Review of Canadian standards as they relate to the SOFT TOUCH system and the spot welder connected to the Unitrol control, all to requirements of page 727 of O. Reg. 528/00, sections (5) and (6)

The SOFT TOUCH SYSTEM is fully passive and operates without any operator intervention. It is automatic and does not depend on operator adjustments for safety. Change in electrode gap (spacing) on the welder does not require any adjustment of the system.

The spot welders connected to these control systems consist of a simple air-operated moving head that places one welding electrode against a fixed electrode prior to passage of welding current.

We have reviewed the compliance of this Unitrol system connected to a standard spotwelder against the above Ontario Regulation made under the Occupational Health and Safety Act. We feel that our SOFT TOUCH system and these welders are in compliance with all applicable sections of this regulation to prevent crush injury between the electrodes.

Here are our findings:

1. Section (5): "When item 2 of the Table applies, a pre-start health and safety review is not required if
    a. The protective element was not installed at the time the apparatus was manufactured and the conditions set in paragraphs 1,2,3 and 4 of subsection (6) are met; or
    b. The protective element was not installed at the time the apparatus was manufactured and the conditions set in paragraphs 1,2,3 and 4 of subsection (6) are met.

UNITROL FINDINGS: This system can be used both for new equipment and also for field-installed upgrade to existing equipment. Because a standard spotwelding machine has only one pneumatically moving part, and actuation of the pneumatic cylinder is controlled by solenoid valves operated by the Unitrol control with the SOFT TOUCH feature, the entire system operates as a whole to match requirements of this section.

2. Section (6): The following are the conditions mentioned in clause (5)(a) and (b):

    1. The apparatus was manufactured in accordance with and meets current applicable standards, or it has been modified to meet current applicable standards

    UNITROL: This welding machine and the control that supports this system matches all applicable standards as shown below that are sited in the Table.

    2. The apparatus and welding machine is installed in accordance with the manufacture's instructions and current applicable standards.

UNITROL: Specific installation instructions are included with each control system (with SOFT TOUCH feature) and welder. This includes both pneumatic and electronic diagrams and instruction for safe installation of the system.

3. The protective element was manufactured in accordance with and meets current applicable standards, or it has been modified to meet current applicable standards.

UNITROL: This SOFT TOUCH component (protective element) of the system matches all applicable standards as shown below that are sited in the Table.

4. The protective element is installed in accordance with the manufacture's instructions, and current applicable standards.

UNITROL: Specific installation instructions are included with each SOFT TOUCH system for mechanical, and electrical installation to the SOLUTION welding control. This includes both pneumatic and electronic diagrams and instruction for safe installation of the system. Incorrect installation will result in a system that will not operate in any mode

The majority of specifications shown on the Table sited in this standard do not apply to this particular device. This list of non-applicable standards is:

ISO 13851 - Hand safety controls. Not applicable
ISO 13853 - Distance to pinch point. Not applicable
ISO 13853 - Distance to pinch point. Not applicable
ISO 13854 - Gap between pinch points. Not applicable
ISO 13855 - Position of pinch points. Not applicable
ISO 13856 - Pressure sensitive safety devices (ie. switch mats, etc.). Not applicable
ISO 14119 - Interlocking devices associated with guards. Not applicable
IEC 61496 - Photo sensitive switches. Not applicable
ISO 4413 - Hydraulic safety. Not applicable
ISO 4414 - Pneumatic fluid poser. Not applicable
CSA Z142 - Power press safety only. Not applicable
CSA Z434 - Robotics. Not applicable
CSA Z615 - Hot forging. Not applicable
ANSI B11.1 - Mechanical power presses. Not applicable
ANSI B11.2 - Hydraulic Presses. Not applicable
ANSI B11.3 - Press brakes. Not applicable
ANSI B11.6 - Metal shears. Not applicable
ANSI B11.8 - Drilling machines. Not applicable
ANSI B11.10 - Metal saws. Not applicable
ANSI B11.20 - Integrated manufacturing systems. Not applicable
ANSI B11.21 - Lasers. Not applicable
ANSI B65.1 - Printing presses. Not applicable
ANSI B65.2 - Binding machines. Not applicable
ANSI 65.5 - Web feed printing presses. Not applicable
ANSI B151.1 - Plastic-molding machines. Not applicable

ANSI Z245.1 - Waste-recycling machinery. Not applicable.
ANSI Z245.2 - Stationary compactors. Not applicable
ANSI 245.5 - Bailing equipment. Not applicable.

