Fixture Clamp 1 option is enabled.)</td>
</tr>
<tr>
<td>20</td>
<td>Red/Green</td>
<td>FIXTURE CLAMP 2 CLOSED SENSOR</td>
<td>Activate when fixture clamp 2 is fully closed. (Used only when Fixture Clamp 2 option is enabled.)</td>
</tr>
<tr>
<td>21</td>
<td>Orange/Green</td>
<td>FIXTURE CLAMP 1 CLOSED SENSOR</td>
<td>Activate when fixture clamp 1 is fully closed. (Used only when Fixture Clamp 1 option is enabled.)</td>
</tr>
<tr>
<td>22</td>
<td>Black/White/Red</td>
<td>AUTOMATION ENABLE</td>
<td>Function depends on use of light curtains: If light curtains are not integrated with the welder, activate to permit operation in automation (signal must always be on if the Initiate Mode is set to Automation, but it does not initiate motion). If light curtains are integrated with the welder and Initiate Mode is set to Automation, signal must be off.</td>
</tr>
<tr>
<td>23</td>
<td>White/Black/Red</td>
<td>SYSTEM LATCH RESET</td>
<td>Activate to reset latch if bad part is detected (output J3-7) when option Abort Cycle and Latch on Bad Part is enabled.</td>
</tr>
<tr>
<td>24</td>
<td>Red/Black/White</td>
<td>ALARM RESET</td>
<td>Activate to reset alarm.</td>
</tr>
<tr>
<td>25</td>
<td>Green/Black/White</td>
<td>CYCLE STOP</td>
<td>Activate to stop weld cycle.</td>
</tr>
</tbody>
</table>
(Note: An external +22 to +30 VDC supply can be used instead of the welder’s internal supply. The wiring shown above would be altered by replacing the connection to J2-1 with a connection to the external supply positive terminal, and the connection to J2-2 with a connection the external supply negative terminal.)

**Figure 8–5**  Wiring with PLC Sourcing Output Card

(Note: An external +22 to +30 VDC supply can be used instead of the welder’s internal supply. The wiring shown above would be altered by replacing the connection to J2-1 with a connection to the external supply positive terminal, and the connection to J2-2 with a connection the external supply negative terminal.)

**Figure 8–6**  Wiring with PLC Sinking Output Card
Figure 8–7  Wiring with Relay Contact Closure

(Note: An external +22 to +30 VDC supply can be used instead of the welder’s internal supply. The wiring shown above would be altered by replacing the connection to J2-1 with a connection to the external supply positive terminal, and the connection to J2-2 with a connection to the external supply negative terminal.)
**J3 OUTPUTS Connector**

The OUTPUTS connector is the interface for welder outputs. It is a DB-15 socket (female) connector. The pin numbers for the connector are shown in Figure 8–8. The pin assignments, wire colors, signal descriptions, and functions are given in Table 8-III. The wire colors correspond to the Dukane cables listed above.

All outputs are optically isolated from the internal circuits and can be connected to sinking or sourcing PLC input cards. Each output is rated to sink or source up to 350 mA. The welder +22 VDC supply (J3-15) is limited to 800 mA. Wiring examples are provided in Figure 8-9 (PLC Sourcing Input Card) and Figure 8-10 (PLC Sinking Input Card).
<table>
<thead>
<tr>
<th>Pin</th>
<th>Wire Color (cable 200-2071-XXM)</th>
<th>Signal</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Black</td>
<td>READY STATUS</td>
<td>ON when welder is ready to run a weld cycle. OFF when welder is not ready to run a weld cycle.</td>
</tr>
<tr>
<td>2</td>
<td>White</td>
<td>TOP OF STROKE STATUS</td>
<td>ON when press is at Top of Stroke Position. OFF when press is not at Top of Stroke Position.</td>
</tr>
<tr>
<td>3</td>
<td>Red</td>
<td>HOMING STATUS</td>
<td>ON when welder needs to be homed or motors need to be moved to cycle start positions. OFF when welder is homed and motors are in cycle start positions.</td>
</tr>
<tr>
<td>4</td>
<td>Green</td>
<td>WELDER IN CYCLE</td>
<td>ON when weld cycle is in progress. OFF when weld cycle is not in progress.</td>
</tr>
<tr>
<td>5</td>
<td>Orange</td>
<td>WELDER ALARM</td>
<td>ON when at least one alarm is active. OFF when no alarms are active.</td>
</tr>
<tr>
<td>6</td>
<td>Blue</td>
<td>GOOD PART STATUS</td>
<td>ON after weld cycle is complete during which no process limits were violated. OFF when a cycle is in progress.</td>
</tr>
<tr>
<td>7</td>
<td>White/Black</td>
<td>BAD PART STATUS</td>
<td>ON during or after weld cycle in which at least one process limit was violated or an alarm occurred. OFF when weld cycle is in progress (unless a process limit violation or alarm(s) occur), and after weld cycle is complete during which no process limit violation(s) or alarm(s) occurred.</td>
</tr>
<tr>
<td>8</td>
<td>Red/Black</td>
<td>FIXTURE CLAMP 1 CLOSE</td>
<td>ON when welder commands closure of fixture clamp 1. OFF when welder commands opening of fixture clamp 1. (Used only when Fixture Clamp 1 option is enabled.)</td>
</tr>
<tr>
<td>9</td>
<td>Green/Black</td>
<td>FIXTURE CLAMP 2 CLOSE</td>
<td>ON when welder commands closure of fixture clamp 2. OFF when welder commands opening of fixture clamp 2. (Used only when Fixture Clamp 2 option is enabled.)</td>
</tr>
<tr>
<td>10</td>
<td>Orange/Black</td>
<td>FIXTURE CLAMP 1 OPEN</td>
<td>ON when welder commands opening of fixture clamp 1. OFF when welder commands closure of fixture clamp 1. (Used only when Fixture Clamp 1 option is enabled.)</td>
</tr>
<tr>
<td>11</td>
<td>Blue/Black</td>
<td>FIXTURE CLAMP 2 OPEN</td>
<td>ON when welder commands opening of fixture clamp 2. OFF when welder commands closure of fixture clamp 2. (Used only when Fixture Clamp 2 option is enabled.)</td>
</tr>
<tr>
<td>12</td>
<td>Black/White</td>
<td>SPARE OUTPUT 1</td>
<td>Not used</td>
</tr>
<tr>
<td>13</td>
<td>Red/White</td>
<td>ISOLATED OUTPUT COMMON</td>
<td>ISOLATED OUTPUT COMMON connection shared by all OUTPUTS (pins 1-12).</td>
</tr>
<tr>
<td>14</td>
<td>Green/White</td>
<td>GND</td>
<td>Chassis ground</td>
</tr>
<tr>
<td>15</td>
<td>Blue/White</td>
<td>+22 VDC</td>
<td>+22 VDC supply from welder (800 mA max.)</td>
</tr>
</tbody>
</table>

*Table 8-III* Pin Assignments and Signal Description for the J3 OUTPUTS Connector
Figure 8–10  Wiring with PLC Sinking Input Card

(Note: An external +22 to +30 VDC supply can be used instead of the welder's internal supply. The wiring shown above would be altered by replacing the connection to J3-15 with a connection to the external supply positive terminal, and the connection to J3-14 with a connection to the external supply negative terminal.)
Automated Operation

Homing
After power-up, the welder must be homed before any other motion can be initiated. The HOMING STATUS output (J3-3) will turn ON to indicate that the welder needs to be homed. To perform the homing sequence, all 4 of the operate signals (J6-1, J6-2, J6-6, and J6-8), must be put in the “operate” states simultaneously as indicated in Table 8-I. Once HOMING STATUS turns OFF, the homing process is complete and the operate signals must be returned to the “not operating” states. To check the current states of the operate signals, activate HMI screen RUN > LIVE DATA > INPUTS/OUTPUTS and look at the 4 “Op. Switch” lines indicated in Figure 8-11. As shown in this figure, all 4 signals are in the “not operating” states.

If any alarms are active, indicated by the WELDER ALARM output (J3-5) being ON, at the same time that HOMING STATUS is ON, the alarm(s) must first be cleared before the welder will respond to the operate signals.

Moving to Start Position(s)
Both servo motors must be in specific positions as defined in the setup before a weld cycle is allowed to start. If either motor is not in the expected position, the HOMING STATUS output (J3-3) will turn ON. To move the motor(s), follow the same process as described in Homing.

Welder Configuration for Cycling in Automation
The following initial configuration steps are needed to prepare the welder for cycling in automation mode:

1. Activate the AUTOMATION ENABLE input (J2-22) if light curtains are not integrated directly with the welder. This input permits cycling in automation mode, and should be left ON as long as the welder is being used in an automated environment. This signal is used to configure welder hardware only. It does not initiate a cycle.

2. On the HMI, the “Initiate Mode” setting in the active welder setup must be set to “Automation” (on screen SETUP > GENERAL).

3. Clear any alarms on the HMI related to hardware configuration, which occur when transitioning from manual mode to automation mode.

<table>
<thead>
<tr>
<th>SAFE INPUT X20SLX910</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>4</td>
</tr>
<tr>
<td>5</td>
</tr>
<tr>
<td>6</td>
</tr>
</tbody>
</table>

Figure 8-11 Verification of Operate Signals
Running a Weld Cycle
Before a weld cycle is allowed to start, the RUN screen must be active on the HMI and the READY STATUS output (J3-1) must be ON. It is recommended that the TOP OF STROKE STATUS output (J3-2) also be monitored and in the ON state before initiating a cycle.

To start the cycle, all 4 of the operate signals (J6-1, J6-2, J6-6, and J6-8) must simultaneously be put in the “operate” states as indicated in Table 8-I for a minimum of 100 ms. At the end of this period, the operate signals can be returned to the “not operating” states as they are not required for the cycle to continue.

While the cycle is in progress, the READY STATUS output (J3-1) and TOP OF STROKE STATUS output (J3-2) will be OFF and the WELDER IN CYCLE output (J3-4) will be ON. When the press head fully retracts at the end of the cycle, the TOP OF STROKE STATUS output will turn ON. The READY STATUS output will come ON at this time if the operate signals are in the “not operating” states.

Stopping a Weld Cycle
To stop a weld cycle running in automation mode, activate the CYCLE STOP input (J2-25), which will cause the motors to decelerate rapidly and stop. An alarm will be triggered by this input. Alternatively, or in addition to the CYCLE STOP input, engage the E-stop by simultaneously putting both E-stop inputs (J6-3 and J6-4) into the “engaged” states as indicated in Table 8-I.

Position Teaching
During application development, it is convenient to “teach” various position parameters contained in a setup rather than to enter their numerical values. On a stand-alone, manually-operated system, the teach process involves jogging motors by activating the operate switches as described in Section 5. This process is made safe by the use of 2 anti-tie-down operate switches on a Dukane base.

In an automated environment, it is the responsibility of the end-user to safely implement this function. Once a TEACH screen is activated on the HMI and the direction/speed selections for the desired motor are set, jogging motion will be initiated when all 4 of the operate signals (J6-1, J6-2, J6-6, and J6-8) are put in the “operate” states simultaneously as indicated in Table 8-I. Motion will continue as long as the “operate” states are active, and stop when the 4 signals are returned to the “not operating” states.
Light Curtains

Light curtains can be directly interfaced with the ServoWeld™ Plus Spin Welder to free the operator to perform other tasks while the welder is in cycle.

Perform the following configuration steps for operation with light curtains:

1. Provide an external supply to power the light curtains (do not power the light curtains using the welder supply).
2. Connect the two light curtain channel outputs to the welder J2 INPUTS connector (J2-16 and J2-17). Wiring details and required signal states are described under the heading J2 INPUTS Connector above.
3. Power up the welder.
4. On the welder HMI, navigate to screen SYSTEM > UTILITIES, then press the Enable Light Curtains button. This will initiate a safety commissioning process. Wait for this process to complete, which will take several minutes.
5. To permit the operator to run a weld cycle by momentarily activating the operate switches, navigate to screen SETUP > GENERAL and set the Initiate Mode to Automation.

During operation, intrusion into the light curtains (i.e., blocking the light beam) causes rapid deceleration of both motors if they were in motion, then removal of power from the motors and the actuation of the vertical actuator holding brake. The exception to this behavior is during a cycle between the start of the STATIC HOLD phase and the end of the UPSTROKE phase, where an intrusion will not interrupt motion.

