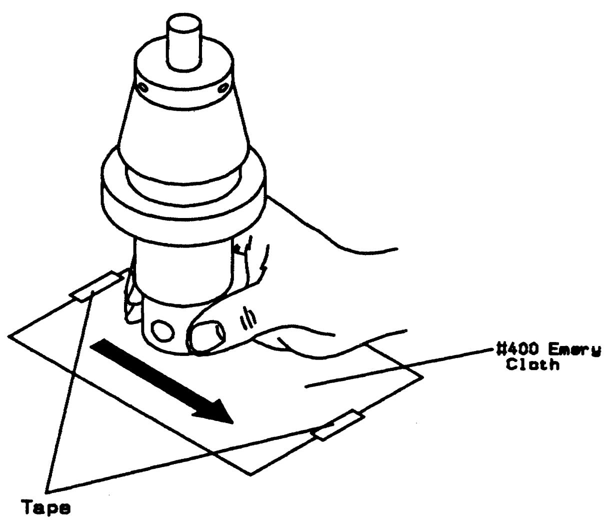
6.4 Reconditioning Converter-Booster-Horn Stack Mating Surfaces

Welding system components work most efficiently when the Converter-Booster-Horn Stack mating surfaces are flat, in solid contact, and free from fretting corrosion. Poor contact between mating surfaces wastes power output, makes tuning difficult, increases noise and heat, and may cause damage to the converter.

Caution: Never clean the Converter-Booster-Horn Stack mating surfaces with a buffing wheel.

1. Disassemble the Converter-Booster-Horn Stack and wipe the mating surfaces with a clean cloth or paper towel.
2. Examine all mating surfaces. If any mating surface shows corrosion or a hard, dark deposit, recondition it.
3. If necessary, remove the threaded stud from the part.
4. Tape a clean sheet of #400 (or finer) grit emery cloth to a clean, smooth, flat surface (such as a sheet of plate glass).

Figure 6-5
Reconditioning Stack Mating Surfaces



5. Place the interface surface on the emery cloth. Grasp the part at the lower end, with your thumb over the spanner-wrench hole, and lap the part in a straight line across the emery cloth (Figure 6-5). Do not apply downward pressure — the weight of the part alone provides sufficient pressure.

Caution: Use extreme care to avoid tilting the part and losing flatness of the surface. Doing so can make the system inoperative – due to uneven mating surfaces.

6. Lap the part, two or three times, in the same direction against the emery cloth (Figure 6-5).
7. Rotate the part 120 degrees, placing your thumb over the spanner-wrench hole, and repeat the lapping procedure in step 6.
8. Rotate the part another 120 degrees to the next spanner-wrench hole, and repeat the lapping procedure in step 6.
9. Re-examine the mating surface. If necessary, repeat steps 2-5 until you remove most of the contaminant. Remember, this should not require more than two to three complete rotations for an aluminum horn or booster; a titanium component may require more rotations.
10. Before re-inserting a threaded stud in an aluminum booster or horn:
    a. Using a file card or wire brush, clean any aluminum bits from the knurled end of the stud.
    b. Using a clean cloth or towel, clean the threaded hole.
    c. Examine the knurled end of the stud. If worn, replace the stud. Also, examine the stud and threaded hole for stripped threads.

Caution: Threaded studs cannot be re-used in titanium horns or boosters. Replace all studs in these components.

11. Reassemble and re-install the stack. (Refer to the appropriate actuator manual for details.) Use the following torque specifications:

Figure 6-6 Torque Specifications

Stud Size	Torque	Part No.
3/8-24 x 1/2	90 in lbs/33 Nm	100-098-120
3/8-24 x 1 1/4	290 in lbs/33 Nm	100-098-121
1/2-20 x 1 1/4	450 in lbs/47 Nm	100-098-370
1/2-20 x 1 1/2	450 in lbs/47 Nm	100-098-123

Studs come in different lengths. Use this rule as a guide for proper stud usage:

- 3/8-24 studs should protrude approximately 9/16 in.
- 1/2-20 studs should protrude approximately 3/4 in.

Assembly of Converter, Booster and Horn 4.5

Assembling the Converter-Booster-Horn Stack 4.5.1

1. Clean the mating surfaces of the converter and booster, and remove any foreign matter from the threaded hole in the converter and the booster's threaded stud. Make sure that the stud is tight in the booster (see Figure 4-6).

Stud size	Torque
M8 × 1.25	70 inch-pounds, 7.9 newton-meters
3/8-24	290 inch-pounds, 33 newton-meters
1/2-20	450 inch-pounds, 47 newton-meters

Figure 4-6
Stud Torque Specifications

2. Coat one of the mating surfaces with a thin film of silicone grease. Be careful not to apply grease to the threaded stud.