The standards that have applicable sections are shown below. The sections shown here are the only ones that we can find in each standard that has any even remote application to this SOFT TOUCH system:

ISO 12100-2

3.2 Making machines inherently safe by virtue of - … the limitation of the actuating force to a sufficiently low value, so that the element does not generate a mechanical hazard.
UNITROL: The welder has, as maximum pinch point force, the dead weight of the welder's moving head. This is a fixed value typically in the 40 – 90lb range that is well below the level that could cause significant injury to an operator's finger or other body part if caught between the electrodes.

The solenoid valves that operate the low and high forces in the welder are air-piloted spring return types that fail in the closed condition to prevent any movement of the welder's head.

The SOFT TOUCH system restricts the available force between the electrodes to a safe level that will not cause permanent damage to the operator's finger or other body parts.

ANSI B11.19:

3.7.1 The primary action for starting or accelerating the movement of a mechanism should be performed by application or increase of voltage or fluid pressure…
UNITROL: A positive voltage from the control to solenoid valves initiates all actions in the system. An absence of voltage to these spring-return solenoid valves will cause the solenoid valves to return to the closed position and electrodes to move to the fully open and safe condition.

3.7.5 Duplication (or redundancy) of "critical" components: other components than well tried (inherently safe) components may be used to perform a safety function provided that in case of failure of one component, another one (or others) can further on perform this function…
UNITROL: Initial operation of the low-pressure solenoid valve requires both the direct voltage closing of an electro-mechanical relay and the simultaneous energization of a photo-optic triac. Since the relay does not depend on any semi-conductors for operation and must have positive voltage supplied directly from the operator's initiation switch (foot or hand), the system is totally redundant for initiation of even the low-pressure solenoid valve.

3.7.6 Automatic monitoring. Automatic monitoring ensures that a safety measure is initiated if the ability of a component or an element to perform its function is diminished, or if the process conditions are changed in such a way that hazards are generated.
UNITROL: The monitoring of electrode continuity is continuous and is even operating prior to the operator's closing of the initiation switch. It is therefore not affected by changes in the hazard generation.

3.7.7 Safeguarding safety functions in re-programmable control systems. Systems intended to be capable of re-programming present additional safety problems. Such systems include… valves affecting otherwise "hardware based logic"…

UNITROL: If the SOLUTION control that operates the welder is reprogrammed for another mode, the welder will never be able to operate the high-pressure solenoid valve under any conditions.

(3.7.7 (continues) When such arrangements are used in a safety critical control system, care should be taken to provide reliable means which prevent inadvertent or deliberate alteration of the stored program. Such means can include…locks restricting access.

UNITROL: A keylock is provided with all SOLUTION controls to prevent change of operating mode. However in this case, even a change in operating mode will still leave the system without the ability to operate the high-pressure solenoid valve under any conditions.

3.8 Preventing hazards from pneumatic and hydraulic equipment… - the maximum allowed pressure cannot be exceeded in the circuits (e.g. by means of pressure limiting devices). No hazard may result from pressure losses, pressure drops or losses of vacuum.

UNITROL: The limiting factor is the welder's head weight. The counterbalance of force is done with a precision regulator that is locked in a NEMA-4 enclosure. If the pressure on these regulators is increased, the counterbalancing design of the system will lower the force between electrodes and eventually stop the electrodes from even closing. Loss of air pressure will result in the maximum force equal to that of the welder's head, typically 40-90lbs. This is the limiting factor of the welder.

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4.1.4 Where access to the danger zone is required for machine setting…cleaning or maintenance. As far as possible, machines shall be designed so that the safeguards provided of the production operator may ensure also safety of personnel in charge of setting, teaching, etc., without hindering them in performing their task.

UNITROL: The same safety for the operator is also present for the setup personnel and maintenance personnel since the movement of the electrode is still controlled by the same SOFT TOUCH protected system under all modes of operation and operated by the same spring-returned solenoid valves.

4.2.3 Safety devices shall be operated and connected with the control system so that they cannot be easily defeated. The level of performance of safety devices shall be consistent with the control system into which they are integrated.