During normal operation, intrusion into the light curtains is required between each of the following events:

- Welder power up and the first subsequent cycle or jog motion (homing motion excluded)
- Reset of E-stop and the first cycle thereafter
- Each consecutive cycle
Remote Setup Switching
The active welder setup can be selected using the REMOTE SETUP BIT inputs on J2-7 through J2-12 after the option “Remote Setup Switching” on screen SYSTEM > CONFIGURATION is enabled (see Section 5). Inputs are mapped to the setups as shown in table 8-IV.

<table>
<thead>
<tr>
<th>REMOTE SETUP BIT 5 (J2-7)</th>
<th>REMOTE SETUP BIT 4 (J2-8)</th>
<th>REMOTE SETUP BIT 3 (J2-9)</th>
<th>REMOTE SETUP BIT 2 (J2-10)</th>
<th>REMOTE SETUP BIT 1 (J2-11)</th>
<th>REMOTE SETUP BIT 0 (J2-12)</th>
<th>Setup Number</th>
</tr>
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<tbody>
<tr>
<td>0</td>
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<td>0</td>
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<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>64</td>
</tr>
</tbody>
</table>

Table 8-IV  Remote Setup Switching, Bit Input

Signal Monitoring
When commissioning the welder in an automated environment, it may be useful to monitor the status of the welder digital I/O to determine if the signals between the welder and external equipment are properly interfaced. HMI screen RUN > LIVE DATA > INPUTS/OUTPUTS shows the status of all welder I/O, grouped by the internal welder module (see Figure 5-9). The cross-references between the external J connector pins on the back of the welder and these modules are listed in Table 8-V.
<table>
<thead>
<tr>
<th>External Connector Pin</th>
<th>Signal</th>
<th>HMI screen RUN &gt; LIVE DATA &gt; INPUTS/OUTPUTS (Module-Pin)</th>
</tr>
</thead>
<tbody>
<tr>
<td>J2-7</td>
<td>REMOTE SETUP BIT 5</td>
<td>X20DIF371-11</td>
</tr>
<tr>
<td>J2-8</td>
<td>REMOTE SETUP BIT 4</td>
<td>X20DIF371-10</td>
</tr>
<tr>
<td>J2-9</td>
<td>REMOTE SETUP BIT 3</td>
<td>X20DIF371-9</td>
</tr>
<tr>
<td>J2-10</td>
<td>REMOTE SETUP BIT 2</td>
<td>X20DIF371-8</td>
</tr>
<tr>
<td>J2-11</td>
<td>REMOTE SETUP BIT 1</td>
<td>X20DIF371-7</td>
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<tr>
<td>J2-12</td>
<td>REMOTE SETUP BIT 0</td>
<td>X20DIF371-6</td>
</tr>
<tr>
<td>J2-13</td>
<td>EXTERNAL TRIGGER</td>
<td>X20DIF371-5</td>
</tr>
<tr>
<td>J2-14</td>
<td>PART PRESENCE SENSOR 2</td>
<td>X20DIF371-4</td>
</tr>
<tr>
<td>J2-15</td>
<td>PART PRESENCE SENSOR 1</td>
<td>X20DIF371-3</td>
</tr>
<tr>
<td>J2-16</td>
<td>LIGHT CURTAIN STATUS 2</td>
<td>X20SLX910-17</td>
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<tr>
<td>J2-17</td>
<td>LIGHT CURTAIN STATUS 1</td>
<td>X20SLX910-16</td>
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<tr>
<td>J2-18</td>
<td>FIXTURE CLAMP 2 OPEN SENSOR</td>
<td>X20SLX910-15</td>
</tr>
<tr>
<td>J2-19</td>
<td>FIXTURE CLAMP 1 OPEN SENSOR</td>
<td>X20SLX910-14</td>
</tr>
<tr>
<td>J2-20</td>
<td>FIXTURE CLAMP 2 CLOSED SENSOR</td>
<td>X20SLX910-13</td>
</tr>
<tr>
<td>J2-21</td>
<td>FIXTURE CLAMP 1 CLOSED SENSOR</td>
<td>X20SLX910-12</td>
</tr>
<tr>
<td>J2-22</td>
<td>AUTOMATION ENABLE</td>
<td>X20SLX910-11</td>
</tr>
<tr>
<td>J2-23</td>
<td>SYSTEM LATCH RESET</td>
<td>X20SLX910-10</td>
</tr>
<tr>
<td>J2-24</td>
<td>ALARM RESET</td>
<td>X20SLX910-9</td>
</tr>
<tr>
<td>J2-25</td>
<td>CYCLE STOP</td>
<td>X20SLX910-8</td>
</tr>
<tr>
<td>J3-1</td>
<td>READY STATUS</td>
<td>X20DOF322-1</td>
</tr>
<tr>
<td>J3-2</td>
<td>TOP OF STROKE STATUS</td>
<td>X20DOF322-2</td>
</tr>
<tr>
<td>J3-3</td>
<td>HOMING STATUS</td>
<td>X20DOF322-3</td>
</tr>
<tr>
<td>J3-4</td>
<td>WELDER IN CYCLE</td>
<td>X20DOF322-4</td>
</tr>
<tr>
<td>J3-5</td>
<td>WELDER ALARM</td>
<td>X20DOF322-5</td>
</tr>
<tr>
<td>J3-6</td>
<td>GOOD PART STATUS</td>
<td>X20DOF322-6</td>
</tr>
<tr>
<td>J3-7</td>
<td>BAD PART STATUS</td>
<td>X20DOF322-7</td>
</tr>
<tr>
<td>J3-8</td>
<td>FIXTURE CLAMP 1 CLOSE</td>
<td>X20DOF322-8</td>
</tr>
<tr>
<td>J3-9</td>
<td>FIXTURE CLAMP 2 CLOSE</td>
<td>X20DOF322-9</td>
</tr>
<tr>
<td>J3-10</td>
<td>FIXTURE CLAMP 1 OPEN</td>
<td>X20DOF322-10</td>
</tr>
<tr>
<td>J3-11</td>
<td>FIXTURE CLAMP 2 OPEN</td>
<td>X20DOF322-11</td>
</tr>
<tr>
<td>J6-1</td>
<td>OPERATE SIGNAL 1 INPUT, N.O.</td>
<td>X20SLX910-3</td>
</tr>
<tr>
<td>J6-2</td>
<td>OPERATE SIGNAL 2 INPUT, N.O.</td>
<td>X20SLX910-5</td>
</tr>
<tr>
<td>J6-3</td>
<td>E-STOP INPUT, N.C.</td>
<td>X20SLX910-1</td>
</tr>
<tr>
<td>J6-4</td>
<td>E-STOP INPUT, N.O.</td>
<td>X20SLX910-2</td>
</tr>
<tr>
<td>J6-6</td>
<td>OPERATE SIGNAL 1 INPUT, N.C.</td>
<td>X20SLX910-4</td>
</tr>
<tr>
<td>J6-8</td>
<td>OPERATE SIGNAL 2 INPUT, N.C.</td>
<td>X20SLX910-6</td>
</tr>
</tbody>
</table>

**Table 8-V** Cross-Reference Between External Welder J Connectors and Internal Modules
Cycle Data Output
Cycle data parameters displayed on the ServoWeld™ Plus Spin Welder RUN screen are available for retrieval by external devices using the following protocols: OPC UA, Modbus TCP, or FTP. The configuration details for each protocol are listed below. A connection to the J9 ETHERNET port (RJ45) on the welder is required using a standard Ethernet patch cable (or Dukane cable 200-1552-XXM, where XX designates cable length in meters: 03, 05, or 10).

Cycle data is available following each weld cycle when the Ready Status Output (J3-1) comes on if no alarms occurred during the cycle, or shortly after an alarm. The data contains the following parameters:

1. Part Number
2. Part Analysis (GOOD or BAD)
3. Position At Trigger (mm)
4. Weld Time (s)
5. Weld Peak Force (%)
6. Weld Collapse (mm)
7. End Position (mm)
8. Hold Collapse (mm)
9. Total Collapse (mm)
10. Stroke Distance (mm)
11. Torque At Trigger (%)
12. Weld Orientation (deg.)
13. Weld Rotations
14. Peak Spin Speed (RPM)
15. Weld Energy (J)
16. Peak Motor Torque (%)
17. Peak Part Torque (%)

(Note: This parameter is populated only when the Idle Spin Torque Compensation option is enabled.)
18. Total Cycle Time (s)
19. Alarm
20. Setup ID - Setup Name
21. Timestamp (YYYY-MM-DD HH:MM:SS)

OPC UA
Configuration:
Server: opc.tcp://10.1.30.10
(Note: If the HMI IP address was changed from the default value 10.1.30.10, use the Current IP value listed on screen SYSTEM > CONFIGURATION instead.)
Security: None
Username: DukaneSSW
Password: spin
Data location: Objects -> PLC -> Modules -> <Default> -> Global PV -> RunHistoryString
Node: ::AsGlobalPV:RunHistoryString

The variable “RunHistoryString” contains the parameters listed above separated by commas. It is overwritten after every cycle.

Modbus TCP
Configuration:
Start Address: 0 or 1 (depending on convention)
Function Code: 4
Number of Registers: 1000

The registers contain byte-swapped values representing the cycle data string, with the parameters listed above separated by commas. The registers are overwritten after every cycle.

FTP
Configuration:
FTP Host: 10.1.30.10
(Note: If the HMI IP address was changed from the default value 10.1.30.10, use the Current IP value listed on screen SYSTEM > CONFIGURATION instead.)
User name: DukaneSSW
Password: spin

Once access is gained, data for last weld cycle is stored in file: LastCycleData.csv. This file is overwritten after every cycle. (Note: This directory also contains historical cycle data files in .csv format, which may be copied to the external device.)
## Optional Kits

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper Tool Vacuum</td>
<td>99</td>
</tr>
<tr>
<td>Overview</td>
<td>99</td>
</tr>
<tr>
<td>Installation</td>
<td>100</td>
</tr>
<tr>
<td>Controls</td>
<td>100</td>
</tr>
<tr>
<td>Operation</td>
<td>101</td>
</tr>
<tr>
<td>Tool Design for Vacuum</td>
<td>102</td>
</tr>
<tr>
<td>Maintenance</td>
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</tr>
<tr>
<td>Remote Touch Screen</td>
<td>103</td>
</tr>
<tr>
<td>Serial Cycle Data Output</td>
<td>104</td>
</tr>
</tbody>
</table>
Upper Tool Vacuum

Overview

As an aid in holding the spinning part in the tool, the welder can optionally be equipped with vacuum in the upper tool by installing a vacuum system kit (part number 438-1069 for models SSW3000 & SSW4000; part number 438-1070 for model SSW800). This kit includes all components needed to generate, control, and transfer the vacuum to the spin tool. An external compressed air supply (not provided with the welder) is required to generate vacuum.

The system, as installed on the welder, is shown in Figure 9-1. The main components are:

- Vacuum Control Enclosure – assembly with components for generating, controlling, and sensing vacuum
- Vacuum Transfer Assembly – assembly installed above the tooling hub for transferring vacuum from a stationary air fitting to the rotating tool (kit 438-1069 version shown in Figure 9-1; kit 438-1070 is similar)
- Filter/Regulator
- Tubing – plastic tubing for the air supply and vacuum output
- Control Cable

A closeup view of the Vacuum Transfer Assembly used in kit 438-1069 is shown in Figure 9-2. The vacuum passes through the inside of the tooling hub and exits on the inside of the O-ring at the bottom. With holes between the top of the tool and the part cavity, the vacuum retains the part in the tool while it is spinning or at rest.
Installation
The complete kit is pre-installed on the welder at the factory as shown in Figure 9-1. The external compressed air supply must be connected to the kit’s regulator input via the 8 mm tube labeled “1” shown in Figure 9-1. The supply pressure must not exceed 145 psi (1.0 MPa).