3. Hand assemble the converter and booster together and, using the spanner wrench supplied with the power supply, tighten securely (see Figure 4-7).

Booster application	Torque
20kHz	220 inch-pounds, 25 newton-meters
40kHz	110 inch-pounds, 12.42 newton-meters

Figure 4-7
Booster Interface Torque Specifications

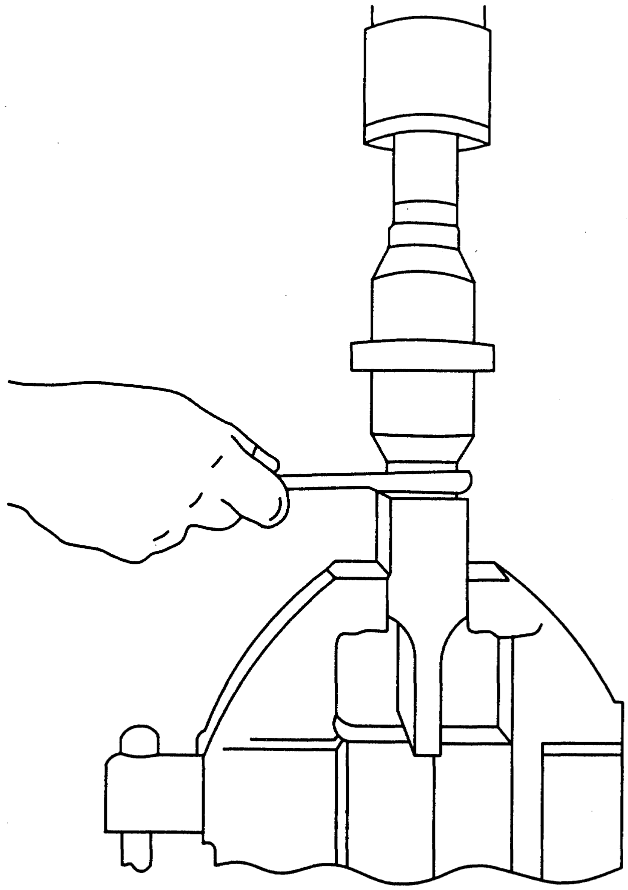
4. Clean the mating surfaces of the booster and horn, and remove any foreign matter from the hole and stud. Make sure that the stud is tight in the horn. Use the specifications in Figure 4-6.

5. Coat one of the mating surfaces with a thin film of silicone grease. Be careful not to apply grease to the threaded stud.

6. Screw the horn into the booster and, using the spanner wrench, tighten securely (see Figure 4-7).

Caution: If necessary, secure the largest portion of a square or rectangular horn in a soft-jawed vise. NEVER attempt to assemble or remove a horn by holding the converter housing or the booster clamp ring in a vise.

Figure 4-8
Assembling Converter, Booster and Horn



4.5.2 Connecting Tip to Horn

1. Clean the mating surfaces of the horn and tip, and remove any foreign matter from the threaded stud and the hole.

2. Hand assemble the tip to the horn. Do not use any silicone grease.

3. Use the spanner wrench and an open-end wrench to tighten the tip to the following specifications:

Figure 4-9
Horn-Tip Interface Torque Specifications

Tip thread	Torque
1/4-28	110 inch-pounds, 12.42 newton-meters
3/8-24	180 inch-pounds, 20.33 newton-meters