UNITROL: The SOFT TOUCH system is hard wired to the control. If removed, the system will never energize the high-force solenoid valve. The SOFT TOUCH system is designed to be an integral part of the SOLUTION welding control and is not available for integration in other brand systems.

4.2.3.2.1 The presence-sensing device shall be designed and constructed to create a field sensitive to the presence of the operator's hand or other body part.

UNITROL: The SOFT TOUCH sensor board only senses the presence of metallic material between the electrodes using continuity. If wiring from the welder to the continuity sensor board becomes detached, the system will never detect continuity and will prevent high force from being applied between the electrodes under all conditions.

4.2.3.2.2 The presence-sensing device shall have an identifiable minimum object sensitivity such that an obstruction of a same or greater size will always be detected anywhere within its sensing field regardless of the plane of intrusion.

UNITROL: The continuity sensing system requires a maximum resistance of 2 micro ohm. A human finger has a typical resistance of 2 meg ohms. This extreme range means that there is no possible way that a human finger or other body part can cause the system to accept it to allow full force to be applied between the electrodes. This is independent of angle of insertion between electrodes or the distance between the electrodes.

4.2.3.2 The presence-sensing device shall have a minimum sensitivity stated by the manufacture…

UNITROL: This maximum value is 2 micro ohms.

4.2.3.2.3 The device shall have a maximum response time that shall not be affected by object sensitivity adjustments or environment changes.

UNITROL: The response time for detection of an object between electrodes is continuous and not settable. No operator adjustments are available for this sensing sequence, and response is not affected by changes in air temperature or moisture.

4.2.3.2.4 Presence-sensing devices that require adjustments to accommodate variations in ambient or operating conditions or that incorporate channel blanking or floating window features shall be designed such that these adjustments or features are capable of being supervised by the employer.

UNITROL: There are no operator adjustments that can be made in the system. Changes in window size or other operating conditions do not require any changes in the system. It is totally passive.

4.2.3.2.5 The device shall incorporate easily observable visual displays to indicate that the device is detecting the entry of the operator's or other's hand or other body part within the effective sensing field of the device.

UNITROL: An LED alpha display shows in words if the sensor is satisfied, and also shows if the system has timed out. This display is in direct eye view by the operator.

4.2.6 Probe Detection Devices. UNITROL: This is the closest category of protective device that, in function, matches the SOFT TOUCH continuity sensing system.

4.2.6.2.1.1 The probe detection device shall be designed and constructed to verify the absence of the operator's hand or other body part from the hazard area prior to initiation of the machine cycle.

UNITROL: While continuity is not strictly a "probe detection device", it covers the intention. Before full welding force can be applied to the electrodes, the SOFT TOUCH sensor board must see positive continuity representing metal between the electrodes ("probes").

4.2.6.2.2 The probe device shall be designed and constructed of material that will allow adjustment or fabrication of the probe to protect the operator…

UNITROL: Since the "probe" is actually the welder's welding electrodes, any standard or custom welding electrode will function correctly to detect continuity. There are no adjustments necessary or even possible with this SOFT TOUCH system.

4.2.6.2.3 The probe device shall be designed and constructed such that a single component failure shall prevent hazardous actuation of the machine tool.
UNITROL: A. If the continuity sensor system fails in the "closed" condition, the control will not even allow closing of the low-force solenoid valve. B. If the continuity sensor system fails in the "open" condition, the high force solenoid valve will never be actuated.

4.2.6.2.4 The probe device shall be designed such that the operator cannot reach into the hazard area…
UNITROL: Since continuity checking is continuous between the electrodes, there is no area in the pinch zone that the operator can "reach".

4.2.6.2.5 The probe device shall be designed and constructed so as not to create a hazard.
UNITROL: Since there is no mechanical device from the SOFT TOUCH system in the electrode area, no hazard can be created by the SOFT TOUCH hardware.

5.4 Markings, signs (pictograms), written warnings.

a) For its unambiguous identification; at least – name and address of the manufacturer, designation of series or type, serial, number, if any

UNITROL: A permanently adhered laminated label is installed on every SOFT TOUCH system that clearly shows a pictogram of a pinch point in the welder, gives instructions on not operating the system if the padlock is not present and the pressure regulator cabinet locked closed, provides the manufactures' information and a serial number. The welder contains full identification with serial numbers, capacity, etc. and the name and address of the manufacturer.