Controls
The controls and indicator are shown in Figure 9-3. The Regulator is used to set the air pressure supplied to the Vacuum Control Enclosure, which is indicated on the Pressure Gauge. The Flow Control adjusts the volume of incoming airflow, which affects the amount of vacuum produced by the vacuum generator. The Vacuum Status LED indicates the state of the Vacuum Switch inside the Vacuum Control Enclosure. It is illuminated when the set vacuum level is detected once a part is loaded into the spin tool. The Vacuum Switch Level Adjustment is located on top of the switch and can be accessed after removing the control enclosure cover (Note: When this cover is removed, electrical terminals with low voltage are exposed. DO NOT touch any components inside the enclosure except for the Vacuum Switch Level Adjustment screw.). This adjustment controls the level of vacuum at which the Vacuum Switch will turn on. For testing purposes, the valve manual operation button is exposed through the Valve Access Hole on the back of the enclosure, which will cause the vacuum to activate when pressed regardless of the control signal state.
Operation

The vacuum system operates in one of two modes, depending on how parts are loaded into the spin tool: manual or part pickup.

Manual mode is the most commonly used method, in which the parts are loaded manually by an operator into the tool. To enable this mode, the Tool Vacuum option must be enabled and the Part Pickup option must be disabled (both options are on HMI screen SETUP > GENERAL > OPTIONS). In this mode, the vacuum operates as follows:

1. After the welder is homed or reset, the vacuum is ON and the welder is ready to accept a part. The HMI will display “WAITING FOR PARTS” in the STATUS area and the message “LOAD PARTS” until sufficient suction is detected by the vacuum switch.

2. After a part is loaded and the vacuum switch is activated, the STATUS becomes “READY”, indicating the welder is ready to start a weld cycle.

3. After a weld cycle is initiated, the vacuum remains ON until start of the HOLD phase. It is then turned OFF for the remainder of the cycle.

4. After the press retracts to the Top of Stroke Position, the vacuum is turned ON again.

In this mode, the vacuum shuts off after a period of inactivity of 5 minutes to conserve compressed air. To re-energize the vacuum, one of the operate switches must be activated.

Part pickup mode is typically used with automated part feed systems where the parts to be joined are both placed on the lower (stationary) fixture and the press head moves down to “pick up” the top part. To enable this mode, the Part Pickup option must be enabled, the pickup Method must be set to Vacuum Sense, and the associated parameters with this Method set as described in Section 5 under the heading PARK PICKUP SETUP, Method 1. In this mode, the vacuum operates as follows:

1. After the welder is homed or reset, vacuum is OFF.

2. When a weld cycle is initiated, the press moves down and vacuum is turned ON.
3. After the press reached the Sensing Start Position, the state of the vacuum switch is monitored by the welder as the press continues to travel at the Sensing Speed.

4. When the vacuum switch is activated, indicating the part is loaded into the spin tool, press motion stops. The press then moves up slightly and the spin motor accelerates to the programmed speed.

5. The weld cycle proceeds as programmed. Vacuum remains ON until the start of the HOLD phase. It is then turned OFF for the remainder of the cycle.

## Tool Design for Vacuum
The spin tool must contain specific features to interface with the kit, including:

- One or more openings between the mounting face and the part cavity to provide a vacuum path from the tooling hub to the part. These openings must be contained within the diameters (on the mounting surface from the center of the tool) listed in Table 9-I.

- A continuous, flat area where the tool contacts the O-ring on the hub for a proper seal. The inner and outer diameters of this area are also specified in Table 9-I.

For additional details on tool design, contact the Dukane Applications Department.

### Table 9-I  Tool Design Dimensions for Vacuum Kit

<table>
<thead>
<tr>
<th>Opening containment diameter (in. [mm])</th>
<th>Welder Model</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SSW3000, SSW4000</td>
</tr>
<tr>
<td>1.85 [47]</td>
<td>2.60 [66]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>O-ring area inner &amp; outer diameters (in. [mm])</th>
<th>Welder Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.05 [52] - 2.35 [60]</td>
<td>3.50 [89] - 3.90 [99]</td>
</tr>
</tbody>
</table>
Maintenance

Depending on the application and welder setup, the following vacuum kit maintenance steps may be periodically necessary:

1. Clean out particulate (plastic particles generated during welding process), which can accumulate inside the spin tool, tubing, and Vacuum Control Enclosure. Turn welder power OFF before opening the enclosure cover for cleaning.

2. Lubricate the lip seals inside of the Vacuum Transfer Assembly. Applications on which the weld spin speed exceeds 1500 RPM are more likely to require lubrication. Contact Dukane for details on this process.

Remote Touchscreen

In situations where it is desirable to provide access to the touch screen some distance away from the welder, the remote touch screen kit (part number 438-1071) can be used. The touch screen is mounted in a separate enclosure as shown in Figure 9-4, which can be up to 16 ft. (5 m) away from the welder. Two cables (power and communications), supplied with the kit, 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 400-2476 for dimensions). When the kit is installed, the welder status light, USB port, as well as connectors J9 ETHERNET and J22 COMM reside on the remote enclosure instead of the welder. This kit is compatible with all SSWxxxx models.

Figure 9-4  Remote Touch Screen Components
Serial Cycle Data Output

This kit is used to output weld cycle data from the welder to an external device via a serial port (RS-232). The use of this kit is necessary if the data cannot be retrieved using Ethernet-based protocols (OPC UA, Modbus TCP, or FTP) provided on a standard welder configuration (J9 connector).

The data is sent after each cycle ends. The serial port is located on the back of the welder in the J22 COMM slot as shown in Figure 9-5. It is a standard 9-pin male D-sub connector. This connector is covered by a cap when the welder is shipped to protect against electrical discharge, and should be removed once the welder is installed. A cable with the mating 9-pin female D-sub connector is included with the kit. The cable is 10 ft. (3 m) long, and has a 9-pin female D-sub connector on the opposite end.

To receive the data, the required serial port settings on the device connected to the welder must match Table 9-I. When this kit is installed, the welder is configured to send the data after each cycle, regardless of whether a receiving device is connected.

The data for each cycle consists of one line of comma-delimited fields in the following order:

1. Part Number
2. Part Analysis (GOOD or BAD)
3. Position At Trigger (mm)
4. Weld Time (s)
5. Weld Peak Force (%)  
6. Weld Collapse (mm)
7. End Position (mm)
8. Hold Collapse (mm)
9. Total Collapse (mm)
10. Stroke Distance (mm)
11. Torque At Trigger (%) 
12. Weld Orientation (deg.)
13. Weld Rotations
14. Peak Spin Speed (RPM)
15. Weld Energy (J)
16. Peak Motor Torque (%) 
17. Peak Part Torque (%)
18. Total Cycle Time (s)
19. Alarm
20. Setup ID - Setup Name
21. Timestamp (YYYY-MM-DD HH:MM:SS)

Table 9-I  RS-232 Connection Requirements

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</tr>
<tr>
<td>Parity</td>
<td>None</td>
</tr>
<tr>
<td>Stop Bits</td>
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</tr>
<tr>
<td>Flow Control</td>
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</tbody>
</table>

NOTE

Some extraneous ASCII character output may occur between the time the welder is powered up and the first weld cycle is started. These are not part of the cycle data and should be ignored.
SECTION 10

Tooling

Moment of Inertia ................................. 107

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Determining the Moment of Inertia ............... 107

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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:

$$\text{Inertia} = \frac{1}{8} \times M \times D^2,$$

where

- Inertia is in $kg\cdot cm^2$
- $M$ is the mass in $kg$
- $D$ is the cylinder diameter in $cm$

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

$$\text{Inertia} = .098 \times \rho \times L \times D^4,$$

where

- $\rho$ is the density in $kg/cm^3$
- $L$ is the cylinder length in $cm$

Determining the Moment of Inertia
If a 3D model of the spin tool exists, the simplest and most accurate method of determining the moment of inertia is to query the CAD system for its value. The material(s) of the tool must be properly assigned to the model, and the axis of tool rotation selected for the inertia measurement.

If a 3D model is not available, the inertia can be determined by calculation. 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. Refer to the example calculation shown to the right.

Example:
Aluminum tool with outside dimensions:
- $D = 4\; in. = 10.1\; cm$
- $L = 2.5\; in. = 6.4\; cm$
- $P = 0.1\; lb/in.^3$
  (density of Aluminum) = .0028 $kg/cm^3$

Part void:
- $D = 3\; inches = 7.6\; cm$
- $L = 1\; inch = 2.5\; cm$

The inertia would be calculated as follows:

- Inertia, cylinder = $.098 \times .0028 \times 6.4 \times (10.1)^4 = 18.1\; kg\cdot cm^2$
- Inertia, void = $.098 \times .0028 \times 2.5 \times (7.6)^4 = 2.3\; kg\cdot cm^2$
- Inertia, tool = Inertia, cylinder – Inertia, void = 16 $kg\cdot cm^2$
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:

• The spin tool cavity should be designed such that part being held is firmly retained in the tool so that it does not fall out before being welded.

• The spin tool should surround the part being held where possible – the exterior of the tool should be a continuous cylindrical surface (i.e. avoid protruding parts).

• Rotational play between tooling (both spin and fixture) and part should be minimized – this will affect the angular orientation accuracy and repeatability.

• The spin tool should be as light as possible to allow for rapid deceleration and to keep machine energy consumption to a minimum.

• The spin tool should be balanced as accurately as possible to avoid excessive machine vibration and bearing wear.

• The bottom fixture should grip the part firmly to maintain accurate weld orientation and prevent undesirable vibrations during welding.
# SECTION 11

## Specifications

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<th>Page</th>
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Tooling Specifications

Tooling Size
Refer to Table 5-I for maximum spin tool sizes as indicated by the Max. Value of Tool Inertia. Refer to Figure 11-2 for maximum lower fixture dimensions.

Machine Weight
Refer to Table 11-I for the weights of all welder models (excludes tooling).

Power Requirements
The ServoWeld™ Plus 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 11–1.

<table>
<thead>
<tr>
<th>Model Weight lb. (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model Weight</td>
</tr>
<tr>
<td>Complete System</td>
</tr>
<tr>
<td>SSW800</td>
</tr>
<tr>
<td>SSW3000</td>
</tr>
<tr>
<td>SSW4000</td>
</tr>
<tr>
<td>Thruster Only</td>
</tr>
<tr>
<td>(SSWxxxx-T)</td>
</tr>
<tr>
<td>(SSWxxxx-T)</td>
</tr>
<tr>
<td>(SSWxxxx-T)</td>
</tr>
<tr>
<td>Less Base Assembly</td>
</tr>
<tr>
<td>(SSWxxxx-LB)</td>
</tr>
<tr>
<td>(SSWxxxx-LB)</td>
</tr>
<tr>
<td>(SSWxxxx-LB)</td>
</tr>
</tbody>
</table>

Identification Numbers

Welder Model & Serial Number
The welder model and serial number are indicated on a label affixed to the back of the welder. They are also listed on the HMI screen SYSTEM > INFO.

Operating Environment
Operate the ServoWeld™ Plus Spin Welder within these guidelines:

Temperature: 40°F to 95°F (+5°C to +35°C)
Altitude: 2,000 m (6,500 ft.) max.
Air Particulates: Keep the welder dry. Minimize exposure to moisture, dust, dirt, smoke and mold.
Humidity: 5% to 95% non-condensing

NOTE
The rated fault current (or leakage current) is equal to or less than 100 mA.
Figure 11–2  ServoWeld™ Plus Spin Welder Dimensions

NOTE: All specifications are subject to change without notice. The specifications listed are current at the time of publication.
Regulatory Agency Compliance

FCC
The ServoWeld™ Plus Spin Welder 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 ServoWeld™ Plus Spin Welder complies with the following CE requirements.
- The EMC Directive 2014/30/EU for Heavy Industrial —
  - EN 61000-6-4
  - EN 55011
  - EN 61000-6-2
  - 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 2014/35/EU
- The Machinery Directive 2006/42/EC
- EN ISO 12100: Safety of Machinery - General principles of design, risk assessment, and risk reduction.

UL & CSA
The ServoWeld™ Plus Spin Welder complies with these standards:
- Tested to Underwriters Laboratories (UL):
  - UL 61010-1, IEC 61010-1 and
- National Standards of Canada (CSA):
  - CAN/CSA C22.2 No. 61010-1
  as verified by TÜV Rheinland.

IP Rating
The ServoWeld™ Plus Spin Welder has an IP (International Protection) rating from the IEC (International Electrotechnical Commission).
The rating is IP2X, in compliance with finger-safe industry standards.