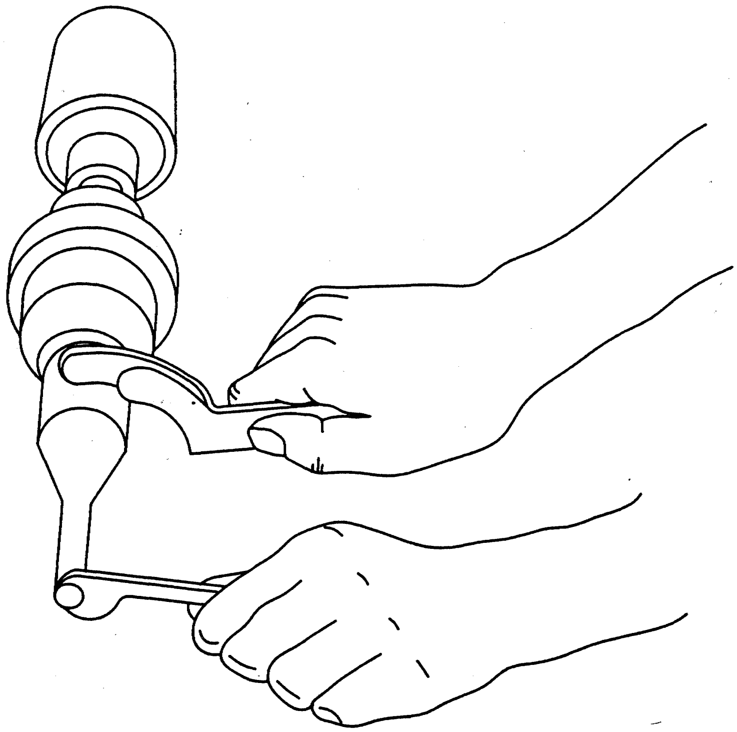


Figure 4-10
Connecting Tip
to Horn

Converter Cooling (Fixed Stack Applications Only) 4.6

Converter performance and reliability can be adversely affected if the converter is subjected to temperatures in excess of 140° F (60° C). The converter front driver temperature should not exceed 122° F (50° C). To prolong converter life and maintain a higher degree of system reliability, it is advisable to cool the converter assemblies with a directed stream of clean, dry, compressed air, particularly if your application calls for continuous ultrasonics operation. Converter cooling is especially critical in 40kHz applications.

> **Note:** Additional heat will be generated if the converter-booster-horn interfaces need reconditioning. Be sure the stack is in good condition and properly assembled.

Two types of converters are normally used with Branson equipment:

- R-type — equipped with a barbed cooling nipple that accommodates 1/16 in. I.D. flexible tubing to direct cooling air to the interior of the converter assembly.

- J-type — equipped with holes in the perimeter of the top and bottom plates to provide chimney convection cooling. If additional cooling is required for this type of converter, a directed orifice must be placed under the converter.

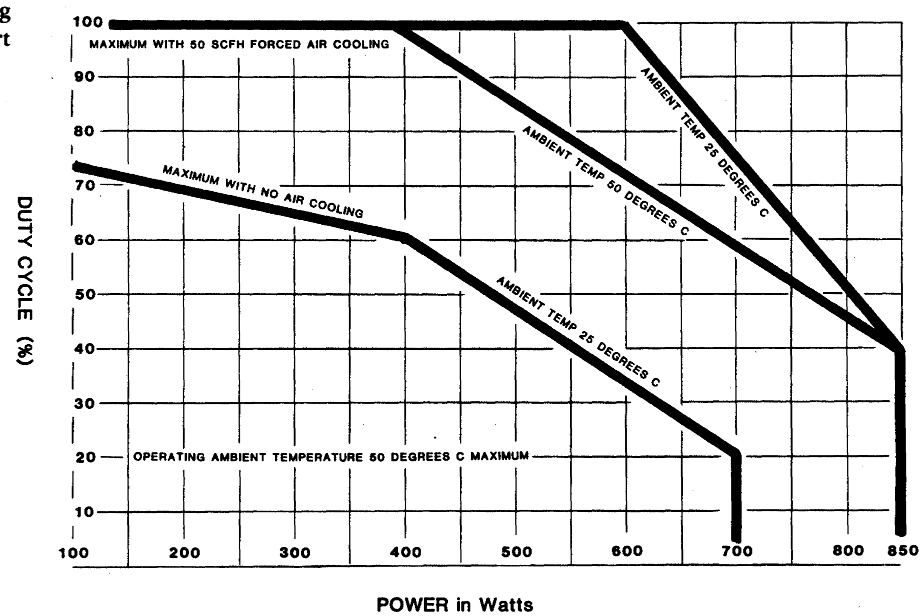
Two procedures can be used to determine if a converter is operating at a temperature that is too high. In both cases, determinations should be made immediately after substantial machine operation and without power applied to the horn.

- Using a pyrometer (or similar temperature measuring device), tape the probe onto the outer shell of the converter assembly. Wait for the probe to reach the temperature of the shell. If the temperature is 120° F (48° C) or higher, a cooling air stream is required.

- If a temperature measuring device is unavailable, use your hand to feel the shell of the converter. If the converter is hot to the touch, a cooling air stream is required.

The amount of cooling air required can be determined by referring to the chart in Figure 4-11.

Figure 4-11
Converter Cooling Requirements Chart



If converter cooling is required, use the following procedure:

1. Start with a 50 psi air source (or higher) from a 0.060 in. orifice (I.D.). On a J-type converter, direct the air upward from the bottom of the assembly.

2. Perform a run of welding operations.

3. Immediately after completing the run, check the converter temperature.

4. If the converter is still too hot, increase the diameter of the orifice in small increments until the temperature falls within the ranges on the chart.

A 0.060 in. orifice at 50 psi will result in a reading of 80 cubic feet per hour. This should be sufficient to cool most applications requiring an air stream. In continuous welding operations, or applications with longer duty cycles, it may be necessary to cool the horn as well as the converter. Horns require cooling because of the cumulative residual heat that is transferred from contacting the workpiece.

