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Mitigating HSE and MHE Risk

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INTRODUCTION

Auto-ignition of ultrasonic couplants during NDT thickness gauging and corrosion mapping at high temperature is increasing in frequency and is a Major Hazard Event (MHE) concern. Auto-ignition is an unexpected, dangerous and often costly event for which inspectors are neither trained nor equipped to respond effectively. The potential for personnel injury, operations disruption, and facility damage mandates a reduction in the potential for auto-ignition to "As Low As Reasonably Practicable" (ALARP).

Fires from auto-ignition incidents have resulted in emergency shut-downs, inspector panic reactions, and injury to personnel, plant and equipment. This article details the basis for the lack of understanding about the potential for ultrasonic couplant auto-ignition and outlines an ALARP operating practice for mitigation.

ULTRASONIC COUPLANTS AND AUTO-IGNITION

Couplant used in ultrasonic testing (UT) facilitates sound energy transmission between the transducer and the object being inspected. Even a thin air gap between the transducer and the object will prevent sufficient sound energy transmission. Thickness gauging and corrosion mapping are often conducted at temperatures between 500°and 1000°F (250° and 550°C) where auto-ignition of the couplant may occur. Ultrasonic transducers and instruments capable of operating at temperatures up to 950°F (510°C) are routinely used, and development programs are targeting new designs with capabilities up to 1100°F (590°C).

The auto-ignition temperature of a substance is the lowest temperature at which it will spontaneously ignite in normal atmosphere without an external source of ignition, such as a flame or spark. ASTM E659 is the most widely accepted standard for determining auto-ignition temperatures. Many commercial laboratories cannot test auto-ignition above 1000°F; however, forensic fire laboratories can provide testing above 1300°F. When ultrasonic couplants are exposed to temperatures above their auto-ignition temperature, they can self-ignite. While auto-ignition can occur under most conditions, it most commonly occurs in enclosed or semi-enclosed areas, such as inspection ports. The United States has over 1 MILLION inspection ports in use in over 130 operating refineries. An estimated 15% of these ports are in use at temperatures above 700°F. Inspection ports have been used in the US since the mid-90's, with temperature capabilities reaching 1200°F (650°C).

Couplant manufacturers address auto-ignition risk by specifying the Operating Range of high-temperature ultrasonic couplants, with the following considerations:

- Auto-ignition temperature of the couplant.
- Limitations in performance from vaporization of the base fluid, and the melting point of a plastic polymer, when incorporated into couplant.
  - In the event of couplant auto-ignition, plastic powder, if incorporated into the formulation, will ignite and the fire becomes more difficult to extinguish.
- Product liability considerations.

Some high-temperature couplants in use today were developed 40 years ago and have been owned by as many as five different manufacturers. Formulas, manufacturing methods, and/or test methods have changed, often resulting in operating ranges lower than when the couplants were initially introduced. However, the product names have remained the same. In addition, there are obsolete datasheets on distributor websites and in customer files which are no longer correct and can be misleading.

Figure 1. Ultrasonic Testing Couplants.

The only operating range and auto-ignition temperature that can be presumed to be accurate are those marked on the product and

Table 1. UT Couplant Manufacturers' Published Data.

Couplant	Auto Ignition Temperature	Initial Manufacturer Specified Operating Range °F	Current (5.16.16) Manufacturer Specified Operating Range °F	Manufacturer's Limitation for Confined Space (inspection ports)	Current (5.16.16) Markings on product
VersaSonic®	788°F 420°C	Not specified	-10° to 750°F Thickness & flaw	None - Same as operating range	Operating range
Sono® 600	788°F / 420°C	T Gage 0° to 600°F	0° to 700°F thickness 50° to 500°F flaw	< 439°F	Refer to SDS prior to use (no data on SDS)
Sono® 900	770°F / 410°C	T Gage 600° to 900°F	600° to 680°F	< 460°F Below min operating range	Refer to SDS prior to use
Sono® 950	849°F / 454°C	T Gage 600° to 950°F	600° to 760°F	< 435°F Below min operating range	Refer to SDS prior to use
Sono® 1100	862°F / 461°C	T Gage 700° to 1100°F	700° to 775°F	< 455°F Below min operating range	Refer to SDS prior to use
Pyrogel® 100	894°F / 479°C	T Gage –50° to + 800° F	-50° to 805°F thick- ness 0 to 600F flaw	< 559°F	Refer to SDS prior to use
EchoTherm™	Above 1300°F Above 704°C	700° to 1200°F	700° to 1000°F	None - Same as operating range	Operating Range and Auto Ignition
EchoTherm™ Extreme	Above 1300°F Above 704°C	-40° to 1250°F	-40° to 1250°F	None - Same as operating range	Operating Range and Auto Ignition

Reducing the risk of Auto-Ignition during UT to ALARP requires careful selection of high temperature ultrasonic couplants with an operating range appropriate for the temperature of the object being inspected and insuring that any and all restrictions on the use of the couplant is clearly labeled on the product and SDS.

on the SDS (safety data sheet) accompanying the product or on the manufacturer's website. Many high-temperature couplants have neither their operating range nor auto-ignition temperature indicated on the product label, and some do not have the operating range or auto-ignition temperature on the SDS / MSDS.

This ambiguity is further complicated with some couplants by a restriction on the manufacturer's datasheet against use in an "enclosed or semi-enclosed area" such as inspection ports. This safety limitation is often not reflected on the couplant label or on the SDS/MSDS.

The following table compiled from manufacturers' published data lists the initial and current (highlighted) operating ranges and port restrictions for most high-temperature ultrasonic couplants.

Changes in operating ranges over the decades illustrates the need for utilizing current data in the selection of a high-temperature couplants. The couplant selection process is complicated when the current operating range for the product is not marked on the container or tube, nor listed on the SDS / MSDS. Additionally, when the product datasheet restricts the use of the couplant in enclosed or semi-enclosed areas (such as ports) to under the flash point, this restriction is often not captured on the product label or SDS.

Reducing the risk of Auto-Ignition during UT to ALARP requires careful selection of high temperature ultrasonic couplants with an operating range appropriate for the temperature of the object being inspected and insuring that any and all restrictions on the use of the couplant is clearly labeled on the product and SDS.

REDUCING THE RISK OF AUTO-IGNITION

1. **Check the Package:** Look for the manufacturer's specified operating range on the couplant container. The container must also carry any restrictions for use, such as in ports, enclosed or semi enclosed areas.

2. **If the operating range is not on the container, refer to SDS/MSDS** for auto-ignition temperature and for the specified operating range and mark it on the container. If the operating range is not listed on the SDS, refer to the product data sheet, and mark the operating range and restrictions on the container. This indicates that the inspector is aware of the operating range and restrictions.

3. **Determine the Temperature of the Test Object**

Figure 2. Temperature Measurement Tools.

- Factor in the accuracy of the temperature measurement device

4. **DO NOT PROCEED IF…**

- The operating range is **NOT** clearly marked on the container.
- The test object is **ABOVE** the operating range.
- There are restrictions on the product, such as its use in ports, enclosed or semi enclosed areas, that will be violated by the inspection. ■

For more information on this subject or the author, please email us at inquiries@inspectioneering.com.

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