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COUPLANTS: KEY ROLE TO OPTIMIZE THE ULTRASONIC INSPECTION

Cevenini Michele – NDT ITALIANA SRL – Concorezzo (MB)

Summary

During non-destructive testing with liquid penetrants and magnetic powders, only specific products are used with test certificates, conformity certificates for each production batch and safety data sheets.

During ultrasonic testing instead, many unspecific fluids or mixtures are often used as couplants, easily and without appropriate precaution (i.e. wallpaper glue, various kind of oils etc.). These products are certainly good for the purpose they were produced for but are not formulated to ensure a good result for ultrasonic testing and to be in contact for a long time with operators's hands.

NDT Italiana offers a range of couplants that meet, at the same time:

- the requirements in order to optimize the results of ultrasonic testing obtained with modern equipment (phased array, T.O.F.D., etc.);*
- the ecological respect for the environment;*
- operators' safety;*
- anti-corrosive formulations to protect the pieces*
- money saving in the ultrasonic testing.*

A series of comparative tests show that, in order to obtain reliable results, it is necessary to use a suitable couplant, non-toxic and non-corrosive, every day and not only when working on advanced materials, special applications or difficult pieces.

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Ultrasonic operators of great experience who use very sophisticated equipment, together with very expensive probes are far from getting the best results, because they do not use specific couplants.

The use of a non-specific couplant such as grease, oil, glue, etc., is "written" in the minds of many operators, as well as in some specifications.

A series of comparative tests show that, in order to obtain reliable results, it is necessary to use a suitable couplant, non-toxic and non-corrosive, every day and not only when working on advanced materials, special applications or difficult pieces.

A series of tests have been carried out on Elite couplants in order to examine:

- 1-Technical documentation supplied
- 2-Packaging and labelling
- 3-Conformity with ASME Sec. V
- 4-Functional and operational characteristics

1-Technical documentation supplied:

The integrity and quality of information has been verified.

The following documents are provided, as required by law:

- Technical Data Sheets (TDS) that describe the characteristics of the product, the conditions of use and the method of use.
- Certificates of Analysis (Test Certificate) for each production batch, with references to the latest versions of the applicable norms.
- Safety Data Sheets (MSDS) in accordance with the EU Regulation 1907/2006 / EC Article 31 (REACH).

2-Packaging and labelling

It is important, when operating on the field, that the product has a suitable package in order to carry and use it easily.

The couplants Elite are supplied in envelope, tubes, pails of 5 Kg or drums of 200 liters.

According to REACH, the labels include information that identify the product (name and batch number), the supplier, safety conditions applicable, production date and expiry date.

3-Conformity with ASME Section V

- Art. 4 T433 – Art. 5 T533

We have verified on analysis certificates that couplants used on a nickel-based alloys contain less than 250 ppm of sulfur and that those one used on titanium or austenitic stainless steel contain less than 250 ppm of halogens (Cl + F).

In comparison to Elite specific couplants, the following are used:

- oils: often sulfur is added to improve lubricating properties and consequently they cannot be used on materials based on nickel;
- metylan (wallpaper glue): no information on the mixture of components, test certificate not available.

It is also difficult to dissolve properly these mixtures in water without lumps.

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- Art. 4 T477 and Art. 5 T577
The cleaning of the piece, after the ultrasonic testing with Elite couplants, has been quick and easy and did not affect the surface of the material.
If necessary, the removal non-specific couplants is very hard (oils leave unwanted residues; wallpaper glue oxidizes the pieces).
- Art.4 T462.3 T492 (e) and Art.5 T562.3 –T592 (e)
For each ultrasonic testing name, brand and type of couplant used were recorded.
For calibration and control the same couplant was used.

4-Functional and operational characteristics

We have carried out test on Elite couplants with instrument GE USM35, HT400 double crystal probe, 22.2 mm reference step.

L'ASME V Art.23 reads: "Couplants may not be comparable to one another", which means that there are differences in the performance of different couplants.