CAUTION
DO NOT make any modifications to the ServoWeld™ Plus Spin Welder or associated cables. The changes may result in violating one or more regulations under which this equipment is manufactured.
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SECTION 12

Maintenance

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AC Power Cord .................................................. 117
Other ............................................................ 117
### Touch Screen Display

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

### Other

After turning welder power off and unplugging the power cord, visually inspect external cables once a week, and replace or repair if necessary.

Check if parts being welded are properly retained in the spin tool and lower fixture. Make any necessary adjustments or repairs to ensure parts loaded in the spin tool do not fall out during operation and parts loaded into the fixture are held securely.

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

Check if the fan venting slots on the back of the welder near the top are clear. Clean if necessary after turning welder power off and unplugging the power cord.

Lubrication of internal welder components is sufficient for the expected life of the machine if it is used within the operating environment specifications. If desired, however, the lubrication internal to the vertical actuator may be “refreshed” periodically, such as every 1 million cycles, to maximize the life of the actuator. To do so, the press should be jogged down and up the full stroke several times using the TEACH Function, or several cycles should be run with a temporary “maintenance” setup which involves vertical travel spanning close to the full stroke of the welder.

If a spin tool vacuum system kit is installed (part number 438-1069 or 438-1070), additional maintenance may be needed (refer to Section 9).
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SECTION 13

Troubleshooting

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Welding Process

Material Choice
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 Speed (Spin RPM)
Insufficient surface speed 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 speed is determined by both the weld joint diameter and the spin motor speed.

Vertical Speed
In conjunction with surface velocity, axial speed determines whether the plastic reaches the melting temperature. Both surface and axial speed are needed to produce sufficient frictional heating. Excessive axial speed may cause the material in the joint area to be scraped away instead of being melted, resulting in insufficient melt volume.

Weld Depth
Insufficient welding depth may not allow the melt to propagate far enough into the plastic to achieve the necessary melt volume and the required weld strength. Excessive weld depth typically results in the formation of undesirable amounts of flash.

Hold
Insufficient static holding time may prevent the plastic from solidifying and forming a strong permanent bond. Excessive dynamic hold distance may cause the molten plastic to be squeezed out of the weld joint area, resulting in low strength.

Troubleshooting
Table 13-I lists some potential problems with the weld process and suggested solutions.
Welder

Mechanical
The fixture securing the lower part being welded should be leveled and centered so that the parts are parallel and concentric to each other. Ensure the fixture and spin tool are securely mounted.

Ensure the thruster is securely fastened to the column by checking that the (3) Height Adjustment Lock Nuts shown in Figure 3-7 are tight.

Ensure the welder is mounted to a rigid support structure, and that it is isolated from any vibrations that may be generated by nearby equipment.

Electrical Power
Make sure the AC power cord is plugged into 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 connected between the base and the back of the welder. If the cable is not plugged in, or is faulty, the base switches will not initiate any action or the E-Stop signals will be activated.

To verify that the signals from the operate switches and E-Stop are being detected by the welder, first navigate to the following screen on the HMI: RUN > LIVE DATA > INPUTS/OUTPUTS. With the operating switches not activated and E-Stop not activated (i.e., button is not pressed in), the top 6 channels on the SAFE INPUT module should be in the states shown in Figure 13-1.

Machine Alarms
A list of all welder alarms, their meaning, and possible solutions to problems are given in Table 13-II.
### Table 13–I  Welding Process Troubleshooting

<table>
<thead>
<tr>
<th>Problem</th>
<th>Symptom</th>
<th>Possible Cause(s)</th>
<th>Solution(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overwelding</td>
<td>Excessive weld flash</td>
<td>Weld Distance is too large or Weld duration is too long.</td>
<td>Reduce Weld Distance, Position, Energy, or Peak Spin Torque.</td>
</tr>
<tr>
<td>Overwelding</td>
<td>Welded assembly dimensions too small</td>
<td>Weld Spin Speed is too high.</td>
<td>Reduce Weld Spin Speed.</td>
</tr>
<tr>
<td>Overwelding</td>
<td>Low strength weld</td>
<td>Weld Distance is too small or Weld Duration is too short.</td>
<td>Increase Weld Vertical Speed.</td>
</tr>
<tr>
<td>Underwelding</td>
<td>Welded assembly dimensions too large</td>
<td>Weld Spin Speed is too low.</td>
<td>Reduce Weld Vertical Speed.</td>
</tr>
<tr>
<td>Underwelding</td>
<td>Low strength weld</td>
<td>Weld Vertical Speed is too high.</td>
<td>Reduce Weld Vertical Speed.</td>
</tr>
<tr>
<td>Underwelding</td>
<td>Moisture is retained in parts.</td>
<td>Material is difficult to weld due to low friction coefficient.</td>
<td>Degrease joint interface to remove mold release agent. Consider changing material (i.e. avoid PTFE).</td>
</tr>
<tr>
<td>Non-uniform or inconsistent weld joints</td>
<td>Excessive weld flash</td>
<td>Weld interface is uneven.</td>
<td>Check fixture leveling. Check spin tool alignment to fixture. Check spin tool concentricity (pilot bore to part cavity). Check molding process conditions.</td>
</tr>
<tr>
<td>Non-uniform or inconsistent weld joints</td>
<td>Low weld strength</td>
<td>Fixture and part are not parallel.</td>
<td>Level fixture where necessary. Check that tooling is true to base.</td>
</tr>
<tr>
<td>Non-uniform or inconsistent weld joints</td>
<td>Failure when leak tested</td>
<td>Poor alignment of parts in tool and/or fixture.</td>
<td>Change part or tool dimensions. Improve part consistency.</td>
</tr>
<tr>
<td>Non-uniform or inconsistent weld joints</td>
<td>Part failure in service</td>
<td>Tooling does not provide sufficient part support.</td>
<td>Check for parts shifting during welding. Provide features in parts for rotational driving (i.e. drive ribs or cavities).</td>
</tr>
<tr>
<td>Non-uniform or inconsistent weld joints</td>
<td>Part walls are flexing during weld.</td>
<td></td>
<td>Redesign parts with reinforcing ribs and/or tongue-and-groove joints. Provide additional part support in tool(fixture).</td>
</tr>
<tr>
<td>Non-uniform or inconsistent weld joints</td>
<td>Excessive filler present in parts or filler distribution is uneven.</td>
<td></td>
<td>Reduce amount of filler. Improve processing conditions to ensure even distribution of filler.</td>
</tr>
<tr>
<td>Final part orientation different than programmed orientation</td>
<td>Parts not aligned properly</td>
<td>Deceleration is too low.</td>
<td>Increase Spin Deceleration as high as possible (if set too high, welder will alarm with position errors).</td>
</tr>
<tr>
<td>Final part orientation different than programmed orientation</td>
<td>Weld Vertical Speed is too high.</td>
<td></td>
<td>Reduce Weld Vertical Speed to decrease spin torque required. Enable “Melt-Match® Mode”.</td>
</tr>
<tr>
<td>Final part orientation different than programmed orientation</td>
<td>Spin tuning is poor.</td>
<td></td>
<td>Determine spin tool moment of inertia and check that correct value is entered into Tool Inertia setup parameter. Contact DUKANE for special tuning requirements.</td>
</tr>
<tr>
<td>Final part orientation different than programmed orientation</td>
<td>Parts are not held properly by tool or fixture.</td>
<td></td>
<td>Ensure tooling does not allow excessive play.</td>
</tr>
<tr>
<td>Final assembly height different than programmed height</td>
<td>Measured weld distance not achieved</td>
<td>Weld Vertical Speed is too high.</td>
<td>Reduce Weld Vertical Speed. Enable “Melt-Match® Mode”.</td>
</tr>
<tr>
<td>Final assembly height different than programmed height</td>
<td>Parts are flexing during welding.</td>
<td></td>
<td>Provide sufficient support in areas prone to deflection. Compensate for anticipated deflection by changing weld depth.</td>
</tr>
<tr>
<td>Final assembly height different than programmed height</td>
<td>Geometry of parts being welded is not consistent.</td>
<td></td>
<td>Improve part consistency.</td>
</tr>
</tbody>
</table>
## Table 13-II  Machine Alarms

<table>
<thead>
<tr>
<th>Alarm</th>
<th>Description</th>
<th>Cause(s)</th>
<th>Solution(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>S101: Emergency stop is active.</td>
<td>Emergency stop is active.</td>
<td>1. Emergency stop button is pressed (if system includes DUKANE base).&lt;br&gt;2. Emergency stop signals are active (if system excludes DUKANE base).&lt;br&gt;3. Cable between base and welder is loose or not connected.</td>
<td>1. Reset emergency stop button.&lt;br&gt;2. Deactivate emergency stop signals.&lt;br&gt;3. Check cable connection on both ends.</td>
</tr>
<tr>
<td>S102: Operating switches released during weld process.</td>
<td>Operating switches were deactivated during the weld process.</td>
<td>1. At least one operating switch was de-activated between start of cycle and start of static hold phase (or start of upstroke phase if static hold is disabled).&lt;br&gt;2. If at least one fixture clamp option is enabled, at least one operating switch was deactivated between start of cycle and clamp opening at end of cycle.</td>
<td>1. Once the weld cycle starts, maintain activation of both switches until start of static hold phase (or start of upstroke phase if static hold is disabled).&lt;br&gt;2. Once the weld cycle starts, maintain activation of both switches until clamps open at end of cycle (after retraction to Top of Stroke).</td>
</tr>
<tr>
<td>S103: Vertical lower limit switch activated.</td>
<td>Vertical axis reached downward limit switch.</td>
<td>Press traveled down until the limit switch was reached.</td>
<td>Adjust setup parameters to ensure weld cycle can complete within the rated welder stroke. If in Teach mode, jog vertical axis up.</td>
</tr>
<tr>
<td>S104: Vertical upper limit switch activated.</td>
<td>Vertical axis reached upward limit switch.</td>
<td>Press traveled up until the limit switch was reached.</td>
<td>Jog vertical axis down.</td>
</tr>
<tr>
<td>S105: Vertical travel limit exceeded.</td>
<td>Vertical axis position exceeded software travel limit.</td>
<td>Press traveled down while in teach mode until the position exceeded the software travel limit defined in setup parameter Vertical Travel Limit.</td>
<td>Increase value of Vertical Travel Limit (on screen SETUP &gt; GENERAL), or avoid jogging the press beyond the programmed Vertical Travel Limit position.</td>
</tr>
<tr>
<td>S106: Vertical position (lag) error limit exceeded.</td>
<td>Vertical axis position error (commanded position vs actual position) exceeded limit.</td>
<td>1. Vertical weld or dynamic hold speed(s) too high.&lt;br&gt;2. Weld or dynamic hold distance(s) too large.&lt;br&gt;3. Weld Spin Speed too low.</td>
<td>1. Reduce vertical speed(s), or enable “Melt-Match™ Mode”.&lt;br&gt;2. Reduce weld or dynamic hold distance(s).&lt;br&gt;3. Increase Spin Speed setting.</td>
</tr>
<tr>
<td>S108.0: Spin servo drive fault: General drive error.</td>
<td>Spin servo drive fault.</td>
<td>1. This alarm can occur in conjunction with other alarm(s).&lt;br&gt;2. Excessive current draw from spin servo amplifier averaged over time, causing drive to shut down.&lt;br&gt;3. Cause depends on specific error code listed at the end of alarm message.</td>
<td>1. Follow solution(s) to other alarms that occur at the same time.&lt;br&gt;2. Reduce spin motor duty cycle by increasing the time between weld cycles or changing setup parameters to reduce amount of spin torque during weld cycle.&lt;br&gt;3. Contact DUKANE with specific error code.</td>
</tr>
<tr>
<td>S108.1: Spin servo drive fault: Error during initialization phase.</td>
<td>Error during initialization of spin servo drive.</td>
<td>Internal file(s) of spin servo drive parameters corrupt or missing.</td>
<td>Restart welder. If alarm persists, contact DUKANE.</td>
</tr>
<tr>
<td>S108.2: Spin servo drive fault: Input parameters invalid.</td>
<td>Invalid parameter(s) sent to spin servo drive.</td>
<td>Internal machine error or faulty hardware.</td>
<td>Reset alarm. If it persists, contact DUKANE.</td>
</tr>
<tr>
<td>S108.3: Spin servo drive fault: Motor overtemperature.</td>
<td>Spin motor too hot.</td>
<td>1. Weld phase is too long.&lt;br&gt;2. Time between cycles is too short.&lt;br&gt;3. Spin motor failure.</td>
<td>1. Reduce duration of weld phase.&lt;br&gt;2. Increase amount of time between cycles.&lt;br&gt;3. Contact DUKANE.</td>
</tr>
</tbody>
</table>
### Table 13-II  Machine Alarms (continued)

