

SOLUTION CONTROL TECHNICAL DATA SHEET #1 SOLID STATE DIFFERENTIAL PRESSURE TRANSDUCER OPTION #9181-05C

THEORY: A major variable in the resistance welding process is **TIP (electrode) FORCE**. Since the electrical resistance between parts being joined **decreases** as force between the welding electrodes **increases**, the heat generated during the weld changes accordingly.

Since the tip force also acts as a **forge** in the nugget development process, process variations will greatly affect weld strength and ductility.

Lastly, if current starts to flow before proper **TIP FORCE** has been reached, metal expulsion (flash) will occur causing part indentation, tip pick-up of metal, and potential danger to the operator and others in the area of the welder.

*Welding before proper tip force has been reached **DRASTICALLY** reduces the quantity of welds possible between tip dressing, and **REDUCES** overall weld strength, consistency, and appearance.*

CALCULATING ELECTRODE TIP FORCE: The SOLUTION uses the **differential** pressure measurement to calculate electrode force as follows:

ELECTRODE TIP FORCE (lbs.) = AIR PRESSURE (psi) X CYLINDER PISTON AREA

- For *PRESS* or *PROJECTION* welders, this is the exact electrode force used by the SOLUTION.
- For *ROCKER ARM* welders, this value has to be modified by the welder's mechanical leverage as shown in the direction book. Once this value has been entered when the control is first installed, all calculations are automatically done by the SOLUTION control each time a weld is made.
- For two and three stack welding cylinders as well as Intensifier style cylinders, the manufacturer's marking of cylinder piston area is used for this calculation.

The **TIP FORCE**, as shown in FIGURE A on the next page, remains at zero (0) until the electrode touches the work piece at point #2. **Then the tip force increases in direct proportion to the change in air pressure.**

INSTALLATION: The #9181-05C **DIFFERENTIAL PRESSURE TRANSDUCER** option connects to the weld cylinders shown in FIGURE B on the next page using two 1/4" polyflow tubes supplied with the control. The transducer, mounted **inside** the SOLUTION control, subtracts the air pressure on the underside of the cylinder piston from that of the top. The resultant is the **exact** air pressure acting on the cylinder rod.

HI-LOW FEATURE: An **additional** check is made at the **end** of the weld to be sure that the electrode force has not gone **above or below** the customer entered maximum VARIATION.

If this number has been **exceeded**, higher electrode force will **reduce** electrical resistance between the parts to **reduce** weld heat and **reduce** nugget strength, penetration, and ductility.

If force has dropped **below** this number, excessive electrode heating and material surface marking will occur.

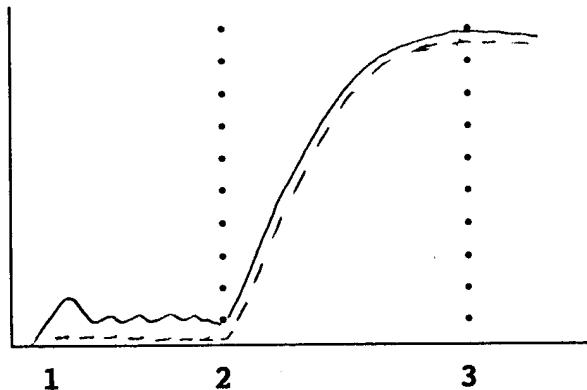
In either case, with this **HI/LOW** feature a fault will be generated by the control to keep the electrodes closed and require operator reset, or close a FAULT RELAY to signal a fault to a remote system..

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APPLICATION: This **SOLUTION** option is designed to start current flow in the welder at the **EXACT** tip force desired. As shown in the graph below, air pressure in the welding cylinder, as measured by the **DOUBLE SIDED** (differential) **PRESSURE TRANSDUCER** supplied with this option, changes in three steps:

1. **WELDER IS INITIATED:** The welder head starts to move at point #1. Before the electrodes touch (point #2), volume in the upper half of the cylinder starts to **INCREASE**. Therefore, during this same time, air pressure in the **VARIABLE** volume cylinder builds only slightly as required to overcome friction and inertia. This varies depending on air temperature, viscosity, oil content in the compressed air, temperature of welder bearings, etc.
2. **ELECTRODE TOUCHES WORK PIECE:** At point #2, the cylinder stops moving, and the now **FIXED** volume of the cylinder causes each additional amount of air to increase pressure. At the same time air exhausts out of the lower side of the cylinder
3. This continues until at point #3 the pressure inside the cylinder has reached that of the welder's pressure regulator, and the pressure on the underside of the piston has reached zero.

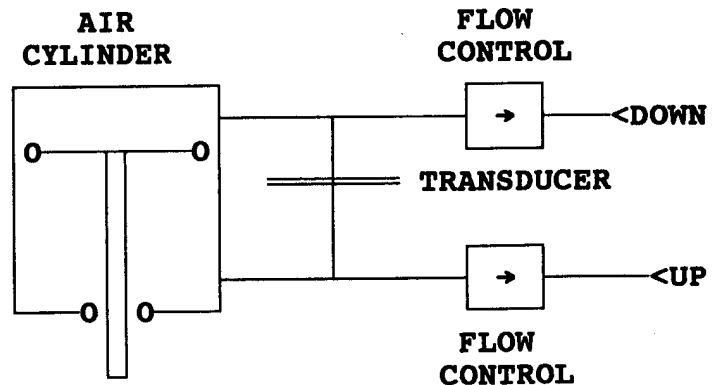
FIGURE A



LEGAND

Air Cylinder Differential Pressure —————
Electrode Tip Force - - - - -

FIGURE B



ELIMINATES NEED FOR SQUEEZE TIME: Because use of a **DIFFERENTIAL** type transducer eliminates error and false signals caused by changes in **welder head advance speed** as set by flow controls in the air system, no artificial **SQUEEZE TIME** is needed. Also, unlike mechanical pressure switches, this device is accurate to better than $\frac{1}{2}$ psi. and will not change even under large temperature swings and changes in air density and composition.

*Use of this option will present the **SAME EXACT ELECTRODE FORCE CONDITIONS** every time that the weld has started. Because of this, resistance in the nugget zone of the parts being joined will be constant and, therefore, reproduce weld strength and ductility throughout the production run.*