We then verified (see final table):

- ultrasonic signal range transmitted (all other factors being the same);
- ultrasonic signal range at constant gain;
- easy application and removal of the various couplants;
- easy preparation and fast transformation in gel concerning powder couplants;
- piece protection from corrosion and no damage to the probe;
- minimum and maximum temperatures in the use of each product;
- operator's safety and environmental protection;
- costs.

MATRIX

Blue fluorescent couplant gel for all finished surfaces, even vertical: it does not dry and it does not corrode.

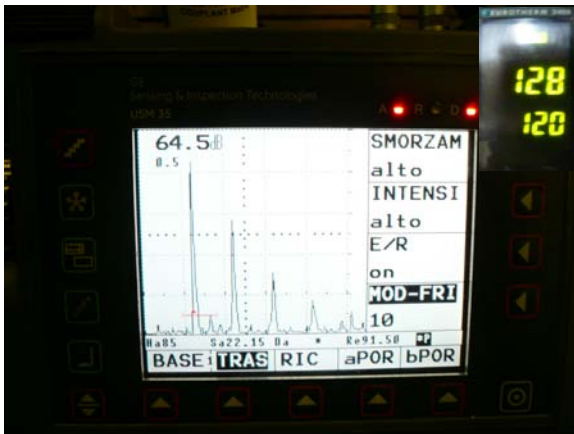
Use from -20° to +120° C

The product in this temperature range works correctly, in particularly there was a modest variation in the intensity of the transmitted signal.

Ready to use, can be diluted in water up to 1:1.

PMUC approved (use in nuclear power plant) from EDF, complies RCCM.

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Signal obtained with Matrix at +128° C



FYr GEL – FYp POWDER

Yellow fluorescent couplant for all surfaces. It dries leaving a non-slippery surface. It gains a lot of dB, providing high acoustic impedance. Use from -10° C to +100° C. Complies RCCM. Ready to use with anti-rust, can be diluted up to 1:1 (FYr) or in concentrate powder, to be diluted in water (FYp).



Signal obtained with FYr gel



Envelope FYp powder

From a comparison between couplant Elite FYp and a non-specific product (wallpaper glue) it was proved that:

- Couplant Elite FYp contains anti-rust that the non-specific product does not have;
- Couplant Elite FYp can be dissolved in water and it can rapidly reach the adequate viscosity to start the ultrasonic testing, without lumps;
- ultrasonic signal range with non-specific products was lower by 20%, so to obtain the same indication, the gain must be increased with higher background noise (grass).

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C333 GEL – C333 POWDER

Blue dense thixotropic couplant.
Special for corroded surfaces, welds,
casting and forgings.
It dries leaving a non-slippery surface.
Use from 0°C to +90°C.

C333 GEL: ready to use.
It contains a powerful anti-rust also active
on cast iron, dilutable up to 1:1.

C333 POWDER: to be diluted with water.
Ideal on aluminium and its alloys,
composite materials.

Couplant Elite C333 adheres remarkably on
all surfaces, even in difficult positions for the
operator, e.g. ensuring the contact probe-
piece, defined as “gap” by the regulations,
also on special surfaces such as rough
casting or overhead without dripping.
The calibration and sensitivity of the control in
ultrasonic testing is influenced by the type of
couplant and its ability to adhere on
surfaces.

Couplant is a key element because it
ensures the optimal transmission of the
acousting pression by guaranteeing the best
coupling action on “difficult” surfaces with
greater penetration and signal range.

MHT

Special paste Extended Temperature Range
for surface temperatures from -30°C up to
+300°C.

It does not dry on transducer, increasing its
life and cleaning time.

Non flammable. It does not produce irritant
or harmful fumes for the health of the
operator.

We verified the temperatures of use and the
signal range.