<table>
<thead>
<tr>
<th>Alarm</th>
<th>Description</th>
<th>Cause(s)</th>
<th>Solution(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>S108.6: Spin servo drive fault: Voltage sag on the drive enable input.</td>
<td>Voltage on spin servo drive “enable” input dropped below threshold. Drive is disabled.</td>
<td>1. Emergency stop is active.  2. Safety monitor tripped.  3. Interconnect PCB failure.</td>
<td>1. Reset emergency stop.  2. Contact DUKANE for troubleshooting assistance.  3. Contact DUKANE.</td>
</tr>
<tr>
<td>S108.8: Spin servo drive fault: Main voltage problem: DC bus voltage drop - over voltage - over current.</td>
<td>Problem with spin servo drive power input or output.</td>
<td>1. Loose AC supply cable(s).  2. Incorrect AC supply voltage.  3. Short circuit in spin motor.  4. Spin servo drive failure.</td>
<td>1. With welder powered off and AC power cord unplugged, check all AC supply cables and wires.  2. Ensure supplied AC voltage is within the required range (see specification on rear of welder).  3-4. Contact DUKANE.</td>
</tr>
<tr>
<td>S108.9: Spin servo drive fault: Safety related error.</td>
<td>A safety-related fault occurred on spin servo drive.</td>
<td>1. Incorrect spin servo drive configuration.  2. Failure with communication to spin servo drive.  3. Spin feedback failure.</td>
<td>Contact DUKANE.</td>
</tr>
<tr>
<td>S108.11: Spin servo drive fault: Communication (Powerlink) breakdown - cable unplugged or defective.</td>
<td>Communication problem with spin servo drive.</td>
<td>1. Powerlink cable unplugged.  2. Powerlink cable faulty.</td>
<td>1. Check connections on both ends of spin servo drive Powerlink cable.  2. Contact DUKANE.</td>
</tr>
<tr>
<td>S109.0: Vertical servo drive fault: General drive error.</td>
<td>Vertical servo drive fault.</td>
<td>1. This alarm can occur in conjunction with other alarm(s).  2. Excessive current draw from vertical servo amplifier averaged over time, causing drive to shut down.  3. Cause depends on specific error code listed at the end of alarm message.</td>
<td>1. Follow solution(s) to other alarms that occur at the same time.  2. Reduce vertical motor duty cycle by increasing the time between weld cycles or changing setup parameters to reduce amount of force during weld cycle.  3. Contact DUKANE with specific error code.</td>
</tr>
<tr>
<td>S109.1: Vertical servo drive fault: Error during initialization phase.</td>
<td>Error during initialization of vertical servo drive.</td>
<td>Internal file(s) of vertical servo drive parameters corrupt or missing.</td>
<td>Restart welder. If alarm persists, contact DUKANE.</td>
</tr>
<tr>
<td>S109.2: Vertical servo drive fault: Input parameters invalid.</td>
<td>Invalid parameter(s) sent to vertical servo drive.</td>
<td>Internal machine error or faulty hardware.</td>
<td>Reset alarm. If it persists, contact DUKANE.</td>
</tr>
<tr>
<td>S109.3: Vertical servo drive fault: Motor overtemperature.</td>
<td>Vertical actuator too hot.</td>
<td>1. Weld cycle is too long.  2. Time between cycles is too short.  3. Vertical actuator failure.</td>
<td>1. Reduce duration of weld cycle.  2. Increase amount of time between cycles.  3. Contact DUKANE.</td>
</tr>
<tr>
<td>S109.5: Vertical servo drive fault: Positive or negative limit switch reached.</td>
<td>Vertical axis reached down or up limit switch.</td>
<td>Press moved to either end of travel.</td>
<td>Adjust setup parameters to ensure weld cycle can complete within the rated welder stroke. If in Teach mode, jog vertical axis away from activated switch.</td>
</tr>
</tbody>
</table>
### Table 13-II  Machine Alarms (continued)

<table>
<thead>
<tr>
<th>Alarm</th>
<th>Description</th>
<th>Cause(s)</th>
<th>Solution(s)</th>
</tr>
</thead>
</table>
| S109.6: Vertical servo drive fault: Voltage sag on the drive enable input. | Voltage on vertical servo drive “enable” input dropped below threshold. Drive is disabled. | 1. Emergency stop is active.  
2. Safety monitor tripped.  
3. PCB failure. | 1. Reset emergency stop.  
2. Contact DUKANE for troubleshooting assistance.  
3. Contact DUKANE. |
2. Vertical actuator feedback failure.  
2-3. Contact DUKANE. |
| S109.8: Vertical servo drive fault: Main voltage problem: DC bus voltage drop - over voltage - over current. | Problem with vertical servo drive power input or output. | 1. Loose AC supply cable(s).  
2. Incorrect AC supply voltage.  
4. Vertical servo drive failure. | 1. With welder powered off and AC power cord unplugged, check all AC supply cables and wires.  
2. Ensure supplied AC voltage is within the required range (see specification on rear of welder).  
3-4. Contact DUKANE. |
2. Failure with communication to vertical servo drive.  
3. Vertical feedback failure. | Contact DUKANE. |
| S109.10: Vertical servo drive fault: Problem with holding brake. | Problem with vertical servo actuator holding brake. | 1. Brake cables unplugged or connection(s) loose.  
2. Brake too hot.  
3. Brake failure. | 1. With welder powered off and AC power cord unplugged, check brake cables and connections.  
2. Power welder off to cool brake.  
3. Contact DUKANE. |
2. Powerlink cable unplugged.  
3. Powerlink cable faulty. | 1. Change setup parameters to reduce vertical force during weld cycle, or increase amount of time between cycles.  
2. Check connections on both ends of vertical servo drive Powerlink cable.  
3. Contact DUKANE. |
2. Vertical servo drive failure. | Contact DUKANE. |
| S109.13: Vertical servo drive fault: Overload on motor. | Current limit of vertical actuator was exceeded. | 1. Incorrect vertical servo drive configuration.  
2. Short circuit in vertical actuator.  
3. Vertical servo drive failure. | Contact DUKANE. |
| S122: Unexpected states on Operate Switch 1 channels. Cycling welder power is required. | Operate Switch 1 signals are not in proper states (expected states: 1 channel HIGH and 1 channel LOW). | 1. Cable between base and welder is loose or not connected.  
2. Incorrect wiring or signal activation (if system excludes Dukane base).  
3. Problem with base or base cable (if system includes Dukane base). | 1. Check cable connection on both ends.  
2. Check for proper wiring and signal activation.  
3. Contact DUKANE. |
| S123: Unexpected states on Operate Switch 2 channels. Cycling welder power is required. | Operate Switch 2 signals are not in proper states (expected states: 1 channel HIGH and 1 channel LOW). | same as alarm S122 | same as alarm S122 |
| S124: Unexpected states on light curtain channels. Cycling welder power is required. | Light curtain signals are not in proper states (expected states: both channels HIGH or both channels LOW). | 1. Incorrect light curtain wiring.  
2. Light curtain failure. | 1. Check wiring.  
2. Replace light curtain. |
<table>
<thead>
<tr>
<th>Alarm</th>
<th>Description</th>
<th>Cause(s)</th>
<th>Solution(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>S125: Fault detected by safety monitor. To reset fault, press and release E-stop or cycle welder power.</td>
<td>Safety monitor circuitry detected fault.</td>
<td>Cause dependents on specific error code flashed on LED located above HMI.</td>
<td>Contact DUKANE with specific error code information for troubleshooting assistance.</td>
</tr>
</tbody>
</table>
| S126: Fixture clamp(s) not open. | One or both fixture clamp(s) did not stay open when commanded to be in open position. | 1. Fixture clamp(s) not configured correctly.  
2. Fixture clamp component failure.                                                           | 1. Check wiring, valve(s), air supply, and associated controls.  
2. Identify and replace faulty component(s).                                                   |
| S127: Fixture clamp(s) not closed. | One or both fixture clamp(s) did not stay closed when commanded to be in closed position. | same as alarm S126                                                                                                                                   | same as alarm S126                                                                                     |
| S128: Fixture clamp Open and Closed sensors are on at the same time. | Fixture clamp Open and Closed sensors are active simultaneously. | 1. Clamp sensors not configured correctly.  
2. Identify and replace faulty component(s).                                                       |
| S129: Operating switches released during clamp motion | Operating switches were released while fixture clamp(s) were moving. | Activation of operating switches was not maintained during fixture clamp motion.                                                                 | Maintain activation of operating switches until all clamp motion completes, including opening at end of cycle. |
| S130: Operating switches released during homing routine. Switches must be on until welder is homed. | Operating switches were deactivated during the homing process. | At least one of the operating switches was deactivated before the homing process completed. | Maintain activation of operating switches until the homing process completes (indicated by HOMED in STATUS area). |
| S131: Part Presence not detected at start of weld. | Part Presence sensor(s) not active at start of weld. | 1. Part(s) not loaded or retained in tool properly.  
2. Part sensor configuration problem or failure.                                               | 1. Check part loading and retention.  
2. Check sensor wiring and configuration. Replace if faulty.                                      |
| S133: Vacuum not detected at weld start. | Vacuum not detected at start of weld. | 1. Part(s) not loaded or retained properly in spin tool.  
2. Insufficient level of vacuum in spin tool.  
3. Incorrect vacuum switch setting.  
2. Check and clear any blockages in vacuum line and tool passages. Adjust air supply pressure and flow control setting to generate higher vacuum if needed.  
3. Adjust vacuum switch to activate at lower vacuum level.  
4. Contact DUKANE.                                                                             |
| S134: Vacuum lost during weld. | Vacuum not detected during weld phase. | same as alarm S133                                                                                                                             | same as alarm S133                                                                                     |
| S135: Machine mode changed during weld cycle. | Machine mode changed when welder was in cycle. | User pressed SETUP or SYSTEM button on HMI during weld cycle.                                                                                 | Ensure RUN button is active throughout weld cycle.                                                   |
| S136: Spin position (lag) error limit exceeded while in ready state. | Spin axis position error (commanded position vs actual position) exceeded limit while welder was in ready state. | 1. Spin tool rotated out of position by hand.  
2. Improper spin servo tuning.                                                                 | 1. Avoid excessive tool rotation when loading and unloading parts.  
2. Ensure Tool Inertia setting matches physical inertia of the spin tool.                            |
| S137: Spin torque limit exceeded while in ready state. | Spin axis torque exceeded limit while welder was in ready state. | same as alarm S136                                                                                                                             | same as alarm S136                                                                                     |
## Table 13-II  Machine Alarms (continued)