ISO 12100-1

3.23.5 Trip devices which cause a machine or machine elements to stop (or ensure an otherwise safe condition) when a person or a part of his body goes beyond a safe limit.

Trip devices may be: non-mechanically actuated: e.g. photo-electric devices, devices using capacitive, ultra-sonic, etc. means to achieve detection.
UNITROL: The SOFT TOUCH sensor board achieves detection using continuity as a secure means of preventing application of high force between the electrodes.

4.2 Mechanical hazard. Mechanical hazard is a general designation for all physical factors…

4.2.1 the elementary forms of mechanical hazard are notably crushing hazard…
UNITROL: The SOFT TOUCH system is designed to prevent a crushing hazard

4.2.2 The mechanical hazard which may be generated by machine parts (or workpieces) is conditioned, among other factors by:

-mass and stability (potential energy of elements which may move under the effect of gravity

-potential energy of elastic elements (springs), or of liquids or gasses under pressure or vacuum.

UNITROL: Because the SOFT TOUCH system counterbalances (pneumatically) the welder's moving head weight, the force imposed on the operator's finger between electrodes is less than this gravity weight. However the dead weight of the head is the maximum possible force prior to acceptance of the continuity for application of high force. This also covers potential energy by gasses (compressed air) used to move the welder's head.

5. Strategy for selecting safety measures, last paragraph: For the continuous safe operation of the machine, it is important that the safety measures allow its intended use and do not hinder its intended use. Failure to do this could lead to safety measures being by-passed in order to achieve maximum utility of the machine.

UNITROL: The continuity sensing does not change the operation of the welder in any way. Also the operator has no way to bypass the system (ie. no operator accessible override).

5.7.1 The designer should determine as completely as possible the different machine operating modes and the different intervention procedures for the operators…

UNITROL: The SOFT TOUCH system does not depend on any particular operating mode. If the wrong mode has been selected in the locked area of the control, the welder will never operate the high-pressure solenoid valve.

Z423-04

4.2.1.5 When a hazard cannot be eliminated or avoided, other measures for reducing the risk of injury should be sought. These measures may include reducing the scale of injury…

UNITROL: The action of a spotwelder requires closing of electrodes under high force and cannot be avoided when making welds. The SOFT TOUCH system reduces the available force between the welding electrodes to a low and safe level until continuity has been sensed between the electrodes. If the operator's finger or other body part is caught between the closing electrodes, the pinch force is low enough to prevent serious injury.

5.6.2 Eliminate the hazard or reduce the risk by design. Elimination of the hazard or reduction of the risk by design provides the highest degree of risk reduction. Examples of such include
(c) Reducing energy

UNITROL: The SOFT TOUCH system reduces the available force between the welding electrodes to a low and safe level. If the operator's finger or other body part is caught between the closing electrodes, the pinch force is low enough to prevent serious injury.

5.6.3 Applying safeguards. Where the hazard cannot be eliminated per Clause 5.6.2, the following safeguards shall apply:
(b) Safeguards providing high/intermediate risk reduction are
(ii) Physical devices that do not require adjustment for use or other operator intervention…

UNITROL: This system is totally passive and does not have any operator adjustments. The system is independent of weld pressure setting on the main pressure regulators, and does not require any operator setting of limit switches or other sensor systems. If it fails, it fails safe and never reaches the full welding force but stays at low force.

6.1.3.2 Elementary forms of mechanical hazards

(g) Crushing occurs as the result of bodily contact between one part of machinery moving against another part.

UNITROL: This system passively protects against serious injury caused by crushing action between the closing welder's electrodes on the operator's finger or any other body part.

6.2.1.1 General. Intrinsic design consists in the following actions, used separately or combined:

(a) Avoiding or reducing as many of the hazards as possible by suitable choice of design features; and

(b) Limiting the exposure of persons to hazards by reducing the need for operator intervention in danger zones.

UNITROL: This system reduces the potential available force between electrodes to a very low level that will not produce severe injury to the operator. The operator does not have any way to influence the operation of this system (ie. totally passive).