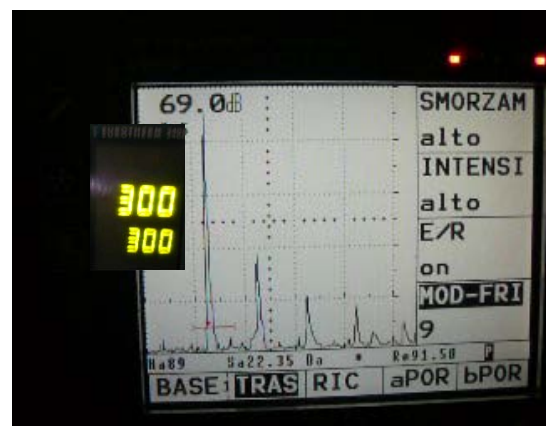
Little changes between minimum and
maximum temperature of use.



Envelope C333 powder



Test using C333 gel



MHT Signale at +300° C

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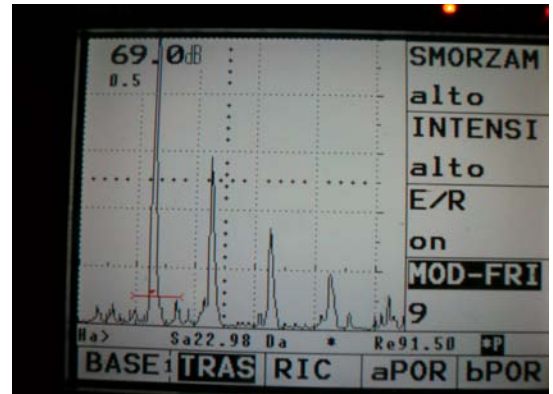
UHT

Special paste Extended Temperature Range for surface temperatures from +100°C up to +600°C.

It does not dry on transducer, increasing its life and cleaning time.

Non flammable. It does not produce irritant or harmful fumes for the health of the operator.

We checked the temperatures of use and verified that the signal range changes little between the 2 extreme temperatures indicated.



UHT Signal at +500° C

We carried out comparative tests with another high temperature couplant (supplied with the instrument) competitor of products Elite MHT and UHT and we used a high-temperature probe for these tests.

The disadvantages identified using this competitor couplant were:

- the couplant drops;
- the signal range is less than 30% ca.;
- the couplant “fries” on the pieces leaving residues;
- fumes and unpleasant odours were produced.

W4US

Additive for water used for immersion ultrasonic testing, with squirters but also for standard application with probe. Mixture of surfactants, corrosion inhibitors and additives (anti-algae, anti-fungal, anti-bacterial). The surfactants facilitate the adhesion of water on the surfaces, reducing drastically the microbubbles contained in it, for the maximum reliability of the control. The inhibitors protect the immersed pieces and the mechanical parts of the ultrasonic systems, furthermore they prolong the life of the bath and guarantee the hygiene of the workplace, they do not produce foam and do not alter the composite materials.

C200

Special couplant gel for surfaces from -50°C up to +200°C.

Its viscosity and its transmission characteristics of ultrasonic energy remain stable during this range. At room temperature C200 does not evaporate for unlimited time and is therefore ideal for the coupling between the probe and wedge in angled transducers.

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SAFETY OF THE PRODUCTS

- operator (non-toxic, non-irritating, non-flammable, non-smoky, etc.)
- environment (free of substances that make the waste become toxic and/or harmful)
- materials (non-aggressive/corrosive and easy to remove)

Concerning the line of ultrasonic couplants Elite, all items above mentioned are supplied with updated safety data sheets in 16 points.

COSTS

The line of couplants Elite has a significantly lower cost than other specific or non-specific products.

CONCLUSION

In conclusion, since the couplants Elite are safe, odourless, non-sticky, easy to apply and to remove after testing and being even cheaper, we believe that it is appropriate to use them always, improving and accelerating your work.

The following table shows the overall evaluation related to all test carried out and the results obtained by the single products.