<table>
<thead>
<tr>
<th>Alarm</th>
<th>Description</th>
<th>Cause(s)</th>
<th>Solution(s)</th>
</tr>
</thead>
</table>
| S138: Spin torque limit exceeded during weld reorientation. | Spin axis torque exceeded limit while spin motor was reorienting the tool at end of cycle (after retraction to Top of Stroke). | 1. Spin tool was prevented from rotating freely after press returned to Top of Stroke.  
2. Improper spin servo tuning. | 1. Ensure spin tool can rotate without any external resistance after returning to Top of Stroke. Ensure welded assembly is disengaged from spin tool.  
2. Ensure Tool Inertia setting matches physical inertia of the spin tool. |
| S139: Vertical torque limit exceeded while jogging. | Vertical axis torque limit exceeded while in Teach mode. | 1. Downward press motion is blocked.  
2. Excessive vertical force applied while Teaching. | 1. Clear blockage.  
2. Reduce amount of vertical force. |
| S141: Operating switch(es) active when drives not enabled. | Operating switch(es) active while servo drives were disabled. | Operating switches were activated while servo drives were disabled. | Loose wire connection or hardware problem related to drive enabling circuitry. Contact DUKANE. |
| S142: A system response delay has been detected. Changes were not properly stored. Restart the welder. | Error encountered in storing setup parameters. Setup changes recently made were not saved. | 1. Setup file(s) missing.  
2. Internal error. | Restart welder. If alarm persists, contact DUKANE. |
| S143: Cannot move while motion not enabled. | Motion was commanded when servo drive enable inputs were not active. | 1. Safety program not running.  
2. PCB failure. | 1. Complete the safety commissioning process.  
2. Contact DUKANE. |
| S144: Command received and safety not running. | Command sent to drive(s) while safety is inactive. | Safety program not running. | Complete the safety commissioning process. |
2. Problem with safety component(s). | 1. Complete the safety commissioning process.  
2. Contact DUKANE. |
| S146: Vacuum sensor did not turn off between cycles. | Vacuum sensor remained on from the end of one cycle until the start of the next cycle. | 1. Part was not removed from spin tool after a weld cycle was completed.  
2. Vacuum switch not adjusted properly.  
3. Vacuum path blocked.  
4. Vacuum switch failure. | 1. Remove part from spin tool between the end of one cycle and the start of the next cycle.  
2. Adjust vacuum switch as described in Section 9.  
3. Clean out vacuum passages in tool and vacuum system to clear any blockages or restrictions.  
4. Replace switch. |
| S151: Weld timeout. | Weld phase did not complete within allowable time defined in setup. | 1. Weld Timeout setting too short.  
2. Weld duration too long.  
3. Inconsistent geometry of parts being welded, resulting in weld duration variability. | 1. Increase Timeout setting on screen SETUP > WELD.  
2. Adjust setup parameters to shorten weld duration.  
3. Improve part consistency. |
| S152: Dynamic hold timeout. | Dynamic hold phase did not complete within allowable time defined in setup. | 1. Dynamic Hold Timeout setting too short.  
2. Dynamic Hold duration too long. | 1. Increase Timeout setting on screen SETUP > HOLD.  
2. Adjust setup parameters to shorten Dynamic Hold duration. |
### Table 13-II  Machine Alarms (continued)

<table>
<thead>
<tr>
<th>Alarm</th>
<th>Description</th>
<th>Cause(s)</th>
<th>Solution(s)</th>
</tr>
</thead>
</table>
| S153: Trigger timeout. | Trigger not detected within allowable time defined in setup. | 1. Trigger Timeout setting too short.  
2. Sensing Start Position setting too low.  
3. Weld Vertical Speed too small.  
4. Spin Torque setting too high.  
5. Parts being welded not loaded properly.  
6. Inconsistent geometry of parts being welded, resulting in trigger detection variability. | 1. Increase Timeout setting on screen SETUP > TRIGGER.  
2. Increase numerical value of Sensing Start Position (if Trigger Method is Spin Torque or External Signal).  
3. Increase Vertical Speed setting.  
4. Decrease Spin Torque setting (if Trigger Method is Spin Torque).  
5. Check part loading and retention in spin tool.  
6. Improve part consistency. |
2. Spin Torque setting too low.  
3. Parts being welded not loaded properly.  
4. Inconsistent geometry of parts being welded, resulting in premature trigger detection. | 1. Decrease numerical value of Sensing Start Position.  
2. Increase Spin Torque setting, or enable option Idle Spin Torque Compensation.  
3. Check part loading.  
4. Improve part consistency. |
| S155: Cycle aborted by Cycle Stop input. | Cycle stopped due to activation of Cycle Stop input. | Cycle Stop signal on J2 INPUTS connector was activated during cycle. | Reset Cycle Stop input and clear alarm. |
| S156: An axis error has occurred during weld cycle. | An error occurred on spin or vertical axis during weld cycle. | An error was detected by motion software for spin or vertical axis during weld cycle. | Contact DUKANE. |
2. Press motion was obstructed during high speed downstroke motion (i.e. crashed).  
3. Vertical weld or dynamic hold speed(s) too high.  
4. Weld or dynamic hold distance(s) too large.  
5. Weld Spin Speed too low.  
6. Joint weld diameter too large for welder model. | 1. Ensure Trigger Position or Sensing Start Position is set such that no contact between unwelded parts occurs when press reaches this position.  
2. Check part loading and retention in spin tool. Check if correct tooling is installed and thruster is at correct position on column. Eliminate any obstructions to press motion.  
3. Reduce vertical speed(s), or enable “Melt-Match™ Mode”.  
4. Reduce weld or dynamic hold distance(s).  
5. Increase Spin Speed setting.  
6. Use welder model with larger spin torque and vertical force capacity. |
| S158: Vertical axis reached travel limit. | Vertical axis position exceeded software travel limit. | Press traveled down until the position exceeded the software travel limit defined in setup parameter Vertical Travel Limit. | Increase value of Vertical Travel Limit (on screen SETUP > GENERAL), or adjust other setup parameters to ensure press does not travel beyond the programmed Vertical Travel Limit during weld cycle. |
| S159: Spin axis cannot be repositioned due to excessive orientation drift. | If setup option Reposition Spin Tool After Upstroke is enabled, the amount of rotation needed to reposition spin tool at end of cycle (after retraction to Top of Stroke) exceeded angular limit. | 1. Spin Deceleration too low.  
2. Improper spin servo tuning. | 1. Increase Spin Deceleration setting.  
2. Ensure Tool Inertia setting matches physical inertia of the spin tool. |
| S161: Check jog settings selections (direction and speed). | Jog settings not set properly in Teach mode. | Either jog direction or jog speed not selected. | Select both jog direction and jog speed. |
Table 13-II  Machine Alarms (continued)

<table>
<thead>
<tr>
<th>Alarm</th>
<th>Description</th>
<th>Cause(s)</th>
<th>Solution(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>S162: Trigger occurred after weld end position reached.</td>
<td>Trigger detected after press reached weld end position.</td>
<td>1. Spin Torque setting too high. 2. Weld end position too low. 3. Parts being welded not loaded properly. 4. Inconsistent geometry of parts being welded.</td>
<td>1. Decrease Spin Torque setting. 2. Increase numerical value of Position setting on screen SETUP &gt; WELD. 3. Check part loading. 4. Improve part consistency.</td>
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<tr>
<td>S163: Trigger not detected in time for the weld to complete.</td>
<td>Trigger detected too late for weld to complete properly.</td>
<td>1. Weld duration too short. 2. Spin Torque setting too high. 3. Parts being welded not loaded properly. 4. Inconsistent geometry of parts being welded.</td>
<td>1. Increase weld duration by increasing weld collapse or decreasing weld Vertical Speed. 2. Decrease Spin Torque setting. 3. Check part loading. 4. Improve part consistency.</td>
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<tr>
<td>S164: Invalid settings. Spin axis cannot accelerate in time. Change settings to allow more time between cycle start and trigger.</td>
<td>Spin axis cannot accelerate to programmed weld speed in time based on current setup parameters.</td>
<td>1. Distance between Top of Stroke Position and Trigger Position too low. 2. Distance between Top of Stroke Position and Sensing Start Position too low. 2. Weld Spin Speed too high. 3. Weld Vertical Speed too high.</td>
<td>1. Decrease numerical value of Top of Stroke Position setting or increase numerical value of Trigger Position setting. (Note: the welder may need to be positioned higher on the support column.) 2. Decrease numerical value of Top of Stroke Position setting or increase numerical value of Sensing Start Position setting. (Note: the welder may need to be positioned higher on the support column.) 3. Decrease weld Spin Speed setting. 4. Decrease weld Vertical Speed setting.</td>
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<tr>
<td>S165: Spin axis cannot reach the proper end orientation due to vertical travel being too small.</td>
<td>Proper spin axis orientation at end of weld cannot be achieved due to insufficient vertical travel.</td>
<td>1. Vertical weld travel too small. 2. Spin Deceleration too low. 3. Weld Spin Speed too high. 4. Weld Vertical Speed too high.</td>
<td>1. Increase weld Distance, Position, Energy, or Peak Spin Torque settings. 2. Increase Spin Deceleration setting. 3. Decrease weld Spin Speed setting. 4. Decrease weld Vertical Speed setting.</td>
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<tr>
<td>S166: Spin axis cannot decelerate in time to reach the proper end orientation due to vertical travel being too small.</td>
<td>Time to decelerate spin axis is longer than time for vertical axis to travel to end of weld.</td>
<td>same as alarm S165</td>
<td>same as alarm S165</td>
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<tr>
<td>S167: Weld cannot complete before reaching the Vertical Travel Limit.</td>
<td>Completion of weld not possible due to press reaching Vertical Travel Limit.</td>
<td>1. Vertical Travel Limit too low. 2. Vertical weld travel too low. 3. Weld Spin Speed too high. 4. Weld Vertical Speed too high.</td>
<td>1. Increase numerical value of Vertical Travel Limit setting. 2. Reduce vertical travel by decreasing weld Distance, Position, Energy, or Peak Spin Torque. 3. Decrease weld Spin Speed setting. 4. Decrease weld Vertical Speed setting.</td>
</tr>
<tr>
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<tr>
<td>S168: Weld cannot complete before reaching the Vertical Travel Limit.</td>
<td>same as alarm S167</td>
<td>same as alarm S167</td>
<td>same as alarm S167</td>
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<tr>
<td>S169: Weld stopped because the weld end position would exceed Vertical Travel Limit.</td>
<td>same as alarm S167</td>
<td>same as alarm S167</td>
<td>same as alarm S167</td>
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</tr>
<tr>
<td>S170: Weld stopped because the weld end position would exceed Vertical Travel Limit.</td>
<td>same as alarm S167</td>
<td>same as alarm S167</td>
<td>same as alarm S167</td>
</tr>
<tr>
<td>Alarm</td>
<td>Description</td>
<td>Cause(s)</td>
<td>Solution(s)</td>
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<tr>
<td>S171: Weld unable to complete as configured. Trigger Position is beyond end of weld.</td>
<td>Trigger Position is beyond Weld Position.</td>
<td>1. Trigger Position too high. 2. Weld Position too low.</td>
<td>1. Decrease numerical value of Position setting on screen SETUP &gt; TRIGGER. 2. Increase numerical value of Position setting on screen SETUP &gt; WELD.</td>
</tr>
<tr>
<td>S172: Weld unable to complete as configured. Trigger Position is beyond Vertical Travel Limit.</td>
<td>Trigger Position is beyond Vertical Travel Limit.</td>
<td>1. Trigger Position too high. 2. Vertical Travel Limit too low.</td>
<td>1. Decrease numerical value of Position setting on screen SETUP &gt; TRIGGER. 2. Increase numerical value of Vertical Travel Limit setting.</td>
</tr>
<tr>
<td>S174: Weld unable to complete as configured. Sensing Start Position is beyond weld end position.</td>
<td>Sensing Start Position is beyond Weld Position.</td>
<td>1. Sensing Start Position too high. 2. Weld Position too low.</td>
<td>1. Decrease numerical value of Sensing Start Position setting. 2. Increase numerical value of Position setting on screen SETUP &gt; WELD.</td>
</tr>
<tr>
<td>S175: Dynamic Hold Distance is too small for vertical axis to accelerate and decelerate.</td>
<td>Completion of dynamic hold phase not possible based on current setup parameters.</td>
<td>1. Dynamic Hold Distance too small. 2. Dynamic Hold Vertical Speed too high.</td>
<td>1. Increase Dynamic Hold Distance setting. 2. Decrease Vertical Speed setting on screen SETUP &gt; WELD.</td>
</tr>
<tr>
<td>S176: Rotation to Spin Tool Load Orientation not permitted due to part not detected in fixture.</td>
<td>If setup option Spin Tool Load Orientation is enabled, the sensor checking for part presence in the bottom fixture was off just before or during motion of the spin tool to the load orientation.</td>
<td>1. Welded assembly not retained in bottom fixture when head retracts to Top of Stroke position. 2. Part presence sensor not adjusted properly to sense parts in bottom fixture. 3. Part presence sensor wiring problem. 4. Part presence sensor failure.</td>
<td>1. Ensure tooling functions properly to secure the welded assembly in the fixture when the head retracts. Part retention can be improved by using fixture clamps. 2. Adjust sensor such that it turns on when the parts are loaded and off when parts are not loaded. 3. Ensure sensor is wired properly to activate Part Presence Sensor 1 on J2 INPUTS connector. 4. Replace sensor.</td>
</tr>
<tr>
<td>S177: Rotation to Spin Tool Load Orientation not permitted due to part detected in spin tool.</td>
<td>If setup option Spin Tool Load Orientation is enabled, the sensor checking for part presence in the spin tool was on just before or during motion of the spin tool to the load orientation.</td>
<td>1. Welded assembly remains in spin tool after head retracts to Top of Stroke position. 2. Part remains in spin tool after head retracts to Top of Stroke position due to lack of weld during the cycle. 3. Part presence sensor or vacuum switch not adjusted properly to sense part in spin tool. 4. Part presence sensor wiring problem. 5. Part presence sensor or vacuum switch failure.</td>
<td>1. Ensure tooling functions properly to secure the welded assembly in the fixture when the head retracts. 2. Adjust setup parameters to achieve a proper weld. 3. Adjust part presence sensor or vacuum switch such that it turns on when the part is loaded in the spin tool, and off when the part is not loaded. 4. Ensure part presence sensor is wired properly to activate Part Presence Sensor 2 on J2 INPUTS connector. 5. Replace sensor or vacuum switch.</td>
</tr>
<tr>
<td>S178: Spin torque or position (lag) error limit exceeded during rotation to Spin Tool Load Orientation.</td>
<td>If setup option Spin Tool Orientation is enabled, spin motor torque or position error exceeded a limit during motion of the spin tool to the load orientation.</td>
<td>1. Obstruction to spin motion. 2. Improper spin servo tuning.</td>
<td>1. Ensure there is no obstruction to spin motion after the head retracts to the Top of Stroke position at the end of the cycle. 2. Ensure Tool Inertia setting matches physical inertia of the spin tool.</td>
</tr>
<tr>
<td>S190: Excessive vertical force detected.</td>
<td>Excessive vertical force detected when welder is in Ready state.</td>
<td>1. Excessive upward force applied on spin tool when loading or unloading parts. 2. Welder malfunction.</td>
<td>1. Reduce upward force when loading or unloading parts. 2. Reset alarm. If it persists, contact DUKANE.</td>
</tr>
</tbody>
</table>
### Table 13-II  Machine Alarms (continued)