6.2.1.3 Consideration of geometrical and physical factors. Geometrical and physical factors should be considered at the machine's design stage…

(c) the limitation of the actuating force to a sufficiently low value so that the element does not generate a mechanical hazard;

UNITROL: This system limits the actuating force between the electrodes to a very low level and will not switch to a higher force level until continuity between the electrodes has been established.

6.2.1.7.4 All elements of the" operator-machine" interface, such as controls, signaling, or data elements shall be designed in such a way that unambiguous interaction between the operator and the machine is possible.

UNITROL: The control displays when the continuity sensor system is closed or opened. This is done in plain English on a bright LED display. This will tell the operator if this system is closed when it should be clear, or when it has not been opened after a weld sequence. If it is closed when it should not be closed, the display will show this but the system will not allow any movement or operation of the welder until this condition has been cleared.

If the time to close the continuity sensor system is longer than the proghead maximum time, the display will release the weld head (goes to full open position) and will display that the time limit has been exceeded. The system will not close electrodes again until the initiation switch has been opened and then closed again.

6.2.1.9.6 Use of "oriented failure mode" components. "Oriented failure mode" components or systems are those in which the predominant failure mode is known in advance.

UNITROL: If the sensor board of the system fails, the output has a known "high" level. This goes to the computer. If the "high" level is detected prior to initiation of the welder, the computer will lock the system out and display this fault. No movement of the weld head will occur under this failure mode. Also because the control uses both solid-state and electro-mechanical relays to produce output voltage to the welder solenoid valve, and because the electro-mechanical relay will only operate when a voltage is present on the input initiation terminal (not through any solid-state devices), no movement of the welder head can occur without a hard initiation switch closure.

The failure mode for spring-return solenoid valves used in these welders is to bring the electrodes to the fully open position.

6.2.1.9.8.1 Automatic monitoring ensures that a protective measure is initiated if the ability of a component or an element to perform its function is diminished, or if the process conditions are changed in such a way that hazards are generated. There are two categories of automatic monitoring:

(a) "Continuous" automatic monitoring, whereby the protective measure is immediately initiated when a failure occurs…

UNITROL: The SOFT TOUCH system continuously and automatically monitors impedance of the welder secondary. This does not depend on any action by the operator, and the process cannot be bypassed without automatically locking out the welder. If a failure in the detection system occurs (ie. detection system output is "high" prior to the proper sequence), the computer will automatically lock out the welder and not allow any action to occur.

6.2.1.9.9.2 When such arrangements are used in a safety critical control systems, care shall be taken to provide a means of preventing inadvertent or deliberate alteration of the stored program. Such means may include

(a) Embedded software, e.g., read-only memory (ROM);
(b) Password access to software

6.2.1.9.10 Selection of control and operating modes. If machinery has been designed and built to allow for its use in several control or operating modes presenting different safety levels (e.g., to allow for adjustment, maintenance, inspections), it shall either be fitted with a mode selector that can be locked in each position or incorporate another selection means that restricts the use of certain functions of the machinery to certain categories of operation…

UNITROL (for both above): The programming for this function is in an EPROM chip and imbedded in the computer board system. Selection of the function is through a multi-level keypad sequence that requires opening of a keylock-protected keyboard. If an incorrect mode is selected in this manner, the welder will never operate the high-force solenoid valve and will only produce low force no matter what inputs are sent to the control. There is no way to override this feature.

6.2.1.10 Preventing hazards from pneumatic and hydraulic equipment. Pneumatic and hydraulic equipment of machinery shall be so designed that

(a) The maximum allowed pressure cannot be exceeded in the circuits (e.g., by means of pressure-limiting devices);
(b) No hazard may results from pressure losses, pressure drops, or losses of vacuum

UNITROL: The maximum possible force between the electrodes can occur if all system pressure drops to zero. At this point, the maximum force is the dead weight of the welder's head. This normally is 40 – 90lbs and will not cause permanent injury to the operator's finger or other body part that might be caught between the electrodes.

The pressure regulators in the system provide bucking force. If they are set too high or fail in the fully open condition, there will be more force trying to raise the head than the head weights. This will prevent any movement of the head under this failure condition.

If the air pressure drops to zero, the worst possible force between the electrodes will be that of the welder head weight, typically 40-90lbs.