B.1 Ultrasonic Plastics Welding

Thermoplastic parts are welded ultrasonically by applying high frequency vibrations to the parts being assembled. The vibrations, through surface and intermolecular friction, produce a sharp rise in temperature at the joint where the parts meet.

When the temperature is high enough to melt the plastic, there is a "flow" of material between the parts. When the vibrations stop, the material solidifies under pressure and a uniform weld results.

Most plastics welding systems operate at a frequency above the range of human hearing (18 kHz) and are thus called ultrasonic.

B.2 The Plastics Welding System

The welding system consists of a power supply, an actuator, and a converter-booster-horn stack. The system can perform ultrasonic welding, inserting, staking, spot welding, swaging, degating, and continuous ultrasonic operations. It is designed for automated, semi-automated and/or manual production units.

B.2.1 Power Supply

The power supply converts conventional 50/60 Hz line current to 20 or 40 kHz electrical energy. It contains all the electronic controls and can be located up to 25 ft/8.5 meters from the actuator (15 ft/5.1 meters for 40 kHz units). This allows the operator to adjust or reprogram the welding cycle remotely from the welding system.

B.2.2 Converter

The ultrasonic electrical energy from the power supply is applied to the converter or transducer element. This transforms the high frequency electrical oscillations into mechanical vibrations at the same frequency as the electrical "vibrations." The heart of the converter is a lead zirconate titanate electrostrictive element. When subjected to an alternating voltage, this element expands and contracts, resulting in better than 90% energy conversion.

B.2.3 Booster

Success in ultrasonic welding, staking or inserting often depends on the right amplitude of movement at the horn face. Amplitude is a function of horn shape, which is largely determined by the size and form of the parts to be assembled. The booster may be used to modify the amplitude of vibrations applied to the parts through the horn.

The booster is a resonant half-wave section of aluminum or titanium. It is mounted between the converter and the horn and provides a clamping point for more rigid stack mounting.

Boosters are designed to resonate at the same frequency as the converter with which they are used. Boosters are usually mounted at a nodal (minimum vibration) point of axial motion. This minimizes the loss of energy and prevents sound transmitting into the support column.

B.2.4 Horn

The horn is usually selected or designed for a specific application. Each horn is a half-wave section which applies the necessary pressure to the parts to be assembled. It also transfers ultrasonic vibrations from the converter to the workpiece.

Depending on their profile, horns are referred to as stepped, conical, exponential, or catenoidal. The shape of the horn alters the gain factor. Depending on the application, horns may be made from titanium alloys, aluminum or steel. Titanium alloys are the best materials for horn fabrication. Aluminum horns are usually chrome- or nickel-plated or hard-coated.

B.2.5 Dynamic Trigger Mechanism

The Dynamic Trigger Mechanism ensures that pressure is applied to the part prior to the application of ultrasonic energy. This adjustable, pressure-activated device is located between the air cylinder and the converter.

To maintain horn-to-part contact and force as the joint collapses, springs provide dynamic follow-through. As the plastic melts, the springs extend to ensure smooth transmission of ultrasonic energy into the part.

A.3 Standard Accessories

1. Boosters

Type of Booster	Description	Where used	Part Number
900 Series, 1/2-20 Horn, 20 kHz	Aluminum, 1:0.6 (Purple) Aluminum, 1:1 (Green) Aluminum, 1:1.5 (Gold) Aluminum, 1:2 (Silver) Titanium, 1:0.6 (Purple) Titanium, 1:1 (Green) Titanium, 1:1.5 (Gold) Titanium, 1:2 (Silver) Titanium, 1:2.5 (Black)	905/910BC 920B power supplies	101-149-055 101-149-051 101-149-052 101-149-053 101-149-060 101-149-056 101-149-057 101-149-058 101-149-059
489, 3/8-24 Horn, 20 kHz	Aluminum, 1:0.6 (Purple) Aluminum, 1:1 (Green) Aluminum, 1:1.5 (Gold) Aluminum, 1:2 (Silver) Titanium, 1:2.5 (Black)	905/910 power supplies:	101-149-090 101-149-093 101-149-092 101-149-094 101-149-091
XL, M8 x 1.25 Horn, 40 kHz	Aluminum, 1:0.6 (Purple) Aluminum, 1:1 (Green) Aluminum, 1:1.5 (Gold) Aluminum, 1:2 (Silver) Aluminum, 1:2.5 (Black) Titanium, 1:1 (Green) Titanium, 1:1.5 (Gold) Titanium, 1:2 (Silver) Titanium, 1:2.5 (Black)	943B/947BC power supplies	101-149-087 101-149-079 101-149-080 101-149-081 101-149-082 101-149-085 101-149-086 101-149-083 101-149-084