<table>
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</tr>
</thead>
<tbody>
<tr>
<td>S251: Light curtain obstructed</td>
<td>Light curtain obstructed during operation.</td>
<td>1. Light curtain obstructed while both operating switches are active.</td>
<td>Prevent light curtain obstruction for causes listed.</td>
</tr>
<tr>
<td></td>
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<td>2. Light curtain obstructed while welder is between start of cycle and start of static hold phase or start of upstroke phase if static hold is disabled.</td>
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<tr>
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<td>3. If at least one fixture clamp option is enabled, light curtain obstructed while welder is between start of upstroke phase and end of cycle.</td>
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<tr>
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<td>4. If at least one fixture clamp option is enabled, light curtain obstructed while weld cycle has started but clamp(s) have not yet closed.</td>
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<tr>
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<td>5. Light curtain obstructed while one or both axes are moving during homing.</td>
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<td></td>
<td>6. Light curtain obstructed while one or both axes are moving during position teaching.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. One or both servo axes not moving properly.</td>
<td>2. Check servo motors and drives.</td>
</tr>
<tr>
<td>S303: Part Pickup timeout.</td>
<td>Part pickup did not complete within allowable time.</td>
<td>1. Part Pickup timeout too short.</td>
<td>1. Increase Timeout setting on screen SETUP &gt; GENERAL &gt; OPTIONS &gt; Part Pickup SETTINGS.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Part Pickup Sensing Start Position too low.</td>
<td>2. Increase numerical value of Sensing Start Position setting on screen SETUP &gt; GENERAL &gt; OPTIONS &gt; Part Pickup SETTINGS.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. Part Pickup Force too high.</td>
<td>3. Reduce Force setting on screen SETUP &gt; GENERAL &gt; OPTIONS &gt; Part Pickup SETTINGS.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4. Vacuum not detected during part pickup.</td>
<td>4. Check spin tool vacuum functionality.</td>
</tr>
<tr>
<td>S304: Fixture clamp 1 close timeout.</td>
<td>Fixture clamp 1 did not close within allowable time.</td>
<td>1. Fixture clamp Timeout too short.</td>
<td>1. Increase Clamp Timeout setting.</td>
</tr>
<tr>
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<td></td>
<td>2. Parts being welded not loaded properly into fixture.</td>
<td>2. Check part loading.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. Problem with fixture clamp.</td>
<td>3. Check fixture clamp functionality. Adjust air supply and associated controls if needed.</td>
</tr>
<tr>
<td>S305: Fixture clamp 2 close timeout.</td>
<td>Fixture clamp 2 did not close within allowable time.</td>
<td>same as alarm S304</td>
<td>same as alarm S304</td>
</tr>
<tr>
<td>S306: Fixture clamp 1 open timeout.</td>
<td>Fixture clamp 1 did not open within allowable time.</td>
<td>1. Fixture clamp Timeout too short.</td>
<td>1. Increase Clamp Timeout setting.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Problem with fixture clamp.</td>
<td>2. Check fixture clamp functionality. Adjust air supply and associated controls if needed.</td>
</tr>
<tr>
<td>S307: Fixture clamp 2 open timeout.</td>
<td>Fixture clamp 2 did not open within allowable time.</td>
<td>same as alarm S306</td>
<td>same as alarm S306</td>
</tr>
<tr>
<td>S308: Weld aborted due to process limit violation.</td>
<td>Weld cycle terminated due to cycle data parameter(s) being outside defined process limits.</td>
<td>1. Weld process results were outside the intended limits.</td>
<td>1. Investigate which parameter was outside limits and address underlying cause. Check consistency of parts being welded.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Limits too narrow for weld process.</td>
<td>2. Widen process limit window(s) or adjust setup parameters to achieve more consistent results.</td>
</tr>
</tbody>
</table>
### Table 13-II  Machine Alarms (continued)

<table>
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<tr>
<th>Alarm</th>
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<th>Cause(s)</th>
<th>Solution(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>S309: Vacuum turned off due to welder inactivity.</td>
<td>Vacuum in spin tool was suspended due to inactivity.</td>
<td>Vacuum generator within vacuum control box was turned off to conserve compressed air.</td>
<td>Clear alarm and resume normal operation.</td>
</tr>
<tr>
<td>S310: Light curtain intrusion not detected. Break light curtain to clear alarm.</td>
<td>Expected light curtain intrusion not detected.</td>
<td>Light curtain intrusion was not detected for one of the following conditions: 1. Between welder power up and first cycle or jog motion. 2. Between recovery from Emergency stop and first subsequent motion. 3. Between end of cycle and start of subsequent cycle.</td>
<td>Intrude into light curtain for each condition listed.</td>
</tr>
<tr>
<td>S311: Excessive vertical axis travel time during homing while upper travel limit switch is active.</td>
<td>Downward motion during homing did not complete within allowable time.</td>
<td>1. Malfunction of upper travel limit switch. 2. Vertical axis not moving properly.</td>
<td>1. Check upper travel limit switch. 2. Check vertical servo actuator and drive.</td>
</tr>
<tr>
<td>S312: Remote setup switching is enabled. Disable to change setup from screen.</td>
<td>With Remote Setup Switching option enabled, setup selection is permitted only via the digital inputs on the J2 INPUTS connector.</td>
<td>Operator attempted to load different setup by selecting from list on HMI when Remote Setup Switching is enabled.</td>
<td>Disable Remote Setup Switching option on screen SYSTEM &gt; CONFIGURATION to permit manual setup selection on HMI.</td>
</tr>
<tr>
<td>S401: Critical memory failure.</td>
<td>Retained variable memory has been lost.</td>
<td>Machine settings required for operation have been lost due to corrupt or missing file(s).</td>
<td>Motor configuration and other files must be restored. Contact DUKANE.</td>
</tr>
<tr>
<td>S402: Motor configuration file load error. Check file parameters and reset welder.</td>
<td>Problem with motor configuration file.</td>
<td>File is missing or corrupt.</td>
<td>Contact DUKANE.</td>
</tr>
<tr>
<td>S403: Unable to replace tuning database. Ensure file is on USB and has the correct file name.</td>
<td>Problem with importing tuning database file.</td>
<td>File is missing, corrupt, or not configured properly.</td>
<td>Contact DUKANE.</td>
</tr>
<tr>
<td>S404: USB device has less than 100MB free.</td>
<td>USB drive plugged into welder has less than 100MB of space available.</td>
<td>1. USB drive was plugged into welder too slowly. 2. Insufficient space remaining on USB flash drive.</td>
<td>1. Clear alarm, remove USB drive, and insert quickly. 2. Increase available space on USB drive.</td>
</tr>
<tr>
<td>S405: Permanent memory lost or no motor configuration loaded.</td>
<td>Data retained in permanent memory lost or motor configuration file not loaded.</td>
<td>File is missing, corrupt, or not loaded.</td>
<td>Contact DUKANE.</td>
</tr>
<tr>
<td>S501: Process results are outside the enabled limit(s).</td>
<td>Weld cycle data parameter(s) outside defined process limits.</td>
<td>same as alarm S308</td>
<td>same as alarm S308</td>
</tr>
<tr>
<td>S502: Spin torque reached 100% during cycle.</td>
<td>Weld cycle terminated due to excessive torque demand on spin axis.</td>
<td>same as alarm S107</td>
<td>same as alarm S107</td>
</tr>
<tr>
<td>S503: Vertical torque reached 100% during cycle.</td>
<td>Weld cycle terminated due to excessive torque demand on vertical axis.</td>
<td>same as alarm S106</td>
<td>same as alarm S106</td>
</tr>
</tbody>
</table>
### Table 13-II  Machine Alarms (continued)

<table>
<thead>
<tr>
<th>Alarm</th>
<th>Description</th>
<th>Cause(s)</th>
<th>Solution(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>S601: Setup error - Top of Stroke Position is beyond Vertical Travel Limit.</td>
<td>Top of Stroke Position is larger than Vertical Travel Limit.</td>
<td>1. Top of Stroke Position is too high. 2. Vertical Travel Limit is too low.</td>
<td>1. Decrease numerical value of Top of Stroke Position setting. 2. Increase numerical value of Vertical Travel Limit setting.</td>
</tr>
<tr>
<td>S602: Setup error - Trigger Sensing Start Position is beyond Vertical Travel Limit.</td>
<td>Trigger Sensing Start Position is larger than Vertical Travel Limit.</td>
<td>1. Trigger Sensing Start Position too high. 2. Vertical Travel Limit is too low.</td>
<td>1. Decrease numerical value of Sensing Start Position setting on screen SETUP &gt; TRIGGER. 2. Increase numerical value of Vertical Travel Limit setting.</td>
</tr>
<tr>
<td>S603: Setup error - Trigger Position is beyond Vertical Travel Limit.</td>
<td>Trigger Position is larger than Vertical Travel Limit.</td>
<td>1. Trigger Position too high. 2. Vertical Travel Limit too low.</td>
<td>1. Decrease numerical value of Position setting on screen SETUP &gt; TRIGGER. 2. Increase numerical value of Vertical Travel Limit setting.</td>
</tr>
<tr>
<td>S606: Setup error - Weld Position is beyond Vertical Travel Limit.</td>
<td>Weld Position is larger than Vertical Travel Limit.</td>
<td>1. Weld Position too high. 2. Vertical Travel Limit too low.</td>
<td>1. Decrease numerical value of Position setting on screen SETUP &gt; WELD. 2. Increase numerical value of Vertical Travel Limit setting.</td>
</tr>
<tr>
<td>S607: Setup error - End of weld (Trigger Sensing Start Position + Weld Distance) is beyond Vertical Travel Limit.</td>
<td>Position at end of weld is larger than Vertical Travel Limit.</td>
<td>1. Trigger Sensing Start Position too high. 2. Weld Distance too high. 3. Vertical Travel Limit too low.</td>
<td>1. Decrease numerical value of Sensing Start Position setting on screen SETUP &gt; TRIGGER. 2. Decrease numerical value of Distance setting on screen SETUP &gt; WELD. 3. Increase numerical value of Vertical Travel Limit setting.</td>
</tr>
<tr>
<td>S608: Setup error - End of weld (Trigger Position + Weld Distance) is beyond Vertical Travel Limit.</td>
<td>Position at end of weld is larger than Vertical Travel Limit.</td>
<td>1. Trigger Position too high. 2. Weld Distance too high. 3. Vertical Travel Limit too low.</td>
<td>1. Decrease numerical value of Position setting on screen SETUP &gt; TRIGGER. 2. Decrease numerical value of Distance setting on screen SETUP &gt; WELD. 3. Increase numerical value of Vertical Travel Limit setting.</td>
</tr>
<tr>
<td>S609: Setup error - End of hold (Trigger Sensing Start Position + Weld Distance + Dynamic Hold Distance) is beyond Vertical Travel Limit.</td>
<td>Position at end of hold is larger than Vertical Travel Limit.</td>
<td>1. Trigger Sensing Start Position too high. 2. Weld Distance too high. 3. Dynamic Hold Distance too high. 4. Vertical Travel Limit too low.</td>
<td>1. Decrease numerical value of Sensing Start Position setting on screen SETUP &gt; TRIGGER. 2. Decrease numerical value of Distance setting on screen SETUP &gt; WELD. 3. Decrease Dynamic Hold Distance setting. 4. Increase numerical value of Vertical Travel Limit setting.</td>
</tr>
<tr>
<td>S610: Setup error - End of hold (Trigger Position + Weld Distance + Dynamic Hold Distance) is beyond Vertical Travel Limit.</td>
<td>Position at end of hold is larger than Vertical Travel Limit.</td>
<td>1. Trigger Position too high. 2. Weld Distance too high. 3. Dynamic Hold Distance too high. 4. Vertical Travel Limit too low.</td>
<td>1. Decrease numerical value of Position setting on screen SETUP &gt; TRIGGER. 2. Decrease numerical value of Distance setting on screen SETUP &gt; WELD. 3. Decrease Dynamic Hold Distance setting. 4. Increase numerical value of Vertical Travel Limit setting.</td>
</tr>
</tbody>
</table>
### Table 13-II  Machine Alarms (continued)