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TECHNICAL DOCUMENTATION PROVIDED	Completeness and quality of information	<p>Following documents are provided:</p> <ul style="list-style-type: none"> • Technical data sheets (TDS) that define clearly and completely the products and how to use them, indicating specific characteristics, description and application. • Test certificates for every production batch, according to the last applicable rules, including also requests for specific analysis coming from Nuclear Industry. • Safety data sheets (SDS) <p>All documents are provided in Italian and English language.</p>
	Technical reference	Characterics and norms are exhaustively indicated and updated.
PACKING, LABELLING AND RELATIVE INFORMATION	Packing	Packing is suitable for the use of the product. Products are sold in tube, pails or drums of 200 L.
	Labeling	Labels are clear and readable, contain basic information for the use of the product, the batch number and the safety instructions, in Italian and English language.
	Safety data sheets	Safety data sheets are available in Italian and English language, complete with all updated points according to Reach norms.
	Expiry date of the products	<p>Production and expiry date are indicated according to norms. Product life is:</p> <ul style="list-style-type: none"> - 5 years for products refered to medium and high temperatures - 3 years for all other couplants.
CONSUMABLES' CHARACTERISTICS IN CONFORMITY WITH:	ASME Sec. V Art. 4 T433 Art. 5 T533	All tested couplants, including additives, are not dangerous for the material to be examined. Couplants used on nickel-based alloys contain less than 250 ppm of sulfur; those used on titanium or austenitic stainless steel contain less than 250 ppm of halogens (Cl+F).
	ASME Sec. V Art. 4 T477 e Art. 5 T577	The cleaning of the piece, after ultrasonic testing with couplants, is easy and fast and it does not affect the surface conditions of the material.
	ASME Sec. V Art. 4 T462.3 – T492(e) Art. 5 T562.3 – T592(e)	<ul style="list-style-type: none"> - For the calibration and the testing the same couplant was used. - For each ultrasonic testing were registered name, brand and type of couplant used.
FUNCTIONAL AND OPERATIONAL CHARACTERISTICS	MATRIX	Blue fluorescent gel couplant for all finished surfaces, even vertical: it does not dry and it does not corrode. Use from -20° to +120° C. Ready to use, can be diluted in water up to 1:1. The probe flows easily and quickly reaches the peak of the signal. PMUC approved (use in nuclear power plant) from EDF, complies RCCM.
	FYr GEL FYp POWDER	Yellow fluorescent couplant for all surfaces. It dries leaving a non-slippery surface. It earns a lot of dB, providing high acoustic impedance. Complies RCCM. Ready to use with anti-rust, can be diluted up to 1:1 (FYr) or in concentrate powder, to be diluted in water (FYp). Use from -10° C to +100° C.
	C333 GEL C333 POWDER	Blue dense thixotropic couplant. Special for corroded surfaces, welds, casting and forgings. It dries leaving a non-slippery surfaces. Use from 0°C to +90°C. C333 GEL: ready to use. It contains a powerful anti-rust also active on cast iron, dilutable up to 1:1. C333 POWDER: to be diluted with water. Ideal on alluminium and its alloys, composite materials. It does not contain anti-rust for iron.
	MHT	Special paste Extended Temperature Range Surface from -30°C up to +300°C. It does not dry on transducer, increasing its life and cleaning time. Non flammable. It does not produce irritant or harmful fumes for the health of the operator.
	UHT	Special paste Extended Temperature Range Surface from +100°C up to +600°C. It does not dry on transducer, increasing its life and cleaning time. Non flammable. It does not produce irritant or harmful fumes for the health of the operator.
	W4US	Additive for water used for immersion ultrasonic testing, ideal for squirters application. Mixture of surfactants, corrosion inhibitors and additives (anti-algae, anti-fungal, anti-bacterial). It does not alter the composite materials.
	C200	Special couplant gel for surfaces from -50°C up to +200°C. Its viscosity and its transmission characteristics of ultrasonic energy remain stable within this range.
	Safety	All couplants Elite tested, even at high temperatures, guarantee maximum safety for operator, since they are not dangerous and do not produce toxic and irritating fumes.