<table>
<thead>
<tr>
<th>Alarm</th>
<th>Description</th>
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<th>Solution(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>S611: Setup error - End of hold (Weld Position + Dynamic Hold Distance) is beyond Vertical Travel Limit.</td>
<td>Position at end of hold is larger than Vertical Travel Limit.</td>
<td>1. Weld Position too high. 2. Dynamic Hold Distance too high. 3. Vertical Travel Limit too low.</td>
<td>1. Decrease numerical value of Position setting on screen SETUP &gt; WELD. 2. Decrease Dynamic Hold Distance setting. 3. Increase numerical value of Vertical Travel Limit setting.</td>
</tr>
<tr>
<td>S617: Setup error - Weld Position is smaller than Trigger Sensing Start Position.</td>
<td>Weld Position is smaller than Trigger Sensing Start Position.</td>
<td>1. Weld Position too low. 2. Trigger Sensing Start Position too high.</td>
<td>1. Increase numerical value of Position setting on screen SETUP &gt; WELD. 2. Decrease numerical value of Sensing Start Position setting on screen SETUP &gt; TRIGGER.</td>
</tr>
<tr>
<td>S618: Setup error - Weld Position is smaller than Trigger Position.</td>
<td>Weld Position is smaller than Trigger Position.</td>
<td>1. Weld Position too low. 2. Trigger Position too high.</td>
<td>1. Increase numerical value of Position setting on screen SETUP &gt; WELD. 2. Decrease numerical value of Position setting on screen SETUP &gt; TRIGGER.</td>
</tr>
<tr>
<td>S621: Setup error - Spin axis cannot accelerate in time. Change settings to allow more time between cycle start and trigger.</td>
<td>same as alarm S164</td>
<td>same as alarm S164</td>
<td>same as alarm S164</td>
</tr>
<tr>
<td>S631: Setup error - Peak Spin Torque is smaller than Trigger Spin Torque.</td>
<td>Peak Spin Torque is smaller than Trigger Spin Torque.</td>
<td>1. Peak Spin Torque is too low. 2. Trigger Spin Torque is too high.</td>
<td>1. Increase Peak Spin Torque setting. 2. Decrease Spin Torque setting on screen SETUP &gt; TRIGGER.</td>
</tr>
</tbody>
</table>
### Table 13-II  Machine Alarms (continued)

<table>
<thead>
<tr>
<th>Alarm</th>
<th>Description</th>
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<th>Solution(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>S632: Setup error - Options not set properly for using Spin Tool Load Orientation.</td>
<td>If setup option Spin Tool Load Orientation is enabled, options for sensing part presence in spin tool and bottom fixture must also be enabled in the setup.</td>
<td>Options for part sensing are not enabled as described in Section 5, SETUP Mode, General, OPTIONS, Spin Tool Load Orientation.</td>
<td>Enable options.</td>
</tr>
<tr>
<td>S701: Incorrect hardware configuration for operation in automation mode.</td>
<td>Hardware not configured for operation in automation mode.</td>
<td>Automation Enable signal on J2 INPUTS connector not active when Initiate Mode is set to Automation.</td>
<td>Activate Automation Enable signal on J2 INPUTS connector when operating in automation mode.</td>
</tr>
<tr>
<td>S702: Programmed Tool Inertia not found in tuning database.</td>
<td>Tool Inertia value programmed in setup is not within expected range.</td>
<td>1. Tool Inertia is too large. 2. Tuning database is missing or corrupt.</td>
<td>1. Enter value for Tool Inertia which is within the limits listed on numeric keypad. If maximum allowable value is smaller than physical tool inertia, use different welder model. 2. Contact DUKANE.</td>
</tr>
<tr>
<td>S703: Spin axis not configured. Ensure that spin drive is set to correct node number.</td>
<td>Spin servo drive not properly configured.</td>
<td>Incorrect node setting on spin servo drive.</td>
<td>Contact DUKANE.</td>
</tr>
<tr>
<td>S704: Vertical axis not configured. Ensure that vertical drive is set to correct node number.</td>
<td>Vertical servo drive not properly configured.</td>
<td>Incorrect node setting on vertical servo drive.</td>
<td>Contact Dukane.</td>
</tr>
<tr>
<td>S705: An alarm has occurred which can only be cleared by powering welder off, then back on.</td>
<td>An alarm has occurred which requires that the welder power be turned off, then back on to reset.</td>
<td>This alarm is asserted immediately following a S108.11 or S109.11 alarm (Powerlink communications).</td>
<td>Turn welder power off, then back on to resume operation. If problem persists, contact Dukane.</td>
</tr>
<tr>
<td>S720: Saving of recipe failed (MOTOR).</td>
<td>An error occurred during saving of recipe parameters. No parameters were saved.</td>
<td>Corrupt or missing file device (memory card or USB flash drive).</td>
<td>Check that the file device (memory card or USB flash drive) is properly connected. If alarm persists, contact DUKANE.</td>
</tr>
<tr>
<td>S721: Partial failure of recipe saving (MOTOR).</td>
<td>An error occurred during saving of recipe parameters. Not all parameters were saved.</td>
<td>File device (memory card or USB flash drive) malfunction.</td>
<td>Contact DUKANE.</td>
</tr>
<tr>
<td>S722: Loading of recipe failed (MOTOR).</td>
<td>An error occurred during loading of recipe parameters. No data was loaded.</td>
<td>1. Incorrect file name or format. 2. Corrupt or missing file device (memory card or USB flash drive).</td>
<td>Contact DUKANE.</td>
</tr>
<tr>
<td>S723: Partial failure of recipe loading (MOTOR).</td>
<td>An error occurred during loading of recipe parameters. Not all parameters were loaded correctly.</td>
<td>1. File(s) corrupted. 2. File device (memory card or USB flash drive) malfunction.</td>
<td>Contact DUKANE.</td>
</tr>
<tr>
<td>S724: Saving of recipe failed (SETUP).</td>
<td>same as alarm S720</td>
<td>same as alarm S720</td>
<td>same as alarm S720</td>
</tr>
</tbody>
</table>
### Table 13-II  Machine Alarms (continued)

<table>
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<tr>
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<th>Solution(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>S725: Partial failure of recipe saving (SETUP).</td>
<td>same as alarm S721</td>
<td>same as alarm S721</td>
<td>same as alarm S721</td>
</tr>
<tr>
<td>S726: Loading of recipe failed (SETUP).</td>
<td>same as alarm S722</td>
<td>same as alarm S722</td>
<td>same as alarm S722</td>
</tr>
<tr>
<td>S727: Partial failure of recipe loading (SETUP).</td>
<td>same as alarm S723</td>
<td>same as alarm S723</td>
<td>same as alarm S723</td>
</tr>
<tr>
<td>S728: Saving of recipe failed (TUNE).</td>
<td>same as alarm S720</td>
<td>same as alarm S720</td>
<td>same as alarm S720</td>
</tr>
<tr>
<td>S729: Partial failure of recipe saving (TUNE).</td>
<td>same as alarm S721</td>
<td>same as alarm S721</td>
<td>same as alarm S721</td>
</tr>
<tr>
<td>S730: Loading of recipe failed (TUNE).</td>
<td>same as alarm S722</td>
<td>same as alarm S722</td>
<td>same as alarm S722</td>
</tr>
<tr>
<td>S731: Partial failure of recipe loading (TUNE).</td>
<td>same as alarm S723</td>
<td>same as alarm S723</td>
<td>same as alarm S723</td>
</tr>
<tr>
<td>S732: Saving of recipe failed (USB).</td>
<td>same as alarm S720</td>
<td>same as alarm S720</td>
<td>same as alarm S720</td>
</tr>
<tr>
<td>S733: Partial failure of recipe saving (USB).</td>
<td>same as alarm S721</td>
<td>same as alarm S721</td>
<td>same as alarm S721</td>
</tr>
<tr>
<td>S734: Loading of recipe failed (USB).</td>
<td>same as alarm S722</td>
<td>same as alarm S722</td>
<td>same as alarm S722</td>
</tr>
<tr>
<td>S735: Partial failure of recipe loading (USB).</td>
<td>same as alarm S723</td>
<td>same as alarm S723</td>
<td>same as alarm S723</td>
</tr>
<tr>
<td>S736: Saving of recipe failed (CONFIGURATION).</td>
<td>same as alarm S720</td>
<td>same as alarm S720</td>
<td>same as alarm S720</td>
</tr>
<tr>
<td>S737: Partial failure of recipe saving (CONFIGURATION).</td>
<td>same as alarm S721</td>
<td>same as alarm S721</td>
<td>same as alarm S721</td>
</tr>
<tr>
<td>S738: Loading of recipe failed (CONFIGURATION).</td>
<td>same as alarm S722</td>
<td>same as alarm S722</td>
<td>same as alarm S722</td>
</tr>
<tr>
<td>S739: Partial failure of recipe loading (CONFIGURATION).</td>
<td>same as alarm S723</td>
<td>same as alarm S723</td>
<td>same as alarm S723</td>
</tr>
</tbody>
</table>
SECTION 14

Contacting Dukane

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Contacting Dukane

Equipment Identification and Problem Details
When contacting Dukane about a service–related problem, be prepared to give the following information:

- SSW model number and serial number (see label affixed on the back of the welder or on HMI screen SYSTEM > INFO)
- Any alarm indicators on the HMI (touch screen display)
- Description of the problem and steps taken to resolve it
- History of any changes recently made to the welder setup, fixturing, or parts being welded.
- Application or System Snapshot files (refer to Section 5, Diagnostics)

Some 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
2900 Dukane Drive
St. Charles, IL 60174 USA

Main Phone: (630) 797–4900
Main Fax: (630) 797–4949
Service & Parts Fax: (630) 584–0796

Website
The website has information about our products, processes, solutions, and technical data (including 3D CAD models). Downloads are available for many kinds of literature.

Main page:
www.dukane.com

Downloads page:
https://www.dukane.com/support/downloads/

You can locate your local representative at:
www.dukane.com/contact-us/
SECTION 15

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ISO CERTIFICATION

Dukane chose to become ISO 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 certification, you must prove to one of the quality system registrar groups that you meet three requirements:

1. Leadership
2. Involvement

The ISO standards establish 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.

View the Dukane ISO certificate of compliance at: https://www.dukane.com/support/downloads/
Please refer to our website at:

www.dukane.com/contact-us/

to locate your local representative.